AQUIND Limited

AQUIND INTERCONNECTOR

Design and Access Statement

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)q

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1. INTRODUCTION

1.1. GENERAL OVERVIEW

1.1.1.1. This Design and Access Statement ('DAS') is submitted on behalf of AQUIND Limited (the 'Applicant') to accompany an application (the 'Application') for a Development Consent Order ('DCO') submitted to the Secretary of State ('SoS') for Business, Energy and Industrial Strategy ('BEIS'). The application relates to the UK elements of AQUIND Interconnector which constitutes the Proposed Development.

1.1.1.2. The DAS sets out the 'Design Principles' which, alongside the Parameter Plans [APP-012], and Parameters Table (Table WN2 of [APP-019]) would set the framework for the detailed design of the Converter Station, Telecommunications Buildings and Optical Regeneration Station(s) ('ORS'). The document presents the process of concept development which have informed these principles and parameters, an illustrative example of how these could be developed into a detailed design and how these principles ensure the Proposed Development will achieve 'good design'.

1.2. THE PROJECT

1.2.1.1. The purpose of the Project is to make a significant contribution towards increasing the cross-border capacity between the UK and France, providing a net transmission capacity of 2,000 megawatts ('MW'). Greater cross-border transmission capacity improves competition in energy markets, delivers security and flexibility of energy supply in both countries as well as helping to tackle climate change by enabling countries to integrate more renewable energy sources like solar and wind in their electricity supply.

1.2.1.2. The wider benefits of the Project are outlined and described in the Needs and Benefits Report [APP-115 and document reference 7.7.7].

1.2.1.3. The Proposed Development includes:

- High Voltage Direct Current ('HVDC') Marine Cables from the boundary of the UK Exclusive Economic Zone ('EEZ') to the Mean High Water Springs ('MHWS') at Eastney in Portsmouth;
- Jointing of the HVDC Marine Cables and HVDC Onshore Cables;
- The Onshore HVDC Cables consisting of two underground HVDC Circuits from Mean Low Water Springs ('MLWS') at Eastney to the Converter Station;
- Two ORS. These are structural units housing telecommunications equipment and provide amplification of optical signals. They will be located at the Landfall within Fort Cumberland car park at Eastney;
- The Converter Station Area with
  - the Converter Station and associated equipment;
  - a Works Compound and Laydown Area;
  - an Access Road and associated haul roads;
  - surface water drainage and associated attenuation ponds;
  - landscape and ecology measures
  - utilities such as potable water, electricity and telecom;
  - the compound comprising the Telecommunications Building(s) and associated equipment.
- High Voltage Alternating Current ('HVAC') Onshore Cables and associated infrastructure connecting the Converter Station to the GB Grid at the existing National Grid substation at Lovedean; and
- Smaller diameter Fibre Optic Cables ('FOC') installed together with the HVDC and HVAC Cables and associated infrastructure ('FOC Infrastructure').

1.2.1.4. Chapter 3 [APP-118] of the Environmental Statement ('ES') Volume 1 [APP-116] contains a detailed description of the Proposed Development for which consent is sought under the Application.

1.3. THE DESIGN AND ACCESS STATEMENT

1.3.1.1. This DAS has been prepared in support of the Application and is submitted pursuant to Regulation 5(2)(q) of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 to assist in the determination of the Application, as a document considered necessary to support the Application. Although Regulation 5(2)(q) does not explicitly refer to the need for a DAS it does state that the application must be accompanied by "any other documents considered necessary to support the application". The Planning Inspectorate Advice Note 6: Preparation and submission of application documents (2016) lists examples of documents that this might cover, including a DAS.

1.3.1.2. The purpose of this DAS is to demonstrate the design process that has been followed during the development of the onshore elements of the Proposed Development at the pre-application stage and how the final design will be confirmed in accordance with the requirements of the DCO once granted.

1.3.1.3. The DAS explains the principles and concepts that have influenced the form and appearance of the onshore elements of the Proposed Development and provides a tool to communicate how the requirements for good design and access provision have been considered.

1.3.1.4. This DAS importantly also sets out the design principles for the Onshore Components of the Proposed Development, which will be required to be adhered to when confirming and obtaining approval for the final design post the grant of the DCO.

1.3.1.5. Paragraph 4.5.4 of NPS EN-1 (the Overarching National Policy Statement for Energy) notes that applicants should be able to demonstrate in their application documents how the design process was conducted and how the proposed design evolved. In the absence of any specific guidance relating to the preparation and reporting of Design and Access Statements for infrastructure projects of national significance this DAS has been prepared in line with national guidance on the subject, specifically:

- Design and Access Statement: How to Read, Write and Use them, produced by CABE (2007).
- Guidance on Information Requirements and Validation published by the Department for Communities and Local Government (2010).

1.3.1.6. The Proposed Development has been developed in accordance with formal Environmental Impact Assessment ('EIA') procedures, the outcomes of which have been reported in an ES that accompanies the Application [APP-116] to [APP-487].

1.3.1.7. Information contained within the ES has been used to inform the preparation of this DAS, and reference should be made to this document for full details of both the onshore and marine elements of the Proposed Development and their relationship to the receiving environment.

1.3.1.8. The Planning Statement submitted in support of the Application [APP-108] provides information regarding the relevant planning policies applicable to the Proposed Development, and the Needs and Benefits Report [APP-115 and document reference 7.7.7] explain the need for the Proposed Development.

1.3.1.9. The DAS is structured as follows:

- Section 2: an overview of the legislative policy and planning guidance context.
- Section 3: a summary of consultation meetings with Local Planning Authorities ('LPAs') and the South Downs National Park Authority ('SDNPA') outlining the responses to matters raised and explaining how this informed the Design Principles
- Section 4: an analysis of site selection and design development
- Section 5: the Design Principles derived from the functional and operational requirements of the Proposed Development; the site context; feedback from the consultation process; and initial design development
- Section 6: review of the illustrative proposals to explain how they comply with the Design Principles.
- Section 7: an explanation of how the design approach complies with the relevant planning policies, and of how the DAS complies with the relevant legislative guidance.
- Section 8: summary.

2. CONTEXT

2.1. LEGISLATION, POLICY AND GUIDANCE CONTEXT

2.1.1. INTRODUCTION

2.1.1.1. This DAS should be read in conjunction with the Planning Statement [APP-108] which sets out a comprehensive review of the legislative context and policy framework relevant to the Proposed Development.

2.1.1.2. This section of this DAS provides a summary of the legislative context and policy framework for the Proposed Development, with particular emphasis on the relevant National Policy Statement ('NPS') EN-1 and how it promotes good design as part of the application process.

2.1.2. NATIONAL LEGISLATIVE CONTEXT

The Climate Change Act 2008

- The Climate Change Act 2008 established a legal requirement for an 80% reduction in the Greenhouse Gases ('GHG') emissions of the UK economy by 2050 in comparison to the 1990 baseline. In June 2019 the UK Government updated this commitment to net zero emissions by 2050.
- As set out in more detail in the Needs and Benefits Report [APP-115], interconnector projects can make important contributions to help the UK meet its climate change objectives by facilitating renewables integration.

Planning Act 2008

- The objective of the Planning Act 2008 (the Act) is to improve the process for delivering major infrastructure projects by making the process more certain. The Act makes provision for the Government to produce NPS's setting out the national policy. The NPSs set out the strategic policy framework against which individual proposals will be assessed prior to a recommendation being made to the SoS.
- NPSs are of primary importance to the determination of applications for development consent. Section 104 of the Planning Act 2008 (as amended) states:
    - (2) In deciding the application, the Secretary of State must have regard to: (a) any national policy statement which has effect in relation to development of the description to which the application relates (a "relevant national policy statement") ...
    - (3) The Secretary of State must decide the application in accordance with any relevant national policy statement, except to the extent that one or more of subsections (4) to (8) applies.
- In accordance with the direction issued by the Secretary of State pursuant to section 35 of the Act dated 30 July 2018, NPS (EN-1) is to have effect in relation to the Proposed Development "in a manner equivalent to its application to development consent for the construction and extension of a generating station within section 14(a) of the Act of a similar capacity as the proposed project so far as the impacts described in EN-1 are relevant to the proposed Development". Therefore the Secretary of State is required to consider the Application pursuant to Section 104 of the Act.
- Section 10 of the Act 'Sustainable development' is of relevance and provides that when designating an NPS and in turn setting the policy framework against which an application where an NPS applies will be considered the SoS must have regard to the desirability of achieving 'good design'.

The Town and Country Planning (Development Management Procedure) (England) Order 2015

- Whilst not applicable to an application for development for development consent under the Planning Act 2008, the Town and Country Planning (Development Management Procedure) (England) Order 2015 ('DMPO') (which applies to applications for planning permission under the Town and Country Planning Act ('TCPA') 1990 (as amended)) has been referred to as an example of good practice with regard to the matters to be addressed within a DAS.
- Article 9(3) 'Design and access statements' states that a DAS must:
    - explain the design principles and concepts that have been applied to the development;
    - demonstrate the steps taken to appraise the context of the development and how the design of the development takes this context into account;
    - explain the policy adopted as to access, and how policies relating to access in relevant local development documents have been taken into account
    - state what, if any, consultation has been undertaken on issues relating to access to the development and what account has been taken of the outcome of any such consultation; and
    - explain how any specific issues which might affect access to the development have been addressed.

- Whilst the proposed Converter Station and ORS at the Landfall involve new buildings and structures, the other works (e.g. the proposed Onshore HVDC Cable) for the most part represent engineering works. Article 9(4) of the DMPO confirms a DAS is not required for an application for planning permission for engineering works. Accordingly, this DAS is therefore concerned with the Converter Station and ORS only.

2.1.3. NATIONAL POLICY

NPS EN-1 - The Overarching National Policy Statement for Energy

- NPS EN-1 contains government policy applicable to all types of nationally significant energy infrastructure. As explained above (with reference to the direction issued by the Secretary of State dated 30 July 2018 pursuant to section 35 of the Ac) EN-1 has effect in so far as the impacts described in EN-1 are relevant to the Proposed Development.
- EN-1 notes that it is critical that the UK continues to have secure and reliable supplies of electricity as it makes the transition to a low carbon economy.
- EN-1 also recognises the important role that interconnection can play in compensating for the intermittency of renewable generation. The NPS notes that:
  - 'existing transmission and distribution networks will have to evolve and adapt in various ways to handle increases in demand'.
  - The need for interconnector projects, and AQUIND specifically, is addressed in detail in the Needs and Benefits Report [APP-115].

Good Design as Part of NPS EN-1

- Section 4.5 of EN-1 promotes the use of good design in the DCO process and includes criteria for 'good design' for energy infrastructure.
- Paragraph 4.5.1 notes that whilst visual appearance of a building:
  - 'is sometimes considered to be the most important factor in good design…. high quality and inclusive design goes far beyond aesthetic considerations. The functionality of an object - be it a building or other type of infrastructure - including fitness for purpose and sustainability, is equally important. Applying "good design" to energy projects should produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction and operation, matched by an appearance that demonstrates good aesthetic as far as possible. It is acknowledged, however that the nature of much energy infrastructure development will often limit the extent to which it can contribute to the enhancement of the quality of the area'.
- Whilst therefore placing a requirement on the Applicant to satisfy the SoS that the Proposed Development is sustainable and demonstrates good aesthetics as far as possible, EN-1 recognises that the nature of energy infrastructure will often limit the extent to which it can enhance the quality of an area.
- This DAS therefore sets out how the Applicant has taken into account both functionality (including fitness for purpose and sustainability) and aesthetics (including its contribution to the quality of the area in which it would be located and the sensitivity of its location) as far as possible.
- Paragraph 4.5.2 notes that good design is also a means by which many of the policy objectives in the NPS can be met, for example the siting and use of appropriate design measures can help mitigate flood or noise impacts.
- Paragraph 4.5.3 states that the decision maker needs to be satisfied that energy infrastructure developments are sustainable are as attractive, durable as adaptable as the can be – and that the Applicant has taken into account both functionality and aesthetic as far as possible.
- Paragraph 4.5.3 also recognises that the Applicant may not have any or very limited choice in the physical appearance but 'there may be opportunities for the applicant to demonstrate good design in terms of siting relative to existing landscape character, landform and vegetation. Furthermore, the design and sensitive use of materials in any associated development assist in ensuring that such development contributes to the quality of the area'.
- Paragraph 4.5.4 requires Applicants to be able to demonstrate in their application how the design process was conducted and how the proposed design evolved. This includes the reasons for favoured choices where a number of different designs were considered. It also states that the decision maker should "take into account the ultimate purpose of the infrastructure and bear in mind the operational, safety and security requirements which the design has to satisfy".
- The concept of good design has therefore not only informed the selection of the technologies, the location of the Converter station and the ORS at Landfall but also those embedded mitigation measures which will minimise adverse effects both during the construction and operation of the Proposed Development.

2.1.5. OTHER NATIONAL AND LOCAL PLANNING POLICY

2.1.5.1. Whilst EN-1 forms the primary basis for determining DCO applications to which it relates, paragraph 4.1.5 of EN-1 is clear that other matters that the SoS can consider "*important and relevant*" in decision making can include Development Plan documents or other documents in the Local Development Framework. It is also clear, however, that where there is any conflict, the NPS prevails for the purposes of decision making given the national significance of infrastructure.

2.1.5.2. This section considers other national and local planning policy in so far as it may be considered important and relevant in regard of Section 104 of the Planning Act 2008.

National Planning Policy Framework 2019

- Paragraph 5 of the (National Planning Policy Framework) NPPF makes it clear that the document does not contain specific policies for NSIPs and that applications in relation to NSIPs are to be determined in accordance with the decision-making framework set out in the PA 2008 and relevant NPSs (where applicable), as well as any other matters that are relevant, which may include the NPPF. The NPPF is built around the concept of sustainable development, with paragraph 10 stating that a presumption in favour of sustainable development is "at the heart of the framework". As detailed in NPPF paragraph 8, the achievement of sustainable development has three (economic, social and environmental) interdependent objectives which should be delivered through the preparation and implementation of plans and the application of policies in the NPPF.

2.1.6. LOCAL PLAN POLICIES

- As set out previously, NPS EN-1 represents the primary policy document for the determination of the Application. Local policy may, however, be an important and relevant, in particular with regard to local context and defining local mitigation measures where considered relevant. The DAS has had regard to key policies relevant to good design and access from the host local authorities as set out in Table 2.1 below. This is not an exhaustive list of all planning policy, and more detail is set out at Appendix 4 of the Planning Statement [APP-108].
- The policies of East Hampshire District Council ('EHDC'), the SDNPA and Winchester City Council ('WCC') are relevant to the Converter Station having regard to its location, with the policies of Portsmouth City Council ('PCC') relevant to the ORS building.

2.1.7. SUMMARY

2.1.7.1. The development plan policies in Table 2.1 highlight the importance of high quality and sustainable design which acknowledges local character and enhances the local environment. The development plan policies do not provide criteria for determining the acceptability of nationally significant infrastructure to be consented pursuant to the Act. However, the themes highlighted by the development plan policies have helped to guide the development of the Proposed Development.

2.1.7.2. The DAS has been provided to demonstrate how the Proposed Development has taken into account the criteria for good design contained within EN-1 as well as other legislation and policy.

2.1.7.3. The DAS describes how the design has evolved to reflect the functional and operational requirements of the Proposed Development, to provide an appearance that demonstrates good aesthetic, as far as possible, taking into account the site context and feedback received from the relevant stakeholders.

Table 2.1 – Key Policy Documents

Host local Authority	Local Plan	Policy Relevant to Good Design
EHDC and SDNPA	Local Plan Part 1: EHDC and South Downs National Park Authority Joint Core Strategy adopted June 2014	Policy CP20 Landscape – requires development to conserve and enhance the natural beauty, tranquillity, wildlife and cultural heritage of the South Downs Natural Park and its setting.
		Policy CP28 Green infrastructure – requires new development to maintain, manage and enhance the network of new and existing green infrastructure. Requires new green infrastructure to be provided through either on-site provision or financial contributions.
		Policy CP29 Design – states that the built environment must be of an exemplary standard and highly appealing in terms of visual appearance. Requires new development to respect the character, identity and context of the district's towns, villages and countryside.
		Policy CP31 Transport – encourages the fullest possible use of sustainable modes of transport and a reduction in dependence on private cars through implementation of Hampshire Local Transport Plan (2011-2031). Sets out the transport requirements / standards new development is expected to meet.
SDNPA	Local Plan 2019	SD4 Landscape Character - development proposals will only be permitted where they conserve and enhance the landscape character. Details how development proposals should demonstrate accordance with this requirement.
		SD5 Design – states that development proposals will only be permitted where they adopt a landscape-led approach and respect the local character, through sensitive and high-quality design that makes a positive contribution to the overall character and appearance of the area. Design principles that should be adopted are outlined.
		SD6 Safeguarding Views – development proposals will only be permitted where they preserve the visual integrity, identity and scenic quality of the National Park. Key views and views of key landmarks should be preserved and enhanced.
		SD7 Relative Tranquillity – requires development proposals to conserve and enhance relative tranquillity. Outlines the impacts that should be considered
		SD8 Dark Night Skies – requires development proposals to converse and enhance the intrinsic quality of dark night skies and the integrity of the Dark Sky Core. Requires proposals to demonstrate that all opportunities to reduce light pollution have been taken. Sets out hierarchy that development proposals should follow.
WCC and SDNPA	Local Plan Part 1: WCC and SDNPA Joint Core Strategy adopted March 2013	Policy CP10 Transport – states that the Local Planning Authority will seek to reduce demands on the transport network, manage existing capacity efficiently and secure investments to make improvements. Requires development to be located and designed to reduce the need to travel.

Host local Authority	Local Plan	Policy Relevant to Good Design
		Policy CP12 Renewable and decentralised energy – outlines the Local Planning Authorities support of renewable and decentralised energy generation in the district. Sets out details of how proposals for energy schemes will be assessed.
		Policy CP13 High quality design – requires new development to meet the highest standards of design and details how proposals are expected to demonstrate this.
		Policy CP15 Green infrastructure – development proposals which maintain, protect and enhance the function / integrity of the existing green infrastructure network and/or provide a net gain of green infrastructure will be supported.
WCC and SDNPA	Local Plan Part 1: WCC and SDNPA Joint Core Strategy adopted March 2013	CP19 South Downs National Park – new development should be keeping with the context and the setting of the landscape and settlements of the South Downs National Park.
		CP20 Heritage and Landscape Character – states that emphasis should be given to conserving local distinctiveness, especially in terms of characteristic materials, built form and layout, tranquillity, sense of place and setting.
WCC	Local Plan Part 2: Development Management and Allocations adopted April 2017	Policy DM15 Local distinctiveness – requires development to respect the qualities, features and characteristics that contribute to the distinctiveness of the local area. States that regard will be hard to the cumulative effects of development on the character of an area.
		Policy DM16 Site design criteria – outlines design criteria proposals will be expected to accord with.
		Policy DM18 Access and parking – sets out parking and access requirements new developments will be expected to accord with.
PCC	Portsmouth Plan (Portsmouth Core Strategy) adopted January 2012	Policy PCS17 Transport – states that the council will work to deliver a strategy that will reduce the need to travel and provide a sustainable and integrated transport network. Encourages development around transport hubs. Safeguards land for new transport infrastructure
		Policy PCS23 Design and Conservation – requires all new development to be well designed and to respect the character of the city.

(Note: as the DAS deals with the Converter Station and ORS, HBC Policies relating to the below ground cable routes are not included in this table)

3. SITE CONTEXT AND SELECTION

3.1. SITE CONTEXT AND ANALYSIS

3.1.1. INTRODUCTION

3.1.1.1. The full description of the Proposed Development is set out in Chapter 3 of the ES (Description of the Proposed Development) with the full description of site context set out in the Chapter 15 of the ES [APP-118]. As noted in Section 1.2 above, the main focus of this DAS is the Converter Station Area and ORS at Landfall. The context below focuses on these areas.

3.1.2. LOVEDEAN (CONVERTER STATION AREA)

3.1.2.1. The following describes the key components proposed for the Converter Station Area:

- the Converter Station and associated equipment;
- the connection between the HVAC Cables and the National Electricity Transmission System (NETS) at Lovedean Substation;
- the HVAC Cable Corridor to accommodate the AC Cables and FOC between the Converter Station and Lovedean Substation;
- the HVDC Cables and FOC corridor from the Converter Station southwards;
- a Works Compound and Laydown Area;
- an Access Road and associated haul roads;
- surface water drainage and associated attenuation ponds;
- landscape and ecology measures;
- utilities such as potable water, electricity and telecom; and
- the compound comprising the Telecommunications Building(s) and associated equipment.

3.1.2.2. The Converter Station Area is situated next to the existing Lovedean Substation, located in a rural fringe area east of Winchester, approximately 13.5 km north of Portsmouth city centre. The settlement of Lovedean is located approximately 1.3 km to the south-east.

3.1.2.3. The Converter Station Area itself is a mixture of arable and grazing farmland. The topography of the Converter Station Area site falls from approximately 97 m to 67 m AOD. Surrounding the Converter Station Area are mixed agricultural fields with established hedgerow boundaries and hedgerow trees. Some smaller fields to the west are used by off-road vehicles and horse grazing.

3.1.2.4. The South Down National Park boundary lies just on the edge of the Converter Station Area with Monarch's Way (Public Right of Way) approximately 600 m to the north-east.

3.1.2.5. There are residential and individual farm properties approximately 200 m to the north and 250m to the west on Old Mill Lane; and approximately 400m to the south and 600 m to the south-west on Broadway Lane. These are domestic scale and low-height structures.

3.1.2.6. The Converter Station Area will be accessed during construction and the subsequent operation of the Project by a new vehicular access route connecting to Broadway Lane near the junction to Day Lane to the south-east of the site. The A3 public highway is approximately 2 km from this junction.

3.1.2.7. The existing Lovedean substation, associated transmission towers and overhead lines are dominant elements in the landscape of the Converter Station Area and the immediate surrounding area, abutting the proposed site.

3.1.2.8. The Environments Agency's Flood Risk Data indicates that the site is located in an area at low risk of flooding (Flood Zone 1).

3.1.2.9. The Converter Station is not located within the immediate proximity of any statutory or non-statutory heritage assets. A number of Listed Buildings, predominately Grade II, lie within Lovedean, Denmead, Hambledon and along the narrow lanes mainly to the east of the Converter Station Area, with the closest being at Denmead Farm (two Grade II Listed Buildings), off Edneys Lane to the south west and Ludmore Cottages to the north east (one Grade II Listed Building).

3.1.2.10. There are pockets of ancient woodland to the south-east of the proposed Converter Station Area.

3.1.2.11. The Converter Station is located within the administrative area of Winchester City Council with the wider Converter Station Area and a part of the existing Lovedean Substation located within the administrative boundary of East Hampshire District Council.

3.1.2.12. The Converter Station would therefore be viewed as part of an existing industrialised landscape, with the surrounding environment comprising agricultural land interspersed with established hedgerow boundaries and hedgerow with the settlement of Lovedean to the south-east.

3.1.3. OPTICAL REGENERATION STATION INFRASTRUCTURE

3.1.3.1. The following describes the ORS infrastructure which will be required within 1km of the UK Landfall of the Proposed Development (this location is shown on the Optic Regeneration Station Parameter Plan [APP-017].

3.1.3.2.

3.1.3.3. The ORS infrastructure will comprise two ORS buildings. Each building would be up to 4m high and located within a securely fenced compound. This compound would also potentially contain auxiliary power generation equipment and a fuel tank. The compound for the ORS infrastructure would have a maximum size of 18 m x 35 m. Inside the compound, there will be the provision for parking for up to two vehicles for maintenance purposes. The two ORS buildings, will be located approximately 10 m apart.

3.1.3.4. The location of the ORS infrastructure is to be located within the Fort Cumberland Car Park, which is located on the coast, approximately 5 km south-east of Portsmouth city centre. The existing car park south of Fort Cumberland Road is used to access a short path to Eastney beach and the Eastney Beach Site of Importance for Nature Conservation ('SINC') as well as Fort Cumberland SINC, an area of open space next to the car park.

3.1.3.5. There are a number of residential properties to the north, northeast and west of the Fort Cumberland Car Park. These are a mixture of houses and three storey flats ranging in ages from late 1950's to more recent developments in early 2000's. Fort Cumberland Road which leads to Eastney Marina is the only local road which borders to the Landfall to the north. Southsea Holiday Home, Lodge and Leisure Park with static caravans bounds the site to the south and west and there is a small children's play area to the west of the car park's entrance.

3.1.3.6. Sustrans National Cycle Route No.2, which is also known as the Shipwrights Way, follows Fort Cumberland Road and passes within 300 m of the site to the north.

3.1.3.7. The Environment Agency's Flood Risk Data indicated that the Landfall site flood risk designation is updated from Flood Zone 2 to Flood Zone 3 from January 2020, based on the most recent environmental studies.

3.1.3.8. The Fort Cumberland Scheduled Monument (a Georgian fortification) lies approximately 225 m to the east of the ORS at the Landfall and to the north west of Fort Cumberland Road and Halliday Crescent, and includes one Grade II* Listed Building and three Grade II Listed Buildings; Eastney Sewage Pumping Station Scheduled Monument. In addition, the World War II Anti-Tank defences at Eastney Beach Listed Building is located within 300 m southwest of the ORS at the Landfall and the caravan park.

3.1.3.9. The ORS is located within the administrative area of the City of Portsmouth. The ORS and related compound would therefore be viewed as part of a semi- residential coastal landscape, with the surrounding environment comprising residential, leisure and open space interspersed with notable features such as the Fort Cumberland Scheduled Monument to the east and Eastney Beach to the south.

3.2. SITE SELECTION

3.2.1. CONVERTER STATION SITE SELECTION

3.2.1.1. The Applicant conducted a preliminary Converter Station site identification exercise in April 2016, using the agreed grid connection point of Lovedean Substation as the focus for the optioneering exercise.

3.2.1.2. The following criteria were used in the initial siting exercise:

- The site should be within 2 km (radius) of the existing Lovedean Substation. This criterion was adopted for the following reasons;
  - a greater distance would result in greater electricity transmission losses along the HVAC Cables (and consequently reduce the efficiency of the Interconnector);
  - HVDC Cables have a resistance loss, where HVAC Cables have resistance, inductive and capacitive losses, resulting in greater transmission losses; and
  - An HVAC cable also requires a wide easement (approximately 11 m wide), creating a corridor where no tree or hedge growth is permitted, although the land can be returned to agriculture. As such, a shorter distance for the AC cable route, and thus closer proximity of the Converter Station and Lovedean Substation reduces potential disruption and impact on the local environment in terms of ecology and visual impact. The constriction corridor width for HVAC cables extends up to 23 m (depending on haul road requirements), and though temporary, maintaining a restricted distance of the HVAC cable provides an environmental benefit.
- Overall site dimensions of 200 m x 200 m with a permanent access way of at least 6 m wide (note that this area has since increased following engagement with Converter Station suppliers);
- An additional area nearby of approximately 100 m x 100 m to use as a temporary Laydown Area during the construction period;
- Beside or close to existing roads to minimise new road construction;
- Allowance for a turning radius of 30 m for the site entrance;
- Aim to avoid areas of high environmental value or public amenity, such as ridge tops and rare species habitats;
- Aim to minimise close proximity to dwellings, public buildings, and public spaces due to possible audible noise and electromagnetic interference from the Converter Station;

- Areas of high coastal salt or industrial contamination should be avoided;
- Flood plains, rivers or streams should be avoided;
- Marshland which would require piling for foundations should be avoided; and
- Footpaths and historic public rights of way should be avoided, where practicable.

3.2.1.3. Constraints identified within the 2 km study area (Plate 3.1) from Lovedean Substation posed limitations to the potential location of the Converter Station. These included:

- SDNP and its setting – the National Park is located approximately 500 m to the north, directly east and approximately 700m west of Lovedean Substation:
- Densely populated/urban areas to the east and south (Waterlooville and Denmead), with the strategic gap between;
- Numerous rural dwellings in close proximity to the Lovedean Substation;
- Listed Buildings in the southwest segment of the search area;
- Existing transmission lines/towers and underground cables entering/exiting the Lovedean Substation.

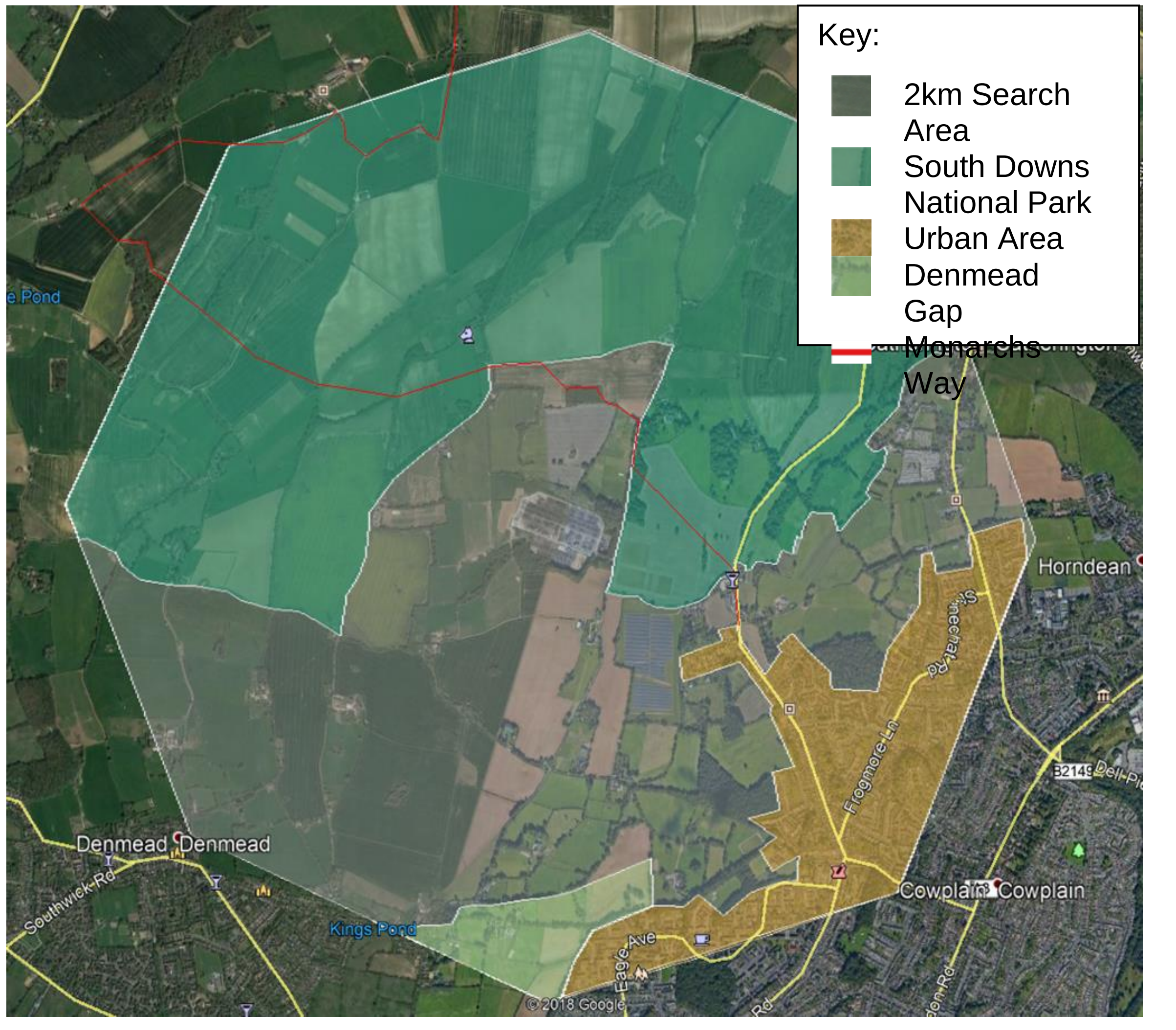


Plate 3.1- Converter Station Search Area and Initial Constraints

3.2.1.5. The Applicant initially identified five sites within the 2 km radius as possible locations to develop the Converter Station, these are denoted by the orange areas identified in Plate 3.2

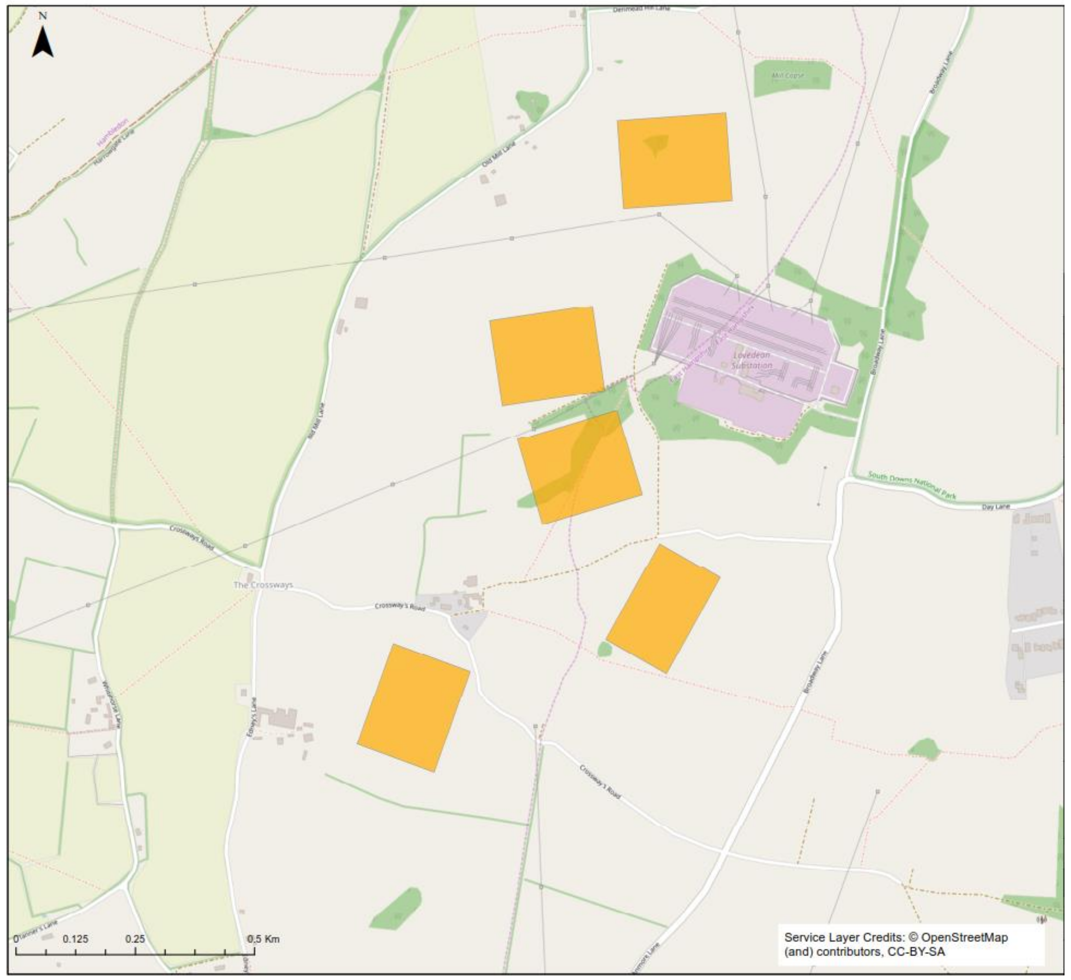


Plate 3.2- Preliminary Converter Station Investigation Options

3.2.1.6. After the initial identification of the five potential Converter Station site areas, the Applicant conducted further detailed assessments to ensure the technical viability and environmental constraints of siting the Converter Station within the search area.

3.2.1.7. Localised constraints such as the widespread coverage of the SDNP to the northeast and west of the Lovedean Substation meant that Converter Station locations to the north of the Lovedean Substation were considered not viable and the northern most location was discounted. One of the proposed sites was situated on Ancient Woodland (Stoneacre Copse). This option was relocated further south and the site footprint was elongated to avoid the Ancient Woodland. In addition, due to proximity of residential receptors at the settlements of Denmead and Anmore, the southwestern-most option was also discounted. The result of this exercise identified three potential Converter Station locations to be progressed.

3.2.1.8. Ongoing consultations with Planning Officers from WCC and EHDC resulted in an additional option been introduced at their request, which was perceived to potentially offer reduced landscape and visual amenity effects by virtue of being located further south from residential receptors than the previous southwestern option. The four alternative locations, shown in Plate 3.3, considered further were therefore as follows:

- Option A: Southwest of Lovedean Substation;
- Option B: West of Lovedean Substation, between the existing 400 kV OHLs;
- Option C: Located between Stoneacre Copse and the existing 132 kV cable circuits of the existing Lovedean Substation; and
- Option D: Further southwest of Lovedean Substation (by LPA request).

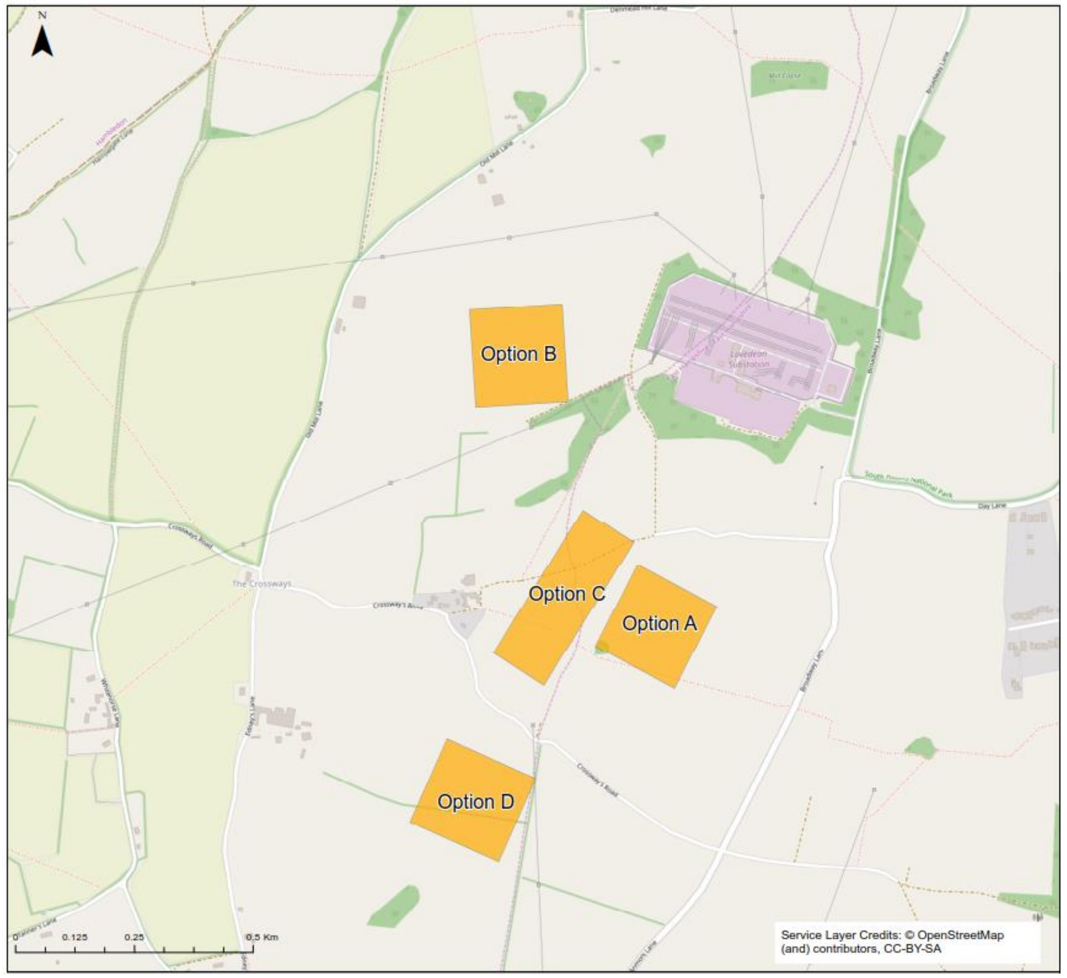


Plate 3.3- Preliminary Converter Station Investigation Options

3.2.1.9. Further investigation resulted in the discounting of Option C due to its potential impact on the Ancient Woodland, impact upon visual receptors and likely permanent diversion of a Public Right of Way (PRoW). Option D was also discounted due to the location having a significant visual impact on the settlement of Denmead. Options A and B were taken forward to further investigations.

3.2.1.10. In Quarter 3 and 4 of 2017, the Applicant conducted a desktop study and carried out site visits and on-site studies to identify the environmental constraints for the siting of the Converter Station Options A and B, alongside consultation with the LPAs.

3.2.1.11. Based on the analysis and assessment undertaken for both Converter Station options, Option B was identified as the preferred option. The preference for Option B was strongly related to its more positive environmental outcomes from a noise, ecology and landscape and visual perspective. In addition, this option also performed best from a technical engineering perspective.

3.2.1.12. It was considered that landscape and visual effects were one of the most important distinguishing factors between the sites due to the relative sensitivity of the location, including but not exclusive to their proximity to sensitive features such as SDNP.

3.2.1.13. Option B benefited from existing topography, which provided natural screening of the Converter Station site, however the associated access route would be of greater visibility in the landscape due to the route's longer length. Overall, it was considered that this option would be better screened from key receptors including the urban area, public highway and PRoWs by virtue of existing topography and vegetation to provide screening and provided the opportunity of being mitigated by the introduction of additional landscaping. It was therefore concluded that Option B had the potential to result in a lesser visual impact.

3.2.1.14. Following the selection of Option B, the Applicant carried out further ecological and arboricultural surveys. These surveys confirmed the absence of dormice but identified a number of badger setts within close proximity to the initial Converter Station site, to which the hedgerow retention would allow an appropriate buffer.

3.2.1.15. As a result, the Applicant looked at refining the Converter Station location to avoid or reduce these impacts, and in doing so identified a potential to microsite the Converter Station to the east (approximately 40 m east and 11 m north). This resulted in Option B (i) and Option B (ii) being established, see Plate 3.4. Both options are included in the Application, with the final siting of the Converter Station subject to landowner discussions and to be finalised following the grant of the DCO.

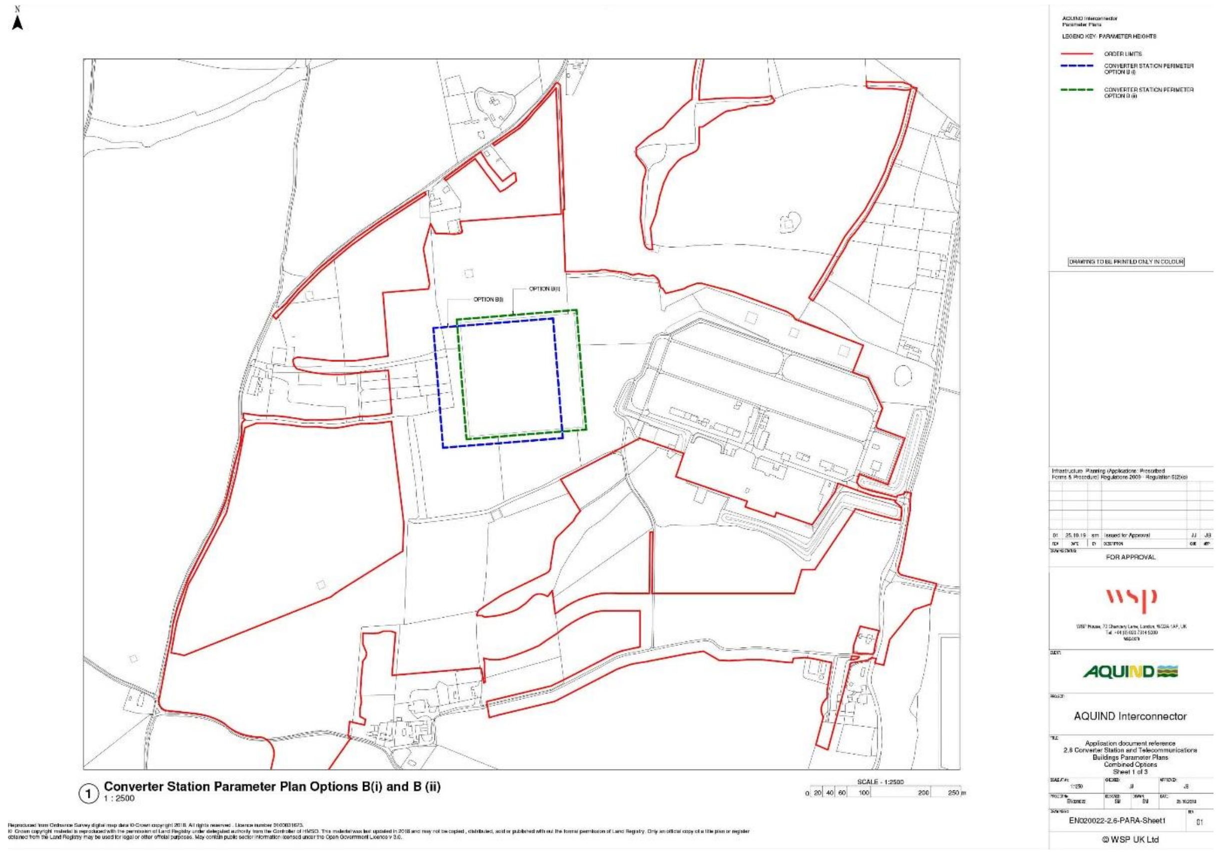


Plate 3.4- Options B (i) (Blue) and B (ii) (Green) sites

3.2.2. ORS SITE SELECTION

3.2.2.1. Consideration was given to the location of the ORS infrastructure, which in considering the parameters for the buildings and compound required an area of up to 450m², was not considered appropriate for the open space to the east of the car park due to its designation as a SINC, and the reduced proximity the location would have on Fort Cumberland, as a Scheduled Monument.

3.2.2.2. The marina and ferry areas beyond have no suitable open space to accommodate requirements. With the limited formal amenity space in the locality, the open areas around Lumsden Road were not considered suitable, taking into account the associated impacts on residential amenity. Other alternatives of Bransbury Park, the Royal Marines playing fields north of Driftwood Gardens, land around Eastney Swimming Pool, and Kingsley Road open space were also considered unsuitable due to the nature of the open space.

3.2.2.3. The car park, providing an area of compacted ground for car parking, with no formal open space use, directly adjacent to the proposed Landfall, the Onshore Cable Route and Transition Joint Bays (which cannot be built over) was considered to provide the most appropriate location in the area in terms of available land, reduced impact on open space, and no impact on residential amenity, with an opportunity for screening to reduce the visual impact of the above ground elements.

3.2.2.4. Additional information regarding the alternatives is included in the Flood Risk Sequential and Exception Sequential and Exception Test included within Section 3 of the Flood Risk Assessment ('FRA') [APP-439] and in its addendum document reference 7.8.1.9.

4. CONSULTATIONS

4.1. OVERVIEW

4.1.1.1. This section of the DAS sets out the design specific consultations undertaken in relation to the Converter Station Area and the ORS and how they have influenced the formulation of the Design Principles.

4.2. OPTICAL REGENERATION STATION (ORS)

4.2.1.1. The ORS facility is located within the jurisdiction of PCC. The concept of an ORS within 1 km of Landfall was identified with the Consultation Document presented at the statutory consultation stage. In the response from PCC to this consultation there was no reference to the ORS. However, as the Project was keen to ensure the views of PCC were captured on this matter the ORS was discussed on a conference call with PCC on the 16th August 2019. This was followed up with plans tabled at the meetings held on the 22nd August 2019, 10th September 2019 and 25th September 2019 following the confirmed location of the ORS within the car park at Landfall. Regular update calls and meetings were agreed with PCC to ensure regular contact was maintained as the project evolved. The location and design of the ORS was part of a wider project agenda with indicative designs, as shown in this DAS, shared with PCC as they evolved through August and September 2019. The indicative design for the ORS is functional with limited opportunity to alter the aesthetics. The siting of the ORS has been selected to minimise the impact upon the area with the parameters, as shown in Plate 5.1, controlling the limited mass and footprint of the facility.

4.3. CONVERTER STATION DESIGN MEETINGS

4.3.1.1. This section summarises items discussed at consultation meetings attended by the host LPA's and the SDNPA relevant to the Converter Station design and outlines the design responses incorporated into the indicative designs developed to support the DCO submission.

4.3.1.2. All meetings were attended by representatives from:

- EHDC;
- WCC; and
- SDNPA.

4.3.1.3. An initial Converter Station Area specific meeting was held on the 15th October 2018. This meeting took the form of a Landscape and Visual Amenity Briefing with relevant LPA's (EHDC, WCC) and the SDNPA in attendance.

4.3.2. LANDSCAPE AND VISUAL AMENITY BRIEFING MEETING – 15TH OCTOBER 2018

4.3.2.1. The purpose of this meeting was to update the attendees on the progress of the Project since the consultation undertaken in January 2018, to seek views on possible content of the Preliminary Environmental Information Report ('PEIR') in terms of Landscape and Visual Impact Assessment ('LVIA') and set out associated timescales for the progression of the Proposed Development.

4.3.2.2. The associated baseline and indicative mitigation impacts upon the zones of theoretical visibility (Zone of Theoretical Visibility - computer-generated tool to identify the likely (or theoretical) extent of visibility of a development) was discussed along with indicative species palettes, and agreement on local viewpoints to be used for the EIA. The assessment methodology for the LVIA EIA was also further discussed and agreed.

4.3.2.3. The opportunity was taken to discuss early design concepts and colour palette for the converter buildings. The initial design concepts presented at the meeting used a patchwork of panels in varying shades of green, with hipped and curved roof examples (refer to Plates 4.1 and 4.2 below).

Plate 4.1- Green panels and curved roofs

Plate 4.2- Green panels and hipped roofs

4.3.2.4. A number of questions and comments were received, notably:

- **Comment**: (WCC) Why are vertical rather than horizontal bands being used?
- **Response**: Vertical band were selected as Architects had worked on buildings of similar scale. EHDC commented that they had seen the successful application on a number of projects with vertical bands.
- **Comment:** (WCC) Should the size of band widths be wider to reflect an "honesty" in the size of a large scale building?
- **Response:** Band widths could be varied and looked at, in option development.
- **Comment**: (WCC) Could timber be used to replicate some of the barns within the vicinity?
- **Response:** Due to operational requirements wooden materials are not acceptable within a live converter station site.
- **Comment:** Should the building be concealed or celebrated?
- **Response:** This was a concept that was proposed by EHDC, but other attendees expressed a preference for concealment. The alternatives were debated and it was agreed that prominent curved roofs (Plate 4.1) would be discounted.

4.3.3. LANDSCAPE AND VISUAL AMENITY BRIEFING MEETING – 15TH OCTOBER 2018

4.3.3.1. Building upon the initial meeting it was agreed with all the relevant stakeholders, as set out in section 3.3, that a specific focus group would be established to progress the discussions around landscape mitigation and indicative design options that would head to the crystallisation of Design Principles to control the final design to be approved pursuant to a DCO requirement post grant of the DCO.

4.3.3.2. The site constraints were highlighted and discussed and three design options were explained in more detail. Options one and two both used rich green cladding arranged vertically and horizontally in order to blend into the landscape, with the third option being a darker option with a stronger architectural character. The first two options therefore sought to soften the building while the third option sought to celebrate the building. (Plates 4.3; 4.4 & 4.5)

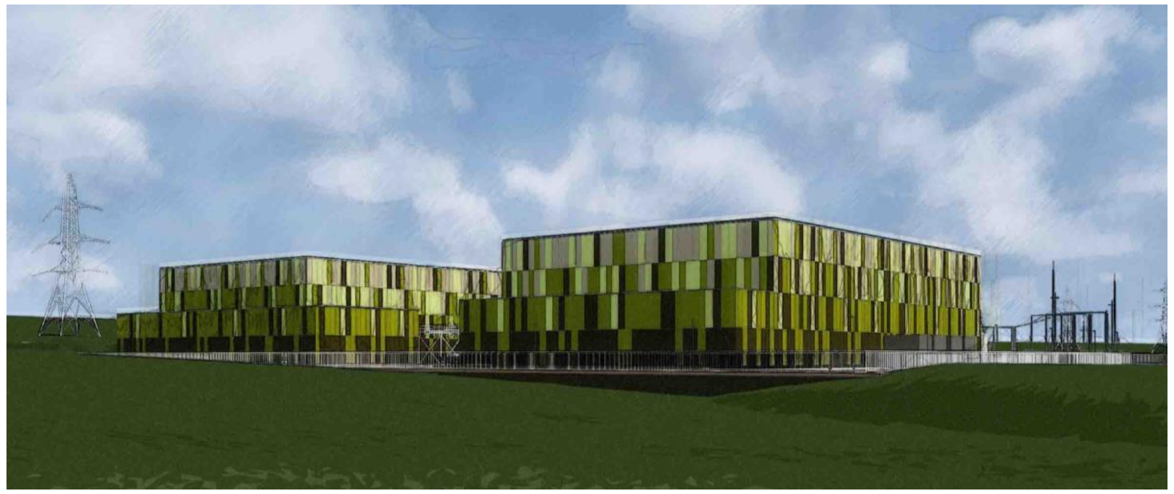


Plate 4.3 – Vertically arranged green cladding

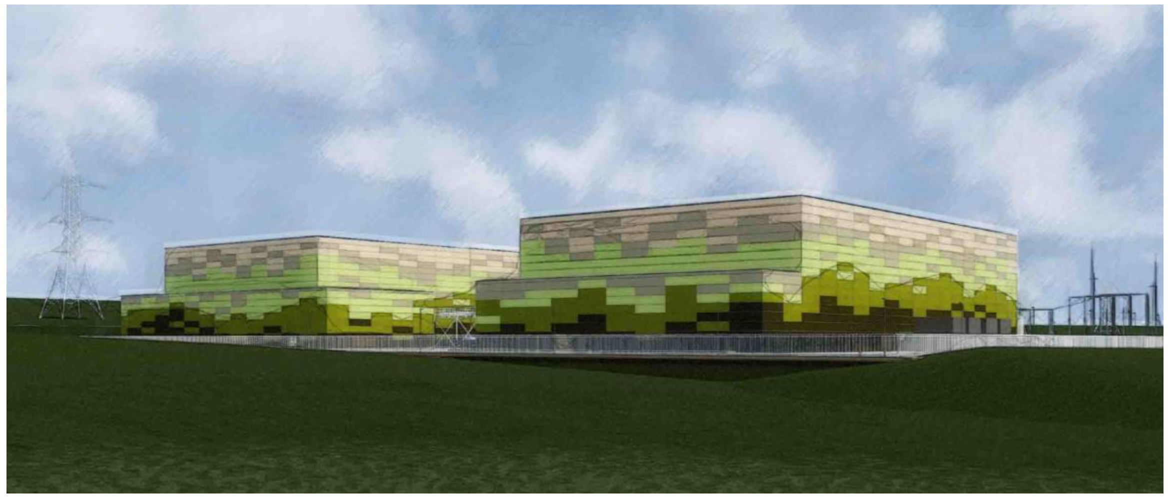


Plate 4.4 – Horizontally arranged green cladding

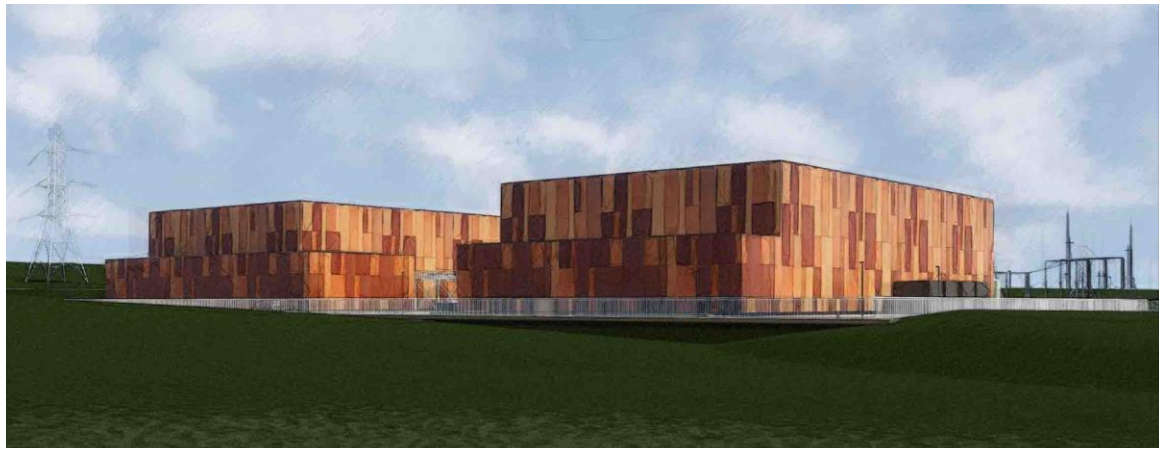


Plate 4.5 – Vertically arranged brown cladding

- **Comment:** (WCC) The concept of "hiding" the building or "celebrating" it was discussed again.
- **Response:** There was no strong preference either way from the attendees. It was agreed that the differing concepts would be considered as the indicative designs progressed.
- **Comment:** (WCC) Request to consider using cut and fill to lower the overall height of the building further.
- **Response:** It was noted that the site sits above an aquifer that would restrict the extent of excavations but it was the projects intention to conduct a cut and fill assessment exercise.
- **Comment**: (SDNPA) Type and nature of roofing materials queried.
- **Response:** It was confirmed at the meeting that neutral, matt, mid-range colours for roof cladding would be considered.
- **Comment:** (WCC) Preference for darker, less reflective colours.
- **Response:** Taken on board in selection of colour palette.
- **Comment:** (WCC, EHDC and SDNPA): Concerns raised regarding delivery of final design within the DCO process.
- **Response:** Agreed that a set of Design Principles and Parameters will be developed for inclusion in the DCO. (Refer to section 6) These would be the mechanism that would control the final design.
- **Comment:** (WCC) Access to site queried, particularly to ensure this avoids the ancient woodland to the south.
- **Response:** It was confirmed that**:**
    - Access to Broadway Lane to the east will avoid the ancient woodland.
    - Access through the existing substation is not feasible for security reasons.

- **Comment:** (EHDC) Question regarding constraints on future development and landscaping from cable routes.
- **Response**: HVDC Cables running between the Converter Station and the Landfall would be buried so that small scale planting and agriculture could occur following commissioning, but mature tree planting would not be possible over the route. The HVAC Cables between Lovedean substation and converter station has far greater technical constraints and requires greater land take. The technical constraints relating to the HVAC Cables was an important factor in determining the location of the Converter Station.

4.3.4. 2ND CONVERTER STATION DESIGN MEETING – 31ST JANUARY 2019

4.3.4.1. Following feedback at the 1st Design Meeting a presentation was given on the operational need, requirement and constraints of a converter station and how that impacts the built form.

4.3.4.2. The proposed approach to the statutory consultation was re-outlined, explaining that photomontages would be contained within the PEIR utilising a single indicative design.

- **Comment**: (WCC) Request to consider rearrangement of the components of the Converter Station to enable greater design flexibility
- **Response**: It was confirmed that the components are arranged in a specific order to convert the electricity from DC to AC as such there is limited scope to rearrange the components.
- **Comment:** (EHDC) Preference raised for a more architecturally expressive approach.
- **Response:** It was confirmed that this would be developed by the selection of small individually coloured cladding elements – possible use of "baguettes" cladding.
- **Comment:** (WCC and EHDC) Request to consider a more direct access route from the west of the site, utilising an existing farm access.
- **Response**: It was confirmed at the meeting that the road to the west was too small to meet access requirements for delivery of transformers and that the existing access point was too narrow, requiring removal of ancient woodland to adapt it, creating an unacceptable impact

4.3.4.3. The opportunity was taken to restate that the statutory consultation that would commence shortly after the meeting would utilise a single illustrative design as the DCO would not seek approval of a specific design, with Design Principles and Parameters being secured to control the final design. WCC questioned the lack of optionality and would have preferred design options consulted upon. It was maintained that to retain flexibility for final design post consent, when contractors are appointed, a Design Principles and Parameter approach would be pursued.

4.3.4.4. It was agreed at this meeting that these focused meetings would be paused during the statutory consultation period to allow consultees time to digest all the consultation material and the project team to respond to comments after the close of the consultation.

4.3.5. 3RD CONVERTER STATION DESIGN MEETING – 21ST JUNE 2019

4.3.5.1. The first Converter Station Design Meeting post the statutory consultation stage. The known site constraints were tabled (refer to Plate 4.6) to explain the limitations that influence where and what landscape mitigation can occur. Building upon this, the built form responses to the consultation were presented and explained (refer to Plate 4.7 below)

Plate 4.6 – Site Layout Plan – indicating existing ancient woodland (green) and infrastructure exclusion zones (hatched)

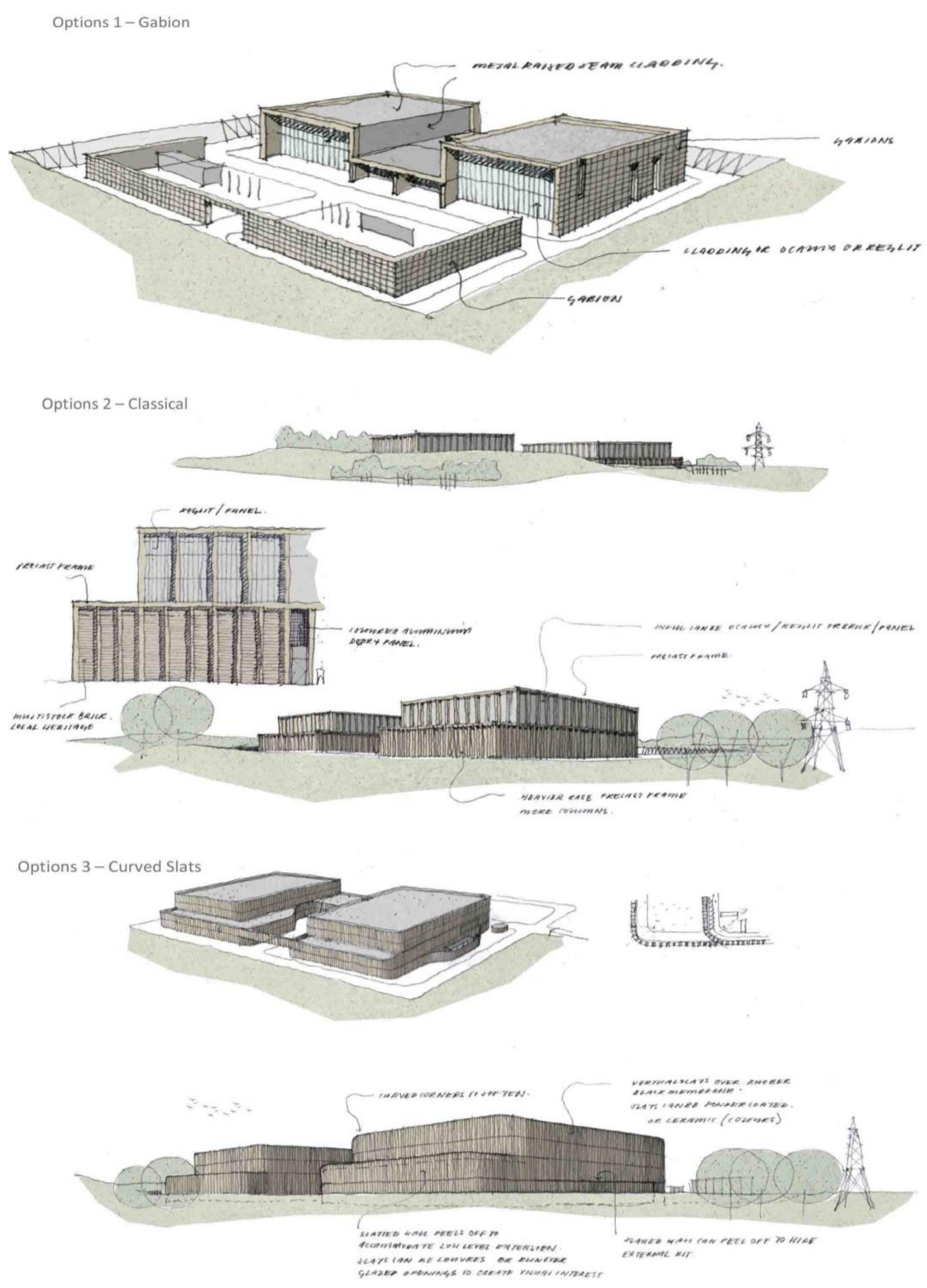


Plate 4.7 – Design options presented

- **Comment:** (EHDC) Further development of contextual colour studies presented requested (refer to Plate 4.10 for studies presented). Variation and graduation of colours to different elevations considered.
- **Response**: Defined colour palettes will be developed from the contextual studies. Variation and graduation of colours to different elevations to be considered.
- **Comment**: (WCC) Request to consider fenestration to the southern elevation.
- **Response:** It was confirmed at the meeting that it is an unmanned site, so fenestration is not necessary and more importantly not possible due to operational requirements.
- **Comment**: (WCC) Request to consider use of double faces to add interest to cladding surfaces.
- **Response**: It was confirmed at the meeting that the "baguette" option under consideration will have this effect as the applied vertical sections will stand off the cladding below, creating a shadow effect (refer to Plates 4.8 & 4.9 – showing effects created from varying the colours of the "baguettes", and the shadows resulting from the different layers of cladding).
- **Comment:** (WCC, EHDC and SDNPA) Agreement that dark, non-reflective colours for roofing would be the best option
- **Response**: To be considered.
- **Comment:** (WCC) Request to consider sloping or stepping the Converter Station compound to follow the existing contours.
- **Response**: It was confirmed at the meeting that this would not be feasible due to access and operational requirements.

Plate 4.8– Indicative illustration of "baguettes" showing patterning created by colour variations

Plate 4.9 – Indicative illustrations of "baguettes", showing shadowing effects to provide a layered texture to the facades

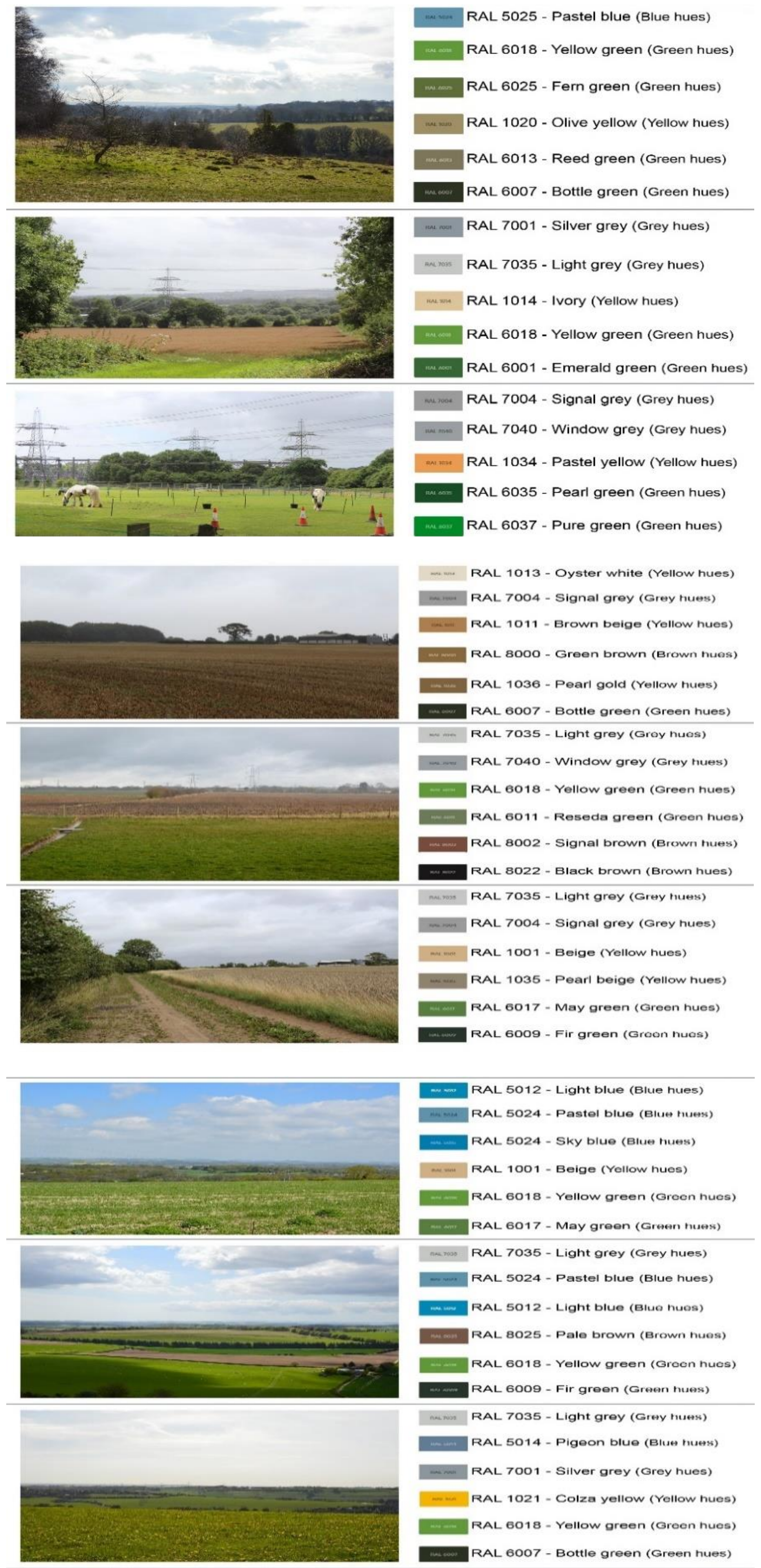


Plate 4.10 – Contextual colour studies

4.3.6. 4TH CONVERTER STATION DESIGN MEETING – 10TH JULY 2019

4.3.6.1. The meeting followed a similar format to the 3rd meeting with updates and progress on landscape mitigation followed but built form responses. The indicative landscape mitigation proposals were tabled and comments welcomed. The evolution of the illustrative design shown at the 3rd meeting was presented and discussed (Plates 4.11 & 4.12 illustrating alternative colour options and "wave" forms to parapets).

- **Comment**: (WCC) Request to consider splitting site on an east west divide.
- **Response**: It was advised that a staggered split may be feasible but will be difficult due to site constraints and agreed that splitting the site would add little benefit.
- **Comment:** (WCC) Comment on grading that darker cladding to the northern elevation and lighter to the southern would be better.
- **Response:** It was agreed that this would be incorporated.
- **Comment:** (WCC) Confirmation sought that darker roof cladding would not have a detrimental thermal effect.
- **Response:** It was confirmed that thermal performance requirements could still be met with darker roofing colours.
- **Comment:** (WCC) Request to explore a distinctive plinth element.
- **Response**: It was agreed to consider in further detailed design development
- **Comment:** (WCC and SDNPA) Agreement to discount the "summer greens" colour palette (refer to Plate 4.11).
- **Response:** Agreed to be discounted from illustrative designs.
- **Comment:** (WCC and SDNPA) Agreement that darker colours rather than lighter would be preferable.
- **Response:** Preference noted.
- **Comment:** (WCC) Request to ensure horizontal banding is included.
- **Response:** Agreed to retain and emphasise.
- **Comment:** (WCC and SDNPA) Concern expressed that "wave" forms to roof (refer to Plate 4.11) would have little impact when viewed from a distance.
- **Response:** Agreed to omit.
- **Comment:** (WCC) Request to consider blue/grey/brown colours.
- **Response**: Colour palettes to be investigated further for next meeting.

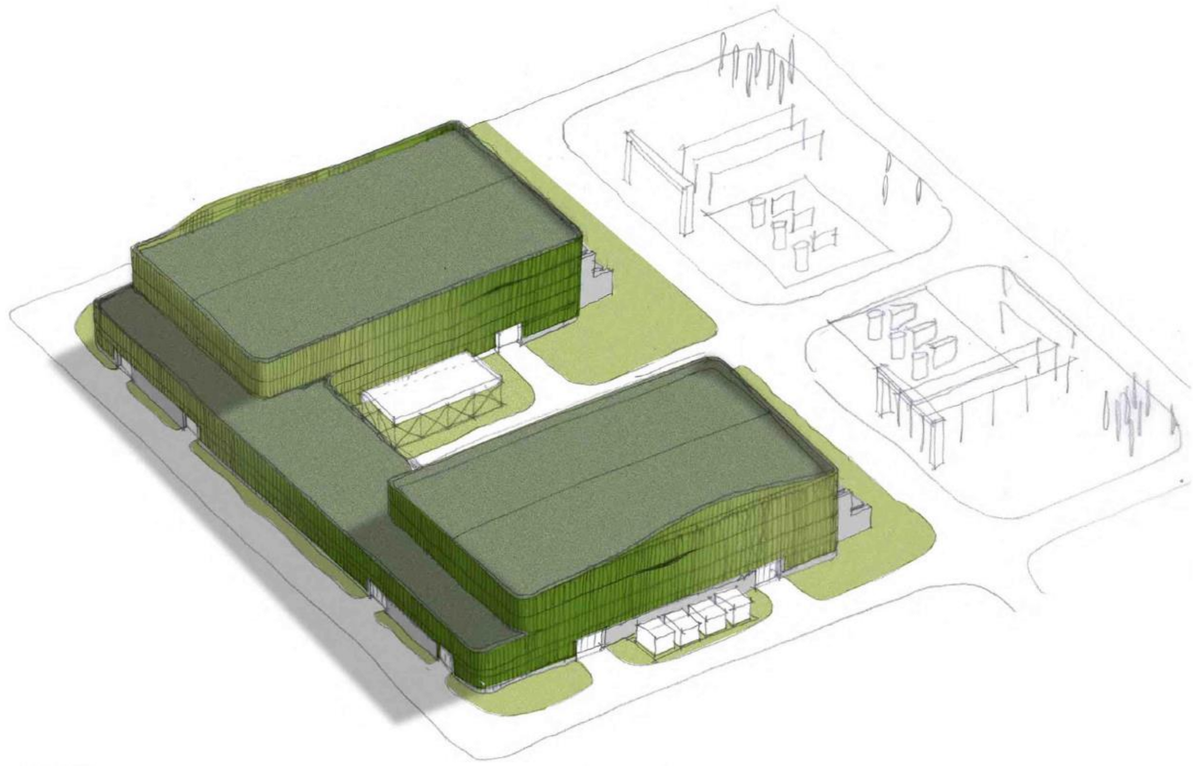


Plate 4.11– "Summer Greens" option.

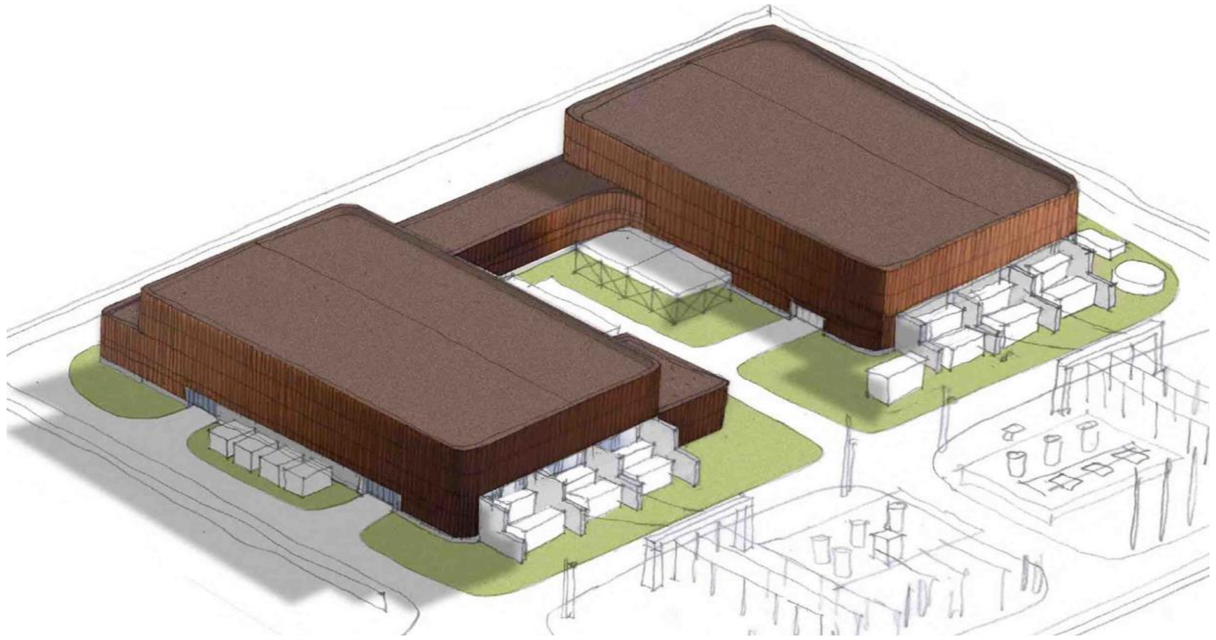


Plate 4.12 – Graded "autumnal" colours option

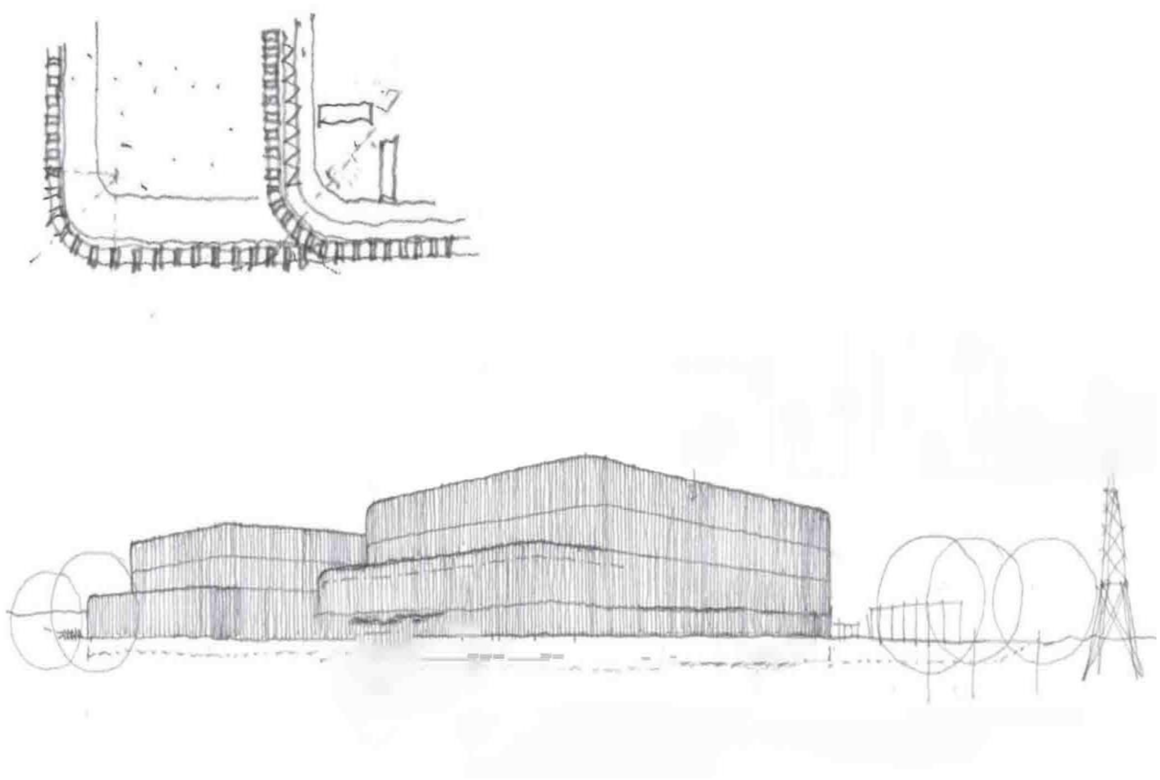


Plate 4.13 – Curved corners sketch

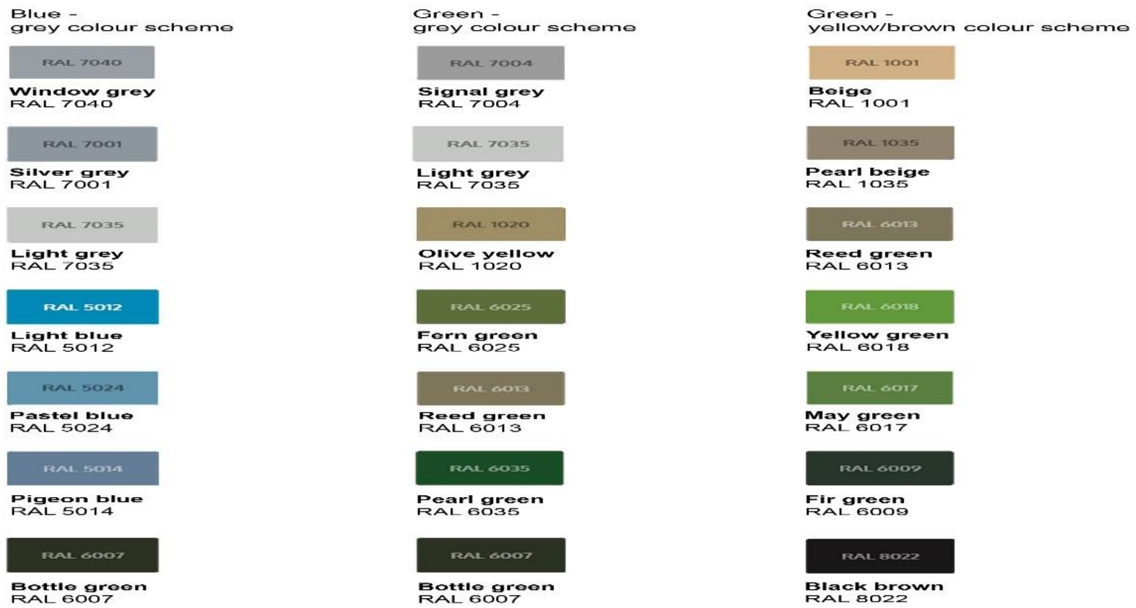


Plate 4.14 – Colour palette – abstracted from contextual colour studies

Plate 4.15 – "Autumnal" colours – indicative elevations

4.3.6.2. **Summary:** It was concluded at the meeting that the design concepts and colour palettes presented (Plates 4.11 to 4.15) should be looked at further with darker colours explored.

4.3.7. 5TH CONVERTER STATION DESIGN MEETING – 20TH AUGUST 2019

4.3.7.1. Following the general consensus that the indicative design concept discussed at the 4th meeting was to be progressed, the focus turned to exploring how the various design aspects could be converted into Design Principles. The comments on landscape mitigation, previously received, were discussed and responses made. Development of colour palettes (Plate 4.16) was also presented and finally a round table discussion, with the use of examples, as to the Design Principles that should be established was held.

- **Comment:** (WCC, EHDC and SDNPA) autumnal colours would be preferable to blue-grey.
- **Response**: Agreed to proceed with autumnal colours.
- **Comment:** (WCC) Request to consider "wrap arounds" to single storey elements to add interest to building form.
- **Response:** Agreed to consider in indicative design.
- **Comment**: (WCC, EHDC and SDNPA) Request to include Design Principles focusing on the following important aspects:
  - Levels.
  - Layout - consolidation of built form as much as possible.
  - Landscaping – layer principles with basis to be the retention of as much existing vegetation as possible, building upon this to then look at management of the existing and finally new planting where needed.
  - Access road – surface to be as sensitive to location as possible.
  - Roof plan – can the roof be clear of any ancillary paraphernalia?
- **Response:** All requests implemented in the development of the Design Principle.

Blue/ grey palette

Grey/brown palette

Grey/green/yellow palette

Autumnal palette

Plate 4.16 – Colour palettes presented

Summary:

- Blue grey palette was dismissed by general consensus.
- Grey/ brown and Grey/ green/ yellow brown palettes had a mixed reception.
- Autumnal palette was preferred by general consensus.

4.3.8. 6TH CONVERTER STATION DESIGN MEETING – 23RD OCTOBER 2019

4.3.8.1. Following the 5th meeting where example Design Principles were discussed and the direction in which the Design Principles for the Project should go. The focus of this meeting was to discuss the draft Design Principles that has been shared with the attending LPAs a week before the meeting and seek comments from attendees. Design Principles under the following headings were presented, General Principles, Building Design Principles, Landscape Design Principles, Sustainability Principles, ORS and Telecommunications Buildings Principles.

- **Comment:** (WCC and EHDC) Building Design Principles are too prescriptive and don't retain enough flexibility for material type and colour for detailed design stage.
- **Response**: The Building Design Principles had been developed following the detailed discussed and consensus expressed by the attendees at the previous design meetings.
- **Comment**: (EHDC) With regards the Landscape Design Principles request that additional principle be added to commit to as much advance planting as practicable.
- **Response**: Agreed to draw into existing Principles.
- **Comment:** (WCC) Commented that the Sustainability Principles don't go far enough and would like to see greater aspirational Principles.
- **Response:** The Project agreed to look at what additional elements could be secured as sustainability principles.
- **Comment:** (WCC) Glad to see the Project had listened in previous meetings and responded to issues that have been raised. There are key Principles drafted to cover the areas that the Councils wanted to see covered.
- **Response:** Noted.

4.3.9. CONTINUED CONVERTER STATION DESIGN MEETINGS AND CORRESPONDENCE

4.3.9.1 A further three meetings were held in August, October and November 2020 to progress discussions on outstanding matters.

4.3.9.2 Design calls on 25th August and 21st October 2020 focused on colour and responded to specific queries over the height of buildings, plant on the roofs, staircases, lightning masts, lighting columns, the access road and maintenance.

- **Comment:** (WCC) expressed that the colour palette was their main concern and does not reflect the aim of creating a visually recessive building. (SDNPA) supported the approach of the early contextual study and requested further work is undertaken to review each elevation. A decision over autumnal colours was premature without more evidence and more than four colours are required.
- **Response:** The design for the Converter Station aims to blend the buildings into the landscape as much as possible and visually break up the mass of the building. The images presented would not be bright in reality and the baguettes would add a shadowing effect as well as texture. A further Contextual Colour Palette Study was undertaken looking at direction, seasonality and distance and presented at October's meeting. It was agreed that the outcome would be to refine the colours further for each elevation. Draft design principles were reviewed against other queries and refined for further discussion and agreement.

4.3.9.3 A design group call was held on 25 November 2020 where a refined set of colours identified in the revised 'Contextual Elevation Study' (dated 24.11.20) was presented to LPAs for discussion. This call focused on agreeing many of the design principles and the colour palette.

- **Comment:** (WCC) specific reference should be included in Building Design Principle 3 regarding a further onsite contextual study post consent.
- **Response:** Design Principle 3 revised with a clause added that a further on site contextual study would be required post consent.
- **Comment:** (WCC) expressed concerns over the use of lighter colours and wanted to see a focus on darker recessive colours for each elevational view.
- **Response:** (WCC, EHDC) agreed the colour palette study to be revised to include only four dark recessive colours for each elevational view. The 'Contextual Elevation Study' (dated 27.11.20) was then updated with the revised colour palette showing dark recessive colours.

4.3.9.4 A follow up call with WCC was undertaken on 03 December 2020 where the revised 'Contextual Elevation Study' and a design principles note was discussed.

- **Comment:** (WCC) agreed to a palette of 11 colours.

4.3.9.5 A Design Principles Note documenting the changes to design principles was circulated to the design group members on 03.12.2020 (WCC, SDNPA and EHDC).

- **Comment:** (WCC and EHDC) responded to confirm they accept the revised design principles set out in the note dated 03.12.2020.

4.3.9.6 A separate call with SDNPA was undertaken on 04 December 2020 to discuss where the revised 'Contextual Elevation Study' and the design principles note circulated on 03.12.2020.

- **Comment:** (SDNPA) felt the range of agreed colours set out in the latest revision of the 'Contextual Elevation Study' (dated 27.11.20) was not sufficiently broad enough to be able to be used to mitigate the proposals. Whilst accepting that the lower levels of the building do need the darker, more recessive appearance SDNPA requested that a wider colour range be adopted to ensure a suitable treatment where the built form is set against the sky, incorporating the paler colours identified in the previous iteration (24.11.20).

The above concludes the design group calls. Nevertheless consultation has remained ongoing through email exchanges. Two photomontages were prepared from Local Viewpoint B (Figure 15.36E and 15.36F) and shared with the LPAs on 22 December 2020 for discussion to try and achieve a consensus on colour.

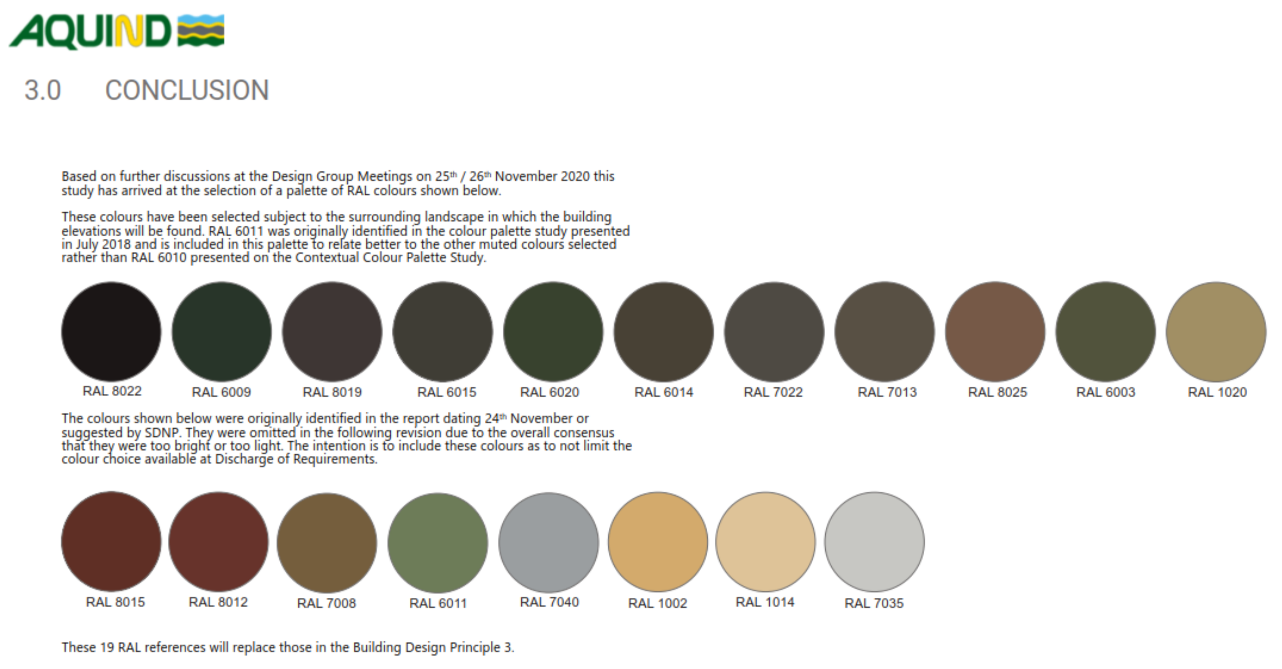
- **Comment:** (WCC) re-affirmed their view that the darker colouring is preferred. (SDNPA) confirmed that a wider study needs to be undertaken to determine what colour schemes might suit different elevations and what might be acceptable in views from the SDNP.
- **Response:** Given the continued discussions had with the LPA's with no consensus reached, the Applicant was minded to include the wider colour range and this will be referred to in Building Design Principle 3.

4.3.9.8 The Design team considers the wider colour range is the best approach and this is now referred to in a revised Building Design Principle 3. The basis for this approach is the design view that a broader range of colours, which includes lighter colours, is required for where the building cuts the skyline (for instance viewpoint 3, 12 and 14). The further on-site contextual study to be undertaken as part of the detailed design will test each elevation from different viewpoints and angles to determine the colours ratios and whether overall such elevations should have a greater transition of darker to lighter colour.

4.3.9.9 Building Design Principle 3 on colour palette amended to read as follows:

3. Colours will be selected from a palette of contextual colours (which are primarily dark recessive colours) within the ranges below chosen to complement the surrounding landscape. A contextual study will be undertaken to review the colour ratios for each elevation from the below colour range. The roofing will be in a dark recessive non-reflective colour to minimise visual impact.

- *RAL 8022; 6009; 8019; 6015; 6020; 6014; 7022; 7013; 8025; 6003; 1020; &*
- *RAL 8015; 8012; 7008; 6011; 7040; 1002; 1014; 7035*


3.0 CONCLUSION

Based on further discussions at the Design Group Meetings on 25th / 26th November 2020 this study has arrived at the selection of a palette of RAL colours shown below.

These colours have been selected subject to the surrounding landscape in which the building elevations will be found. RAL 6011 was originally identified in the colour palette study presented in July 2018 and is included in this palette to relate better to the other muted colours selected rather than RAL 6010 presented on the Contextual Colour Palette Study.

RAL 8022, RAL 6009, RAL 8019, RAL 6015, RAL 6020, RAL 6014, RAL 7022, RAL 7013, RAL 8025, RAL 6003, RAL 1020

The colours shown below were originally identified in the report dating 24th November or suggested by SDNP. They were omitted in the following revision due to the overall consensus that they were too bright or too light. The intention is to include these colours as to not limit the colour choice available at Discharge of Requirements.

RAL 8015, RAL 8012, RAL 7008, RAL 6011, RAL 7040, RAL 1002, RAL 1014, RAL 7035

These 19 RAL references will replace those in the Building Design Principle 3.

5. DESIGN DEVELOPMENT

5.1. ONSHORE PROJECT DESIGN OVERVIEW

5.1.1.1. The key Onshore Components of the Proposed Development comprise:

- Landfall Area
  - Including underground transition joint bays of no residual design impact and ORS buildings.
  - The design approach for the ORS buildings has been developed through an iterative design process. The design development has resulted in the establishment of Parameter Plans and the Design Principles, stated within section 5 of this DAS, which have been developed alongside the progression of an illustrative design to provide tangible visual context to the design of the ORS equipment.
- Onshore Cable Routes:
  - These will be buried, and areas reinstated on completion in accordance with the Landscape Mitigation Proposals. There will be no residual design impact, with the exception of link pillars (1 m x 1 m x 0.6 m height) or link boxes (0.8 m x 0.8 m x 0.6 m height) which will typically be located alongside joint bays. As such, the Onshore Cable Route is not considered further in this DAS.
- Converter Station:
  - The Converter Station is located on agricultural land adjacent to the existing Lovedean National Grid substation to the North of Waterlooville.
  - The Converter Station is required to convert the electric current from +/-320kV high voltage direct current (HVDC) to +/-400kV high voltage alternating current (HVAC) – used in the electricity transmission network and vice versa depending on the direction of electricity flows on each of two interconnector circuits with the capacity of 1037.5MW (net 1000MW).

5.1.1.2. The design approach to the Converter Station has been developed through an iterative design process in consultation with the relevant LPAs and the SDNPA. The design development has resulted in the establishment of Parameter Plans and the Design Principles, stated within section 5 of this DAS, which have been developed alongside the progression of an illustrative design to provide tangible visual context to the design of the Converter Station and the associated equipment.

5.1.1.3. The final design of the Converter Station will be developed in accordance with the Parameter Plans, the Parameter Table and the Design Principles.

5.1.1.4. The following sections describe the development of the Parameter Plans, Design Principles and the illustrative designs of the visual components which provide the design envelope, the Parameter Tables in the DCO requirements [APP-019] which provide the maximum massing for the relevant buildings and electrical equipment within the envelope provided by the Parameter Plans, and the Design Principles which guide the aesthetic form and layout, and will be subject to approval by the LPAs in consultation with the SDNPA. The final design will be confirmed during the detailed design stage.

5.1.1.5. The following aims to clarify how the size of the Converter Station and heights of the Converter Buildings are derived from functional and environmental requirements by providing further understanding on the equipment required to build the station, including the equipment's size, shape and quantity.

5.2. CONVERTER STATION

5.2.1. GENERAL OVERVIEW

5.2.1.1. The Converter Station itself is within a fenced compound comprising all the necessary equipment to convert AC to DC and vice versa. A Converter Station must meet a number of technical requirements in order to be fit for purpose and to allow safe installation and operation.

5.2.1.2. The Converter Station is situated to the west of the existing Lovedean substation where the compound and buildings are orientated on a slightly skewed east-west axis to respond to the local context by aligning with established boundaries and hedgerows.

5.2.1.3. As stated above and illustrated on the Parameter Plans options for the siting of the compound (as shown in Plates 5.1, 5.2 and 5.3) are submitted to enable the retention of existing hedgerows, if land ownership negotiations are successful so as to allow for the Converter Station compound to be located in the footprint of Option B (ii).

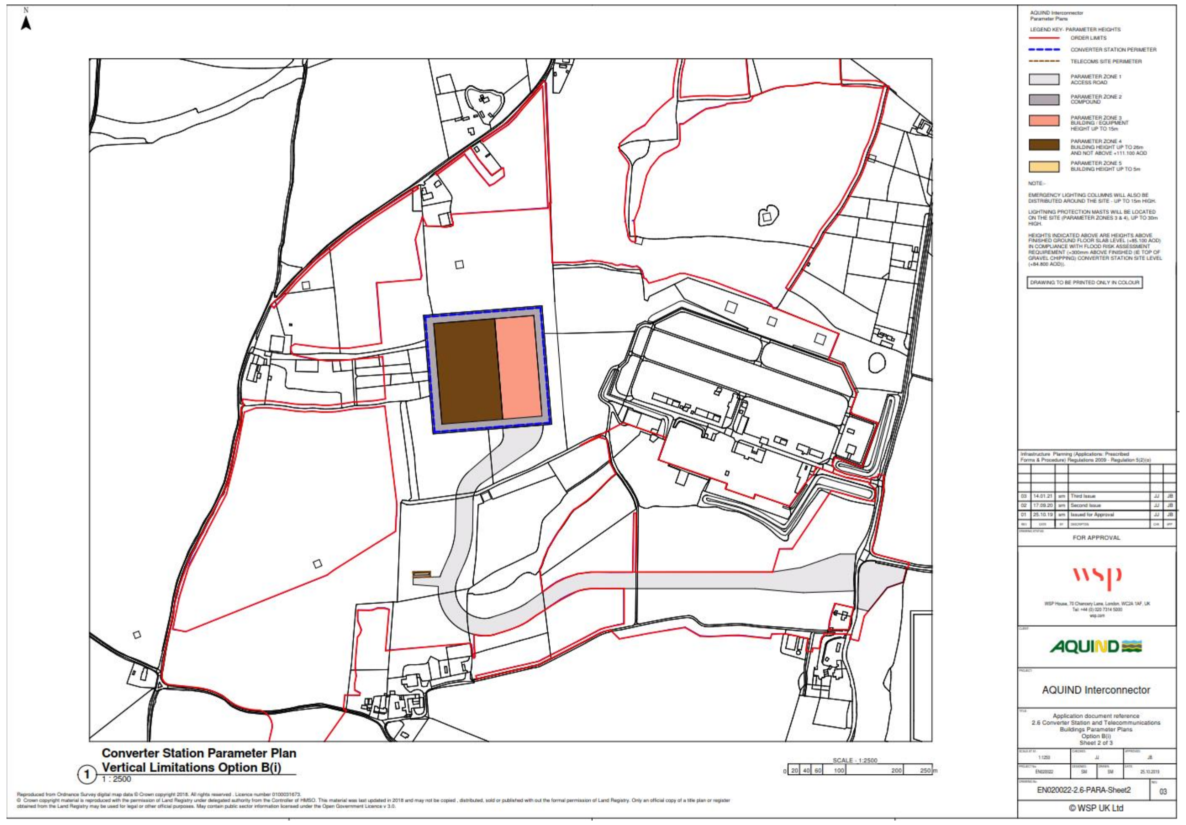


Plate 5.1 – Converter Station Parameter Plan Option B (i)

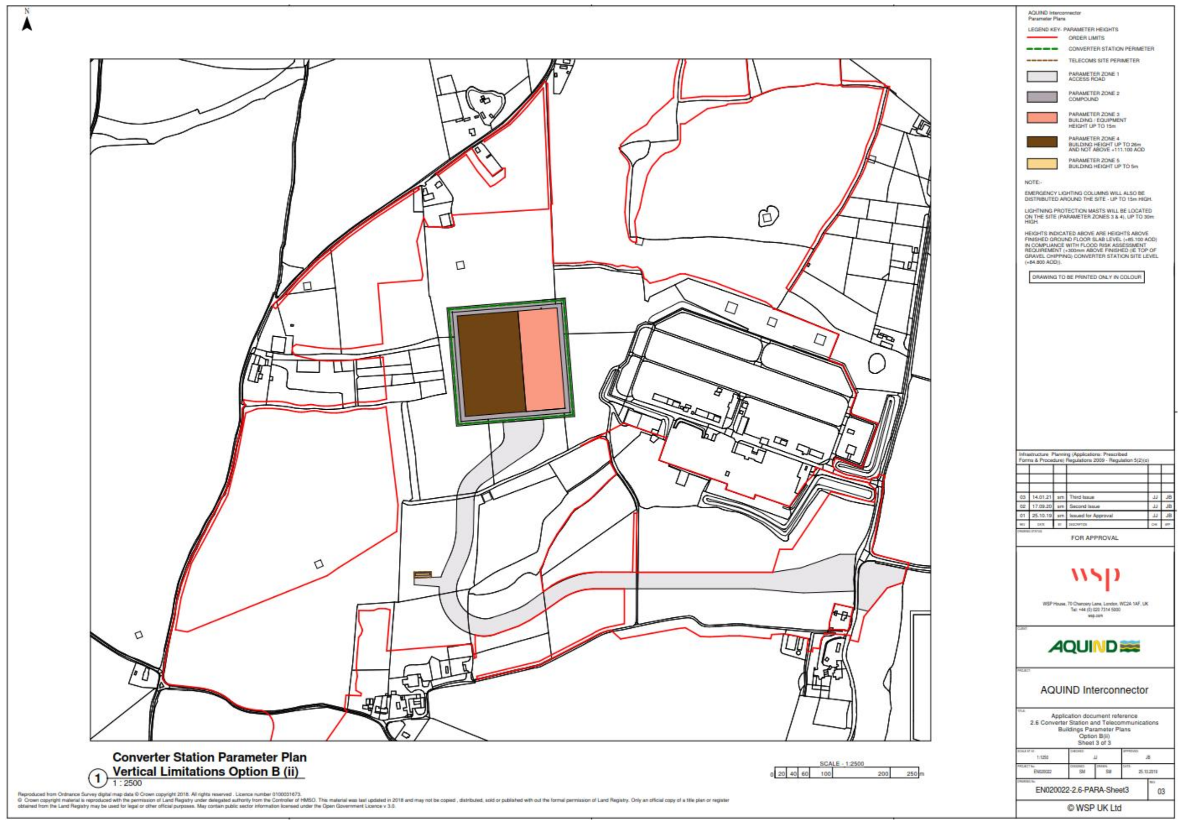


Plate 5.2 – Converter Station Parameter Plan Option B (ii)

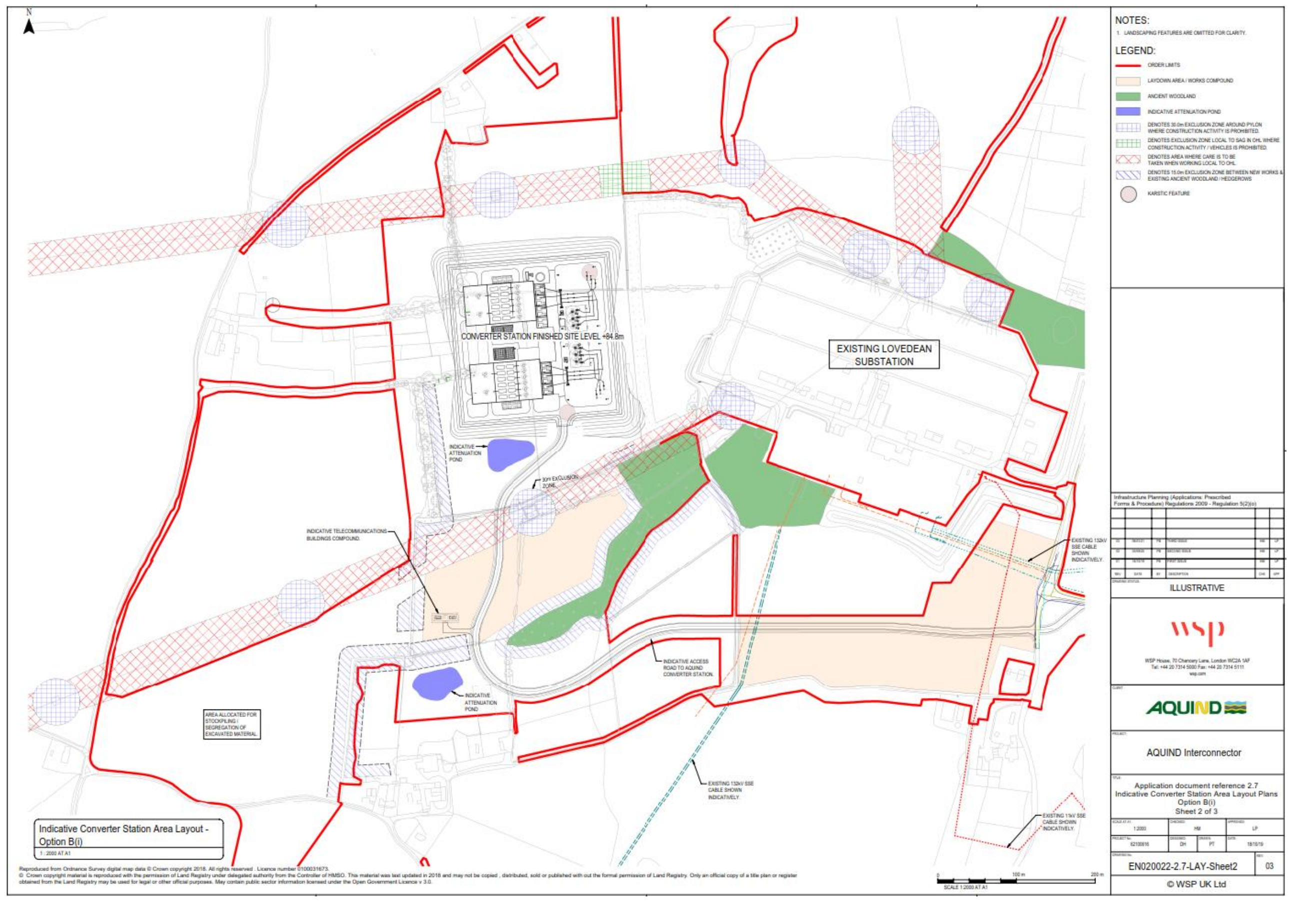


Plate 5.3 – Indicative site layout (Option B (i)): illustrating the location of the compound defined by the Parameter Plans and how the access to it could be arranged to preserve the ancient woodland and land ownership constraints.

5.2.2. CONVERTER STATION DESIGN

5.2.2.1. The location and arrangement of electrical equipment of each of the two interconnector circuits is determined by the requirement to transmit HVDC current using HVDC cables installed underground to the West and HVAC current using HVAC cables installed underground to the substation to the East. The function of each electrical component within the Converter Station dictates the layout and arrangement of buildings and equipment.

5.2.2.2. This has resulted in the siting of a Converter Building enclosing the valve halls and control equipment (HVDC equipment) to the West of the compound, with external transformers and other HVAC equipment to the East. This is shown in Plate 5.4.

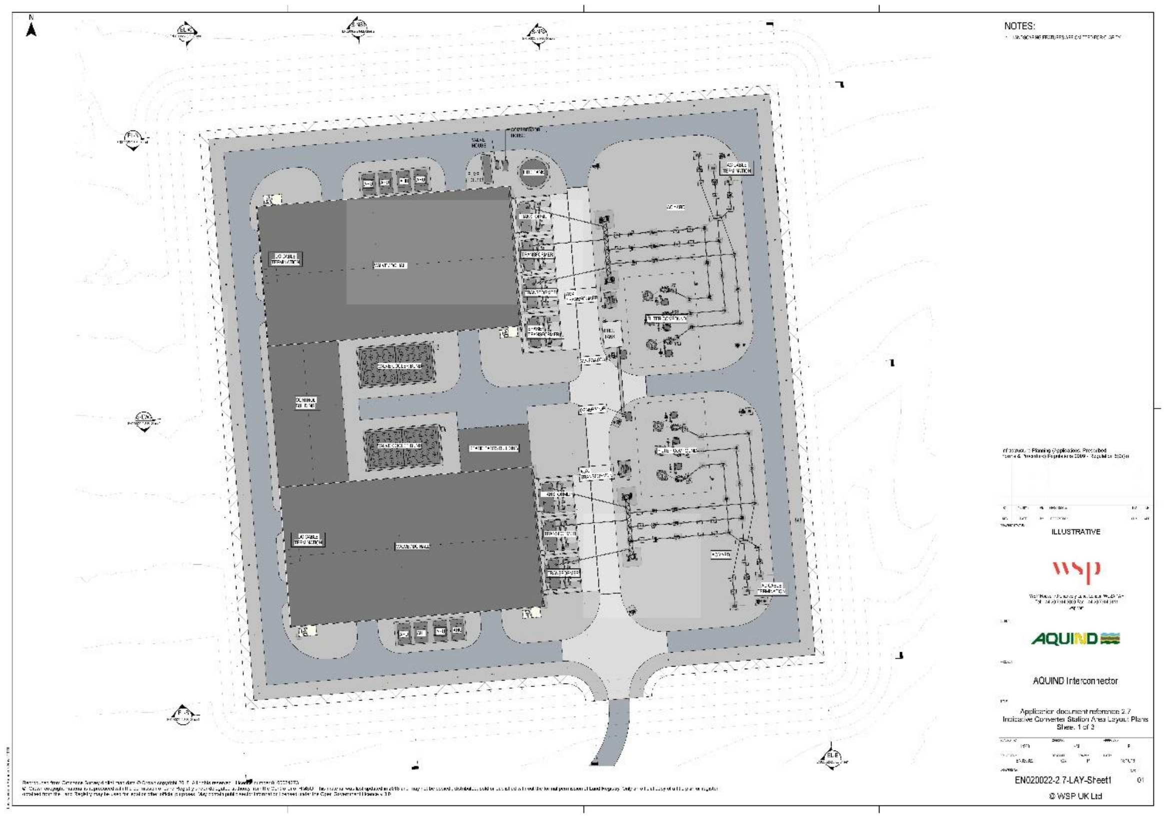


Plate 5.4 – Indicative Converter Station plan [APP-013]: illustrating how buildings and equipment could be arranged within the compound to comply with the Parameter Plan

5.2.2.3. The drawings within Appendix 1 illustrate the key components that make up the Converter Station. The Converter Station contains the essential equipment required for the Proposed Development to operate to meet the necessary safety and technical requirements. The Original Equipment Manufacturer ('OEM'), once appointed, will carry out a detailed design exercise. The key Converter Station areas are shown in Plate 5.5.

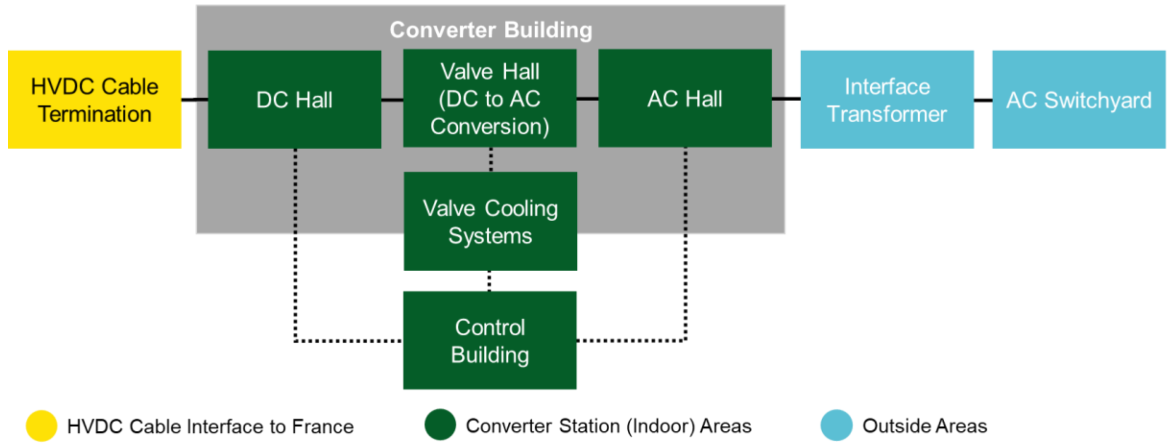


Plate 5.5 – Converter Process with key areas

5.2.2.4. It is important that each of these areas be positioned in a sequential order for the conversion process to be possible. Additionally, their size and location are critical factors to ensure the Converter Station will operate as required.

5.2.2.5. The Converter Station will comprise the areas illustrated by Plate 5.5. The following provides additional information regarding these areas:

- AC switchyard. The Proposed Development has two identical AC switchyards, one for each of the HVDC Circuits.
- Interface transformers. The Converter Station has seven interface transformers in total, three for each HVDC Circuit with one additional spare.
- Converter Buildings. There are two main Converter Buildings, one for each of the HVDC Circuits. These buildings are identical, and each have three main rooms; AC Hall, Valve Hall, and a DC Hall.
- Control Building. The Proposed Development has one Control Building that manages both HVDC Circuits.
- Valve cooling system. The Converter Station has two valve cooling systems, one for each of the Converter Buildings.

5.2.2.6. Further clarification of the Converter Station layout can be found in Appendix 1.

5.2.3. AC SWITCHYARD

5.2.3.1. In Chapter 3 (Description of the Proposed Development) of the ES Volume 1 [APP-118], the AC switchyard is described solely based on the equipment size, a 400 kV outdoor AC site where individual items of equipment that will be similar to the equipment that is found within typical electrical substations, such as the adjacent National Grid's Lovedean Substation.

5.2.3.2. To provide greater context, the outdoor AC switchyard is designed to recognised British and international engineering standards (such as IEC, IEEE and Cigré) in order to meet strict safety standards and physical clearances for both normal operation and maintenance.

5.2.3.3. There are two identical AC switchyards (one for each of the HVDC Circuits) and the site area of each is approximately 80 m x 50 m. The AC switchyard contains equipment listed in section 5.2.3.5 of this report.

5.2.3.4. The height of the equipment in the AC switchyard will typically be between 5 to 8 m, with some equipment extending from 9 to 11 m. Normally the busbar connections between the different items of equipment run above the equipment, at approximately 12.5 m height.

5.2.3.5. The purpose of the AC switchyard is an interface between the conversion process and the National Grid network. It is an outdoor area containing electrical conductors, equipment and the associated structures required to support this.

5.2.3.6. The AC Switchyard can be broken down into 9 primary components:

- AC cable terminations;
- Surge arresters;
- Lightning masts;
- Circuit breakers;
- Ground switches
- Disconnectors;
- AC harmonic filters;
- Pre-insertion Resistor; and
- Auxiliary power system.

AC Cable Terminations

5.2.3.7. The six 400kV underground HVAC cables from National Grid's substation (Lovedean) will be terminated at the cable termination structures, similar to those shown in Plate 5.6 (illustrative only), of which the switchyard will have 6; one for each AC cable from Lovedean substation.

Plate 5.6 – Typical 400kV Cable Terminations Image: ©GE

5.2.3.8. The Proposed Development will require three HVAC Cables for each 1000 MW circuit, totalling 6 cables, each of which will be up to 1 km in length and buried in a trench between National Grid's site and the Converter Station. AC cable terminations are then used to transfer the electricity from the 6 incoming underground cables to outdoor HV connections.

5.2.3.9. The AC cable terminations are comprised of two parts, a support structure and termination point.

5.2.3.10. The support structure is typically 2.4 m tall, and the AC cable emerges from the ground inside the structure to the termination point at the top of the structure where the insulator meets the structure. The cable terminations are typically 6-7 m in total height to ensure the 400kV connectors have appropriate safety clearances. The devices have a solid insulation inside, removing the risk of material leaking to the ground or atmosphere, and since they are passive and have no moving parts there is no electromechanical forces to make any noise.

Surge Arresters

5.2.3.11. The outdoor equipment in the AC switchyard is vulnerable to HV surges which could be caused by lightning strikes. Surge arresters similar to those, shown in Plate 5.7, will be installed to protect the electrical equipment. The Proposed Development is anticipated to have 3 surge arresters installed close to the cable terminations to protect the AC cable and 3 more installed close to the interface transformer, to protect this expensive item of equipment.

Plate 5.7 – Typical HV Serge Arresters Image: ©ABB

5.2.3.12. Surge arresters are important as they limit the voltage on a system to safe operating levels in the event of a fault to protect the equipment in the Converter Station. They operate in the same manner as a domestic surge suppressor and a typical converter station will usually have more than one ranging between 6 – 7 m in height.

5.2.3.13. Surge arresters use air as the active gas material to operate, therefore removing the risk of pollution to the ground or atmosphere. Additionally, they do not create any noise as they have no moving parts.

Lightning Masts

5.2.3.14. Within the AC switchyard lightning masts will be installed to protect the outdoor high voltage equipment from direct lightning strikes. These will consist of steel masts, from 26 – 30 m in height located around the switchyard, as shown in Plate 5.8. Depending upon the design of the switchyard, thin steel wires may be strung between the masts, to provide additional protection from lightning strikes. Shorter lightning masts, about 4 m high, will be installed on the Converter Building to protect it from direct lightning strikes.

Plate 5.8 – Typical Lightning Masts Image: ©GE

Circuit Breakers

5.2.3.15. Circuit breakers, shown on Plate 5.9, are fast acting mechanical switches that can be opened or closed remotely and are used to temporarily disconnect the cables to the Converter Station. They are used as a protection device for the Converter Station and National Grid's transmission network, operating when a fault occurs in either the Converter Station, National Grid's network or HVDC Cables and provides safety for personnel and equipment.

Plate 5.9 – Typical HVAC Circuit Breaker Image: ©ABB

5.2.3.16. Circuit breakers are typically 6 - 7 m in total height for HV protection and have a span of approximately 5 m with a bank of three occupying a typical area of 12 m. Unlike cable disconnectors and surge arresters, circuit breakers are active devices with an operating mechanism at the base of the structure to control the opening/closing of the switch. Circuit breakers have moving parts and emit an audible noise; however, operation is rare (a couple of times a year) and there is no continuous noise.

Disconnectors

5.2.3.17. Disconnectors are mechanical switches which can be manually or automatically opened/closed. They are widely used throughout the Converter Station to isolate areas of the AC switchyard when maintenance is required on the electrical equipment.

5.2.3.18. Disconnectors are classified as a slow acting switch, usually taking 5 – 10 seconds to change from opened to closed (or visa-versa). A typical arrangement has been provided in Plate 5.10 to provide further understanding.

5.2.3.19. For the figure shown, the electrical circuit between the left and right posts is broken by rotating the centre post. Disconnectors may also have additional safety considerations, such as an integrated ground switch to connect the HV terminals to earth potential to ensure that the circuit has been isolated and grounded before conducting maintenance work.

Plate 5.10 – Typical HVAC Disconnector Image: ©ABB

5.2.3.20. Generally, disconnectors are 6 – 7 m in total height and make no noise in normal operation, either open or closed. When operating, however, they do make a noise as the mechanical contact opens/closes, but this will only occur a couple of times a year and this temporary event will emit minimal noise.

AC Harmonic Filter

5.2.3.21. AC harmonic filters are used in a Converter Station to improve the quality of the AC voltage from National Grid's electricity network to ensure that any interference from the AC to DC conversion equipment does not cause unacceptable issues for customers on the network.

5.2.3.22. A typical harmonic filter arrangement is shown in Plate 5.11, however, the number of filter banks required will be determined during the construction phase of the Proposed Development as detailed studies are undertaken.

Plate 5.11 – Typical AC Switchyard Harmonic Filters Image: ©ABB

5.2.3.23. A harmonic filter consists of three items of equipment:

- A high voltage capacitor bank, comprising multiple racks of individual small capacitor units, which can stand 8 – 10 m in height;
- Reactor coils: encased in epoxy resin (grey cylinders in above image); and
- Resistor banks: housed in steel containers (grey boxes in above image).

5.2.3.24. Given the height of the capacitor banks (8 – 10 m), the harmonic filter equipment is mounted at ground level and, therefore, requires its own safety fence within the existing site boundary perimeter fence. The internal fence is typically 30 m x 30 m in size to accommodate the filter bank anticipated for the Proposed Development.

5.2.3.25. The harmonic filter equipment itself is passive and, therefore, has no moving parts, however the inductor coils and, to a lesser extent, the capacitor banks, do vibrate and hence emit acoustic noise. This has been considered in the noise and vibration assessment. Noise attenuation measures have also been applied to the reactors and capacitor banks to mitigate their noise contribution by installing an enclosure around the reactor and capacitor banks.

5.2.3.26. The capacitor units are typically oil-filled with a very low volume of free oil in each unit. This has been considered in Table 2 and Section 1.1.3.6 of Appendix 3.5 (Additional Supporting Information for Onshore Works) of the ES Volume 3 [APP-359]. In addition, the inductors and resistors within the capacitor units are air-insulated and air-cooled (in other words the insulation/cooling systems is not fuelled by oil or gas). A circuit breaker will be used to switch the filter in/out of service. If a fault is detected within the filter, this breaker will automatically switch out the filter, but the remainder of the station equipment will remain in service.

Auxiliary Transformers

5.2.3.27. In normal operation the auxiliary power supply for the Converter Station, including lighting, heating, and controls, is derived from the main interface transformer. However, if that unit is out of service, e.g. during maintenance, a back-up power supply is provided from the local electricity distribution company, via an auxiliary power transformer.

5.2.3.28. The Converter Station will have two auxiliary transformers, one transformer for each of the 1000MW circuits, similar to that, shown in Plate 5.12.

Plate 5.12 – Typical Auxiliary Power System Image: ©ABB

5.2.3.29. This transformer consists of a steel tank approximately 2 m length x 1 m depth x 2 m height. The tank is oil-filled to insulate and cool the equipment inside, however the tank will be mounted on a bund to ensure that in the event of an oil leak, the oil does not enter the ground or the water table.

5.2.3.30. When in use, the transformers will generate a low level of audible noise, however, they will only be in operation a few days a year.

5.2.3.31. In emergency conditions, when auxiliary power from the interface transformer or the local distribution company is lost, each 1000 MW circuit will have a back-up diesel generator. This will operate for short periods to maintain electrical power to critical systems within the Converter Station. A typical example of such diesel generator is shown in Plate 5.13.

Plate 5.13 – Typical Diesel Generator Image: ©ABB

5.2.3.32. The Converter Station will have two of these sound-proof units within the AC switchyard (outdoors) in a concrete bund. The units are typically 5 m length x 2.2 m width x 2.5 m height and the audible noise from them is included in the overall site noise assessment.

5.2.3.33. A bunded fuel storage tank associated with these generators will be located within the AC switchyard and will be sized for 72 hours of continuous operation.

Interface Transformers

5.2.3.34. Each of the Project's 1000 MW circuits require three transformers, thus there are six operational units, with one additional spare unit. Each transformer has a typical size of 5 m length x 3 m width x 4 m height, which is dependent on the Original Equipment Manufacture specifications outlined in their detailed design.

5.2.3.35. A spare transformer (of same dimensions) will also be provided as this is a critical item for the operation of the interconnector. The spare unit is not connected to the high voltage system during normal operation.

5.2.3.36. A typical bank of three transformers is shown in Plate 5.14.

5.2.3.37. The interface transformers are oil-cooled and oil-insulated devices and are therefore mounted in steel tanks, however each transformer sits on top of an oil collection bund, such that any oil leakage is trapped and cannot enter the ground or the water table. This has been considered in Section 1.1.3.6 of 6.3.3.5 Environmental Statement - Volume 3 - Appendix 3.5 (Additional Supporting Information for Onshore Works) [APP-359].

Plate 5.14 – Typical Interface transformers Image: ©ABB

5.2.3.38. The transformer bunds will be interlinked to an underground dump tank of a sufficient capacity to accommodate the oil capacity of the largest transformer, and a separate bund will also be provided for the spare transformer and linked to the underground tank.

5.2.3.39. The HV electrical connection is made of bushings, as shown at the top of the units in Plate 5.14. Great care is taken in the installation of interface transformers to ensure that they do not cause issues to other equipment or to the environment. As shown in Plate 5.14, each unit is mounted between concrete fire walls, such that if one unit is damaged by fire this will not spread to other units.

5.2.3.40. The transformers and their fan assisted radiators represent the main source of audible noise emission from the Converter Station. As such, positioning and noise attenuation measures have been considered for the Proposed Development to ensure that audible noise does not represent a nuisance to any nearby residents (see Environmental Statement – Volume 3 – Appendix 24.5 Noise and Vibration Assessment Assumptions) [APP-464]. Noise attenuation barriers can be used, where the transformers are contained with front panels and a roof, which included ventilation conduits.

5.2.3.41. The transformer represents the largest and heaviest single load, each weighing about 300 tonnes, which must be transported to site. This will require a permanent heavy-duty access road from the public highway to the new converter station site.

5.2.3.42. The dimensions of a transformer are dictated by its specification, transport conditions, roads, bridges, and cranes at seaports, but are typically 5 m length x 3 m width x 4 m height. The high voltage bushing on top of the transformer will bring the total height to 7 – 8 m depending on the manufacturer.

Instrument Transformers (Current and Voltage Transformers)

5.2.3.43. These devices are used throughout the Converter Station to measure current and voltage for three key uses: to meter the power flowing in the link, to provide signals to the control system, and to provide signals to the protection system.

5.2.3.44. These measurements are particularly important for the protection of personnel and equipment, as when the current or voltage is too high the scheme can be automatically shut down for safety. Typical examples of current transformers and voltage transformers are shown in Plate 5.15 and Plate 5.16 respectively.

Plate 5.15 – Typical Current Transformer Image: ©ABB

Plate 5.16 - Typical Voltage Transformer Image: ©ABB

5.2.3.45. Instrument transformers have no moving parts and therefore make no noise. Both are normally mounted on steel structures to provide the minimum safety clearances and stand 6 – 7 m in total height.

Pre-Insertion Resistor

5.2.3.46. A pre-insertion resistor is used to provide a "soft start" when energising the Converter Station. This avoids a major electrical disturbance on the 400kV transmission systems on either side of the link. It consists of a resistor bank, similar to those discussed in Section 5.2.3.24 and a parallel connected circuit breaker, similar to that shown in Plate 5.9.

5.2.4. CONVERTER BUILDINGS

5.2.4.1. There are two Converter Buildings in the Converter Station, one for each 1000 MW circuit. Each building will have a steel structural frame, with an outer cladding and each will be approximately 90 m in length x 50 m in width and between 22 m and 26 m in height as shown in Appendix 1.

5.2.4.2. The size of each building is influenced by both the electrical equipment required within the building and the final detailed roof design. In addition, the associated safety and maintenance access clearances shall be considered, whilst also minimising landscape and visual impacts on the surrounding area.

5.2.4.3. Plate 5.17 and Table 5.1 provide additional detail of the how the typical equipment size and clearances dictate the Converter Building height. A standard roof design will result in a building height of 22 m. However, a more complex architectural solution, shown in dotted line in Plate 5.17 could result in up to 26 m height. To ensure the environmental impacts related to the appearance of the Converter Buildings accord with those assessed, a maximum height of +111.10m AOD has been provided for in relation to these buildings, being 26m above the indicative finished floor level used for assessment purposes of +85.10m AOD (set based on known constraints as a consequence of the principal aquifer beneath the Converter Station Area). The finished floor level able to be achieved for the Converter Station Area will therefore dictate the maximum height of the Converter Buildings and the roof design that can be achieved within the set parameters.

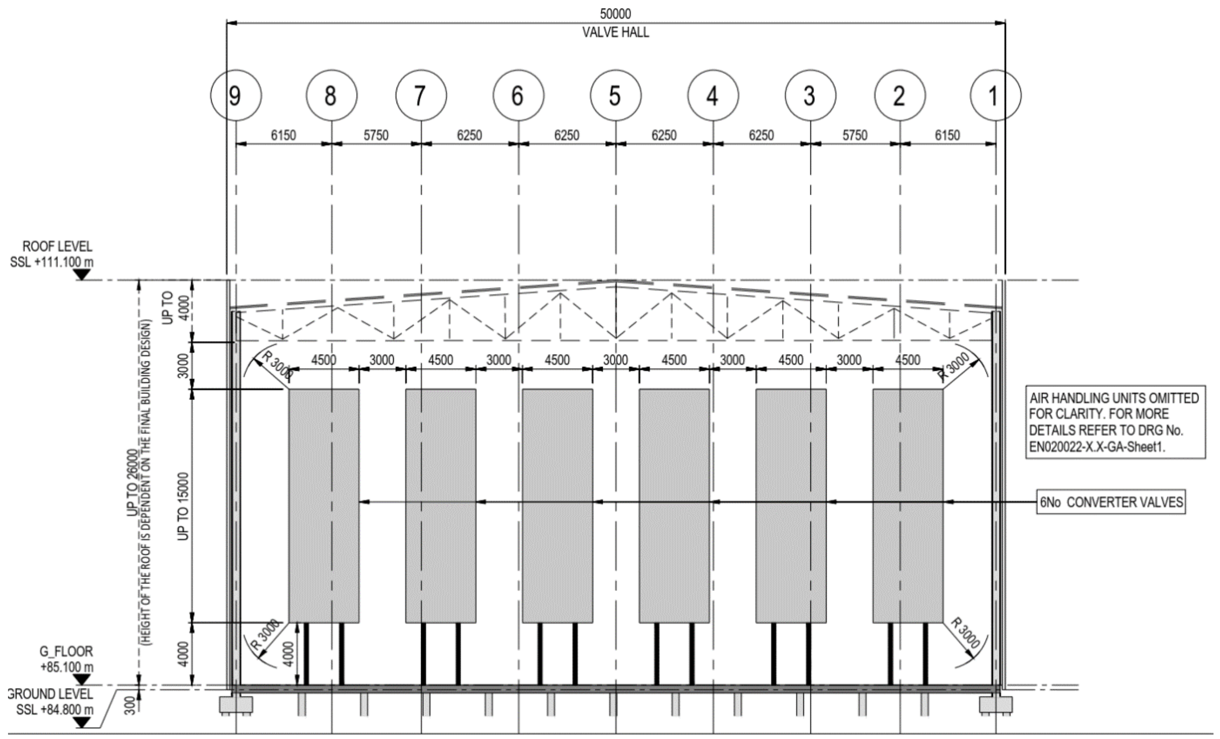


Plate 5.17 – Converter building design Section view 2, extracted from indicative drawing EN020022-X.X-CHLP-Sheet1 in Appendix 1 (not to scale)

Table 5.1 - Typical Converter Building size and clearances

Typical Valve Hall	Height Dimensions
TOTAL WIDTH	**50.0 meters (W)**
Converter Valves	15.0 m (H)
Floor Clearance of Valves	4.0 m (H)
Roof Clearance of Valves	3.0 m (H)
Roof Structure including tolerances, lights, and fittings (subject to final design agreement)	Up to 4.0 m (H)
TOTAL HEIGHT	**22.0 – 26.0 meters (H)**

5.2.4.4. The power electronic converters, described from section 5.2.4.15 onwards, have a major influence on the height and width of the building. The halls containing the AC and DC reactors add to the overall length of the building. The Converter Buildings have 3 main parts:

- The AC Hall;
- The Valve Hall; and,
- The DC Hall;

5.2.4.5. Plate 5.18 and Table 5.2 illustrates the approximate dimensions of the Converter Building (90 m in length x 50 m in width x 22 m in height) and an additional 4 m (height) to account for the roof, tolerances, lights, and fittings. Plate 5.18 and Table 5.2 also provide indicative dimensions of the AC Hall, Valve Hall, and DC Hall. Further details are provided in drawing EN020022-X.X-CHLP-Sheet1, located at Appendix 1 to this DAS.

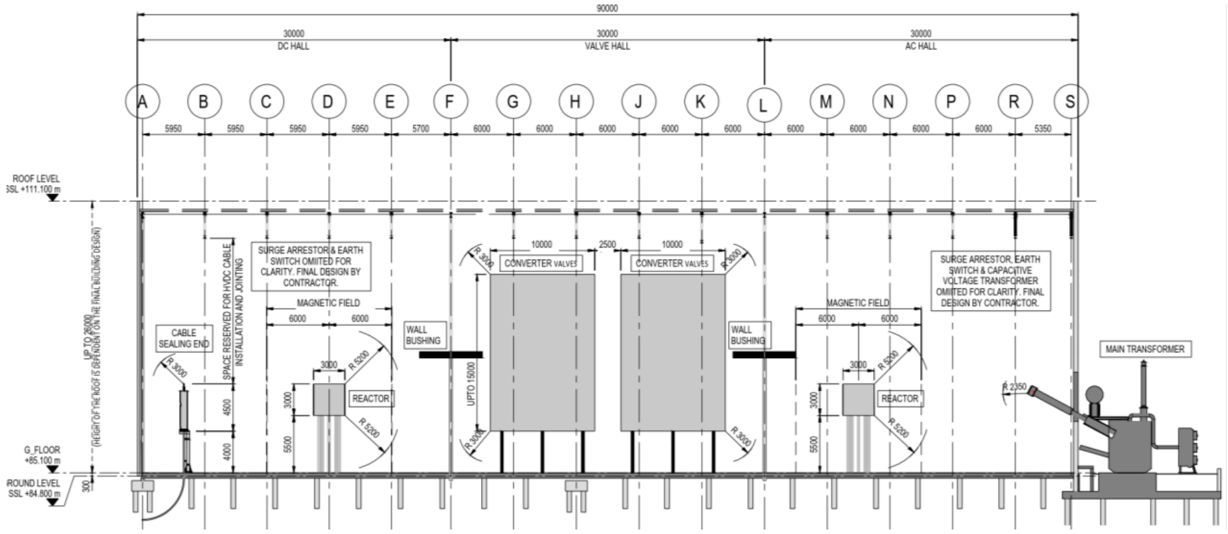


Plate 5.18 – Converter building design Section view 1, extracted from indicative drawing EN020022-X.X-CHLP-Sheet1 in Appendix 1 (not to scale)

Table 5.2 – Typical Converter Building size

Converter Building Room	Dimensions
DC Hall (Left)	30m length x 22 m height*
Valve Hall (Middle)	30m length x 22 m height*
AC Hall (Right)	30m length x 22 m height*
Converter Building Width (Plate 2.14)	50 m width

***Internal roof height. An additional 4 m height could be required and is subject to the final building design to account for the roof, tolerances, lights, and fittings. Therefore the maximum height parameter is 26m. The allocation of the internal space between areas of the Converter Building may differ depending on the selected technology provider.**

AC Hall

5.2.4.6. The AC Hall is the first section of the Converter Building and is generally located in the area next to the interface transformers. It takes the electricity from the interface transformers discussed in Section 5.2.3.37 and delivers it to the Valve Hall. To achieve this connection are made to six air cored phase reactors.

5.2.4.7. The dimensions of the AC Hall are chosen to accommodate the dimensions of the phase reactors, shown in Plate 5.18. The AC Hall, to house 6 phase reactors, is anticipated to be 30 m length x 50 m width.

5.2.4.8. Phase Reactors are naturally air-cooled devices and as such are normally mounted outdoors, as shown in Plate 5.19, which also simplifies access to the units for maintenance and replacement Phase reactors consist of coils of aluminium wire encased in epoxy-resin.

Plate 5.19 – Typical Phase reactors (outdoor) Image: ©GE

5.2.4.9. Typically, each reactor could be 2.5 – 3.0 m in diameter and 3.0 m in height. The phase reactors for the Proposed Development could be mounted on support insulators, as shown on Plate 5.19. The final design of the reactors will be determined by the manufacturers and suppliers.

5.2.4.10. Phase reactors are passive devices and therefore have no moving parts, but they do vibrate, creating a source of noise emission. They were therefore included in the Environmental Statement – Volume 3 – Appendix 24.5 Noise and Vibration Assessment Assumptions [APP-464].

5.2.4.11. Noise attenuation measures were included in the assessment, specifically an outer jacket made from sound absorbing material and a top cap can be fitted as a mitigation measure to reduce noise emissions.

5.2.4.12. Where the phase reactors are mounted inside a building this effectively mitigates any noise pollution, however this results in the building size needing to increase.

The Application proposes that the phase reactors are housed in a separate AC Hall sharing a common wall with the main Valve Hall.

5.2.4.13. The reactors create a low magnitude AC magnetic field and the location of the coils will need to be chosen to ensure that these fields comply with national guidelines for occupational (inside the station) and public (outside the station) exposure. Mounting the reactors inside a building has no impact on stray magnetic fields.

5.2.4.14. Between the transformer bushings and the reactors, there is likely to be other items of equipment, similar to that of the outdoor AC switchyard such as earth switches, instrument transformers and surge arresters.

Valve Hall

5.2.4.15. The Valve Hall is the central section of the Converter Building and houses the core AC to DC conversion equipment, linking the AC and DC Halls. The height of the Converter Building is primarily driven by the Valve Hall which is comprised of the Valve stacks, where strict safety and design clearances are required, as shown in Plates 5.17 and 5.18, which in turn dictate the internal building height of 22 m. Appendix 1 details the Valve Hall clearances.

5.2.4.16. Plate 5.17 and 5.18 extracted from Appendix 1 provide an illustration of the typical equipment size and clearances that dictate the Converter Building height. The Valve Hall equipment and clearances are primary driver of this height, which have been summarised in Table 5.3.

Table 5.3 - Typical converter building size and clearances

Typical Valve Hall	Height Dimensions
TOTAL WIDTH	**50.0 meters (W)**
Converter Valves	15.0 m (H)
Floor Clearance of Valves	4.0 m (H)
Roof Clearance of Valves	3.0 m (H)
Roof Structure including tolerances, lights, and fittings (subject to final design agreement)	Up to 4.0 m (H)
TOTAL HEIGHT	**22.0 – 26.0 meters (H)**

Valve Equipment

5.2.4.17. The Valve Hall houses the Valve which converts electricity from AC to DC and vice versa. This is achieved by a series of small sub-modules, as shown in Plate 5.20, which can switch a small DC voltage on and off, like switching a battery on and off. If these switches are operated in the correct sequence, the individual small DC voltages can be synthesised into an AC voltage waveform, which can then be connected to the national grid via the interface transformers.

5.2.4.18. This technology is known as a Voltage Source Converter ('VSC'), i.e. the converter can generate a controlled voltage at its AC connection from the DC voltage on the cable connected to the remote station. By suitable control of this voltage the power, which is supplied from France to the UK, or vice versa, can be instantaneously adjusted to match the demand or generation in either country.

5.2.4.19. Each sub-module is approximately 1.1 m long x 0.2 m wide x 0.6 m high and contains the power electronic switching devices; a capacitor which stores the DC voltage and the relevant control equipment to switch the power electronic devices between on/off.

5.2.4.20. Each individual sub-module communicates via fibre optic cables to a master control system, which coordinates all of the thousands of sub-modules in the Converter Building to achieve the conversion from DC voltage to AC voltage and vice versa.

Plate 5.20 – Typical Sub-module and power module layout Image: ©IEEE

5.2.4.21. Typically, eight of these sub-modules are connected in series into a power module (depending on manufacturer) as shown in Plate 5.20 – which becomes the "building block" for the AC to DC converter equipment. A number of these power modules are then connected in series to form a rack, as shown in Plate 5.21 (in the illustration there are six modules, but their number is dependent on the manufacturer and technical requirements).

5.2.4.22. The racks are mounted on top of each other to form a stack of power modules (on the illustration below there are four racks per stack). The total number of sub-modules is dependent on the DC voltage, which in the case of the Proposed Development is ±320kV. The number of sub-modules is directly related to the choice of DC voltage, thus a higher power scheme, with a higher DC voltage, would require more sub-modules and therefore larger internal air clearances between the high voltage equipment and the walls, floor and roof.

Plate 5.21 – Typical Valve Hall with stacks of Power Modules Image: ©GE

5.2.4.23. The AC/DC converter contains no moving parts and all the equipment is air insulated. There is no oil insulation or oil cooling allowed inside the Converter Buildings. This reduces the overall environmental risk posed by the equipment. The individual sub-modules are water-cooled, as described in the next section, with water entering the sub-modules via the white plastic hoses shown Plate 5.20.

5.2.4.24. The power conversion equipment is typically ground mounted based on the supplier's detailed design, as shown indicatively in Plate 5.18, where the electrical clearance and overall height of the stacks dictate the overall height of the Converter Building. The lower clearance is 3-4 m and a similar clearance is required above the stack to the inside of the roof structure.

5.2.4.25. To allow for the equipment operation and installation along with the structural design of the roof, the overall height of the building may be up to 26 m. A 3 m electrical clearance is also required to the walls of the building and this may be increased to allow for the movement of maintenance vehicles within the building. The estimated footprint of each Valve Hall is approximately 30 m length x 50 m width.

5.2.4.26. During energised operation, the Converter Buildings are not accessible as it is a high voltage environment, with air temperatures around 50 – 60 ºC, and would, therefore, be unsafe even for trained personnel. Any attempt to enter the building would result in an instant switch-off of the complete station, as all access doors to HV areas are protected against accidental access for the safety of site personnel.

5.2.4.27. All of the buildings will be fitted with a sensitive smoke detection system to provide an alarm in the event of any overheating of the equipment which may cause smouldering or burning of the material of the power modules or other high voltage equipment. This will be augmented by an arc detection system in the valve hall, where ultra-violet light sensors will detect any electrical sparks within the equipment.

5.2.4.28. Upon detection of smoke or an arc an alarm can be sent to the operator, or if the event is serious enough the link will be automatically switched off. It is not normal practice to install fire-fighting equipment, such as water spray or gas deluge systems, as the consequences of firefighting can be more damaging than the original fire. All the materials within the Valve Hall are chosen to be fire retardant and any fire will not persist once the high voltage has been disconnected.

5.2.4.29. Due to the heat generated by the stacks of sub-modules, air handling plants are required around the exterior of the building to circulate air through the building. The audible noise from these air handling units has been fully assessed in the overall noise emissions from the station.

Valve Cooling System

5.2.4.30. A sophisticated pumping system, shown Plate 5.22, circulates water between the indoor AC/DC converter equipment and the outdoor heat exchangers, as shown Plate 5.23. For each 1000 MW circuit the heat exchangers occupy a space of approximately 26 m x 15 m. The pumping system consists of motors and pumps and makes a considerable level of noise when operating. However, this equipment is mounted inside the Converter Station Control Building to minimise the contribution to the overall noise emission. This is discussed in the Environmental Statement – Volume 3 – Appendix 24.5 Noise and Vibration Assessment Assumptions [APP-464].

Plate 5.22 – Typical Water Pumping Station Image: ©ABB

Plate 5.23 – Typical Outdoor Heat exchangers Image: ©GE

5.2.4.31. The heat exchangers use fan assisted cooling; hence the noise from the fans adds to the overall noise emission from the station. As considered in the Environmental Statement – Volume 3 – Appendix 24.5 Noise and Vibration Assessment Assumptions [APP-464]. Mitigation methods, such as screening, have been considered in the design of the heat exchangers to ensure the noise emission from the station meets the noise emission criteria. The heat exchanger can also be positioned between the two large Converter Buildings to help mitigate and reduce noise emissions from the heat exchangers to nearby properties.

5.2.4.32. As the cooling system must be suitable for operation in sub-zero temperature conditions, an anti-freeze liquid (ethylene glycol) is mixed with the water, the same liquid used in cars to avoid radiators freezing in the winter. To ensure that any leakage of water and anti-freeze does not enter the ground or the water table, the heat exchangers are mounted over a bund which will retain spillage from the equipment. As considered in Table 2 and Section 1.1.3.6 of Appendix 3.5 (Additional Supporting Information for Onshore Works) of ES Volume 3 [APP-359].

DC Hall

5.2.4.33. The DC Hall is the final section of the Converter Building and links the Valve Hall's DC equipment to the HVDC cables. The equipment in the DC Hall is similar to the AC switchyard, except that for each link only 2 items of equipment are required. The following lists the equipment required for the DC Hall:

- DC Cable termination/sealing end;
- Surge arresters;
- Instrument transformers;
- HVDC reactors; and,
- Disconnectors;

5.2.4.34. The DC Hall contains similar components to the AC Hall and cable sealing ends (AC switchyard). It therefore has a similar footprint (30 m length x 50 m width) as Section 5.2.4.6 has discussed. The DC Hall does not contain a circuit breaker which is not required, as all switching of the link occurs from the AC side of the station. Similarly, no harmonic filter is required on the DC transmission system.

5.2.4.35. As DC equipment is more sensitive to atmospheric pollution than the AC equipment, particularly salt pollution in coastal regions, all of the DC Hall equipment will be housed indoors in the DC Hall. This mitigates against high levels of maintenance to clean the DC equipment and avoid any issues related to audible noise. However, it requires a building section similar to the indicative drawings provided in Appendix 1 in the main Converter Building. As all the DC equipment will be indoors, there will be no issues related to audible noise from this area of the site.

5.2.5. CONTROL BUILDING

5.2.5.1. The Control Building is essentially the 'brain' of the Proposed Development and contains servers, computers and electronics required to monitor, control, protect, and operate the Proposed Development. The Control Building has a proposed size of 25 m width x 50 m in length x 15 m in height.

5.2.5.2. The Control Building can be segmented into two main areas: (i) control and protection rooms; and (ii) building facilities. Primarily the size of the Control Building is dictated by the internal equipment like control and protection cubicles, cable tray management, mandatory clearances from the cubicles and to the roof, etc and facilities as shown in Plate 5.24.

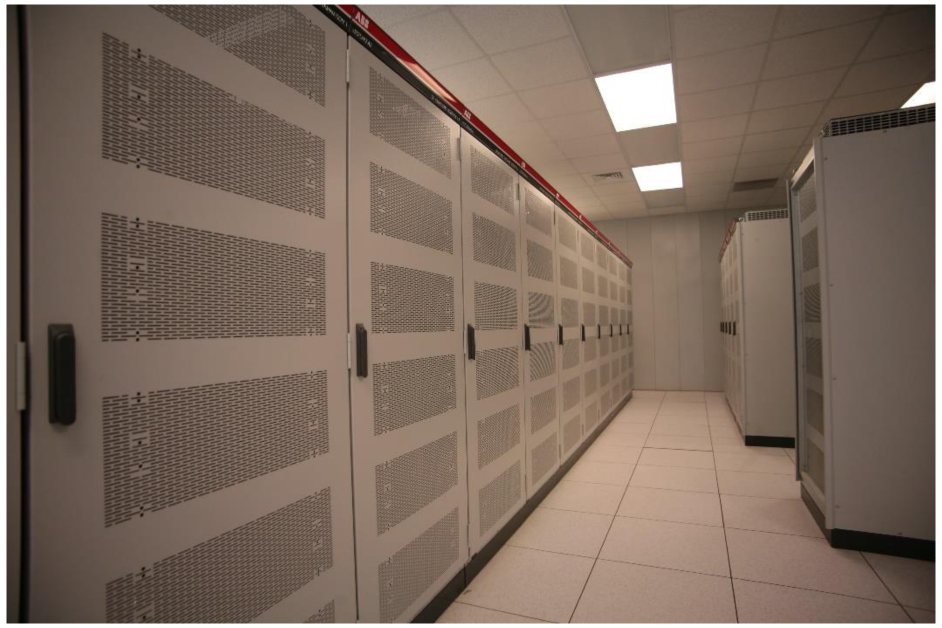


Plate 5.24 – Typical Control and Protection Cubicles Image: ©ABB

5.2.5.3. To provide the required space for these systems, the Control Building will comprise a two-storey steel frame structure building with the heavy building facilities, such as cooling plant and batteries typically being on the ground floor and typically the control and protection equipment on the first floor. The overall height of the building is typically 15 m, as discussed in Section 5.2.5.4 to 5.2.5.11.

Control and Protection Rooms

5.2.5.4. The control and protection equipment is typically located in the control and protection rooms which are conventionally on the first floor of the Control Building. The station will have two separate control and protection rooms, one for each 1000 MW circuit. Each room will have cubicles which contain the control and protection equipment, to operate the Converter Station.

5.2.5.5. Multiple cubicles are required to operate the many different systems within the Converter Station, including: the master station control, individual pole controls, interface cubicles for the AC/DC converters, protection cubicles for the station equipment, telecommunications cubicles, and fault data loggers.

5.2.5.6. The control and protection equipment to run the Proposed Development has been designed such that it could be unmanned, however a workstation in the control room will be typically provided as a monitoring point for the systems.

5.2.5.7. This is one of the few areas within the Proposed Development, which is fully accessible to occupational personnel, while the Converter Station is energised. Visitors to the Converter Station will be accompanied at all times, including in this room. The internal layout of the Control Building will be developed to house AC and DC electrical plant, DC converter module cooling plant, Heating, Ventilation and Air Conditioning ('HVA/C'), batteries, auxiliary power supplies, communication systems and interface with National Grid.

5.2.5.8. By having two separate control and protection rooms, this ensures that any issues related to the control and protection cubicles or the monitoring systems will not affect both links simultaneously. The protection system covers all the equipment in the outdoor and indoor areas of the station. Depending on the type of equipment and the nature of the fault, the protection system can issue an alarm to the operator or immediately switch off the equipment. The control and protection equipment are vital to the operation of the station and hence it is fully duplicated, as each 1000 MW circuit has two controllers - one running the link and the other in "hot standby".

Building Facilities Rooms

5.2.5.9. In addition to the two main control and protection rooms, the Control Building will have a number of other rooms to provide a working environment for the station personnel (including operators of the Converter Station and visiting maintenance personnel). These rooms will include:

- Valve cooling system (as described above);
- Maintenance workshop;
- Low voltage (230V/400 V) power distribution room;
- Battery (48V/110 V) room with battery charger;
- Telecommunications room (for inter-station communication); and,
- Spares for control systems;

5.2.5.10. These rooms are only accessible to operational and maintenance personnel. The building facilities will also include a meeting room, offices, kitchen, mess room, toilets, and showers accessible by all personnel and by visitors.

Noise

5.2.5.11. The Proposed Development's valve cooling systems are expected to generate noise and have, therefore, been included in the noise modelling and assessment. As this equipment is located inside the Control Building, external noise break-out from this equipment will be minimised.

5.2.5.12. Additionally, the Control Building will be located between the two Converter Buildings to serve three functions:

- Optimise the water pipes design from the cooling plant to control room;
- Optimise the fibre optic cable routes to the control room; and,
- As explained in Appendix 1, the positioning of the Control Building along the western edge of the Converter Station compound forms an uninterrupted noise screen between the outdoor valve cooling systems and Millfield Farm, thereby minimising operational noise effects at this receptor.

5.2.6. SPARE PARTS BUILDING

5.2.6.1. A separate building is required to house the spare equipment necessary for the maintenance of the Converter Station. This will contain the strategic spares, typically one of each type described above for the large outdoor equipment plus a number of sub-modules for the Valve Hall. The building will be steel framed and metal clad. Appropriate road and access ramp(s) would be provided to the building and to facilitate plant access to the storage area appropriately sized roller shutter door/s will be provided.

5.2.6.2. The storage building has been designed and dimensioned so that all spare parts can be extracted without moving other parts or equipment. Therefore, an electric overhead crane may be required to facilitate the movement of spare parts. The overhead crane size will be dependent on the Safe Working Load ('SWL') and the manufacturer that will be confirmed by the contractor at the detailed design stage.

5.2.6.3. The building will be approximately 27 m length x 15 m width, as illustrated in Appendix 1. The building height will be approximately 15 m to suit minimum lift height as well as the overhead crane, hoist, roof structure and clear space between the top of the hoist and underside of the roof structure for access and maintenance of the crane. The building will be equipped with heating, lighting, power, fire detection and security installation in accordance with the specification. All external doors will be a steel security type. As this building houses spare parts, it does not emit any audible noise.

5.2.7. PERIMETER FENCE

5.2.7.1. A perimeter fence will enclose the Converter Station with an external steel palisade fence and inner electrified fence of approximately 3.0 m height and 4.0 m in height, respectively.. The perimeter fence will be 200 m wide x 200 m long, which is the footprint of the Converter Station.

5.2.7.2. To ensure safety from electrical equipment a minimum of 2 m separation must be maintained between the fence and the main earth system and equipment connected to it (this is applicable where a perimeter fence is independently earthed). A minimum 2.0 m wide path shall be provided within the Converter Station fenced compound to allow for future vehicular access for maintenance and inspection.

5.2.7.3. The Converter Station perimeter security (fencing and gates) will be designed to National Grid Technical Specifications which state that the overall height of the perimeter fence (external fence) should be 3 m above base level with an electric pulse fence installed within the security fence (internal fence).

5.2.8. ANCILLARIES

5.2.8.1. The configuration of the Converter Station must ensure that there is acceptable access for fire and rescue service vehicles, including; fire hydrants, static water tanks, buildings and large equipment such as transformers. The following will be also located within the Converter Station Area:

- Car parking spaces;
- Surface water, foul and oily water drainage including their associated bund water control units;
- dump tanks and interceptor ideally in a place not subject to any significant and/or accidental wheel load;
- Air handling units to serve the Converter Building (Valve Hall and DC Hall) to control the internal temperature and humidity range;
- Fire deluge system (dependant on the final site arrangement); and
- Fire water hydrant and its associated 120,000 l water tank and pump house.

5.2.8.2. A minimum 1 m wide footpath as recommended by National Grid Technical Specification will be provided between all buildings and there will be ramped accesses to all roller shutters to facilitate safe access.

5.2.9. ROADWAYS

5.2.9.1. As part of the protection for personnel on site and to provide safe vehicular manoeuvrability, a minimum of 2 m distance between any access road and outdoor high voltage plant, or other electrical equipment is to be provided.

5.2.9.2. Roadways within the Converter Station shall be arranged to facilitate the installation and removal, and potential emergency replacement, of high voltage plant such as transformers and reactors.

5.2.9.3. As a result, the wheel, load capacity, vertical and horizontal alignment of roads must be suitable for all vehicles that will be necessary to construct, operate, inspect, maintain and demolish the works. The maximum required width of roads within the Converter Station based on initial assessment are likely to be as follow;

- Abnormal Indivisible Loads ('AILs') 7.3 m
- Fire and Rescue Service vehicle routes 5 m

5.2.9.4. Width of access dedicated for AILs at bends shall be increased to a minimum of 6 m with inner curb radius of any bends not being less than 30 m. The vehicular access shall be configured such that in the event of a fire, access to the remainder of the site it still possible. This shall be achieved by either ensuring that no fire damage zone encroaches on to an access road or that there are two or more vehicular routes into and/or around the substation, or a combination of both.

5.2.10. PROPOSED SITE LEVEL AND EARTHWORK METHODOLOGY

5.2.10.1. An initial Earthworks study was carried out to determine appropriate site level and building finished level:

- To ensure the platform level lies within the structureless chalk to minimise impact on the SPZ1;
- To satisfy recommendation of the flood risk assessment;
- To make appropriate allowance within structureless chalk for installation of below ground services such as drainage, low voltage and high voltage cable ducts, drawpits and trenches; and
- Maximise retention of the excavated material on site to minimise offsite disposal of the excavated material and a lower environmental impact.

5.2.10.2. The Converter Station site slopes gradually from the north to the south. The Converter Station Area is known to be underlain by a Principal Aquifer (chalk), designated as a Source Protection Zone 1 ('SPZ1'). Following discussion with the Environment Agency and Portsmouth Water, the SPZ1 requires a considered approach to mitigate any potential contamination, turbidity or groundwater issues caused by construction and operation activities over the design life of the development.

5.2.10.3. The ground investigation found that the proposed Converter Station is directly underlain by Head Deposits consisting predominantly of gravelly Clays; sometimes becoming clayey Gravel. Generally, underlying the Head Deposits are Structureless Grade D Chalk, predominately described as grade Dm (matrix-dominated) with occasional interbedded layers of Dc (clast-dominated). Below the Structureless grade D chalk, chalk quality and grade will broadly improve with depth and become Structured Chalk Grades C to A.

5.2.10.4. Groundwater was not encountered during the ground investigation; the deepest exploratory location was 30 m below ground level (m bgl). Portsmouth Water informed the groundwater to be approximately 40-50 m bgl. The unsaturated zone of the aquifer is considered to be in the Structured Chalk between the groundwater and the Structured-Unstructured Chalk Boundary.

5.2.10.5. The Converter Station is located in Flood Zone 1 with no watercourses in the near vicinity, therefore there is no requirement to consider the impact of climate change in relation to peak river flows or sea level rise. Peak rainfall allowances as a result of climate change are considered and the proposed surface water drainage strategy at the Converter Station has been designed to manage surface water run-off generated up to and including the 1 in 100-year return period pluvial event with an allowance for climate change. In addition, the Converter Station external building thresholds/ entrances are expected to have a threshold of up to 300 mm above proposed converter station general site/platform level subject to detailed design by the Applicant's Contractor, to provide resilience against any potential extreme rainfall events exceeding the design standard or localised reduction in capacity of the drainage system associated to local blockages or failure.

5.2.10.6. It is considered deep excavations into the Structured Chalk Grade C to A is likely to increase the risk of contamination to the SPZ1. Therefore, to mitigate risk of creating pathways to the Aquifer, the excavation must be kept to a maximum depth within the Structureless Chalk strata. Also, consideration must be given to the method of construction of the embankments from a landscaping perspective to allow natural slope of 1:4 to tie-in the developed area to the existing landscape and to avoid any hard engineering solutions such as retaining structures or slope strengthening (i.e. soil nails and rock bolts) and to minimise imported material.

5.2.10.7. To create a suitable area for construction of the Converter Station, it is proposed to cut the platform into the gentle hill slope. To demonstrate the likely impact of different platform levels on the cut/fill quantities and the slope stability, earthwork modelling was undertaken for the proposed site based on initial 84.80 m AOD (higher limit) and 84.30 m AOD (lower limit) site level. The recommendation of the flood risk assessment is to set the finished floor level 300 mm above finished site level, therefore at 85.1 m AOD or 84.6 m AOD respectively.

5.2.10.8. The comparison of the earthwork modelling for the two proposed site levels highlighted that, although the difference in the visual impact of the two proposed site levels are negligible, considering the site slope north to south, the lower site level will generate significantly higher quantities of excavated material to dispose off-site and therefore, will have much higher environmental impact in this regard. The higher platform level also provided the benefit of less imported material requirements and remaining higher within the Structureless Chalk, allowing for the drainage, HV and LV cables to be located in the Structureless Chalk. Therefore 84.80 m AOD was agreed to be a suitable indicative Converter Station general finished platform/site level, correlating to a finished floor level of 85.1 m AOD.

5.2.10.9. The converter station external building threshold of 300mm that is included in the assessment, as explained in 5.2.10.5, is based on the worst-case parameters for groundwater and flooding. The preliminary ground investigation data supported the indicative platform level, which allows for the below ground services to be located within the Structureless Chalk, as seen in Plates 5.25 and 5.26. The indicative platform level is closest to the Structured Chalk to the north at the toe of the cutting at approximately 2 m clearance, informed from the closest exploratory location which is approximately 34 m south of the cutting toe.

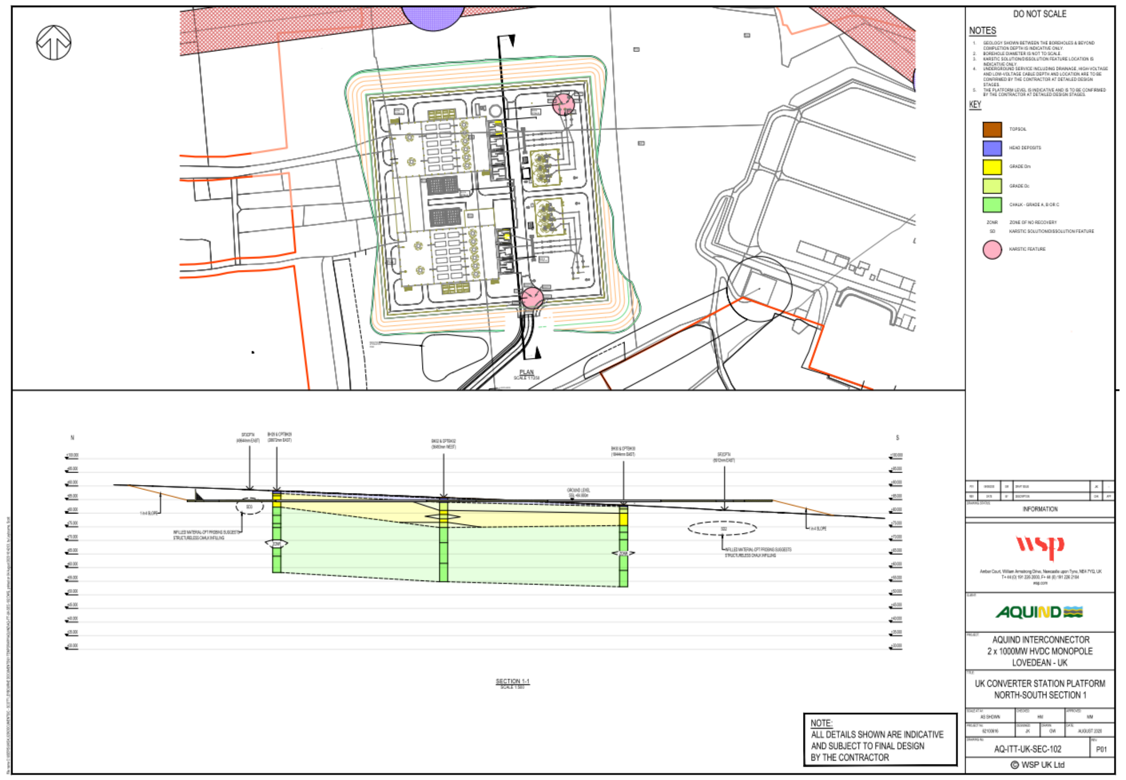


Plate 5.25 – Converter Station Platform, North-South Section

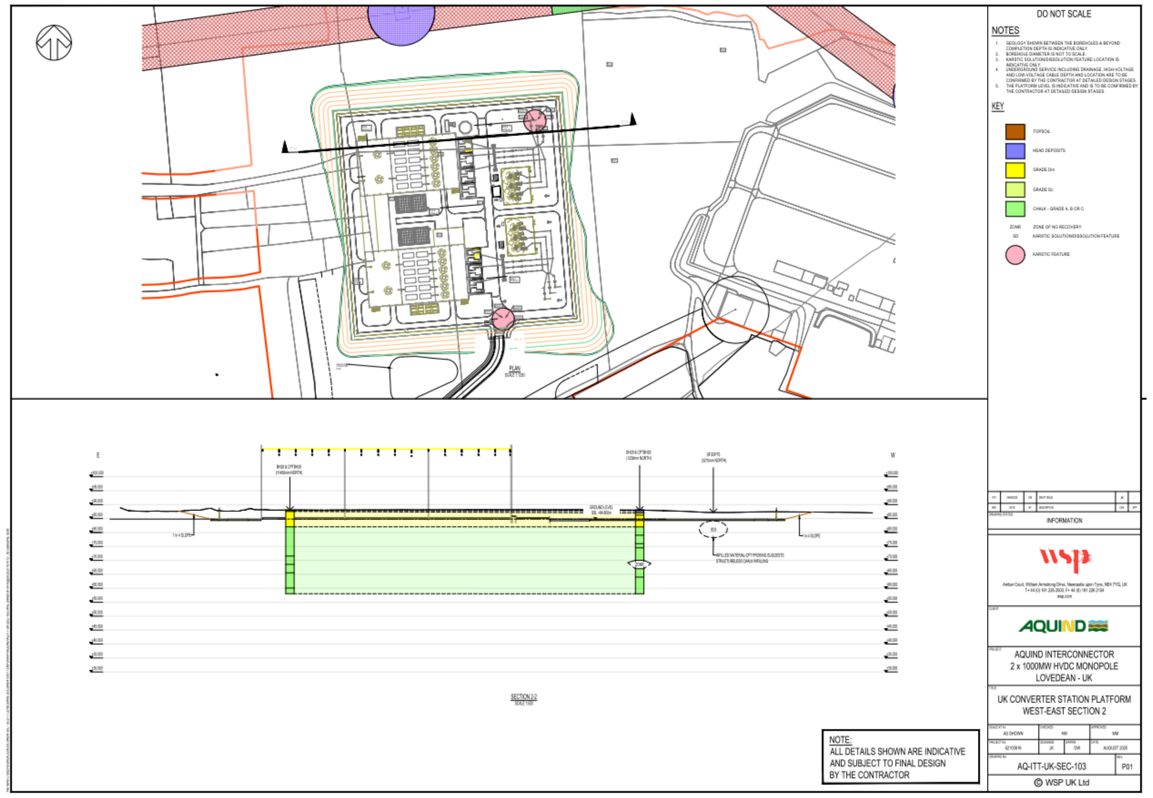


Plate 5.26 – Converter Station Platform, West-East Section

5.2.10.10. During detailed design, if investigation shows the cutting could expose the Structured Chalk the platform level may require refinement, which may also require further construction methodologies and sequencing mitigation to manage the risk of exposing the Structured Chalk. Construction methodologies, mitigation and management will be to industry guidance with the review and approval from Portsmouth Water and Environment Agency.

5.2.10.11. To ensure the building height will not exceed the parameter envelope assessed, an AOD threshold 111.10 meters is provided for the Converter Station and Telecommunications Building Parameter Plan 2.6 Converter Station and Telecommunications Buildings Parameter Plans Option B(i) and Option B(ii), [APP-012] which is required to be complied with in accordance with DCO Requirement 5. Amendments would be made to roof profile design to address any refinement to the site level for the Converter Station and ensure the building height does not exceed the parameter envelope assessed.

5.3. CONVERTER STATION LAYOUT, SCALE, AND MASSING

5.3.1.1. The compound siting and layout (refer to indicative plans – Plates 5.3) is derived from the operational and functional requirements of the Converter Station to meet relevant guidelines and maintain electrical and magnetic separation. It will occupy an area approximate 200 m x 200 m.

5.3.1.2. To accommodate the potential functional space requirements of the equipment the main building is currently shown on the indicative elevations at a maximum height of 26 m (which is the maximum permissible height in accordance with the requirements of the DCO [APP-019] where the finished floor level is +85.1 m AOD.

5.3.1.3. The final height will be subject to confirmation once the design of the electrical installation is complete which may result in a lower building height (refer to indicative elevations and sections – Plates 5.27 & 5.28)

5.3.1.4. The external equipment shown indicatively is also subject to further design development but will not exceed the maximum height of 15m, as illustrated on the Parameter Plans, but the very nature of this equipment means that there will not be a single solid height as there would be with the ridge of a building.

5.3.1.5. The majority of the equipment within this area will be considerably below the 15m maximum height with some elements extending close to this maximum height. The indicative plans show air handling units at low level. There will be no plant located on the roofs of the Valve Hall buildings.

5.3.1.6. There will be a need for lightning protection masts at locations within the compound to be determined by detailed design. These are required to be 4 m above buildings and equipment. The masts are shown indicatively at 30 m high, but this may reduce if building heights are reduced. The lightning masts will be the only equipment which extends above +111.10m AOD and has been assessed on this basis.

5.3.1.7. The Telecommunications Buildings will be limited to 4 m maximum height, located within a compound 30 m x 10 m, as defined on the Parameter Plans.

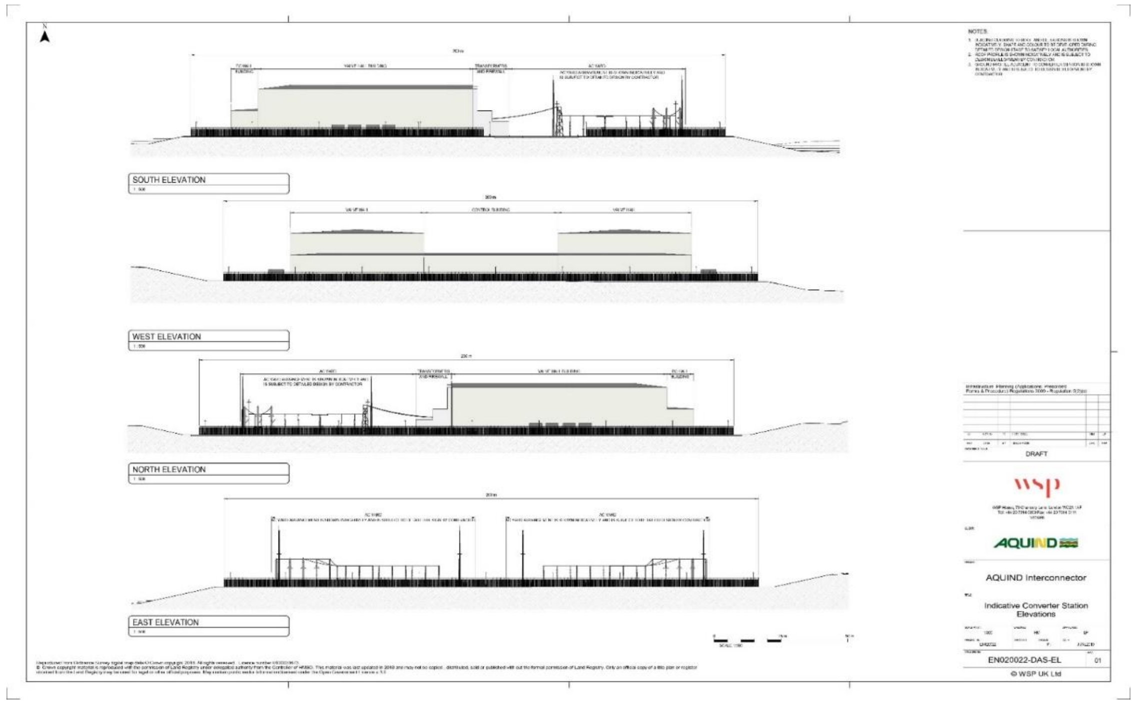


Plate 5.27 – Converter Station view 1 – Submission reference 2.8 Indicative Converter Station Elevations [APP-014]

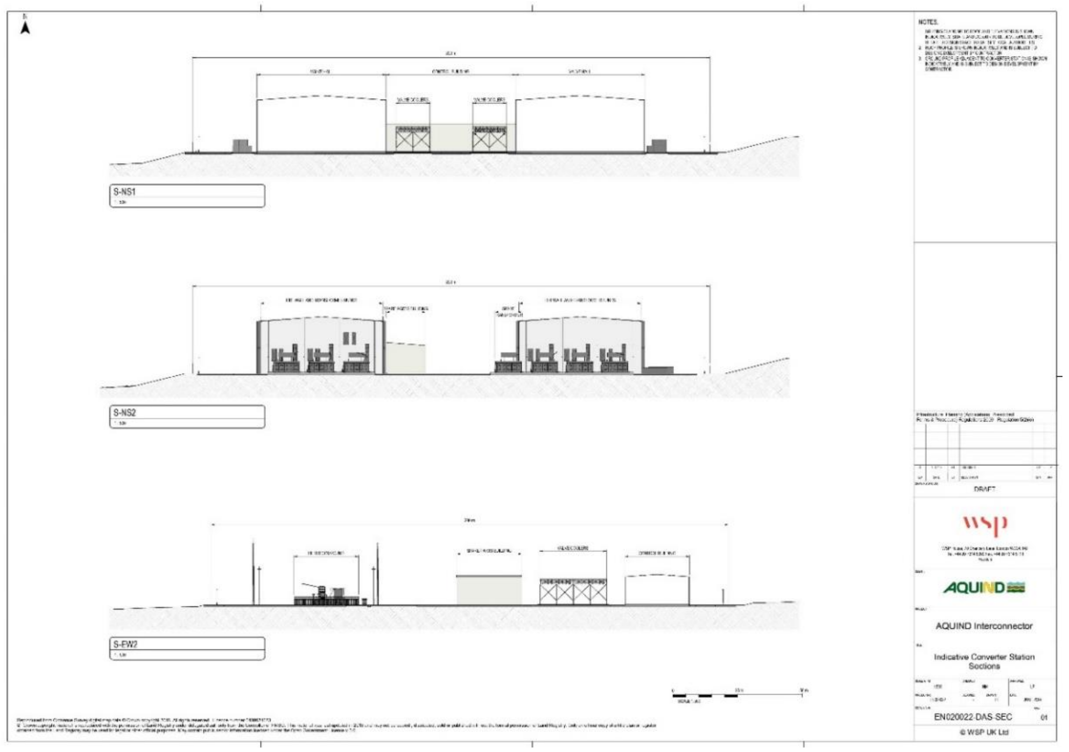


Plate 5.28 – Converter Station view 2 – Submission reference 2.8 Indicative Converter Station Elevations

5.3.2. APPEARANCE

5.3.2.1. The illustrative design of the building accompanying the DCO submission (Plate 5.29 below) is derived from a colour coated metal "baguette", or vertical fin cladding system incorporating insulated internal panels which enables the colour variations established by design development and meets the functional requirements of durability, acoustic insulation and fire separation.

Plate 5.29 – Converter Station – indicative illustration

5.3.2.2. The cladding elements are individually coloured using differing hues from the palette to break up the mass of the building and provide visual interest. Further visual interest is added by horizontal banding which includes staggering of colour patterns.

5.3.2.3. The building illustrated has curved corners to soften the massing. The Telecommunications Buildings will have external walls of durable low maintenance, in accordance with the Design Principles.

5.3.3. LIGHTING

5.3.3.1. It is proposed that the outdoor areas within the compound will be illuminated by lighting columns between 6 m and 15 m high. The lighting will be required for emergency situations and unplanned maintenance only – there will be no requirement for external lighting during normal operation.

5.3.4. SURFACING TO COMPOUNDS

5.3.4.1. The external areas within the Converter Station compound and the telecommunications compound illustrated are intended to be gravel with concrete vehicular access routes and hard standing for equipment.

5.3.5. BOUNDARY TREATMENTS

5.3.5.1. The compounds will be surrounded by metal security fencing with access control gates – as illustrated on the indicative elevations.

5.3.6. ACCESS TO CONVERTER STATION

5.3.6.1. Access to the Converter Station from Lovedean substation has been considered but discounted due to security constraints. Alternative access routes from Old Mill Lane to the north-west and Broadway Lane to the south-east were considered. Old Mill Lane has been discounted as it is unsuitable for the size of vehicles required for construction and (occasional) replacement of equipment. Broadway Lane connects with the A3 trunk road, which is approximately 2 km from the junction to the proposed site access road.

5.3.6.2. The indicative layout plans show a potential access road approximately 1.2 km long x 7.2 m wide from Broadway Lane to the south side of the proposed Converter Station (Plate 5.3). The route is shown curved to relate to the site context and avoid the established Ancient Woodland. The final details of the junction to Broadway Lane and the route of the access road will be subject to further design development and approval but will be contained within the zone indicated on the Parameter Plans.

5.3.6.3. The access road will be used for the construction of the Converter Station and compound and delivery of electrical components. Traffic during operation will be minimal and consist of light vehicles, larger vehicles may be required on rare occasions for delivery of replacement plant or components. Construction traffic associated with construction of the Converter Station is estimated to reach potential levels of 43 two-way HGVs and 150 construction workers per day plus occasional Abnormal Indivisible Loads to deliver equipment (transformers, for example) and telescopic cranes. In addition, up to 7 HGVs, 14 LGVs and 56 construction workers associated with construction of the Onshore Cable Route will use the Converter Station as their main site compound. Construction traffic will be subject to agreement of a Construction Traffic Management Plan with the relevant local authority(s).

5.3.6.4. A contractor's Works Compound, including vehicular parking and lay down areas (estimated at approximately 4-5 Ha) will be situated within the access zone, and also subject to agreement with the relevant local authority(s). Full re-instatement of landscaping will be implemented on completion of the works.

5.3.6.5. The Converter Station will be unmanned, with 3-4 staff on 24-hour emergency call out. Maintenance will be required on 3 – 4 days per year. These operations will only require access by light vehicles, with parking provided within the compound. There may be occasional requirements for access by larger vehicles, including Abnormal Indivisible Loads should the need arise to replace equipment.

5.3.6.6. Further design development will give consideration to the selection of surfacing materials to respond to the site context, which may include a distinction between normal access requirements and temporary access for larger vehicles.

5.3.6.7. The Telecommunications compound will be situated within the access zone illustrated on the Parameter Plans and will be accessed from the Converter Station access road. This is also unmanned, requiring occasional access by light vehicles for emergencies and maintenance. Parking for two cars/ light vans will be provided within the compound.

5.4. CONVERTER STATION AREA

5.4.1. TELECOMMUNICATIONS BUILDINGS

5.4.1.1. The Proposed Development includes a compound containing two Telecommunications Buildings which house equipment associated with the Fibre Optic Cables (FOCs). One FOC will be installed alongside each circuit of HVDC cables (Marine and Onshore). As a standard industry practice and requirements, FOC cables are installed together with HVDC cables for the purposes of control, monitoring and protection of the HVDC cables as well as communication between the Converter Stations and thus are an essential part of the Proposed Development. The spare capacity within the FOC can be used to provide telecommunications services to third parties. The management of the third-party telecommunication data signal will require appropriate equipment to be installed in the Telecommunications Buildings. An indicative drawing of the compound with Telecommunications Buildings has been provided in Plate 5.30, extracted from the Indicative Telecommunications Buildings Elevations and Floor Plans [APP-015].

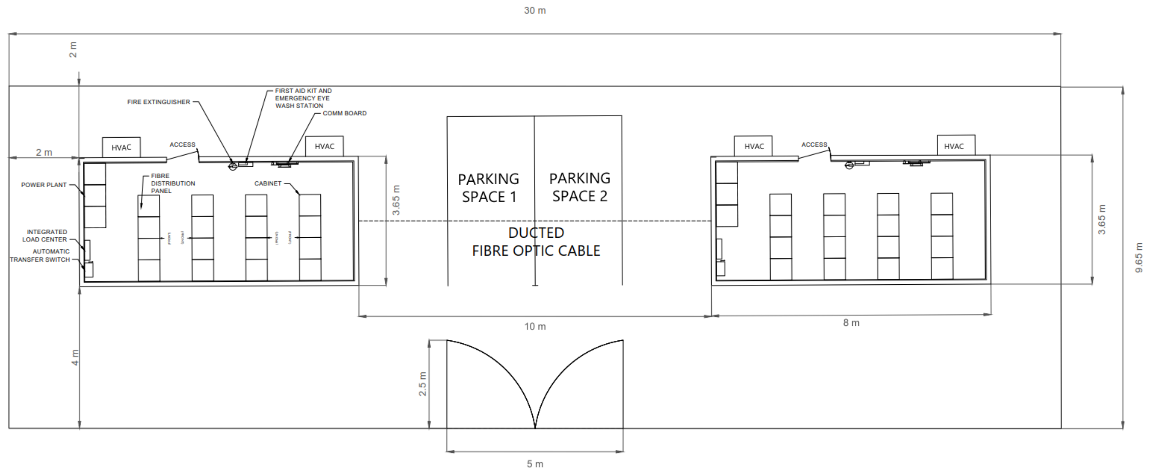


Plate 5.30 - Indicative Telecommunications Building drawing (not to scale). EN020022-000466-2.9 Indicative Telecommunications Building(s) Elevations and Floor Plans [REP1-020].

5.4.1.2. Two Telecommunications Buildings (one for each of the fibre optic cables to be installed with each of the HVDC Cable Circuits) are to be located within a small compound to the south west of the main Converter Station compound. The separate location of the Telecommunications Buildings is necessary due to the strict access requirements at the Converter Station which restrict third party access for security and health and safety reasons. It also enables the equipment to be more easily accessible for maintenance and management purposes. The two Telecommunications Buildings will be located 10 metres apart within the same compound. This separation is required to maintain the independence of the fibre optic cables in each HVDC circuit, providing greater resilience in the event of equipment failure, fire, adverse weather, vandalism and/or accidents.

5.4.1.3. One Telecommunications Building is required for each FOC with a 10 m separation between the two buildings. The separation helps to maintain independence of each FOC and provides greater resilience in event of equipment failure, fire, adverse weather conditions, vandalism, accident etc. The parameters of each Telecommunications Building will be a maximum of 8 m long x 4 m wide x 3 m high, and they will be located within a compound area that has a maximum footprint of 30 m long x 10 m wide. Auxiliary power supply would be taken from the Converter Station.

5.4.1.4. The size of each building is based on the quantity and size of equipment inside. The key equipment inside each building will be:

- Heating, Ventilation and Air Conditioning (‘HVA/C’) units;
- Low Voltage Alternating Current (‘LVAC’) intake and distribution board – this assumes connected to the main converter station LV auxiliary supply and associated backup power arrangement;
- LVAC consumer units;
- Uninterruptible Power Supply (‘UPS’) battery charger unit with battery racks;
- Four sections of cabinets to accommodate the telecommunications and control equipment. Each section would likely have a footprint of 2.4 m x 0.6 m x 2.0 m (height which could be increased to 2.3 m with supports) with a spacing between them about 1 m. Indicative size of each cabinet is 0.6 m x 0.6 m x 2.0 m (height). Each cabinet will house the following typical equipment:
  - Multiplexor
  - Dense Wavelength Division Multiplexing (‘DWDM’)
  - Fibre distribution panels
  - Optical amplifier

5.4.1.5. The HVA/C units are the only external noise producing equipment at the Telecommunications Buildings and have been included in the operational noise modelling and assessment of the Converter Station Area.

5.4.1.6. They produce lower levels of noise compared with the equipment located in the

Converter Station compound. To ensure noise effects are minimised, the equipment will be positioned on the northern facade of the Telecommunications Buildings, thereby facing away from Little Denmead Farm, the nearest noise sensitive receptor. As explained in Chapter 24 (Noise and Vibration) of the ES Volume 1 [APP-139], the likely operational noise effects from the Telecommunications Buildings are negligible.

5.4.2. ATTENUATION PONDS

5.4.2.1. As part of Sustainable Drainage System ('SuDS'), two attenuation ponds are proposed as part of the Proposed Development as illustrated in purple by Plate 5.31 (extracted from Indicative Converter Station Area Layout Plans [APP-013]):

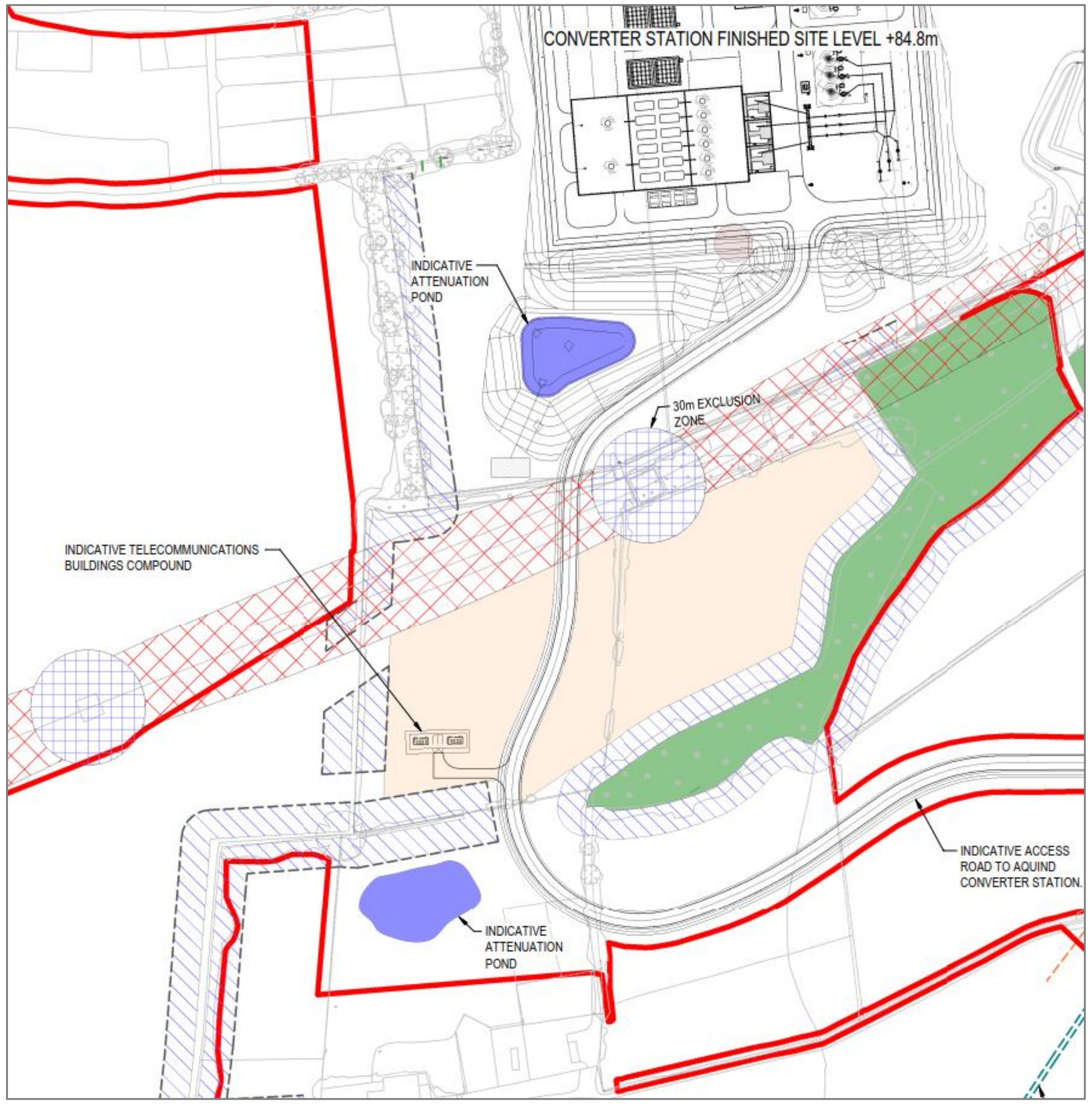


Plate 5.31 - Indicative drawing of the Attenuation Pond locations (not to scale)

Attenuation Pond 1 (Detention Basin)

5.4.2.2. The attenuation ponds are located south of the proposed Converter Station to collect run-off from the Converter Station. The detention basin will be lined and impermeable but will contain a layer of added filter media to allow treatment by infiltration.

5.4.2.3. The basins will be designed for the dual purposes of water quality treatment and surface water attenuation upstream of the soakaway. The required volume of surface water storage will be determined by the infiltration rate of the existing substrate surrounding the soakaway, which is yet to be confirmed.

5.4.2.4. In the absence of this information, the current basin design provides approximately 2300 m^3 of surface water storage based on a Microdrainage Quickstorage Estimate of between 1700m^3 - 2400m^3 for an event with a 1:100 year return period plus 40% Climate Change and a discharge rate of 3.4 l/s.

5.4.2.5. This discharge rate was calculated from 2l/s/ha of impermeable area generating the runoff, as advised within the HR Wallingford Greenfield Runoff Rate Estimation Tool (UKSuDS, 2018).

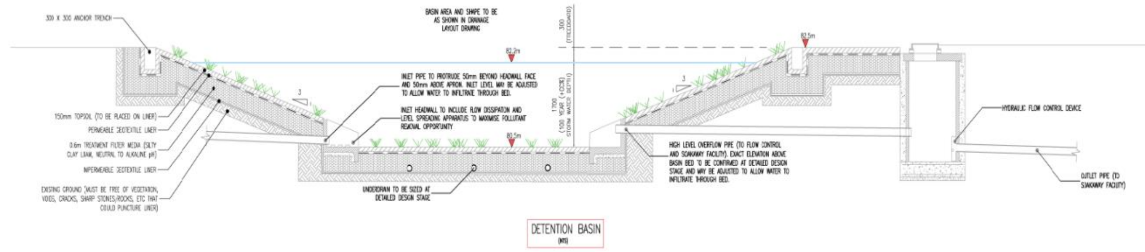


Plate 5.32 – Detention basin – image 1 (not to scale)

Attenuation Pond 2 (Infiltration Basin)

5.4.2.6. The infiltration basin is proposed for the southwest west of the Access Road and directly south of the proposed Telecommunications Building at a low point in the existing topography. This will allow run-off from Access Road to be conveyed along infiltration swales from the north and east.

5.4.2.7. The size and outline design of the infiltration basin is the same as the detention basin further north, providing approximately 2300 m^3 of surface water storage with maximum bank gradient of 1:3 and a depth of approximately 2m which includes a 0.3 m freeboard.

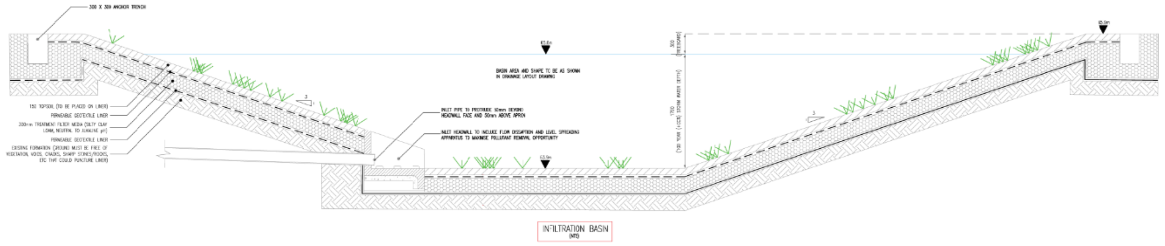


Plate 5.33 – Infiltration basin – image 2 (not to scale)

5.4.2.9. For further information, refer to updated Surface Water Drainage and Aquifer Contamination Mitigation Strategy in Appendix 3.

5.5. LANDFALL AND OPTICAL REGENERATION STATIONS

5.5.1. GENERAL OVERVIEW

5.5.1.1. To ensure reliable and high-speed communication between the UK and France Converter Stations two Optical Regeneration Stations (ORS) (one for each HVDC circuit) at the Landfall are required to maintain the signal strength across the entire route.

5.5.1.2. The Proposed Development has two ORS buildings as each HVDC Circuit requires a dedicated ORS. A 10 m separation between the buildings helps to maintain independence of FOC installed alongside each of the HVDC Circuit and the associated equipment, and provides greater resilience in event of equipment failure, fire, adverse weather conditions, vandalism, or accident.

5.5.1.3. Each ORS requires a small scale single storey structure located within the defined parameters. Once cable laying and construction activities have been completed the only above ground infrastructure will be the ORS. The ORS Parameter Plan (Plate 5.34) shows the locational extent of the buildings, within the existing area. The compound for an ORS will have a maximum size of 18 m x 35 m.

Plate 5.34 – Optical Regeneration Station(s) Parameter Plan [REP1-009]

5.5.2. OPTICAL REGENERATION STATION DESIGN

5.5.2.1. The appearance of the structures would be determined post consent with the submission of a detailed design that would be within the defined parameters plan (Plate 5.35). The ORS design will be confirmed in accordance with the Design Principles, and an indicative design can be seen in Plate 5.35.

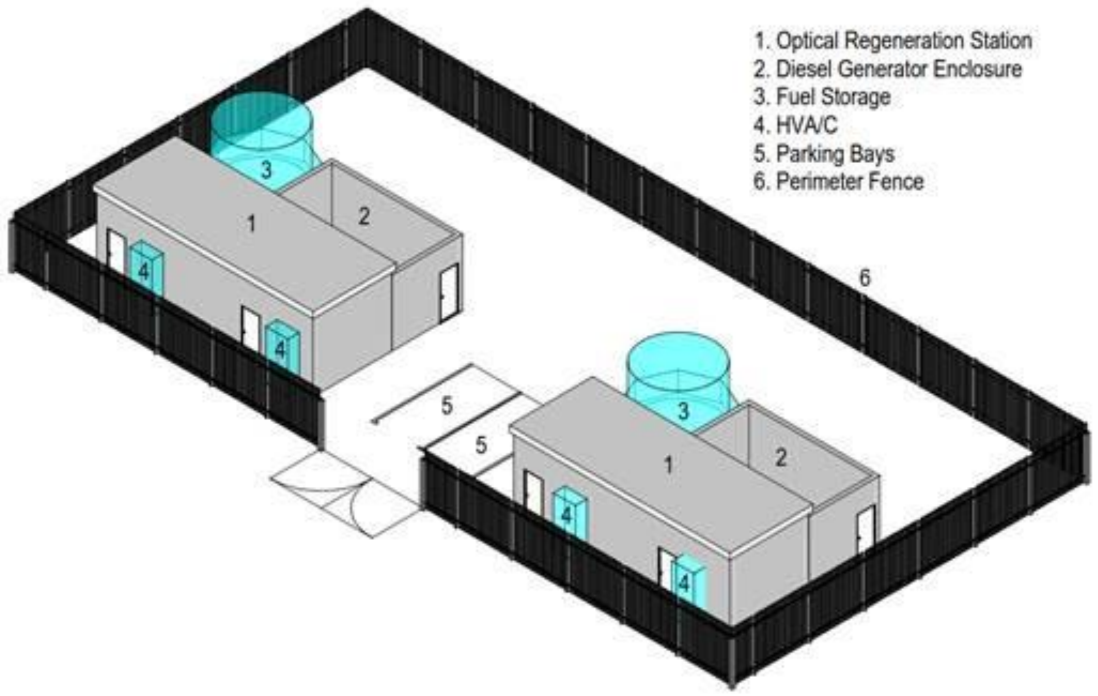


Plate 5.35 – Indicative view of Optical Regeneration Station

5.5.2.2. An illustrative drawing of the ORS compound has been provided in Plate 5.36, and extract from Indicative Optical Regeneration Station(s) Elevations and Floor Plans 2.10 [APP-016].

5.5.2.3. The required parameters of each ORS building are 11 m long x 4 m wide and up to 4 m in height, with a compound of 18 m x 35 m maximum dimensions. The ORS buildings would be located within a securely fenced compound at the Landfall Area, which would also contain auxiliary power generation equipment and fuel tanks.

5.5.2.4. The auxiliary (back-up) power generator, No. 2 in Plate 5.35, is anticipated to be used infrequently in the event of disruption to main power supply. Noise modelling and assessment has been completed to assess noise from the HVA/C units at the ORS buildings, however the back-up power generator has not been included in the noise assessment because it is anticipated to be used very infrequently.

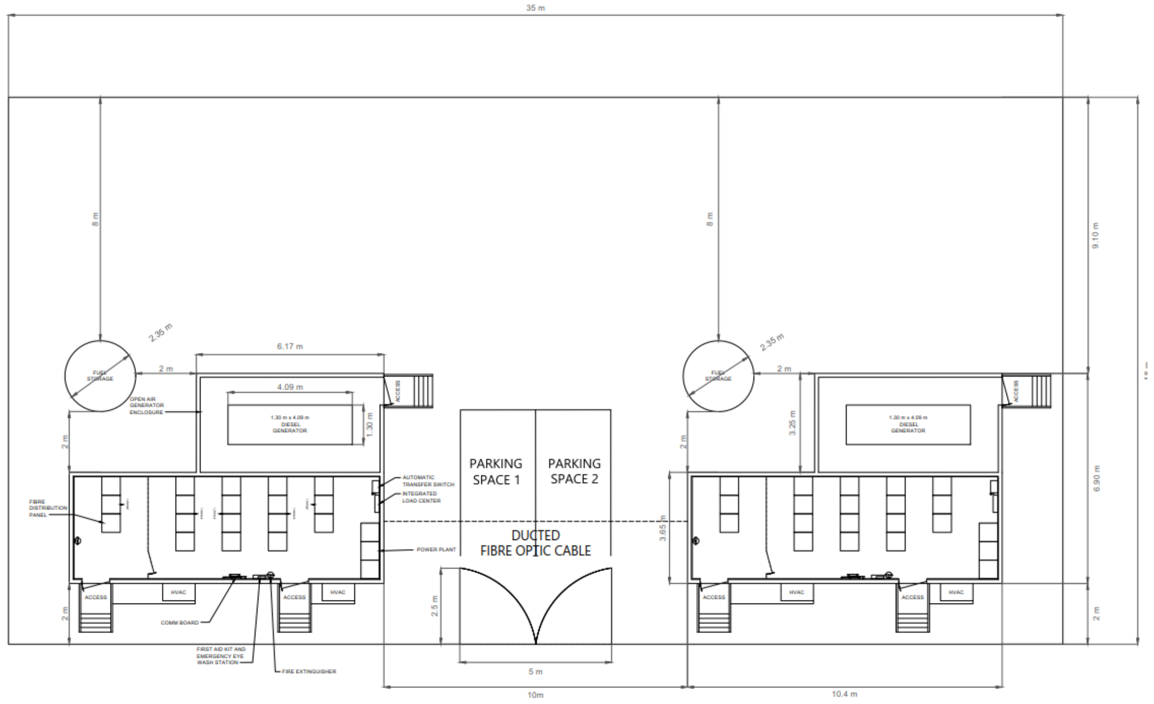


Plate 5.36 – Plan view of ORS site (not to scale). EN020022-000466-2.10 Indicative Optical Regeneration Station Elevations and Floor Plans [REP1-008].

5.5.2.5. The size of the ORS buildings is dictated by the quantity and size of amplification and FOC equipment inside.

5.5.2.6. The key equipment inside each building will be:

- HVA/C units;
- DC power plants with battery racks;
- Cabinets (each with indicative size of 0.6m x 0.6m x 2.0m (height)), two thirds of which will be used for the spare fibre strands that will be installed at the same time to build in future availability, and that will house the following typical equipment:
  - Multiplexor
  - DWDM
  - Fibre distribution panels
  - Optical amplifier

5.5.2.7. Indicative images show the typical cabinets layout (Plate 5.37) as well as the typical cabinets configuration (Plate 5.38).

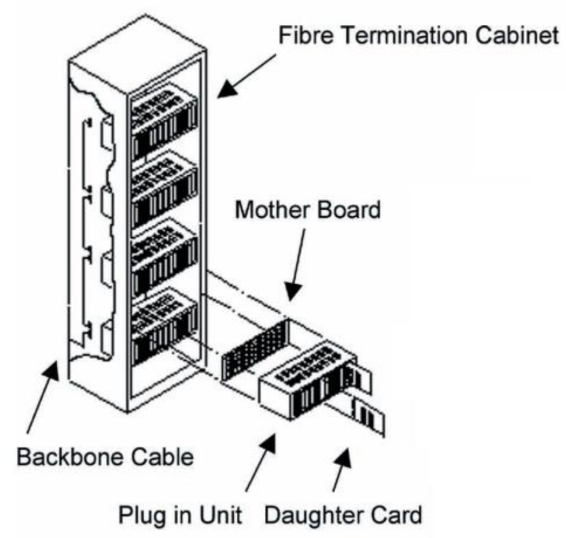


Plate 5.37 – Typical cabinets layout (Copyright – B&M FOC System Detailed Study Issue A May 2019)

Plate 5.38 – Typical cabinets (Copyright – B&M FOC Review Report Issue D Sept. 2018)

Plate 5.39 – Indicative illustration of an ORS Building (Copyright – B&M FOC Review Report Issue D Sept. 2018)

5.5.2.8. Plate 5.39 provides an additional illustration of a typical telecommunications room. Given the location of the ORS in Flood Zone 3 and the predicted flood levels, as identified by the Environment Agency (including climate change) as detailed in the FRA addendum.

5.5.2.9. To provide tidal flood resilience the finished floor level (external threshold) of the ORS will be set above the predicted 1 in 1000yr predicted tidal flood event flood level during the future 2065 scenario (40 year serviceable life), which includes an allowance for sea level rise. The provision of an internal raised threshold, by raising equipment off the floor, would act as an additional freeboard from the external finished floor level to the bottom of the equipment inside the ORS(s). This would provide further resilience against uncertainties of the predicted flood levels and uncertainties in climate change and sea level rise as well as potential exceedance events, whilst also facilitating resilience to a longer serviceable life. As such, two key design considerations have been made:

- External raised threshold of 950 mm (4.35m AOD) – which is above the modelled 1 in 1000yr tidal flood event flood level (undefended 4.31m AOD, defended 4.26m AOD) during the future 2065 scenario.
- Internal raised threshold to bottom of equipment of 300 mm (4.65m AOD) providing additional resilience against uncertainties linked to climate change scenarios.

5.5.2.10. An illustrative drawing of the ORS compound has been provided in and extract from Indicative Optical Regeneration Station(s) Elevations and Floor Plans 2.10 [APP-016].

5.5.2.11. The exact level of internal and external raising would be determined during detailed design based on the level of resilience deemed to be appropriate for the Proposed Development's vulnerability. The final level of resilience will be based on acceptable commercial risk management to the Proposed Development.

5.5.2.12. Noise modelling and assessment has been completed to assess noise from the HVA/C units at the ORS buildings. To ensure noise effects are minimised, the HVA/C equipment will be positioned on the south-eastern façade of the ORS buildings, thereby facing away from the nearest noise sensitive receptors on Fort Cumberland Road. As explained in section 24.6.11 of Chapter 24 (Noise and Vibration) of the ES Volume 1 [APP-139], the operational noise effects from the ORS are expected to be negligible.

5.5.3. LIGHTING

5.5.3.1. With an acknowledgement of the context of the location in which the ORS is to be located and nothing that external lighting is not required from an operational perspective. The ORS will not be illuminated other than in the event of an emergency. The emergency external lighting design will be developed during detailed design to allow for safe movement of vehicles and pedestrians and the repair, replacement and operation of equipment in the event of an emergency in accordance with the appropriate Chartered Institution of Building Services Engineers ('CIBSE'), British Standards Institution ('BSI') and Health and Safety publications.

5.5.4. SURFACING TO COMPOUNDS

The external areas within the ORS compound are intended to be gravel or similar hardstanding surface.

5.5.5. BOUNDARY TREATMENTS

The ORS compound will be surrounded by metal security fencing with access control gates – as illustrated on the indicative drawing.

5.5.6. ACCESS

Regular access to the ORS at the Landfall will be required during the Operational Stage. Vehicular access to the ORS will be via the existing car park.

5.6. NOISE MITIGATION

5.6.1.1. Operational noise has been an integral consideration during the evolution of the Converter Station design during the pre-application stage. Computerised 3D acoustic modelling has been completed to enable the Converter Station design to be optimised, and operational noise impacts to be minimised.

5.6.1.2. Stakeholders, including Environmental Health Officers ('EHOs') at the relevant LPAs have been consulted regularly throughout the pre-application stage to ensure that any concerns have been proactively addressed as part of the Converter Station design and the following measures are integral to minimising noise impacts.

5.6.2. NOISE CRITERIA

5.6.2.1. The noise modelling of the equipment and mitigation measures listed in Table 5.4 demonstrate that a solution exists which avoids significant adverse operational noise effects. It is acknowledged that the exact equipment specification and appropriate mitigation measures may change following the appointment of a contractor to complete the works. It is, therefore, imperative that the noise criteria stated in the noise and vibration assessment are embedded into the Converter Station design through the DAS and draft DCO. This ensures that the noise criteria are secured, regardless of equipment and mitigation incorporated into the design.

5.6.2.2. Compliance with the noise criteria will be demonstrated through a noise management plan, as stated in Requirement 20 of the draft DCO. This noise management plan, which will require LPA approval, will include the mitigation measures (and attenuation afforded by these measures) to achieve the criteria, a scheme for noise monitoring to ensure compliance with the criteria, and a complaints procedure. This is the reason for the inclusion of Building Design Principle 9 in the section 6.2.2 of this report: "Operational noise from the Converter Station will meet the criteria detailed in Chapter 24 Noise and Vibration (Section 24.4.5 and Appendix 24.6)."

5.6.2.3. To provide further detail, the broadband noise criteria that must be achieved are contained in broadband and octave band noise criteria document (6.2.24.4 ES - Vol 2 - Figure 24.4 Section 1 [APP-338]). These noise criteria are applicable at the facades of the surrounding noise sensitive receptors and vary by location depending on the background noise levels measured during the baseline survey. The daytime octave band noise criteria that must be achieved are also set out in the broadband and octave band noise criteria document (6.2.24.5 ES - Vol 2 - Figure 24.5 Section 10 [APP-339])). The criterion at a given receptor is dependent on the background noise level at the representative measurement position (quantified during the baseline survey), as shown in section 24.4.1 of Chapter 24 (Noise and Vibration).

5.6.2.4. The night-time octave band noise criterion is Noise Rating (NR) 20 measured internally at all sensitive receptors. Further detail is provided in paragraph 24.4.5.11 of Chapter 24 (Noise and Vibration) [APP-139].

5.6.3. BUILDING LAYOUT, ORIENTATION, AND HEIGHT

5.6.3.1. With respect to layout and orientation, both Converter Station options (B(i) and B(ii)) are orientated such that the plant items which dominate the noise levels (i.e. the interface transformers (and fans) and outdoor valve cooling systems) are screened from the nearest sensitive receptors (The Haven and Old Mill Cottage, Hillcrest and Millfield Farm) by the Converter Buildings and Control Buildings.

5.6.3.2. The Preliminary Environmental Information Report ('PEIR') submitted during the pre-application stage, detailed adverse operational noise impacts at Millfield Farm. Since then, the Control Buildings have been relocated to the western edge of the Converter Station compound forming an uninterrupted screen between the outdoor valve cooling systems and Millfield Farm, thereby reducing the operational noise effects to negligible at this receptor.

5.6.3.3. As stated in Section 5.2.2, the height of the Converter Buildings is primarily driven by the equipment requirements in the Valve Halls. However, it also worth noting that buildings of the heights specified above (up to 26 m) are highly effective in providing noise screening between the external plant items and receptors.

5.6.3.4. A noise contour plot showing the predicted broadband noise levels from the operational Converter Station is presented in Figure 24.4 of the ES Volume 2 [APP-338].

5.6.4. MITIGATION AT THE SOURCE

5.6.4.1. A key aspect of the Converter Station design is the mitigation of equipment items at source. The Proposed Development team has identified example mitigation measures that could be applied to the key noise producing equipment items, and this mitigation has been included in the 3D noise model to demonstrate that significant operational noise effects can be avoided. The noise levels (expressed as broadband sound power, L_w) for the key noisy equipment items, with and without proposed mitigation are presented in Table 5.4.

5.6.4.2. The octave band noise levels (i.e. the noise level in each frequency band across the 31.5 Hz to 8 kHz range) for the equipment and mitigation is presented in Section 1.5.2 of Appendix 24.5 [APP-464]. These noise levels and mitigation values are based on the most robust information available at the time of the ES assessment.

Table 5.4 - Sound power levels and mitigation for the Proposed Development

Equipment item	Equipment quantity	Sound power level (dB Lw) without mitigation	Mitigation measure	Sound power level (dB Lw) with mitigation
Converter transformer	6	101	Acoustic enclosure	68
Converter transformer fans	6	90	Silencer	74
Valve Converter Cooling Fan Banks*	20	89	Reducing operating fan speed	86
Aux transformer	2	80	Acoustic enclosure	47
AC filter reactor	6	80	Acoustic enclosure with top hat	70
AC filter capacitor	6	80	Acoustic enclosure	73

***Ten valve converter cooling fan banks make up each of the two valve cooling systems.**

5.6.5. MANAGEMENT PRESCRIPTIONS

5.6.5.1. Management prescriptions (which would be covered throughout the operational lifetime of the Converter Station) are covered in the updated Outline Landscape and Biodiversity Strategy and further detail would be provided in the detailed landscaping scheme which will be submitted to the relevant local planning authority and SDNPA for approval under requirement 7 of the draft Development Consent Order [APP-021]. The detailed landscaping scheme will include detailed landscape mitigation plans with management, maintenance and monitoring plans as well as confirmed management responsibilities.

5.7. PLANNING AND LANDSCAPING

5.7.1. OVERVIEW

5.7.1.1. Indicative Landscape Mitigation Proposals include:

- Minimising the loss of existing trees and hedgerows, especially long established.
- Considering the context of adjacent woodland (including areas of ancient woodland), native hedgerows and trees, grassland and shrub, established National Grid mitigation planting, arable farmland, pasture, and recreation areas.
- Replacement of trees and hedgerows lost by the development and because of ash dieback.
- Consideration of the siting of the compound with relation to existing topography and cutting into the hillside as much as possible within constraints.
- Grading of contours around the Converter Station compound, making use of arisings from excavations.
- Proposed sympathetic native hedgerows and trees, mixed woodland, scrub, species rich grassland, taking account of offset constraints from perimeter fencing and buildings.
- Attenuation basin to manage surface water drainage, including marginal planting and vegetated conveyance and infiltration swale
- Management of and reinstatement of planting within existing hedgerows and woodland.

5.7.1.2. The updated Outline Landscape and Biodiversity Strategy (OLBS) [REP6-038 Rev004] sets out the indicative mitigation measures for the effects of the Proposed Development upon landscape and biodiversity features. A detailed landscaping scheme is required within the DCO [REP6-015 Rev005].

5.7.2. PLANNING CONSIDERATION

5.7.2.1. A number of meetings were held in the pre-application phase with the Local Planning Authorities ('LPAs') and other stakeholders, including representatives of the South Downs National Park Authority ('SDNPA') to discuss the proposed Converter Station location and design. These are documented in section 4 of this report. One of the key considerations discussed at these meetings was whether the Converter Buildings should be integrated within the existing topography and blend into the surroundings or "make a statement." Discussions concluded that the Converter Buildings should be integrated within the existing topography and screened as far as possible to soften the impact of the Proposed Development on its surroundings.

5.7.2.2. The Design Principles set out in section 7 of this report (and agreed at these meetings) established that visual clutter from several different sized buildings should be avoided where practicable and instead the different building functions should be rationalised into simple building forms.

5.7.2.3. Cladding typically consists of narrow vertical elements of varied contextual colours (primarily dark recessive colours). The colour palette focuses primarily on darker recessive colours with some additional lighter colours included should these be required where the building cuts the skyline. This approach to include a broader range of colours will provide a degree of flexibility when undertaking the contextual study at detailed design. The clause to undertake a further contextual study included in design principle 3 will test each elevation from different viewpoints and angles to determine the colour ratios and whether overall such elevations should have a greater transition of darker to lighter colours. This does not imply that the lighter colours will be used, but rather that they may be included subject to the study's findings and agreed in discussion with the relevant discharging authority in consultation with the SDNPA. The roof of each building will be a dark recessive non reflective colour to minimise visual impact.

5.7.2.4. Curved corners will be incorporated into the Converter Building forms to soften the visual impact. This is now reflected in Building Design Principle 6 (see section 6.2.2. below).Materials used will have a long design life and low maintenance requirements. The illustrative designs included in the DAS incorporated parapets set at the maximum heights of the buildings to mask the roofs behind.

5.7.3. LANDSCAPING AT LOVEDEAN (CONVERTER STATION AREA)

5.7.3.1. Landscaping (including cut and fill, reprofiling if/where appropriate and the associated planting) is proposed around the perimeter of the Converter Station to mitigate against the landscape and visual amenity impacts and to screen as far as possible the proposed Converter Station with its surroundings.

5.7.3.2. The landscape and visual effects, and the consequence of embedded mitigation from a landscape and visual amenity perspective, are discussed in Chapter 15 (Landscape and Visual Amenity) of the ES Volume 1 [APP-130], with relevant ecological considerations discussed at Chapter 16 (Onshore Ecology) of the ES Volume 1 [APP-131].

5.7.3.3. Proposals have taken into account both existing environmental and infrastructure constraints including proximity to overhead lines and easements as well as technical requirements associated with the Converter Station and Telecommunications Buildings. Planting to offset the landscape and visual effects for the Converter Station Area was proposed in accordance with the health and safety regulations (issued by the Health and Safety Executive under the Electricity, Safety, Quality and Continuity Regulations 2002 (as amended)).

5.7.3.4. The Regulations seek to ensure that electrical earthing remains clear of any risk of root damage, that trees do not fall onto the security fencing compromising safety and breaching unauthorised access, and access is maintained to ease the removal of all fallen or felled trees.

Reprofiling

5.7.3.5. The proposed Converter Station is located on a hillside sloping downwards from north to south. Utilising the topography to partially screen the buildings, bulk earthworks will achieve a general finished level platform of 84.8 m AOD with an approximate maximum cut of 4.5 m and an approximate maximum fill of 4.5 m.

5.7.3.6. A finished platform level of 84.8 m AOD will keep the excavation within structureless chalk strata to mitigate contamination of the aquifer. Following initial flood risk assessment, the Converter Station's indicative finished floor level will be +85.10 m AOD (300 mm above finished site level).

5.7.3.7. Excess fill will be used to create new naturalistic landforms to the north and south of the Converter Station providing some screening for sensitive receptors.

Planting

5.7.3.8. Proposals seek to minimise the loss of existing vegetation as it serves an important ecological, landscape character and screening function. To aid connectivity in terms of biodiversity, landscape character and visual screening, existing hedgerows and hedgerow trees will be protected and enhanced, and in some locations replaced with new hedgerow and hedgerow tree planting where planting has been lost, affected by ash dieback or is over mature.

5.7.3.9. New planting will be introduced which is sympathetic to the surrounding landscape character and reflective of native species. The planting palette of species has been agreed in principle with the relevant local authorities and SDNPA, as detailed in Chapter 15 and supported by Appendix 15.7 (Landscape Schedule, Planting Heights and Image Board) of the ES Volume 3 [REP6-029 Rev002].

5.7.3.10. New planting will include new woodland, copses, scrub and hedgerow planting within the locations broadly indicated in Plates 5.40 and 5.41 below. New species rich wildflower grassland (aiming towards calcareous grassland) will be created using seed from a local provenance.

5.7.3.11. Careful consideration will be given to improving and diversifying habitats through the planting mixes and management regimes whilst maintaining wildlife corridors. A historic field boundary will be reinstated to the north of the Converter Station and new links created to existing ancient woodland (as far as reasonably practicable given the location of existing overhead lines, the Access Road and associated easements) to avoid fragmentation.

5.7.3.12. The position of new planting has been influenced by the existing environmental (landscape and ecological) and infrastructure (overhead lines and cables) constraints on site. The new planting will be offset from the Converter Station Area and Telecommunications Building(s) in response to health and safety regulations outlined above, further details of which are included in the updated Outline Landscape and Biodiversity Strategy [REP6-038 Rev004].

5.7.3.13. To aid visual screening new planting will take place early in the construction programme where practicable and where it is not affected by construction works. Agreements are being sought with existing landowners over rights to protect and enhance existing hedgerows and hedgerow trees.

5.7.3.14. Illustrative drawings of the landscape have been provided in Plates 5.40 to 5.43:

- Plates 5.38 and 5.39: Extracted from 6.2.15.48 Environmental Statement - Volume 2 - Figure 15.48 Indicative Landscape Mitigation Plan Option B(i), North [REP6-027 Rev04] and South [REP6-028 Rev04] respectively.
- Plates 5.40 and 5.41: Supplement the proposed landscape mitigation and represent a second option – Indicative Landscape Mitigation Plan Option B(ii), both North and South [REP6-054 Rev04]. The full drawings have been provided in Appendix 2.

Plate 5.40 – Indicative Landscape Mitigation Plan for Option B(i) (north) (not to scale). Indicative Landscape Mitigation Plan Option B(i) (north) [REP6-027 Rev04].

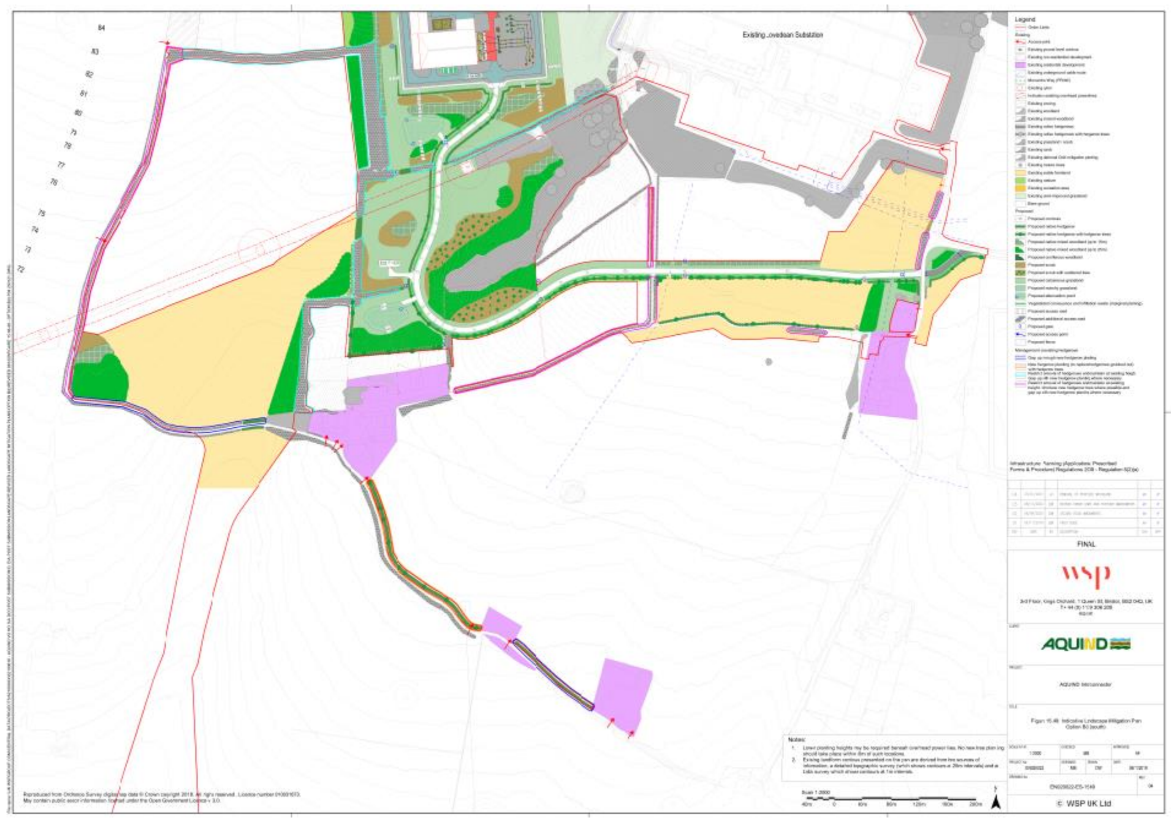


Plate 5.41 – Indicative Landscape Mitigation Plan for Option B(i) (south) (not to scale). Indicative Landscape Mitigation Plan Option B(i) (south) [REP6-028 Rev04].

Plate 5.42 – Indicative Landscape Mitigation Plan for Option B(ii) (north) (not to scale). Indicative Landscape Mitigation Plan Option B(ii) (north) [REP6-054 Rev04].

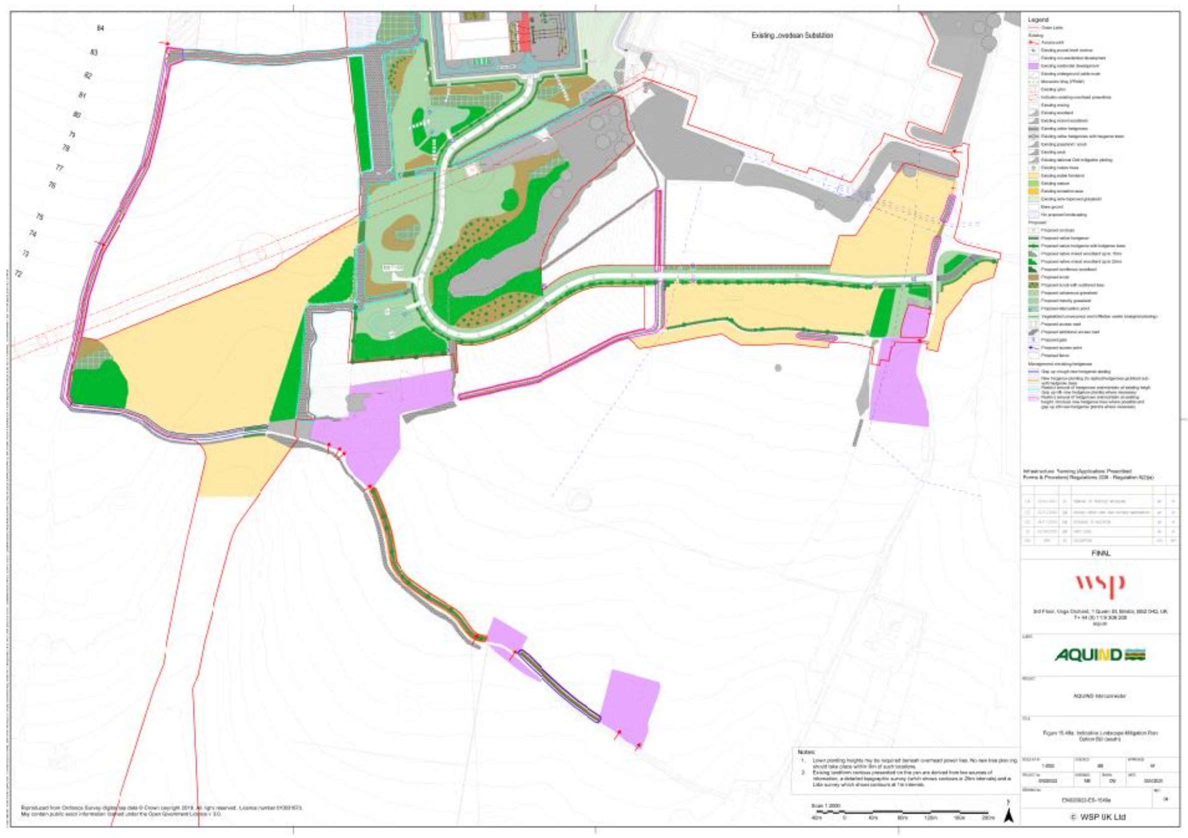


Plate 5.43 – Indicative Landscape Mitigation Plan for Option B(ii) (south) (not to scale). Indicative Landscape Mitigation Plan Option B(ii) (south) [[REP6-054 Rev04].

5.7.4. LANDSCAPING FOR EASTNEY (LANDFALL)

5.7.4.1. Whilst there would be no significant effects on the overall urban character area (UCA 10 – Eastney), given the size of this area, there would be localised effects on landscape features, namely the sense of openness and tranquillity. The ORS buildings, surrounding compound and associated security fencing would be prominent features in an otherwise open landscape.

5.7.4.2. Visual impacts would be experienced by immediate residents overlooking the structures and recreational users. The plan is to plant native trees, a native hedgerow and hedgerow trees, as part of the landscaping to screen the ORS buildings and associated compound which would enhance the biodiversity of the area and improve the visual landscape around the only permanent visual installation at the Landfall during the Operational Stage. This would reduce effects on residential and recreational receptors will reduce as landscape screening around the ORS buildings matures.

5.7.4.3. Plate 5.44 provides an illustration of the landscaping around the ORS and has been extracted from EN020022-000736-6.2.15.50 ES - Vol 2 - Figure 15.50 Indicative Landscape Mitigation (Landfall).

Plate 5.44 – Indicative Landscape Mitigation Plan at Landfall (not to scale) EN020022-000736-6.2.15.50 ES - Vol 2 - Figure 15.50 Indicative Landscape Mitigation (Landfall)

6. THE DESIGN PRINCIPLES

6.1. INTRODUCTION

6.1.1.1. The Design Principles are derived from the Consultation and Design Development processes described in the preceding Sections 4 and 5.

6.1.1.2. The Parameter Plans and Parameter Tables (which set the maximum dimensions for buildings and equipment) provide the 'envelope' for the built form of the Converter Station, Telecommunications Buildings, associated infrastructure, and ORS at the Landfall. The subsequent designs of these elements of the project will be developed within these parameters.

6.1.1.3. Requirements of the DCO require the submission of drawings showing how the Converter Station, associated infrastructure and the ORS will be constructed within the confines of the maximum parameter envelopes. These will be approved by the relevant discharging authority as provided for within the DCO.

6.2. THE CONVERTER STATION

6.2.1.1. The detailed design of the Converter Station, to be approved pursuant to a DCO Requirement, must in addition to being in accordance with the Parameter Plans and Parameter Table be in accordance with the following Design Principles and Landscaping Design Principles. Adherence to these principles will ensure that the detailed design for the Converter Station will satisfy the principles of 'good design' as required by NPS EN-1 and meet its functional and operational requirements whilst responding to its setting.

6.2.1. GENERAL PRINCIPLES

1. The site layout and design will meet the operational requirements of the Converter Station facility.
2. The design will seek to integrate the proposed Converter Station and associated infrastructure into the surrounding topography, as far as practicable within operational requirements and environmental constraints. In the event that earthwork cutting might expose Structured Chalk, the platform, construction methodologies and sequencing mitigation may require review. The construction methodologies, mitigation and management will accord with CIRIA Report C574
3. Where practicable and subject to environmental constraints the Converter Station construction platform would be cut into the hill slope to reduce the ridge level of the building.
4. The Converter Station buildings and associated above ground equipment will be contained within a secure compound, as depicted upon the Parameter Plans.
5. The Telecommunications Building(s) will be contained within a separate compound.
6. All HVDC Cables and the associated fibre optic cables from the Marine Cable Corridor to the Onshore Cable Corridor and Converter Station, as well as the HVAC Cables, will be buried and the land above re-instated on completion to minimise impact. There is a requirement for Link Boxes or Link Pillars approximately every 6 km for the Onshore Cable Route. Only the Link Pillars would be above ground and would measure approximately 1.0m x 1.0m x 0.6m
7. The access road will be designed and configured to allow maintenance access and include the movement of abnormal indivisible loads, whilst minimising environmental impact, including on the setting of the South Downs National Park. Permanent surfacing and landscaping will take account of the local context and be detailed in accordance with the 'Landscape Design Principles'
8. The design of the Converter Station will comply with building control requirements and generally follow the National Grid Technical Guidelines, including the design life of materials and components to meet its functional and operational needs relating to: structural stability; thermal and acoustic performance; fire safety; electrical safety; future maintenance; security and access for operation and maintenance. The operational needs for the Converter Station will include:
   - Appropriate operational space, including electrical and magnetic clearances, and space for maintenance and anticipated repair operations within the Converter Station.
   - Allowances for replacement of equipment in a timely manner to ensure minimal disruption or interruption to operation.
   - Dual perimeter security fencing with sterile zone to allow appropriate entry and exit provisions for workers and deter access by others.

6.2.2. BUILDING DESIGN PRINCIPLES

1. External cladding and roofing to the buildings will be pre-coated metal, or equivalent durable low-maintenance material which is of a high quality standard.
2. The wall cladding be comprised of narrow vertical elements of varied colours to break up the mass of the building and reduce its visual prominence.
3. Colours will be selected from a palette of contextual colours (which are primarily dark recessive colours) within the ranges below chosen to complement the surrounding landscape. A contextual study will be undertaken to review the colour ratios for each elevation from the below colour range. The roofing will be in a dark recessive non-reflective colour to minimise visual impact.

   RAL 8022; 6009; 8019; 6015; 6020; 6014; 7022; 7013; 8025; 6003; 1020;

RAL 8015; 8012; 7008; 6011; 7040; 1002; 1014; 7035[1]

4. Building massing will be designed to rationalise the different functions required and avoid visual clutter which could result from different sized buildings scattered across the site.
5. The Converter Station will be orientated on an east-west axis with the HVDC Cables entering the Valve Hall to the western side of the site, the Valve Hall and buildings of up to 26m in height being located to the western side of the site and the outdoor infrastructure, up to 15m in height, to the eastern side. The HVAC Cables exit the Converter Station site on the eastern boundary travelling towards Lovedean Substation further to the east.
6. Curved corners of the Converter Buildings will be included, to soften the visual impact and attention will be applied to relationships between the component parts of the main structures to add interest and further reduce the perceived mass of the building.
7. Lightning masts will be up to 30m in height (4.0m higher than the highest point/ridge of the Converter Buildings) and of a slender steel construction. They will be erected within the outdoor high voltage switchyard at suitable locations to protect the equipment from direct lightning strikes. In addition, lightning spikes, about 4 m in height, will be installed in the roof of the Converter Buildings to protect them from direct lightning strikes. The final location of the lightning masts and spikes on the building are subject to a detailed design, which will be undertaken by the supplier of the Converter Station.
8. There will be no plant on the roofs of the highest buildings.
9. The Converter Station will not be illuminated other than in exceptional circumstances such as upon activation of an intruder alarm or maintenance or repair operations.

6.2.3. LANDSCAPE DESIGN PRINCIPLES

1. The primary purpose of the proposed landscaping is to screen as far as possible and soften the impact of the Converter Station on its surroundings.
2. The proposals for landscaping will be developed and approved in accordance with the indicative landscape mitigation plans. A DCO Requirement will ensure that detailed designs, post consent, will be in accordance with those plans and the further design principles detailed below.
3. The design will seek to minimise the loss of existing vegetation of ecological, landscape character and / or screening value as far as practicable and will include management repair measures where appropriate with reference to the indicative landscape mitigation plan.
4. New planting will be introduced which is sympathetic to the surrounding landscape character and reflective of native species.
5. The biodiversity of the grassland at the Converter Station will be improved to achieve a species rich grassland.
6. Species rich woodland glades would be created within areas of new planting, taking into consideration soil types, seeding mixes and management regimes.
7. New woodland, scrub and hedgerow planting, within locations broadly indicated upon the indicative landscape mitigation plans, will be introduced within the Order Limits to provide appropriate screening from sensitive receptors, enhance landscape character, increase landscape and ecological connectivity and improve biodiversity.
8. Detailed landscaping proposals will include appropriate measures to maintain and enhance wildlife habitats and corridors wherever feasible.
9. Excess fill will be utilised in a sympathetic manner to create new naturalistic landforms and provide screening from sensitive receptors.
10. New planting will take place early in the construction programme where practicable, and where planting will not be affected by construction works.

6.2.4. LIGHTING DESIGN PRINCIPLES

1. The lighting scheme for the Converter Station Area will be developed in accordance with the SDNPA Technical Advice Note 2018, Dark Skies.

6.2.5. SURFACE WATER DRAINAGE AND AQUIFER CONTAMINATION MITIGATION STRATEGY

1. The design of the surface water drainage for the Converter Station Area will accord with the technical and design requirements of the Surface Water Drainage and Aquifer Contamination Mitigation Strategy. This forms Appendix 3 of this report.

6.2.6. SUSTAINABILITY PRINCIPLES

1. In response to climate change concerns the development approach will aspire to reduce the carbon footprint of the Proposed Development wherever feasible.
2. The Converter Station design will adopt sustainable approach to design which will involve the following measures:
   - Reducing where possible material and energy use in construction and

[1] (RAl is a universal colour system used for metal cladding and other building materials)

minimising the use of high carbon materials.

- Buildings should be energy and resource efficient, with the incorporation of material resource efficiency where practicable.

3. External building materials and finishes will have a design life of 20 years to first major maintenance.
4. The design of the Converter Station will seek to balance cut and fill of excavated earthworks in order to minimise the quantity of imported earthwork material and maximise the reuse of arisings.
5. The Converter Station will not be illuminated at night other than in exceptional circumstances such as upon activation of an intruder alarm or for maintenance or repair operations.
6. Drainage to only be installed where necessary to reduce the modification of surface water drainage patterns. Sustainable drainage design will be implemented wherever feasible.
7. The design development will be in accordance with the Resilience Design Principles set out in Table 6.1 below.

Table 6.1 - Resilience design principles within the design of the Converter Station

Receptor	Design Requirement	Potential impact addressed
Converter Station	Cooling systems will be required to remove heat generated within the Converter Station building. Power electronics equipment is to be housed indoors, within the two converter hall buildings. Auxiliary power supplies will be provided in the event of a power failure at the Converter Station to ensure continuity of operation. Back-up sources such as stand-by diesel generators will be only used if other sources of auxiliary supply are unavailable during construction and operational timescales. A Fire Prevention Procedure will be implemented and developed alongside the final design and implemented for operation.	Overheating of Converter Station buildings and equipment Risk of fire as a result of overheating Flooding of the converter station and supporting infrastructure, resulting in loss of supply
Access Road	Attenuation ponds are to be provided to capture surface water run-off from the Converter Station and Access Road. levels (See Appendix 20.1 (Flood Risk Assessment (‘FRA’)) of the ES Volume 3 (APP-439).	Increased surface water runoff Flooding of access road
Drainage	Attenuation ponds are to be provided to capture surface water run-off from the Converter Station and Access Road.	Drainage infrastructure overwhelmed leading to surface water flooding Increased surface runoff leading to surface water flooding and siltation
Structures	Given the topography of the Converter Station Area, bulk earthworks will be required to create a level platform of 84.8 m AOD. The buildings will likely be constructed of steel frame and cladding.	Flooding of the Converter Station site Deterioration of material structure and fabric Damage from high winds and rain-infiltration into surfaces and materials

6.3. THE TELECOMMUNICATIONS BUILDINGS AND OPTICAL REGENERATION STATION PRINCIPLES

6.3.1. DESIGN PRINCIPLES

1. The site layout and design will meet the operational requirements of the ORS and the telecommunications facilities.
2. The ORS and the Telecommunications Buildings will be contained within secure compounds, as depicted upon the Parameter Plans.
3. The design and land take for the ORS and the Telecommunications Buildings will be minimised as much as possible
4. The proposals for landscaping will be developed and approved in accordance with the illustrative landscape mitigation plans.
5. The ORS and Telecommunications Buildings will not be illuminated other than in circumstances such as upon activation of an intruder alarm or maintenance or repair operations.
6. The ORS and Telecommunications Buildings compounds are intended to be gravel or similar hardstanding surface.

6.3.1.1. The following specific design measures are embedded into the design of the ORS at Landfall to provide resistance and resilience to the risk of tidal flooding affecting the building, users and associated equipment (see Chapter 20 (Surface Water Resources and Flood Risk) of the ES Volume 1 (document reference 6.1.20) for further information):

- The ORS will include a raised external threshold to 0.95 m above existing ground level; and
- Electrical equipment within the ORS will be raised internally by 300 mm.

6.4. THE ONSHORE CABLE CORRIDOR PRINCIPLES

6.4.1. CABLE DEPTH

6.4.1.1. The cable burial depth within the highway will be consistent with the depth specified in NGTS 357 and ENA TS 09-02.

6.4.2. HORIZONTAL DIRECTIONAL DRILLING (HDD)/MICROTUNNELLING

6.4.2.1. HDD must be used for the purpose of passing under:

- Denmead Meadows (HDD-5);
- Langstone Harbour (HDD-3);
- Sea Defences at Milton Common (HDD-6);
- Eastney and Milton Allotments (HDD-2); and
- Eastney Beach (HDD-1)

6.4.2.2. Trenchless microtunnelling is to be used to install the cable under the Brighton to Southampton Railway Line (HDD-4)

6.4.2.3. The detailed design of HDD-1 and HDD-2 will be informed by the invert level of Southern Water's Eastney to Budd Farm Rising Main when established.

6.4.2.4. The detailed design of HDD-3 will be informed by the location of the A27 piles when established.

6.4.2.5. The detailed design of HDD-5 is to be designed to avoid creating a pathway between the overburden and the underlying Chalk Aquifer.

6.4.2.6. The detailed design of HDD-6 is to be informed by additional ground investigation.

6.4.3. JOINT BAYS

6.4.3.1. Joint Bays should be located beyond the carriageway of the highway unless such a location is unavoidable. Where unavoidable, joint bays must be sited where their construction involves no greater constraint on the operation of the highway than traffic management associated with the laying of the Onshore Cable in the same location permissible in accordance with the Framework Traffic Management Strategy

6.4.3.2. Joint Bays should also be located to avoid the playing surfaces of existing playing pitches where practicable.

6.4.4. MAIN RIVERS, WATERCOURSES AND FLOOD DEFENCES

6.4.4.1. A number of Main River and Ordinary Watercourse crossings are located within the Order Limits as detailed in ES Appendix 20.3 (Watercourses Summary) (APP-308).

6.4.4.2. Disruption of Main Rivers and Ordinary Watercourses located within the Order Limits is to be avoided in the detailed design by ensuring that all installed ducts do not pass through watercourses with appropriate clearances to the watercourse (e.g. pass under the watercourse or pass over the watercourse if it is confined to a culvert or similar).

6.4.4.3. The overall principles of the Onshore Cable Corridor and ducting crossing watercourses will be subject to an Ordinary Watercourse Consent or Flood Risk Activities Permit and in principle, any works would need to ensure that: watercourse flow is maintained, there is no increase to the local flood risk, and appropriate pollution prevention measures are in place.

6.4.4.4. Any temporary or permanent works over, under or directly adjacent to watercourses/watercourse structures (culvert/sewer) and flood defences will be designed so as to ensure that the integrity and function of any such watercourse, structure or defence is not adversely affected.

6.4.4.5. The design of the Onshore Cable Corridor will avoid works to existing or proposed coastal flood defence and where appropriate HDD or Trenchless techniques are to be used to pass under the coastal flood defences.

6.4.4.6. Use of HDD/ Trenchless techniques are proposed at open watercourses, including crossing of:

- Soake Farm East (Main River) [WC.02] – Kings Pond HDD-5;
- Farlington Marshes Gutter (Ordinary Watercourse) [WC.11] – Farlington Railway Crossing Trenchless HDD-4; and
- Broom Channel (Main River/ Transitional/ Tidal Watercourse) [WC.13] – Langstone Harbour HDD-3.

6.4.4.7. Use of HDD/ Trenchless techniques are proposed to cross under coastal flood defences, including crossing of:

- Broom Channel Coastal Flood Defences – HDD-3, and
- Milton Common Coastal Flood Defences – HDD-6

6.4.4.8. Use of open trench techniques are proposed over culverted watercourses, including crossing of:

- Unnamed (Ordinary Watercourse) [WC.03] – Carriageway Culvert/ Sewer;
- Old Park Farm (Main River) [WC.04] – Carriageway Culvert;
- Unnamed (Ordinary Watercourse) [WC.05] – Carriageway Culvert/ Sewer;
- Unnamed (Ordinary Watercourse) [WC.06] – Carriageway Culvert/ Sewer;
- Unnamed (Ordinary Watercourse) [WC.08] – Carriageway Culvert/ Sewer;
- North Purbrook Heath (North) (Main River) [WC.09] –Carriageway Culvert; and
- Great Salterns Drain (Main River) [WC.14] –Carriageway Culvert.

6.4.4.9. Other minor ditches and dry watercourses, also defined as Ordinary Watercourses, have not been individually identified at this stage and will depend on the exact alignment of the Onshore Cable Route; however, it is anticipated that a number of additional Ordinary Watercourse crossings may be required within the Onshore Cable Corridor and may include ditches to the side of roads and extreme weather overland flow routes that are typically dry known as 'winterbourne or dry watercourse'. Due to the limited nature and scale of these watercourses open trench techniques may be used with appropriate temporary works to install ducting under these open channel watercourses and will need to conform with the same overarching principles and requirements noted above in 6.4.4.2 & 6.4.4.3

6.4.5. NOISE

6.4.5.1. Mitigation in the form of screening will be designed for those Joint Bay locations where the works are predicted to have more than a negligible impact at surrounding receptors. The mitigation shall achieve at least 5dB attenuation. Such screening will also be provided for all HDD compounds.

6.4.6. TREES

6.4.6.1. The detailed design of the Cable Corridor will ensure that tree loss occurs only when it is unavoidable. The detailed design should ensure that Root Protection Areas (RPAs) are avoided where practicable, and where unavoidable, shall include measures to avoid major route damage in accordance with BS 5837. Where it is not possible to avoid trees, the design will give priority to avoiding higher value (Category A and B trees).

6.4.7. SUSTAINABILITY PRINCIPLES

6.4.7.1. The design development for the Onshore Cable Corridor will be in accordance with the Resilience Design Principles set out in Table 6.2 below.

Table 6.2 - Resilience design principles within the design of the Onshore Cable Corridor

Receptor	Design features	Potential impact addressed
Onshore Cable Corridor	The Onshore Cables will be buried in cable ducts The AC cables may be installed alongside an Earth Continuity Conductor, an insulated metallic conductor to provide a path to earth for any fault currents.	Reduction in the ability of the ground to conduct heat away from underground cables during high temperatures UV degradation of exposed cabling equipment Lightning strike
	Link boxes / HVDC joints / Terminations will be fully sealed to water ingress damage.	Damage due to flooding
Drainage	Soil bunds are to be seeded to prevent surface runoff across the site, which otherwise might erode or impact on exposed soil and stockpiles, to carry suspended solids in the runoff. Silt fencing, dams, cut off ditches, settlement ponds or proprietary settlement equipment (e.g. Silt buster) are to be used to prevent water pollution entering watercourses/ and surface water drains.	Drainage infrastructure overwhelmed Increased surface water runoff
Structures	ORS buildings have been designed to a level above flood levels (See Appendix 20.1 (Flood Risk Assessment ('FRA')) of the ES Volume 3 (APP-439).	Reduction of earthwork stability due to sea level rise and flooding Increased rate of deterioration of materials
	The shore landing ducts, installed by HDD will run from 250 m inland to approximately 1000 m offshore, passing below the beach at a depth of 15-20 m, so costal erosion is not expected to affect the Onshore HVDC Cable Corridor.	

7. ILLUSTRATIVE DESIGNS WHICH COMPLY WITH THE DESIGN PRINCIPLES

7.1.1.1. The indicative illustrations of examples of design approaches in this section are presented to show how the Design Principles in Section 6 have been implemented.

7.1.1.2. Detail design development will be subject to a formal application and approval process with the relevant Local Authorities

7.2. THE CONVERTER STATION GENERAL PRINCIPLES

1. “The site layout and design will meet the operational requirements of the Converter Station facility”.
   - The indicative plan (Plate 7.1) shows an example of the distribution of buildings and above ground apparatus to meet operational requirements, within the site compound identified on Parameter Plans

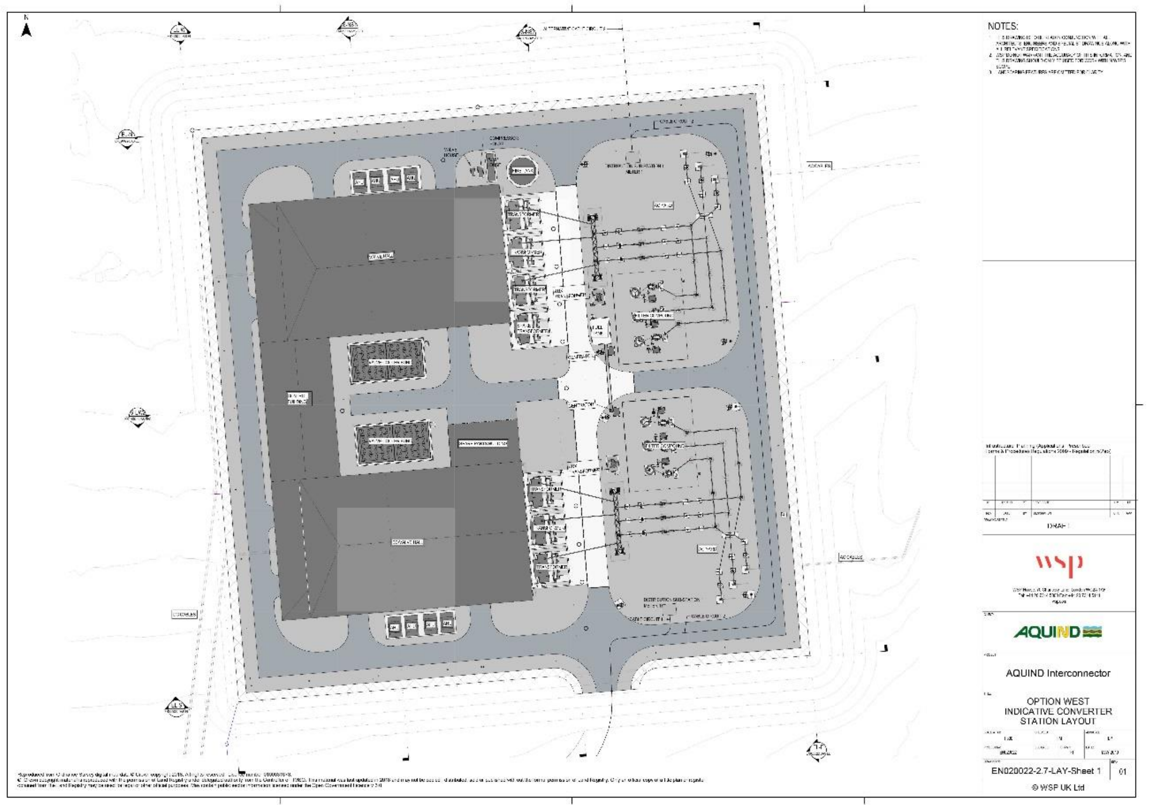


Plate 7.1 Option West Indicative Converter Station Layout

2. “The design will seek to integrate the proposed Converter Station and associated infrastructure into the surrounding topography, as far as practicable within operational requirements and environmental constraints.”
   - The illustrative layout (Plate 7.2) below shows the indicative proposed relationship between the Converter Station compound and access road and existing features, the compound is sited to avoid impact on the area of ancient woodland to the south, and the access road is routed around it.

Plate 7.2 Indicative Converter Station Layout Plan

3. “The Converter Buildings and associated above ground equipment will be contained within a secure compound, as depicted upon the Parameter Plans.”
   - The illustrative plan on the left shows the compound around the Converter Station buildings and equipment, the dual perimeter fence is represented by the light grey border around the compound.
4. “The access road will be designed and configured to allow maintenance access and include the movement of abnormal indivisible loads, whilst minimising environmental impact including on the setting of the South Downs National Park. Permanent surfacing and landscaping will take account of the local context and be detailed in accordance with the ’Landscape Design Principles’

- The indicative landscape mitigation plans (REP6-027 Rev04, REP06-028 Rev04 and REP06-054 Rev00 as well as Plate 7.3 and 7.4) shows how the access road can be routed to avoid the existing ancient woodland ('B' on the plan) and additional landscaping mitigation measures (in shades of green and brown). These proposals are explained in more details in the updated OLBS.

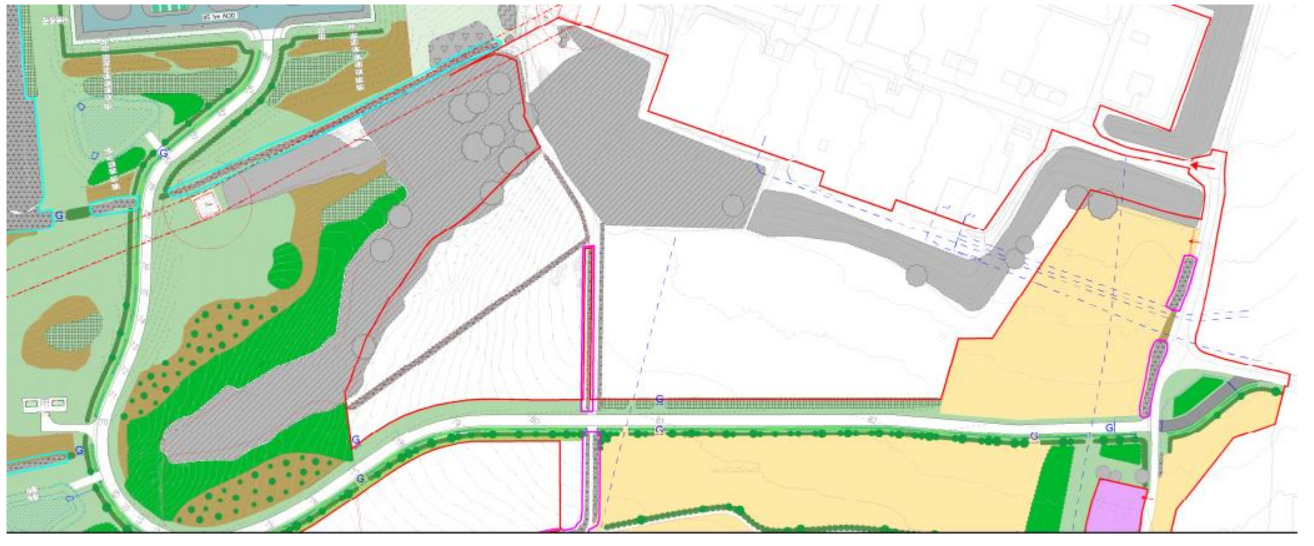


Plate 7.3 Indicative landscape plan Option B(i) (North)

Plate 7.4 Indicative landscape plan Option B(i) (South)

7.3. THE CONVERTER STATION BUILDING DESIGN PRINCIPLES

1. "External cladding and roofing to the buildings will be pre-coated metal, or equivalent durable low-maintenance material which is of a high quality standard".
2. "The wall cladding be comprised of narrow vertical elements of varied colours to break up the mass of the building and reduce its visual prominence".
3. "Colours will be selected from a palette of contextual colours (which are primarily dark recessive colours) within the ranges below chosen to complement the surrounding landscape. A contextual study will be undertaken to review the colour ratios for each elevation from the below colour range. The roofing will be in a dark recessive non-reflective colour to minimise visual impact.

   RAL 8022; 6009; 8019; 6015; 6020; 6014; 7022; 7013; 8025; 6003; 1020;

   RAL 8015; 8012; 7008; 6011; 7040; 1002; 1014; 7035"

Plate 7.5 Photomontage from Local Viewpoint B

4. "Building massing will be designed to rationalise the different functions required and avoid visual clutter which could result from different sized buildings scattered across the site".

- The indicative sections (Plate 7.6) show how the different functions of the Converter Station can be housed in a set of interconnected buildings

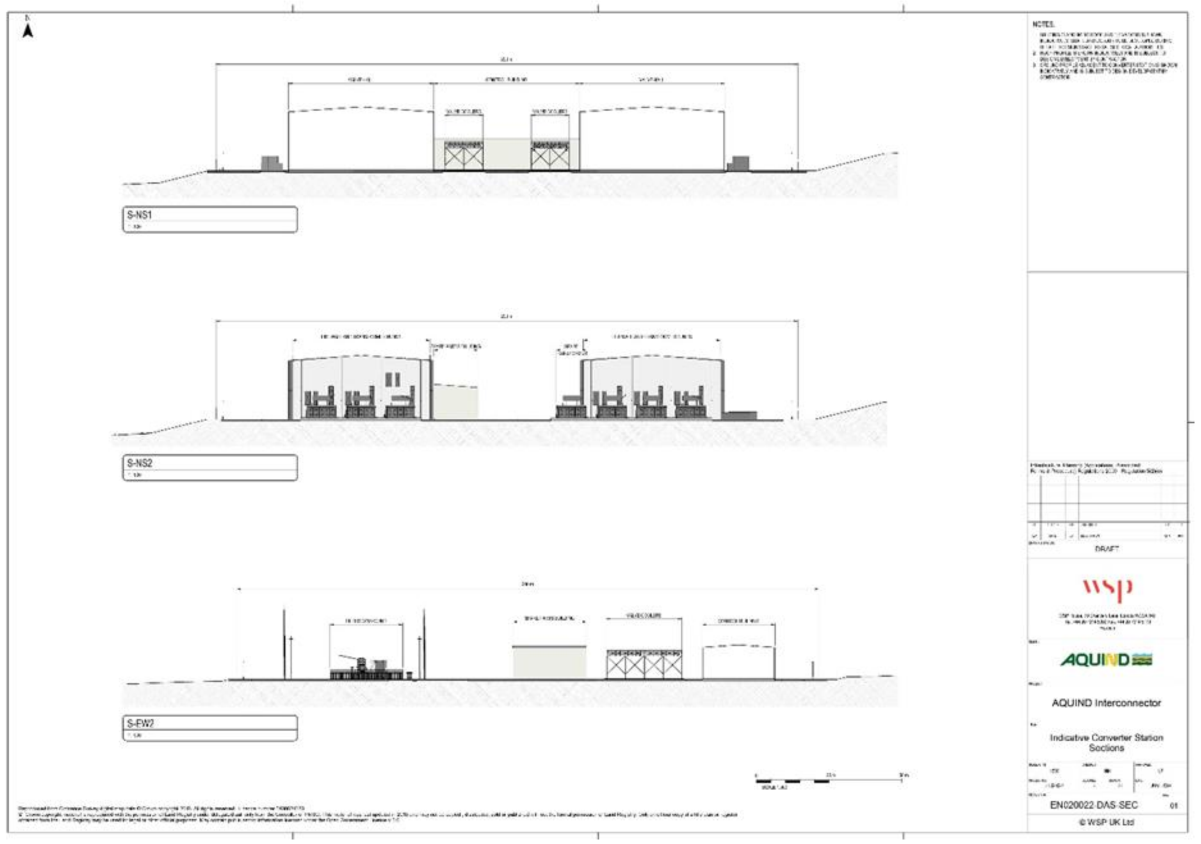


Plate 7.5 Indicative Converter Station Sections

5. "The Converter Station will be orientated on an east-west axis with the HVDC Cables entering the Valve Hall to the western side of the site, the Valve Hall and buildings of up to 26m in height being located to the western side of the site and the outdoor infrastructure, up to 15m in height, to the eastern side. The HVAC Cables exit the Converter Station site on the eastern boundary travelling towards Lovedean Substation further to the east."

   - Plate 7.7 shows the Converter Station compound (defined by the green dashed line) aligned on an east-west axis. The HVDC Cables will enter from the West, HVAC Cables will exit from the East to connect to the Lovedean substation to the West. The higher buildings (up to 26m high) are located in the West part of the compound (shown by dark brown shading), external apparatus (up to 15m high) is located in the East part of the compound (shown by lighter brown shading)

Plate 7.6 Converter Station compound aligned on east-west axis

6. "Curved corners of the Converter Buildings will be included, to soften the visual impact and attention will be applied to relationships between the component parts of the main structures to add interest and further reduce the perceived mass of the building"

- The indicative image (Plate 7.8) shows how curved corners can soften the visual impact

Plate 7.7 Photomontage from Local Viewpoint B

7. "Lightning masts will be up to 30m in height (4.0m higher than the highest point/ridge of the Converter Building) and of a slender steel construction. They will be erected within the outdoor high voltage switchyard at suitable locations to protect the equipment from direct lightning strikes. In addition, lightning spikes, about 4m in height, will be installed on the roof of the Converter Buildings to protect them from direct lightning strikes. The final location of the lightning masts and spikes on the building are subject to a detailed design, which will be undertaken by the supplier of the converter station."

- The indicative elevation (Plate 7.9) shows potential lightning masts (the two high structures on the left of the image) in relation to the heights of the Converter Station buildings

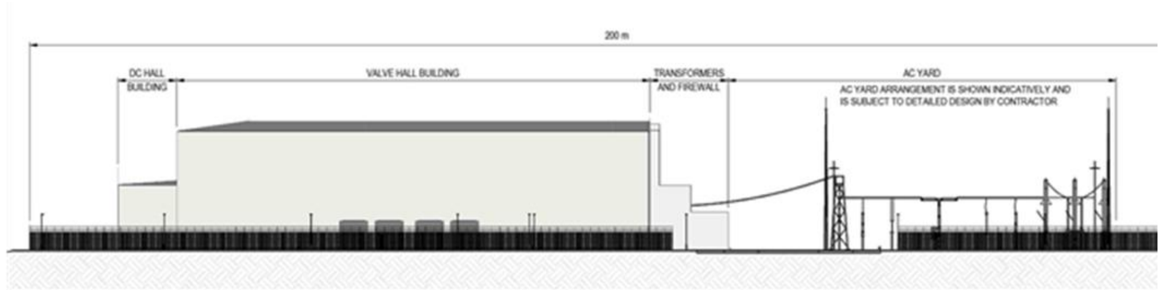


Plate 7.8 Indicative elevation

7.4. LANDSCAPE DESIGN PRINCIPLES

1. "The primary purpose of the proposed landscaping is to screen as far as possible and soften the impact of the Converter Station on its surroundings."
2. "The proposals for landscaping will be developed and approved in accordance with the indicative landscape mitigation plans. A DCO Requirement will ensure that detailed designs, post consent, will be in accordance with those plans and the further design principles detailed below."
3. "The design will seek to minimise the loss of existing vegetation of ecological, landscape character and / or screening value as far as practicable and will include management repair measures where appropriate with reference to the indicative landscape mitigation plan".
4. "New planting will be introduced which is sympathetic to the surrounding landscape character and reflective of native species. "
5. "The biodiversity of the grassland at the Converter Station will be improved to achieve a species rich grassland."
6. "Species rich woodland glades would be created within areas of new planting, taking into consideration soil types, seeding mixes and management regimes".
7. "New woodland, scrub and hedgerow planting, within locations broadly indicated upon the indicative landscape mitigation plans, will be introduced within the Order Limits to provide appropriate screening from sensitive receptors, enhance landscape character, increase landscape and ecological connectivity and improve biodiversity".
   - The illustrative landscape mitigation plans (Plate 7.10 and 7.11) show how the designs have sought to maximise the retention of existing vegetation with Option B(ii) proposed to aid the retention of a greater amount of existing vegetation. Where vegetation is retained the indication landscape mitigation plans look to add to and enhance this vegetation, such as the ancient woodland buffer to the south east of the converter station. The plans also show the creation of species rich woodland glades and new woodland, scrub and hedgerow planting.

Plate 7.9 Illustrative Landscape Mitigation Option B (ii) –North section

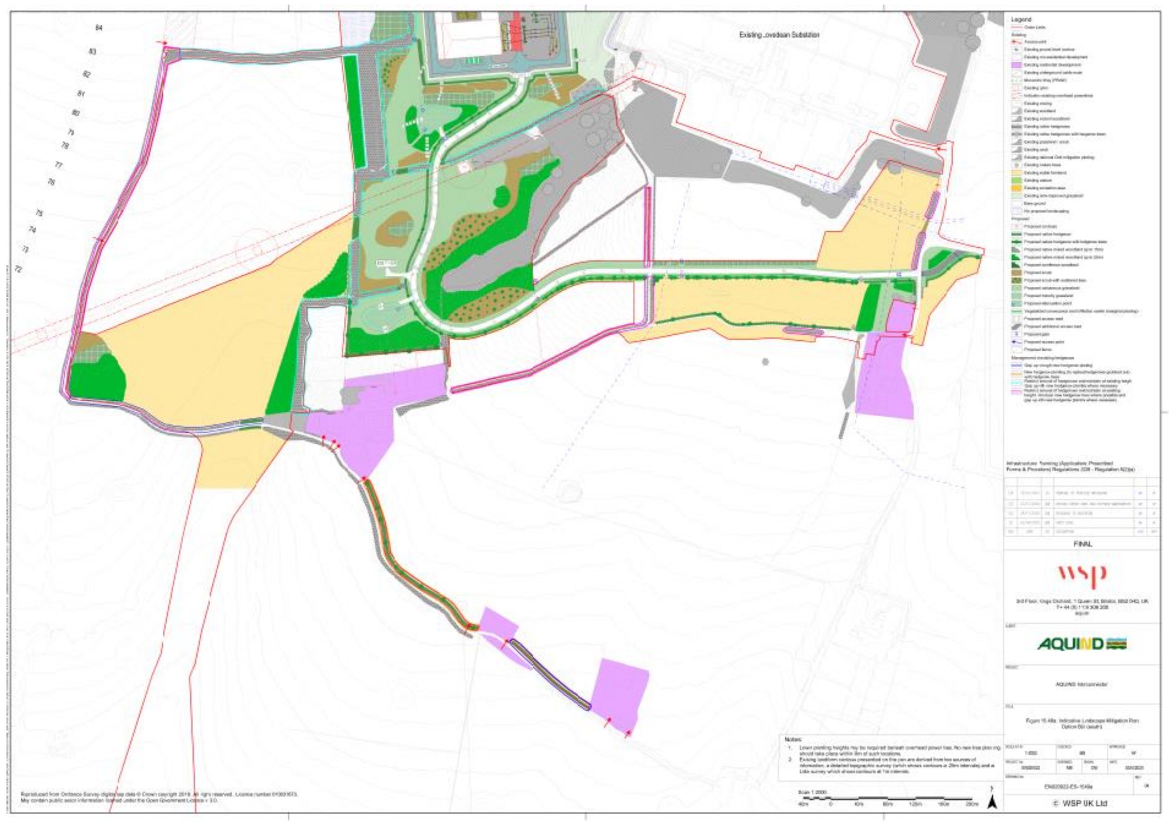


Plate 7.10 Illustrative Landscape Mitigation Option B (ii) –South section

8. “Detailed landscaping proposals will include appropriate measures to maintain and enhance wildlife habitats and corridors wherever feasible. “
9. “Excess fill will be utilised in a sympathetic manner to create new naturalistic landforms and provide screening from sensitive receptors.”
10. “New planting will take place early in the construction programme where practicable, and where planting will not be affected by construction works.”

7.5. OPTICAL REGENERATION STATION DESIGN PRINCIPLES

1. “The site layout and design will meet the operational requirements of the ORS and the telecommunications facilities”.
2. “The ORS and the Telecommunications Buildings will be contained within secure compounds, as depicted upon the Parameter Plans”.
3. “The design and land take for the ORS and the Telecommunications Buildings will be minimised as much as possible”.
4. The indicative location plan (Plate 7.12) shows the scale and layout of the Optical Regeneration Station in relation to the surrounding landscape

5. “The proposals for landscaping will be developed and approved in accordance with the illustrative landscape mitigation plans”.
   - Plate 7.13 illustrates indicative landscape mitigation proposals

Plate 7.11 ORS Location Plan

Plate 7.12 ORS Landscape Mitigation

6. The ORS and Telecommunications Buildings will not be illuminated other than in exceptional circumstances such as upon activation of an intruder alarm or maintenance or repair operations.
7. The ORS and Telecommunications Buildings compounds are intended to be gravel or similar hardstanding surface.

8. COMPLIANCE OF THE DESIGN APPROACH WITH DESIGN PRINCIPLES AND LEGISLATIVE POLICY AND GUIDANCE

8.1.1.1. The following table summarises compliance of the illustrative design approach with the Design Principles and Legislative Policy and Guidance.

Table 8.1 – Compliance of Design Approach with the Design Principles and Legislative Policy and Guidance.

CONVERTER STATION		
GENERAL PRINCIPLES		
Design Principle	**How it may be met in the illustrative design**	**NPS policy adhered to and relevant local policy**
1. The site layout and design will meet the operational requirements of the Converter Station facility.	Buildings and above ground apparatus will be designed to meet operational requirements and located within the site compound identified on Parameter Plans.	Takes into account functionality including fitness for purpose (NPS EN-1, Para 4.5.1).
2. The design will seek to integrate the proposed Converter Station and associated infrastructure sympathetically into the surrounding topography, as far as practicable within operational requirements and environmental restraints.	The illustrative layout plans show the indicative proposed relationship between the Converter Station compound and access road and existing features. The compound is sited to avoid impact on the area of ancient woodland to the south, and the access road is routed around it.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3). Connects new development seamlessly to surrounding development in terms of layout, scale, form, enclosure, space and materials (WCC LPP1, Para 9.15) Minimises the impact of the apparatus and any associated development by appropriate routing, siting, materials and colour (WCC LPP2, Policy DM22 (ii))
3. Where practicable and subject to environmental constraints the Converter Station construction platform will be cut into the hill slope to reduce the ridge level of the building.	It is proposed that the compound platform will be cut into that existing slope as much as possible, within geological and site constraints.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3). The built and natural environment should be naturally integrated (WCC LPP1, Para 9.15)
4. The Converter Buildings and associated above ground equipment will be contained within a secure compound, as depicted upon the Parameter Plans.	The illustrative plans include a compound around the Converter Station buildings and equipment, with a dual security fence to the perimeter.	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3).
5. The Telecommunications Buildings will be contained within a separate compound.	The telecommunications compound will be located within the order limits, accessed from the access road serving the Converter Station (refer to Parameter Plans)	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
6. All HVDC Cables and the associated Fibre Optic Cables from the Marine Cable Corridor to the Converter Station, as	Cables will be buried as stated	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3).

well as the HVAC Cables, will be buried with the land above re-instated on completion to minimise impact. There is a need for Link Boxes or Link Pillars every 6 km for the Onshore Cable Route. Only the Link Pillars would be above ground and would measure approximately 1.0m x 1.0m x 0.6m.		Good design in terms of use siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
7. The access road will be designed and configured to allow maintenance access and include the movement of abnormal indivisible loads, whilst minimising environmental impact **including on the setting of the South Downs National Park**. Permanent surfacing and landscaping will take account of the local context and be detailed in accordance with the 'Landscape Design Principles'.	The indicative landscape mitigation plans [APP-281 and APP-282] show how the Access Road can be routed to avoid the existing ancient woodland ('B' on the plan) and additional landscaping mitigation measures (in shades of green and brown) (These proposals are explained in more details in the indicative landscape mitigation plans)	Good design in terms of siting relative to existing landscape character (NPS EN-1, Para 4.5.3) Demonstrates that an analysis of the constraints and opportunities of the site and its surroundings have informed the principles of design (WCC LPP1, Policy CP13)
8. The design of the Converter Station will comply with building control requirements and generally follow the National Grid Technical Guidelines, including the design life of materials and components to meet its functional and operational needs relating to: structural stability; thermal and acoustic performance; fire safety; electrical safety; future maintenance; security and access for operation and maintenance. The operational needs for the Converter Station will include: - Appropriate operational space, including electrical and magnetic clearances, and space for maintenance and anticipated repair operations within the Converter Station. - Allowances for replacement of equipment in a timely manner to ensure minimal disruption or interruption to operation. - Dual perimeter security fencing with sterile zone to allow appropriate entry and exit provisions for workers and deter access by others.	The detailed design will be developed to comply with the Design Principle.	Reflects the limited choice in the physical appearance of some energy infrastructure (NPS EN1, Para 4.5.3). Responds to the functionality of the object as equally as important as aesthetic considerations (NPS EN-1, Para 4.5.1)
BUILDING DESIGN PRINCIPLES		
1. External cladding and roofing to the buildings will be pre-coated metal, or equivalent durable low-maintenance material which is of a high quality standard. 2. The wall cladding be comprised of narrow vertical elements of varied colours to break up the mass of the building and reduce its visual prominence. 3. Colours will be selected from a palette of contextual colours (which are primarily dark recessive colours) within	The illustrative designs developed show narrow vertical pre-coated metal elements of varied colours using a palette of colours derived from the ranges defined in the Design Principle: RAL 8022; 6009; 8019; 6015; 6020; 6014; 7022; 7013; 8025; 6003; 1020; RAL 8015; 8012; 7008; 6011; 7040; 1002; 1014; 7035	Applies good design sensitive to place (NPS EN-1, Para 4.5.1). Demonstrates regard to both functionality and aesthetics (NPS EN-1, Para 4.5.3) Demonstrates that energy infrastructure developments are as attractive, durable and adaptable as they can be (NPS EN-1, Para 4.5.3) An individual design response will be determined by the local context (WCC LPP1, Para 9.15)

the ranges below chosen to complement the surrounding landscape. A contextual study will be undertaken to review the colour ratios for each elevation from the below colour range. The roofing will be in a dark recessive non-reflective colour to minimise visual impact. RAL 8022; 6009; 8019; 6015; 6020; 6014; 7022; 7013; 8025; 6003; 1020; RAL 8015; 8012; 7008; 6011; 7040; 1002; 1014; 7035"		Minimises the impact of the apparatus and any associated development by appropriate routing, siting, materials and colour (WCC LPP2, Policy DM22 (ii))
4. Building massing will be designed to rationalise the different functions required and avoid visual clutter which could result from different sized buildings scattered across the site.	The different functions of the Converter Station can be housed in a set of interconnected buildings.	Demonstrates regard to both functionality and aesthetics (NPS EN-1, Para 4.5.3) Building massing reflects the limited choice in the physical appearance of some energy infrastructure (NPS EN-1, Para 4.5.3)
5. The Converter Station will be orientated on an east-west axis with the HVDC Cables entering the Valve Hall to the western side of the site, the Valve Hall and buildings of up to 26m in height being located to the western side of the site and the outdoor infrastructure, up to 15m in height, to the eastern side. The HVAC Cables exit the Converter Station site on the eastern boundary travelling towards Lovedean Substation further to the east.	The Parameter Plans establish that the Converter Station compound will be aligned on an east-west axis. The HVDC Cables will enter from the West, HVAC Cables will exit from the East to connect to the Lovedean substation to the West. The higher buildings (up to 26m high) are located in the West part of the compound, external apparatus (up to 15m high) is located in the East part of the compound.	Building massing reflects the limited choice in the physical appearance of some energy infrastructure (NPS EN-1, Para 4.5.3) Good design in terms of use siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
6. Curved corners of the Converter Buildings will be included, to soften the visual impact and attention will be applied to relationships between the component parts of the main structures to add interest and further reduce the perceived mass of the building.	Initial exploration of technical design and space requirements has established that curved corners can be incorporated	Demonstrates consideration of good aesthetic as far as possible (NPS EN-1, Para 4.5.1)
7. Lightning masts will be up to 30m in height (4.0m higher than the highest point/ridge of the Converter Building) and of a slender steel construction. They will be erected within the outdoor high voltage switchyard at suitable locations to protect the equipment from direct lightning strikes. In addition, lightning spikes, about 4m in height, will be installed on the roof of the Converter Buildings to protect them from direct lightning strikes. The final location of the lightning masts and spikes on the building are subject to a detailed design, which will be undertaken by the supplier of the converter station.	The final location of lightning masts will be established by detailed design and application of the relevant code.	Reflects a functional requirement of the type of infrastructure (NPS EN-1, Para 4.5.1)
8. There will be no plant on the roofs of the highest buildings.	HVAC plant will be located at low level or within the buildings	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)

		Demonstrates consideration of good aesthetic as far as possible (NPS EN-1, Para 4.5.1) Minimises the impact of the apparatus and any associated development by appropriate routing, siting, materials and colour (WCC LPP2, Policy DM22 (ii))
9. The Converter Station will not be illuminated other than in exceptional circumstances such as upon activation of an intruder alarm or maintenance or repair operations.	There will be no external lighting, other than upon activation of an intruder alarm or maintenance or repair operations	Developments should not have an unacceptable effect on the rural tranquillity of the area, including the introduction of lighting or noise (WCC LPP2, Policy DM23)
LANDSCAPE DESIGN PRINCIPLES		
1. The primary purpose of the proposed landscaping is to screen as far as possible and soften the impact of the Converter Station on its surroundings.	The indicative landscape mitigation plans illustrate the designs that have sought to maximise the retention of existing vegetation to serve a visual screening function with consideration given to the location of new planting alongside measures to lower site levels to minimise the visual impact of the Converter Station.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3) Developments should respect the qualities, features and characteristics that contribute to the distinctiveness of the local area (WCC LPP2, Policy DM15)
2. The proposals for landscaping will be developed and approved in accordance with the indicative landscape mitigation plans. A DCO Requirement will ensure that detailed designs, post consent, will be in accordance with those plans and the further design principles detailed below.	Requirements 6 and 7 or the DCO [APP-019] set out the need for detailed landscaping scheme to be approved before the commencement of Work Number 2,5 and 6.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3) Good design should produce sustainable infrastructure sensitive to place (NPS EN-1, Para 4.5.1) Where appropriate, a satisfactory landscaping/restoration scheme is included (WCC LPP2, Policy DM22 (v))
3. The design will seek to minimise the loss of existing vegetation of ecological, landscape character and / or screening value as far as practicable and will include management repair measures where appropriate with reference to the indicative landscape mitigation plans.	The indicative landscape mitigation plans illustrate the designs that have sought to maximise the retention of existing vegetation with option B (ii) proposed to aid the retention of a greater amount of existing vegetation. Where vegetation is retained the indication landscape mitigation plans look to add to and enhance this vegetation, such as the ancient woodland buffer to the south east of the converter station. With regards to the ORS facility there is no existing vegetation to be retained but the indicative landscape mitigation plan makes provision for native hedgerow, hedgerow trees and grassland.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3) Emphasis should be given to conserving recognised built form and designed or natural landscape (WCC LPP1, Policy CP20) Developments should respect the qualities, features and characteristics that contribute to the distinctiveness of the local area (WCC LPP2, Policy DM15)
4. New planting will be introduced which is sympathetic to the surrounding landscape character and reflective of native species.	The OLBS sets out the proposed planning schedules, including native species, for the Converter Station Area and the Landfall.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)

		Developments should respect the qualities, features and characteristics that contribute to the distinctiveness of the local area (WCC LPP2, Policy DM15)
5. The biodiversity of the grassland at the Converter Station will be improved to achieve a species rich grassland.	It is proposed that a suitable seed mix of a local provenance is introduced.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)
6. Species rich woodland glades would be created within areas of new planting, taking into consideration soil types, seeding mixes and management regimes.	This is reflected within the indicative landscape mitigation plans for the Converter Station.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)
7. New woodland, scrub and hedgerow planting, within locations broadly indicated upon the indicative landscape mitigation plans, will be introduced within the Order Limits to provide appropriate screening from sensitive receptors, enhance landscape character, increase landscape and ecological connectivity and improve biodiversity.	This is reflected within the indicative landscape mitigation plans for the Converter Station.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)
8. Detailed landscaping proposals will include appropriate measures to maintain and enhance wildlife habitats and corridors wherever feasible.	The OLBS demonstrated how landscape features and biodiversity have been considered in designing the indicative landscape mitigation plans. Requirements in the DCO will ensure this is carried through to the detailed design stage through detailed landscaping schemes.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)
9. Excess fill will be utilised in a sympathetic manner to create new naturalistic landforms and provide screening from sensitive receptors.	The indicative landscape mitigation plans indicate the type and form of landforms that are proposed, to the north and south of the Converter Station.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)
10. New planting will take place early in the construction programme where practicable, and where planting will not be affected by construction works.	It is the aspiration of the Project to establish as much planting as practicable, as early as practicable in the construction programme.	Demonstrates good design in terms of siting relative to existing landscape character, landform and vegetation (NPS EN-1, Para 4.5.3)
LIGHTING DESIGN PRINCIPLES		
1. The lighting scheme for the Converter Station Area will be developed in accordance with the SDNPA Technical Advice Note 2018, Dark Skies. 2. Angle lights downwards – no unnecessary light above or near the horizontal; 3. Lamps above 500 lumens should be installed in dark sky friendly fixtures that prevent unnecessary upward light;	The design will include the level of lighting, angle of lighting fixtures and operation plans for the lighting across the converter station to meet the minimum lighting requirements.	Good design should produce sustainable infrastructure sensitive to place (NPS EN-1, Para 4.5.1) Impacts of the development should be kept to a minimum and at a level that is acceptable (NPS EN-1, Para 5.6.3) Developments should conserve and enhance the intrinsic quality of dark skies and demonstrate that all opportunities to reduce light pollution have been taken, including the introduction of lighting or noise (WCC LPP2, Policy DM23) (SDNPA LP, Policy SD8 and SD54).

4. Point where the light is needed not in a direction that causes a nuisance to neighbours or wildlife; 5. Switch off lighting when not needed. Consider the use proximity sensors and avoid dusk-till-dawn sensors; 6. Light to the appropriate illuminance; **7.** Avoid bright white and cooler temperature LED's; and Install at the lowest possible height to achieve required lighting levels.		
SURFACE WATER DRAINAGE AND AQUIFER CONTAMINATION		
The design of the surface water drainage for the Converter Station Area will accord with the technical and design requirements of the Surface Water Drainage and Aquifer Contamination Strategy (Appx 3 to this document)	This is reflected within the surface water drainage and aquifer contamination mitigation strategy for the Converter Station.	The proposed flood risk mitigation resilience has been developed in accordance with NPS-EN1 Part 5.7 and Para 5.7.5.
SUSTAINABILITY PRINCIPLES		
1. In response to climate change concerns the development approach will aspire to reduce the carbon footprint of the Project wherever feasible.	This is reflected in the Construction Environmental Management Plan and engineering specifications adopted for the Converter Station.	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
2. The Converter Station design will adopt sustainable approach to design which will involve the following measures: ▪ Reducing where possible material use in construction and minimising the use of high carbon materials. ▪ Buildings should be energy and resource efficient.	This is reflected in the Construction Environmental Management Plan, Waste Management Plan and engineering specifications adopted for the Converter Station.	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
3. External building materials and finishes will have a design life of 20 years to first major maintenance.	Cladding materials and other external building materials in the illustrative design are developed from commercially available products which do not require major maintenance for the first 20 years.	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
4. The design of the Converter Station will seek to balance cut and fill of excavated earthworks in order to minimise the quantity of imported earthwork material and maximise the reuse of arisings.	It is the aspiration of the Project, noting the existing aquifer levels, ground conditions and site levels (taking into consideration the consultation responses), to process arisings to maximise their use as fill material or within landscaping features.	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)

5. The Converter Station will not be illuminated at night other than in exceptional circumstances such as upon activation of an intruder alarm or for maintenance or repair operations.	This illustrative design seeks to reduce the ongoing energy requirements and light pollution to the surrounding environment	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
6. Drainage to only be installed where necessary to reduce the modification of surface water drainage patterns. Sustainable drainage design will be implemented wherever feasible.	The illustrative design includes a Sustainable Drainage System ('SuDS'), this comprises two attenuation ponds as part of the Proposed Development.	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
CARBON AND CLIMATE CHANGE		
1. The Converter Station design will adopt a sustainable approach which will involve the following measures: • Reducing, where practicable, material use in construction and minimising the use of high carbon materials. Buildings should be energy and resource efficient.	Construction materials in the illustrative design are developed from commercially available products that meet British Standards.	Demonstrates good design in terms of sustainability and having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
2. As far as practicable, incorporate resource efficiency and waste minimisation best practice into design, in particular improving the cut/fill balance of the Proposed Development.	This is reflected in the Onshore Outline Construction Environmental Management Plan, Waste Management Plan and engineering specifications adopted for the Converter Station.	Demonstrates good design in terms of sustainability and having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
3. The resilience of the Proposed Development during operation will be improved through the following measures: • Regularly clearing and maintenance of drainage infrastructure to prevent blockage. • Using vegetation to slow down the movement of surface water. • Consideration of the projected change in soil moisture when specifying foundation depth – potentially need deeper foundations. • Specifying appropriate materials (e.g. asphalt, concrete mix) to take account of higher average temperatures. • Using mould inhibiting paints as part of regular maintenance and updating. Using slope stabilisation measures.	The detailed design will be developed to comply with the Design Principles.	Demonstrates good design in terms of sustainability and having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)
3. The design Development will be in accordance with the Resilience Design Principles in Table 6.1 and 6.2 above	The detailed design will be developed to comply with the Resilience Design Principles.	Demonstrates good design in terms of sustainability and, having regard to regulatory and other constraints (NPS EN-1, Para 4.5.3)

OPTICAL REGENERATION STATION		
1. The site layout and design will meet the operational requirements of the ORS and the Telecommunications Buildings. 2. The ORS and the Telecommunications Buildings will be contained within secure compounds, as depicted upon the Parameter Plans. 3. The design and land take for the ORS and the telecommunications facility will be minimised as much as possible	The indicative location plan for the ORS shows the scale and layout of the Optical Regeneration Station in relation to the surrounding landscape.	Reflects the limited choice in the physical appearance of some energy infrastructure (NPS EN1, Para 4.5.3). Responds to the functionality of the object as equally as important as aesthetic considerations (NPS EN-1, Para 4.5.1) Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
4. The proposals for landscaping will be developed and approved in accordance with the illustrative landscape mitigation plan.	The indicative landscape mitigation plan illustrates landscape proposals for the ORS	Reflects the limited choice in the physical appearance of some energy infrastructure (NPS EN1, Para 4.5.3). Responds to the functionality of the object as equally as important as aesthetic considerations (NPS EN-1, Para 4.5.1) Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
5. The ORS and Telecommunications Building(s) will not be illuminated other than in exceptional circumstances such as upon activation of an intruder alarm or maintenance or repair operations.	There will be no external lighting, other than upon activation of an intruder alarm or maintenance or repair operations	Developments should not have an unacceptable effect on the rural tranquillity of the area, including the introduction of lighting or noise (WCC LPP2, Policy DM23)
6. The ORS and Telecommunications Building(s) compounds are intended to be gravel or similar hardstanding surface.	The compounds will be surfaced.	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3).

7. The following specific design measures are embedded into the design of the ORS at Landfall to provide resistance and resilience to the risk of tidal flooding affecting the building, users and associated equipment: ▪ The ORS will include a raised external threshold (floor level 0.95 m above existing ground level of 3.4 m AOD); and ▪ Electrical equipment within the ORS will be raised internally by 300 mm.	ORS external threshold and electrical equipment will be raised to an elevation in accordance with the FRA addendum to provide resistance and resilience to the risk of tidal flooding, as included in the Parameter Plans.	The proposed flood risk mitigation resilience has been developed in accordance with NPS-EN1 Part 5.7 and Para 5.7.5.
ONSHORE CABLE CORRIDOR		
Cable Depth 1. The cable burial depth within the highway will be consistent with the depth specified in NGTS 357 and ENA TS 09-02	The cable trench depth will be designed and installed to national standard specifications.	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
Horizontal Directional Drilling (HDD)/Microtunnelling 1. HDD is to be used at HDD 1-3, 5 and 6 2. Trenchless microtunnelling is to be used to install the cable under the railway at HDD 4 3. The detailed design of HDD 1 and 2 will be informed by the invert level of Southern Water's Eastney to Budd Farm Rising Main when established 4. The detailed design of HDD 3 will be informed by the location of the A27 piles when established 5. The detailed design of HDD 5 is to avoid creating a pathway between the overburden and the underlying Chalk Aquifer 6. The detailed design of HDD 6 is to be informed by additional ground investigation The HDD compounds are to accord with those shown on Appendix 2 to the HDD Position Statement save in relation to HDD 5 where flexibility has been retained	The detailed design will be developed to comply with the design requirements and principles discussed within the Design and Access Statement and the HDD Position Statement.	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)

Joint Bays Joint Bays should be located beyond the carriageway of the highway unless such a location is unavoidable. Where unavoidable, joint bays must be sited where their construction involves no greater constraint on the operation of the highway than traffic management associated with the laying of the Onshore Cable in the same location.	The location of the Joint Bays will be defined at detailed design by the Contractor, taking into account environmental and other constraints/considerations.	Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
Main Rivers, Watercourses and Flood Defences 1. Disruption of Main Rivers and Ordinary Watercourses located within the Order Limits is to be avoided in the detailed design by ensuring that all installed ducts and trenching across culverted watercourses are undertaken in the highway. Where open channel watercourses are present within the Order Limits, HDD or Trenchless techniques are to be used to pass under the relevant watercourse, however open trench techniques may be used on other minor ditches and dry watercourses (also known as Ordinary Watercourses) to install ducting under these open channel watercourses. 2. Any temporary or permanent works over, under or directly adjacent to watercourses/watercourse structures (culvert/sewer) and flood defences will be designed so as to ensure that the integrity and function of any such watercourse, structure or defence is not adversely affected, there is no increase in local flood risk, there is no reduction in conveyance and that suitable pollution prevention measures are in place during both construction and operation. The design of the **Onshore Cable Corridor** will avoid works to existing or proposed coastal flood defenceand where appropriate HDD or Trenchless techniques are to be used to pass under the coastal flood defences.	The detailed design of the Onshore Cable Route will comply with the mitigation and enhancement measures detailed in section 20.7 (embedded mitigation) and 20.9 (mitigation and enhancement) of ES Chapter 20 to ensure works near to watercourses detailed in ES Appendix 20.3 are undertaken in accordance with EA and LLFA requirements subject to relevant Main River (Flood Risk Activity Permit) or Ordinary Watercourse consents where applicable.	The proposed flood risk mitigation resilience has been developed in accordance with NPS-EN1 Part 5.7 and Para 5.7.5. Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
Noise **1.** Mitigation in the form of screening will be designed for those Joint Bay locations where the works are predicted to have more than a negligible impact at	Based on studies carried out at detailed design, if required, hoarding will be provided to mitigate the effects of acoustic noise, as assessed within ES Chapter 24 (Noise and Vibration) (APP-139).	Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2) The proposed noise mitigation has been developed in accordance with NPS-EN1 Part 5.11 and Para 5.11.3)

surrounding receptors. The mitigation shall achieve at least 5dB attenuation. Such screening will also be provided for all HDD compounds.		
Trees The detailed design of the Cable Corridor will ensure that tree loss occurs only when it is unavoidable. The detailed design should ensure that RPAs are avoided where practicable, and where unavoidable, shall include measures to avoid major route damage in accordance with BS 5837. Where it is not possible to avoid trees, the design will give priority to avoiding higher value (Category A and B trees).	The detailed design will seek to maximise the retention of trees and minimise root damage as detailed in the Arboriculture Report and appended Arboricultural Method Statement (APP-411), and the Tree Survey Schedule and Constraint Plans (REP3-007).	Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts (NPS EN-1, Para 4.5.2)
Lighting **1.** For the HDD compounds the Engineering Manager will undertake a lighting assessment to manage light impacts. Temporary site lighting will be restricted to meet on-site safety and security requirements [5.2.2.2 of the CEMP]	The lighting for the HDD compounds will be established at detailed design to provide on-site safety and security requirements.	Good design should produce sustainable infrastructure sensitive to place (NPS EN-1, Para 4.5.1) Developments should maintain and enhance the intrinsic quality of dark skies and demonstrate that all opportunities to reduce light pollution have been taken, including the introduction of lighting or noise (WCC LPP2, Policy DM23) (SDNPA LP, Policy SD8 and SD54).
HUMAN HEALTH		
1. Joint Bays will be positioned in highway verges, fields or car parks, where practicable, to limit the need for road closures; 2. Where the Onshore Cable Corridor crosses greenspace, the route has been designed to avoid key recreational facilities, wherever practicable; 3. Public activities and events that are planned in proximity to the Proposed Development will be taken into consideration during the phasing of the of construction works along the Onshore Cable Route; and 4. To minimise disruption, a single lane closure will be used, where practicable,	The Onshore Cable Corridor seeks to minimise the impact on human health, providing a detailed design in line with the mitigation schedule in relation to the sections of the onshore cable corridor.	Good design in terms of use, siting and appropriate technologies can help mitigate adverse impacts on noise and air quality (NPS EN-1, Para 4.5.2) The proposed mitigation identified for noise and air quality has been developed in accordance with NPS-EN1 Part 4.10 and Para 4.10.1 which recognises that separate regulation under the pollution control framework or other consenting and licensing regimes may be required, and is considered to be effective mitigation for these topics. No potential adverse effects are predicted in respect of Electro Magnetic Fields, which is not a matter referred to in NPS-EN1. It is not considered that human health concerns will either constitute a reason for consent not be granted or require specific mitigation under the Planning Act 2008 (NPS EN-1, Para 4.13.5) Reflects the need for functionality and fitness for purpose (NPS EN-1, Para 4.5.3). The Onshore Outline CEMP (REP5-019, Rev005) states that: Where practicable, any mature trees and hedgerows which are within the site boundary will be retained. Highway trees will only be removed as a last resort, where retention in the presence of the scheme would be contrary to sound arboricultural practice as confirmed in writing by the relevant local

		planning authority Arboriculture professional and with agreement on compensation / mitigation (dependant on LPA position) values for each highway tree prior to its removal. There will be no third-party tree planting within the highway without express permission from the Highway Authority. Where agreed, the Local Highway Authority will undertake any highway tree mitigation planting required, to be funded from the highway tree compensation monies; There will be no third-party tree planting within the highway without express permission from the Highway Authority. Where requested, tree mitigation planting will be undertaken by the Highway Authority through CAVAT funding.

9. SUMMARY

9.1.1.1. This DAS forms part of a suite of documents submitted as part of the Development Consent Order Application for the Interconnector Project, and importantly sets out the Design Principles which control the final design of the Converter Station, Optical Regeneration Station and Telecommunications Buildings, which form the permanent visual components of the Interconnector Project.

9.1.1.2. The document describes how the Parameter Plans and Design Principles have been established from analysis of the context and requirements for the Interconnector Project, developed by the consultation process with key stakeholders

9.1.1.3. Section 2 of this document sets out the Legislation, Policy and Guidance Context for the proposals, and describes the site context analysis exercises undertaken, providing the framework for the subsequent design development and consultations.

9.1.1.4. Section 3 sets out the site context for the built components and demonstrates how options have been explored to establish optimum locations and siting, taking into account operational requirements and response to the surrounding landscape and environment.

9.1.1.5. Permanent and temporary (construction) access to the Converter Station has been considered and indicative proposals illustrated which take account of the functional requirements and site context.

9.1.1.6. There is no requirement for public access to any of the facilities. Appropriate security will be maintained during construction and installation, and subsequent operation of the facility to ensure unauthorised access is prevented.

9.1.1.7. Section 4 describes how the design development process has been built upon and informed by consultation with key stakeholders, focused in relation to the Converter Station and the other buildings upon how the design will correspond to the landscape, whilst taking into account the technical and geophysical constraints of the proposed infrastructure. Environmental constraints, including ecological, visual amenity and noise control have also been taken into account. These consultations have influenced site selection, design evolution, the Parameters Plans and the Design Principles, set out in Section 6.

9.1.1.8. The Indicative Landscape Mitigation Plans have also been developed in consultation with key stakeholders and set out how the site can be successfully incorporated within the existing landscape with detailed landscape design including the planting of a selection of appropriate species to also increase site biodiversity. The landscape design and consultation process has resulted in the Landscape Design Principles, set out in Section 6.

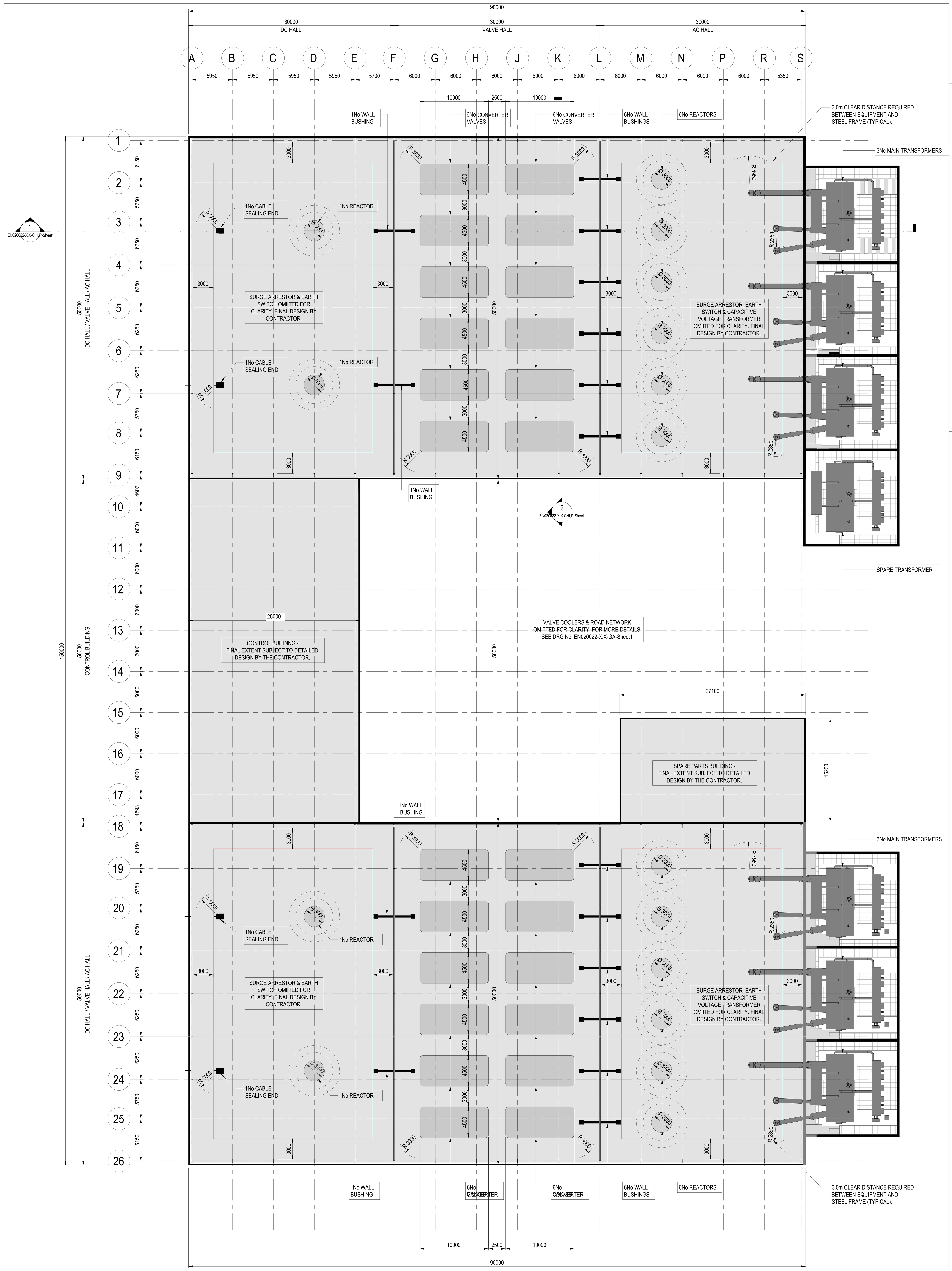
9.1.1.9. Section 5 describes the process of design development informed by the consultation process, resulting in the Parameter Plans and Design Principles, and illustrates indicative design solutions

9.1.1.10. Section 6 sets out the Building Design Principles and Landscape Design Principles which will ensure that the detailed design of the Converter Station, ORS and Telecommunications Buildings and landscaping will satisfy the principles of “good design” as required by NPS EN-1 and meet its functional and operational requirements whilst responding to its setting. The detailed designs will be subject to approval pursuant to the DCO Requirement.

9.1.1.11. Section 7 provides illustrative examples of how the Design Principles and Parameter Plans could be complied with in the shape of site layouts and built forms. These indicative drawings and images have also taken account of feedback from the consultations with stakeholders. The final designs will be subject to further technical development and formal approvals within the legal framework established by the Parameter Plans and Design Principles.

9.1.1.12. Section 8 describes how the Design Principles and illustrative designs comply with Legislation, Policy and Guidance.

Appendix 1 – CONVERTER STATION DRAWINGS



Indicative Converter Hall Layout Plan

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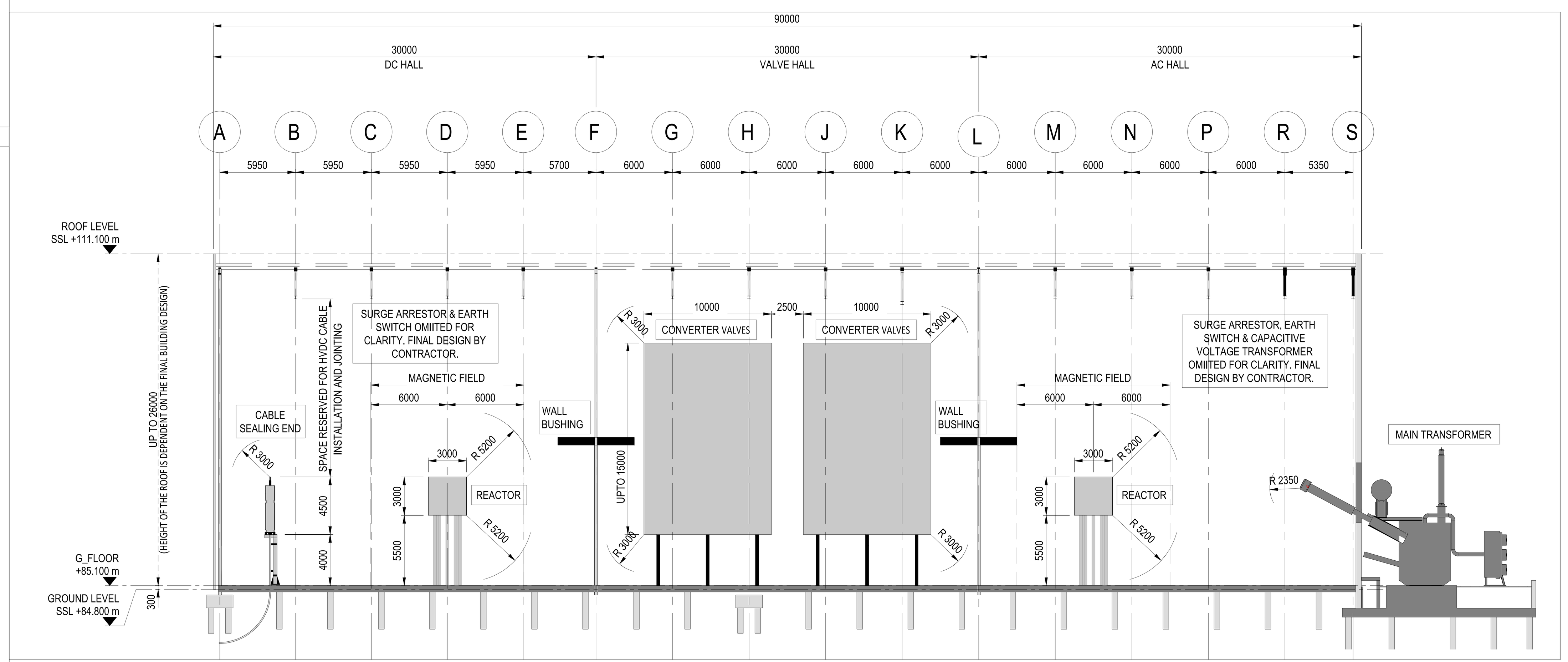

SECTION 1

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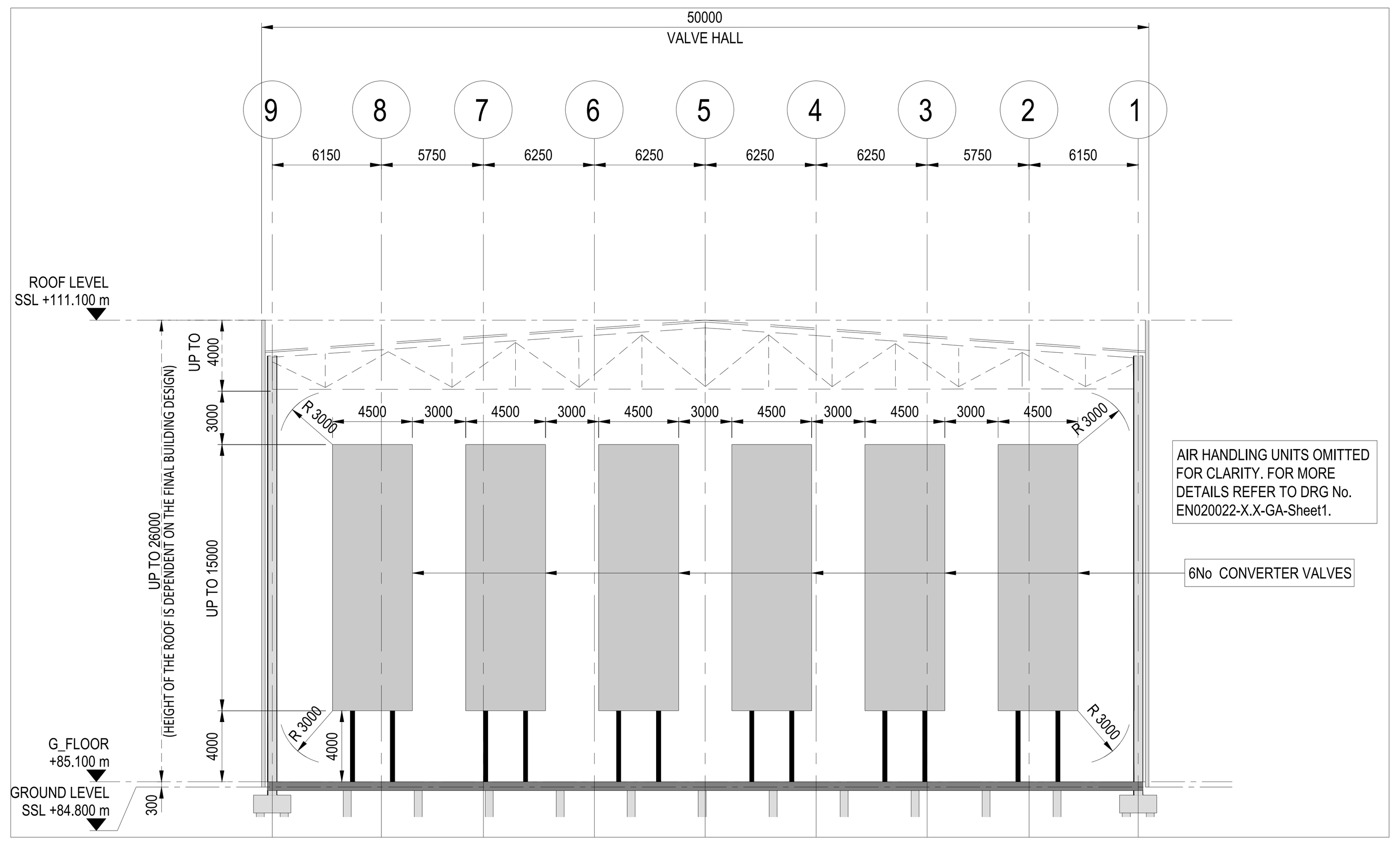

SECTION 2

1 : 250

NOTES:-

1. DO NOT DIMENSION FROM THIS DRAWING. ALL DIMENSIONS SHOWN ARE INDICATIVE.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DAS SUPPLEMENTARY REPORT.
3. ALL DETAILS SHOWN ARE STRICTLY INDICATIVE. FINAL DESIGN TO BE UNDERTAKEN BY CONTRACTOR.

LEGEND:-

R 3000 — DENOTES ELECTRICAL CLEARANCE REQUIRED.

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009-Regulation 5(2)(o)

REV	DATE	BY	DESCRIPTION	CHK	APP
04	02.06.20	HB	MINOR UPDATES	CS	ST
03	29.05.20	PB	MINOR UPDATES	CS	ST
02	24.04.20	PB	MINOR UPDATES	ST	ST
01	06.03.20	PB	FIRST ISSUE	SU	ST

DRAWING STATUS: ILLUSTRATIVE

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Tel: +44 20 7314 5000 Fax: +44 20 7314 5111
http://www.wsp.com

CLIENT: AQUIND

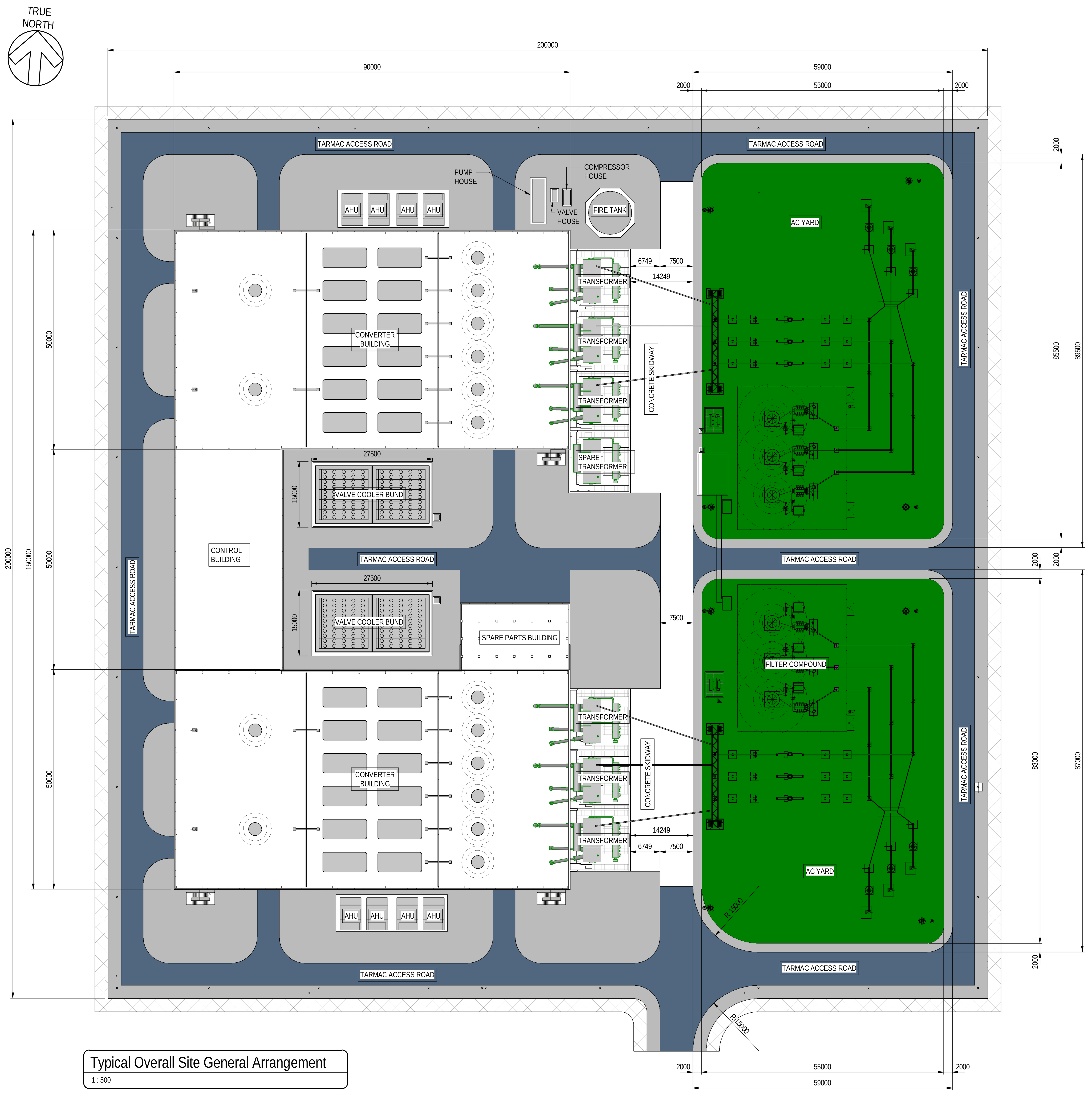
PROJECT: AQUIND Interconnector

TITLE: Typical Converter Hall Layout Plan

SCALE AT A0: 1:250	CHECKED: SU		APPROVED: ST
PROJECT No: EN020022	DESIGNED:	DRAWN: PB	DATE: MARCH 2020

DRAWING No: EN020022-X.X-CHLP-Sheet1 REV: 04

PRELIMINARY



Typical Overall Site General Arrangement

1 : 500

NOTES:-

1. DO NOT DIMENSION FROM THIS DRAWING. ALL DIMENSIONS SHOWN ARE INDICATIVE.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DAS SUPPLEMENTARY REPORT.
3. ALL DETAILS SHOWN ARE STRICTLY INDICATIVE. FINAL DESIGN TO BE UNDERTAKEN BY CONTRACTOR.
4. ROAD WIDTHS WILL BE 5.0m UNLESS NOTED OTHERWISE. ROAD BENDING RADIUS' TO BE 6.0m UNLESS NOTED OTHERWISE.
5. DISTANCE FROM PERIMETER FENCE TO ROAD EDGE TO BE 3.0m.

LEGEND:-

DENOTES REQUIRED AREA FOR AC YARD WITH 2.0m CLEARANCE TO ROAD EDGE.

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009-Regulation 5(2)(o)

REV	DATE	BY	DESCRIPTION	CHK	APP
03	29.05.20	PB	MINOR UPDATES	CS	ST
02	24.04.20	PB	MINOR UPDATES	ST	ST
01	06.03.20	PB	FIRST ISSUE	HM	ST

DRAWING STATUS: ILLUSTRATIVE

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CLIENT: AQUIND

PROJECT: AQUIND Interconnector

TITLE: Typical Overall Site General Arrangment

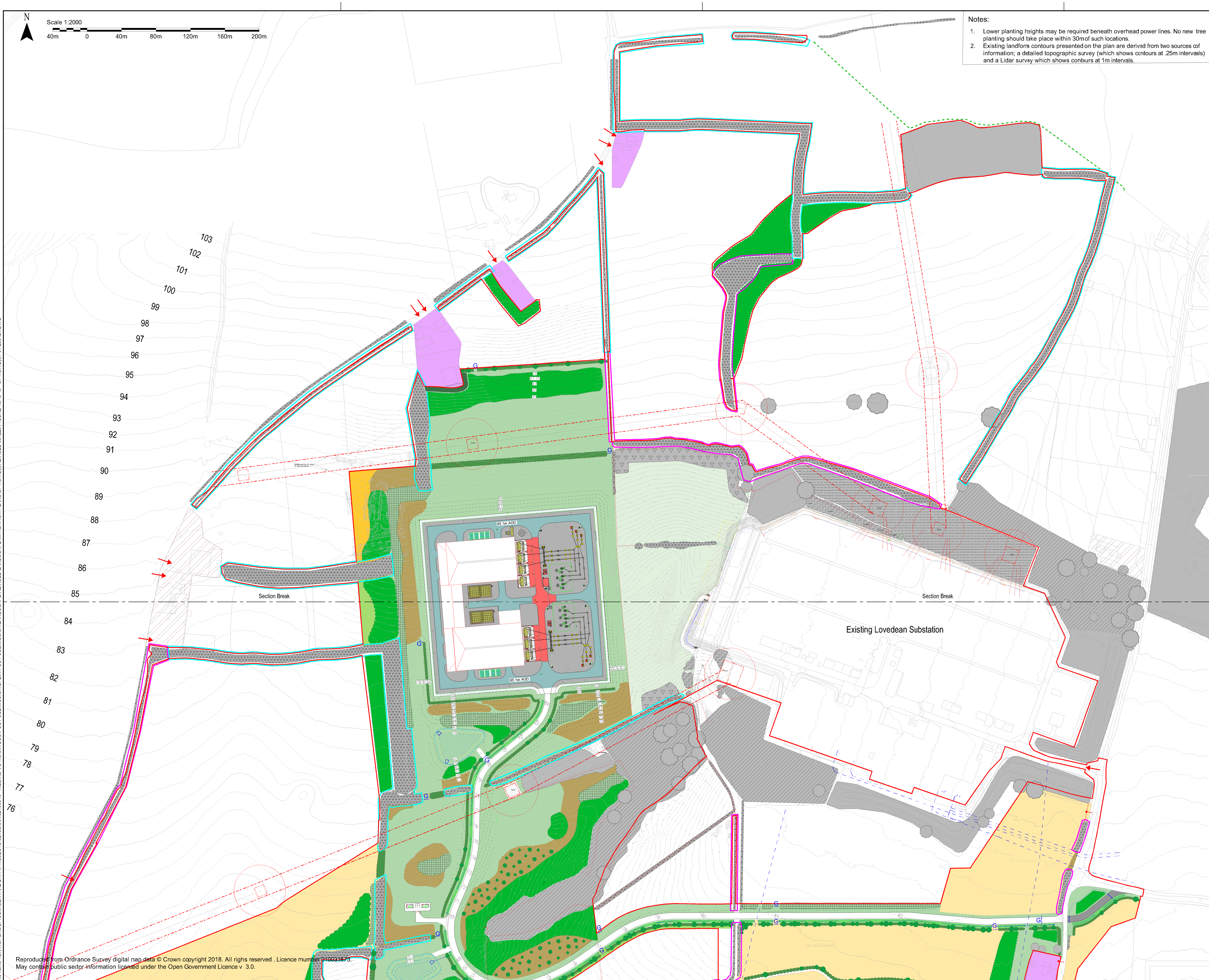
SCALE AT A1: 1:500	CHECKED: HM	APPROVED: ST
PROJECT No: EN020022	DESIGNED:	DRAWN: PB
DATE: MARCH 2020		

DRAWING No: EN020022-X.X-GA-Sheet1

REV: 03

PRELIMINARY

Appendix 2 – LANDSCAPING DRAWINGS



Notes:

1. Lower planting heights may be required beneath overhead power lines. No new tree planting should take place within 30m of such locations.
2. Existing landform contours presented on the plan are derived from two sources of information; a detailed topographic survey (which shows contours at .25m intervals) and a Lidar survey which shows contours at 1m intervals.

Legend

- Order Limits

Existing

- Access point
- Existing ground level contour
- Existing non-residential development
- Existing residential development
- Existing underground cable route
- Monarch's Way (PRoW)
- Existing pylon
- Indicative existing overhead power lines
- Existing fencing
- Existing woodland
- Existing ancient woodland
- Existing native hedgerows
- Existing native hedgerows with hedgerow trees
- Existing grassland / scrub
- Existing scrub
- Existing National Grid mitigation planting
- Existing mature trees
- Existing arable farmland
- Existing pasture
- Existing recreation area
- Existing semi-improved grassland
- Bare ground

Proposed

- Proposed contours
- Proposed native hedgerow
- Proposed native hedgerow with hedgerow trees
- Proposed native mixed woodland (up to 15m)
- Proposed native mixed woodland (up to 25m)
- Proposed coniferous woodland
- Proposed scrub
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- Proposed marshy grassland
- Proposed attenuation pond
- Vegetatated conveyance and infiltration swale (marginal planting)
- Proposed access road
- Proposed additional access road
- Proposed gate
- Proposed access point
- Proposed fence

Management of existing hedgerows

- Gap up through new hedgerow planting
- New hedgerow planting (to replace hedgerows grubbed out) with hedgerow trees
- Restrict removal of hedgerows and maintain at existing height. Gap up with new hedgerow planting where necessary
- Restrict removal of hedgerows and maintain at existing height. Introduce new hedgerow trees where possible and gap up with new hedgerow planting where necessary

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(a)

REV	DATE	BY	DESCRIPTION	CHK	APP
04	25/01/2021	JK	REMOVAL OF PROPOSED WOODLAND	MB	AF
03	08/12/2020	DW	REVISED ORDER LIMITS AND FURTHER AMENDMENTS	MB	AF
02	08/09/2020	DW	SECOND ISSUE AMENDMENTS	MB	AF
01	06/11/2019	DW	FIRST ISSUE	MB	AF

DRAWING STATUS: FINAL

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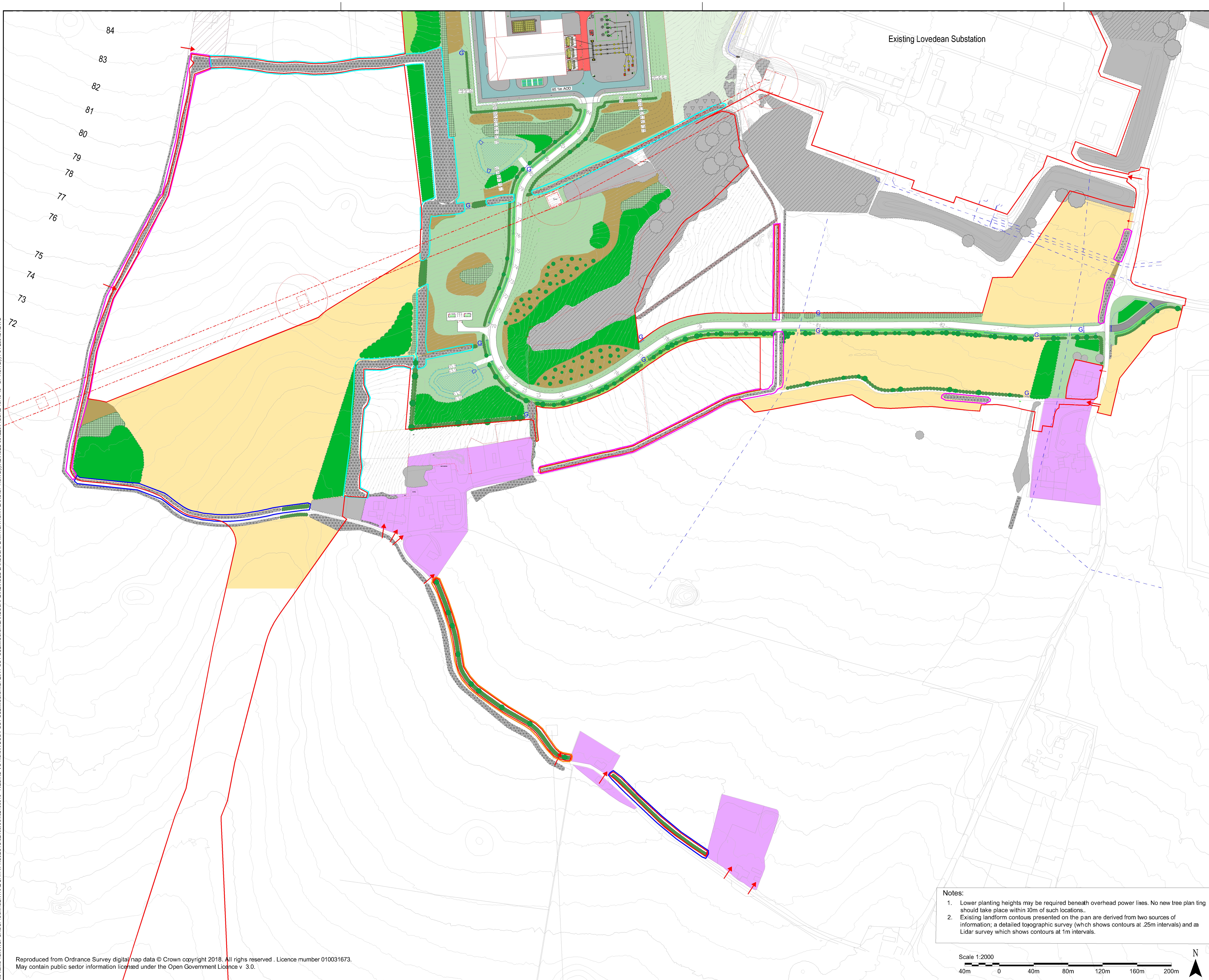
CLIENT: AQUIND

PROJECT: AQUIND Interconnector

TITLE: Figure 15.48: Indicative Landscape Mitigation Plan Option B(i) (north)

SCALE AT A1: 1-2000	CHECKED: MB		APPROVED: AF
PROJECT No: EN020022	DESIGNED: MB	DRAWN: DW	DATE: 06/11/2019
DRAWING No: EN020022-ES-15.48			REV: 04

File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\62100XXX\62100616 - AQUIND VO NO.3A DCO\POST SUBMISSION\ EIA POST SUBMISSION\LANDSCAPE\REVISED LANDSCAPE MITIGATION PLANS\OPTION B(I)\REVISED 081220\FIGURE 15.48-49 - OPTION B(I) P04 250121.DWG



Legend

- Order Limits

Existing

- Access point
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- Existing non-residential development
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Notes:

1. Lower planting heights may be required beneath overhead power lines. No new tree planting should take place within 10m of such locations.
2. Existing landform contours presented on the plan are derived from two sources of information; a detailed topographic survey (which shows contours at .25m intervals) and a Lidar survey which shows contours at 1m intervals.

Scale 1:2000

40m 0 40m 80m 120m 160m 200m

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File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\62100XXX\62100616 - AQUIND VO NO.3\A DCO\POST SUBMISSION\D EIA POST SUBMISSION\LANDSCAPE\REVISED LANDSCAPE MITIGATION PLANS\OPTION B(I)\REVISED 081220\FIGURE 15.48-49 - OPTION B(I) P04 250121.DWG

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(a)

REV	DATE	BY	DESCRIPTION	CHK	APP
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02	08/09/2020	DW	SECOND ISSUE AMENDMENTS	MB	AF
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PROJECT:

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TITLE:

Figure 15.49: Indicative Landscape Mitigation Plan Option B(i) (south)

SCALE AT A1: 1-2000	CHECKED: MB		APPROVED: AF
PROJECT No: EN020022	DESIGNED: MB	DRAWN: DW	DATE: 06/11/2019
DRAWING No: EN020022-ES-15.49			REV: 04

Notes:

1. Lower planting heights may be required beneath overhead power lines. No new tree planting should take place within 30m of such locations.
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Legend

Order Limits

Existing
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Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(a)

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02	24/11/2020	DW	REVISIONS TO VEGETATION	MB	AF
01	03/04/2020	DW	FIRST ISSUE	MB	AF

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PROJECT: AQUIND Interconnector

TITLE: Figure 15.48a: Indicative Landscape Mitigation Plan Option B(i) (north)

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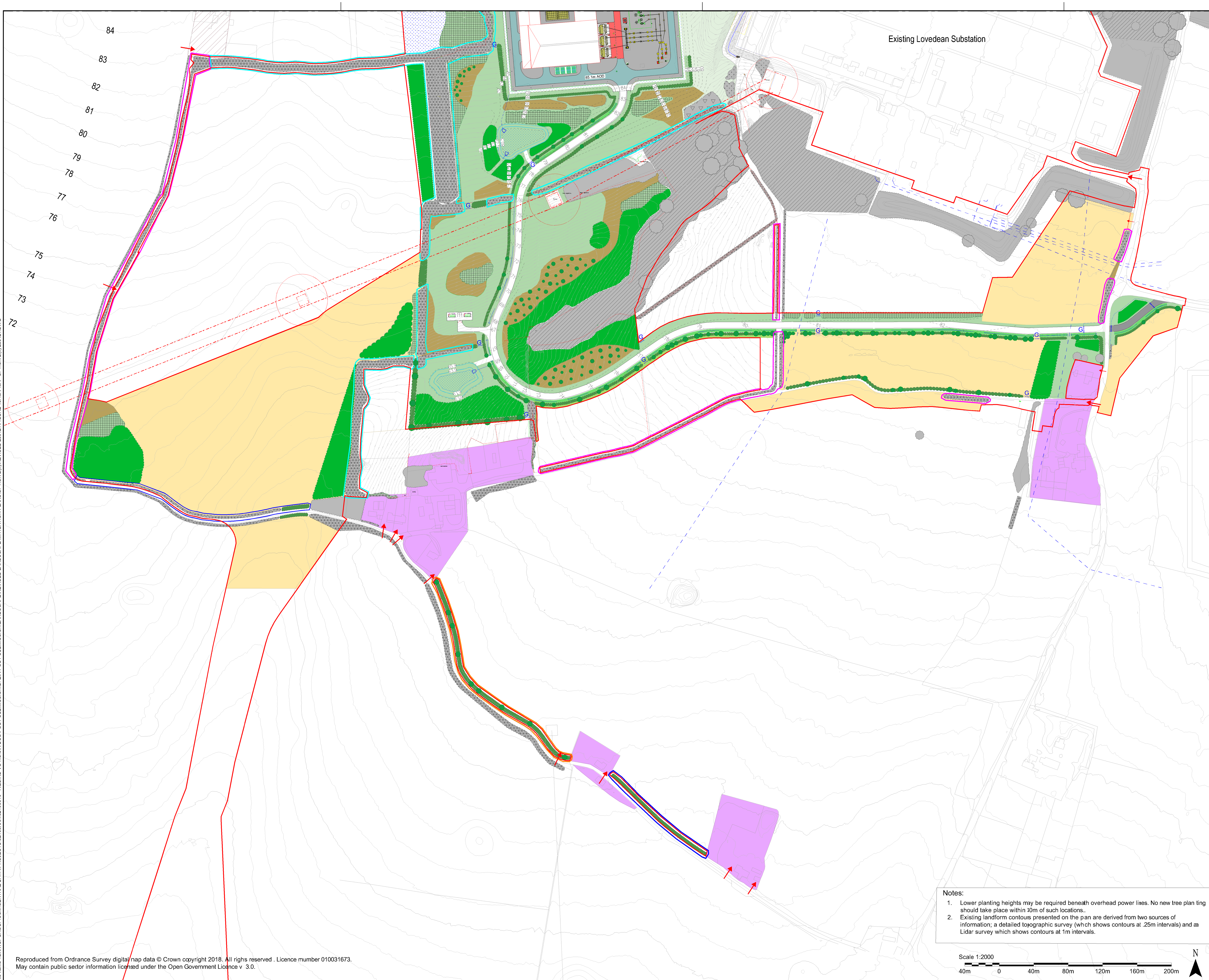
EN020022	MB	DW	03/04/2020

DRAWING No: EN020022-ES-15.48a
REV: 04



Legend

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Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(a)

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TITLE: Figure 15.49a: Indicative Landscape Mitigation Plan Option B(ii) (south)

SCALE AT A1: 1-2000	CHECKED: MB		APPROVED: AF
PROJECT No: EN020022	DESIGNED: MB	DRAWN: DW	DATE: 03/04/2020
DRAWING No: EN020022-ES-15.49a			REV: 04

Notes:

1. Lower planting heights may be required beneath overhead power lines. No new tree planting should take place within 10m of such locations.
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Scale 1:2000

40m 0 40m 80m 120m 160m 200m

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File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\62100XXX\62100616 - AQUIND VO NO 3\A DCO\POST SUBMISSION\D. EIA POST SUBMISSION\LANDSCAPE\REVISED LANDSCAPE MITIGATION PLANS\OPTION B(II)\REVISED 250121\FIGURE 15.49A-49A - OPTION B(II) 250121.DWG

Appendix 3 – SURFACE WATER DRAINAGE AND AQUIFER CONTAMINATION MITIGATION STRATEGY

AQUIND Limited

AQUIND INTERCONNECTOR

Design and Access Statement – Appendix 3 – Surface Water Drainage and Aquifer Contamination Mitigation Strategy

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

Document Ref: 5.5

PINS Ref.: EN020022

AQUIND Limited

AQUIND INTERCONNECTOR

Design and Access Statement – Appendix 3 – Surface Water Drainage and Aquifer Contamination Mitigation Strategy

PINS REF.: EN020022

DOCUMENT: 5.5

DATE: 25 JANUARY 2021

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DOCUMENT

Document	Design and Access Statement – Appendix 3 – Surface Water Drainage and Aquifer Contamination Mitigation Strategy
Revision	004
Document Owner	WSP UK Limited
Prepared By	H. Mojtabavi
Date	25 January 2021
Approved By	S. Thite
Date	25 January 2021

CONTENTS

TABLES

PLATES

APPENDICES

1. APPENDIX 3 SURFACE WATER DRAINAGE AND AQUIFER CONTAMINATION STRATEGY

1.1. GENERAL

1.1.1. INTRODUCTION

1.1.1.1. The Converter Station Area is known to be underlain by a Principal Aquifer (chalk), Source Protection Zone 1 ('SPZ1') designation. The SPZ1 requires a considered approach to mitigate any potential contamination, turbidity or groundwater issues caused by infiltration of potentially contaminated water into the ground from Construction, Operation and Maintenance activities over the design life of the Proposed Development.

1.1.1.2. This document outlines the strategy to mitigate the potential for contamination of aquifer during the operational life of the Converter Station, providing the minimum technical requirements for the design and construction of the drainage system relating to surface water, foul water and water susceptible to contamination from oil/fuel and glycol, so as to mitigate the potential for contamination of the Aquifer during the construction and the operational life of the Converter Station.

1.1.1.3. This report has been updated from a version submitted in November 2019, further to consultation with Environment Agency ('EA'), Portsmouth Water('PW') on 5th August 2020 and 10th September 2020 as well as in response to the Relevant Representations and Written Questions to provide further clarification relating to the aquifer contamination mitigation strategy, and has been further updated in December 2020 following initial results for infiltration rates becoming available and following discussion with Hampshire County Council on 26th November to agree amendments to strategy reporting to incorporate these results. Discussions with Hampshire Council on 26th November were informed by prior issue of a technical note. That technical note has since been superseded by updates to this document.

1.1.1.4. Where relevant to the construction phase of the development, the requirements of this strategy are also required to be complied with as part of the construction environment management plan to be produced in relation to the works to construct the Converter Station, in consultation with PW and EA.

1.1.1.5. The appointed contractor with responsibility for the civil design and construction, will be required to ensure the Converter Station civil works meet relevant requirements of the employer, the Environment Agency and other relevant stakeholders and to identify and comply with all relevant Eurocodes, British Standards and other appropriate codes and guides highlighted within this report.

1.1.2. CONVERTER STATION AREA

1.1.2.1. The Converter Station Area is located within a rural landscape in Winchester, to the west of the outlying settlements of Lovedean and Horndean. The existing National Grid 400/132kV Lovedean Substation is located immediately east of the proposed Converter Station (Plate 1).

1.1.2.2. The site where the Converter Station is to be located (the 'Site') is on a hillside sloping downwards from north to south, with a natural ridge to the west and a valley to the east. The nearest watercourse and surface water feature identified on mapping is located approximately 1.8 km to the south, flowing away from the Site.

1.1.2.3. Existing geology of the Site comprises shallow topsoils overlying Tarrant Chalk bedrock, identified as a Principal Aquifer providing a water supply to Portsmouth.

Plate 1 - Converter Station Area Layout (Option B(i))

1.1.3. SITE FEATURES

Aquifer

1.1.3.1. The Converter Station Area is known to be underlain by a Principal Aquifer (chalk), SPZ1 designation. Therefore, the SPZ1 requires a considered approach to mitigate any potential contamination, turbidity or groundwater issues caused by construction and operation and maintenance activities over the operational lifetime of the Converter Station.

Karstic Features

1.1.3.2. Karstic terrain features are a product of dissolution of soluble rocks by groundwater and can be contributed to further by other geochemical processes. Commonly the rocks most affected by these processes are limestone, chalk, dolomite and gypsum. The formation of sinks, solution pipes, caves/voids, dolines (sinkholes propagated to surface), sink holes and stream sinks are some of the features than can occur in karstic terrains. These ground conditions can lead to the following geotechnical risks, which can impact ground stability and present constraints and risks to development on karstic ground:

- Differential / total settlement
- Soft spots
- Collapsible ground
- Groundwater control issues
- Sinkholes
- Variable depth to rockhead
- Groundwater features or movement through karsts

1.1.3.3. A conductivity and resistivity geophysical survey was undertaken to identify potential karstic features at the Converter Station Area. The potential karstic features are detailed in Plate 2 and Table 1.

Table 1 – Karst Features

Karstic Feature	Coordinates (Approximate Centre Point)	Geophysics Interpretation	CPT Probing
SD1 (Also referred to as Karstic Feature 1)	467359 E 113070 N Located south of proposed access track	A circular feature identified to be approximately 20.00m in diameter and extends to approximately 6.00m below ground level (bgl). Identified in ERT Line 6	Four CPTs were conducted in a north-south direction an east-west probing line was not feasible due to a 132kV power cable. The CPTs achieved between 1.70-4.30m bgl, where they encountered refusal (possible competent rock). Cross referencing with the geophysical report it appears the CPTs were refusing short of the top of the infilled karstic feature. The feature appears infilled approximately 20.00m wide and 6.00m in height, with the feature present from 4.00m bgl to 10.00m bgl.
SD2 (Also referred to as Karstic Feature 2)	467180 E 113479 N Located within proposed Converter Station option B(i) and B(ii)	A circular feature identified to be approximately 25.00m in diameter and extending to 6.00m bgl	Six CPTs were conducted in a cross pattern, approximately north-south and east-west. The CPTs achieved between 7.90-14.70m bgl, where they encountered refusal (possible competent rock). The feature appears infilled, approximately 20.00-25.00m wide and 5.00m in height, with the feature present from 4.00m bgl to 9.00m bgl.
SD3 (Also referred to as Karstic Feature 3)	467209 E 113656 N Located within proposed Converter Station option B(i) and B(ii)	The feature is identified to be circular. The full geometry is difficult to determine from the geophysics due to the feature being identified at the end of the ERT line.	Six CPTs were conducted in a cross pattern, approximately north-south and east-west. The CPTs achieved between 8.80-12.00m bgl, where refusal was encountered (possible competent rock). The feature appears infilled, approximately 10.00m wide and 6.00m in height, with the feature present between 3.00m bgl to 9.00m bgl.

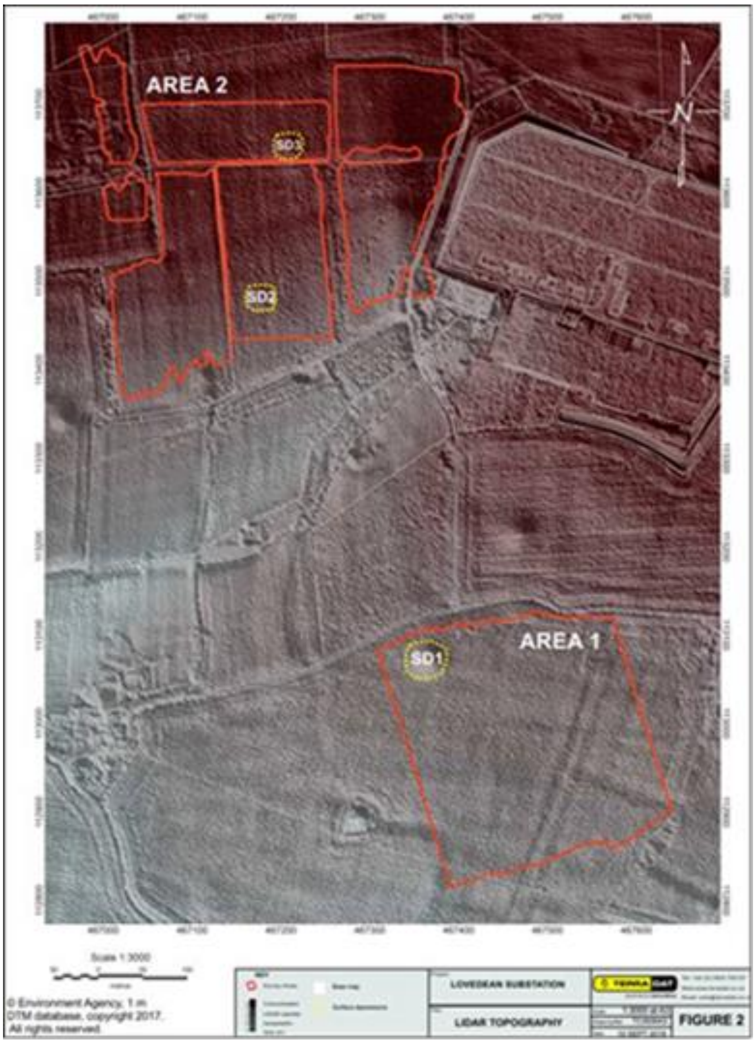


Plate 2 – Karst Features identified via Geophysical Surveys

1.1.3.4. The surveys located two potential karstic features denoted SD2 and SD3 at Converter Station Area as shown on Plate 3 and 4 for Converter Station Layout Option B(i) and Option B(ii).

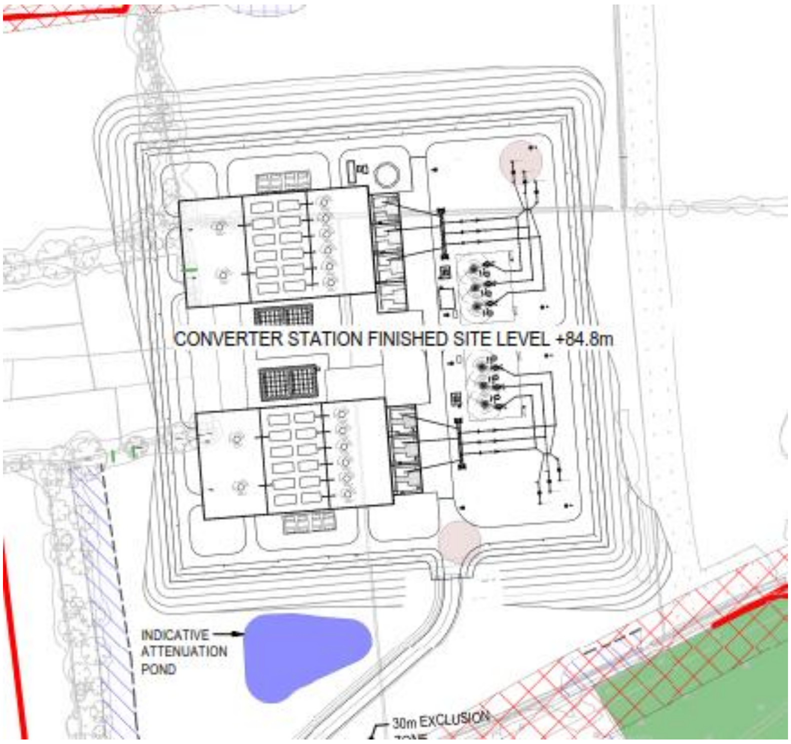


Plate 3 – Karst Features, Converter Station Layout Option B(i)
(Karst Features shown in pale red circles)

Plate 4 – Karst Features, Converter Station Layout Option B(ii)
(Karst Features shown in pale red circles)

1.1.3.5. Following the geophysical survey undertaken in 2018, the features were further investigated for infilling by cone penetration testing (CPT) (information in relation to which is included at Table 1 above). The CPT indicated the karstic features present to be (naturally) infilled with a Grade D Chalk.

1.1.3.6. The potential for perched water tables within the karstic features is highlighted within CIRIA C574, however, no perched water tables were observed during the ground investigation.

1.1.4. IDENTIFICATION OF POTENTIAL SOURCES OF CONTAMINATION AND RISK MANAGEMENT

1.1.4.1. The use of the following liquids or fuels is necessary in connection with the Converter Station, and there is a risk that these liquids or fuels can contaminate the aquifer if infiltrated directly/indirectly into the ground;

- Oil in Converter Transformers;
- Glycol (Antifreeze agent) in Valve Coolers;
- Diesel in Emergency Generators and above ground fuel tank;
- Effluent from kitchen/WC/Bathroom in Control Building;
- Oil contaminated water in oil dump tanks, oil interceptors, oil containment areas and related oil/oily water drainage systems; and
- Lubrication/cooling oil in vehicles, plant, HV switchgear and equipment.

1.1.4.2. During day to day operation of the Converter Station it is unlikely for the above identified liquids or fuels to contaminate the aquifer/watercourse, however to mitigate the risks associated with any accidental incident/spillage, appropriate provisions such as monolithic in-situ concrete bunds and drainage networks will be required to be designed and constructed to capture any water contaminated with the identified liquids or fuels. These networks will either direct the contaminated water to designated treatment facilities or contain it within a fully sealed area such as dump tank for manual removal under controlled conditions.

1.1.4.3. The following sections of this strategy provide further detail and information to clarify how the risk of contamination resulting from accidental incidents/spillage during the operation of the Converter Station will be dealt with in a safe and compliant manner.

1.1.5. GENERAL ASSUMPTIONS

1.1.5.1. Based on available existing underground services information and in lieu of any site-specific Ground Penetrating Radar ('GPR') survey, the following assumptions have been made in relation to drainage and water in the Converter Station Area;

- There is no existing foul drainage network within the Converter Station Area
- There is no existing surface water drainage network within the Converter Station Area.
- There is no existing land drainage system across the site except a shallow overland flow route as identified on the Environment Agency Long Term Flood Map for events with a return period of 100-1000 years

2. SURFACE WATER DRAINAGE

2.1. EXISTING SITE FEATURES

2.1.1.1. The Site is located within a rural landscape in Winchester, west of the outlying settlements of Lovedean and Horndean. The existing National Grid 400/132kV Lovedean Substation is located immediately east of the proposed converter station, which has operated since 1970's, which have a higher contamination risk than that associated with the new Convertor Station, which would be built adopting the latest design and construction methodology and practice.

2.1.1.2. The Site is located on a hillside sloping downwards from north to south, with a natural ridge to the west and a valley to the east. The nearest watercourse and surface water feature identified on mapping is located approximately 1.8 km to the south, flowing away from the site.

2.1.1.3. Existing geology of the Site comprises shallow top soils overlying Tarrant Chalk bedrock, identified as a Principal Aquifer providing a water supply to Portsmouth. As such, the site is located within a SPZ1.

2.2. CONVERTER STATION AREA

2.2.1.1. The Converter Station Area comprises a Converter Station; an access road; a Telecommunications Buildings compound; landscaping; and surface water drainage comprising conventional pipe networks and Sustainable Drainage Systems ('SuDS') features including filter drains, infiltration drains, infiltration swales, a detention basin, infiltration basin and soakaway.

2.3. POLICIES AND GUIDANCE DOCUMENTS

2.3.1.1. Surface water drainage within the Converter Station Area is to be designed in accordance with the following documents:

- Sewers for Adoption (SFA) 7th Edition;
- Local Authority Standards;
- Building Regulations Part H Drainage and Waste Disposal;
- CIRIA SuDS Manual (C753);
- HR Wallingford Greenfield Runoff Rate Estimation Tool (UKSuDS);
- SNIFFER UEUW01: Source control pollution in Sustainable Drainage (Final Report, February 2008);
- SNIFFER UEUW01: Source control pollution in Sustainable Drainage: Supplementary Report (Draft Report, September 2008);
- SNIFFER UEUW02: SuDS Pollution Degradation (Final Report, October 2008);

- Napier, F.; Jefferies, C; Heal, KV; Fogg, P; D'Arcy, BJ; Clarke, R. (2008) *Evidence of traffic-related pollutant control in soil-based Sustainable Urban Drainage Systems (SUDS)*. Edinburgh, Scotland. (Referenced below as Napier *et al* 2008a);
- Napier, F.; D'Arcy, B.J.; Jefferies, C.; Fogg, P.; Lowe, W.; Clarke, R.; (2008) *Oil and SUDS: managing a priority urban pollutant*. 12th International Conference on Integrated Diffuse Pollution Management, Khon Kaen University, Thailand. (Referenced below as Napier *et al* 2008b);
- Non-statutory technical standards for sustainable drainage systems;
- BS EN 752 2017 Drain and Sewer Systems Outside of Buildings (2017);
- BS EN 12056 Gravity drainage inside buildings;
- National Grid Technical Specification 2.10.01 Oil Containment;
- Discharges to surface water and groundwater environmental permits (EA guidance);
- Pollution prevention for businesses (EA guidance); and
- The Environment Agency's approach to groundwater protection.

2.4. SURFACE WATER DRAINAGE STRATEGY

2.4.1.1. Surface water shall be proposed for discharge in accordance with the Building Regulations 2010 Part H hierarchy, which states that surface water should be discharged, in order of priority to:

1. A soakaway or infiltration system; or where that is not reasonably practicable,
2. A watercourse; or where that is not reasonably practicable,
3. A sewer.

2.4.1.2. The proposal for surface water discharge from the Converter Station Area shall be in accordance with the first priority above, an infiltration system.

2.4.1.3. Discharge to the ground is restricted by existing ground infiltration rates, and infiltration rates through the water quality control measure of treatment filter media silty clay loam introduced to protect groundwater in agreement with the Environment Agency, Portsmouth Water and Hampshire County Council, and as such, surface water attenuation is to be provided by SuDS features including infiltration drains, filter drains, infiltration swales, a detention basin, infiltration basin and soakaway. Various SuDS features will independently serve separate parts of the Proposed Development within the Converter Station Area, which are the Converter Station and access road. Attenuation shall be designed and provided to prevent flooding or exceedance flows for events up to and including a 100-year return period plus 40% climate change.

2.4.1.4. Infiltration rates and maximum groundwater levels are determined for this Strategy following an appropriate infiltration survey. Hydraulic modelling using Microdrainage Source Control (Appendix 7) has confirmed that the size of the basins is sufficient, and detailed design will size these in greater detail. In addition, BRE365 Soakaway Design states that proposed basins require a 1m standoff between groundwater and the basin base and as such, this shall also be incorporated into the detailed design for the drainage and attenuation features. Refer to Appendix 1 for Indicative drainage proposal.

2.5. CONVERTER STATION DRAINAGE

2.5.1.1. The Converter Station has a development area of approximately 4.3 ha, which will comprise buildings, roads, external electrical switchgear and associated infrastructure. All the permanent roads, hardstanding and footpaths shall be of impervious construction laid to falls. Otherwise, the Converter Station finishes shall comprise of a minimum 75mm thick layer of surfacing (chipping) over a minimum thickness of 300mm unbound free-draining sub-base, complying with the requirement of series 800: Earthworks in Highway Agency's 'Specification for Highway Works'. The thickness of the unbound free-draining sub-base will be dependent on the result of the CBR test in compliance with EC7- part 2 and BS 1377:part 9 which shall be undertaken at the detailed design stage.

2.5.1.2. The Converter Station drainage network shall receive runoff from building roofs; parts of the road subject to 'oily water'; and oil containment areas including transformer bunds, valve cooler bunds, above ground fuel storage and diesel generator bunds and associated precast trenches and any other precast trenches within oil containment area. Treatment shall be provided by a proprietary oil separator and SuDS features prior to discharge to groundwater via a soakaway, or other infiltration features, subject to the detailed design to suit the Converter Station layout.

2.5.1.3. Based on the current indicative Converter Station layout, approximately 1.7 ha has been considered impermeable and positively drained via a typical gravity controlled below ground pipe and chamber network for the initial and indicative drainage study.

2.5.1.4. In addition to the positive drainage network, the Convertor Station contains significant permeable granular fill/chipping areas which shall be specified to act as infiltration drains with storage attenuation and treatment filter media aspect before discharging to the ground under the Site. These areas shall only receive runoff from low traffic roads within the Convertor Station that are not within the designated oil containment road and paving areas.

2.5.1.5. Drainage from oil containment and 'oily water' areas is outlined here and addressed in detail within Section 4 of this strategy. Oil containment areas shall be bunds designed to capture polluting material including oils, fuels, diesels and glycol coolant to valve coolers during a catastrophic equipment failure, but these areas will also be exposed to rainfall that will be separated and drained to the surface water network. To achieve this, the oil containment areas shall be designed to drain to a dump tank for the first stage of separation, and the bulk of pollutants shall be retained within the dump tank while the water is pumped to an oil separator for the second stage of separation. Discharge from the separator shall then be conveyed through a SuDS network for further removal of pollutants prior to discharge to groundwater.

2.5.1.6. 'Oily water' may be generated on roads adjacent to oil filled plant and equipment, which may be subject to spills or leaks that raise the pollutant loading in rainfall runoff. Runoff from oily water areas shall therefore be collected by channel drains and directed to the oil separator for treatment, bypassing the dump tank. Flow from the separator will then be conveyed through a SuDS network for further removal of pollutants prior to discharge to groundwater.

2.5.1.7. The separation of oily water and treatment by the separator is to be in accordance with the National Grid Technical Specification ('NGTS') 2.10.01 section 3.4.2, accepted by the Environment Agency, which identifies areas within substations which do, and do not, require treatment by an oil separator.

2.5.1.8. The SuDS network receiving flow from the oil separator will comprise flame trap, catchpits, pipes and detention basin then soakaway. The location of catchpit(s) chambers with silt traps will be determined at the detailed design stage and will consider maintenance and engineering requirements.

2.5.1.9. The benefit of catchpit chambers is the early removal of suspended solids into a more easily maintained system. In the absence of catchpits, the solids may build up in pipes or in the sustainable drainage systems (SuDS) which may require more complicated and costly maintenance including the flushing of pipes and/ or the dredging and restoration of the SuDS. The location and frequency of catchpits will be determined, with a need to balance the potential for increased removal of solids with each additional catchpit against over-engineering and unnecessary maintenance requirements. Finally, the use of catchpits for water quality protection within the construction phase will be reviewed to ensure the provision of a clean and functional drainage system for the operational phase.

2.5.1.10. Maintenance of the SuDS systems will be in accordance with the CIRIA SuDS Manual (C753), the SNIFFER (UEUW01 & UEUW02, 2008) reports and Napier *et al* (2008), which form the basis of the SuDS treatment design.

2.5.1.11. Roof run-off will be collected by a positive drainage network which will include catchpit chambers with silt traps. The drainage network will discharge to the detention basin then soakaway, bypassing the dump tank and oil separator.

2.5.1.12. Gravel areas within the compound, but external to the buildings, will be designed to function as infiltration drains that will receive direct rainfall and road runoff, excluding the oily water area. Additional infiltration/cut off collector drains shall surround the converter station site to capture greenfield runoff from the embankment north of the site, in addition to road runoff. Surface water runoff treatment shall be provided through the infiltration drains prior to reaching the groundwater.

2.5.1.13. The infiltration rates through the existing geology underlying the infiltration drains and the introduced treatment filter media are sufficient to discharge runoff from events up to and including a 100-year return period plus 40% climate change, with additional surface water storage provided within the infiltration drains.

2.5.1.14. Groundwater levels have been demonstrated by site investigation to be deeper than 1 m below the base of the infiltration drains which is required by design standards.

2.5.1.15. The detention basin shall be able to overflow during extreme events to an infiltration basin further south, again providing additional surface water storage.

2.6. OVERLAND FLOW DRAINAGE

2.6.1.1. Overland flow and shallow subsurface runoff north of the development may be directed toward the Converter Station due to natural topography. As such, a filter drain shall be designed and installed to intercept these flows prior to the northern embankment. The filter drain shall connect to the outermost infiltration drain surrounding the Converter Station for direct infiltration to the ground. It is expected that the volume of overland flow intercepted shall be limited by the high infiltration capacity of the chalk geology and that the greenfield runoff will not require treatment, although this will still be provided by the filter drain and infiltration drain. Detailed design will give the final depth size of the infiltration drains.

2.6.1.2. A shallow overland flow route is identified on the Environment Agency Long Term Flood Map for events with a return period of 100-1000 years. The flow route intersects with the proposed access road and as such, culverts or other suitable infrastructure shall be incorporated to allow this flow to continue southwest of the road on its existing course. The detailed design shall ensure that there will be no increase in the existing flood risk to local residences from these works.

2.7. ACCESS ROAD DRAINAGE

2.7.1.1. The proposed Access Road will approach the Converter Station from the southeast and will create an impermeable surface of approximately 0.86ha. The road shall be designed with a cross fall to its south/west to direct runoff to an infiltration swale. The swale will be sized to store surface water and allow infiltration through an underlying infiltration drain, but shall also be able to convey exceedance flows to an infiltration basin if additional storage is required. Water quality treatment will be provided by the swale and vegetation, then subsequent infiltration through the underlying treatment filter media.

2.7.1.2. Refer to Appendix 1 for Indicative Drainage Proposal.

2.8. TELECOMMUNICATION COMPOUND DRAINAGE

2.8.1.1. It is proposed that two Telecommunication Buildings will be located on the south of the Converter Station and West of the access road, outside the main Converter Station Security fence.

2.8.1.2. Each Telecommunication Building will have a maximum footprint of 8m long x4m wide x3m high and will also have secure fencing with access with parking for up to two vehicles for maintenance purposes. It is currently anticipated that the compound for the Telecommunication Buildings would have a maximum size of 10mx30m with an anticipated layout illustrated in Plate 5.

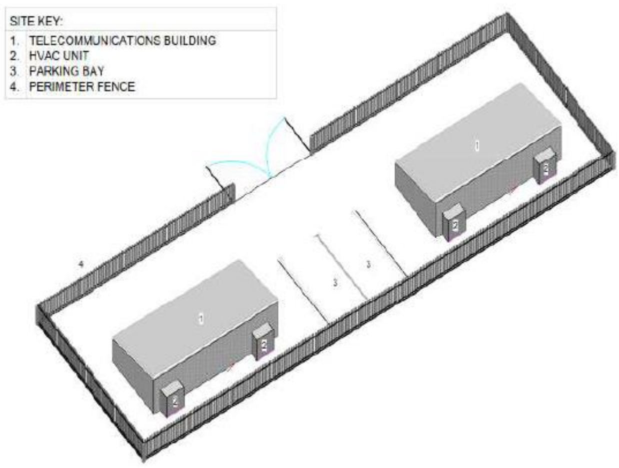


Plate 5 – Indicative Telecommunication Buildings Compound Layout

2.8.1.3. Roof run-off will be collected by a positive drainage network which will include catchpit chambers with silt traps. The drainage network will discharge to the swale on the west side of the access road which, will allow infiltration through an underlying infiltration drain, but will also be able to convey exceedance flows to an infiltration basin if additional storage is required. Water quality treatment will be provided by the swale and vegetation, then subsequent infiltration through the underlying drain.

2.8.1.4. Gravel areas within the compound, but external to the buildings, will be designed to function as infiltration drains that will receive direct rainfall and road runoff.

2.9. VALVE COOLERS

2.9.1.1. Glycol is used as an antifreeze agent in valve coolers. Total cooling liquid per pole is approximately 10,000 litres and 40% glycol that gives approximately 8000 litres with a small amount of about 500 litres in the make-up tanks, which is located inside the building. Valve coolers shall be located within monolithic in-situ reinforced concrete bunds. Bunds will be designed to BS EN 1992-3:2006 – Design of concrete structures for retaining liquids in compliance with the requirement of CIRIA C660 – Early age thermal crack control in concrete.

2.9.1.2. Under normal operational conditions, bunds only discharge run-off from rain water, which will accumulate in a sump within the bund. The sump will host a Bund Water Control Unit (‘BWCU’), which will pump water out into adjacent drainage system. BWCU shall be equipped with glycol detecting system, which will force stop the pump should any glycol be detected. When glycol is detected, an alarm will be activated and all glycol and any rain water entering the bund after alarm activation will be stored in the bund, until the bund is emptied by appropriately trained staff under controlled conditions. The contaminated liquid will be pumped to a designated tanker storage vehicle, which will transfer this off site to an appropriate waste facility.

2.9.1.3. The pump alarm shall be connected to the Converter Station Supervisory Control and Data Acquisition (‘SCADA’) system.

2.9.1.4. It is recommended by AQUASENTRY (BWCU supplier) that a minimum of an annual service is performed, but six monthly servicing is the practical norm within the industry. This recommendation has been given by a supplier which may not be the supplier of the system. Therefore, the final maintenance requirement shall be confirmed during detailed design in-line with the supplier recommendation.

2.10. DIESEL GENERATOR AND FUEL TANK

2.10.1.1. The diesel generator and the fuel tank shall be located within monolithic in-situ reinforced concrete bunds. Binds will be designed to BS EN 1992-3:2006 – Design of concrete structures for retaining liquids in compliance with the requirement of CIRIA C660 – Early age thermal crack control in concrete. The piping between the fuel tank and diesel generator shall be also installed inside a fully sealed precast or in-situ concrete trench that is connected to the oily water drainage system.

2.10.1.2. Under normal operational conditions, bunds will only discharge run-off from rain water, which will accumulate in a sump within the bund into to oily water drainage system. The sump shall host a BWCU, which will pump water out into adjacent oily water drainage system. BWCU will force stop the pump should any diesel be detected. In that case, bund will need to be cleaned manually. The pump will be alarmed and connected to the Converter Station SCADA system.

2.10.1.3. Refer to Appendix 5 for the typical fuel tank bund details.

3. FOUL WATER DRAINAGE

3.1.1.1. The Converter Station and Telecommunication Buildings are typically unmanned. The very limited foul water flows generated from kitchen and toilets in the control building in the Converter Station and welfare facility in the Telecommunication Buildings when the facilities are occupied for routine maintenance, shall be routed via below ground drains to a fully sealed cess tank. The design of the system shall be in accordance with Building Regulations Part H and BS EN 752:2017.

3.1.1.2. All drains shall be provided with suitable gradients to ensure self-cleansing in accordance with Building Regulations Part H and Sewers for Adoption version 7.

3.1.1.3. The cess tank shall be an underground fully sealed container with a minimum of 9000L capacity in an accessible location on site to facilitate future maintenance and emptying. The cess pool shall be double lined i.e. tanker cased in concrete and shall be fitted with a float switch and high-level alarm system connected to the SCADA system. Detailed design shall include a requirement to specify a maintenance strategy for appropriate planned inspection and emptying/cleaning. This strategy will include suitable checks for evidence of leakage

3.1.1.4. Some equipment on site will contain Sulphur Hexafluoride ('SF6'). SF6 is an inorganic, colourless, odourless, non-flammable, heavy gas that is widely used in electrical substations because of it is an excellent electrical insulator. Although SF6 is inert during normal use, highly toxic by-products are produced that pose a serious threat to the workers who come into contact with them when electrical discharge occurs during the maintenance of some of the electrical equipment (only in an unlikely accidental event) within converter station that are contained SF6.

3.1.1.5. Discharge from the SF6 shower/wash-down area that is usually located in the control building and will be used only in an emergency, will be also connected to the fully sealed underground cess tank.

3.1.1.6. Refer to Appendix 3 for the typical cess tank details.

4. OIL CONTAINMENT AND OILY WATER DRAINAGE

4.1. INTRODUCTION

4.1.1.1. Oily water is classified as rainwater runoff and/or surface wash down which may potentially contain small amounts of low hydrocarbon concentrates that can be treated directly by the oil separator.

4.1.1.2. All areas where rainwater runoff may potentially contain small amounts of oil (e.g. resulting from leaks or spillages) shall be drained off site through an oil separator; this drainage is referred to as the oily water drainage. Areas to be drained via the oil separator are:

- Oil handling areas and test areas for oil containing equipment;
- Roads or areas that are designated for the siting of plant/vehicles for servicing of oil containing plant or storage tanks; and
- Skidways and Transformer bunds.

4.1.1.3. The Converter Station will contain six working transformers and a spare transformer which will be kept empty of any oil. Transformer bunds shall be connected into a remote underground containment facility (dump tank); this is referred to as the oil drainage.

4.1.1.4. An Emergency Oil Containment and Water Management Plan shall be prepared as well as an Operating Manual to aid maintenance and to enable the emergency services to deal effectively with an incident involving accidental spillage of oil. The documents shall be prepared in compliance with Environment Agency GPP21.

4.1.1.5. The following areas in the Converter Station Area have been deemed not to typically require drainage via an oil separator;

- Roads and car parking outside the oil containment area which shall drain to the adjacent stone surfacing; and Open areas outside oil containment surfaces by gravel.

4.2. OIL DRAINAGE

4.2.1. TRANSFORMERS

4.2.1.1. Transformers shall be located in a fully reinforced concrete liquid retaining bunds which shall be linked to underground dump tank/s. Subject to the site fire assessment and through discussion with local fire authority a fire active suppression system may be designed and installed on site. The size of the bund shall be determined based on volume of oil, volume of water (for active fire suppression system) as well as an appropriate factor of safety and shall be designed to BS EN 1992 - liquid retaining structures.

4.2.1.2. To ensure that all oil is contained in case of a catastrophic equipment failure the clear horizontal distance between the internal face of the oil retaining area walls and transformer shall be a minimum of 2.0m. The adoption of the compliant underground containment oil design philosophy will prevent flame or burning liquid being transferred into elements of the work outside the bund structure and will limit the fire pool to a defined perimeter in relation to the footprint of the oil containment area.

4.2.1.3. Rain water or other surface water will permeate through a flame trap. Each oil containment area shall have an outlet into the oil drainage system; this shall contain a cast in ductile iron (or an appropriate alternative material) U-bend syphon flame trap (to contain fire to bund area only) and rectangular in-situ manhole chamber housing an isolation gate valve to isolate the bund in an emergency. The isolation gate valve, downstream of the flame trap, in the outlet chamber is to allow the bund to be isolated if required.

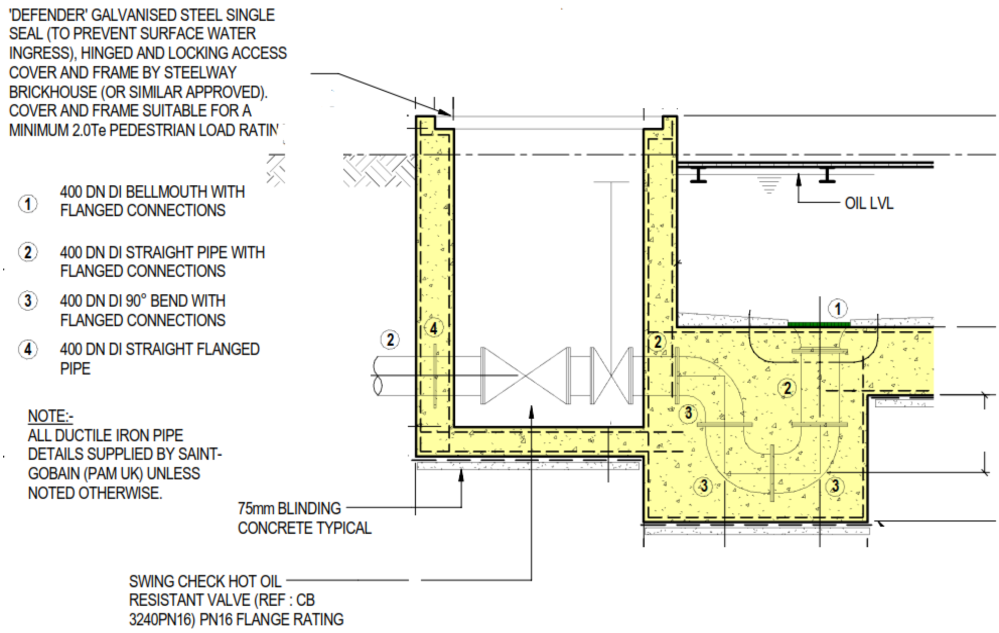


Plate 6 – Typical U-bend Syphon Flame Trap

4.2.1.4. In the event of a catastrophic equipment failure, oil from one bund is prevented from entering an adjacent bund by having independent trenches and pipe outlets and no penetrations through the bund dividing walls. Backing up of oil from one bund into another via the oil pipework is prevented as the oil pipework system is designed to have the capacity to drain away oil flows from the affected bund pipework without backing up.

4.2.1.5. All bunds, following construction, will be subject to a water retention test in accordance with requirements of BS EN 1992 - liquid retaining structures by temporarily sealing the fire trap outlet.

4.2.1.6. Following completion and commissioning of the system it is considered unlikely that any maintenance of the 400 mm diameter pipework would be required.

4.2.1.7. For maintenance and inspection of the oil pipework, should it be required, any personnel entry into the manholes would be regarded as entering confined space and therefore requiring accompanied inspection and necessary monitoring. In the unlikely event of sudden transformer oil discharge occurring during this event sufficient warning/time should be available to vacate the manhole.

4.2.1.8. Should it be necessary to maintain any bund, risk of backflow from adjacent bunds shall be eliminated by the use of appropriate plugs inserted into the pipework.

4.2.1.9. It was requested by PW and EA during a workshop on 18th July 2019 to explore the possibility of enclosures/hard cover to the transformers to collect rain water run-off via an enclosure roof to mitigate potential low hydrocarbon run-off from bunds. In response it is confirmed that usually the radiators and conservator would sit outside any enclosure, as these require cool outside air to blow through them and often fans attach to the bottom of the radiators to encourage that flow of air and therefore a four-sided enclosure (3 sides and the roof) may impact the air circulation and negatively impact the transformer performance. Considering the SuDS and water quality management system that was discussed and is explained in chapter 5 of this strategy, an appropriate system will be designed and constructed which will provide appropriate levels of protection against contamination of the Aquifer without enclosures/hard cover to the transformers.

4.2.1.10. Refer to appendix 2 for the indicative oil containment layout and the typical transformer bund details.

4.2.2. OIL DRAINAGE PIPEWORK

4.2.2.1. The flame traps, manholes and pipes forming the interconnecting drainage system, between the transformers oil retaining areas and the dump tank, is a closed free flowing gravity system capable of accommodating oil and water at temperatures of 80°C at a rate of 7000 litres per minute (117 litres per second)

4.2.2.2. Once the Converter Station site layout has been developed, a detailed and comprehensive fire risk assessment and fire strategy report for the Converter Station including buildings and all site infrastructure/assets will be undertaken. This will include determination of fire compartmentation, fire suppression requirements, fire detention and appropriate fire rating of all buildings and equipment on site. The Contractor shall be required to interface with and seek the approval of the local fire authority, relevant statutory authorities, third parties and local authorities in relation to fire risk and mitigation and will comply with all relevant legislation and building regulation requirements. Subject to the outcome of the detailed fire risk assessment a fire active suppression system may be designed and installed on site. The size of the transformer bund will be determined based on volume of the oil in transformer and water from active fire suppression system as well as appropriate factors of safety. In the event of a catastrophic failure, oil and potential water from the active fire suppression system will permeate through a flame trap into the oil drainage system through a cast in ductile iron (or an appropriate alternative material) U-bend syphon flame trap into underground oil containment, where the oil and water will be stored and emptied manually when it is safe to do so.

4.2.2.3. All the pipework shall be sized to discharge the calculated flow rate (oil and water) into the underground oil containment dump tank without accumulation of fluid in the oil retaining area.

4.2.2.4. The flame trap, manholes and pipes forming the interconnecting drainage system between the transformer bunds and the dump tank will be a closed free flowing gravity system capable of accommodating oil and water at temperature of 80°C at a rate of 7000 litres per minute.

4.2.2.5. The design of pipework between transformers and dump tank/s shall ensure:

- Each individual pipe run is capable of taking the suitable design flow rate and,
- Minor head losses that occur in the longest pipe route (from furthest flame trap to the dump tank) do not reduce flow rate and velocity below the designed minimum acceptable to meet design requirements.

4.2.2.6. The route of the pipework shall be continuous, closed system with the shortest possible length with minimal vertical and horizontal deviation.

4.2.2.7. Four hours fire resistance shall be provided to all pipework within the defined fire damage zone. This will generally be best achieved by direct burring.

4.2.3. UNDERGROUND OIL CONTAINMENT (DUMP TANK)

4.2.3.1. The tank shall be sized to accommodate the maximum volume from a catastrophic failure of the largest oil containing equipment on site including associated active fire protection system.

4.2.3.2. The dump tank construction shall be of Glass Reinforced Polymer ('GRP') with a chemical resistant liner (or reinforced in-situ/precast water and oil tight concrete) resistant to all types of oil at 80°C. Clean water shall be pumped out of the Dump tank via a bund water control pump to a manhole at appropriate discharge rate (to be calculated at detailed design stage), before flowing by gravity to an oil separator prior to be being discharged into the surface water drainage system.

4.2.3.3. The pipework shall incorporate a penstock valve immediately before the dump tank to allow the tank to be isolated during any necessary maintenance.

4.2.3.4. The dump tank shall be double lined i.e. tanker cased in concrete and shall be fitted with a high-level alarm system connected to the SCADA system.

4.2.3.5. Following PW and EA request, the possibility of an above ground dump tank was explored. The proposed drainage system is a gravity system. The raising of the dump tank above ground will require the installation of a pump chambers below ground, which is considered likely to negate any benefits and to introduce additional risk. For example, introducing pumps will introduce the risk of pump failure, which would potentially result in untreated pollutants flooding from the pump chambers to the existing ground. Therefore, a dump tank above ground is likely to add complexity and associated risks to the drainage design and infrastructure with no real benefit

4.3. OILY WATER DRAINAGE

4.3.1. INTERNAL ROADWAYS (OIL CONTAINMENT ROAD AREAS)

4.3.1.1. The main Access Road and skidways immediately adjacent to the transformers shall be fitted with raised sealed kerbs, linear drainage channels, gullies and an associated gravity drainage system which connected to the oil separator. This is to ensure that any minor oil spillages during transformer maintenance work are effectively contained and discharged through the oily water drainage system in accordance with standard supplier's operational protocols.

4.3.2. OIL SEPARATOR

4.3.2.1. The oil separator shall be a Class 1 full retention unit to BS EN 858-1 incorporating a coalescer automatic closure device and high oil level alarm and rated to suit a hard-standing area to cater for the rainfall intensity in accordance with the EA's Pollution Prevention Guideline (PPG3).

4.3.2.2. A minimum oil storage volume to suit catchment area shall be provided by the separator and the separator shall be fully capable of isolating all upstream oil flow if the high-level oil alarm is activated.

4.3.2.3. Oil resistant nitrile rubber seals shall be employed throughout the oil & oily water drainage systems. The oil separator shall be vented in accordance with the manufacturer's recommendations, with vents located clear of all site operating areas, a minimum 2000 mm above ground level. Vent pipes shall be suitably supported and protected from vehicular traffic by means of spaced concrete bollards.

4.3.2.4. The oil separator shall follow the requirement of EA's PPG3 and shall be designed to European Standard BS EN 858-1: Separator systems for light liquids (e.g. oil and petrol)

4.3.2.5. The separated water shall discharge directly into the surface water drainage system, as the treated water.

4.3.2.6. The oily water drainage shall incorporate a penstock to close off the system in accordance with Environmental Agency requirements, to prevent discharge off site in the unlikely event of an environmental incident on site coinciding with a fault of the oil/oily water system separator/dump tank.

4.3.2.7. The interceptor shall be double lined i.e. tanker cased in concrete and will be fitted with float switch and high-level alarm system and shall be connected to the SCADA system.

4.3.2.8. During meeting with PW and EA it was advised that there is a preference for design development of a system with an above ground interceptor. It is considered that raising of the dump tank and interceptor above ground would require the installation of a pump chambers below ground, which is considered likely to negate any benefits and to introduce additional risk. For example, introducing pumps will introduce the risk of pump failure, which would potentially result in untreated pollutants flooding from the pump chambers to the existing ground. Finally, there is limited space above ground, so to raise the infrastructure would require detailed changes to the compound boundary and layout. Therefore, an interceptor tank above ground is likely to add complexity and associated risks to the drainage design and infrastructure with no real benefit.

5. SUDS AND WATER QUALITY SYSTEM

5.1.1.1. Surface water from oil containment areas and oily water areas shall be directed through the proprietary system of an oil separator. A manufacturer SPEL has provided specifications for their 'Puraceptor' which advises that, for all units tested, the discharge water has an average hydrocarbon concentration of 1.22mg/litre. The Environment Agency has advised that the

> '…*former drinking water standard (still used by most water companies) is 0.01 mg/l. As well as this, in line with the permitting regulations, hydrocarbons must not enter groundwater at detectable quantities.'*

5.1.1.2. Therefore, it is proposed to use SuDS to further reduce the hydrocarbon concentration of water discharged from the oil separator, prior to discharge via a soakaway to groundwater.

5.1.1.3. The principles of treatment below present existing research into the removal of TPH (total petroleum hydrocarbons), PAH (polycyclic aromatic hydrocarbons) and heavy metals, from water by SuDS. Included in the research is soil selection, effect of environmental parameters and design recommendations, as well as data to demonstrate the subsequent pollutant removal by SuDS.

5.2. PRINCIPLES OF TREATMENT

5.2.1.1. The principles of treatment are based on the SNIFFER (UEUW01 & UEUW02, 2008) reports and Napier *et al* (2008) articles identified in Section 2.3 and which also support the CIRIA C753 SuDS Manual. This series of documents were produced by dual projects researching the water quality treatment provided by infiltration SuDS receiving carriageway runoff that contained Total Petroleum Hydrocarbons') ('TPH'), Polycyclic Aromatic Hydrocarbons ('PAH') and heavy metals. The research was undertaken in laboratory and field experiments. Within the laboratory, experiments used soil core lysimeters to which pollutants were applied and their discharge concentration measured, before destructive sampling of the soils; in addition, degradation studies were undertaken to assess the effect of varying parameters upon the degradation of organic pollutants within soil. Within the field, researchers measured pollutant concentration in the soils and pore water of SuDS that have been operational for approximately 10 years (UEUW02, 2008 pp.20).

5.2.1.2. The studies identified a two-stage process for pollutant removal; the first stage is removal of TPH, PAH and heavy metals from water by infiltrating it through soils; the second stage is removal of the TPH and PAH from the soils by 'degradation', which removes these organic pollutants from the SuDS system. UEUW01 (2008) identified that the process of degradation may involve biotransformation of TPH and PAH to daughter products or smaller molecules 'before the compound could be said to be completely degraded or mineralised' (pp. 22). While Napier *et al* (2008b) confirms that it is only the organic compounds, TPH and PAH that will be degraded, as the heavy metals will remain within the soils.

5.4. SOIL SELECTION, LYSIMETER AND DEGRADATION STUDIES

5.4.1.1. To inform soil selection, the lysimeter study investigated loamy sand (HOST class 3 (Hydrology of Soil Type), clay loam (HOST class 21), silty clay loam (HOST class 18) and a constructed SuD lysimeter of gravel, sand and a top layer of biologically active topsoil. The lysimeter study applied a single dose of pollutants in solution, to the surface of the soil cores and irrigated these for 135 days, measuring the pollutant concentrations within the discharging drainage water. At the end of the irrigation period destructive sampling of the soil cores was undertaken.

5.4.1.2. The separate degradation study investigated the effects upon pollutant degradation of moisture, temperature, pollutant concentration and bioactivity (microbial activity) by destructive sampling of loamy sand lysimeters. This degradation study was undertaken for 2 months and reported in UEUW01 (2008), then extended to 6 months being reported in UEUW02 (2008) to give further results for TPH degradation. Napier *et al* (2008 b) identifies that heavy metals will be retained within the soils, but not degraded and as such, high loadings may eventually require removal and appropriate disposal.

5.4.1.3. The pollutant removal rates from water by all soil types was shown to be high, as discussed below and presented in Plate 7, 8 and 9. UEUW02, (2008; pp. 30 Fig. 21) recommends 'loamy soil' as most suitable for pollutant removal and the study results demonstrate that the silty clay loam (HOST class 18) achieves the highest degradation of pollutants collected within the soils. The study however does not provide specific infiltration rates for the soils and a review of standard infiltration rate for 'silty clay loam' ($1*10^{-8}$ to $1*10^{-6}$, Ciria C753 Table 4) demonstrated the need for modification to allow infiltration through the treatment filter media sufficient for the SuDS to function effectively. As such it is recommended that a modified silty clay loam with an infiltration rate of $4*10^{-6}$ m/s is used as the SuDS treatment filter media in the Converter Station Area.

5.4.1.4. It is assumed that the modified silty clay loam will be made more permeable by the addition of sand, however this will be confirmed in detailed design by the contractor. Based on this assumption it is considered that the modified material will still achieve the same high removal of pollutants from the water into the soil, which was achieved for all soils (Plates 7-9 below) and will achieve similar degradation of pollutants within the soil, as was achieved by the silty clay loam. The detailed design by the contractor will incorporate monitoring of pollutants within the soils, and if deemed required, the discharge water from the detention basin upstream of the soakaway to be undertaken to inform maintenance and replacement of the treatment filter media.

5.4.1.5. To maintain water quality at the area within Order Limits as suitable to the underlying chalk, the pH of the silty clay loam filter media selected should be neutral or alkaline, while an acidic soil should not be used.

5.4.1.6. SNIFFER UEUW02 (2008) also identified the influence of nutrient levels, particularly nitrogen to support microbial activity. However, the study recognised that fertiliser would not typically be added to SuDS and as such did not use it to artificially enhance microbial degradation in the experiments. The nitrogen concentration of the soils used in the study was reported as 'within the range of reported concentrations (2.5mg/kg – 29.8 mg/kg)' (pp.4) which may be suitable for a comparative range if it is of concern during construction. However, addition of nitrogen to the Converter Station Area is not recommended.

5.5. TPH AND PAH DEGRADATION

5.5.1.1. The SNIFFER and Napier *et al* (2008) studies highlight the importance of degradation to remove TPH and PAH pollutants from the soils and therefore from the SuDS system. Microbial degradation was identified as 'the main method of hydrocarbon degradation in soils and sediments' (UEUW02, 2008 pp.3). While the environmental parameters relevant to SuDS which can further affect or compliment microbial degradation are changes in temperature, soil moisture and pollutant loading.

5.5.1.2. It is worthwhile noting that changes in these parameters were not reported as affecting the removal of TPH and PAH from water into the soils, but rather as slowing the rate of organic pollutant degradation within the soils for overall removal from the SuDS. UEUW02 (2008) also suggests that the breakdown of organic pollutants may experience seasonal variation, particularly with regard to temperature with 'rapid breakdown in summer temperatures and slower rates in winter' (2008, pp.3). Therefore, it is expected that warmer seasons will allow for the degradation of pollutants retained within soils.

5.5.1.3. Soil moisture is reported in the SNIFFER and Napier *et al* (2008) documents as strongly affecting organic pollutant degradation. As part of the field study, ponds under permanently saturated conditions were found to contain high concentrations of pollutants that have been captured by the soils, but not degraded. It was considered likely that the permanent saturation had resulted in low oxygen conditions which prevented the aerobic microbial degradation (UEUW02, 2008 pp.22). Whereas, the basins subject to a wet/dry cycle experienced aerobic conditions that resulted in organic pollutant degradation. As such, this cycle is recommended by SNIFFER and Napier *et al* (2008) to achieve removal of organic pollutants from SuDS. Therefore, a wet/dry cycle is also recommended for the design of SuDS at the Converter Station Area.

5.5.1.4. Pollutant loading was reported as resulting in higher residual pollutant concentrations within the soils, which had not been degraded. However, at the Converter Station, discharge from the oil separator is advised by the manufacturer SPEL as providing an average hydrocarbon concentration of 1.22 mg/l (The unit does work at a discharge rate of <5mg of oil per litre - 5 parts per million when discharging to surface water). As such, high concentrations or extreme fluctuation of discharged organic pollutant are not expected. In addition, runoff from roads discharging to infiltration drains and not to the separator, is expected to contain comparatively low pollutant loads due to the low traffic levels.

5.6. POLLUTANT REMOVAL

5.6.1.1. The UEUW01 Final Report (2008) demonstrates through the lysimeter studies that greater than 99.9% of TPH and PAH was removed by soils, leaving less than 0.068% of pollutants to potentially reach the groundwater. Of the >99.9% organic pollutants removed by the soils, the silty clay loam achieved the highest degradation with 76.06% TPH and 68.10% PAH removed from the soils.

Due to the effectiveness of all studied soils at removing pollutants from water, it is expected that the modification of the silty clay loam to achieve a design infiltration rate of $4*10^{-6}$ m/s will achieve equally effective water quality treatment, while allowing the SuDS to function effectively. It is recognised that the degradation of pollutants captured within the modified silty clay loam may be lower than the 68.10% identified in the study, but it is expected still to be higher than was achieved for the Sand with 35.10% degradation. . As stated in section 5.3.1.4 above, the detailed design by the contractor will incorporate monitoring of pollutants within the soils, and if deemed required, within the discharge water from the detention basin upstream of the soakaway to be undertaken to inform maintenance and replacement of the treatment filter media. The detailed design shall specify a maintenance regime suitable to the characteristics of the filter media produced, approved and installed to best protect the groundwater environment, to be agreed with the statutory approving bodies.

	SUD	Sand	Silt	Clay
% leached	0.003	0.003	0.005	0.056
% retained	64.00	64.90	31.89	54.56
% degraded	35.99	35.10	68.10	45.38

% retained included any PAH present in the soil prior to treatment.

Plate 7 - PAH mass balance for SUD, sand, silt and clay lysimeters (UEUW01, 2008, Final Report Tb 6)

	SUD	Sand	Silt	Clay
% leached	0.005	0.011	0.012	0.068
% retained	19.30	70.70	23.93	29.39
% degraded	80.69	29.29	76.06	70.54

% retained included any TPH present in the soil prior to treatment.

Plate 8 - TPH mass balance for SUD, sand, silt and clay lysimeters (UEUW01, 2008, Final Report Tb 7)

5.6.1.2. The lysimeter studies also demonstrate that greater than 99.84% and 99.75% of heavy metals were removed by the silty clay loam and the loamy sand respectively leaving only 0.25% to 0.04% of the heavy metals to potentially reach the groundwater. Napier *et al* (2008b) do identify however, that heavy metals are not degraded and will therefore remain within the soils which may require disposal if high concentrations accumulate.

	SUD	Sand	Silt	Clay
Cadmium	0.05	0.25	0.16	0.23
Copper	0.19	0.11	0.13	0.45
Zinc	0.03	0.02	0.04	0.31

Plate 9 - Percentage of applied metals measured in drainage water (UEUW01, 2008, Final Report Tb 8)

5.6.1.3. The UEUW01 Final Report (2008) also took soil water samples to a depth of 0.9m at the inlet of an existing SuDS basin receiving carriageway runoff containing TPH, PAH and heavy metals. The design of the basin (29A) also resulted in the majority of pollutants being removed at its inlet. Therefore, measurement of pollutants within soil water samples at this location is measuring the worst-case scenario.

Sampling date	Cd mg l^{-1}	Cu mg l^{-1}	Pb mg l^{-1}	Ni mg l^{-1}	Zn mg l^{-1}	pH	TPH mg l^{-1}	Total PAH µg l^{-1}
23/03/07	*	0.001	*	0.003	*	ns	*	0.33
31/03/07	*	0.009	0.002	0.003	0.010	7.6	0.2	0.99
11/05/07	*	0.013	0.001	0.003	0.010	7.7	*	0.16
29/06/07	*	0.009	0.002	0.211	0.020	8.2	0.1	ns

Plate 10 - Summary of pollutant concentration in soil water (UEUW01, 2008, Final Report, Tb 17, measurements from Basin 29A)

5.6.1.4. The results demonstrate that the Total PAH concentrations in soil water were a maximum of 0.00099 mg/l (0.99µg/l) while the TPH concentrations 'either remained or very quickly fell to below the analytical reporting limit' (UEUW01, 2008 pp.15) for aqueous samples, as confirmed by the reporting limits included in the UEUW01 (2008) (Table 6 below).

	Reporting limit	
Determinand	Aqueous	Soil/sediment
Cadmium	0.0001 mg l^{-1}	0.1mg kg^{-1}
Copper	0.001mg l^{-1}	0.5mg kg^{-1}
Lead	0.001mg l^{-1}	0.5mg kg^{-1}
Nickel	0.001mg l^{-1}	0.5mg kg^{-1}
Zinc	0.002mg l^{-1}	3mg kg^{-1}
TPH	0.1mg l^{-1}	10mg kg^{-1}
Total PAH	0.01ug l^{-1}	1.28mg kg^{-1}
Nitrate N	0.3mg l^{-1}	5mg kg^{-1}
Ammoniacal N	0.01mg l^{-1}	0.5mg kg^{-1}
Total N		0.30%
Available P		0.1mg l^{-1}
Dissolved P	0.3mg l^{-1}	
Phosphate	0.01mg l^{-1}	
Total P	0.3mg l^{-1}	30mg kg^{-1}
TOC		
FOC	0.1mg l^{-1}	0.02%

Plate 11 - Analytical reporting Limits (UEUW01, 2008, Final Report Tb 25)

5.7. POLLUTANT SOIL RETENTION DEPTH

5.7.1.1. The soil core lysimeters producing the results above, had a depth of 0.6m and the SNIFFER and Napier *et al* (2008) studies identify that TPH, PAH and heavy metal pollutant retention is concentrated within the top 100 mm of soil with limited migration to 300 mm depth.

5.7.1.2. UEUW01 (2008, pp.16) reports that below the top 100 mm of soil, no soil samples showed PAH concentrations above the analytical reporting limits. This result was reported for all soil types, except the clay, however it is the modified silty clay loam that is recommended for the Converter Station Area. In addition, UEUW01 (2008) concludes that the minimum percentage removal for all pollutants and all soils in the lysimeter study was '99.55% within a 300mm deep column of soil' (pp. 45).

5.7.1.3. It has been agreed with PW that as a precautionary measure, an infiltration layer of 0.6 m depth will be implemented at the Converter Station Area for treatment of water discharging from the oil separator, in accordance with the lysimeter studies. The detailed design will also agree the infiltration layer depth to be applied at basins and soakaways, and it may be that review of proposals at that time identifies a benefit of specifying that increased (0.6m) depth at each such location.

5.8. ADDITIONAL DESIGN FEATURES

5.8.1.1. In addition to the research results above, the SNIFFER and Napier *et al* (2008) documents identified design features that further enhanced pollutant removal.

5.8.1.2. Napier *et al* (2008a) best explain the effect of inlet design on the pattern of pollutant removal within a basin (or other SuDS feature) and identify that an inlet where 'inflow velocity quickly dissipates' (pp. 6) will result in the majority of pollutants being deposited near to the inlet; whereas a long narrow inlet channel which maintains inflow velocity will transport pollutants further.

5.8.1.3. In line with the above, SNIFFER and Napier *et al* (2008) recommend that basin design should be 'wide and shallow' rather than 'narrow and deep' (Napier *et al*.; 2008a; pp. 9). UEUW02 (2008) further advises that a small and deep area is the poorest option, but that a long and more narrow design such as a low flow channel, can be a good compromise due to the extended contact provided.

5.8.1.4. These features have been considered in the SuDS design described below.

5.9. SPECIFICATION FOR SUDS COMPONENTS

The water quality treatment features recommended for inclusion in the SuDS design at the Converter Station Area are summarised in this section. While the design of each individual SuDS feature, that must be suitable for surface water flood attenuation as well as water quality treatment, will be described in more detail in section 5.11 and shown on drawing AQD-WSP-OS-UK-DR-D-200340 in Appendix 1, infiltration has been identified as the primary process for removal of TPH, PAH and heavy metals from water and as such, SuDS shall be designed to allow infiltration through filter media that will be specified at the detailed design stage by the Contractor. Infiltration basins and drains will then be able to continue the infiltration to groundwater, whereas detention basins and filter drains that are not intended for direct infiltration to groundwater, shall be designed to collect water in underdrains below the filter media, then convey this water further along the surface water drainage system.

5.9.1.1. The soil type recommended is the modified silty clay loam (HOST class 18), with a neutral or alkaline pH and achieving an infiltration rate of $4*10^{-6}$ m/s. Please note, an acidic soil is not suitable and shall not be used. Although Nitrogen shall not be added to the SuDS or treatment filter media, the naturally occurring nitrogen concentration of the selected silty clay loam, can be compared to the study's reported ranges of 2.5 mg/kg – 29.8 mg/kg if required.

5.9.1.2. The depth of treatment filter media downstream of the oil interceptor shall be minimum of 0.6m, as agreed with PW to replicate the lysimeter studies and as a precautionary approach. If this depth is to be altered in other locations, the treatment filter media shall be no less than 0.3 m in accordance with recommendations in the SNIFFER reports (UEUW01, 2008 pp.45; UEUW02, 2008 pp.30). In the event that other filter media is required for hydraulic performance, this shall be in addition to the 0.6m or 0.3m of treatment media and shall not replace the material, unless its water quality benefits have been demonstrated.

5.9.1.3. The inlets to basins and swales shall incorporate flow dissipation apparatus to enhance pollutant deposition near the inlet. The beds of basins and swales shall also be maintained as shallow and wide as possible to maximise pollutant treatment and spreading of water. In the case of the detention basin, a wide low flow channel shall be proposed to utilise the full length of the basin and maximise retention time for infiltration and pollutant removal. Without the channel, there is potential for flow routes to ‘short circuit’ the basin and flow directly from the inlet to the outlet. The low flow channel width shall be a minimum 2m and the depth shall be a maximum 200 mm, allowing higher flow rates to overtop and spread over the rest of the basin, avoiding erosion into a deep narrow channel.

5.9.1.4. A wet/dry cycle has been identified as essential for degradation of the organic pollutants TPH and PAH and as such, features shall be designed so that complete drainage is possible, creating aerobic conditions within sediments. Where features are designed to permanently hold water, these should be located in areas receiving the lowest pollutant concentrations possible, such as away from the inlet.

5.10. OIL CONTAINMENT AND OILY WATER AREAS

5.10.1.1. As described in section 4, oil containment areas shall drain to the dump tank and then the oil separator; whereas the oily water areas will drain runoff directly to the oil separator. The oil separator will be discharging surface water with an averaged hydrocarbon concentration of 1.22 mg/l (based on information provided by SPEL) which shall be conveyed to the detention basin for additional treatment.

5.11. ROOF RUNOFF AND CATCHPITS

5.11.1.1. Roof runoff shall be directed through the conventional drainage network to the detention basin bypassing the dump tank and hydrocarbon interceptor. The CIRIA C753 Simple Index Method identifies roof runoff from commercial/industrial roofs as having a ‘low’ pollution hazard level which will be suitably treated by any SuDS feature and as such, treatment within the detention basin is considered satisfactory. However, additional pre-treatment for removal of suspended solids shall be provided by catchpit chambers with silt traps that will require maintenance for removal and disposal of sediment and other pollutants.

5.12. DETENTION BASIN

5.12.1.1. The detention basin shall be lined and impermeable, but shall contain a layer of added treatment filter media above the impermeable liner to allow treatment by infiltration to under-pipes which will collect and convey treated water to the soakaway. The basin will be designed for the dual purpose of water quality treatment and surface water attenuation upstream of the soakaway.

5.12.1.2. The basin shall be vegetated, with a maximum bank gradient of 1:3 and a maximum depth to bed level of 2 m which includes 0.3 m freeboard. Underlying the bed shall be a 0.6 m deep layer of treatment filter media (modified silty clay loam, neutral to alkaline pH, infiltration rate of $4*10^{-6}$ m/s). The base of the filter media shall be an impermeable liner to prevent infiltration to groundwater and as such, underdrains placed at the base of the infiltration layer shall collect and convey treated water to the soakaway. If required, treated water will pass through a flow control to ensure discharge at agreed rates, however this is not expected to be a requirement because of the controlled rate of $4*10^{-6}$ m/s achieved by the treatment filter media. During large rainfall events the basin will start to fill as the discharge rate will be limited by the infiltration rate of the filter media. In the event that inlet rates are higher than the infiltration and discharge rates, water will be able to pass through a 'high level overflow' to the roadside swale which will convey it to the southern infiltration basin.

5.12.1.3. The basin shall drain completely and remain dry between rainfall events, due to the need for aerobic conditions within the treatment filter media.

5.12.1.4. The basin inlet shall include a level spreader and flow dissipation apparatus to reduce flow rates and maximise pollutant removal and infiltration near the inlet. A low flow channel, of 2 m width and maximum 0.2 m depth will help spread water through the basin and increase residency time, ensuring that flows don't hydraulically short-circuit through the basin. As flows increase, water will overtop the channel and spread over the basin bed for more uniform infiltration.

5.12.1.5. In the event that erosion protection of the low flow channel is required, then 'rock rolls' such as those provided by Salix could be suitable. The use of coir should be investigated before use, to determine potential effects on nutrients, pH or plant growth.

5.12.1.6. The required volume of surface water storage will be determined by the infiltration rate of the treatment filter media which is more restrictive rate than the in situ chalk, now confirmed by site investigation infiltration testing. The current basin design provides approximately 2300m^3 of surface water storage which has been demonstrated by the MicroDrainage Source Control model (Appendix 7) as sufficient to hold a 1:100year event + 40% climate change, with a half-drain time of 26.5 hours; for runoff from 1.21Ha of the converter station in accordance with the Drainage Strategy outlined in Section 2.5 above. The 1:30 year + 40% climate change event achieved a half-drain time of 1325 minutes (22.1 hours).

5.12.1.7. Table 2 below demonstrates the capacity of SuDS features in the Drainage Strategy, against the surface water attenuation required accounting for the infiltration rates of the treatment filter media and in situ chalk.

5.12.1.8. It should be noted that the basins will be subject to detailed design by the contractor and if the volume is reduced, then the basins should be made shallower with a minimum 1:3 bank gradient and a larger bed to aid infiltration and discharge rates. As opposed to making them deep, steep and narrow.

Table 2 – Infiltration Rates and Storage Capacity of Outline Design Attenuation Features

SuDS Feature	Trial Pit	Maximum Infiltration (m/s)	Minimum Infiltration (m/s)	SCL Infiltration (m/s)	Outline Design Capacity (m^3)	Micro Drainage Critical event	Maximum Volume (m^3)$^!$	Half Drain Time (minutes)
Converter Station Infiltration Trenches – Main area in NE	TP27	$2.08*10^{-4}$	$2.26*10^{-4}$	$4*10^{-6}$	379.17*	60min 100yr Summer + 40% CC	62.7	46
Converter Station Infiltration Trenches - eastern boundary					115.2*	120min 100yr Winter + 40% CC	64.8	145
Northern Detention Basin	TP26	$1.73*10^{-4}$	$1.34*10^{-4}$	$4*10^{-6}$	2268.5 (2810.5 with freeboard)	960min 100 Winter + 40% CC	964.1	1591
	TP25	Awaiting Result	Awaiting Result	$4*10^{-6}$				

SuDS Feature	Trial Pit	Maximum Infiltration (m/s)	Minimum Infiltration (m/s)	SCL Infiltration (m/s)	Outline Design Capacity (m^3)	Micro Drainage Critical event	Maximum Volume (m^3)!	Half Drain Time (minutes)
Soakaway	TP26	$1.73*10^{-4}$	$1.34*10^{-4}$	$4*10^{-6}$	To be sized by contractor. The northern detention basin is the controlling factor and provides the necessary attenuation.			
	TP25	Awaiting Result	Awaiting Result	$4*10^{-6}$				
Access Road Infiltration Swale	TP26	$1.73*10^{-4}$	$1.34*10^{-4}$	$4*10^{-6}$	The southern infiltration basin has been tested assuming 100% runoff from road area of $8570m^2$ with zero infiltration to swale. Some test results within swale area are still to be received. Detailed design and modelling will be by contractor and it is likely that some lengths of swale will be in head deposits and other areas within the non-structured chalk which will affect infiltration.			
	TP25	Awaiting Result	Awaiting Result	$4*10^{-6}$				
	TP23	$2.95*10^{-4}$	$1.69*10^{-4}$	$4*10^{-6}$				
	TP22	$9.74*10^{-5}$	$4.04*10^{-5}$	$4*10^{-6}$				
	TP21	$1*10^{-6}$	Single test	$4*10^{-6}$				
Southern Infiltration Basin (see note in access road swale)	TP24	$4.88*10^{-4}$	$1.86*10^{-4}$	$4*10^{-6}$	2305.2 (2848.9 with freeboard)	720min 100yr Winter + 40% CC	630.5	1117

* Assumed depth of 0.6m engineered fill with a 20% void pore space, above the treatment filter media

! Volumes are based on instantaneous runoff to the basin, the SCL infiltration rate and no 'safety factor' in the model.

5.12.1.9. It is expected that the detention basin will be subject to vegetation management, such as litter & debris collection and an annual cut and rake, but this will be confirmed upon detailed design and with further consultation with the project ecologist and landscape architect. In addition, removal of sediment build-up may be required. Refer to the Outline Landscape and Biodiversity Strategy (REP6-038, Rev004) for further information.

5.13. SOAKAWAY

5.13.1.1. A geocellular soakaway is proposed to allow infiltration of surface water to ground. The infiltration rate of the chalk is now confirmed by field testing and the infiltration rate of the treatment filter media is recommended as $4*10^{-6}$ m/swhich will determine the final size of the feature through detailed design. The soakaway has also been selected at this stage based on the available information, as it provides flexibility to suit the site gradients and to maximise the discharge volumes.

5.13.1.2. The final water quality treatment stage is proposed by lining the soakaway with a geotextile membrane and surrounding the base and sides with a layer of treatment filter media (silty clay loam, neutral to alkaline pH, infiltration rate of $4*10^{-6}$ m/s). A depth/width of 0.3m, is recommended in accordance with recommendations by SNIFFER and Napier *et al* (2008). Based on the studies, it is expected that pollutant concentrations discharging from the detention basin will be very low, at or near analytical reporting limits and as such the additional 0.3 m filter media on the soakaway is precautionary and meets the reports' recommendations. However, should the 0.6 m be required this can be accommodated.

5.13.1.3. Prior to the surface water infiltrating through the soakaway into the underlying Chalk bedrock it will undergo treatment which will increase its carbonate concentration (hardening). This could be in the form of a layer of chalk gravel in the soakaway which the water would pass through before infiltrating. The intention of including this treatment would be to prevent the soakaway from itself becoming a karst dissolution feature gradually over time as rainfall and surface runoff (which would have a low carbonate content) infiltrates into the Chalk. The carbonate treatment system will require long-term maintenance which will be considered at detailed design.

5.14. GRAVEL AREA AND INFILTRATION DRAINS

5.14.1.1. Gravel areas are located within the compound and external to buildings, in locations that are not roads, but may contain infrastructure. In accordance with the National Grid TS 2.10.01 section 3.4.2, these gravel areas will receive direct rainfall and runoff from roads, excluding the oily water areas. As such, the gravel areas will be implemented as infiltration drains.

5.14.1.2. It is expected that traffic within the compound during operation will be low and as such, this has been equated to the CIRIA C753 Simple Index Method land use of 'individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change i.e. <300 traffic movements/day' with a 'low' hazard index.

5.14.1.3. The CIRIA guide identifies that an infiltration trench, with specific design and filtration media requirements, is sufficient to provide treatment to metals and hydrocarbon for this land use. The infiltration trench will also provide the majority of treatment required for total suspended solids, however a permeable geotextile membrane in the upper layers of the media will be required for removal of grit and sediments from filtration water. This layer will require maintenance to remove the trapped sediments and ensure the ongoing function of the infiltration drain.

5.14.1.4. The treatment filter media will be the modified silty clay loam with a neutral to alkaline pH, a depth of 0.3 m and an infiltration rate of $4*10^{-6}$ m/s. A second permeable geotextile membrane should underlie the filter media to ensure it does not enter the chalk. The 0.3 m depth of treatment filter media is in accordance with recommendations by SNIFFER and Napier *et al* (2008) for treatment of runoff from heavily trafficked roads and is therefore considered suitable for treatment of runoff from the low traffic roads within the compound that are not subject to 'oily water' nor the oil containment areas.

5.14.1.5. Table 2 in Section 5.11 indicates the size of infiltration drains within the converter station, which are subject to detailed design. However, it should be noted that within the converter station area, the contractor's detailed road design will dictate the volume runoff to individual infiltration trenches and as such, an assumed worst case scenario has been modelled for the attenuation area north-east in the compound (assuming a 25% loss of volume to infrastructure) and the eastern boundary filter drain. Infiltration drains have been modelled with an assumed capacity of 0.6m depth and 20% porosity above the treatment filter media, which can be made deeper or provided with an underdrain if required.

5.14.1.6. The detailed design and hydraulic will account for these factors to allow suitable sizing of the infiltration drains.

5.15. INFILTRATION SWALE AND ACCESS ROAD RUNOFF

5.15.1.1. An infiltration swale is proposed for capture, infiltration and conveyance of surface water runoff from the Access Road to the Converter Station. The swale is currently proposed for a depth of 0.4 m, a base width of 0.6 m and banks with a 1:3 gradient, giving a total width of 3 m. Underlying the swale will be an infiltration trench and both the trench and swale will be underlain by 0.3 m of infiltration treatment media (silty clay loam, neutral to alkaline pH, infiltration rate of $4*10^{-6}$ m/s).

5.15.1.2. Water quality treatment will be provided by the swale and the infiltration trench sufficient for the pollutants expected to runoff from the access road. Low levels of traffic are expected during operation will be low and as such, this has been equated to the CIRIA C753 Simple Index Method land use of 'individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change i.e. <300 traffic movements/day'.

5.15.1.3. CIRIA C753 identifies that a swale is sufficient to treat the pollutant loading from this land use and as such, the treatment provided by the infiltration trench is an additional benefit, and is to be designed in accordance with the C753 guidance and this report. As such, the 0.3 m depth of treatment filter media is considered sufficient and in accordance with recommendations by SNIFFER and Napier *et al* (2008) for treatment of runoff from heavily trafficked roads and is therefore considered suitable for treatment of runoff from what is expected to be low traffic roads. However, the depth of treatment filter media will be increased up to 0.6m as a precautionary measure in accordance with the lysimeter study reported by SNIFFER and Napier *et al* (2008).

5.15.1.4. Maintenance will be required for the removal of sediments captured by the swale in accordance with SuDS Manual, CIRIA 753. Refer to 5.16.1.2 for further information.

5.15.1.5. Surface water storage will be provided within the swale and within the underlying infiltration drain. Should additional surface water storage be required, the swales will be designed to convey exceedance flows to an infiltration basin. An underdrain can also be added to the infiltration drain if additional conveyance is required. The storage requirements will be confirmed in the final design subject to hydraulic modelling.

5.15.1.6. There is also potential for the infiltration swale to convey exceedance flows from the detention basin in the north, to the infiltration basin further south if additional surface water storage is required. However, this is subject to hydraulic modelling in detailed design and is only expected to occur during extreme events.

5.16. INFILTRATION BASIN

5.16.1.1. The infiltration basin is proposed for the southwest extent of the development and at a low point in the existing topography. This will allow runoff from the Access Road to be conveyed along infiltration swales from the north and east.

5.16.1.2. The size and outline design of the infiltration basin is the same as the detention basin further north, providing 2300 m^3 of surface water storage with a maximum bank gradient of 1:3 and a maximum depth of 2 m which includes a 0.3 m freeboard.

5.16.1.3. Underlying the bed, a 0.3 m deep layer of treatment filter media (modified silty clay loam, neutral to alkaline pH, infiltration rate of $4*10^{-6}$ m/s) will be implemented to provide water quality treatment. The 0.3 m depth of treatment filter media is in accordance with recommendations by SNIFFER and Napier *et al* (2008) for treatment of runoff from heavily trafficked roads and is considered sufficient for the infiltration basin that is receiving surface water from a low traffic road, and which has previously been provided treatment by the infiltration swale. However, the depth of treatment filter media can be increased up to 0.6 m as a precautionary measure in accordance with the lysimeter study reported by SNIFFER and Napier *et al* (2008), if required.

5.16.1.4. Like the detention basin, the infiltration basin is proposed for an inlet design that will include flow dissipation and a level spreader apparatus to maximise pollutant removal near the inlet and to help reduce erosion. However, a low flow channel is not proposed, as the bed area should be maximised for infiltration over its full extent and there is no opportunity for the water to short-circuit to an outlet.

5.16.1.5. The 2300 m^3 of surface water storage provided by the infiltration basin has been based on an early estimate of the impermeable area of 1.7 ha created by the access road, which is now updated to 0.857Ha. The Microdrainage Source Control model results (Appendix 7) are presented in Table 2 in Section 5.11 and demonstrate that the current basin design has sufficient storage to hold a 100year event with 40% climate change with a half-drain time less than 24 hours. The 1:30 year + 40% climate change event achieved a half-drain time of 911 minutes (15.18hrs).

The final volume of the infiltration basin will be determined during detailed design and hydraulic modelling and in the event that less storage is required, then the basins should be made shallower with a minimum 1:3 bank gradient and a larger bed to aid infiltration and discharge rates. As opposed to making them deep, steep and narrow. This is to maximise the infiltration through a larger bed, maximise the water quality treatment benefits from a larger bed, and to maximise the vegetated margins of most benefit to wetland ecology.

5.16.1.6. It is expected that the detention basin will be subject to some vegetation management, such as an annual cut and rake, but this should be confirmed with the ecologist and landscape architect. In addition, removal of sediment build-up may be required. Refer to the Outline Landscape and Biodiversity Strategy (APP-506) for further information.

5.17. SUDS MAINTENANCE

5.17.1.1. Sustainable drainage systems should be designed in accordance with this Strategy and preliminary design drawings in appendix 1, as well as the policies and guidance identified in Section 2.3 including the CIRIA C753 SuDS Manual, to ensure their suitability for surface water storage and water quality treatment.

5.17.1.2. A SuDS maintenance plan shall be developed to outline requirements for vegetation, removal of potential pollutants, and the carbonate treatment system to ensure the long-term function of the SuDS features. Development of the maintenance plan must include a review of requirements within the CIRIA C753 SuDS Manual, the SNIFFER (UEUW01 & UEUW02, 2008) reports and Napier *et al* (2008) which form the basis of the SuDS treatment design.

5.17.1.3. The detailed design by the contractor will incorporate a maintenance strategy for monitoring of pollutants within the soils, and if deemed required, within the discharge water from the detention basin upstream of the soakaway will be undertaken to inform maintenance and replacement of the treatment filter media.

5.18. CONCLUSION

5.18.1.1. Surface water is proposed for infiltration to ground and features are subject to detailed design and hydraulic modelling to confirm their optimum size and ensure no exceedance flows for an event with a return period of 100 years + 40% climate change. The size and design of the drainage strategy network and SuDS features has been demonstrated as sufficient to hold this event and achieve a half-drain time close to 24hours, utilising a treatment filter media of modified silty clay loam with an infiltration rate of $4*10^{-6}$ m/s

5.18.1.2. In the event that less storage is required, then the basins should be made shallower with a minimum 1:3 bank gradient and a larger bed to aid infiltration and discharge rates. As opposed to making them deep, steep and narrow.

5.18.1.3. The drainage strategy proposes water quality treatment through a series of proprietary and SuDS systems. Water from the oil containment areas is proposed for the highest level of treatment through a dump tank then oil separator; while runoff from the oily water areas is proposed for treatment through the oil separator. Flow from the oil separator is expected to contain an average hydrocarbon concentration of 1.22mg/l and therefore will pass through SuDS features for additional water quality treatment.

5.18.1.4. The studies by SNIFFER (2008) and Napier *et al* (2008), demonstrate that properly designed SuDS are capable of removing TPH, PAH and heavy metals from infiltrating water, prior to degradation of the organic pollutants for removal from the SuDS system. The results of the lysimeter studies demonstrate that greater than 99.9% of TPH and PAH, and greater 99.84% of heavy metals were removed from the infiltrating water by silty clay loam, proposed to be the treatment filter media for the Aquind UK site with a modification to achieve the infiltration rate of $4*10^{-6}$ m/s. In addition, field studies of functional SuDS demonstrated that soil water at a depth of 0.9m contained a maximum of 0.00099 mg/l (0.99µg/l) of Total PAH, while the TPH concentrations 'either remained or very quickly fell to below the analytical reporting limit' (presented in section 2.10.4). As such, the SuDS design for the Converter Station Area has been informed by the SNIFFER and Napier *et al* (2008) studies in order to provide water quality treatment and protection of groundwater.

5.18.1.5. The SuDS system will receive discharge from the oil separator which will combine with roof runoff at the detention basin. Roof runoff is proposed for pre-treatment through catch pit chambers with silt traps. At the basin, runoff shall be provided additional treatment prior to discharge via a soakaway.

5.18.1.6. Runoff from low traffic roads within the Converter Station will discharge to gravel areas installed as infiltration drains; while runoff from the site access road will pass to an infiltration swale that has the potential to convey high flows to the southern infiltration basin during extreme events.

5.18.1.7. Basins shall be designed with inlets to dissipate the flow, protect from erosion and maximise pollutant treatment by concentrating this near the basin inlet and allowing any remaining low levels of pollutants to be treated within the remaining basin. The detention basin shall be underlain by minimum of 0.6m of treatment filter media to allow infiltration to an impervious base and underdrains that will convey flow to the soakaway. All other features will allow infiltration to ground and shall be underlain by a minimum of 0.3m of treatment filter media to provide water quality treatment prior to infiltration through the chalk to groundwater. The detailed design of these features shall be developed in accordance with the description provided in this strategy and drawings AQD-WSP-OS-UK-DR-D-200140-141 and AQD-WSP-OS-UK-DR-D-200140-141in Appendix 1.

5.18.1.8. Final design of features is to be undertaken in consultation with the ecology and landscape architect in order to maximise benefits of the feature.

5.18.1.9. The above outline strategy shall be subject to the discussion and agreement with PW and EA and will be subjected to a full hydrological risk assessment by the Contractor to ensure no unacceptable risk to the natural environment and sensitive receptors.

6. SCADA SYSTEM

6.1.1.1. The Converter Station control room will have a SCADA system to remotely control and supervise the Interconnector. Part of the functionality of this system is for the system operators to receive and send information that is sent through from the Converter Stations to the appropriate recipients. This information includes (but is not limited to) major alarms, measurements, indications and minor alarms. Within the maintenance and repair plan for the project there will be personnel on standby to respond to any situations that arise.

6.1.1.2. Depending on the type of alarm, for example, a major alarm, it may result in actions ranging from a repair or investigation at the next scheduled maintenance outage or an immediate site visit within a pre-agreed time frame

6.1.1.3. The interval between an alarm being triggered by the control and protection system shall be sent directly to the SCADA and setup interface such as the standby maintenance and repair personnel happens within milliseconds. Which means that there can be a person on site within the agreed time frame.

7. OUTLINE FOUNDATION SOLUTION

7.1.1.1. The Converter Station Area was found to be directly underlain by Head Deposits consist predominantly of gravelly Clays; sometimes becoming clayey Gravel. Generally underlying the Head Deposits was Structureless Grade D Chalk predominately described as Grade Dm with occasional interbedded layers of Dc. Below the Structureless Grade D Chalk, Chalk quality and grade broadly improved with depth becoming Structure Chalk Grades C to A.

Table 3 - Converter Station West Preliminary Ground Model

Strata	Ground model (m AOD) (unit thickness (m))	Description
Head Deposits	85.00-84.20 (0.80)	Firm to stiff red brown CLAY with gravel and cobble content. Occasionally gravel content becomes such it is clayey GRAVEL.
Structureless Chalk (Grade D)	84.20-76.90 (7.30)	Consisting of both Grade Dm and DC Chalk, interbedded throughout with no distinguishable boundary or profiling.
Structured Chalk (Grade C – A)	76.90-55.00 (21.90+)	Very low to medium density, density increasing with depth. Flint bands were noted during drilling, theses were often thin (0.10-0.30m thick) and occurred between change of grades. There were six notable grade changes. Zones of core loss were recorded within BH29 and BH30, this is considered to be due to flint bands marking the transition from Grade B to C Chalk, with the flint causing loss of recovery. Grade A was noted between 79.06-74.56m AOD and 64.06-58.06m AOD.
Groundwater	40.00-30.00m AOD Informed by Portsmouth Water	The groundwater depth was informed by the Portsmouth Water representatives, who have a monitoring well within 1.00km of the site and detailed groundwater mapping records. Groundwater is known to become shallower from north to south.

7.1.1.2. The majority of the potential fill material will consist of Grade D chalk and head deposits. On-site reworked fill is unlikely to be suitable for shallow foundations above 75KPa as it would not be able to achieve bearing resistance greater than this or the 25mm long term settlement. Where bearing resistance and/or settlement and differential settlement requirements are not met for shallow foundations, deep foundation options such as piles shall be considered. Total and differential settlement limits shall be confirmed by the switchgear and plant manufacturer.

Table 4 – Classification of Chalk by Discontinuity Spacing

Grade	Description
D	Structureless or remoulded mélange.
C	Typical Discontinuity aperture >3 mm
B	Typical Discontinuity aperture <3 mm
A	Discontinuities closed.

7.1.1.3. The presence of the identified karstic features can accelerate water permeation from surface to the aquifer. CIRIA C574 Engineering in Chalk identifies the following treatment strategies for dissolution/karstic features:

- Excavation and replacement with compacted suitable material.
- Bridging.
- Ground stabilisation by grouting.
- Ground treatment by grouting.
- Piling.
- Control of drainage.

7.1.1.4. Groundwater and groundwater flow has a fundamental influence on bedrock dissolution and the formation of karstic features. As such, it was identified that the control of surface water drainage, drainage within the ground and the foundation solution will therefore need to be carefully considered during the detailed design of the Converter Station to avoid increasing the risk of dissolution .

7.1.1.5. It was confirmed by PW and EA that karst stabilisation and treatment by grouting will be their preferred solution. The grouting of the karst features to be carried out as part of the earthworks activity to create the Converter Station platform. In-line with CIRIA C574, to minimise influence of grouting on the SPZ1, a grout mix that is of suitable composition, control and cure time to is required to be proposed to PW and EA for their review and comment.

7.1.1.6. A suitable approach to mitigate karstic risk to the foundations will be piling. This will be reviewed at detailed design when foundation locations and Converter Station layout plans are available. Where possible, access track, cable routes, structures and drainage infrastructure will be moved to avoid known dissolution features. Where this is not possible, the appropriate treatment, or risk management, will be determined and at detailed design.

7.1.1.7. The preliminary Piling Works Risk Assessment ('PWRA') in Appendix 6 of the OOCEMP has been prepared based on pre-cast driven piles as this was discussed with PW and EA at a meeting on 18 July 2019 and considered to have the lowest impact on the chalk aquifer and conditions set by Portsmouth Water around SPZ1 designation. The indicated pre-cast piles can be up to 15m long from the Converter station proposed formation level (formation level is usually about 1.0m below finished converter station level of 84.80m AOD). This is subject to the detailed design.

7.1.1.8. The PWRA will ensure that piling operations do not form a pathway for the migration of contamination at the surface (either existing contaminants, those that form part of the pilling process or those that might be introduced during the operation of the Converter Station) to the aquifer.

7.1.1.9. A piling specialist shall be required to be employed to prepare a project specific piling risk assessment. The risk assessment shall be shared with PW and EA for review and comments in advance of the procurement and construction.

8. MAINTENANCE STRATEGY

8.1.1.1. Civil and building infrastructure in its entirely shall be designed to meet the functional requirements for a minimum of 40 years. The design and construction detail shall be such that future inspection and maintenance is minimised.

8.1.1.2. An Installation, Operation and Maintenance manual shall be prepared prior to commissioning and handover.

8.1.1.3. The Converter Station shall have access roads that provide vehicular access adequate for the safe operation, maintenance and replacement of the entire Converter Station (equipment and civil infrastructure).

8.1.1.4. The Converter Station shall be designed to ensure the Mobile Elevating Work Platform (‘MEWP’) access can be taken, over both access roads and the general compound, to all applicable outdoor equipment for maintenance purposes.

8.1.1.5. The main access road and skidways immediately adjacent to the transformers and oil filled reactor shall be fitted with kerbs and gullies and an associated gravity drainage system which shall be connected to the oil separator. This is to ensure any minor spillage during transformer maintenance work are effectively contained and discharged through the oily drainage system.

8.1.1.6. Oil Separators and septic tanks, cess pools shall be sited adjacent or close to roads to facilitate access for maintenance vehicles.

8.1.1.7. Oil-Petrol Separator shall be full retention class 1 separators with integral silt collection and quality of discharge sampling facilities, together with integral coalescing and automatic closure mechanisms to prevent the flow through the unit in case of excessive oil levels. The Coalescer units shall comprise oil resistant fire-retardant material and be cable of removal for maintenance or replacement.

8.1.1.8. SuDS features are likely to have a more frequent inspection and maintenance regime than traditional drainage system. The Contractor shall prepare SuDS operation and maintenance strategy in compliance with CIRIA C753 and issue to the Employer for review and comment.

8.1.1.9. A project specific Civil Asset Management plan shall be prepared. The plan shall incorporate a Drainage Management section which shall, as a minimum, provide details of all drainage infrastructure, highlight any critical exceptional infrastructure and shall include details of the inspections and maintenance regime required for each element of the infrastructure.

8.1.1.10. The minimum maintenance timescales to the equipment within table 8-1 is likely to be as indicated. This is subject to further development by the Contractor at the detailed design stage in consultation with the equipment providers.

Table 5 - Indicative Maintenance Schedule

Item	Activity	Time Scales*
Bund Water Control Units	Clean/Inspect	Annually
Oil Separator and Alarms	Clean/Inspect	Annually
Lighting (LED)	Clean/Inspect	On bulb failure/every years
HVAC	Clean/Inspect	Every year/In attendance with MEP O&M manual
Site Drainage	Clean	Annually
Septic Tanks/Cess Tank	Clean	When required
EOT Cranes	Clean/inspect	Annually
Building Cladding	Inspect/Localised repair	Annually
Electrified External fence	Inspect	Annually
Deluge system (if necessary for the project)	Test	To be agreed
SuDS	Clean/Inspect	In compliance with CIRIA C753

*Indicated time scales are indicative and are subject to review and confirmation by the equipment supplier at the detailed design stage.

9. CONSTRUCTION SURFACE WATER MANAGEMENT

9.1.1.1. For construction surface water management, refer to section 6.3.4 of the Onshore Outline Construction Environmental Management Plan ('OOCEMP'), the Generic Method Statement (Appendix 7 of the OOCEMP) .

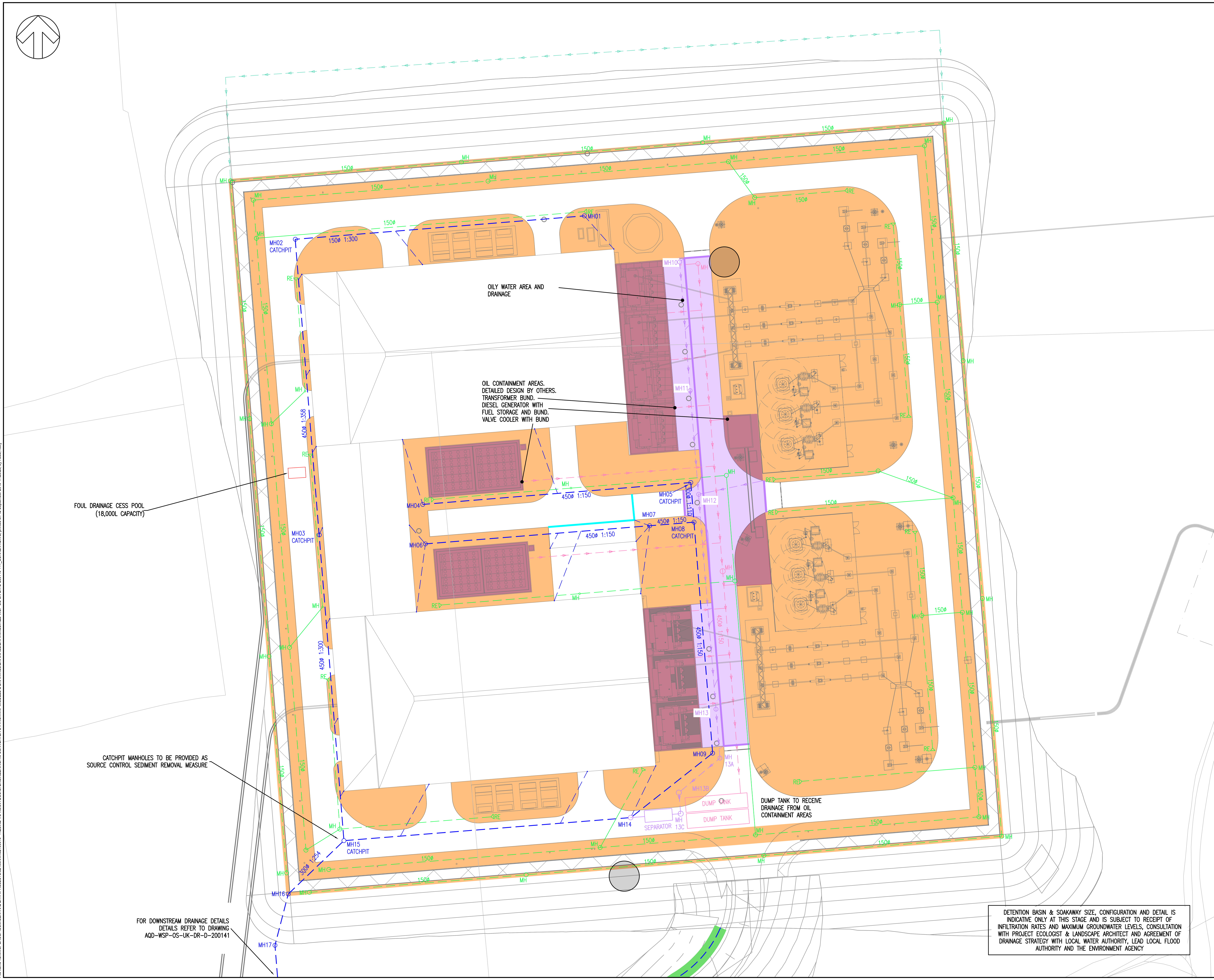
9.1.1.2. The temporary car park shall be impermeable with surface water collected and conveyed by channel drains discharging to an underground network with oversized pipes to provide surface water storage. If necessary, an infiltration drain shall be constructed to intercept overland flow from the fields and direct it away from the carpark. A raised kerb shall surround the carpark on all sides to prevent potentially polluted surface water from running off the site to surrounding fields. Water quality treatment shall be provided by a proprietary treatment (e.g. hydrocarbon interceptor) followed by a sealed filter drain. This shall connect to the infiltration swale adjacent the access road that can also convey water to the infiltration basin, both of which shall be designed for the operational phase. The interceptor volume and type shall be specified by the contractor. Design of the infiltration drain shall be in accordance with the operational phase SuDS and is illustrated on the Indicative carpark drainage drawing AQ-ITT-UK-LAY-101 in Appendix 6 to this document.

10. REFERENCES

- National Grid Technical Specification 2.10.01- Issue 1 – April 2017 : Oil Containment
- National Grid technical Specification 2.10.09 – Issue 1 – April 2017 : Site Drainage
- Environment Agency (2001a) PPG1 General Guide to the Prevention of Pollution.
- Environment Agency (2011a) PPG2 Above Ground Oil Storage Tanks.
- Environment Agency (2006) PPG3 Use and design of oil separators in surface water drainage systems.
- Environment Agency (2007a) PPG5 Works and Maintenance In or Near Water.
- Environment Agency (2010) PPG6 Working at Construction and Demolition Sites.
- Environment Agency (2011) PPG7 The safe operation of refuelling facilities.
- Environment Agency (2004) PPG8 Safe Storage and Disposal of Used Oils.
- Environment Agency (2007b) PPG13 Vehicle Washing and Cleaning.
- Environment Agency (2000) PPG18 Managing fire water and major spillages.
- Environment Agency (2009) GPP21 Pollution incident response planning.
- Environment Agency (2011c) PPG22 Dealing with Spills.
- Environment Agency (2001) PPG25 Development and Flood Risk.
- Environment Agency (2011) PPG26 Storage and handling of drums and intermediate bulk containers.
- Environment Agency (2011d) PPG27 Installation, decommissioning and removal of underground storage tanks.
- Discharges to surface water and groundwater environmental permits (EA guidance)
- Pollution prevention for businesses (EA guidance)
- The Environment Agency’s approach to groundwater protection
- British Standard BS 10175 (2011) Investigation of Potentially Contaminated Sites
- Department for Environment, Food and Rural Affairs (Defra) (2012) Environmental Protection Act 1990: Part 2A- Contaminated land Statutory Guidance
- Environment Agency (2012) Groundwater Protection: Principles and Practice (GP3)
- Environment Agency (2004) Contaminated Land Report 11
- BS EN 752 2008 Drain and Sewer Systems Outside of Buildings (2017)

- BS EN 12056 Gravity drainage inside buildings
- CIRIA C532 Control of water Pollution from Construction Sites. Construction
- Industries Research Association;
- CIRIA C502 Environmental Good Practice on Site. Construction Industries
- CIRIA C697 The SuDS manual.
- CIRIA C650 Control of Water Pollution in form Construction Sites – Guidance for Consultants and Contractors
- CIRIA C753 SuDS Manual
- Sewers for Adoption (SFA) 7th Edition
- Local Authority Standards
- Building Regulations Part H Drainage and Waste Disposal
- SNIFFER UEUW01: Source control pollution in Sustainable Drainage (Final Report, February 2008)
- SNIFFER UEUW01: Source control pollution in Sustainable Drainage: Supplementary Report (Draft Report, September 2008)
- SNIFFER UEUW02: SuDS Pollution Degradation (Final Report, October 2008)
- Napier, , F; Jefferies, C; Heal, KV; Fogg, P; D'Arcy, BJ; Clarke, R. (2008) Evidence of traffic-related pollutant control in soil-based Sustainable Urban Drainage Systems (SUDS). Edinburgh, Scotland. (Referenced below as Napier et al 2008a)
- Napier, F.; D'Arcy, B.J.; Jefferies, C.; Fogg, P.; Lowe, W.; Clarke, R.; (2008) Oil and SUDS: managing a priority urban pollutant. 12th International Conference on Integrated Diffuse Pollution Management, Khon Kaen University, Thailand. (Referenced below as Napier et al 2008b)
- Non-statutory technical standards for sustainable drainage systems

Appendix 1 Proposed Surface Water Drainage (DRAFT)



DETENSION BASIN & SOAKAWAY SIZE, CONFIGURATION AND DETAIL IS INDICATIVE ONLY AT THIS STAGE AND IS SUBJECT TO RECEIPT OF INFILTRATION RATES AND MAXIMUM GROUNDWATER LEVELS, CONSULTATION WITH PROJECT ECOLOGIST & LANDSCAPE ARCHITECT AND AGREEMENT OF DRAINAGE STRATEGY WITH LOCAL WATER AUTHORITY, LEAD LOCAL FLOOD AUTHORITY AND THE ENVIRONMENT AGENCY

DO NOT SCALE

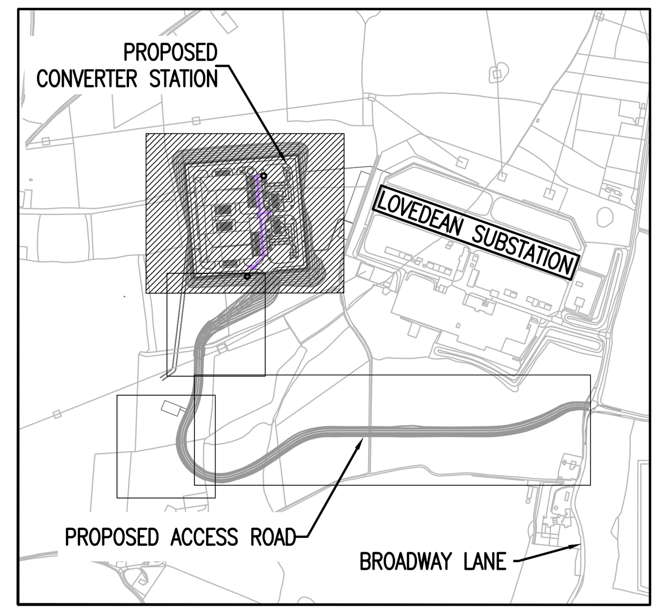
NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, SCHEDULES AND SPECIFICATIONS INCLUDING:
   - AQD-WSP-OS-UK-RP-D-200001 AQUIND UK AQUIFER CONTAMINATION PREVENTION STRATEGY
   - AQD-WSP-OS-UK-DR-D-200141 BELOW GROUND DRAINAGE LAYOUT (SHEET 2 of 2)
   - AQD-WSP-OS-UK-DR-D-200340 BELOW GROUND DRAINAGE TYPICAL DETAIILS

KEY:

- SURFACE WATER DRAINAGE
- SURFACE WATER FILTER DRAIN (SITE)
- SURFACE WATER FILTER DRAIN (EARTHWORKS)
- SURFACE WATER DRAINAGE CHANNEL
- DRAINAGE FROM OIL CONTAINMENT AREA
- OIL CONTAINMENT AREA (BUND)
- OILY WATER DRAINAGE
- OILY WATER DRAINAGE CHANNEL
- OILY WATER DRAINAGE AREAS
- GRAVEL SURFACE AREAS
- SuDS – SWALE
- SUDS – DETENSION BASIN
- SUDS – INFILTRATION BASIN
- SUDS – SOAKAWAY
- KARST FEATURES

LOCATION PLAN:



REV	DATE	BY	DESCRIPTION	CHK	APP
P02	12/09/2019	KR	UPDATED BASIN WITH UNDERDRAINS AND OTHER SUDS TO INCLUDE TREATMENT FILTER MEDIA. UPDATED OILY WATER AND OIL CONTAINMENT AREAS WITH SEPARATE DRAINAGE. UPDATED GRAVEL AREAS WITH UNDERDRAIN.	PW	NM
P01	10/07/2019	KR	FIRST ISSUE	MD	PW

DRAWING STATUS: S2 - FOR INFORMATION

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wsp.com

CLIENT: AQUIND

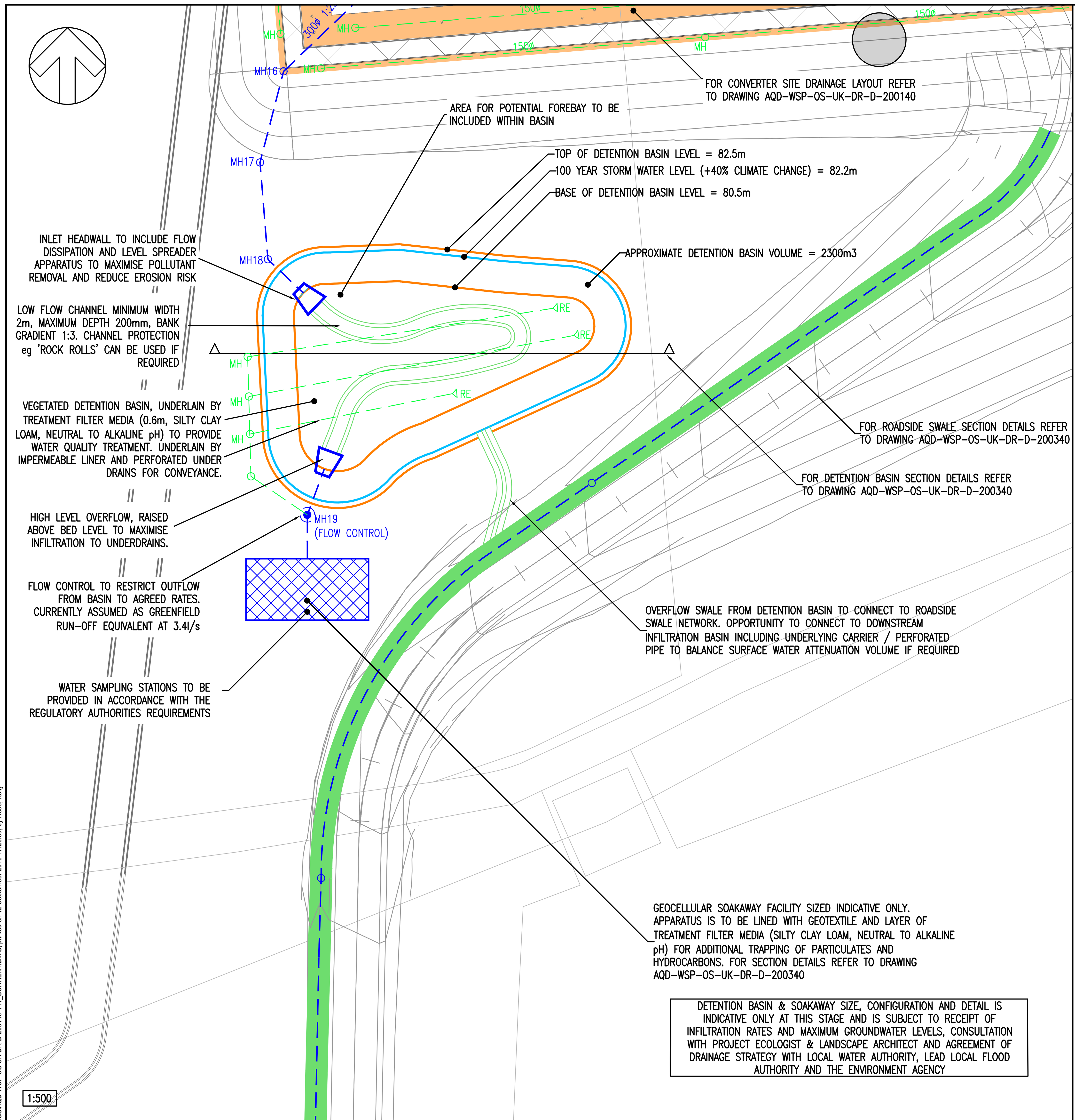
ARCHITECT: -

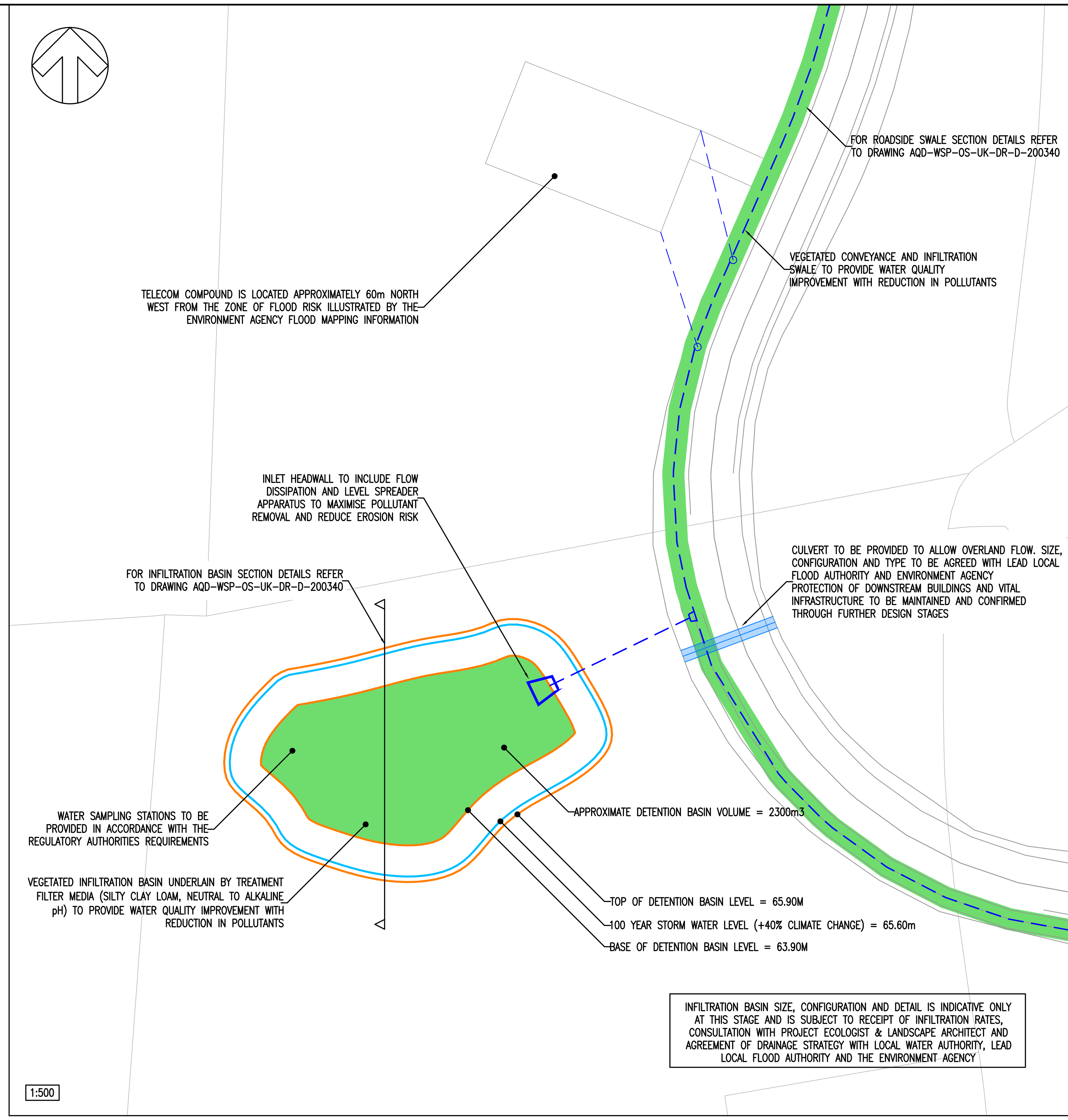
SITE/PROJECT: AQUIND HVDC INTERCONNECTOR

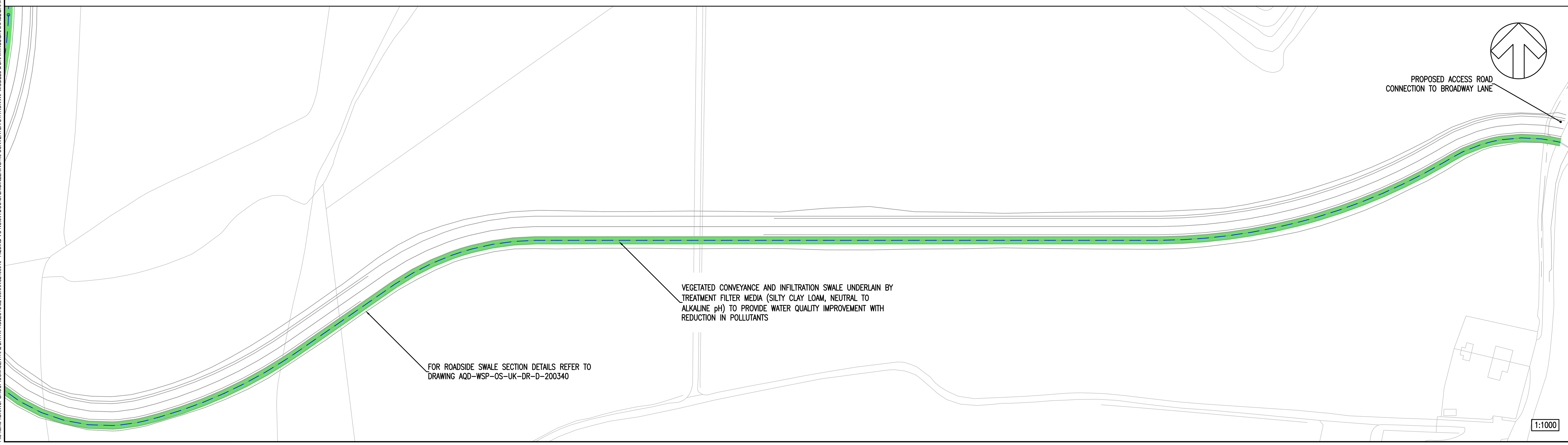
TITLE: BELOW GROUND DRAINAGE LAYOUT (SHEET 1 OF 2)

SCALE @ A1: 1:500m	CHECKED: MD		APPROVED: PWW
PROJECT NO: 62100616	DESIGNED: KR / PWW	DRAWN: KR	DATE: September 19

DRAWING No: AQD-WSP-OS-UK-DR-D-200140 REV: P01







DO NOT SCALE

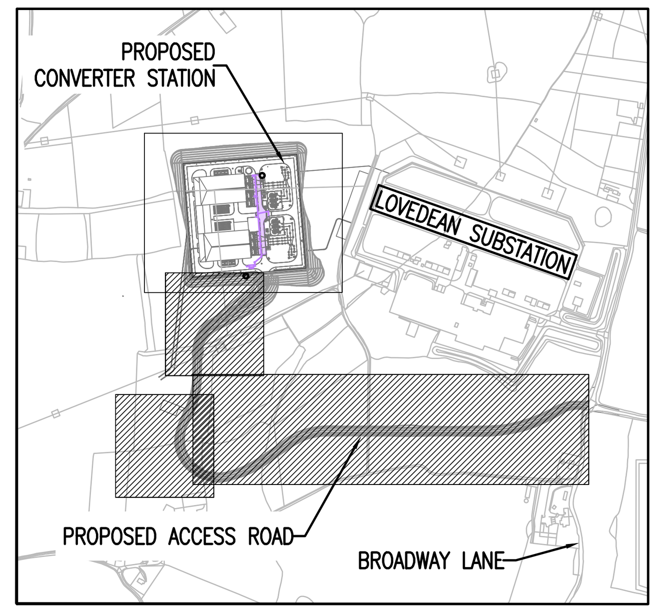
NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, SCHEDULES AND SPECIFICATIONS INCLUDING:
   - AQD-WSP-OS-UK-RP-D-200001 AQUIND UK AQUIFER CONTAMINATION PREVENTION STRATEGY
   - AQD-WSP-OS-UK-DR-D-200140 BELOW GROUND DRAINAGE LAYOUT (SHEET 1 of 2)
   - AQD-WSP-OS-UK-DR-D-200340 BELOW GROUND DRAINAGE TYPICAL DETAIILS

KEY:

- SURFACE WATER DRAINAGE
- SURFACE WATER FILTER DRAIN (SITE)
- SURFACE WATER FILTER DRAIN (EARTHWORKS)
- SURFACE WATER DRAINAGE CHANNEL
- DRAINAGE FROM OIL CONTAINMENT AREA
- OIL CONTAINMENT AREA (BUND)
- OILY WATER DRAINAGE
- OILY WATER DRAINAGE CHANNEL
- OILY WATER DRAINAGE AREAS
- GRAVEL SURFACE AREAS
- SuDS - SWALE
- SUDS - DETENSION BASIN
- SUDS - INFILTRATION BASIN
- SUDS - SOAKAWAY
- KARST FEATURES

LOCATION PLAN:



REV	DATE	BY	DESCRIPTION	CHK	APP
P02	12/09/2019	KR	UPDATED BASIN WITH UNDERDRAINS AND OTHER SUDS TO INCLUDE TREATMENT FILTER MEDIA. UPDATED OILY WATER AND OIL CONTAINMENT AREAS WITH SEPARATE DRAINAGE. UPDATED GRAVEL AREAS WITH UNDERDRAIN.	PW	NM
P01	10/07/2019	KR	FIRST ISSUE	MD	PW

DRAWING STATUS: S2 - FOR INFORMATION

wsp

Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ, UK
T+ 44 (0) 191 226 2000, F+ 44 (0) 191 226 2104
wsp.com

CLIENT: AQUIND

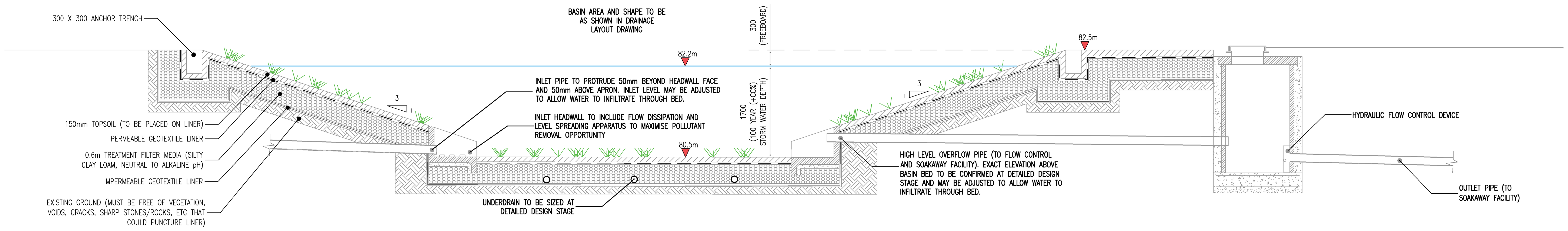
ARCHITECT: -

SITE/PROJECT: AQUIND HVDC INTERCONNECTOR

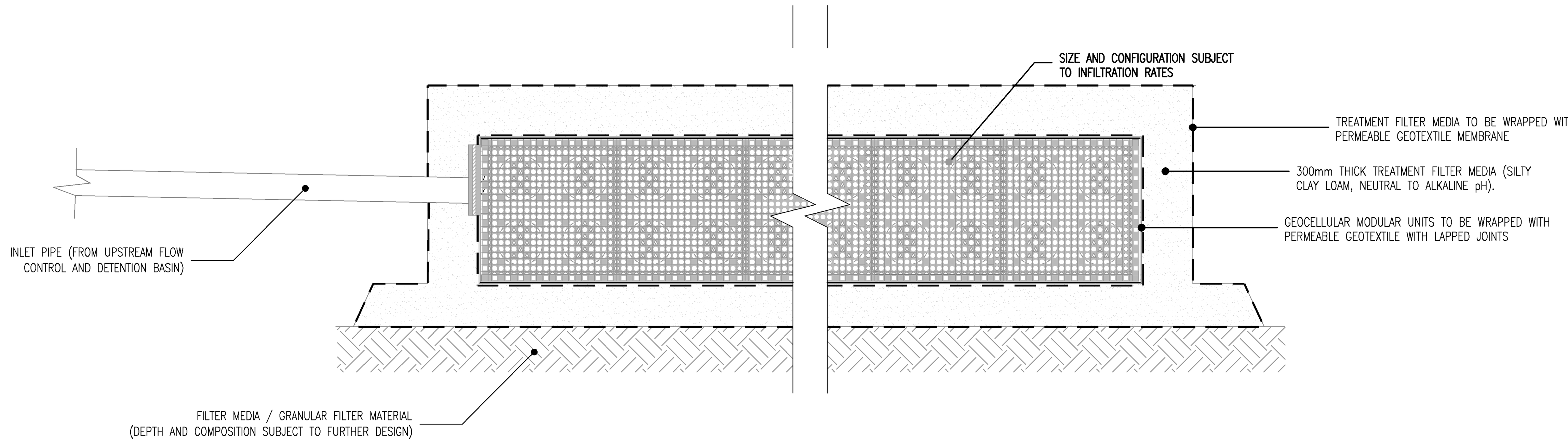
TITLE: BELOW GROUND DRAINAGE LAYOUT (SHEET 2 OF 2)

SCALE @ A1: AS SHOWN	CHECKED: MD	APPROVED: PWW
PROJECT NO: 62100616	DESIGNED: KR / PWW; DRAWN: KR	DATE: September 19

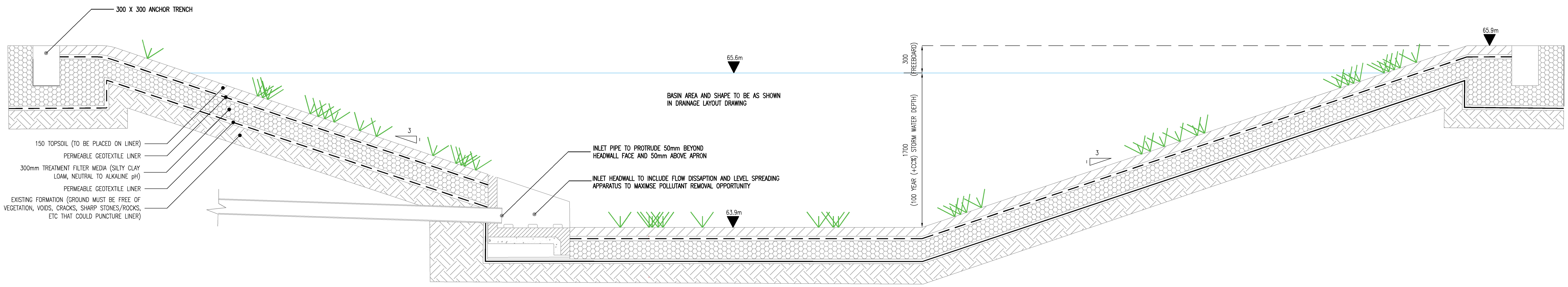
DRAWING No: AQD-WSP-OS-UK-DR-D-200141 — REV: P01



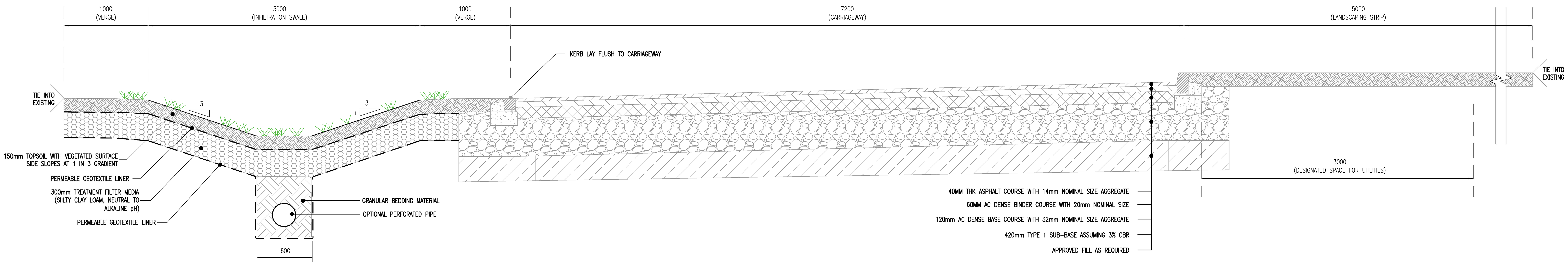
DETENTION BASIN
(NTS)



GEOCELLULAR SOAKAWAY
(NTS)



INFILTRATION BASIN
(NTS)



ACCESS ROAD WITH INFILTRATION SWALE
(NTS)

DO NOT SCALE

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, SCHEDULES AND SPECIFICATIONS INCLUDING:
   - AQD-WSP-OS-UK-RP-D-200001 AQUIND UK AQUIFER CONTAMINATION PREVENTION STRATEGY
   - AQD-WSP-OS-UK-DR-D-200140 BELOW GROUND DRAINAGE LAYOUT (SHEET 1 OF 2)
   - AQD-WSP-OS-UK-DR-D-200141 BELOW GROUND DRAINAGE LAYOUT (SHEET 2 OF 2)
2. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. FOR ACCESS ROAD CONSTRUCTION IT IS ASSUMED THAT THESE ROADWAYS WILL BE REGULARLY USED BY HEAVY VEHICLES.

   DETAIL PROVIDED IS APPLICABLE FOR SUBGRADE CBR VALUES OF 3.0%. ADVICE TO BE SOUGHT IF SUBGRADE IS FOUND TO BE WEAKER THAN 3.0%.

   ACCESS ROAD IS NOT TO BE USED BY CONSTRUCTION TRAFFIC ACCESSING THE SITE WHILST IN A TEMPORARY STATE UNTIL THE DENSE BINDER CAUSE IS APPLIED TO THE ROAD CONSTRUCTION.
4. FINAL DESIGN, SELECTION OF MATERIAL AND CONSTRUCTION IS TO BE IN ACCORDANCE WITH CIRIA C753 GUIDANCE AND DESIGN REQUIREMENTS FOR WATER QUALITY TREATMENT (CHAPTER 26) AND MAINTENANCE:

   TREATMENT FILTER MEDIA TO BE AS SPECIFIED IN AQD-WSP-OS-UK-RP-D-200001 AQUIND UK AQUIFER CONTAMINATION PREVENTION STRATEGY: SILTY CLAY LOAM (HOST CLASS 18), WITH A NEUTRAL OR ALKALINE pH. ACIDIC SOIL IS NOT SUITABLE AND SHOULD NOT BE USED. NITROGEN OR OTHER SUBSTANCES SHOULD NOT BE ADDED TO THE SUDS OR THE TREATMENT FILTER MEDIA. THE DEPTH AND TYPE OF TREATMENT FILTER MEDIA SHOULD BE AS SPECIFIED AND NOT REDUCED OR CHANGED WITHOUT AGREEMENT FROM WSP, PORTSMOUTH WATER AND THE ENVIRONMENT AGENCY. SHOULD ANOTHER TYPE OF FILTER MEDIA BE REQUIRED THIS SHOULD BE IN ADDITION TO THE TREATMENT FILTER MEDIA AND SHOULD NOT REPLACE THE MATERIAL.

REV	DATE	BY	DESCRIPTION	CHK	APP
P02	12/09/19	KR	SPECIFIED DEPTH AND TYPE OF TREATMENT FILTER MEDIA AND GEOTEXTILE MEMBRANES	PWW	NM
P01	10/07/19	RF	FIRST ISSUE	MD	PWW

DRAWING STATUS:
S2 - FOR INFORMATION

wsp
Amber Court, William Armstrong Drive, Newcastle upon Tyne, NE4 7YQ, UK
T+ 44 (0) 191 226 2000, F+ 44 (0) 191 226 2104
wsp.com

CLIENT: AQUIND

ARCHITECT: -

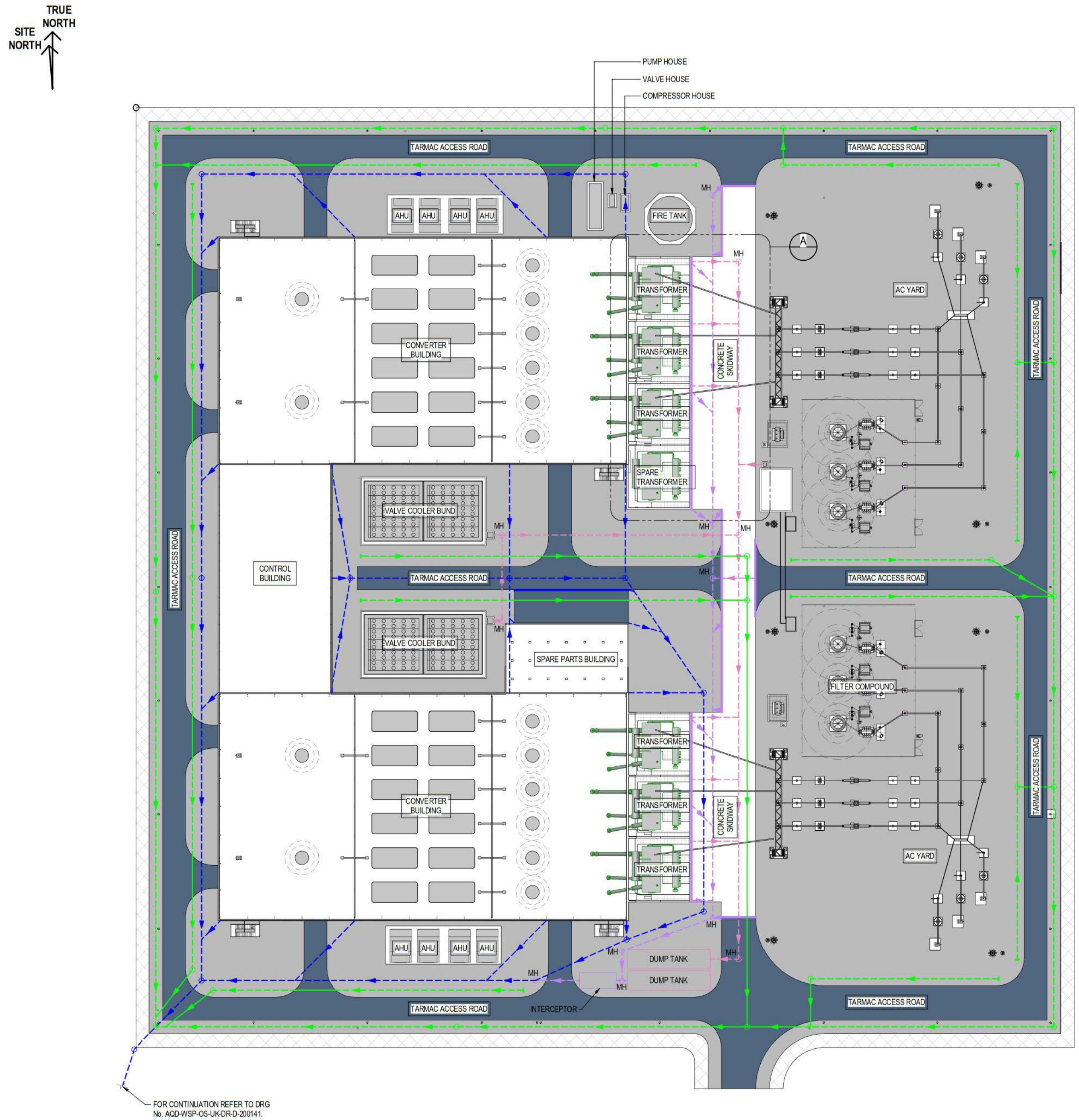
SITE/PROJECT: AQUIND HVDC INTERCONNECTOR

TITLE: BELOW GROUND DRAINAGE TYPICAL DETAILS

SCALE @ A1: NTS	CHECKED: MD		APPROVED: PWW
PROJECT NO: 62100616	DESIGNED: KR / PWW	DRAWN: RF	DATE: September 19

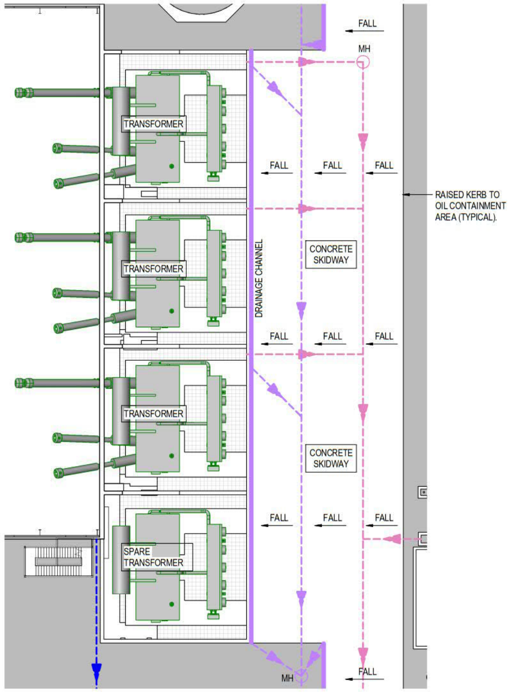
DRAWING No: AQD-WSP-OS-UK-DR-D-200340 — REV: P02

Appendix 2 Typical Oil Containment Details



INDICATIVE OIL CONTAINMENT AREA

1 : 500



DETAIL A - TYPICAL ENLARGED TRANSFORMER SKIDWAY DETAILS

1 : 250

NOTES:-

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, SERVICES AND ENGINEERS DRAWINGS TOGETHER WITH RELEVANT SPECIFICATIONS.
2. DIMENSIONS ARE NOT TO BE SCALED FROM THIS DRAWING.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH BELOW GROUND DRAINAGE LAYOUTS SHOWN ON DRG No's. AQD-WSP-OS-UK-DR-D-200140 (SHEET 1) AND AQD-WSP-OS-UK-DR-D-200141 (SHEET 2).

LEGEND:-

- OIL CONTAINMENT DRAINAGE
- OILY WATER DRAINAGE
- OILY WATER DRAINAGE CHANNEL
- SURFACE WATER DRAINAGE
- SURFACE WATER DRAINAGE CHANNEL
- LAND DRAINAGE
- MH — MANHOLE

REV	DATE	BY	DESCRIPTION	CHK	APP
00	01.07.20	PB	ISSUED FOR INFORMATION	HM	MM

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London WC2A 1AF
Tel: +44 20 7314 5000 Fax: +44 20 7314 5111
http://www.wsp.com

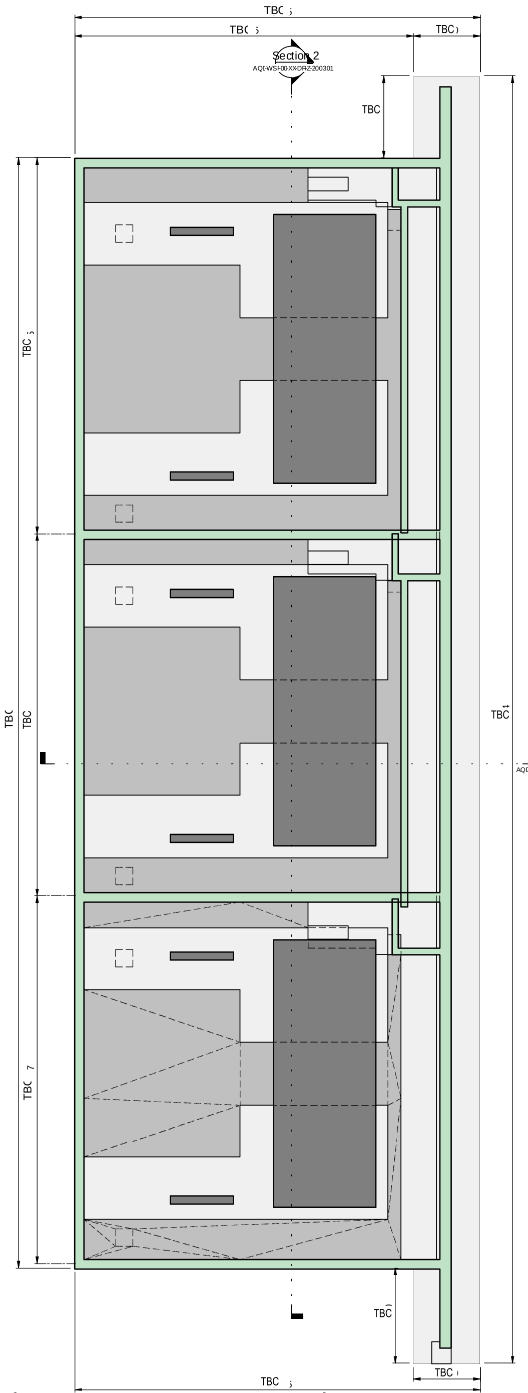
CLIENT: AQUIND

PROJECT: AQUIND INTERCONNECTOR 2 x 1000MW HVDC MONOPOLE LOVEDEAN UK

TITLE: INDICATIVE OIL CONTAINMENT LAYOUT

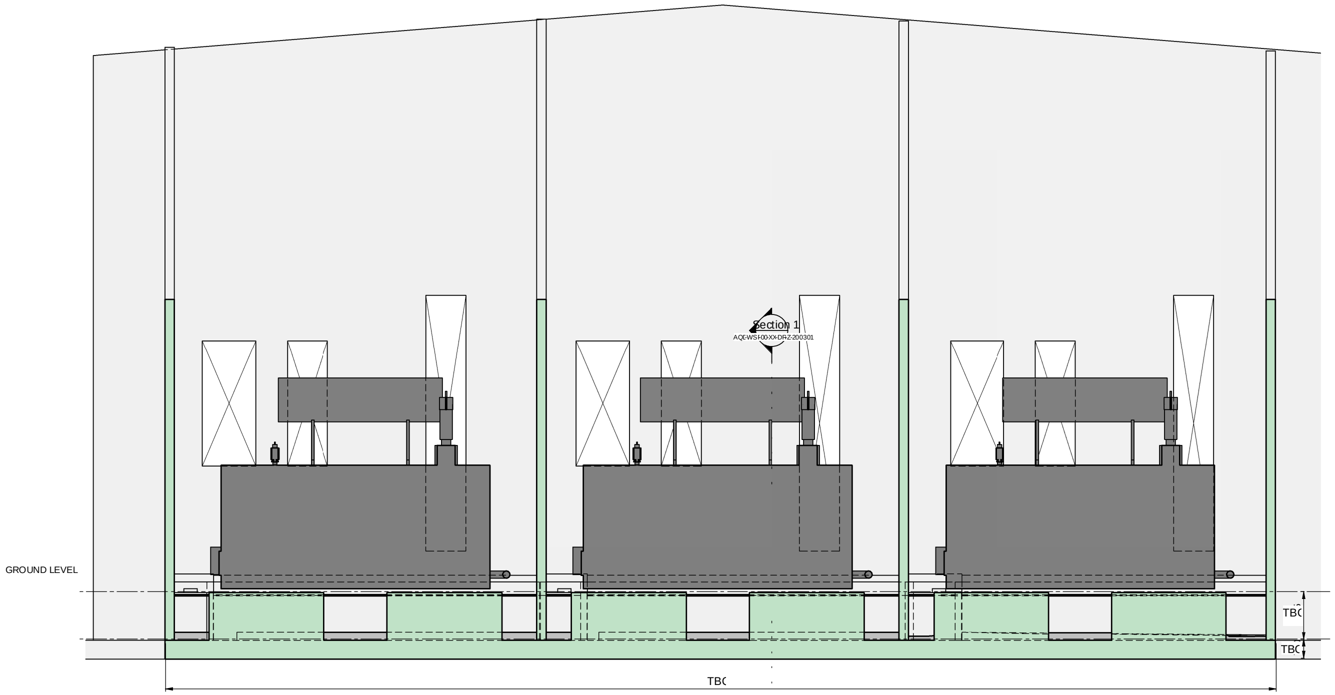
SCALE AT A1: AS NOTED	CHECKED: HM	APPROVED: MM
PROJECT No: 62100616	DESIGNED: / DRAWN: PB	DATE: JUNE 2020
DRAWING No: AQ-WSP-UK-CS-DR-Z-200807		REV: P01

NOTE:-
ALL DETAILS SHOWN ARE INDICATIVE AND WILL SUBJECT TO FINAL DESIGN BY THE CONTRACTOR.



GROUND LEVEL

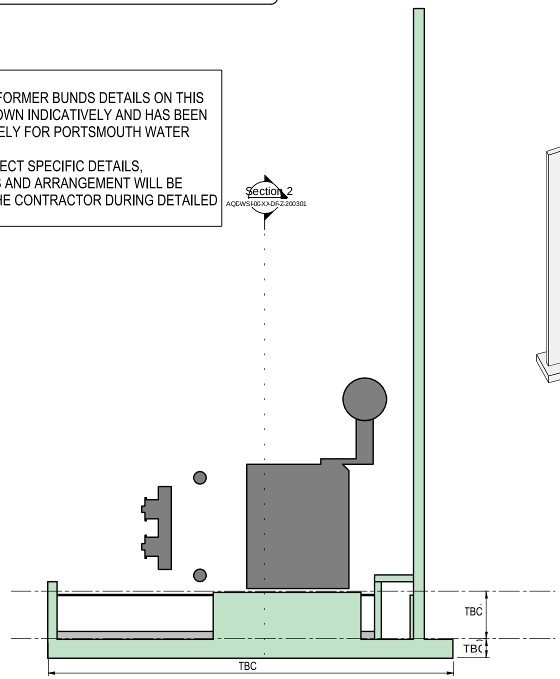
1 : 100



Section 2

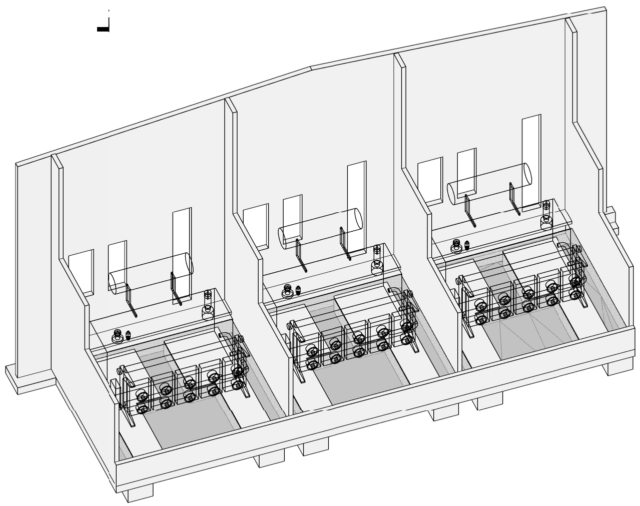
1 : 100

NOTE:
TYPICAL TRANSFORMER BUNDS DETAILS ON THIS DRAWING IS SHOWN INDICATIVELY AND HAS BEEN PRODUCED SOLELY FOR PORTSMOUTH WATER INFORMATION.
FINAL AND PROJECT SPECIFIC DETAILS, SPECIFICATIONS AND ARRANGEMENT WILL BE PROVIDED BY THE CONTRACTOR DURING DETAILED DESIGN STAGE.



Section 1

1 : 100



GROUND LEVEL

NOTE:
ALL DETAILS SHOWN ARE INDICATIVE AND WILL SUBJECT TO FINAL DESIGN BY THE CONTRACOTR

NOTES:

1. DRAWING IS FOR PRELIMINRY PURPOSES ONLY.
2. FOUNDATION SIZES INDICARE SHOWN INDICATIVELY
3. MAXIMUM PERMISSIBLE DIFFERENTIAL SETTILEMENT TO BE NO GREATER THAN 25mm SUBJECT TO CONFIRMATION FROM ELECTRICAL EQUIPMENT PROVIDER.

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(i)

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	01.07.2	PB	ISSUED FOR INFORMATION	HM	MM

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London WC2A 1AF
Tel: +44 (0)20 7314 5000 Fax: +44 (0)20 7314 5001
http://www.wsp.com

CLIENT: AQUIND

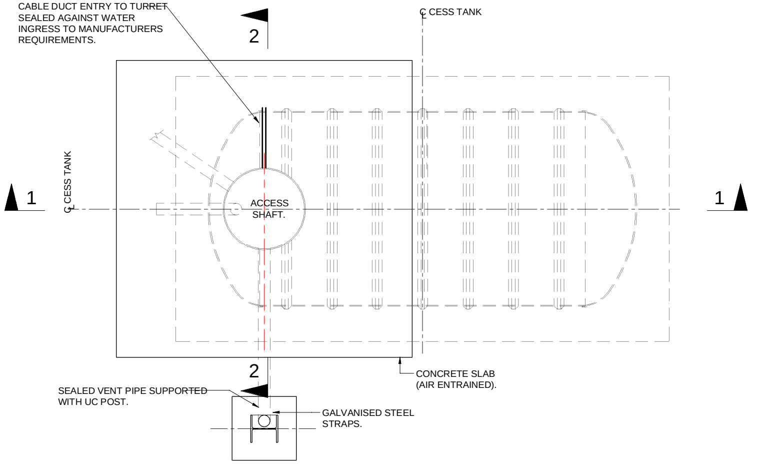
PROJECT: AQUIND INTERCONNECTOR 2X1000MW HVDC MONOPOLE LOVEDEAN UK

TITLE: TYPICAL TRANSFORMER BUND INDICATIVE ARRANGEMENT

SCALE AT A1: 1:100	CHECKED: HM		APPROVED: MM
PROJECT No: EN020022	DESIGNED:	DRAWN: PT	DATE: SEPTEMBER 2018

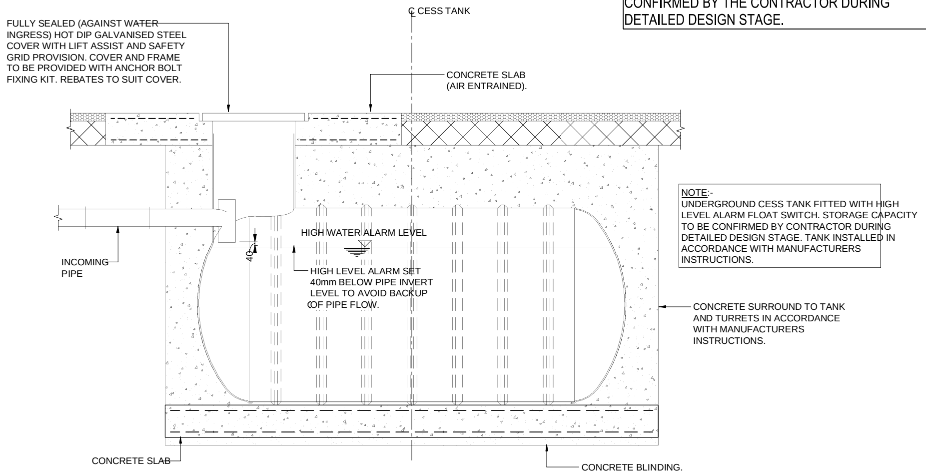
DRAWING No: AQ-WSP-UK-CS-DR-Z-200301 REV: P01

Appendix 3 Typical Cess tank Details

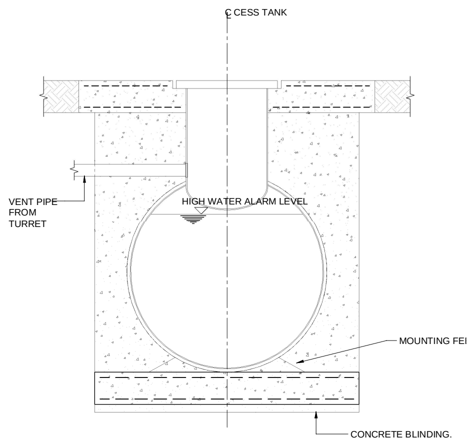


PLAN ON CESS TANK
(SCALE 1:25)

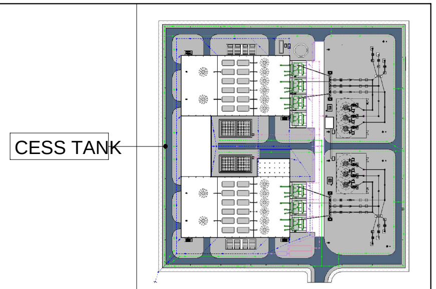
NOTE:
TYPICAL CESS TANK DETAILS ON THIS DRAWING IS SHOWN INDICATIVELY AND HAS BEEN PRODUCED SOLELY FOR PORTSMOUTH WATER INFORMATION. FINAL AND PROJECT SPECIFIC DETAILS, SPECIFICATIONS AND SETTING OUT WILL BE CONFIRMED BY THE CONTRACTOR DURING DETAILED DESIGN STAGE.



SECTION 1-1
(SCALE 1:25)



SECTION 2-2
(SCALE 1:25)



PLAN ON AQUIND CONVERTER STATION

Last saved in Autodesk Revit 2019.

NOTE:
ALL DETAILS SHOWN ARE INDICATIVE AND WILL SUBJECT TO FINAL DESIGN BY THE CONTRACOTR

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(i)

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	01.07.2	PB	ISSUED FOR INFORMATION	HM	MN

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London WC2A 1AF
Tel: +44 20 7314 5000 Fax: +44 20 7314 5111
http://www.wsp.com

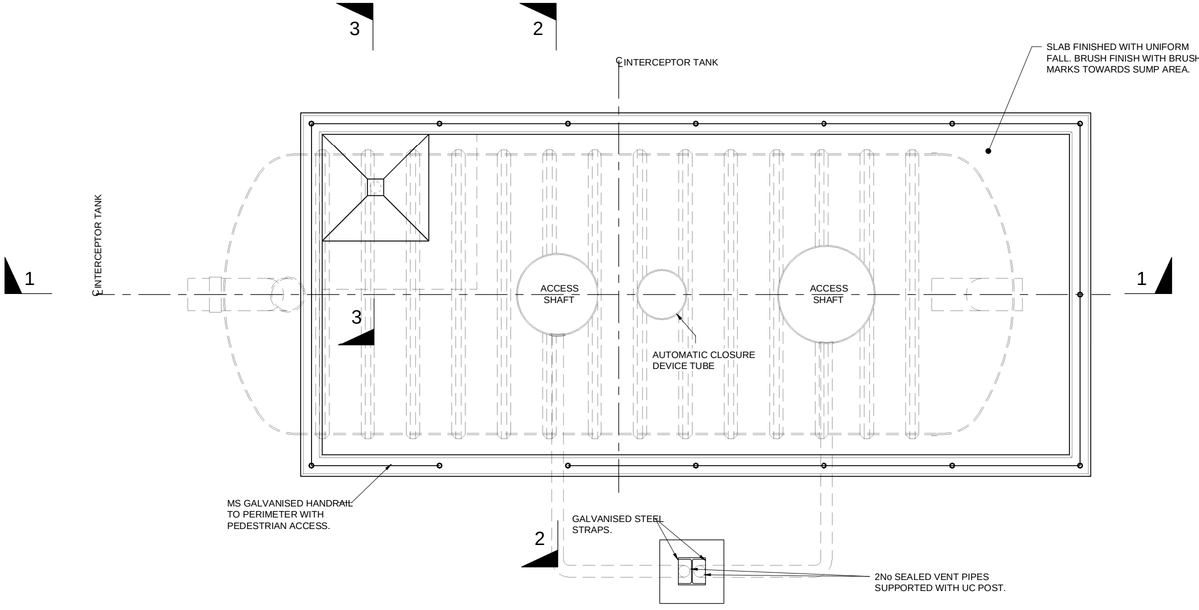
CLIENT: AQUIND

PROJECT: AQUIND INTERCONNECTOR 2X1000MW HVDC MONOPOLE LOVEDEAN UK

TITLE: TYPICAL CESS TANK DETAILS

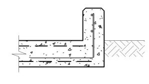
SCALE AT A1: AS NOTED	CHECKED: HM	APPROVED: MN
PROJECT No: EN020022	DESIGNED: / DRAWN: PB	DATE: OCT 2019
DRAWING No: AQ-WSP-UK-CS-DR-Z-200803		REV: P01

Appendix 4 Typical Interceptor Details



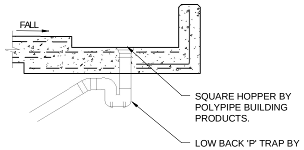
PLAN ON FULL RETENTION OIL INTERCEPTOR

(SCALE 1:25)



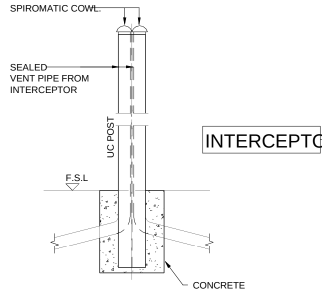
DETAIL 'A'

(SCALE 1:25)



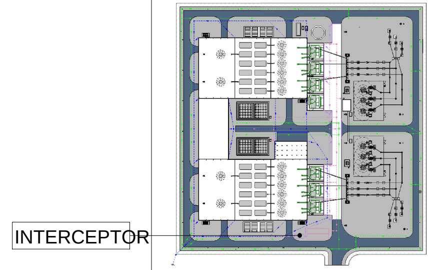
SECTION 3-3

(SCALE 1:25)



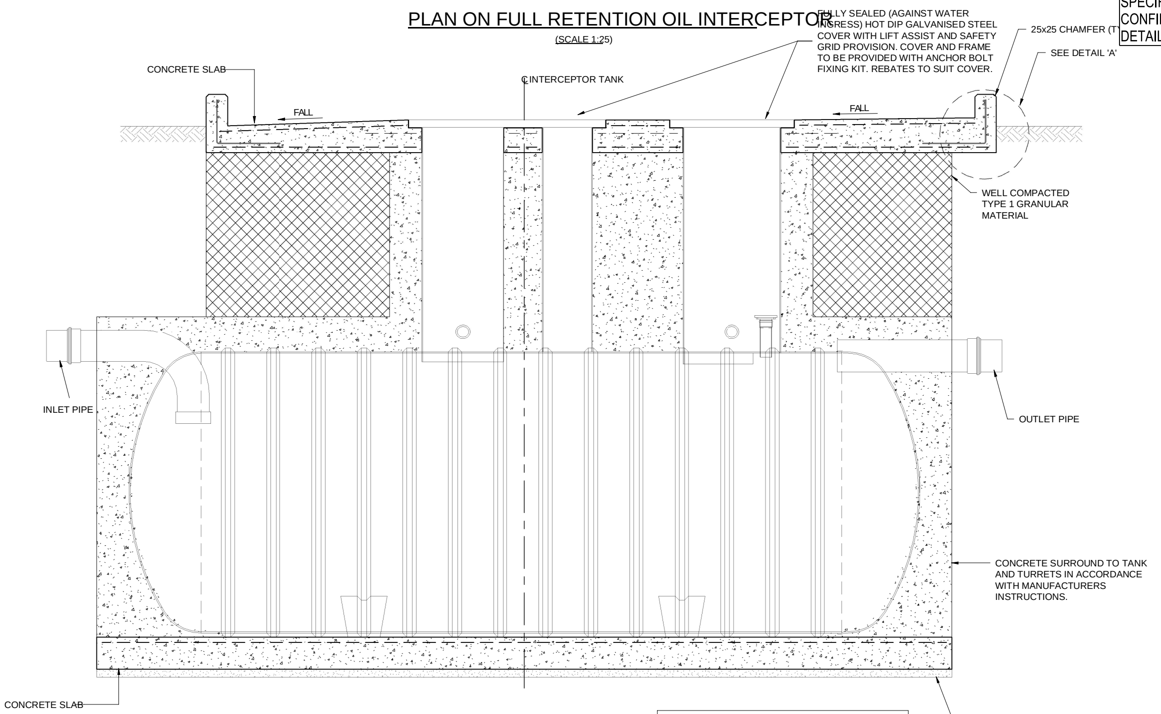
TYPICAL VENT PIPE DETAIL

(SCALE 1:25)



PLAN ON AQUIND CONVERTER STATION

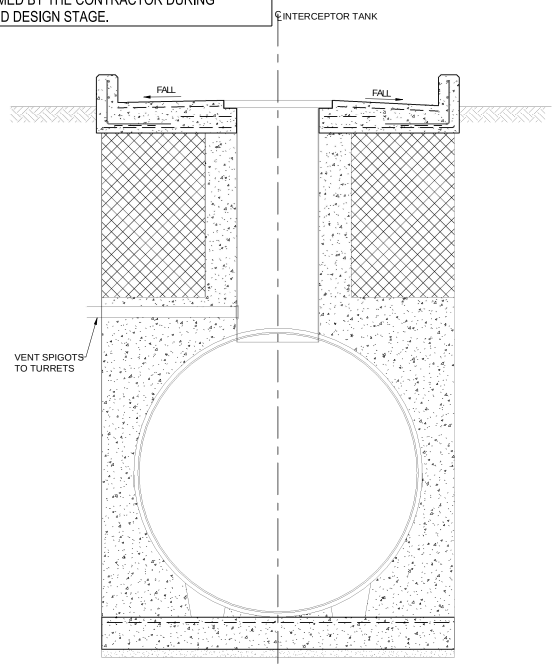
NOTE:
TYPICAL INTERCEPTOR DETAILS ON THIS DRAWING IS SHOWN INDICATIVELY AND HAS BEEN PRODUCED SOLELY FOR PORTSMOUTH WATER INFORMATION. FINAL AND PROJECT SPECIFIC DETAILS, SPECIFICATIONS AND SETTING OUT WILL BE CONFIRMED BY THE CONTRACTOR DURING DETAILED DESIGN STAGE.



SECTION 1-1

(SCALE 1:25)

NOTE:-
SPEL PURACEPTOR CLASS 1, TWO CHAMBER FULL RETENTION SEPERATOR TO EUROPEAN STANDARD BS EN858-1 COMPLETE WITH AUTOMATIC CLOSURE DEVICE, COALESCING FILTER AND FUEL / OIL LEVEL ALARM PROBE AND CONTROL UNIT. STORAGE CAPACITY TO BE CONFIRMED BY CONTRACTOR DURING DETAILED DESIGN STAGE. TANK INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.



SECTION 2-2

(SCALE 1:25)

NOTE:
ALL DETAILS SHOWN ARE INDICATIV AND WILL SUBJECT TO FINAL DESIGN BY THE CONTRACOTR

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(i)

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	01.07.20	PB	ISSUED FOR INFORMATION	HM	MN

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, LONDON WC2A 1AF
Tel: +44 (0)20 7314 5000 Fax: +44 (0)20 7314 5001
http://www.wsp.com

CLIENT: AQUIND

PROJECT: AQUIND INTERCONNECTOR 2X1000MW HVDC MONOPOLE LOVEDEAN UK

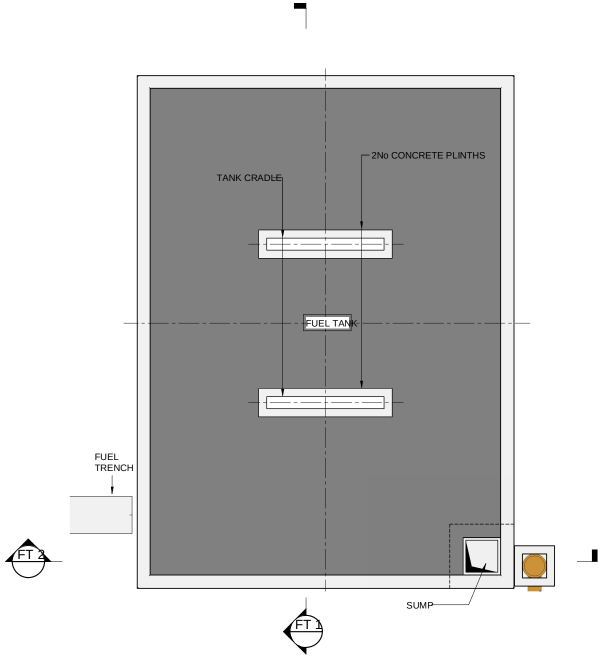
TITLE: TYPICAL INTERCEPTOR DETAILS

SCALE AT A1:	CHECKED:	APPROVED:
AS NOTED	HM	MN

PROJECT No:	DESIGNED:	DRAWN:	DATE:
EN020022		PB	OCT 2019

DRAWING No:	REV:
AQ-WSP-UK-CS-DR-Z-200801	P01

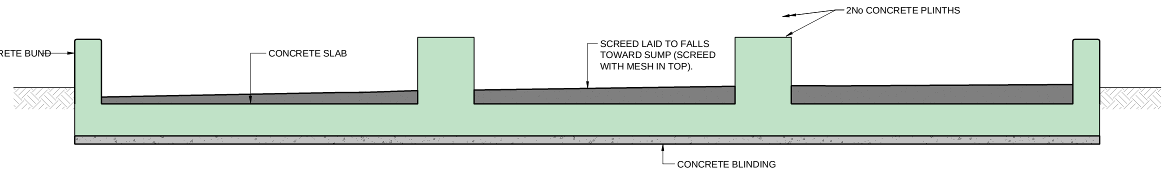
Appendix 5 Typical Fuel Tank Details



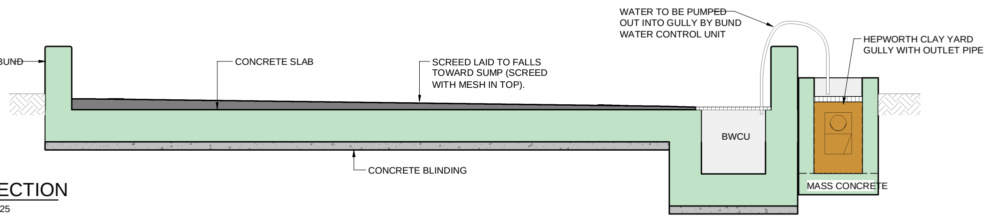
1 TYPICAL FUEL TANK BUND
1 : 50

BUND DETAILS SHOWN ON THIS DRAWING ARE ALSO TYPICAL TO DIESEL GENERATOR BUND.

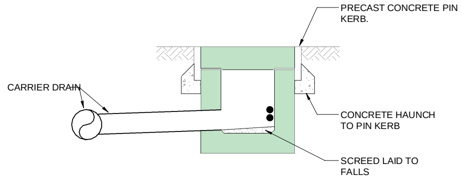
NOTE:
TYPICAL FUEL TANK BUND ON THIS DRAWING IS SHOWN INDICATIVELY AND HAS BEEN PRODUCED SOLELY FOR PORTSMOUTH WATER INFORMATION. FINAL AND PROJECT SPECIFIC DETAILS, SPECIFICATIONS AND SETTING OUT WILL BE CONFIRMED BY THE CONTRACTOR DURING DETAILED DESIGN STAGE.



FT 1 SECTION
1 : 25

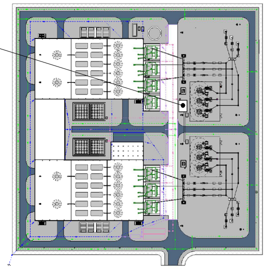


FT 2 SECTION
1 : 25



TYPICAL SECTION THROUGH FUEL TRENCH
SHOWING RAINWATER OUTFALL TO DRAINAGE PIPE
(SCALE 1:20)

FUEL TANK BUND



PLAN ON AQUIND
CONVERTER STATION

Infrastructure Planning (Applications: Prescribed Forms & Procedure) Regulations 2009 - Regulation 5(2)(i)

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	01.07.2	PB	ISSUED FOR INFORMATION	HM	MN

DRAWING STATUS:
INFORMATION

WSP House, 70 Chancery Lane, LONDON WC2A 1AF
Tel: +44 (0)20 7314 5000 Fax: +44 (0)20 7314 5001
http://www.wsp.com

CLIENT:
AQUIND

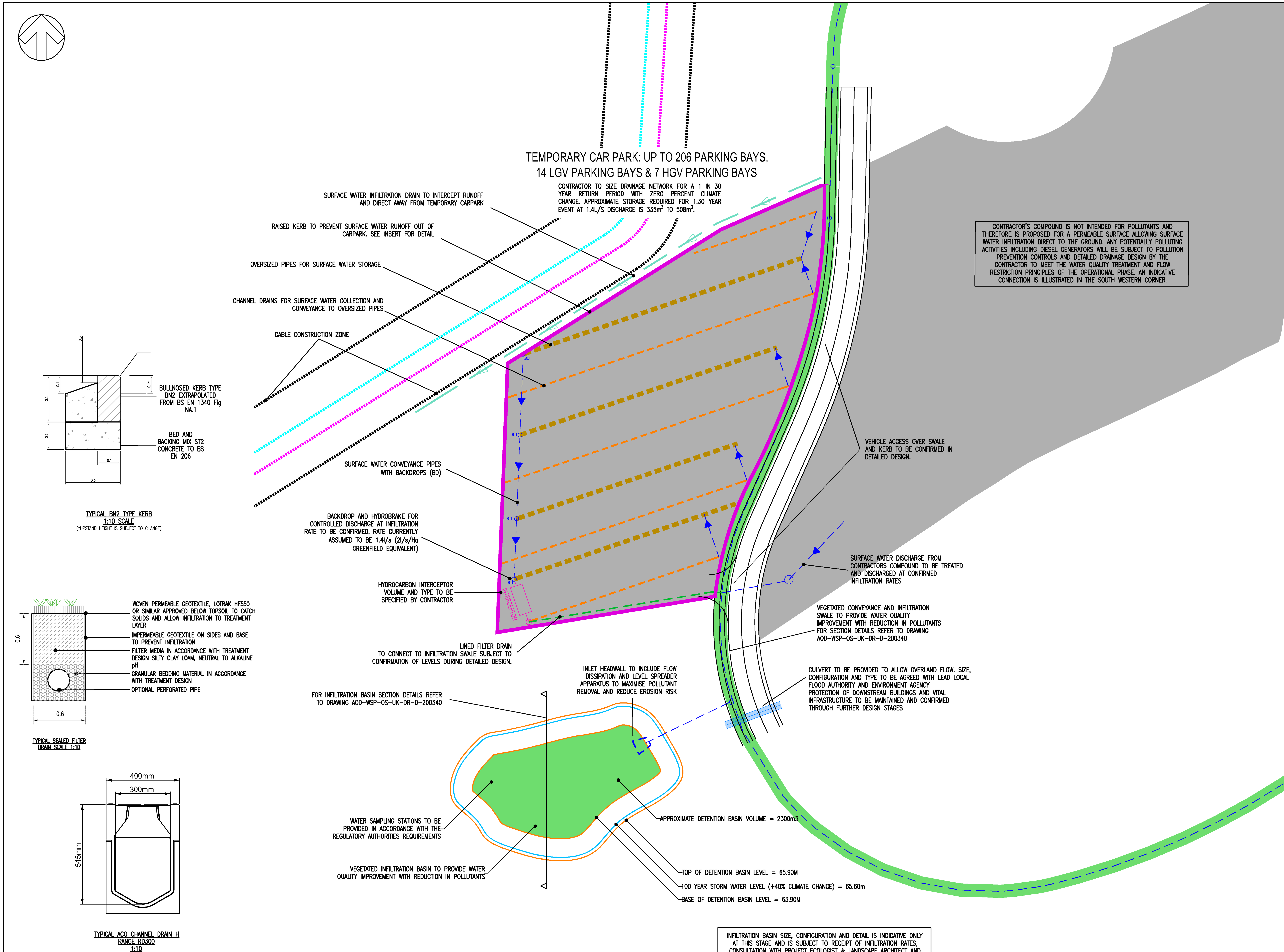
PROJECT:
AQUIND INTERCONNECTOR
2X1000MW HVDC MONOPOLE
LOVEDEAN UK

TITLE:
TYPICAL FUEL TANK & DIESEL
GENERATOR BUND DETAILS

SCALE AT A1: AS NOTED	CHECKED: HM	APPROVED: HM
PROJECT No: EN020022	DESIGNED:	DRAWN: PB	DATE: OCT 2019
DRAWING No: AQ-WSP-UK-CS-DR-Z-200804		REV: P01

NOTE:
ALL DETAILS SHOWN ARE INDICATIVE AND WILL SUBJECT TO FINAL DESIGN BY THE CONTRACOTR

Appendix 6 ± Indicative Temporary Car Park and Compound Drainage Layout



NOTE:
ALL DETAILS SHOWN ARE INDICATIVE AND SUBJECT TO FINAL DESIGN BY THE CONTRACTOR

REV	DATE	BY	DESCRIPTION	CHK	APP
P02	23/09/2020	JM	ADDITION OF ACO CHANNEL DRAIN CONSTRUCTION DETAIL AND REVISED LAYOUT		
P01	04/08/2020	KR	FIRST ISSUE		

DRAWING STATUS: FOR INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: AQUIND

PROJECT: AQUIND Interconnector

TITLE: INDICATIVE TEMPORARY CARPARK AND COMPOUND DRAINAGE LAYOUT

SCALE AT A1: 1:500	CHECKED: NM / HM	APPROVED: MM
PROJECT No: 62100616	DESIGNED: KR	DRAWN: KR	DATE: 04/08/2020

DRAWING No: AQ-ITT-UK-LAY-101 | REV: P01

Appendix 7 ± Microdrainage Source Control Results

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1591 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	80.870	0.370	4.6	0.0	4.6	386.1	O K
30 min Summer	80.984	0.484	4.8	0.0	4.8	516.4	O K
60 min Summer	81.103	0.603	5.0	0.0	5.0	658.8	O K
120 min Summer	81.172	0.672	5.1	0.0	5.1	744.4	O K
180 min Summer	81.214	0.714	5.2	0.0	5.2	796.5	O K
240 min Summer	81.243	0.743	5.2	0.0	5.2	833.2	O K
360 min Summer	81.280	0.780	5.3	0.0	5.3	881.6	O K
480 min Summer	81.304	0.804	5.3	0.0	5.3	912.4	O K
600 min Summer	81.319	0.819	5.4	0.0	5.4	932.3	O K
720 min Summer	81.329	0.829	5.4	0.0	5.4	945.2	O K
960 min Summer	81.338	0.838	5.4	0.0	5.4	956.8	O K
1440 min Summer	81.331	0.831	5.4	0.0	5.4	947.3	O K
2160 min Summer	81.312	0.812	5.3	0.0	5.3	922.7	O K
2880 min Summer	81.295	0.795	5.3	0.0	5.3	900.5	O K
4320 min Summer	81.268	0.768	5.3	0.0	5.3	865.3	O K
5760 min Summer	81.248	0.748	5.2	0.0	5.2	840.1	O K
7200 min Summer	81.236	0.736	5.2	0.0	5.2	824.1	O K
8640 min Summer	81.227	0.727	5.2	0.0	5.2	813.2	O K
10080 min Summer	81.225	0.725	5.2	0.0	5.2	810.3	O K
15 min Winter	80.870	0.370	4.6	0.0	4.6	386.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	135.464	0.0	0.0	19
30 min Summer	91.000	0.0	0.0	34
60 min Summer	58.534	0.0	0.0	64
120 min Summer	33.649	0.0	0.0	124
180 min Summer	24.393	0.0	0.0	184
240 min Summer	19.432	0.0	0.0	242
360 min Summer	14.114	0.0	0.0	362
480 min Summer	11.267	0.0	0.0	482
600 min Summer	9.465	0.0	0.0	602
720 min Summer	8.213	0.0	0.0	722
960 min Summer	6.570	0.0	0.0	960
1440 min Summer	4.799	0.0	0.0	1344
2160 min Summer	3.518	0.0	0.0	1708
2880 min Summer	2.836	0.0	0.0	2080
4320 min Summer	2.112	0.0	0.0	2936
5760 min Summer	1.732	0.0	0.0	3752
7200 min Summer	1.501	0.0	0.0	4608
8640 min Summer	1.346	0.0	0.0	5440
10080 min Summer	1.239	0.0	0.0	6248
15 min Winter	135.464	0.0	0.0	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	80.984	0.484	4.8	0.0	4.8	516.4	O K
60 min Winter	81.103	0.603	5.0	0.0	5.0	658.9	O K
120 min Winter	81.173	0.673	5.1	0.0	5.1	745.1	O K
180 min Winter	81.215	0.715	5.2	0.0	5.2	797.6	O K
240 min Winter	81.244	0.744	5.2	0.0	5.2	834.6	O K
360 min Winter	81.282	0.782	5.3	0.0	5.3	883.7	O K
480 min Winter	81.306	0.806	5.3	0.0	5.3	915.3	O K
600 min Winter	81.322	0.822	5.4	0.0	5.4	936.2	O K
720 min Winter	81.333	0.833	5.4	0.0	5.4	950.1	O K
960 min Winter	81.343	0.843	5.4	0.0	5.4	964.1	O K
1440 min Winter	81.340	0.840	5.4	0.0	5.4	959.4	O K
2160 min Winter	81.314	0.814	5.3	0.0	5.3	925.6	O K
2880 min Winter	81.292	0.792	5.3	0.0	5.3	897.1	O K
4320 min Winter	81.249	0.749	5.2	0.0	5.2	840.5	O K
5760 min Winter	81.209	0.709	5.2	0.0	5.2	790.5	O K
7200 min Winter	81.177	0.677	5.1	0.0	5.1	750.2	O K
8640 min Winter	81.150	0.650	5.1	0.0	5.1	716.4	O K
10080 min Winter	81.130	0.630	5.0	0.0	5.0	692.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	91.000	0.0	0.0	34
60 min Winter	58.534	0.0	0.0	64
120 min Winter	33.649	0.0	0.0	122
180 min Winter	24.393	0.0	0.0	180
240 min Winter	19.432	0.0	0.0	240
360 min Winter	14.114	0.0	0.0	358
480 min Winter	11.267	0.0	0.0	474
600 min Winter	9.465	0.0	0.0	590
720 min Winter	8.213	0.0	0.0	704
960 min Winter	6.570	0.0	0.0	932
1440 min Winter	4.799	0.0	0.0	1370
2160 min Winter	3.518	0.0	0.0	1732
2880 min Winter	2.836	0.0	0.0	2192
4320 min Winter	2.112	0.0	0.0	3112
5760 min Winter	1.732	0.0	0.0	4032
7200 min Winter	1.501	0.0	0.0	4904
8640 min Winter	1.346	0.0	0.0	5792
10080 min Winter	1.238	0.0	0.0	6656

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.950
FEH Rainfall Version	2013	Cv (Winter)	0.950
Site Location	GB 467141 113621 SU 67141 13621	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.212

Time From:	**(mins) To:**	**Area (ha)**
0	4	1.212

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 82.500

Infiltration Basin Structure

Invert Level (m) 80.500 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01440 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	972.4	1.700	1732.8	2.000	1884.0

Weir Overflow Control

Discharge Coef 0.544 Width (m) 2.400 Invert Level (m) 82.200

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1117 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	64.158	0.258	4.5	272.1	O K
30 min Summer	64.239	0.339	4.6	363.4	O K
60 min Summer	64.325	0.425	4.8	462.2	O K
120 min Summer	64.373	0.473	4.8	519.2	O K
180 min Summer	64.401	0.501	4.9	552.4	O K
240 min Summer	64.420	0.520	4.9	574.8	O K
360 min Summer	64.442	0.542	5.0	601.8	O K
480 min Summer	64.454	0.554	5.0	616.4	O K
600 min Summer	64.460	0.560	5.0	623.5	O K
720 min Summer	64.462	0.562	5.0	625.8	O K
960 min Summer	64.458	0.558	5.0	620.9	O K
1440 min Summer	64.443	0.543	5.0	603.5	O K
2160 min Summer	64.423	0.523	4.9	578.2	O K
2880 min Summer	64.404	0.504	4.9	556.1	O K
4320 min Summer	64.372	0.472	4.8	517.4	O K
5760 min Summer	64.345	0.445	4.8	485.3	O K
7200 min Summer	64.324	0.424	4.8	460.4	O K
8640 min Summer	64.306	0.406	4.7	440.0	O K
10080 min Summer	64.294	0.394	4.7	425.6	O K
15 min Winter	64.158	0.258	4.5	272.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.464	0.0	19
30 min Summer	91.000	0.0	34
60 min Summer	58.534	0.0	64
120 min Summer	33.649	0.0	124
180 min Summer	24.393	0.0	182
240 min Summer	19.432	0.0	242
360 min Summer	14.114	0.0	362
480 min Summer	11.267	0.0	482
600 min Summer	9.465	0.0	602
720 min Summer	8.213	0.0	720
960 min Summer	6.570	0.0	932
1440 min Summer	4.799	0.0	1154
2160 min Summer	3.518	0.0	1536
2880 min Summer	2.836	0.0	1960
4320 min Summer	2.112	0.0	2768
5760 min Summer	1.732	0.0	3624
7200 min Summer	1.501	0.0	4400
8640 min Summer	1.346	0.0	5192
10080 min Summer	1.239	0.0	6048
15 min Winter	135.464	0.0	19

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	64.240	0.340	4.6	363.4	O K
60 min Winter	64.325	0.425	4.8	462.3	O K
120 min Winter	64.374	0.474	4.8	519.8	O K
180 min Winter	64.402	0.502	4.9	553.4	O K
240 min Winter	64.421	0.521	4.9	576.0	O K
360 min Winter	64.444	0.544	5.0	603.7	O K
480 min Winter	64.456	0.556	5.0	619.1	O K
600 min Winter	64.463	0.563	5.0	627.2	O K
720 min Winter	64.466	0.566	5.0	630.5	O K
960 min Winter	64.463	0.563	5.0	627.9	O K
1440 min Winter	64.444	0.544	5.0	604.7	O K
2160 min Winter	64.418	0.518	4.9	572.3	O K
2880 min Winter	64.390	0.490	4.9	538.6	O K
4320 min Winter	64.336	0.436	4.8	474.3	O K
5760 min Winter	64.287	0.387	4.7	418.2	O K
7200 min Winter	64.247	0.347	4.6	372.0	O K
8640 min Winter	64.212	0.312	4.6	332.7	O K
10080 min Winter	64.185	0.285	4.5	301.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	91.000	0.0	33
60 min Winter	58.534	0.0	62
120 min Winter	33.649	0.0	122
180 min Winter	24.393	0.0	180
240 min Winter	19.432	0.0	238
360 min Winter	14.114	0.0	356
480 min Winter	11.267	0.0	470
600 min Winter	9.465	0.0	584
720 min Winter	8.213	0.0	698
960 min Winter	6.570	0.0	914
1440 min Winter	4.799	0.0	1182
2160 min Winter	3.518	0.0	1624
2880 min Winter	2.836	0.0	2080
4320 min Winter	2.112	0.0	2984
5760 min Winter	1.732	0.0	3856
7200 min Winter	1.501	0.0	4680
8640 min Winter	1.346	0.0	5456
10080 min Winter	1.238	0.0	6256

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.950
FEH Rainfall Version	2013	Cv (Winter)	0.950
Site Location	GB 467141 113621 SU 67141 13621	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.857

Time (mins) From:	To:	Area (ha)
0	4	0.857

Model Details

Storage is Online Cover Level (m) 65.900

Infiltration Basin Structure

Invert Level (m)	63.900	Safety Factor	1.0
Infiltration Coefficient Base (m/hr)	0.01440	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1005.7	1.700	1739.6	2.000	1886.2

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 46 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	84.571	0.071	12.6	44.8	O K
30 min Summer	84.588	0.088	12.6	55.7	O K
60 min Summer	84.599	0.099	12.6	62.7	O K
120 min Summer	84.592	0.092	12.6	58.3	O K
180 min Summer	84.584	0.084	12.6	53.1	O K
240 min Summer	84.576	0.076	12.6	48.0	O K
360 min Summer	84.562	0.062	12.6	39.2	O K
480 min Summer	84.552	0.052	12.6	33.0	O K
600 min Summer	84.547	0.047	11.8	29.4	O K
720 min Summer	84.542	0.042	10.7	26.8	O K
960 min Summer	84.536	0.036	9.2	22.8	O K
1440 min Summer	84.528	0.028	7.1	18.0	O K
2160 min Summer	84.522	0.022	5.5	13.8	O K
2880 min Summer	84.518	0.018	4.6	11.4	O K
4320 min Summer	84.514	0.014	3.5	8.7	O K
5760 min Summer	84.511	0.011	2.8	7.3	O K
7200 min Summer	84.510	0.010	2.6	6.3	O K
8640 min Summer	84.509	0.009	2.3	5.7	O K
10080 min Summer	84.508	0.008	2.1	5.1	O K
15 min Winter	84.571	0.071	12.6	44.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.464	0.0	17
30 min Summer	91.000	0.0	30
60 min Summer	58.534	0.0	48
120 min Summer	33.649	0.0	82
180 min Summer	24.393	0.0	114
240 min Summer	19.432	0.0	148
360 min Summer	14.114	0.0	208
480 min Summer	11.267	0.0	266
600 min Summer	9.465	0.0	326
720 min Summer	8.213	0.0	386
960 min Summer	6.570	0.0	508
1440 min Summer	4.799	0.0	750
2160 min Summer	3.518	0.0	1108
2880 min Summer	2.836	0.0	1472
4320 min Summer	2.112	0.0	2204
5760 min Summer	1.732	0.0	2936
7200 min Summer	1.501	0.0	3664
8640 min Summer	1.346	0.0	4384
10080 min Summer	1.239	0.0	5136
15 min Winter	135.464	0.0	17

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	84.588	0.088	12.6	55.7	O K
60 min Winter	84.598	0.098	12.6	61.9	O K
120 min Winter	84.587	0.087	12.6	55.2	O K
180 min Winter	84.575	0.075	12.6	47.5	O K
240 min Winter	84.564	0.064	12.6	40.5	O K
360 min Winter	84.549	0.049	12.3	30.9	O K
480 min Winter	84.542	0.042	10.6	26.3	O K
600 min Winter	84.536	0.036	9.2	23.0	O K
720 min Winter	84.532	0.032	8.2	20.4	O K
960 min Winter	84.527	0.027	6.8	16.8	O K
1440 min Winter	84.520	0.020	5.1	12.6	O K
2160 min Winter	84.515	0.015	3.7	9.4	O K
2880 min Winter	84.512	0.012	3.1	7.6	O K
4320 min Winter	84.509	0.009	2.3	5.7	O K
5760 min Winter	84.508	0.008	2.0	4.8	O K
7200 min Winter	84.507	0.007	1.7	4.1	O K
8640 min Winter	84.506	0.006	1.5	3.6	O K
10080 min Winter	84.505	0.005	1.3	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	91.000	0.0	30
60 min Winter	58.534	0.0	50
120 min Winter	33.649	0.0	86
180 min Winter	24.393	0.0	122
240 min Winter	19.432	0.0	154
360 min Winter	14.114	0.0	210
480 min Winter	11.267	0.0	272
600 min Winter	9.465	0.0	334
720 min Winter	8.213	0.0	396
960 min Winter	6.570	0.0	514
1440 min Winter	4.799	0.0	750
2160 min Winter	3.518	0.0	1128
2880 min Winter	2.836	0.0	1452
4320 min Winter	2.112	0.0	2200
5760 min Winter	1.732	0.0	2928
7200 min Winter	1.501	0.0	3816
8640 min Winter	1.346	0.0	4408
10080 min Winter	1.238	0.0	5240

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.950
FEH Rainfall Version	2013	Cv (Winter)	0.950
Site Location	GB 467141 113621 SU 67141 13621	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.163

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.163

Model Details

Storage is Online Cover Level (m) 85.100

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.01440	Trench Width (m)	10.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	316.0
Safety Factor	1.0	Slope (1:X)	0.0
Porosity	0.20	Cap Volume Depth (m)	0.000
Invert Level (m)	84.500	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 145 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	84.712	0.212	3.8	40.7	O K
30 min Summer	84.776	0.276	3.8	53.0	O K
60 min Summer	84.834	0.334	3.8	64.1	Flood Risk
120 min Summer	84.835	0.335	3.8	64.4	Flood Risk
180 min Summer	84.824	0.324	3.8	62.1	Flood Risk
240 min Summer	84.812	0.312	3.8	60.0	Flood Risk
360 min Summer	84.790	0.290	3.8	55.7	O K
480 min Summer	84.769	0.269	3.8	51.6	O K
600 min Summer	84.748	0.248	3.8	47.6	O K
720 min Summer	84.728	0.228	3.8	43.9	O K
960 min Summer	84.692	0.192	3.8	36.9	O K
1440 min Summer	84.632	0.132	3.8	25.4	O K
2160 min Summer	84.574	0.074	3.8	14.2	O K
2880 min Summer	84.550	0.050	3.8	9.6	O K
4320 min Summer	84.538	0.038	2.9	7.3	O K
5760 min Summer	84.531	0.031	2.4	6.0	O K
7200 min Summer	84.527	0.027	2.1	5.3	O K
8640 min Summer	84.525	0.025	1.9	4.7	O K
10080 min Summer	84.523	0.023	1.7	4.3	O K
15 min Winter	84.712	0.212	3.8	40.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	135.464	0.0	18
30 min Summer	91.000	0.0	33
60 min Summer	58.534	0.0	62
120 min Summer	33.649	0.0	120
180 min Summer	24.393	0.0	148
240 min Summer	19.432	0.0	180
360 min Summer	14.114	0.0	246
480 min Summer	11.267	0.0	314
600 min Summer	9.465	0.0	382
720 min Summer	8.213	0.0	448
960 min Summer	6.570	0.0	578
1440 min Summer	4.799	0.0	822
2160 min Summer	3.518	0.0	1148
2880 min Summer	2.836	0.0	1472
4320 min Summer	2.112	0.0	2204
5760 min Summer	1.732	0.0	2936
7200 min Summer	1.501	0.0	3672
8640 min Summer	1.346	0.0	4392
10080 min Summer	1.239	0.0	5128
15 min Winter	135.464	0.0	18

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	84.776	0.276	3.8	53.1	O K
60 min Winter	84.835	0.335	3.8	64.3	Flood Risk
120 min Winter	84.838	0.338	3.8	64.8	Flood Risk
180 min Winter	84.823	0.323	3.8	62.0	Flood Risk
240 min Winter	84.809	0.309	3.8	59.3	Flood Risk
360 min Winter	84.777	0.277	3.8	53.3	O K
480 min Winter	84.746	0.246	3.8	47.2	O K
600 min Winter	84.715	0.215	3.8	41.3	O K
720 min Winter	84.686	0.186	3.8	35.7	O K
960 min Winter	84.635	0.135	3.8	25.9	O K
1440 min Winter	84.563	0.063	3.8	12.2	O K
2160 min Winter	84.541	0.041	3.1	7.9	O K
2880 min Winter	84.533	0.033	2.6	6.4	O K
4320 min Winter	84.525	0.025	1.9	4.8	O K
5760 min Winter	84.521	0.021	1.6	3.9	O K
7200 min Winter	84.518	0.018	1.4	3.4	O K
8640 min Winter	84.516	0.016	1.2	3.1	O K
10080 min Winter	84.515	0.015	1.1	2.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	91.000	0.0	32
60 min Winter	58.534	0.0	60
120 min Winter	33.649	0.0	116
180 min Winter	24.393	0.0	164
240 min Winter	19.432	0.0	186
360 min Winter	14.114	0.0	262
480 min Winter	11.267	0.0	336
600 min Winter	9.465	0.0	406
720 min Winter	8.213	0.0	472
960 min Winter	6.570	0.0	598
1440 min Winter	4.799	0.0	806
2160 min Winter	3.518	0.0	1124
2880 min Winter	2.836	0.0	1472
4320 min Winter	2.112	0.0	2208
5760 min Winter	1.732	0.0	2944
7200 min Winter	1.501	0.0	3744
8640 min Winter	1.346	0.0	4368
10080 min Winter	1.238	0.0	5016

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.950
FEH Rainfall Version	2013	Cv (Winter)	0.950
Site Location	GB 467141 113621 SU 67141 13621	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.136

Time (mins) From:	To:	Area (ha)
0	4	0.136

Model Details

Storage is Online Cover Level (m) 85.100

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.01440	Trench Width (m)	4.8
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	200.0
Safety Factor	1.0	Slope (1:X)	0.0
Porosity	0.20	Cap Volume Depth (m)	0.000
Invert Level (m)	84.500	Cap Infiltration Depth (m)	0.000

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 1325 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	80.799	0.299	4.4	0.0	4.4	307.9	O K
30 min Summer	80.889	0.389	4.6	0.0	4.6	408.0	O K
60 min Summer	80.983	0.483	4.8	0.0	4.8	515.5	O K
120 min Summer	81.048	0.548	4.9	0.0	4.9	591.9	O K
180 min Summer	81.085	0.585	4.9	0.0	4.9	637.0	O K
240 min Summer	81.111	0.611	5.0	0.0	5.0	667.9	O K
360 min Summer	81.142	0.642	5.0	0.0	5.0	707.1	O K
480 min Summer	81.161	0.661	5.1	0.0	5.1	730.6	O K
600 min Summer	81.173	0.673	5.1	0.0	5.1	744.9	O K
720 min Summer	81.179	0.679	5.1	0.0	5.1	752.9	O K
960 min Summer	81.183	0.683	5.1	0.0	5.1	757.0	O K
1440 min Summer	81.174	0.674	5.1	0.0	5.1	745.7	O K
2160 min Summer	81.157	0.657	5.1	0.0	5.1	725.7	O K
2880 min Summer	81.144	0.644	5.0	0.0	5.0	708.6	O K
4320 min Summer	81.123	0.623	5.0	0.0	5.0	683.1	O K
5760 min Summer	81.108	0.608	5.0	0.0	5.0	664.3	O K
7200 min Summer	80.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Summer	80.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Summer	80.500	0.000	0.0	0.0	0.0	0.0	O K
15 min Winter	80.799	0.299	4.4	0.0	4.4	307.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	108.248	0.0	0.0	19
30 min Summer	72.100	0.0	0.0	34
60 min Summer	46.018	0.0	0.0	64
120 min Summer	26.964	0.0	0.0	124
180 min Summer	19.712	0.0	0.0	184
240 min Summer	15.782	0.0	0.0	242
360 min Summer	11.524	0.0	0.0	362
480 min Summer	9.230	0.0	0.0	482
600 min Summer	7.773	0.0	0.0	602
720 min Summer	6.756	0.0	0.0	722
960 min Summer	5.418	0.0	0.0	960
1440 min Summer	3.977	0.0	0.0	1228
2160 min Summer	2.932	0.0	0.0	1604
2880 min Summer	2.375	0.0	0.0	2016
4320 min Summer	1.788	0.0	0.0	2852
5760 min Summer	1.480	0.0	0.0	3688
7200 min Summer	0.000	0.0	0.0	0
8640 min Summer	0.000	0.0	0.0	0
10080 min Summer	0.000	0.0	0.0	0
15 min Winter	108.248	0.0	0.0	19

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	80.889	0.389	4.6	0.0	4.6	408.0	O K
60 min Winter	80.983	0.483	4.8	0.0	4.8	515.6	O K
120 min Winter	81.048	0.548	4.9	0.0	4.9	592.5	O K
180 min Winter	81.086	0.586	4.9	0.0	4.9	638.0	O K
240 min Winter	81.112	0.612	5.0	0.0	5.0	669.2	O K
360 min Winter	81.144	0.644	5.0	0.0	5.0	709.0	O K
480 min Winter	81.164	0.664	5.1	0.0	5.1	733.3	O K
600 min Winter	81.176	0.676	5.1	0.0	5.1	748.6	O K
720 min Winter	81.183	0.683	5.1	0.0	5.1	757.7	O K
960 min Winter	81.188	0.688	5.1	0.0	5.1	764.2	O K
1440 min Winter	81.179	0.679	5.1	0.0	5.1	752.5	O K
2160 min Winter	81.157	0.657	5.1	0.0	5.1	725.0	O K
2880 min Winter	81.136	0.636	5.0	0.0	5.0	699.0	O K
4320 min Winter	81.096	0.596	5.0	0.0	5.0	650.0	O K
5760 min Winter	81.060	0.560	4.9	0.0	4.9	606.8	O K
7200 min Winter	80.500	0.000	0.0	0.0	0.0	0.0	O K
8640 min Winter	80.500	0.000	0.0	0.0	0.0	0.0	O K
10080 min Winter	80.500	0.000	0.0	0.0	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	72.100	0.0	0.0	33
60 min Winter	46.018	0.0	0.0	64
120 min Winter	26.964	0.0	0.0	122
180 min Winter	19.712	0.0	0.0	180
240 min Winter	15.782	0.0	0.0	240
360 min Winter	11.524	0.0	0.0	356
480 min Winter	9.230	0.0	0.0	472
600 min Winter	7.773	0.0	0.0	588
720 min Winter	6.756	0.0	0.0	700
960 min Winter	5.418	0.0	0.0	924
1440 min Winter	3.977	0.0	0.0	1342
2160 min Winter	2.932	0.0	0.0	1668
2880 min Winter	2.375	0.0	0.0	2136
4320 min Winter	1.788	0.0	0.0	3068
5760 min Winter	1.480	0.0	0.0	3928
7200 min Winter	0.000	0.0	0.0	0
8640 min Winter	0.000	0.0	0.0	0
10080 min Winter	0.000	0.0	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.950
FEH Rainfall Version	2013	Cv (Winter)	0.950
Site Location	GB 467141 113621 SU 67141 13621	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.212

Time From:	**(mins) To:**	**Area (ha)**
0	4	1.212

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 82.500

Infiltration Basin Structure

Invert Level (m) 80.500 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01440 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m^2)	Depth (m)	Area (m^2)	Depth (m)	Area (m^2)
0.000	972.4	1.700	1732.8	2.000	1884.0

Weir Overflow Control

Discharge Coef 0.544 Width (m) 2.400 Invert Level (m) 82.200

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 911 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	64.108	0.208	4.4	216.9	O K
30 min Summer	64.171	0.271	4.5	286.8	O K
60 min Summer	64.238	0.338	4.6	361.1	O K
120 min Summer	64.282	0.382	4.7	411.7	O K
180 min Summer	64.306	0.406	4.7	440.2	O K
240 min Summer	64.322	0.422	4.8	458.7	O K
360 min Summer	64.340	0.440	4.8	479.5	O K
480 min Summer	64.348	0.448	4.8	489.3	O K
600 min Summer	64.351	0.451	4.8	492.9	O K
720 min Summer	64.351	0.451	4.8	492.1	O K
960 min Summer	64.346	0.446	4.8	486.1	O K
1440 min Summer	64.334	0.434	4.8	472.3	O K
2160 min Summer	64.316	0.416	4.7	451.2	O K
2880 min Summer	64.299	0.399	4.7	431.8	O K
4320 min Summer	64.271	0.371	4.7	399.2	O K
5760 min Summer	64.247	0.347	4.6	371.9	O K
7200 min Summer	63.900	0.000	0.0	0.0	O K
8640 min Summer	63.900	0.000	0.0	0.0	O K
10080 min Summer	63.900	0.000	0.0	0.0	O K
15 min Winter	64.108	0.208	4.4	216.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	108.248	0.0	19
30 min Summer	72.100	0.0	34
60 min Summer	46.018	0.0	64
120 min Summer	26.964	0.0	124
180 min Summer	19.712	0.0	182
240 min Summer	15.782	0.0	242
360 min Summer	11.524	0.0	362
480 min Summer	9.230	0.0	482
600 min Summer	7.773	0.0	600
720 min Summer	6.756	0.0	720
960 min Summer	5.418	0.0	830
1440 min Summer	3.977	0.0	1082
2160 min Summer	2.932	0.0	1488
2880 min Summer	2.375	0.0	1904
4320 min Summer	1.788	0.0	2724
5760 min Summer	1.480	0.0	3520
7200 min Summer	0.000	0.0	0
8640 min Summer	0.000	0.0	0
10080 min Summer	0.000	0.0	0
15 min Winter	108.248	0.0	19

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	64.171	0.271	4.5	286.9	O K
60 min Winter	64.238	0.338	4.6	361.2	O K
120 min Winter	64.282	0.382	4.7	412.3	O K
180 min Winter	64.307	0.407	4.7	441.1	O K
240 min Winter	64.323	0.423	4.8	459.8	O K
360 min Winter	64.341	0.441	4.8	481.2	O K
480 min Winter	64.350	0.450	4.8	491.9	O K
600 min Winter	64.354	0.454	4.8	496.4	O K
720 min Winter	64.355	0.455	4.8	496.8	O K
960 min Winter	64.349	0.449	4.8	490.1	O K
1440 min Winter	64.332	0.432	4.8	470.8	O K
2160 min Winter	64.306	0.406	4.7	439.7	O K
2880 min Winter	64.278	0.378	4.7	408.0	O K
4320 min Winter	64.228	0.328	4.6	350.6	O K
5760 min Winter	64.185	0.285	4.5	301.7	O K
7200 min Winter	63.900	0.000	0.0	0.0	O K
8640 min Winter	63.900	0.000	0.0	0.0	O K
10080 min Winter	63.900	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	72.100	0.0	33
60 min Winter	46.018	0.0	62
120 min Winter	26.964	0.0	122
180 min Winter	19.712	0.0	180
240 min Winter	15.782	0.0	238
360 min Winter	11.524	0.0	354
480 min Winter	9.230	0.0	468
600 min Winter	7.773	0.0	580
720 min Winter	6.756	0.0	692
960 min Winter	5.418	0.0	902
1440 min Winter	3.977	0.0	1124
2160 min Winter	2.932	0.0	1580
2880 min Winter	2.375	0.0	2044
4320 min Winter	1.788	0.0	2900
5760 min Winter	1.480	0.0	3744
7200 min Winter	0.000	0.0	0
8640 min Winter	0.000	0.0	0
10080 min Winter	0.000	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.950
FEH Rainfall Version	2013	Cv (Winter)	0.950
Site Location	GB 467141 113621 SU 67141 13621	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.857

Time (mins) From:	To:	Area (ha)
0	4	0.857

Model Details

Storage is Online Cover Level (m) 65.900

Infiltration Basin Structure

Invert Level (m) 63.900 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01440 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	1005.7	1.700	1739.6	2.000	1886.2