

Gas Protection Design Report

Site: Land at Greenbooth Road and Edenfield Road, Norden

Reference: 16-465-R7-2

Date: April 25





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E3P DRAWINGS LIST

E3P 16-465-001	Site Location Plan
E3P 16-465-002	Proposed Development Plan
E3P 16-465-024	Ground Gas Mitigation Zoning Plan
E3P 16-465-041	Integrity Testing Plan

AJP CONSULTING ENGINEERS DRAWING LIST

EDE-AJP-XX-00-DR-S-2013, Rev P05, dated 7th April 2025 - Typical Vibro Stone Replacement Column Foundation Details with Gas Protection.

EDE-AJP-XX-00-DR-S-9991, Rev P01, dated February 2025 – NHBC Gas Barrier Detail – Timber Frame – External Wall Detail

MAN001-SBP-ZZ-ZZ-DR-A-04-W301, Rev P01, dated July 2024 – Partnerships Range Block Setting Out Plan Willow 3 Block

MAN001-SBP-ZZ-ZZ-DR-A-04-W401, Rev P01, dated July 2024 – Partnerships Range Block Setting Out Plan Willow 4 Block

MAN003-SBP-ZZ-ZZ-DR-A-04-H201, Rev P01, dated June 2024 – Partnerships Range Block Setting Out Plan Holly Semi Detached (Open Gable)

MAN003-SBP-ZZ-ZZ-DR-A-04-H203, Rev P01, dated June 2024 – Partnerships Range Block Setting Out Plan Holly Semi Detached (Front and Side Gable)

MAN003-SBP-ZZ-ZZ-DR-A-04-H205, Rev P01, dated June 2024 – Partnerships Range Block Setting Out Plan Holly 2 Block

MAN003-SBP-ZZ-ZZ-DR-A-04-H401, Rev P01, dated June 2024 – Partnerships Range Block Setting Out Plan Holly 4 Block

MAN003-SBP-ZZ-ZZ-DR-A-04-Y301, Rev P01, dated June 2024 – Partnerships Range Block Setting Out Plan Yew 3 Block

MAN003-SBP-ZZ-ZZ-DR-A-04-Y501, Rev P01, dated July 2024 – Partnerships Range Block Setting Out Plan Yew 5 Block

MAN003-SBP-ZZ-ZZ-DR-A-04-YO401, Rev P01, dated July 2024 – Partnerships Range Block Setting Out Plan Oak/Yew 4 Block



1. BACKGROUND

Stonebond Properties Ltd have instructed E3P to prepare a Gas Protection Design Report (GPDR) to document the mitigation measures and verification requirements to ensure compliance with the approved Remediation Strategy and ensure that relevant planning conditions are met and can be subsequently discharged.

E3P understand that Stonebond Properties Ltd intend to construct a low-rise residential development comprising 49 residential dwellings with associated gardens, estate roads, infrastructure, and a connecting bridge.

A snapshot of the proposed development layout is indicated in Figure 1 below, with the full drawing presented as Drawing 16-465-002 in APPENDIX III.

Figure 1 **Snapshot of Proposed Development**



This GPDR specifically relates to the Stonebond Properties house types and corresponding mitigation measures and verification requirements.

The site has been subject to numerous phases of Site Investigation, which informed the development of the Conceptual Site Model and, ultimately, the ground gas risk assessment summarised in Section 1.1.



These documents have been reviewed by the Local Planning Authority (LPA) and the Environment Agency (EA), and the subsequent remediation work incorporating the associated building phase mitigation measures has been approved.

This GPDR has specifically been developed to clearly define the mitigation measures required for individual sectors of the site and provide design justification and verification requirements to demonstrate the complaint construction before the first occupation of a house.

If any of the procedures outlined in this summary are not completed, this may delay obtaining a Warranty and Council for Mortgage Lenders and a Certificate of Completion.

Table 1 Previous Works

Historical Reports	The following previous site investigation reports are known to have been completed at the site: ✿ Encia Consulting Ltd – Geoenvironmental Appraisal, Land at Greenbooth Road, Norden; Report Ref: 7112-1, dated June 2006, prepared for Countryside Properties Ltd. ✿ LK Consult – Geoenvironmental Risk Assessment, Land at Greenbooth Road, Norden; Report Ref: CL602-LKC 20 1618-01, dated September 2020, prepared for Norden Developments Ltd.
Date of E3P SI & Ref	✿ E3P Ltd – Phase I Geoenvironmental Site Assessment – Edenfield Road, Norden; Report Ref: 16-465-R1-1, dated December 2022, prepared for Stonebond Group Ltd. ✿ E3P Ltd – Phase II Geoenvironmental Site Assessment – Land at Greenbooth Road and Edenfield Road, Norden; Report Ref: 16-465-R2-3, dated August 2023, prepared for Stonebond Properties Ltd. ✿ E3P Ltd – Ground Gas Addendum Report – Land at Greenbooth Road and Edenfield Road, Norden; Report Ref 16-465-R3-1, incorporated into Report Ref: 16-465-R2-3, dated August 2023, prepared for Stonebond Properties Ltd. ✿ E3P Ltd – Surface Water Management during Construction Plan – Land at Greenbooth Road and Edenfield Road, Norden; Report Ref: 16-465-R5-1, dated August 2023, prepared for Stonebond Properties Ltd. ✿ E3P Ltd – Pile Design Contamination Risk Assessment – Land at Greenbooth Road and Edenfield Road, Norden; incorporated into Report 16-465-R6-1, dated January 2024, prepared for Stonebond Properties Ltd.
Date of Remediation Strategy & Ref	✿ E3P – Remediation & Enabling Works Strategy, Land at Greenbooth Road and Edenfield Road, Norden; Report Ref: 16-465-R4-1, dated August 2023, prepared for Stonebond Properties Ltd.
Date of Enabling Works Validation & Ref	✿ E3P – Remediation Validation Report, Land at Greenbooth Road and Edenfield Road, Norden; Report ref: 17-330-R1-1, dated January 2025, prepared for Urban Regen Limited.



1.1. OVERVIEW OF GROUND GAS RISK ASSESSMENT

The final ground gas risk assessment is documented within the E3P Phase II Geoenvironmental Site Assessment, Section 4.3 (Ground Gas Risk Assessment), dated August 2023 (Ref: 16-465-R2-3), which confirmed.

- ✚ The site can be split into two distinct areas: the former Tack Lea Works (Woodhouse Mills) area occupying the northern and central portions of the site and the former Sheppard Mill area in the east and south-eastern part of the site.
- ✚ Ground gas monitoring suggests that the site can be predominantly classified as CS1. However, given the presence of a historical landfill located in the eastern section of the Tack Lea Works area, it is recommended that CS2 protection measures should be implemented as a minimum across the site.
- ✚ Elevated concentrations of volatile contaminants (naphthalene, TPHs, VOCs, SVOCs, and mercury) have been identified within the Made Ground on-site, which present a potential volatilisation to indoor air risk. Elevated concentrations of volatile contaminants in the northern part of the site are considered to be localised occurrences and therefore these locations can be treated as hotspots. However, elevated concentrations of volatile contaminants have been identified throughout the east and southeast parts of the site and these do not appear to be localised hotspots. Vapour resistant membranes will therefore be required for plots located within the east and southeast parts of the site (Plots 1-10).
- ✚ A BGS Radon Report was purchased for the site, which indicated that the northeast and northwest of the site is situated in an area where 1–3% of homes are above the "Action Level" and the rest of the site is situated in an area where 0–1% of homes are above the "Action Level". Therefore, no radon protective measures are necessary for the construction of new dwellings or extensions.

The E3P Drawing 16-465-024 details the plots that require construction with mitigation measures that are compliant with CS2 Characteristic Situation (Plots 11-49, western part of the site), as well as those requiring vapour resistant membranes (Plots 1-10, east and southeast part of the site).



2. GAS MITIGATION DESIGN & VERIFICATION

2.1. OVERVIEW OF RISK CLASSIFICATION

The Ground Gas Risk Assessment suggests the site will fall into the bracket for Characteristic Situation 2 which will require specialist mitigation measures to be constructed in accordance with BS8485 (2015)+A1(2019).

In addition, vapour resistant membranes will be required to be installed for plots located within the east and southeast part of the site (Plots 1-10) due to elevated concentrations of volatile contaminants.

No radon protection measures will be required in any new dwellings or extensions, as the site is not located with a radon-affected area.

The ground gas risk assessment is to be approved by all stakeholders, including the local authority, building control, and warranty providers, before the commencement of any work on-site to construct mitigation measures.

2.2. OVERVIEW OF REQUIREMENTS FOR RESIDENTIAL BUILDING GAS RISK MITIGATION

2.2.1. DESIGN STANDARDS

The overarching design criteria for mitigation of ground gases are defined within British Standards BS8485:2015 +A1:2019 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Gases for New Buildings.

The BS8485:2015 +A1:2019 design system references the type of building being constructed (Type A to D), and the gas risk as defined by the site Conceptual Site Model (CSM) (CS1 to CS6) to determine a points-based system for the design of the protection measures.

2.2.2. BRITISH STANDARD BS8485:2015+A1:2019

British Standard BS8485 has determined that the proposed development comprises low-rise residential dwellings that are classified as follows:

- ✚ **Type A Building** – Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms are present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
- ✚ **Type B Building** – Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Based on the ground gas risk assessment and the proposed Type A Building, it is envisaged that a point score of 3.5 will be required for affected properties, as summarised in Table 2 and specified in Table 3.



Table 2 BS8485:2015+A1:2019 Points Required for Type A and Type B Buildings

CHARACTERISTIC SITUATION	MINIMUM GAS PROTECTION SCORE (POINTS)	
	HIGH SENSITIVITY	
	TYPE A BUILDING	TYPE B BUILDING
1	0	0
2	3.5	3.5
3	4.5	4
4	6.5 A)	5.5 A)
5	– B)	6
6	– B)	– B)

BS8485 (2015)+A1(2019) Notes:

A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.



Table 3 Summary of Ground Gas Mitigation Measures – BS8485:2015+A1:2019

GAS PROTECTION SCORES FOR THE STRUCTURAL BARRIER		SCORE^A
Floor and Substructure Design		
Precast Suspended Segmental Subfloor (Beam and Block)		0
Cast in Situ Ground Bearing Floor Slab (With Only Nominal Mesh Reinforcement)		0.5
Cast in Situ Monolithic Reinforced Ground Bearing Raft or Reinforced Cast in Situ Suspended Floor Slab With Minimal Penetrations		1 or 1.5 ^B
Basement Floor and Walls Conforming to BS 8102:2009, Grade 2 WaterproofingC D		2
Basement Floor and Walls Conforming to BS 8102:2009, Grade 3 WaterproofingC D		2.5
Notes		
A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed.		
B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2).		
C) The score is conditional on the waterproofing being provided by a suitable structural barrier with the design and detailing of the walls and floor meeting the requirements for Type B protection. The score cannot be assigned for Type A (waterproof membrane) or Type C (drained cavity wall).		
D) If a membrane is installed beneath and around the basement to provide Type A waterproofing (BS 8102:2009), it can be assigned a gas protection score in accordance with Table 7, if it meets all the criteria for a gas resistant membrane in that table.		
When practical, utilities should enter the building above floor level with any conduit or meter housing being properly vented outside of the building.		
PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS
Gas protection scores for ventilation protection measures		
(a) Pressure Relief Pathway – Usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building.	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems.
(b) Passive Subfloor Dispersal Layer – Media used to provide the dispersal layer are: Clear void; Polystyrene void former blanket; Geocomposite void former blanket; No fines gravel layer with gas drains; and No fines gravel layer.	Very good performance	2.5
	Good performance	
(c) Active Dispersal Layer – Usually comprising fans with active abstraction (suction) from a subfloor dilution layer with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.	1.5	If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is 0. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS 8485 (2015). Passive ventilation should be designed to meet at least "good performance".
(d) Active Positive Pressurisation – Provided by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated Car Park – Floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park.	4	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance". Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F [9].



PROTECTION ELEMENT SYSTEM	SCORE	COMMENTS	SCORE	COMMENTS
Gas Protection Score for the Gas Resistant Membrane				
Gas resistant membrane meeting all of the following criteria: Sufficiently impervious to the gases with a methane gas transmission rate < 40 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 151051 manometric method); Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; Sufficiently strong to withstand in service stresses (e.g. settlement if placed below a floor slab); Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools); Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and Verified in accordance with CIRIA C735.	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. If a membrane is installed that does not meet all the criteria opposite then the score is zero.		
A) Membrane with a methane gas transmission rate < 40.0 ml/day/m²/atm (average) for sheets and joints (tested in accordance with BS ISO 151051:2007 manometric method) is regarded as sufficiently impervious. B) For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m² and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 98631:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also C.3). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast in situ floor slabs.				



2.2.3. GAS MITIGATION COMPLIANCE WITH BS8485:2015 +A1:2019

The Contaminated Land Risk Assessment and developed Conceptual Site Model identified a theoretical risk from hazardous ground gas intrusion associated with viable sources as defined within the developed site CSM.

The risk associated with a gas intrusion pathway will be mitigated by constructing all dwellings to comply with Characteristic Situation 2 (CS2), which requires a minimum of 3.5 points as defined within BS8485:2015 +A1:2019.

CIRIA 735 provides guidance with respect to the preparation and implementation of a verification plan and installation processes that will ensure that the potential for vapour ingress into a dwelling is mitigated in full.

The risk posed by a variety of potentially hazardous ground gases associated with intrusion into the proposed dwellings will be mitigated by a multi-layered pathway intervention strategy that will incorporate the following key attributes to achieve the minimum points requirement as stipulated by BS8485:2015 +A1:2019

CS2 – Plots with Sub-floor Voids

- ✧ Construction of all residential structures with a passively ventilated sub-floor void compliant with 'good performance criteria'. Verification of the sub-floor void and passive ventilation system will be completed in accordance with the validation and checking requirements set out in this report. **1.5 Points.**
- ✧ Selection, design and installation of a specialist membrane that will mitigate the migration of hazardous gases into the new dwellings. All membranes will be fully inspected and validated in accordance with industry best practices. **2.0 Points.**

2.2.4. PASSIVE SUB-FLOOR VENTILATION DESIGN

The proposed ventilation of the subfloor layer is required to achieve a minimum 'good performance' following BS8485, clause 7.2.3 and Annex B – **1.5 points.**

Real-world applications and limitations in the ability to install close-centred telescopic and air brick ventilation, particularly to the front elevation of a dwelling, necessitate the need to over-design and install ventilation at all available opportunities.

The National House Building Council (NHBC) standards for the construction of new homes, include requirements for ventilation to prevent damp and condensation, ensuring 'good ventilation performance of a sub-floor void.

NHBC regulations and guidelines determine that airbricks are an essential part of ensuring proper ventilation in spaces such as underfloor voids in newly built houses.

The NHBC requires that subfloor voids in suspended floors be ventilated to prevent moisture build-up and maintain air quality.

Ventilation must be provided at a rate sufficient to achieve a minimum airflow rate to prevent condensation and related problems.



Standard Spacing: NHBC guidelines typically recommend placing airbricks at intervals of approximately 1.5 meters along the external walls. This spacing is intended to ensure even ventilation across the entire underfloor area.

Airbricks should be installed on opposing walls (cross ventilation) to allow air to flow freely across the entire subfloor area. This ensures effective ventilation by enabling air to enter from one side and exit from the other, carrying moisture away.

Airbricks should be positioned above the finished ground level to avoid water ingress, typically at least 150 mm above ground level, to protect against splashing during rain and ensure clear airflow.

Additional airbricks should be placed near corners and where there are obstructions (like internal walls or beams) to ensure that all parts of the underfloor void receive adequate ventilation.

Airbricks can be made of different materials (e.g., clay, plastic, metal), but they should provide a minimum equivalent area of ventilation as specified by NHBC, which is typically around 1,500 mm² per meter run of external wall for underfloor voids.

In addition to spacing, NHBC standards emphasise that there should be a continuous line of ventilation along the perimeter of the building's subfloor void to maintain consistent airflow.

Airbricks should be kept clear of obstructions such as soil, debris, or plants to maintain effective ventilation.

The NHBC suggests regular inspection and maintenance to ensure airbricks remain unblocked.

To ensure compliance with NHBC standards for airbrick spacing and ventilation in new build houses in the UK:

- ✚ Ensure 1.5 m spacing guidelines along external walls;
- ✚ Ensure cross-ventilation by placing airbricks on opposing walls;
- ✚ Position airbricks above ground level to avoid water ingress; and
- ✚ Maintain airbrick openings to prevent blockages and ensure effective ventilation.

By adhering to NHBC guidelines, new build houses can maintain adequate underfloor ventilation, ensuring a minimum performance requirement of 'good' in accordance with BS8485 2015 (+A1 2019).

2.2.5. VENTILATION REQUIREMENTS

BS8485:2015 +A1:2019, Section 7.2.3 covers the design of ventilation measures, which includes passive ventilation layers.

Telescopic vents and air bricks are to be installed at 1.5 m centres on at least three of the external walls.

Ventilation systems (where pumps or power supply is required) are not appropriate for Type A (private residential buildings).

Table 6 within BS8485 states that for passive subfloor dispersal layers, a score of **2.5 points** applies to ensure 'very good performance', whilst 1.5 points is applied to 'good performance'.

The proposed ventilation of the subfloor layer is required to achieve a minimum 'good performance' following BS8485, clause 7.2.3 and Annex B – **1.5 points**.



E3P has prepared ventilation calculations for each of the house types that are to be constructed on the site.

A summary of the ventilation calculations is presented in APPENDIX V and summarised in Table 4. It is noted that the maximum recorded gas concentration (carbon dioxide) and gas flow rates from across the site have been utilised in the calculations.

Table 4 Gas Membrane Performance – Physical Property Minimum Requirements

HOUSE TYPE	AREA OF BUILDING FOOTPRINT (m ²)	HEIGHT OF VENTS (ABOVE GROUND LEVEL) (m)	NUMBER OF VENTS	Qt/Qw
Willow – 3 Block	110.49	0.15	20	0.00
Willow – 4 Block	149.32	0.15	26	0.00
Holly – Semi Detached (Open Gable)	87.06	0.15	18	0.00
Holly – Semi Detached (Front & Side Gable)	87.06	0.15	18	0.00
Holly – 2 Block	87.06	0.15	18	0.00
Holly – 4 Block	174.11	0.15	28	0.00
Yew – 3 Block	108.55	0.15	23	0.00
Yew – 5 Block	180.92	0.15	31	0.00
Oak/Yew – 4 Block (1:3)	151.88	0.15	27	0.00

The results of the ventilation calculations confirms that all house types are recorded below the Qt/Qw thresholds and significantly exceed the BS8485 performance requirements.

2.2.6. MEMBRANE SELECTION AND PERFORMANCE REQUIREMENTS

All membranes to be considered must be subject to testing in accordance with ISO 15105-2:2003.

Guidance on specifying the properties of a gas membrane is provided in Clause 7.2.4 and Table 7 of BS8485:2015 +A1:2019 gas-resistant membranes should be:

- ☛ Sufficiently impervious, both in the sheet material and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and/or carbon dioxide through the membrane;
- ☛ Capable after installation of providing a complete barrier to the entry of the relevant gas;
- ☛ Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- ☛ Sufficiently strong to withstand in-service stresses (e.g. due to ground settlement if placed below a floor slab);
- ☛ Sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre-reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools);
- ☛ Chemically resistant to degradation by other contaminants that might be present and;
- ☛ Verified in accordance with CIRIA C735.



BS8485:2015+A1:2019 places significant emphasis on Gas Transition Rates (GTR) requirements to ensure that a membrane is sufficiently impervious to impede the identified ground gas risk migration. The reliance on GTR must be considered within the context of the site-specific situation and the combined physical barriers that will ultimately inhibit gas migration.

BS8485:2015+A1:2019 Clause 7.2.4 states that *"a methane gas transmission rate of <40.0ml/day/m/atm (average) for sheet and joints (tested in accordance with manometric method BS ISO 15105-1:2007) is usually considered sufficient for a membrane"*.

The maximum Gas Transmission Rate (GTR) that is appropriate depends on the reliance placed on the membrane to impede gas ingress into a dwelling.

BS8485 suggests a maximum value of 40ml/m² /day/atm. This applies where the membrane can be used in any Characteristic Situation, and it is feasible that the membrane will be the only protection against gas ingress.

In this situation, E3P confirms that the maximum GTR as defined within BS8485 2015 (+A1 2019) is a requirement of the overarching mitigation design specification for any foundation types where there is no ventilated sub-floor void with a good performance.

The Visqueen Gas Barrier (Blue) is considered suitable for plots classified as CS2. Membrane specifications are presented in APPENDIX VI.

Details of the vapour resistant membranes required in the east and southeast part of the site (Plots 1-10) are included in Section 3 of this report.

It is important to note that several additional key factors must be considered when selecting a membrane to ensure it is suitable for use within the design situation (Gas Resistance & Robustness). The potential for damage or degradation to a membrane during construction is of particular concern.

The selected membrane must be able to withstand/demonstrate sufficient performance as detailed below.

- ✚ Tensile Strength
- ✚ Puncture resistance;
- ✚ Elongation potential;
- ✚ Impact risk mitigation;
- ✚ Puncture and tear resistance.

The selected gas membrane will comprise a proprietary gas membrane consisting of 2000 gauge (400µm), virgin polymer Low-Density Polyethylene (LDPE).

Statements provided by a membrane supplier to demonstrate durability will be supported by written confirmation from a supplier with respect to Quality Assurance to demonstrate soundness.

All membranes to be utilised in a Characteristic Situation 2 must have minimum mechanical properties as prescribed in Table 5.



Table 5 Gas Membrane Performance – Physical Property Minimum Requirements

PROPERTY	TEST	UNITS	REQUIREMENT
Overall thickness, including scrim mesh	EN 1849-2	mm	0.52
Tensile Strength	EN 12311	N/50mm	350
Tensile Elongation	EN12311	%	20-21
Joint Strength	EN 12317-2	N	332
Resistance to impact	EN12691	mm	200
Durability chemical resistance	EN1847	-	Pass

A manufacturer guarantee of suitability and compliance will accompany all membranes selected for use within the design situation.

All membranes will be approved by E3P prior to their use in the construction.

2.3. MEMBRANE INSTALLATION REQUIREMENTS

Due to the meagre permeation rates that will be required to minimise the risk associated with gas intrusion, it is essential that the membrane is installed correctly and is not damaged afterwards or during construction.

CIRIA C748 defines the dominant mode of fluid transport through poorly installed membranes via holes present due to poor seals and welds, material defects and damage during construction. This mode of transport is significantly greater than permeation through intact membranes.

Installation by suitable, trained and qualified persons and subsequent validation by an independent specialist is vitally important in ensuring the long-term integrity of the membrane and, thus, removal of the theoretical exposure pathway associated with gas migration.

2.3.1. CONTRACTORS PRE-COMMENCEMENT REQUIREMENTS

Prior to the commencement of any installation works, the following will be provided to E3P as a supervising engineer/consultant for review.

- ✳ Relevant qualifications of all operatives (minimum NVQ Level 2 – Gas protection installation).
- ✳ Detailed installation plan inclusive of method Statement, CQA Procedures and qualifications.
- ✳ Provision of the final choice of the membrane system to be utilised.

Section 3.3 of CIRIA C735 states that it is essential that an appropriately experienced and qualified workforce is employed on-site to install ground protection systems. An appropriate, experienced and skilled workforce is recommended with an installer carrying an NVQ level 2 diploma in gas membrane installation or accreditation for plastic welding.

2.4. SITE-SPECIFIC DESIGN REQUIREMENTS

E3P has been provided with AJP Consulting Engineers gas membrane installation details (EDE-AJP-XX-00-DR-S-2013, Rev P05, dated 7th April 2025), which are included in APPENDIX IV.

Following a review of the sub-structure design by the NHBC in March 2025, concerns were raised about the placement of the membrane over the thermalite block, in terms of potentially creating a cavity that would allow for the accumulation of moisture, which in turn could have a detrimental impact upon the timber frame structure.



As such, AJP Consulting Engineers redesigned the sub-structures so that the membrane dipped away from the internal walls and thus removed the potential for moisture to accumulate.

As this redesign occurred during the Build Phase, a number of plots had already had membranes installed in line with the previous designs. As such, AJP Consulting Engineers developed remedial measures for the affected plots; which are included in APPENDIX IV and summarised below.

- 🔗 EDE-AJP-XX-00-DR-S-9991, Rev P01, dated February 2025 – NHBC Gas Barrier Detail – Timber Frame – External Wall Detail – Gas membrane lapped and fully sealed below wall plate with double sided butyl jointing tape 100 mm.



3. CHEMICAL VAPOUR INGRESS - MITIGATION MEASURES

The Contaminated Land Risk Assessment and developed Conceptual Site Model identified a theoretical risk from vapour intrusion associated with residual impact to the Made Ground soils that underlie the east and southeast part of the development site.

The risk associated with a vapour intrusion pathway will be mitigated through the construction of dwellings in the east and southeast part of the site (Plots 1-10) with a passively ventilated sub-floor void and the installation of a specialist membrane that will impede the ingress of any vapour into a dwelling (critical receptor).

CIRIA 748 provides guidance with respect to the design, specification and validation of measures that will ensure that the potential for vapour ingress into a dwelling is mitigated in full.

Residential buildings are often constructed on brownfield sites where volatile organic compounds (VOCs) are present in the ground, as is the case for the east and southeast part of the subject site.

The assessment of vapour risk and potential migration pathways linking the source and receptor should include multiple factors:

- ❖ Type of membrane, manufacturers details and performance;
- ❖ Floor slab construction; and,
- ❖ Sub-floor ventilation potential.

It is possible to consider effects on the ground that will retard vapour migration (e.g. bio-degradation and other processes).

The primary issue associated with VOC ingress is typically long-term chronic health risk materially different from the acute health effects and explosive risk of permanent gases (methane and carbon dioxide).

When considering the design, specification and installation of membranes to mitigate a vapour intrusion risk, the specific permeation potential of VOC compounds must be considered.

3.1. VOC INGRESS MITIGATION OVERVIEW

The residual risk posed by a variety of potential VOCs associated with vapour intrusion into the proposed dwellings (Plots 1-10) will be mitigated by a multi-layered pathway intervention strategy that will incorporate the following key attributes:

- ❖ Removal of all grossly impacted soil and groundwater during the site remediation and enabling earthworks, this approach will ensure the reduction of the 'challenge' compounds to ensure no direct contact with the built environment.
- ❖ Construction of all residential structures with a passively ventilated sub-floor void. Verification of the sub-floor void and passive ventilation system will be completed in accordance with the validation and checking requirements set out in Section 6 of this report.
- ❖ Selection, design and installation of a specialist membrane that will mitigate the migration of residual VOC compounds into the new dwellings. All membranes will be fully inspected and validated in accordance with industry best practise.



3.2. VOC MEMBRANE SUITABILITY ASSESSMENT

The subject site and Initial Conceptual Site Model (CSM) have been utilised to identify the primary groups of VOC contamination impact, and this assessment ensures the selection of the appropriate barrier performance against the identified group of VOCs.

As a standard and basic chemical rule (CIRIA 748) 'like is soluble in like'. Therefore, if the membrane material and contaminant of concern are both polar or non-polar, the solubility will be high. Where the chemical types are opposite (Polar and Non-Polar) permeation will be low.

For example, polyamide is polar, providing a good barrier against non-polar chemicals such as VOC's (BTEX).

HDPE is non-polar and therefore provides poor protection against similar non-polar aromatic VOC's.

Elemental mercury is also non-polar; therefore, polyamide is a good barrier to this chemical.

3.2.1. MEMBRANE SELECTION

All membranes to be considered must be subject to testing in accordance with ISO 15105-2:2003.

The primary Volatile Organic Carbon (VOC) pollution pathways at this site are listed in Table 6.

Table 6 VOC Chemicals of Concern

Chemical Grouping
Polycyclic Aromatic Hydrocarbons (such as Naphthalene) – Non Polar
Volatile Aromatic Petroleum Range Hydrocarbons (C5-C10) (such as BTEX and Trimethylbenzenes) – Non Polar
Cresols (such as 2-Methylphenol and 4-Methylphenol) – Non Polar
Phenols (such as 2,4- Dimethylphenol) - Non Polar
Polychlorinated Organic Compounds (such as Dibenzofuran and Carbazole) – Non Polar
Phthalates (such as Dibutyl phthalate) – Polar & Non Polar
Elemental Mercury – Non Polar

When considering the correct selection of a VOC membrane, the following key parameters require robust consideration:

- ❖ The permeation rate of the identified volatile chemicals should be sufficiently low.
- ❖ The membrane's mechanical properties (strength, tear resistance etc.) should not be adversely affected by the identified chemicals of concern to the extent that the membrane performance is adversely affected.
- ❖ The membrane should be able to withstand the physical stresses exerted in both the temporary state during construction and the permanent condition.



- ✿ The membrane should not degrade from biological degradation (oxidisation), stress or cracking).

The primary VOC's of concern are identified as Non-Polar chemical groupings. Therefore, a membrane with polar attributes is considered the most appropriate mitigation material in this instance.

Based on the review of the challenger compounds within the risk assessment and requirements for a membrane to limit and impede their ingress without undue degradation, the following membranes have been selected as being technically suitable.

- ✿ Visqueen Powerbase VOC Barrier – Plots 1-10.

All membranes to be utilised for the mitigation of VOCs must have minimum mechanical properties as prescribed in Table 7 below.

Table 7 Vapour Membrane Performance – Physical Property Minimum Requirements

PROPERTY	TEST	UNITS	REQUIREMENT
Overall thickness, including scrim mesh	EN 1849-2	mm	0.50
Tensile Strength	EN 12311	N/50mm	430-435
Tensile Elongation	EN12311	%	715-722
Joint Strength	EN 12317-2	N	332
Resistance to impact	EN12691	mm	200
Durability chemical resistance	EN1847	-	Pass

A manufacturer guarantee of suitability and compliance will accompany all membranes selected for use within the design situation.

All membranes will be approved by E3P prior to their use in the construction.

The technical data sheets for the vapour resistant membranes are attached to this report within APPENDIX VI.

3.3. MEMBRANE INSTALLATION REQUIREMENTS

Due to the meagre permeation rates that will be required to minimise the risk associated with VOC vapour intrusion, it is essential that the membrane is installed correctly and is not damaged afterwards during construction.

CIRIA C748 defines the dominant mode of fluid transport through poorly installed membranes is via holes present due to poor seals and weld, material defects and damage during construction. This mode of transport is significantly greater than permeation through intact membranes.

Installation by suitable trained, and qualified persons and subsequent validation by an independent specialist is vitally important in ensuring the long-term integrity of the membrane and, thus, removal of the theoretical exposure pathway associated with VOC vapour migration.

Verification integrity testing requirements are presented in Table 8 as taken from CIRIA 748 (adapted from Mallett et al, 2014).



Table 8 Verification Integrity Testing Requirements

Situation B: Low-Rise Housing – Requirements			
GAS RISK	TYPE OF SLAB	INSTALLER EXPERIENCE	LEVEL OF VERIFICATION AND INTEGRITY TESTING
High Risk	All slabs min 150mm ventilated sub-floor void.	Qualified and experienced installer (all operatives to hold recognised qualification)	Verifier (consultant of third party qualified and experienced) to conduct through verification (visual) inspection of all plots where a vapour membrane is installed. All joints, pipe penetrations etc. to be air lanced to ASTM D4437. Integrity testing will be completed on every second plot constructed.

3.3.1. CONTRACTORS PRE-COMMENCEMENT REQUIREMENTS

Prior to the commencement of any installation works, the following will be provided to E3P as a supervising engineer/consultant for review.

- ✿ Relevant qualifications of all operatives (minimum NVQ Level 2 – Gas protection Installation).
- ✿ Detailed installation plan inclusive of Method Statement, CQA Procedures and qualifications.
- ✿ Provision of the final choice of the membrane system to be utilised.



4. DESIGN INSTALLATION DETAILS

When considering the risk-based assessment, site review and appraisal of design requirements, the Client has commissioned the structural engineer to produce a series of working drawings that clearly define the mitigation system that combines the ventilation requirements and membrane installation.

For the avoidance of doubt E3P has not participated in the design process of the mitigation measures.

The sub-structure designs are included within the AJP Consulting Engineers Foundation Details (attached to this specification in APPENDIX IV).

Stonebond Properties Ltd will construct dwellings using strip or nominally reinforced strip foundations on areas of Ground Improvement by VSC (CS2 / VOCs).

This will result in broadly similar foundation types on-site with materially similar ground gas mitigation requirements.

Figures 2 to 5 confirm the detail of a 150 mm passively ventilated sub-floor void with a continuous gas / VOC membrane.

Figure 2 **Suspended Floor Slab - Typical Edge - VSC**

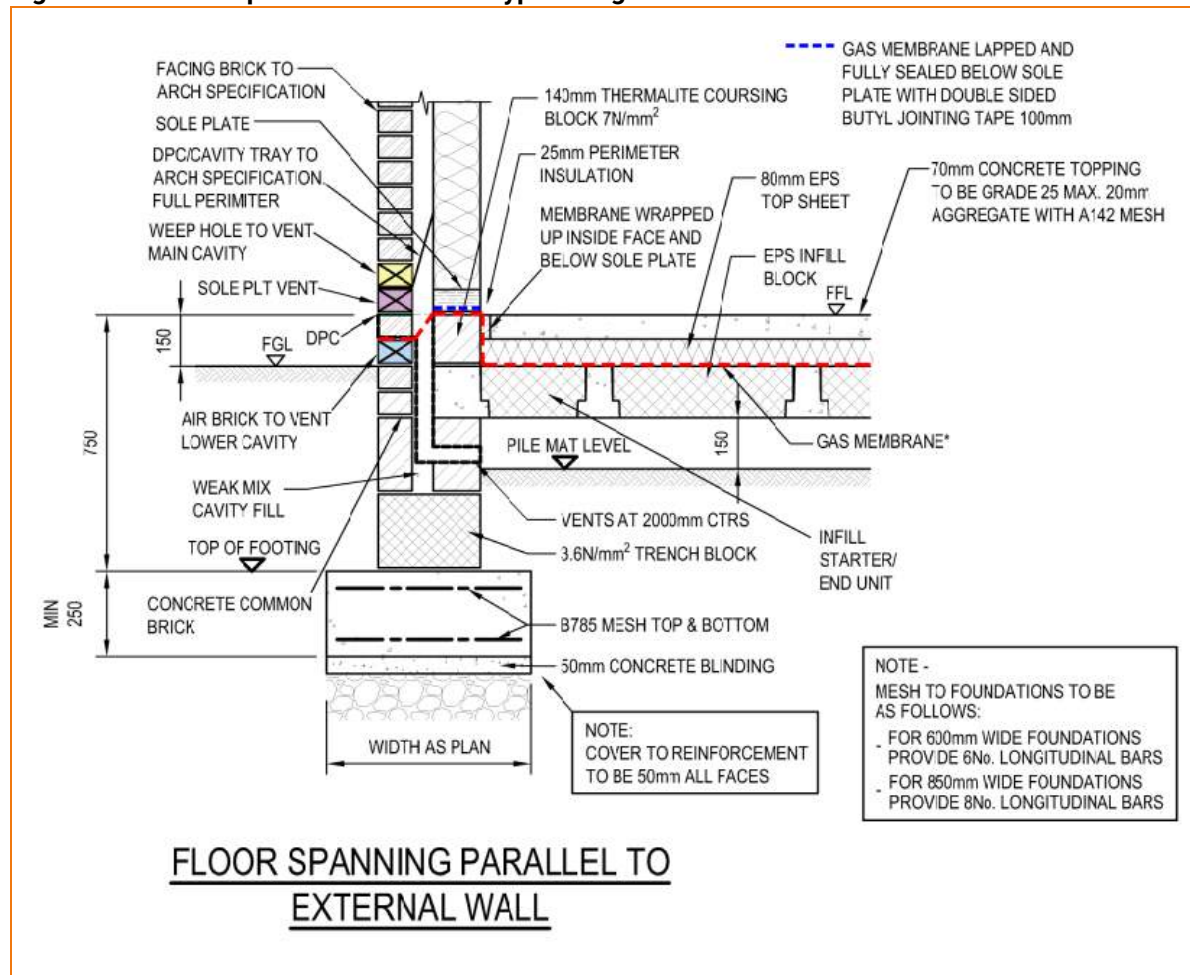




Figure 3 **Suspended Floor Slab - Typical Party Wall - VSC**

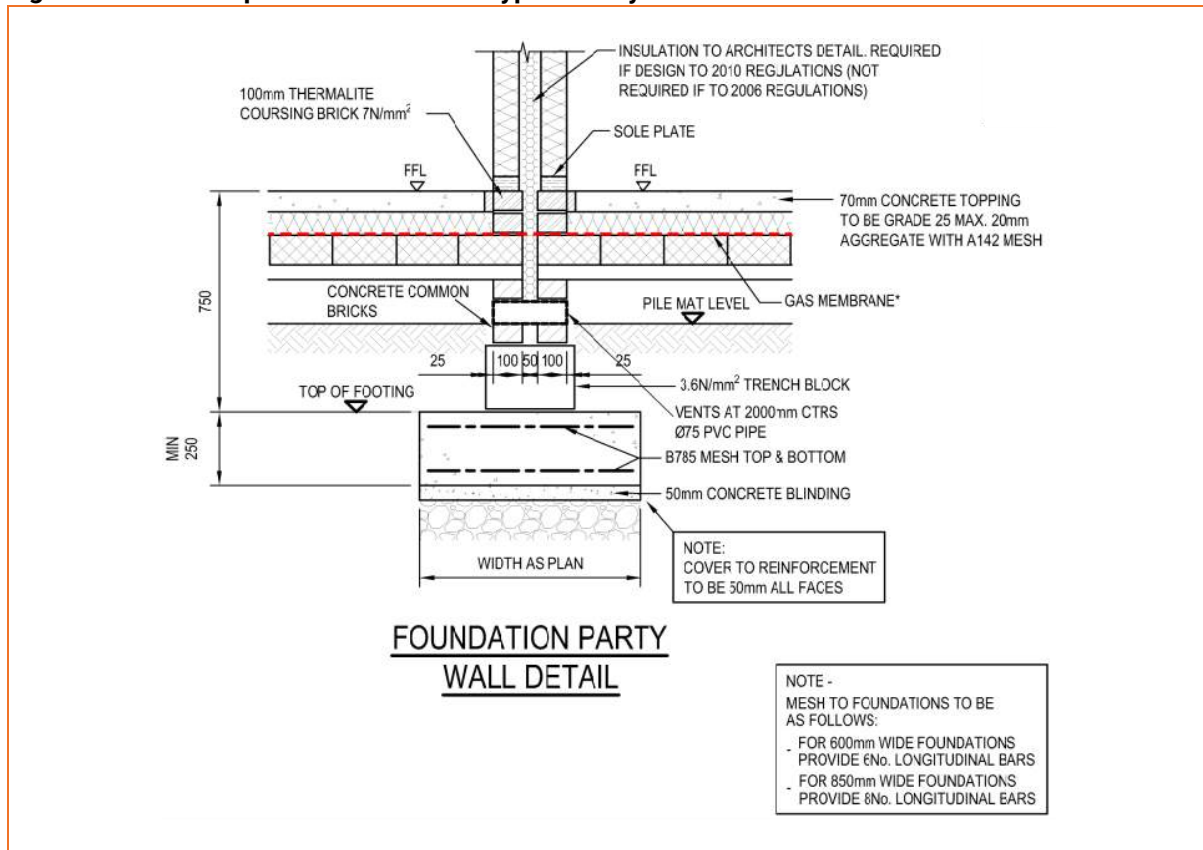


Figure 4 **Suspended Floor Slab - Typical Level Threshold Detail - VSC**

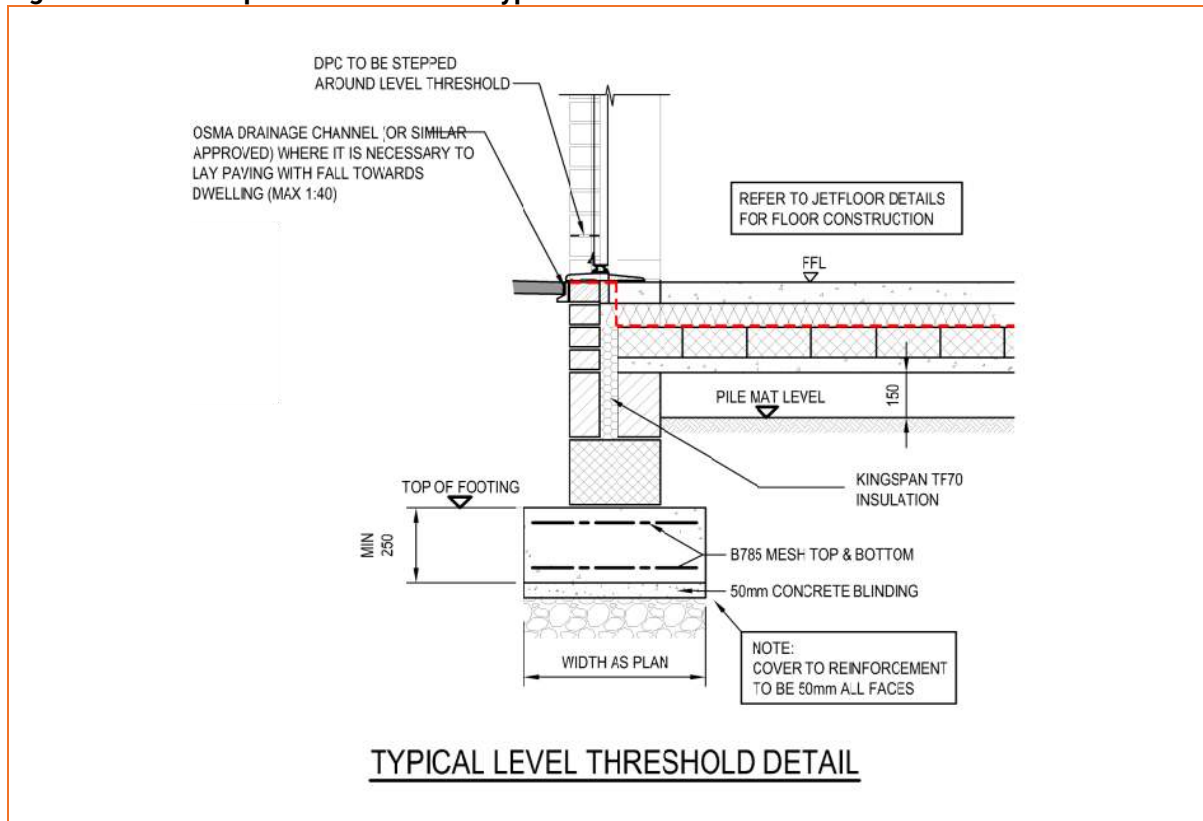
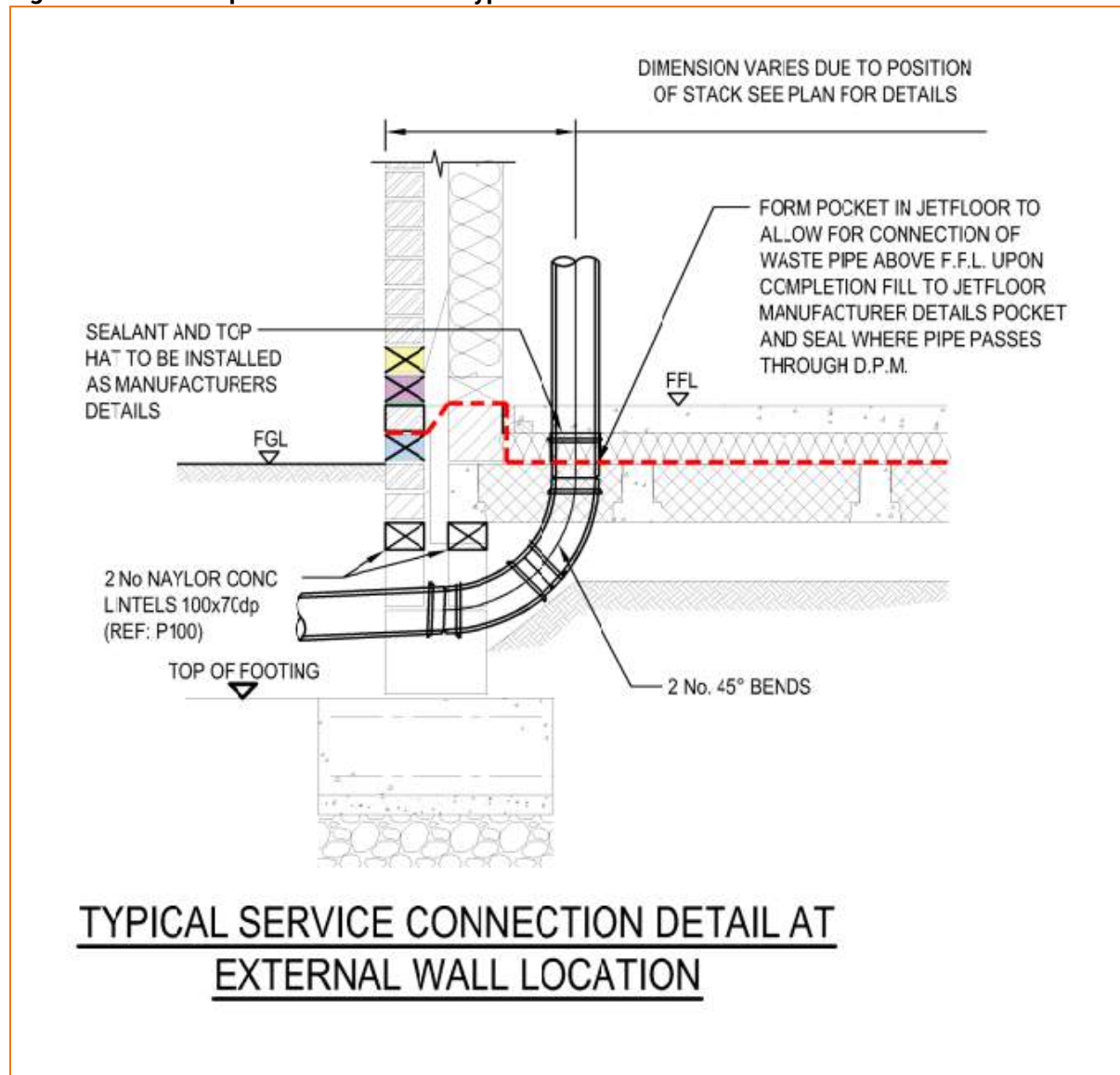




Figure 5 details service penetrations within sealed 'top' hats.

Figure 5 **Suspended Floor Slab – Typical Service Penetration - VSC**

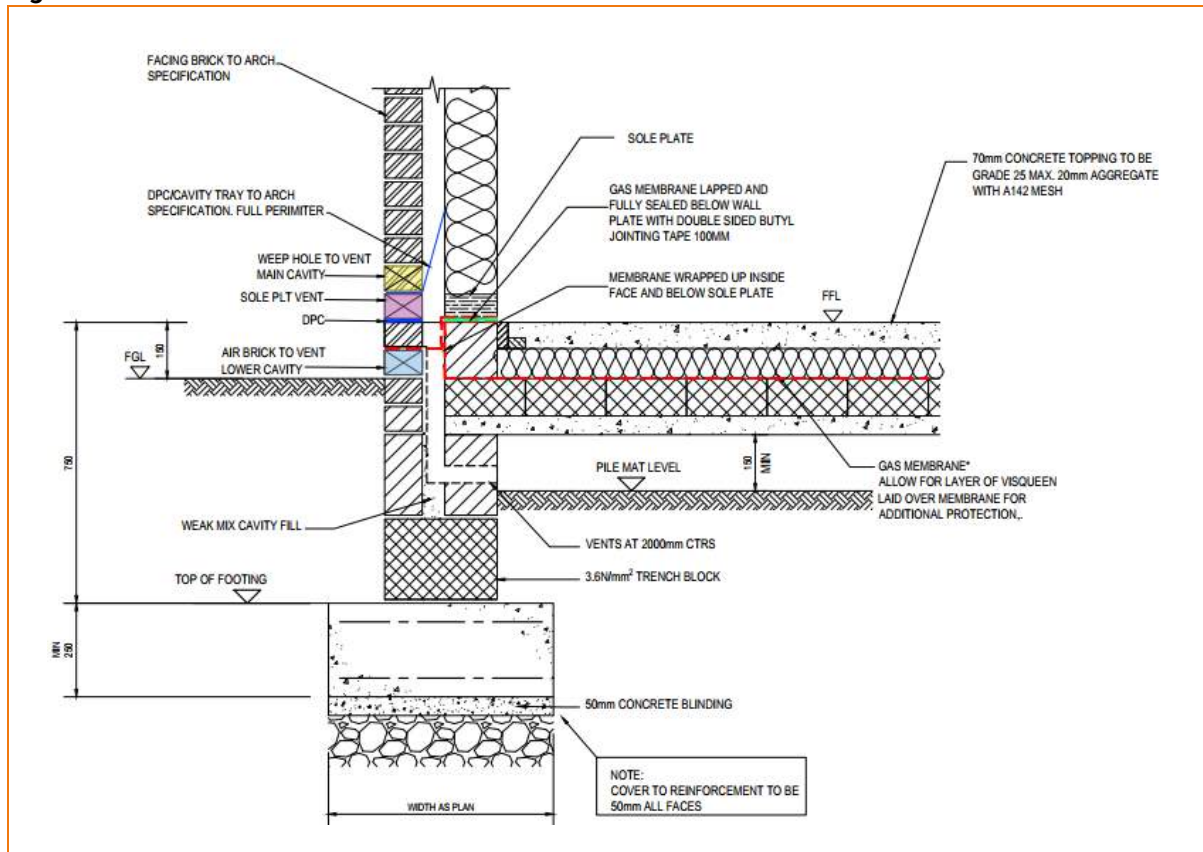


As discussed in Section 2.4, the sub-structures were redesigned in line with comments raised by the NHBC.

For plots where the membranes had already been installed at the time of the sub-structure redesign (Plots 1-10), remedial details in line with drawing EDE-AJP-XX-00-DR-S-9991, Rev P01, dated February 2025 and Figure 7 are to be installed.



Figure 3 NHBC Gas Barrier Detail – Timber Frame – External Wall Detail



The engineering details are included in APPENDIX IV.



5. INSTALLATION REQUIREMENTS – VALIDATION REQUIREMENTS

5.1.1. PERSONS RESPONSIBLE FOR VERIFICATION

CIRIA C735 (Section 3.2.2) states that the person validating the membrane must be independent of the installation contractor or material supplier. It is recognised that under certain circumstances, others may assist the independent third-party verifier, but in such a case, their work must be subject to independent third-party audit.

5.1.2. VERIFICATION ACTIVITY PLAN

Table 9 **Verification Activity Plan**

VERIFICATION ACTIVITY	FREQUENCY
Inspection of the sub-floor void dimensions	Every plot for the first ten structures to establish protocols (as and where possible). Every ten plots thereafter for sub-floor void and internal sleeper wall ventilation. All plots for ventilation and membrane.
Inspection of telescopic ventilation and air-brick system	
Inspection of membrane construction and installation.	
Inspection of reinforcement to raft	

5.1.3. VENTILATED SUB-FLOOR VOID

Photographic evidence will be collected for the relevant plots to demonstrate that, as a minimum a 150mm clear void is present beneath the suspended floor slab with interconnecting ventilation to the periphery constructed in accordance with the structural engineers' design.

Inspection of sub-floor voids will be completed on an intermittent basis as and where possible, it is not practicable to inspect each and every plot. Therefore, intermittent inspections will be completed to demonstrate a high degree of general compliance.

Sub-floor void and any internal sleeper wall to be verified for the first ten plots and every ten plots thereafter.

5.1.4. MEMBRANE STORAGE AND PREPARATION

The gas membrane should be stored horizontally, undercover in its original packaging.

Gas membrane is to be installed on a smooth continuous surface e.g. grouted beam and block floor, a compacted blinding layer e.g. 50mm thick sand blinding, or smooth concrete blinding.

The substrate should be free from irregularities such as voids or protrusions.

When installing the membrane in demanding site conditions, use specialist measures to enhance construction and, specifically, the jointing of membranes.



5.1.5. INSTALLATION GENERAL PRINCIPLES

The approved installation contractor will provide all necessary information pertaining to the installation process, as detailed in the earlier sections of this verification strategy.

- ✿ The gas membrane will be loosely laid on the substrate with the correct side up to avoid direct sunlight.
- ✿ The membrane will be clean and dry at the time of joining.
- ✿ It should be overlapped by at least 150mm, bonded with the appropriate jointing tape and sealed to the manufacturer's specification.
- ✿ Alternatively, lap joints can be heat welded to achieve an effective seal.
- ✿ The overlap in the barrier is typically 100mm, and when hand welding, a 35mm weld is normally achieved.
- ✿ When hand welding, a roller must be used.
- ✿ Airtight seals should be formed around all service entry points.
- ✿ Pre-formed 'Top Hat Units' are recommended for sealing service entry pipes.
- ✿ The base of the top hat and the upstand should be bonded using specialist jointing tape and sealed.
- ✿ Forming an effective barrier to gases may give rise to complex three-dimensional detailing where it is recommended that pre-formed units are used, e.g. corners. Alternatively, specialist detailing strips can be used to seal difficult junctions.
- ✿ If the barrier is punctured or perforated, a patch of the same material should be lapped at least 150mm beyond the limits of the puncture and bonded jointing tape and sealed. Alternatively, a patch can be formed using a detailing strip and lapped at least 150mm beyond the extent of the puncture.
- ✿ Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane.
- ✿ The membrane should be covered by a protective layer immediately after installation to prevent damage from following trades, ultraviolet light, etc.
- ✿ Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying a screed or final floor covering.
- ✿ A minimum thickness of 50mm screed is recommended.
- ✿ When reinforced concrete is to be laid over the barrier, the wire reinforcements and spacers must be prevented from puncturing the barrier.
- ✿ Where there is a high risk of potential damage, the barrier should be covered with specialist guard protection, screed or other approved protection material before positioning the reinforcement.



- ❖ Membrane installation detail currently shows the gas membrane being installed under the thermalite coursing block. Should this not be achievable during installation, the membrane may be installed over the thermalite coursing block with double-sided butyl tape under the membrane on the internal skin, which means that when the sole plate fixings penetrate the membrane, it will be sealed by the butyl tape.

5.1.6. SEALING OF SERVICE DUCTING – CONTRACTORS VERIFICATION RESPONSIBILITY

One of the most common preferential pathways for the migration of hazardous ground gasses into a building is through service ducting that creates a conduit for exaggerated gas ingress.

The contractor and developer will be responsible for sealing all service ducts in their entirety with suitable impervious expanding foam to ensure there is no potential for gas migration.

The adequate sealing of service ducting can be checked at any point during construction. Therefore, there is no requirement for independent attendance by a specialist such as E3P to inspect this work.

It is the client's responsibility, working with their appointed contractors to ensure all service ducts are fully sealed prior to the completion of the development.

5.1.7. GROUND GAS MITIGATION MEASURES VALIDATION

The validation of ground gas mitigations should be completed in line with the items specified in Table 10.

Table 10 Ground Gas Mitigation Measures Validation Items

INSPECTION	METHOD
Product Verification	Confirmation that suitable products have been procured for installation to consist of photographs of product types, labels on packaging and delivery tickets.
Passively Ventilated Sub-floor Cavity	A qualified engineer/consultant will be required to attend the site and validate the compliant construction of the sub-structure with a minimum 150mm sub-floor void. Due to the nature of the construction process and construction using precast suspended segmental floors, it is considered appropriate to check every plot for the first ten structures to establish protocols (as and where possible), and then every ten plots thereafter for sub-floor void (minimum 150 mm sub-floor void) and internal sleeper wall ventilation (to ensure uninhibited airflow).
Wall Cavity Inspection	Confirmation that the gas membrane spans the external wall cavity above the periscopic vents. If membrane installed over the thermalite coursing block, ensure double-sided butyl tape placed under the membrane to seal any sole plate fixing penetrations.
General Condition	The membrane is to be inspected to ensure there are no tears, punctures or rips.
Structural reinforcement	Here, structural reinforcement is used over a membrane, which must either be supported by a physical barrier or inspected after placement over a membrane to ensure no damage.
Jointing	The engineer is to check the overlaps between membranes are correctly sealed with sufficient overlaps.



INSPECTION	METHOD
	The membrane is to be jointed and sealed in accordance with the pre-agreed CQA plan and design requirements.
Service Entry Points	Verification of the presence of pre-formed top hats sealed to the pipe and membrane as per the construction detail.
Remedial Action	Any damage or requirement for remedial action must be recorded and notified in writing. Once repaired, the verifier will undertake the necessary reinspection's.
Passive Venting Systems	The engineer should verify the presence of vents at 1.5 m centres on at least three of the external walls.
CQA / Audit	The verifier must use a ISO approved system to ensure CQA. This will include electronic data capture with time and location stamps to ensure auditability if required.

Examples of gas membrane verification photographs are provided in Figure 6.

It should be noted that these are for illustrative purposes only, as each site will have a site-specific gas membrane specification.



Figure 4 Example Gas Membrane Verification

Plot Inspection 3 - 100%		100%	    				
Plot Number		183					
Type of Development: Other add note		House					
			Condition of sub-grade and underside of gas membrane: Check that the subgrade does not contain rough/uneven surfaces, is appropriately clean and that there are no hard/sharp objects. That protective sand blinding or geotextile (if specified) is present and meets the design criteria.				
Gas Characteristic Situation		CS2	Slab / membrane condition (is membrane clear of debris or insulation): Can membrane be fully seen and photographed – ask contractor to remove an debris so membrane can be fully seen an inspected – this is a requirement of NHBC and local authorities.				
Foundation Type: Other add note		Suspended Floor	   				
Gas Membrane Type: Manufacturer, gauge, and colour.		Yellow visqueen brand not stated	Gas Membrane Condition: Open punctures, tears, rips, stretching, Presence of debris, Repairs, Signs of weakness such as raised or sunken indentations, Protection plan in place to restrict access to lain gas membrane? IF FAIL DESCRIPTION IN ACTIONS AND PHOTOS REQUIRED				
   		Pass					
Laps, welds, and joints seals: Joints lapped and sealed in accordance with manufacturer's requirements/ specification? Minimum overlap insured? Sections taped twice? Are welds complete? Appropriate joining/double-sided tape used, Folds running in line with joints? (no joints cutting across folds)		Pass					
     							
Service entries seals: Top hats seal arrangements fixed around service entries? Use of Jubilee clips?		Yes					
     							
     							
 							
Type of joints/ Lapping		Taped					
Corners / Internal joints: Check all corners are correctly formed or contractor has used performed corners.		Pass					
     							
    							
Extent of Coverage: Is the membrane covering the entire plot? Does membrane span over outside walls?		Yes					



6. VAPOUR MITIGATION MEASURES VALIDATION

Plots 1-10 will require VOC vapour mitigation measures.

A qualified person will validate all VOC vapour mitigation measures in accordance with the requirements of CIRIA 748 and CIRIA 735.

As noted in CIRIA 735, the EA recommends avoiding conflicts of interest in verification. A contractor or gas membrane supplier certifying their own work or product is considered a conflict of interest. All verification and validation works are to be completed by an independent qualified specialist with no conflict of interest.

Verifying vapour protection systems is not just the inspection of a proprietary membrane, it should incorporate all aspects, including passively ventilated sub-floor voids, telescopic ventilation, floor slab types, membranes, service penetrations and workmanship.

The installation and verification process for vapour membranes will include the following key attributes.

1. Membrane to be installed by NVQ Level 2 installer;
2. Prior to the commencement of any works, the specialist contractor will produce a detailed installation plan and method statement. CQA Procedures and qualifications for all parties involved in the construction process. This CQA and Verification plan will be subject to approval by the supervising consultant and will be included within the validation statement to be issued to the LPA;
3. The verification consultant will be deemed suitably competent. This will be either chartered status, personnel with suitable experience (+ 5 years) or formal training in CIRIA 735;
4. Sub-floor void to be inspected at 50% ratio of substructures completed;
5. Each and every vapour membrane to be fully inspected and validated;
6. Every second plot constructed will be subject to air lancing integrity testing in accordance with an internationally recognised standard. The installer and integrity tester will provide the methodology for their works.
7. A detailed verification report will be prepared for each and every plot to be installed with a vapour membrane.

The validation of ground gas mitigations should be completed in line with the items specified in Table 11.

The E3P Drawing 16-465-041 details the plots that will require integrity testing.



Table 11 Ventilation and Membrane Mitigation Measures Validation Items (VOC Membranes)

INSPECTION	METHOD
Product Verification	Confirmation that suitable products have been procured for installation to consist of photographs of product types, labels on packaging and delivery tickets.
Passively Ventilated Sub-floor Cavity	A qualified engineer/consultant will be required to attend the site and validate the compliant construction of the sub-structure with a minimum 150 mm sub-floor void. Due to the nature of the construction process and construction using pre-cast suspended segmental floors, it is considered appropriate to check and verify 50% of the dwellings constructed with the minimum 150 mm sub-floor void.
Wall Cavity Inspection	Confirmation that the gas membrane spans the external wall cavity above the periscopic vents.
General Condition	The membrane is to be inspected to ensure there are no tears, punctures or rips.
Structural reinforcement	Here structural reinforcement is used over a membrane, and this must either be supported by a physical barrier or be inspected after placement over a membrane to ensure no damage.
Jointing	The engineer is to check the overlaps between membranes are correctly sealed with sufficient overlaps. The membrane is to be jointed and sealed in accordance with the pre-agreed CQA plan and design requirements.
Service Entry Points	Verification of the presence of preformed top hats sealed to the pipe and membrane as per the construction detail.
Remedial Action	Any damage or requirement for remedial action must be recorded and notified in writing. Once repaired, the verifier will undertake the necessary reinspection's.
Passive Venting Systems	The engineer should verify the presence of vents at 1.5 m centres on at least three of the external walls.
CQA / Audit	The verifier must use a ISO approved system to ensure CQA. This will include electronic data capture with time and location stamps to ensure auditability if required.

Examples of vapour membrane verification photographs are provided in Figure 5.

It should be noted that these are for illustrative purposes only, as each site will have a site-specific gas membrane specification.



Figure 5 Example VOC Membrane Verification

Plot Inspection 4			
Plot Number	80		
Type of Development: Other add note	House		
Foundation Type: Other add note	Suspended Floor		
Gas Membrane Type: Manufacturer, gauge, and colour.	Powerbase VOC blue		
Gas Membrane Condition: Open punctures, tears, rips, stretching, Presence of debris, Repairs, Signs of weakness such as raised or sunken indentations, Protection plan in place to restrict access to lain gas membrane? IF FAIL DESCRIPTION IN ACTIONS AND PHOTOS REQUIRED	Pass	Extent of Coverage: Is the membrane covering the entire plot? Does membrane span over outside walls? Yes   	
    	Pass	Condition of sub-grade and underside of gas membrane: Check that the subgrade does not contain rough/uneven surfaces, is appropriately clean and that there are no hard/sharp objects. That protective sand blinding or geotextile (if specified) is present and meets the design criteria. 	
Laps, welds, and joints seals: Joints lapped and sealed in accordance with manufacturer's requirements/ specification? Minimum overlap insured? Sections taped twice? Are welds complete? Appropriate joining/double-sided tape used, Folds running in line with joints? (no joints cutting across folds)	Pass	Slab / membrane condition (is membrane clear of debris or insulation): Can membrane be fully seen and photographed – ask contractor to remove an debris so membrane can be fully seen an inspected – this is a requirement of NHBC and local authorities. 	
  	Pass	External Wall Air bricks: Numbers, size, positions as design drawing? (Minimum of 3 walls)   	
Service entries seals: Top hats seal arrangements fixed around service entries? Use of Jubilee clips?	Yes	Passive Venting Sub-floor Void: Is a check possible on future plots (insert Plot number or NO in text box) No	
   			
Type of joints/ Lapping	Welded		
Corners / Internal joints: Check all corners are correctly formed or contractor has used preformed corners.	Pass		
     			
			

6.1. VAPOUR MITIGATION MEASURES – MEMBRANE INTEGRITY TESTING

6.1.1. OVERVIEW

The low-rise residential development is classified as a high-risk receptor following the principles outlined within CIRIA 748. This requires integrity testing of the installed membrane.

E3P has determined that it will be necessary to undertake integrity testing on every second plot constructed, as detailed in the E3P drawing 16-465-041.

The plots to be subject to integrity testing will be determined within the specialist contractor's CQA plan. However, it must be recognised that the actual plots inspected may vary throughout the installation works due to programme and operational constraints.

A dynamic record to ensure up-to-date and accurate records of the ongoing integrity testing will be held by the specialist contractor to be provided to the validation consultant.



6.1.2. TECHNICAL SPECIFICATION

All testing is to be completed in accordance with ASTM D4437, 2008 Edition, April 1, 2008 - Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

ASTM D4437 is a recognised standard practice published by ASTM International. It outlines the procedures for conducting non-destructive testing (NDT) to assess the integrity of seams used in joining flexible polymeric sheet geomembranes. The purpose of this standard is to ensure that the seams meet the required quality and performance standards without causing damage to the geomembranes during the testing process.

This standard is applicable to situations where flexible polymeric sheet geomembranes are joined using various seam techniques, such as heat fusion, adhesive bonding, or other mechanical methods. It is essential for applications where geomembrane integrity is critical to prevent leakage, maintain containment, or protect the environment from hazardous substances.

ASTM D4437 provides detailed instructions on various non-destructive testing methods that can be employed to assess seam integrity. These methods may include visual examination, air lance testing, vacuum testing, vacuum-box testing, or other suitable techniques. The choice of testing method may depend on the specific application, geomembrane material, and project requirements.

The standard specifies the necessary equipment and tools needed for conducting non-destructive testing accurately and reliably. This will involve specialised testing equipment, visual inspection aids, vacuum apparatus, and safety gear to ensure the safety and effectiveness of the testing process.

ASTM D4437 also outlines the acceptance criteria that must be met for the tested seams to be considered acceptable.

These criteria is based on observed defects, leakage rates, or other relevant parameters, ensuring that the seams meet the required standards for the specific application.

To ensure the quality and integrity of seams in joining flexible polymeric sheet geomembranes, it is essential to adhere to ASTM D4437. Compliance with this standard provides confidence in the performance of the seams and helps mitigate the risk of potential leaks or failures that could lead to environmental contamination or compromised containment systems.

The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

6.1.3. GENERAL METHODOLOGY FOR AIR LANCE VERIFICATION (ASTM D4437)

Before entering the site, ensure all site personnel are appropriately inducted and authorised to work on site.

Prior to the visit:

- a) Visually inspect the compressor, along with the hose and lance and check for any problems, replace if necessary;
- b) Check the oil and fuel level as well as drain any condensate from the compressor.
- c) Carrier vehicle checks are conducted before leaving base.



Scope of Works:

- ✿ Have a visual walkover of the area that requires air lance verification prior to air lance testing;
- ✿ If seams are taped, ensure that there is no overlap tape present prior to air lance testing;
- ✿ If overlap tape is present, request ground workers or the membrane fitters to remove this tape before you conduct the visual inspection and air lance test;
- ✿ If multiple non-conformances are identified with a simple visual and pick test then **DON'T** conduct the air lance test until the ground workers have rectified the problems;
- ✿ If minor non-conformances are identified, then proceed with the air lance testing;
- ✿ Make sure test is completed in forward facing direction placing the nozzle of the lance no more the 50 mm from the seam edge, squeeze the trigger and directing the air into the seam, walk at a slow pace up the seam line;
- ✿ When you reach a non-conformance, mark the edges of the non-conformance;

The results of all integrity testing are to be provided to the supervising validation consultant.

END OF REPORT

APPENDIX I

LIMITATIONS





GENERAL

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P "Terms of Business" or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.
3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.
4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEOENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

5. Coverage: This section covers reports with the following titles or combination of titles: Phase 1; Desktop Study; Geoenvironmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Baseline Environmental Assessment; Project Scope Summary Report (PSSR), Program Environmental Impact Report (PEIR), Geotechnical Development Risk Register; Agricultural Land Assessment; Mineral Safeguarding Assessment; Desk Top Coal Mining Risk Assessment; Hydrogeological Appraisal; Construction Environmental Management Plan; and Site Water Management Plan.
6. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.
7. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.



8. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.
9. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and does not constitute or replace full and proper surveys completed by suitably qualified and experienced specialists in these fields.
10. E3P does not warrant work/data undertaken/provided by others.

INTRUSIVE INVESTIGATION REPORTS

11. Coverage: The following report titles (or combination) may cover this category of work: Geoenvironmental Site Investigation; Geotechnical Assessment; GIR (Ground Investigation Reports); Preliminary Environmental And Geotechnical Risk Assessment; Preliminary Summary; Coal Mining Risk Assessment, Ground Gas Addendum; and, Geotechnical Risk Register.
12. The investigation has been undertaken to provide information concerning either:
 - I. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or
 - II. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.
13. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.
14. Unless otherwise specified in the scope of works, any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
15. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.
16. For geotechnical investigations, the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.



17. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the site, and as such can only provide a general indication of conditions.
18. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.
19. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, E3P has used reasonable skill and care to extrapolate conditions between these points based on assumptions to develop our interpretation and conclusions.
20. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation and at the time of the investigation.
21. Conditions can change between investigation points both spatially and over time and these interpretations should therefore be considered indicative. The assessment of extreme weather events and their impact on ground conditions is not within the scope of E3P's work.
22. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the risk assessment process have been outlined within the body or associated appendix of the report.
23. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.
24. Where soil contamination concentrations recorded as part of this investigation are used for commentary on the potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed and the waste classification and any subsequent disposal option agreed upon with licenced subcontractors and/or the relevant regulators.



25. The results of the asbestos testing are factually reported and interpretation is given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.
26. If costs have been included in relation to additional Site works, and/or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

27. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.
28. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIATION AND ENABLING WORK STRATEGY REPORTS

29. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected based on the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.
30. The outputs of the Detailed Quantitative Risk Assessments are based upon the manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.



31. Before adoption on-site, assessment criteria will need to be discussed and agreed upon with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of E3P. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.
32. E3P does not accept liability for any subcontract work that has not been completed in strict accordance with an approved E3P Remediation and Enabling Works Strategy.

GEOTECHNICAL DESIGN REPORT (GDR)

33. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS AND BUILD PHASE MITIGATION)

34. These reports are factual and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of earthworks or remedial works.
35. The data is presented and will be compared with assessment criteria.

APPENDIX II

GLOSSARY





TERMS

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation





MCV	Moisture condition value	WRAP	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m ³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m ²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection



APPENDIX III

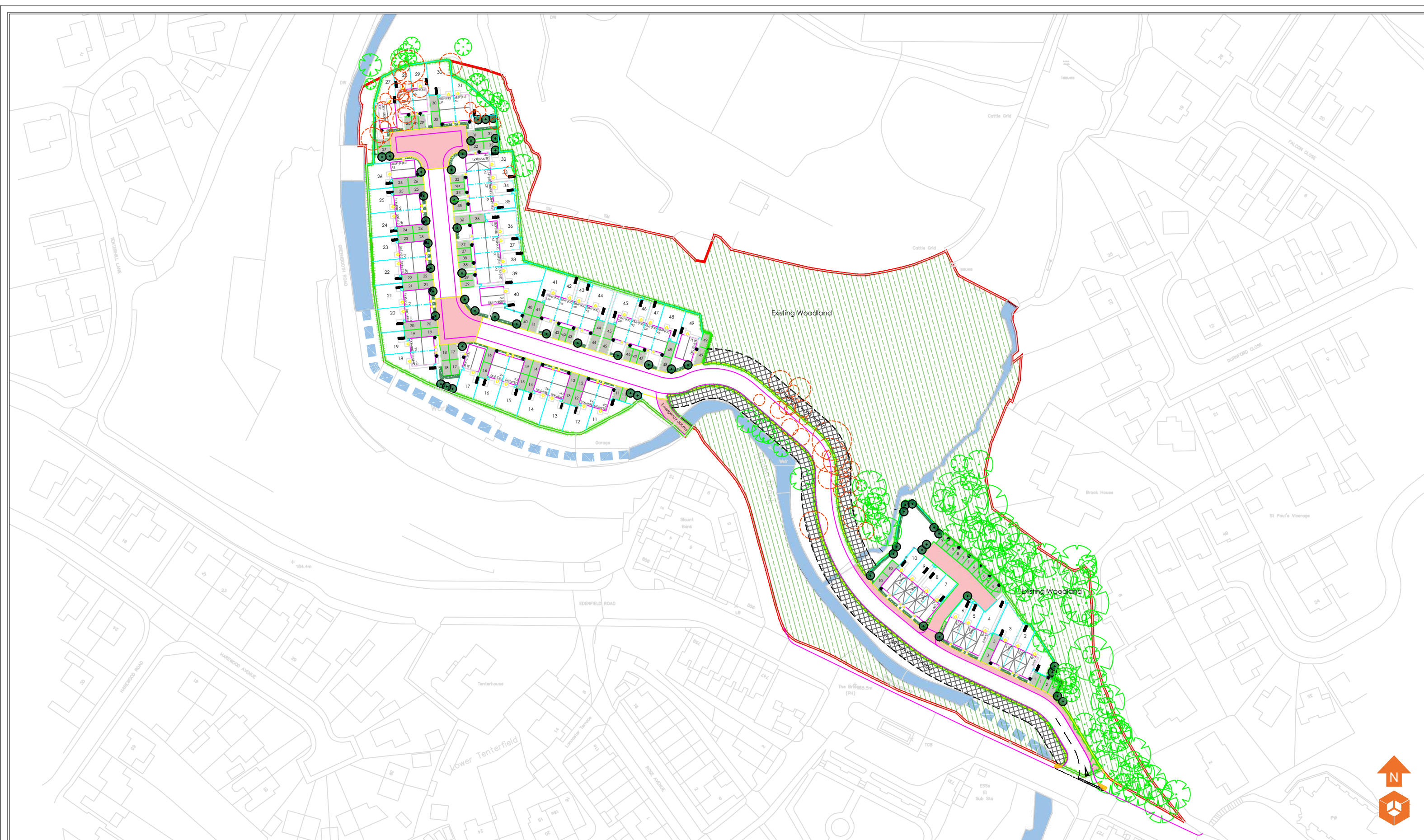
E3P DRAWINGS





DRAWING 16-465-001 – SITE LOCATION PLAN





Notes:				

P1	REVC	16.06.2023	OW	MW
P1	REVB	20.03.2023	EB	RJW
P1	REVA	17.11.2022	OW	MD
Phase	Issue	Date	Drawn	Checked

Client:
Stonebond Properties Ltd

Job Title:
Land at Greenbooth Road and Edenfield Road, Norden

Job No:
16-465
Drawing No:
002

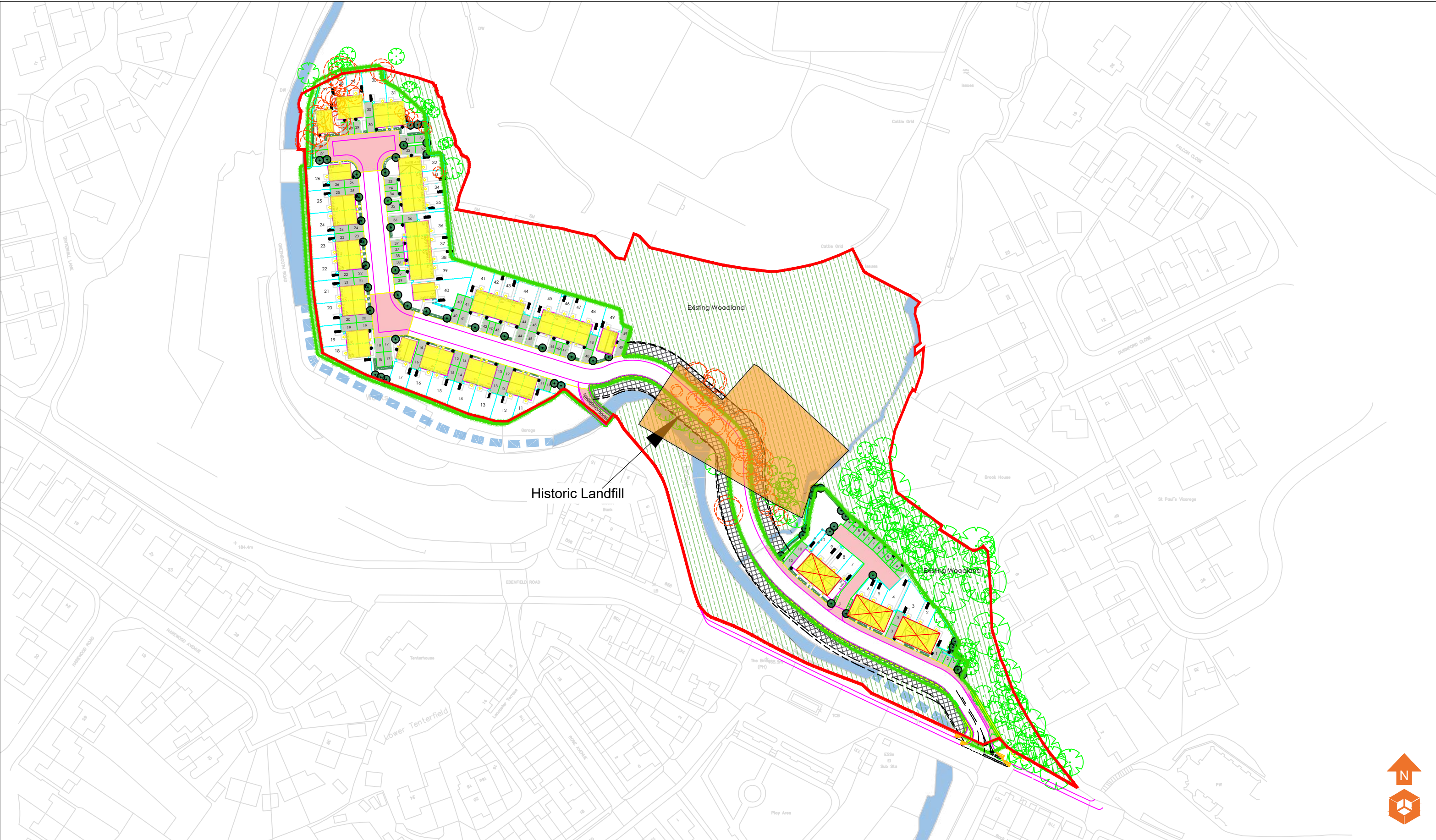
Date:
16.06.2023
Scale:
NTS@ A3

Drawing Title:
Proposed Development Plan



Environmental Engineering
Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Ground Gas

CS2

Vapour Resistant Membranes required.

Notes:				
P1	REVE	02.09.2024	OW	MW
P1	REVD	06.06.2023	OW	MW
P1	REVC	31.03.2023	OW	MW
P1	REVB	28.03.2023	OW	MW
P1	REVA	23.03.2023	OW	HM
Phase	Issue	Date	Drawn	Checked

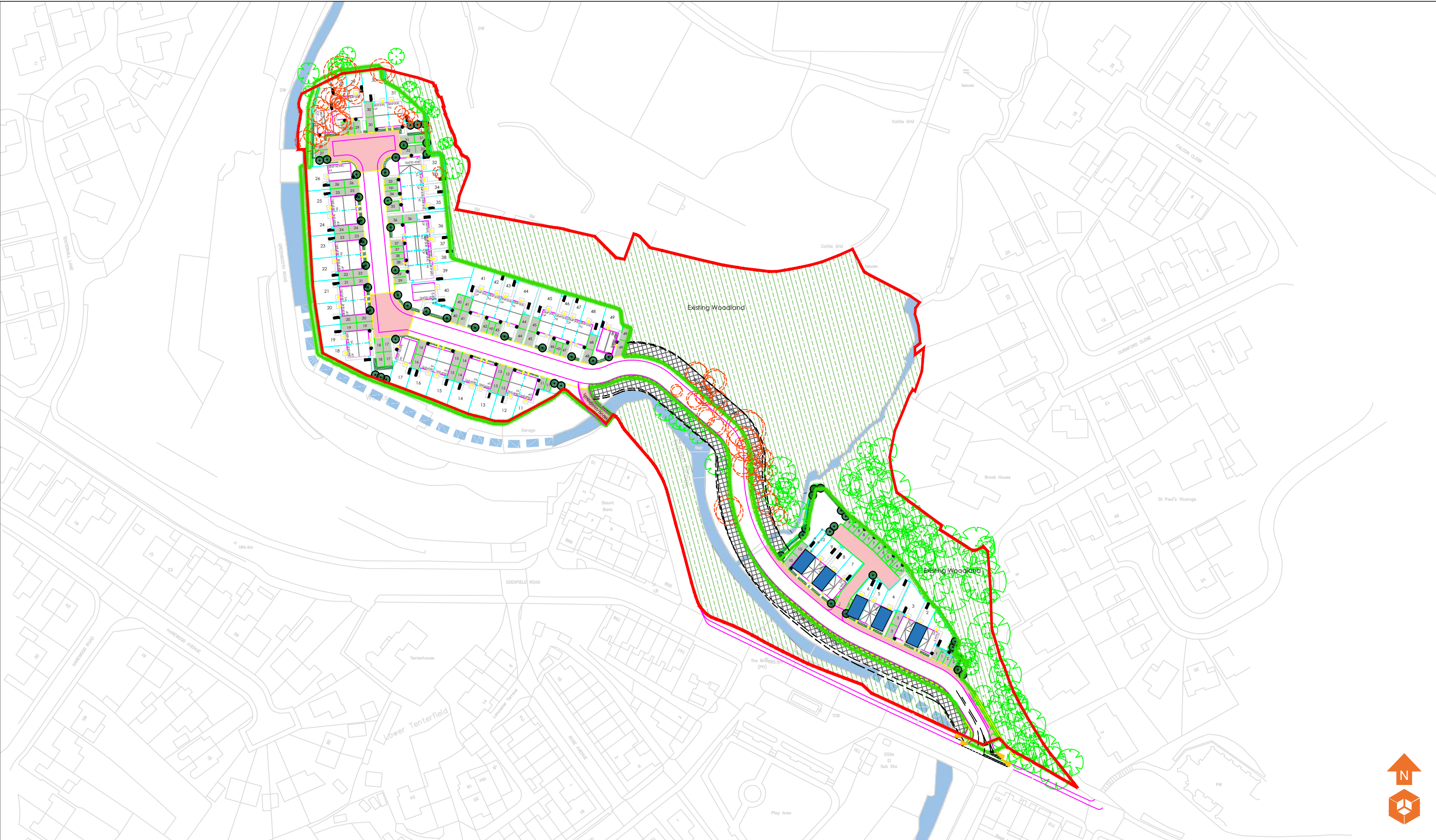
Client:	Stonebond Properties Ltd
Job Title:	Greenbooth Road and Edenfeild Road, Norden

Job No:	16-465
Drawing No:	024
Date:	02.09.2024
Scale:	NTS@ A3
Drawing Title:	Ground Gas Mitigation Plan



Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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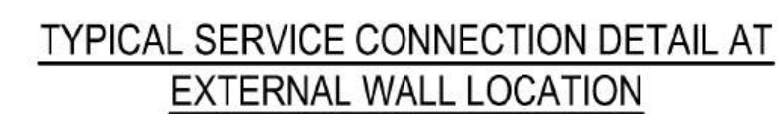
Integrity Plots Proposed for Independent Integrity Testing					Notes:					Client: Stonebond Properties Ltd		Job No: 16-465	Date: 02.09.2024	e3p Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk	
												Drawing No: 041	Scale: NTS@ A3		
					P1 Phase					REVA Issue	02.09.2024 Date	OW Drawn	MW Checked		

APPENDIX IV

STRUCTURAL ENGINEERS

DRAWINGS





NOTE:
ALLOW FOR MINIMUM 150mm VENTILATED FLOOR VOID AS SHOWN. FOR ANY PLOTS IN AREAS OF TREE ROOT INFLUENCE THIS MAY NEED TO INCREASE - REFER TO FOUNDATION ZONING PLAN FOR FURTHER DETAILS

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
2. ALL RELEVANT DIMENSIONS TO BE OBTAINED/ CHECKED AGAINST ARCHITECTS DRAWINGS AND BY SITE MEASUREMENT PRIOR TO THE COMMENCEMENT OF WORKS OR ORDERING OF MATERIALS.

 -DO NOT SCALE FROM THIS DRAWING. DISCREPANCIES BETWEEN THE DRAWINGS AND SITE CONDITIONS TO BE NOTIFIED TO THE ENGINEER.
3. ALL DPM's & DPC's AND WATERPROOFING/ WEATHERING DETAILS TO BE IN ACCORDANCE WITH ARCHITECTS DETAILS.
4. THE CONTRACTOR IS RESPONSIBLE FOR THE LOCATION OF ALL UNDERGROUND SERVICES THAT MAY EXIST AND TO DIVERT THEM IF NECESSARY PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. SETTING-OUT OF WALLS TO BE IN ACCORDANCE WITH LATEST RELEVANT ARCHITECT'S DRAWING.
6. MATERIALS OR WORKMANSHIP NOT COMPLYING WITH THE ENGINEERS DRAWINGS AND SPECIFICATION SHALL BE DEEMED UNACCEPTABLE AND REMOVED FROM SITE AND REPLACED WITH WORK CORRECTLY MANUFACTURED, DELIVERED AND ERECTED.

VSRC'S, WHERE USED, TO PROVIDE A MINIMUM GROUND BEARING CAPACITY OF 150KN/M².

NOTE: AIRBRICK NOT TO BE INSTALLED BENEATH BEARING OF JETFLOOR BEAM

NOTE: FOR HEAVE PROTECTION REQUIREMENTS
REFER TO FOUNDATION ZONING PLAN

***FINISHED GROUND LEVEL TO BE A MINIMUM OF 150mm
BELOW FINISHED FLOOR LEVEL. ALLOWANCE TO BE MADE
FOR UNDERBUILD REQUIREMENTS AS INDICATED ON
EXTERNAL WORKS DRAWING**

DRAWING STATUS: **PRELIMINARY**

CLIENT: STONEBOND PROPERTIES LIMITED

ARCHITECT: STONEBOND PROPERTIES LIMITED

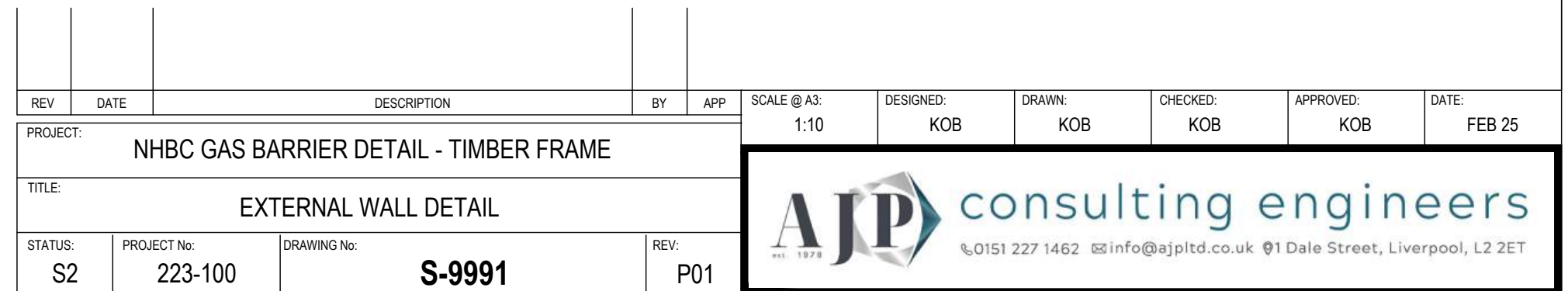
PROJECT:

EDENFIELD ROAD
NORDEN, ROCHDALE

TITLE: TYPICAL VIBRO STONE REPLACEMENT COLUMN FOUNDATION DETAILS WITH GAS PROTECTION

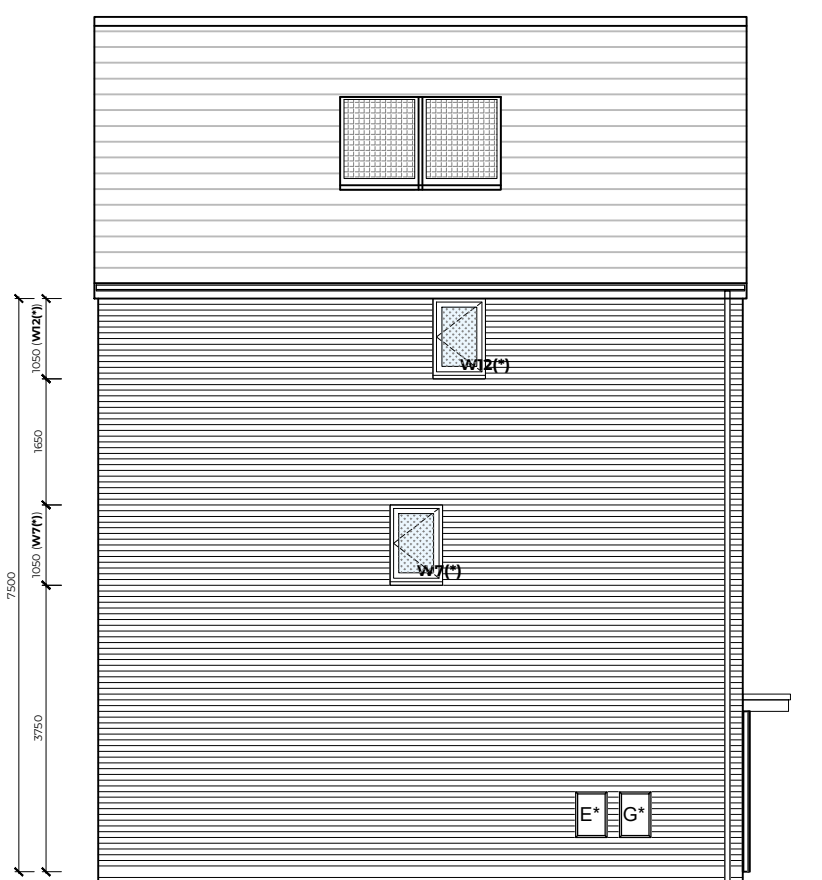
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SCALE @ A1: 1:20	DESIGNED: K.O'Brien	DRAWN: E.Glover	CHECKED: K.O'Brien	APPROVED: K.O'Brien	DATE: JULY 2023
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FRONT ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100



REAR ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100

DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVP'S TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

PLEASE NOTE:

- ALL meter boxes, extract grilles etc that are fitted to / penetrate the external walls **MUST** be coloured to match the external facing material prescribed in the materials schedule (ie. red brick = brown; buff brick = white; stonework = white; render = white; tile-hanging = brown).
- All vent tiles **MUST** be in-line.
- Soffit vents **MUST** be white.
- Rainwater goods **MUST** be black.

Key:

	Soil & Vent Pipe pipe position
	Direct Drain position
	Air Admittance Valve/Durgo position
	Back Inlet Gully position
	Incoming water position
	External tap position
	Incoming fibre/data cable position

Please Note:
Please refer to nominated PC manufacturers detailed design and specification for further information regarding air brick and sleeper wall requirements.

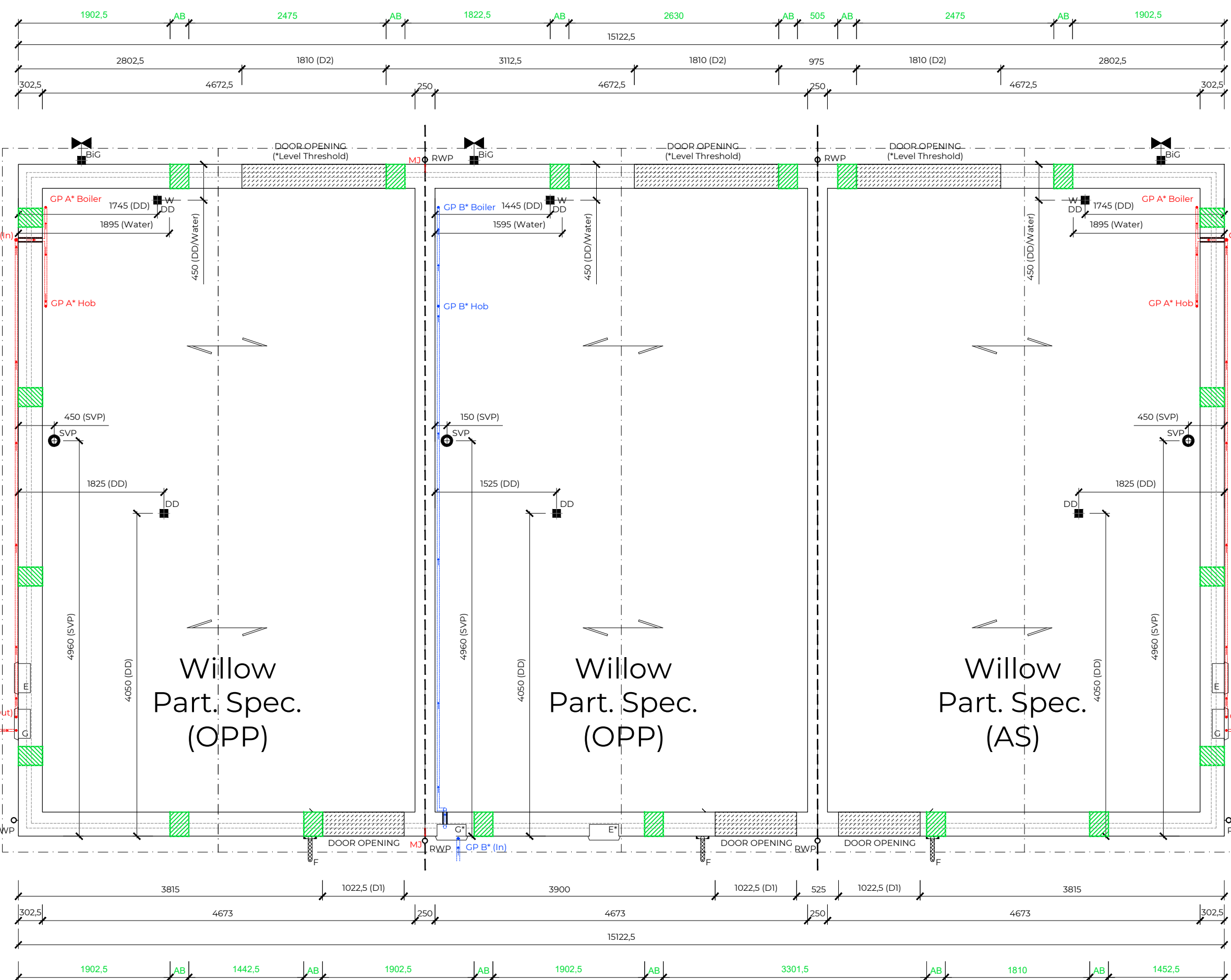
Please Note:
Please refer to nominated structural engineers detailed design and specification for further information regarding foundations ground floor and foundation construction.

Please Note:
To comply with Building Regulations BA1 a common access point (CAP) for a gigabit capable public electronic communications network is required as a part of the building's gigabit ready physical infrastructure.
Master point to be connected to external point via appropriately specified conduit.
Cable to be specified by nominated communications network provider.

Please Note:
Denotes location of air brick within ramped area to level threshold.
To be constructed in accordance with standard detail:
SBM-TSD-3-04
SBM-TSD-3-06

PLOTS:

1-3
4-6



Please Note:
Level Threshold - where site levels dictate that a level threshold **CANT** be achieved to the front of the property then the rear access shall be used as the primary entrance therefore a level threshold will be required.

Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:
Incoming Gas Supply A*
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level (as per SBM SD 777) and within close proximity to both the boiler & gas hob (if applicable)

Please Note:
Incoming Gas Supply B*
Where house is to be plotted in a terraced configuration with kitchen to the **REAR** of the unit then the incoming gas supply is to enter through the front elevation and routed through service wall to both the boiler & gas hob (if applicable) accordingly as per SBM SD 777?

POI	12.07.24	First issue.	AC
Rev	Date	Comments	By

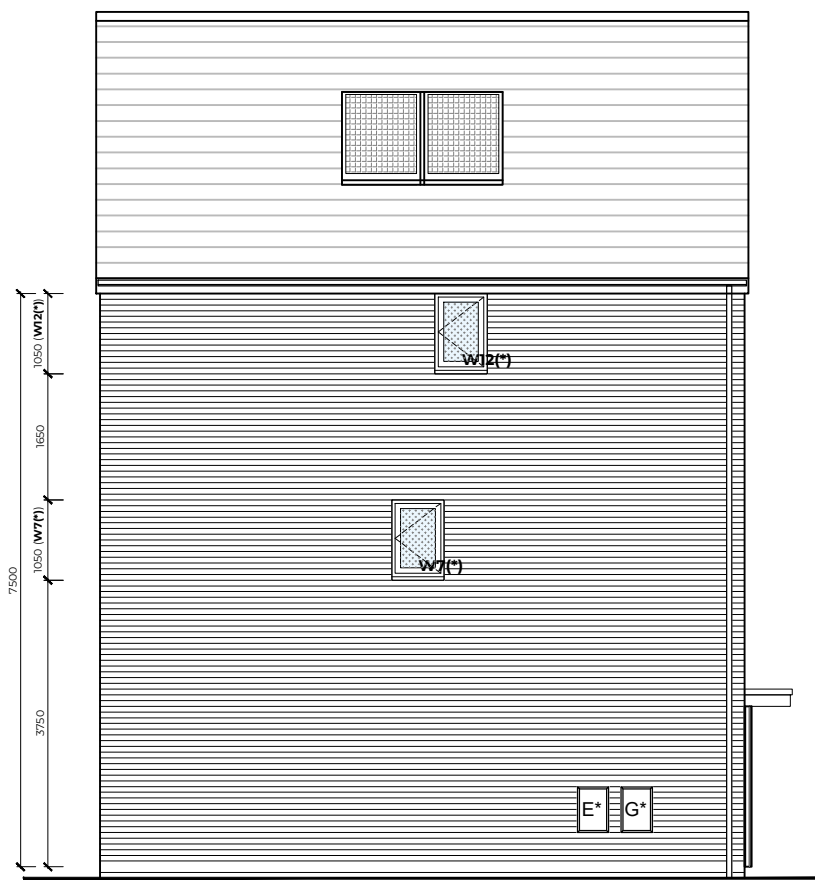
Stonebond.

Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

site:	Stonebond Properties (Manchester) Ltd.		
title:	Partnerships Range Block Setting Out Plan (BSO) Willow 3 Block (OPP/OPP/AS)		
scale: (@A1)	1:50/1:100	drawn by:	SBP
date:	Jul 24	checked:	-
drawing no:	MAN001-SBP-ZZ-ZZ-DR-A-04-W301		
sheet no:	Sheet 1 of 3		revision: -



FRONT ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100



REAR ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100

DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

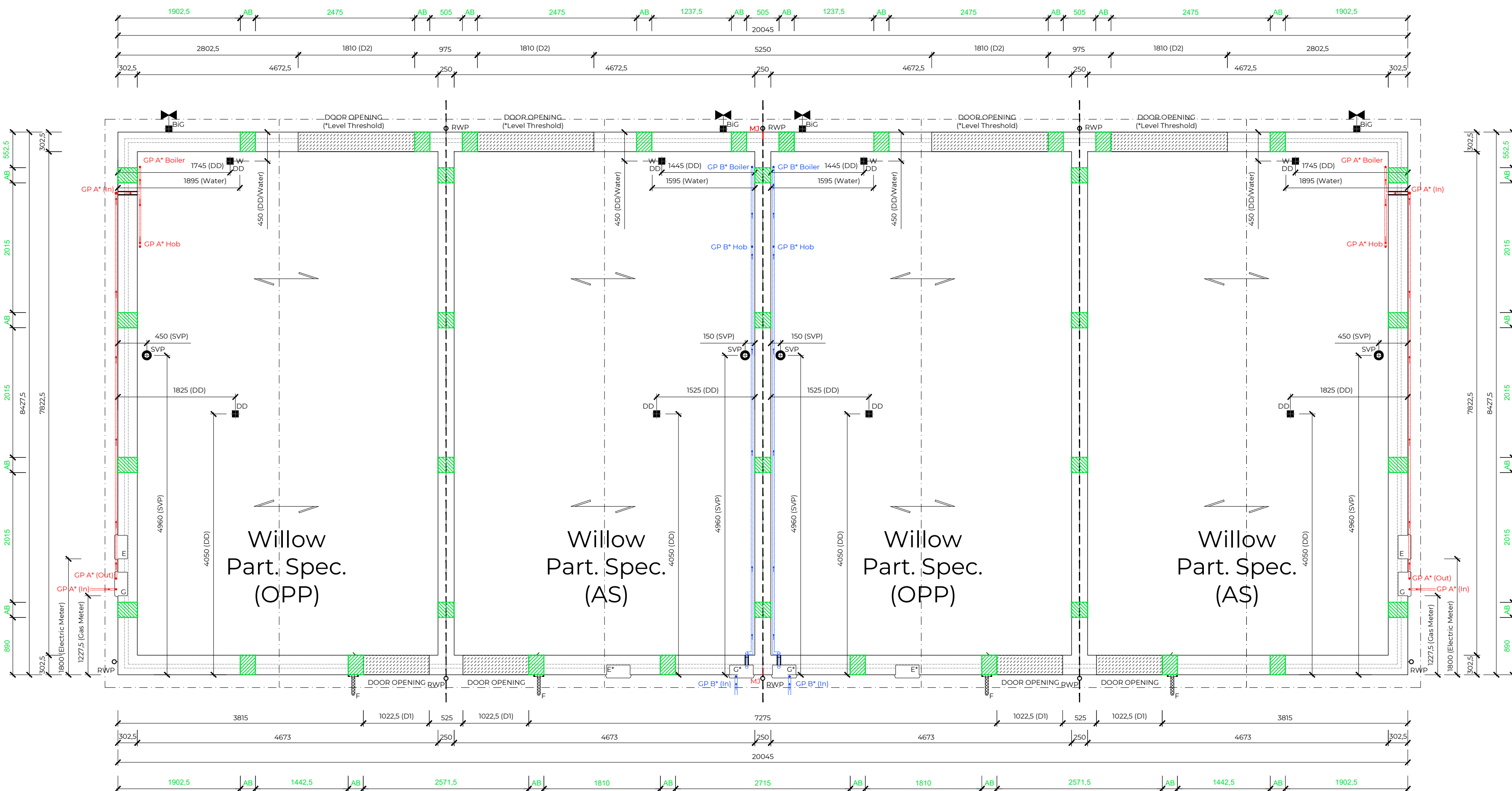
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Key:

	Soil & Vent Pipe pipe position
	Direct Drain position
	Air Admittance Valve/Durgo position
	Back Inlet Gully position
	Incoming water position
	External tap position
	Incoming fibre/data cable position



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Denotes location of air brick within ramped area to level threshold.
To be constructed in accordance with standard detail:
SBM-TSD-3-04
SBM-TSD-3-06

PLOTS:

1-3
4-6

Please Note:
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Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:
Incoming Gas Supply A*
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level (as per SBM SD 7777) and within close proximity to both the boiler & gas hob (if applicable).

Please Note:
Incoming Gas Supply B*
Where house is to be plotted in a terraced configuration with kitchen to the **REAR** of the unit then the incoming gas supply is to enter through the front elevation and routed through service wall to both the boiler & gas hob (if applicable) accordingly as per SBM SD 7777.

POI	12.07.24	First issue.	AC
Rev	Date	Comments	By

Stonebond.

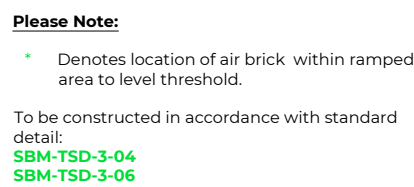
Stonebond Properties (Manchester)Ltd
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scale: (@A1)	1:50/1:100	drawn by:	SBP
date:	Jul 24	checked:	-
drawing no:	MAN001-SBP-ZZ-ZZ-DR-A-04-W401		
sheet no:	Sheet 1 of 3		revision: -

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVP'S TO TERMINATE IN ROOF SPACE OR
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- **All** vent tiles **MUST** be in-line.
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	SVP Soil & Vent Pipe position
	DD Direct Drain position
	AAV Air Admittance Valve/Durgo position
	BIG Back Inlet Gully position
	W Incoming water position
	External tap position
	F Incoming fibre/data cable position



Please Note:
Incoming Gas Supply A*

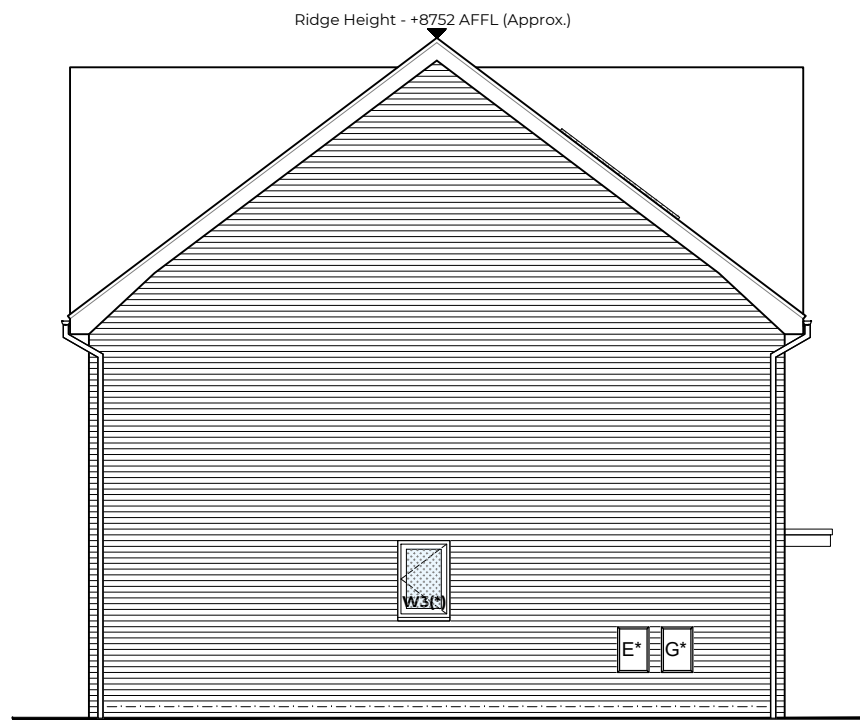
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level and within close proximity to both the boiler & gas hob (if applicable)

Stonebond.

sheet no: Sheet 1 of 2 revision: P07



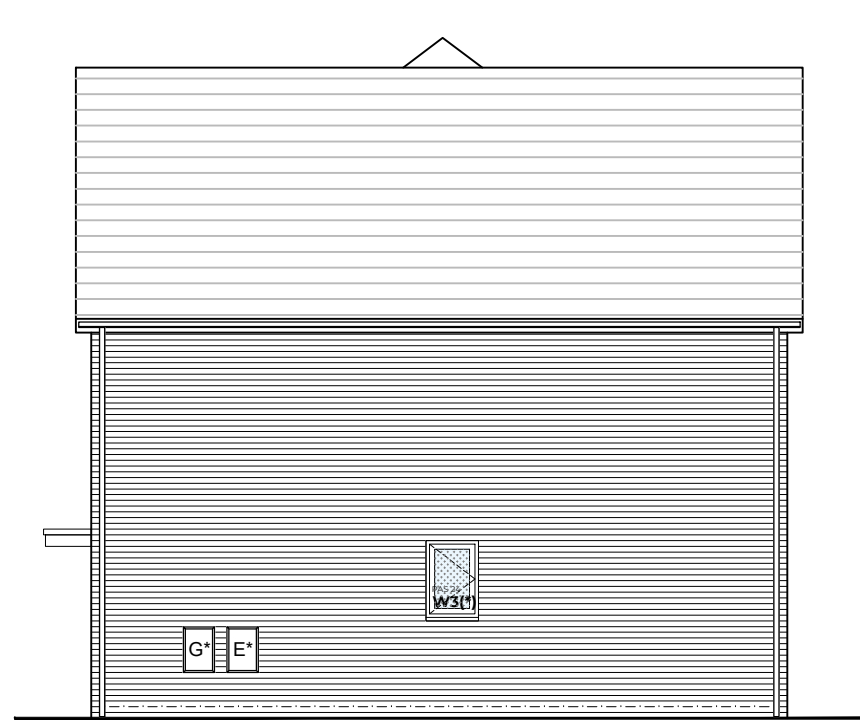
FRONT ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100



REAR ELEVATION
SCALE 1:100



SIDE ELEVATION
SCALE 1:100

DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVP'S TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

PLEASE NOTE:

- ALL meter boxes, extract grilles etc that are fitted to / penetrate the external walls **MUST** be coloured to match the external facing material prescribed in the materials schedule (ie. red brick = brown; buff brick = white; stonework = white; render = white; tile-hanging = brown).
- All vent tiles **MUST** be in-line.
- Soffit vents **MUST** be white.
- Rainwater goods **MUST** be black.

Key:

	Soil & Vent Pipe pipe position
	Direct Drain position
	Air Admittance Valve/Durgo position
	Back Inlet Gully position
	Incoming water position
	External tap position
	Incoming fibre/data cable position

Please Note:
Please refer to nominated PC manufacturers detailed design and specification for further information regarding air brick and sleeper wall requirements.

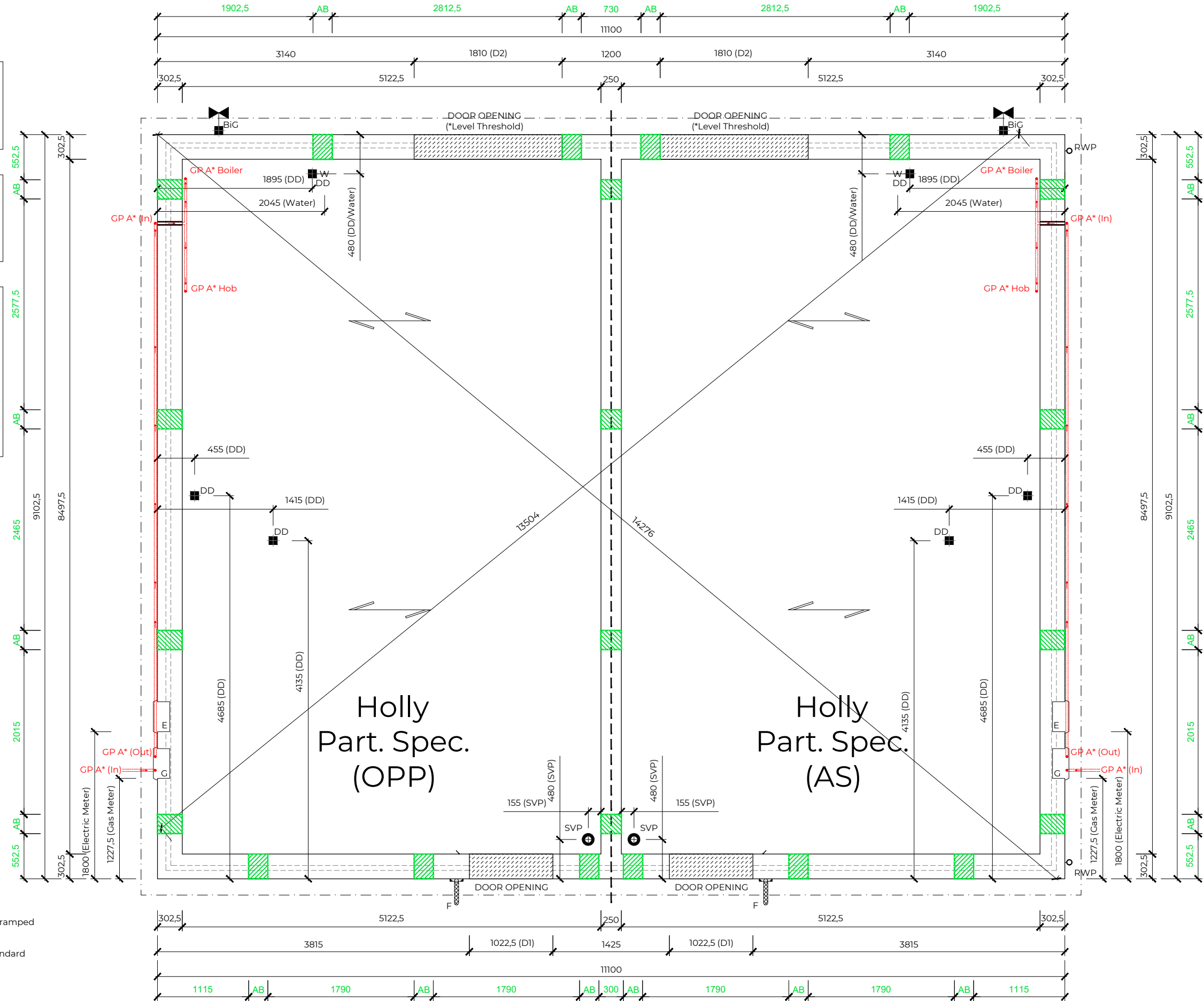
Please Note:
Please refer to nominated structural engineers detailed design and specification for further information regarding foundations ground floor and foundation construction.

Please Note:
To comply with Building Regulations (RA) a common access point (CAP) for a gigabit capable public electronic communications network is required as a part of the building's gigabit ready physical infrastructure.
Master point to be connected to external point via appropriately specified conduit.
Cable to be specified by nominated communications network provider.

PLOTS:

15-16
24-25

Please Note:
* Denotes location of air brick within ramped area to level threshold.
To be constructed in accordance with standard detail:
SBM-TSD-3-04
SBM-TSD-3-06



Please Note:
*Level Threshold - where site levels dictate that a level threshold **CANT** be achieved to the front of the property then the rear access shall be used as the primary entrance therefore a level threshold will be required.
Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:
Incoming Gas Supply 'A'
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level and within close proximity to both the boiler & gas hob (if applicable).

POI	12.07.24	First issue (reissue from HOL-S02-6.0 Rev A)	AC
Rev	Date	Comments	By

Stonebond.

Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

site:	Stonebond Properties (Manchester) Ltd.		
title:	Partnerships Range Block Setting Out Plan (BSO) Holly Semi-Detached (OPP/AS)		
scale: (@A1)	1:50/1:100	drawn by:	SBP
date:	June 2024	checked:	
drawing no:	MAN001-SBP-ZZ-ZZ-DR-A-04-H203		
sheet no:	Sheet 1 of 2		revision: P01

DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVPs TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

- PLEASE NOTE:**
- **ALL** meter boxes, extract grilles etc that are fitted to / penetrate the external walls **MUST** be coloured to match the external facing material prescribed in the materials schedule (ie. red brick = brown; buff brick = white; stonework = white; render = white; tile-hanging = brown).
 - **All** vent tiles **MUST** be in-line.
 - Soffit vents **MUST** be white.
 - Rainwater goods **MUST** be black.

Key:	
	Soil & Vent Pipe pipe position
	Direct Drain position
	Air Admittance Valve/Durgo position
	Back Inlet Gully position
	Incoming water position
	External tap position
	Incoming fibre/data cable position



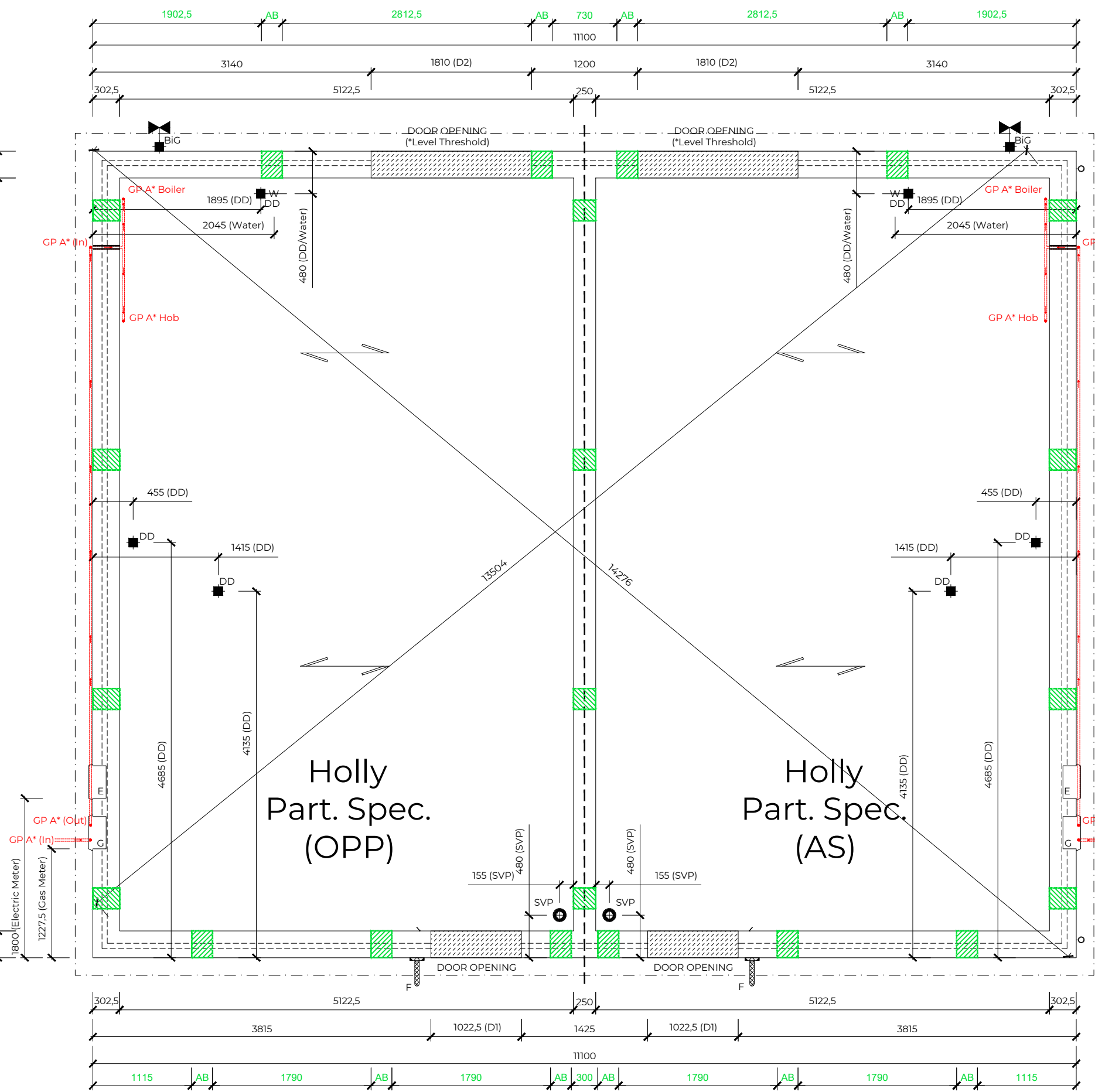
Please Note:
Please refer to nominated PC manufacturers detailed design and specification for further information regarding air brick and sleeper wall requirements.

Please Note:
Please refer to nominated structural engineers detailed design and specification for further information regarding foundations ground floor and foundation construction.

Please Note:
To comply with Building Regulations RA1 a common access point (CAP) for a gigabit capable public electronic communications network is required as a part of the building's gigabit ready physical infrastructure.
Master point to be connected to external point via appropriately specified conduit.
Cable to be specified by nominated communications network provider.

PLOTS:
11-12

Please Note:
• Denotes location of air brick within ramped area to level threshold.
To be constructed in accordance with standard detail:
SBM-TSD-3-04
SBM-TSD-3-06



Please Note:
*Level Threshold - where site levels dictate that a level threshold **CAN'T** be achieved to the front of the property then the rear access shall be used as the primary entrance therefore a level threshold will be required.
Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:
Incoming Gas Supply A*
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level and within close proximity to both the boiler & gas hob (if applicable)

POI	Date	First issue (reissue from HOL-3B-S01-6.0 Rev A)	Comments	By
PO1	12.07.24			AC

Stonebond.

Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

site:	Edenfield Road, Norden Rochdale		
title:	Partnerships Range Block Setting Out Plan (BSO) Holly 2 Block (OPP/AS)		
scale: (@A)	1:50/1:100	drawn by:	SBP
date:	Jun 24	checked:	-
drawing no:	MAN001-SBP-ZZ-ZZ-DR-A-04-H205		
sheet no:	Sheet 1 of 2		revision: PO1

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVP'S TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

- **ALL** meter boxes, extract grilles etc that are fitted to / penetrate the external walls **MUST** be coloured to match the external facing material prescribed in the materials schedule (i.e. red brick = brown; buff brick = white; stonework = white; render = white; tile-hanging = brown).
- **All** vent tiles **MUST** be in-line.
- Soffit vents **MUST** be white.
- Rainwater goods **MUST** be black.

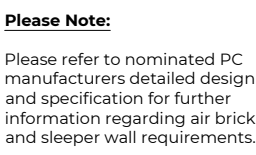
	SVP	Soil & Vent Pipe position
	DD	Direct Drain position
	AAV	Air Admittance Valve/Durgo position
	BIG	Back Inlet Gully position
	W	Incoming water position
		External tap position
		Incoming fibre/data cable position



SIDE ELEVATION
SCALE 1:100

REAR ELEVATION
SCALE 1:100

SIDE ELEVATION
SCALE 1:100



Please Note:
Please refer to nominated structural engineers detailed design and specification for further information regarding foundations ground and foundation construction.

Please Note:

To comply with Building Regulation Part 11, a common access point (CAP) for a gigabit capable public electronic communications network is required as part of the building's gigabit ready infrastructure.

Cable to be specified by nominating communications network provider.

PLOTS:

32-35

Please Note:

- * Denotes location of air brick within ramped area to level threshold.

To be constructed in accordance with standard detail:
SBM-TSD-3-04
SBM-TSD-3-06

Please Note:

***Level Threshold** - where site levels dictate that a level threshold **CANT** be achieved to the front of the property then the rear access shall be used as the primary entrance therefore a level threshold will be required.

Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:

Incoming Gas Supply A*

Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level and within close proximity to both the boiler & gas hob (if applicable)

Please Note:
Incoming Gas Supply B*

Where house is to be plotted in a terraced configuration with kitchen to the **REAR** of the unit then the incoming gas supply is to enter through the front elevation and routed within the ventilated void below the ground floor construction to both the boiler & gas hob (if applicable).

P01	12.07.24	First issue (reissue from HOL-4B-S01-6.0 Rev A)	AC
Rev	Date	Comments	By

Stonebond

Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

site: Edenfield Road, Norden
Rochdale

title: Partnerships Range
Block Setting Out Plan (BSO)
Holly 4 Block (OPP/AS/OPP/AS)

scale: 1:50/1:100
 @AI
 date: Jun 24

drawn by: SBP
 checked: -

drawing
no: MAN001-SBP-ZZ-ZZ-DR-A-04-H40T

sheet no: Sheet 1 of 2 revision: P07

DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVPs TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

PLEASE NOTE:

- ALL meter boxes, extract grilles etc that are fitted to / penetrate the external walls **MUST** be coloured to match the external facing material prescribed in the materials schedule (ie. red brick = brown; buff brick = white; stonework = white; render = white; tile-hanging = brown).
- All vent tiles **MUST** be in-line.
- Soffit vents **MUST** be white.
- Rainwater goods **MUST** be black.

Key:

	Soil & Vent Pipe pipe position
	Direct Drain position
	Air Admittance Valve/Durgo position
	Back Inlet Gully position
	Incoming water position
	External tap position
	Incoming fibre/data cable position



Please Note:
Please refer to nominated PC manufacturers detailed design and specification for further information regarding air brick and sleeper wall requirements.

Please Note:
Please refer to nominated structural engineers detailed design and specification for further information regarding foundations ground floor and foundation construction.

Please Note:
To comply with Building Regulations (RAI) a common access point (CAP) for a gigabit capable public electronic communications network is required as a part of the building's gigabit ready physical infrastructure.
Master point to be connected to external point via appropriately specified conduit.
Cable to be specified by nominated communications network provider.

Please Note:
* Denotes location of air brick within ramped area to level threshold.

To be constructed in accordance with standard detail:

SBM-TSD-3-04

SBM-TSD-3-06

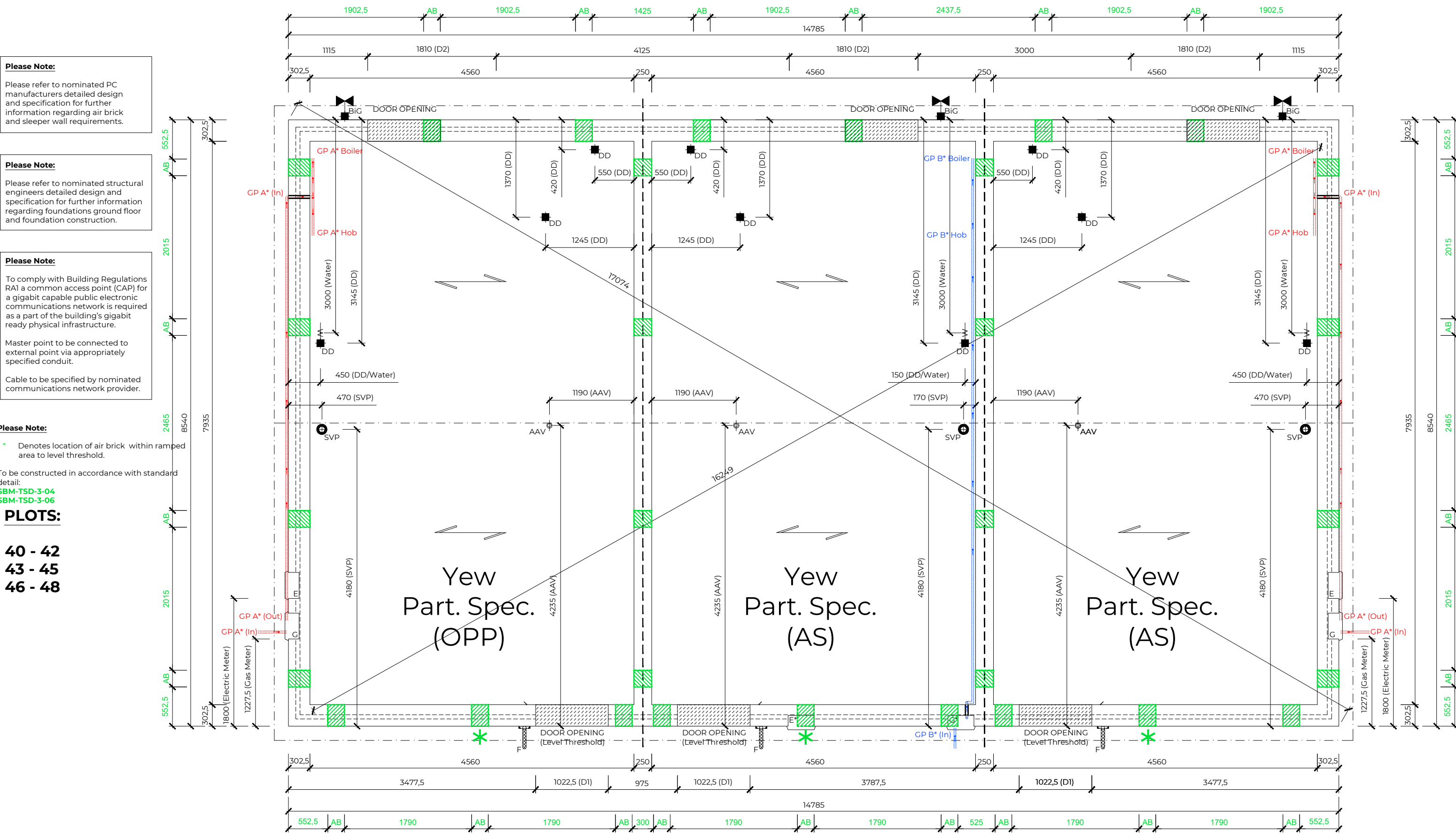
PLOTS:

40 - 42
43 - 45
46 - 48

Please Note:
*Level Threshold - where site levels dictate that a level threshold **CANT** be achieved to the front of the property then the rear access shall be used as the primary entrance therefore a level threshold will be required.
Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:
Incoming Gas Supply A*
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level and within close proximity to both the boiler & gas hob (if applicable)

Please Note:
Incoming Gas Supply B*
Where house is to be plotted in a terraced configuration with kitchen to the **REAR** of the unit then the incoming gas supply is to enter through the front elevation and routed within the ventilated void below the ground floor construction to both the boiler & gas hob (if applicable).



PO1	01.07.24	First issue (reissue from YEW 3B-S03-6.0 Rev A)		SMc
Rev	Date	Comments		By

Stonebond.

Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

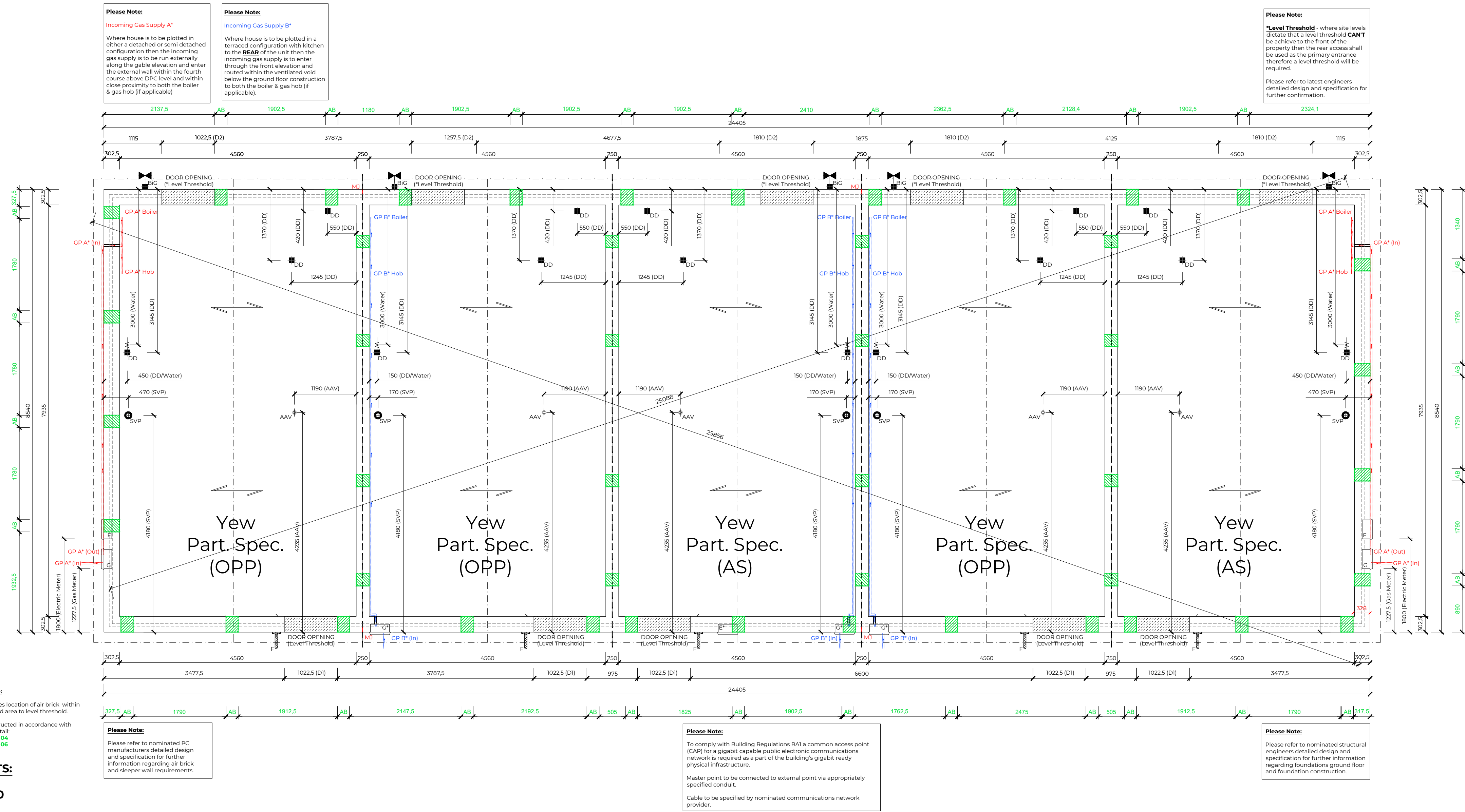
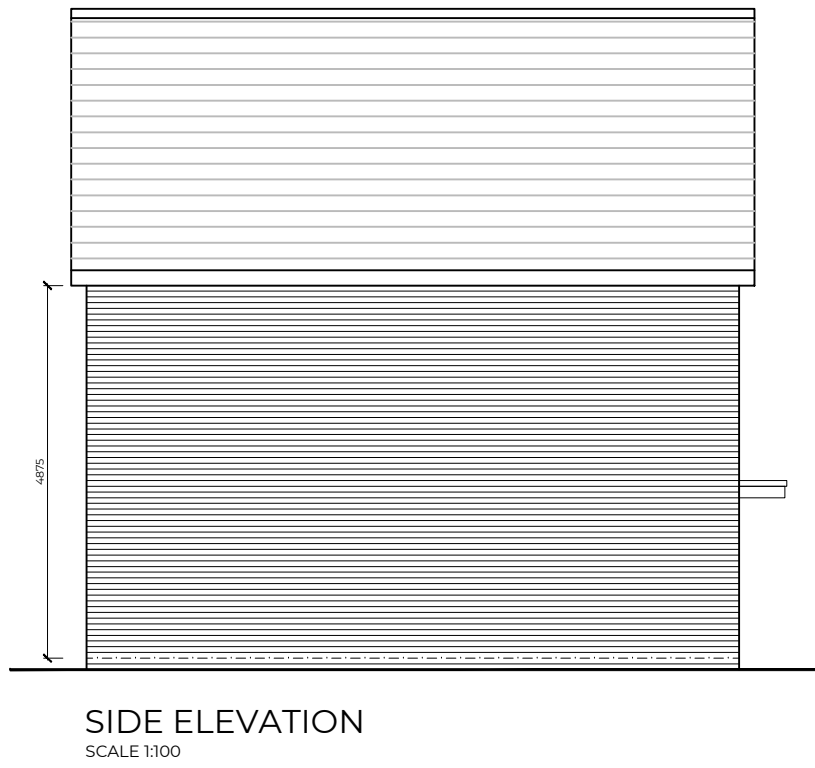
site:	Edenfield Road, Norden Rochdale		
title:	Partnerships Range Block Setting Out Plan (BSO) Yew 3 Block (OPP/AS/AS)		
scale: (@A1)	1:50/1:100	drawn by:	SBP
date:	Jul 24	checked:	-
drawing no:	MAN001-SBP-ZZ-ZZ-DR-A-04-Y301		
sheet no:	Sheet 1 of 2		revision: PO1

DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVP'S TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

PLEASE NOTE:

- ALL meter boxes, extract grilles etc that are fitted to /
penetrate the external walls **MUST** be coloured to match the
external facing material prescribed in the materials schedule
(ie. red brick = brown; buff brick = white; stonework = white;
render = white; tile-hanging = brown).
- All vent tiles **MUST** be in-line.
- Soffit vents **MUST** be white.
- Rainwater goods **MUST** be black.



PO1	01.07.24	First issue.	AC
Rev	Date	Comments	By



Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

site:	Stonebond Properties (Manchester) Ltd.		
title:	Partnerships Range Block Setting Out Plan (BSO) Yew 5 Blk (OPP/OPP/AS/OPP/AS)		
scale: (@A1)	1:50/1:100	drawn by:	SBP
date:	Jul 24	checked:	-
drawing no:	MAN003-SBP-ZZ-ZZ-DR-A-04-Y501		
sheet no:	Sheet 1 of 2		revision: PO1



DRAWING TO BE READ IN CONJUNCTION WITH
STONEBOND PROPERTIES (MANCHESTER) LIMITED
ACCREDITED TIMBER FRAME DETAILS UNDER BUILDING
REGULATIONS

CHECK WITH SITE DRAINAGE PLAN TO DETERMINE
LOCATION OF OPEN VENTED STACKS, OTHERWISE
ALL SVPS TO TERMINATE IN ROOF SPACE OR
VENTED ACCESSIBLE BOXING WITH A DURGO VALVE

- PLEASE NOTE:**
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 - **All** vent tiles **MUST** be in-line.
 - Soffit vents **MUST** be white.
 - Rainwater goods **MUST** be black.

Key:	
	Soil & Vent Pipe pipe position
	Direct Drain position
	Air Admittance Valve/Durgo position
	Back Inlet Gully position
	Incoming water position
	External tap position
	Incoming fibre/data cable position

Please Note:
Please refer to nominated PC manufacturers detailed design and specification for further information regarding air brick and sleeper wall requirements.

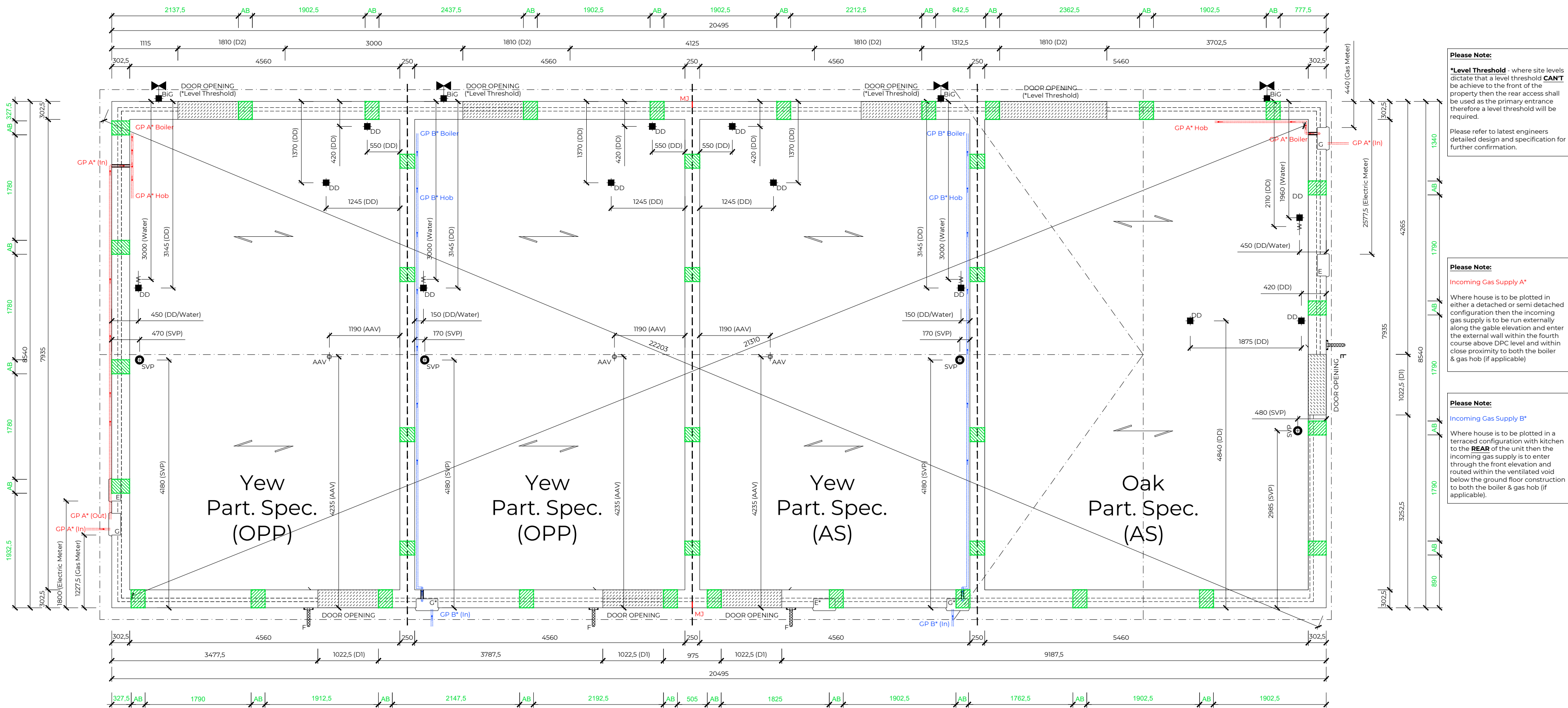
Please Note:
Please refer to nominated structural engineers detailed design and specification for further information regarding foundations ground floor and foundation construction.

Please Note:
To comply with Building Regulations RAI a common access point (CAP) for a gigabit capable public electronic communications network is required as a part of the building's gigabit ready physical infrastructure.
Master point to be connected to external point via appropriately specified conduit.
Cable to be specified by nominated communications network provider.

Please Note:
• Denotes location of air brick within ramped area to level threshold.
To be constructed in accordance with standard detail:
SBM-TSD-3-04
SBM-TSD-3-06

PLOTS:

36-39



Please Note:
•Level Threshold - where site levels dictate that a level threshold **CAN'T** be achieved to the front of the property then the rear access shall be used as the primary entrance therefore a level threshold will be required.
Please refer to latest engineers detailed design and specification for further confirmation.

Please Note:
Incoming Gas Supply A*
Where house is to be plotted in either a detached or semi detached configuration then the incoming gas supply is to be run externally along the gable elevation and enter the external wall within the fourth course above DPC level and within close proximity to both the boiler & gas hob (if applicable)

Please Note:
Incoming Gas Supply B*
Where house is to be plotted in a terraced configuration with kitchen to the **REAR** of the unit then the incoming gas supply is to enter through the front elevation and routed within the ventilated void below the ground floor construction to both the boiler & gas hob (if applicable)

PO1	01.07.24	First issue (reissue from YEW OAK-SOI-6.0 Rev A)	SMc
Rev	Date	Comments	By

Stonebond.

Stonebond Properties (Manchester)Ltd
Registered Office:
Suite 5, Egerton House
Towers Business Park
Wilmslow Rd
Didsbury, M20 2DX

site:	Edenfield Road, Norden Rochdale		
title:	Partnerships Range Block Setting Out Plan (BSO) Oak/Yew 4 Block (OPP/OPP/AS/AS)		
scale: (@A1)	1:50/1:100	drawn by:	SBP
date:	Jul 24	checked:	-
drawing no:	MAN001-SBP-ZZ-ZZ-DR-A-04-YO401		
sheet no:	Sheet 1 of 2	revision:	P01

APPENDIX V

VENTILATION

CALCULATIONS





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 1 - Willow 3 Block

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E) / C_E)$ BS5925:1991, Appendix B, equation (9), pg.29
Area of Building Footprint	A	110.49	m ²	
Rate of Flow for Building	Q_T	4.56E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg.19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg.18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

Teloscopic Vent

$A_{(inlet)}$	A_W	C_d	Q_W (individual)	No of Strips	Q_W (Total)	Q_T/Q_W
0.0065	0.0046	0.61	2.75E-04	20	0.0055	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
Q_W (individual)	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
Q_W (Total)	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 2 - Willow 4 Block

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E) / C_E)$ BS5925:1991, Appendix B, equation (9), pg.29
Area of Building Footprint	A	147.32	m ²	
Rate of Flow for Building	Q_T	6.08E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg.19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg.18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	Q_W (individual)	No of Strips	Q_W (Total)	Q_T/Q_W
Teloscopic Vent	0.0065	0.0046	0.61	2.75E-04	26	0.0072	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
Q_W (individual)	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
Q_W (Total)	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 3 - Holly Semi-detached (Open Gable)

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E) / C_E)$ BS5925:1991, Appendix B, equation (9), pg.29
Area of Building Footprint	A	87.06	m ²	
Rate of Flow for Building	Q_T	3.59E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg.19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg.18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	Q_W (individual)	No of Strips	Q_W (Total)	Q_T/Q_W
Teloscopic Vent	0.0065	0.0046	0.61	2.75E-04	18	0.0050	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
Q_W (individual)	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
Q_W (Total)	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 4 - Holly Semi-detached
(Front & Side Gable)

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E) / C_E)$ BS5925:1991, Appendix B, equation (9), pg.29
Area of Building Footprint	A	87.06	m ²	
Rate of Flow for Building	Q_T	3.59E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg.19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg.18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

Teloscopic Vent

$A_{(inlet)}$	A_W	C_d	Q_W (individual)	No of Strips	Q_W (Total)	Q_T/Q_W
0.0065	0.0046	0.61	2.75E-04	18	0.0050	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
Q_W (individual)	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
Q_W (Total)	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 5 - Holly 2 Block

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E)/C_E)$ BS5925:1991, Appendix B, equation (9), pg. 29
Area of Building Footprint	A	87.06	m ²	
Rate of Flow for Building	Q_T	3.59E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg. 19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg. 18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	$Q_W (individual)$	No of Strips	$Q_W (Total)$	Q_T/Q_W
Telosopic Vent	0.0065	0.0046	0.61	2.75E-04	18	0.0050	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
$Q_W (individual)$	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
$Q_W (Total)$	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road			Design Gas: Carbon Dioxide Maximum Concentration: 1.5 % By Volume Target Concentration: 0.01 % By Volume
Job No. 16-465			
Date: 16/08/2024			
Drafted	Rev	Auth	House Type 6 - Holly 4 Block
MW	MD	MD	

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E)/C_E)$ BS5925:1991, Appendix B, equation (9), pg. 29
Area of Building Footprint	A	174.11	m ²	
Rate of Flow for Building	Q_T	7.18E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg. 19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg. 18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	$Q_W (individual)$	No of Strips	$Q_W (Total)$	Q_T/Q_W
Telosopic Vent	0.0065	0.0046	0.61	2.75E-04	28	0.0077	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
$Q_W (individual)$	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
$Q_W (Total)$	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 7 - Yew 3 Block

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E) / C_E)$ BS5925:1991, Appendix B, equation (9), pg. 29
Area of Building Footprint	A	108.55	m ²	
Rate of Flow for Building	Q_T	4.48E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg. 19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg. 18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	$Q_W (individual)$	No of Strips	$Q_W (Total)$	Q_T/Q_W
Telosopic Vent	0.0065	0.0046	0.61	2.75E-04	23	0.0063	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
$Q_W (individual)$	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
$Q_W (Total)$	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road			Design Gas: Carbon Dioxide Maximum Concentration: 1.5 % By Volume Target Concentration: 0.01 % By Volume
Job No. 16-465			
Date: 16/08/2024			
Drafted	Rev	Auth	House Type 8 - Yew 5 Block
MW	MD	MD	

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E)/C_E)$ BS5925:1991, Appendix B, equation (9), pg.29
Area of Building Footprint	A	180.92	m ²	
Rate of Flow for Building	Q_T	7.46E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg.19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg.19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg.18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	$Q_W (individual)$	No of Strips	$Q_W (Total)$	Q_T/Q_W
Telosopic Vent	0.0065	0.0046	0.61	2.75E-04	31	0.0085	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
$Q_W (individual)$	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
$Q_W (Total)$	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations





Site: Greenbooth Road & Edenfield Road
Job No. 16-465
Date: 16/08/2024

Design Gas: Carbon Dioxide
Maximum Concentration: 1.5 % By Volume
Target Concentration: 0.01 % By Volume

Drafted	Rev	Auth
MW	MD	MD

House Type 9 - Oak/Yew 3 Block (1:3)

Methodology for the design of gas protection measures

Input Parameters	Variable	Value	Unit	Source of parameter value, or formula
Gas Flow	G_F	0.1	l/hr	
Flow from borehole	F_R	2.78E-08	m ³ /s	Flow (l/hr)/(60*60*1000)
Gas Concentration	G_C	0.015		Gas Concentration as a Fraction
Area of Influence	I_A	10	m ²	Peckson, 1986 - CIRIA Report 149
Emmision Rate	q	4.17E-11	m ³ /m ² /s	Flow from Borehole*Gas Concentration/Area of Influence
Equilibrium gas concentration	C_E	0.01		Target Concentraion
Rate of Airflow for Equilibrium	Q	4.13E-09	m ³ /m ² /s	$Q = q ((1 - C_E)/C_E)$ BS5925:1991, Appendix B, equation (9), pg. 29
Area of Building Footprint	A	151.88	m ²	
Rate of Flow for Building	Q_T	6.27E-07	m ³ /s	$Q_T = Q * A$
Assumed Wind Speed	U_{50}	4	m/s	Figure 5, BS 5925:1991, pg.20
Ratio for 80% Wind	R	0.46		Table 9 (exposed (0.56),sheltered (0.46)), BS5925:1991, pg. 19
Wind Speed 80% of time	U_m	1.84	m/s	$U_m = U_{50} * Ratio$
Constant	k	0.35	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Constant	a	0.25	Urban	Constant depending on terrain. Table 8, BS5925:1991,pg. 19
Height of Vents Above GL	Z	0.15	m	Height of Vents Above Ground Level
Wind Speed at Height of Vents	U	0.40	m/s	$U/U_m = kZ^a$ (BS5925:1991, Equation 5,pg. 18)
Surface 'A' (Vent Inlet)	S_A	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Surface 'B' (Vent Outlet)	S_B	-0.5	Pa	BS 5925:1991, Table 13,pg.38
Pressure Coefficient	DC_p	0.06	Pa	$DC_p = 'A' + 'B'$ (0.6Pa stated in Gasflow 25 data sheet)

	$A_{(inlet)}$	A_W	C_d	$Q_W (individual)$	No of Strips	$Q_W (Total)$	Q_T/Q_W
Telosopic Vent	0.0065	0.0046	0.61	2.75E-04	27	0.0074	0.00

Notes

Q_T/Q_W	limiting factor
$A_{(inlet)}$	the open void area of the vent components supplied by Landline Ltd
A_W	the effective equivalent area of single opposing vent components
C_d	0.61 constant
$Q_W (individual)$	the calculated ventilation rate for single opposing vent component sets
No of Strips	Input column for either number of components or ventilation provided by a number of component sets
$Q_W (Total)$	Provide total ventilation rate for individual components (when 1 inserted in previous column) or for total system when total number of components inserted
Q_T/Q_W	Rate of flow required to maintain target gas levels divided by rate of flow provided by system (<1 required)
Note	Maximum gas concentration and gas flow rate from across the site utilised in calculations



APPENDIX VI

MEMBRANE

SPECIFICATIONS





Visqueen Gas Barrier

Features and benefits

- BBA certified - third party accreditation
- Complies with NHBC Foundation's NF94 guidance for use in Type A membrane locations
- Complies with the methane gas transmission rate, mass per unit area and thickness requirements of BS 8485:2015 + A1:2019 - industry standard for methane and carbon dioxide protection
- Also provides radon and damp proof membrane protection
- Dual jointing methods - lap joints can be taped or heat welded

Product description

Visqueen Gas Barrier is a multi-layer reinforced polyethylene gas barrier with a 20 micron aluminium foil. The barrier is coloured blue on the upper surface and silver on the reverse. The product is supplied in single wound rolls (not folded), 2m x 50m.

Approvals and standards

- Third party accreditation (BBA 13/5069)
- Complies with the methane gas transmission rate, mass per unit area and thickness requirements of BS 8485:2015 + A1:2019
- Suitable for all Characteristic Gas Situation (CS) ground gas regimes
- Complies with NHBC Foundation's NF94 guidance for use in Type A membrane locations
- Conforms to the specification requirements of NHBC Amber 1 and Amber 2 applications
- Conforms to the specification requirements of BR 211:2023
- UKCA UKNI CE to EN 13967:2017
- Visqueen certified with Quality Management System ISO 9001:2015
- Visqueen certified with Occupational Health and Safety System ISO 45001:2018
- Visqueen certified with Environmental Management System ISO 14001:2015

Usage

Visqueen Gas Barrier is suitable for use in all types of buildings to prevent the ingress of harmful levels of ground gases e.g. methane, carbon dioxide and radon.

The barrier can be positioned above or below reinforced cast in situ concrete floor slabs or above precast suspended segmental subfloors, e.g. beam and block floor.

The barrier can also be used as a high performance radon membrane and/or damp proof membrane.

Radon, carbon dioxide, and methane protection - NHBC NF94 guidance:

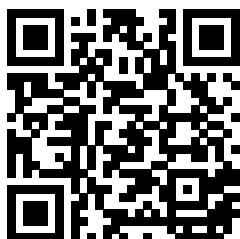
Visqueen Gas Barrier when installed with either taped or welded joints complies with NHBC Foundation's NF94 publication, Hazardous ground gas - an essential guide for housebuilders, in Type A membrane locations in precast suspended segmental subfloors and reinforced cast in situ concrete floor slabs (ground bearing, suspended or raft). For site or zone characteristic gas situations of CS4 and above, contact Visqueen Technical Services.

The product is not intended for use where there is a risk of hydrostatic pressure.

System components

- VisqueenPro Double Sided Jointing Tape, 50mm x 10m
- Visqueen Gas Resistant Foil Lap Tape, 75mm x 50m
- Visqueen GR Lap Tape, 150mm x 10m
- Visqueen Ultimate Top Hat Units
- Visqueen Preformed Units
- VisqueenPro Detailing Strip, 300mm x 10m, 500mm x 10m
- Visqueen TreadGUARD 300, 2m x 75m
- Visqueen TreadGUARD 1500, 1m x 2m

Find your local stockist





Visqueen Gas Barrier

Storage and handling

Visqueen Gas Barrier should be stored horizontally, under cover in its original packaging.

Care should be taken when handling the product in line with current manual handling regulations.

Preparation

Visqueen Gas Barrier should be installed on a smooth continuous surface e.g. grouted beam and block floor, a compacted blinding layer e.g. 50mm thick sand blinding, or smooth concrete blinding. The substrate should be free from irregularities such as voids or protrusions.

The barrier can be cut with a sharp retractable safety knife or robust scissors.

When installing the membrane in demanding site conditions, use Visqueen GR Lap Tape in place of Visqueen Gas Resistant Foil Lap Tape.

Installation

Visqueen Gas Barrier should be loose laid on the substrate with the blue side up so as to avoid sunlight glare.

The barrier should be clean and dry at the time of jointing. It should be overlapped by at least 150mm, bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape. Alternatively lap joints can be heat welded to achieve an effective seal. The overlap in the barrier is typically 100mm and when hand welding, a 35mm weld is normally achieved. When hand welding, a roller must be used.

Airtight seals should be formed around all service entry points. Visqueen Preformed Top Hat Units are recommended for sealing service entry pipes. The base of the top hat and the upstand should be bonded using VisqueenPro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape. The upstand should be secured with the supplied jubilee clip. Alternatively VisqueenPro Detailing Strip can be used to seal service entry points. The upstand should be secured with a jubilee clip.

Forming an effective barrier to gases may give rise to complex three-dimensional detailing where, it is recommended Visqueen Preformed Units are used e.g. corners. Alternatively VisqueenPro Detailing Strip can be used to seal awkward junctions.

If the barrier is punctured or perforated a patch of the same material should be lapped at least 150mm beyond the limits of the puncture and bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape. Alternatively a patch can be formed using VisqueenPro Detailing Strip and lapped at least 150mm beyond the extents of the puncture.

Long periods of exposure to ultraviolet light will reduce the effectiveness of the membrane. The membrane should be covered by a protective layer immediately after installation to prevent damage from following trades, ultraviolet light, etc. Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying a screed or final floor covering. A minimum thickness of 50mm screed is recommended. When reinforced concrete is to be laid over the barrier the wire reinforcements and spacers must be prevented from puncturing the barrier. Where there is a high risk of potential damage, the barrier should be covered with Visqueen TreadGuard protection, screed or other approved protection material before positioning the reinforcement.

Usable temperature range

It is recommended that Visqueen Gas Barrier and all associated system components should not be installed below 5°C.

Additional information

When used in accordance BS8485:2015 + A1:2019 a subfloor ventilation system or pressure relief maybe required

Where hydrocarbon or VOC contamination is present use Visqueen Ultimate HC Blok or Ultimate GeoSeal gas protection systems

To assist build sequencing, Visqueen Ultimate Gas DPC is available for gas protection through the wall constructions

For additional detailing information, contact Visqueen Technical Services +44 (0) 333 202 6800

The information in this datasheet was correct at the time of publication. It is the user's responsibility to obtain the latest version of the datasheet as it is updated on a regular basis. The information contained in the latest datasheet supersedes all previously published editions.

Visqueen Gas Barrier

Property	Test method	Units	Compliance criteria	Result
Dimensions	BS EN 1848-2	m		2 x 50
Overall thickness including scrim mesh	BS EN 1849-2	mm	+/-10%	0.52
Mass	BS EN 1849-2	g/m ²	-0%/+5%	400
Tensile strength - MD	BS EN 12311	N/50mm	MLV	350
Tensile strength - CD	BS EN 12311	N/50mm	MLV	350
Tensile elongation - MD	BS EN 12311	%	MLV	20
Tensile elongation - CD	BS EN 12311	%	MLV	21
Joint strength	BS EN 12317-2	N	MLV	332
Watertightness at 2kPa for 24 hours	BS EN 1928	-	Pass/Fail	Pass
Resistance to impact	BS EN 12691	mm	MDV	150
Dart impact	BS EN 2782	g	MDV	731
Low temperature flexibility	BS EN 495-5	°C	MDV	-40
Durability against ageing	BS EN 1296 and BS EN 1928	-	Pass/Fail	Pass
Durability chemical resistance	BS EN 1847	-	Pass/Fail	Pass
Resistance to tearing (nail shank) CD	BS EN 12310-1	N	MDV	358
Resistance to tearing (nail shank) MD	BS EN 12310-1	N	MDV	368
Resistance to static loading	BS EN 12730	kg	MLV	20
Water vapour resistance	BS EN 1931	MNs/g	MDV	240,000
Water vapour permeability	BS EN 1931	g/m ² /d	MDV	0.0008658
Water vapour resistance factor	BS EN 1931	μ	MDV	120,000,000
Equivalent air layer thickness	BS EN 1931	SD in m	MDV	47,700
BS 8485:2015 + A1:2019 testing requirements				
Mass	BS EN 1849-2	g/m ²	Average >370	400
Methane gas transmission rate	BS ISO 15105-1	ml/m ² /day/atm	MDV	<0.15
Puncture CBR	BS EN 12236	N	MDV	1114
Tensiles yield strength MD	ASTM D4885-01	kN/m	MDV	12.5
Tensiles yield strength CD	ASTM D4885-02	kN/m	MDV	7.3
Resistance to static loading	BS EN 12730	kg	>MLV	20
Yield elongation CD	ASTM D4885-04	%	MDV	19
Tear resistance - trouser method A - MD	BS ISO 34-1	kN/m	MDV	48.2
Tear resistance - trouser method A - CD	BS ISO 34-1	kN/m	MDV	44.8
Tear resistance - angle method B - MD	BS ISO 34-1	N	MDV	53.5
Tear resistance - angle method B - CD	BS ISO 34-1	N	MDV	60.6

Health and safety information

Refer to the Visqueen Gas Barrier safety datasheet (SDS).

Visqueen Gas Barrier

About Visqueen

The Visqueen name has long been recognised as one of the leading manufacturers of high quality advanced membrane technologies and design based solutions by specifiers, distributors, builders merchants and contractors throughout the UK and Europe.

For further guidance on the Visqueen services shown below, please refer to the relevant section of the Visqueen website (www.visqueen.com) or contact Visqueen Technical Services on +44 (0) 333 202 6800 or enquiries@visqueen.com

Complete Range, Complete Solution



Structural
Waterproofing



Gas
Protection



Damp Proof
Membrane



Tapes



Damp Proof
Course



Stormwater



Vapour
Control

Visqueen Technical Support

Visqueen combine an extensive product portfolio with industry leading levels of service and support which includes guidance over the phone, bespoke CAD drawings to help with complex detailing, electronic NBS specifications and access to a dedicated team of highly knowledgeable and experienced field based Technical Support Managers.

Visqueen Technical Support is available to all our customers including architects, specifiers, distributors, builders merchants, contractors and end users. All of our technical team have been awarded the industry recognised qualification Certificated Surveyor in Structural Waterproofing (CSSW).

Visqueen CPD Seminars

The Visqueen Continuing Professional Development (CPD) Seminars provide up-to-date information on changes within Building Regulations/Building Standards and nationally recognised industry guidance affecting damp proofing, water vapour control, hazardous ground gas protection and below ground structural waterproofing.

The one hour seminars have been produced for design specialists within the construction sector and are delivered by our team of Technical Support Managers.

Visqueen Training Academy

Based at our manufacturing facility in Derbyshire, the Visqueen Training Academy is available to support Visqueen customers throughout the UK by providing a wide range of both theory and practical skills related training.

Courses include one day product awareness training for our distributors and builders merchants to help them in their day-to-day jobs, through to intensive three day courses giving detailed hands-on training in the practical skills required for safe and robust product installation.

British Polythene Ltd
t/a Visqueen Building Products

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Derbyshire DE75 7RG



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website: www.visqueen.com

Agrément Certificate

13/5069

Product Sheet 1 Issue 3

VISQUEEN MEMBRANES

VISQUEEN GAS BARRIER

This Agrément Certificate Product Sheet⁽¹⁾ relates to Visqueen Gas Barrier, a low-density polyethylene gas barrier and damp-proof membrane, for use in concrete ground floors above and below slabs not subject to hydrostatic pressure, to protect the building against moisture, radon, methane and carbon dioxide from the ground.

(1) Hereinafter referred to as 'Certificate'.

The assessment includes

Product factors:

- compliance with Building Regulations
- compliance with additional regulatory or non-regulatory information where applicable
- evaluation against technical specifications
- assessment criteria and technical investigations
- uses and design considerations

Process factors:

- compliance with Scheme requirements
- installation, delivery, handling and storage
- production and quality controls
- maintenance and repair

Ongoing contractual Scheme elements†:

- regular assessment of production
- formal 3-yearly review



KEY FACTORS ASSESSED

- Section 1. Mechanical resistance and stability
- Section 2. Safety in case of fire
- Section 3. Hygiene, health and the environment
- Section 4. Safety and accessibility in use
- Section 5. Protection against noise
- Section 6. Energy economy and heat retention
- Section 7. Sustainable use of natural resources
- Section 8. Durability
- Section 9. Design, installation, workmanship and maintenance

The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Third issue: 25 May 2023

Originally Certificated on 10 December 2013

Hardy Giesler
Chief Executive Officer

This BBA Agrément Certificate is issued under the BBA's Inspection Body accreditation to ISO/IEC 17020. Sections marked with † are not issued under accreditation.

The BBA is a UKAS accredited Inspection Body (No. 4345), Certification Body (No. 0113) and Testing Laboratory (No. 3537).

Readers MUST check that this is the latest issue of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.

The Certificate should be read in full as it may be misleading to read clauses in isolation.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

British Board of Agrément

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SUMMARY OF ASSESSMENT AND COMPLIANCE

This section provides a summary of the assessment conclusions; readers should refer to the later sections of this Certificate for information about the assessments carried out.

Compliance with Regulations

Having assessed the key factors, the opinion of the BBA is that Visqueen Gas Barrier, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations:



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	C1(2)	Preparation of site and resistance to contaminants
Comment:		The product can contribute to a construction satisfying this Requirement. See sections 1 and 3 of this Certificate.
Requirement:	C2(a)	Resistance to moisture
Comment:		The product can contribute satisfying this Requirement. See sections 1 and 3 of this Certificate.
Regulation:	7(1)	Materials and workmanship
Comment:		The product is acceptable. See sections 8 and 9 of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)	Fitness and durability of materials and workmanship
Comment:		The product can contribute to a construction satisfying this Regulation. See sections 8 and 9 of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.1	Site preparation – harmful and dangerous substances
Standard:	3.2	Site preparation – protection from radon
Comment:		The product can contribute to satisfying the requirements of these Standards, with reference to clauses 3.1.2 ⁽¹⁾⁽²⁾ , 3.1.6 ⁽¹⁾⁽²⁾ , 3.1.7 ⁽¹⁾⁽²⁾ , 3.1.8 ⁽¹⁾⁽²⁾ , 3.2.1 ⁽¹⁾⁽²⁾ and 3.2.2 ⁽¹⁾⁽²⁾ . See sections 1 and 3 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		The product will enable a structure to satisfy the requirements of this Standard, with reference to clauses 3.4.1 ⁽¹⁾⁽²⁾ , 3.4.2 ⁽¹⁾⁽²⁾ , 3.4.5 ⁽¹⁾⁽²⁾ and 3.4.7 ⁽¹⁾⁽²⁾ . See section 1 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The product can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards applicable to conversions
Comment:		Comments in relation to the product under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ .

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(1)(a)(i)	Fitness of materials and workmanship
Comment:	(iii)(b)(i)	The product is acceptable. See sections 8 and 9 of this Certificate.
Regulation:	26(1)(b)(2)	Site preparation and resistance to contaminants
Comment:		The product will contribute to a structure satisfying the requirements of this Regulation. See sections 1 and 3 of this Certificate.
Regulation:	28(a)	Resistance to moisture and weather
Comment:		The product will enable a structure to satisfy this Regulation. See section 1 of this Certificate.

Additional Information

NHBC Standards 2023

In the opinion of the BBA, Visqueen Gas Barrier, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Technical Requirement R3 and Chapters 4.1 *Land quality – managing ground conditions*, 5.1 *Substructure and ground bearing floors* and 5.2 *Suspended ground floors*.

Fulfilment of Requirements

The BBA has judged Visqueen Gas Barrier to be satisfactory for use as described in this Certificate. The product has been assessed as a gas barrier and damp-proofing membrane for use in concrete ground floors above and below slabs not subject to hydrostatic pressure, to protect the building against moisture, radon, methane and carbon dioxide from the ground.

ASSESSMENT

Product description and intended use

The Certificate holder provided the following description for the product under assessment.

Visqueen Gas Barrier is a multi-layer polyethylene membrane reinforced with an integral aluminium foil and reinforcing grid. The top surface of the membrane is blue and ribbed, and the underside is silver and has a smooth finish. The membrane has the nominal characteristics given in Table 1.

Table 1 Nominal characteristics

Characteristic (unit)	Value
Effective thickness (mm)	0.4
Roll length (m)	25, 50 ⁽¹⁾
Roll width (m)	2 ⁽¹⁾
Mass per unit area (g·m ⁻²)	400
Tensile Strength (N·mm ⁻²)	
MD	350
CD	350
Elongation (%)	
MD	17
CD	15
Nail tear resistance (N)	
MD	358
CD	368
Watertightness (2kPa)	Pass

(1) Other widths and lengths are available on request.

Ancillary items

The following ancillary items are essential to use with the product and have been assessed with the product:

- VisqueenPro Double Sided Jointing Tape— a double-sided butyl tape for bonding laps
- Visqueen Gas Resistant Foil Lap Tape — a single-sided jointing tape for sealing laps
- Visqueen GR Lap Tape — a single-sided jointing tape suitable for sealing laps.

The Certificate holder recommends the following ancillary items for use with the product, but these materials have not been assessed by the BBA and are outside the scope of this Certificate:

- Visqueen Pre-formed Top Hat Units — for sealing around service pipe penetrations
- TreadGUARD1500 — a heavy-duty protection layer used to prevent damage to the membrane
- TreadGUARD300 — a medium-duty protection layer used to prevent damage to the membrane
- VisqueenPro Detailing Strip — a single-sided detailing membrane for sealing awkward or complex junctions e.g. corners, column penetrations, service pipe penetrations, and for repairs/patching of membranes damaged during installation
- Visqueen Gas Resistant Damp Proof Course — a damp-proof course (DPC)
- Visqueen Zedex CPT DPC — a DPC and cavity tray
- Visqueen Gas Resistant Self-adhesive Membrane — an aluminium/polyethylene laminate with a modified bitumen adhesive backing, used to maintain continuity on vertical surfaces
- Visqueen Gas Vent Mat — a 25 or 40 mm thick vent mat which forms a void to collect and transmit gas to adjacent venting outlets.

Definitions for products and applications inspected

The following terms are defined for the purpose of this Certificate as:

- gas-resistant membrane — as defined in BS 8485 : 2015 + A1 : 2019, a membrane placed above, below or within the floor slab construction to restrict methane and carbon dioxide migration from the ground into a building.

Product assessment – key factors

The product was assessed for the following key factors, and the outcome of the assessments are shown below. Conclusions relating to the Building Regulations apply to the whole of the UK unless otherwise stated.

1 Mechanical resistance and stability

Data were assessed for the following characteristics.

1.1 Structural and mechanical properties

1.1.1 Results of tests for mechanical properties are given in Table 2.

Table 2 Results of mechanical properties tests

Product assessed	Assessment method	Requirement	Result
Visqueen Gas Barrier	Static indentation to BS EN 12730 : 2015 Method B	Value achieved	15 kg
Visqueen Gas Barrier	Tensile strength to BS EN 12311-2 : 2000	Value achieved	516 N·mm ⁻²
Visqueen Gas Barrier	Resistance to impact to EN 12691 : 2018 Method A	Value achieved	200 mm
Visqueen Gas Barrier	Nail Tear strength to BS EN 12310-1 : 2000 longitudinal	Value achieved	358 N
Visqueen Gas Barrier	Nail Tear strength to BS EN 12310-1 : 2000 transverse	Value achieved	368 N

1.1.2 On the basis of the data assessed, the product can be punctured by sharp objects and care must be taken when handling building materials over the exposed surface.

1.1.3 Provided there are no sharp objects present on the membrane's surface prior to and during installation of the protective layer, the product will not be damaged by normal foot traffic.

2 Safety in case of fire

Not applicable.

3 Hygiene, health and the environment

Data were assessed for the following characteristics.

3.1 Weathertightness and damp-proofing

3.1.1 Results of damp-proofing tests are given in Table 3.

Table 3 Results of resistance to water and water vapour tests

Product assessed	Assessment method	Requirement	Result
Visqueen Gas Barrier	Watertightness to BS 1928 : 2000	No leakage after 24 hours exposure to 1 m head of water	Pass
Visqueen Gas Barrier	Water vapour permeability (75% RH/25°C) to BS 3177 : 1959 ⁽¹⁾	Declared value ± 30%	Pass
Visqueen Gas Barrier with 50 mm overlap, with VisqueenPro Double-sided Jointing Tape and Visqueen Gas resistant Foil Lap Tape	Resistance to leakage at joints under air pressure to MOAT 27 : 1983	No bubbles or any joint degradation	Pass

(1) Testing was carried out before the harmonised Standard was published.

3.1.2 On the basis of the data assessed the membrane, including joints, provides an effective barrier to the passage of liquid moisture from the ground.

3.1.3 On the basis of data assessed, the membrane is impervious to water and provides a waterproofing layer capable of accepting minor structural movements without damage.

3.2 Resistance to hazardous ground gases

3.2.1 Results of resistance to hazardous ground gases tests are given in Table 4.

Table 4 Results of resistance to hazardous ground gases tests

Product assessed	Assessment method	Requirement	Result
Visqueen Gas Barrier	Radon permeability to SP Technical Research Institute of Sweden internal method	Value achieved	$0.55 \times 10^{-12} \text{ m}^2 \cdot \text{s}^{-1}$
Visqueen Gas Barrier	Carbon dioxide gas transmission rate to BS ISO 2782 : 2006	Value achieved	$14.4 \text{ ml} \cdot \text{m}^2 \cdot \text{day} \cdot \text{atm}^{-1}$
Visqueen Gas Barrier	Methane gas transmission rate to BS ISO 15105-1 : 2007	BS 8485 : 2015 + A1 : 2019 $\leq 0.40 \text{ ml} \cdot \text{m}^2 \cdot \text{day} \cdot \text{atm}^{-1}$	$\leq 0.15 \text{ ml} \cdot \text{m}^2 \cdot \text{day} \cdot \text{atm}^{-1}$

3.2.2 On the basis of data assessed, the product will restrict the ingress of radon, methane and carbon dioxide into buildings from naturally occurring sources, and meets the performance criteria for a gas-resistant membrane as defined in BS 8485 : 2015 + A1 : 2019.

3.2.3 BRE Report BR 211 : 2015 recommends a 300 µm thick polyethylene sheet as the minimum required thickness for a radon gas-resistant membrane. It is generally accepted that other materials with comparable or higher gas resistance are suitable, provided they can withstand the construction process. In the opinion of the BBA, the product meets these criteria.

4 Safety and accessibility in use

Not applicable.

5 Protection against noise

Not applicable.

6 Energy economy and heat retention

Not applicable.

7 Sustainable use of natural resources

Not applicable.

8 Durability

8.1 The potential mechanisms for degradation and the known performance characteristics of the materials in the product were assessed.

8.2 Specific test data were assessed as given in Table 5.

Table 5 Results of durability tests

Product assessed	Assessment method	Requirement	Result
Visqueen Gas Barrier	Low temperature flexibility to BS EN 495-5 : 2001	Value achieved	No splits or cracks on upper and lower face on both longitudinal and transversal directions at -40°C
Visqueen Gas Barrier	Tensile strength to BS EN 12311-2 : 2000 longitudinal		
	Control	Value achieved	516 N·mm ⁻²
	Heat aged at 80°C for 50 days	No significant deterioration	Pass
	UV aged – 100 hours UVB	No significant deterioration	Pass
	Tensile strength to BS EN 12311-2 : 2000 transverse		
	Control	Value achieved	550 N·mm ⁻²
	Heat aged at 80°C for 50 days	No significant deterioration	Pass
	UV aged – 100 hours UVB	No significant deterioration	Pass
	Elongation to BS EN 12311-2 : 2000 longitudinal		
	Control	Value achieved	17%
	Heat aged at 80°C for 50 days	No significant deterioration	Pass
	UV aged – 100 hours UVB	No significant deterioration	Pass
Visqueen Gas Barrier	Elongation to BS EN 12311-2 : 2000 transverse		
	Control	Value achieved	15%
	Heat aged at 80°C for 50 days	No significant deterioration	Pass
	UV aged – 100 hours UVB	No significant deterioration	Pass
	Nail Tear strength to BS EN 12310-1 : 2000 longitudinal		
	Control	Value achieved	358 N
	Aged at 80°C for 56 days	No significant deterioration	Pass
	Nail Tear strength to BS EN 12310-1 : 2000 transverse		
	Control	Value achieved	368 N
	Heat aged at 80°C for 56 days	No significant deterioration	Pass
	Resistance to leakage at joints under air pressure to MOAT 27 : 1983	No bubbles or any joint degradation	Pass
Visqueen Gas Barrier with 50 mm overlap, with VisqueenPro Double-sided Jointing Tape and Visqueen Gas resistant Foil Lap Tape			

Table 5 Results of durability tests (continued)

Visqueen Gas Barrier with 50 mm overlap, with VisqueenPro Double-sided Jointing Tape and Visqueen Gas resistant Foil Lap Tape	Tensile strength of joints to BS EN 12317-2 : 2000 longitudinal Control	Value achieved	319 N·50 mm ⁻¹
	Heat aged at 70°C for 84 days	No significant deterioration	Pass
	Tensile strength of joints to BS EN 12317-2 : 2000 transversal Control	Value achieved	339 N·50 mm ⁻¹
	Heat aged at 70°C for 84 days	No significant deterioration	Pass
Visqueen Gas Barrier with 50 mm overlap, with VisqueenPro Double-sided Jointing Tape and Visqueen Gas resistant Foil Lap Tape	Extension at max load of joints to BS EN 12317-2 : 2000 longitudinal Unaged	Value achieved	12 mm
	Heat aged at 70°C for 28 days	No significant deterioration	Pass
	Extension at max load of joints to BS EN 12317-2 : 2000 transversal Unaged	Value achieved	13 mm
	Heat aged at 70°C for 28 days	No significant deterioration	Pass

8.3 Service life

8.3.1 Under normal service conditions, the product will have a life of at least as long as the building in which it is installed, provided it is designed, installed, and maintained in accordance with this Certificate and the Certificate holder's instructions.

8.3.2 Long periods of exposure to ultraviolet light will reduce the effectiveness of the product and must be avoided.

PROCESS ASSESSMENT

Information provided by the Certificate holder was assessed for the following factors:

9 Design, installation, workmanship and maintenance

9.1 Design

9.1.1 The design process was assessed, and the following requirements apply in order to satisfy the performance assessed in this Certificate.

9.1.2 The continuity of the gas protection must extend over the footprint of the building, and the gas membrane must be sealed to a gas-resistant DPC.

9.1.3 The product contains an aluminium foil layer which may be subject to corrosion by alkaline conditions if damage to the membrane and exposure occurs and care must be taken to avoid this. However, under normal circumstances, the polyethylene faces of the membrane are compatible with other materials and products typically used in the same areas, with the exception of those containing pitch.

9.1.4 There will be no adverse effect on the product from underfloor heating under normal service conditions. In other circumstances, the Certificate's holder advice should be sought, but such advice is outside of the scope of this Certificate.

9.2 Installation

9.2.1 Installation instructions provided by the Certificate holder were assessed and judged to be appropriate and adequate.

9.2.2 Visqueen Gas Barrier must be installed and fixed in accordance with this Certificate, the Certificate holder's instructions and the relevant clauses of BRE Report BR 211 : 2015 and BS 8485 : 2015 + A1 : 2019. A summary of instructions and guidance are provided in Annex A of this Certificate.

9.2.3 All gas membrane installations must be subject to third-party validation, in accordance with BS 8485 : 2015 + A1 : 2019.

9.2.4 The membrane can be installed in all normal site conditions, provided that the air temperature is not below 5°C to prevent the risk of surface condensation.

9.2.5 Unless the base is smooth, a surface blinding of soft sand (or similar material) must be used to prevent puncturing during installation or when concrete screed is being placed.

9.2.6 If the membrane is installed below a reinforced floor or concrete slab, it must be covered with a screed or protection layer prior to the positioning of the reinforcement.

9.2.7 If the membrane is above the slab, installation must be delayed until just before the laying of the screed or flooring, to avoid damage from site traffic.

9.2.8 The product must only be installed over a surface that has a smooth finish, ie it must be free from voids, projections and mortar deposits. Surfaces must be dry and free from dust and frost.

9.2.9 All joints must be bonded with Visqueen Gas Resistant Foil Lap Tape, VisqueenPro Double Sided Jointing Tape and sealed..

9.2.10 The surface of the gas membrane to be lapped must be dry and dust-free.

9.2.11 All end and side overlaps must be a minimum of 150 mm and prepared in accordance with the Certificate holder's instructions.

9.2.12 All service penetrations and direction changes must be properly detailed in accordance with the Certificate holder's instructions. Service ducts must be vented to prevent the possibility of gas accumulating in confined spaces.

9.3 Workmanship

9.3.1 Practicability of installation was assessed against BS 8485 : 2015 + A1:2019, on the basis of Certificate holder's information and a site visit to witness an installation in progress. To achieve the performance described in this Certificate, installation of Visqueen Gas Barrier must be carried out by a competent general builder, or a contractor, experienced with this type of product.

9.3.2 The BBA operates an Approved Installer Scheme for gas membranes; details of approved installer companies are included on the BBA website (www.bbacerts.co.uk).

9.4 Maintenance and repair

9.4.1 As the product is confined under concrete and has suitable durability, maintenance is not required. However, any damage occurring during installation must be repaired using a patch of the membrane, and laps bonded with VisqueenPro Double Sided Jointing Tape and sealed with Visqueen Gas Resistant Foil Lap Tape. All patched areas must extend a minimum of 150 mm from the damaged area.

9.4.2 If required by the local authority, repair work should be confirmed by an independent validation report (see section 9.2.3).

10 Manufacture

10.1 The production processes for the product have been assessed, and provide assurance that the quality controls are satisfactory according to the following factors:

10.1.1 The manufacturer has provided documented information on the materials, processes, testing and control factors.

10.1.2 The quality control operated over batches of incoming materials has been assessed and deemed appropriate and adequate.

10.1.3 The quality control procedures and product testing to be undertaken have been assessed and deemed appropriate and adequate .

10.1.4 The process for management of non-conformities has been assessed and deemed appropriate and adequate an audit of each production location was undertaken, and it was confirmed that the production process was in accordance with the documented process, and that equipment has been properly tested and calibrated.

†10.1.5 The BBA has undertaken to review the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

11 Delivery and site handling

11.1 The Certificate holder stated that the product is delivered to site in packaging bearing the product name, company name, batch number, health and safety information and weight of contents in kilograms. The BBA logo incorporating the number of this Certificate is printed on the leaflet and pallet label.

11.2 Delivery and site handing must be performed in accordance with the Certificate holder's instructions and this Certificate, including:

11.2.1 The rolls must be stacked on a flat surface, kept under cover and protected from sunlight and mechanical damage.

ANNEX A – SUPPLEMENTARY INFORMATION

Supporting information in this Annex is relevant to the product but has not formed part of the material assessed for the Certificate.

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

CE marking

The Certificate holder has taken the responsibility of CE marking the product, in accordance with harmonised European Standard EN 13967 : 2012.

Management Systems Certification for production

The management system of the manufacturer has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by Bureau Veritas (Certificate BE 011118 / BE006239-1).

Additional information on installation

- A.1 The membrane is rolled out with the coloured surface uppermost, ensuring that it is properly aligned.
- A.2 When taping the membrane joints, the joints are pressed down and well rolled. Alternatively, the membrane joints can be fused using a hot-air heat welder and roller.
- A.3 The membrane should be covered by a screed or other protective layer as soon as possible after installation.

Bibliography

BRE Report BR 211 : 2015 *Radon: Guidance on protective measures for new buildings*

BS 3177 : 1959 *Method for determining the permeability to water vapour of flexible sheet materials used for packaging*

BS 8485 : 2015 + A1 : 2019 *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*

BS EN 495-5 : 2001 *Flexible sheets for waterproofing — Determination of foldability at low temperature — Plastic and rubber sheets for roof waterproofing*

BS EN 12310-1 : 2000 *Flexible sheets for waterproofing — Determination of resistance to tearing (nail shank) — Bitumen sheets for roof waterproofing*

BS EN 12311-2 : 2000 *Flexible sheets for waterproofing — Determination of tensile properties — Plastic and rubber sheets for roof waterproofing*

BS EN 12317-2 : 2000 *Flexible sheets for waterproofing — Plastic and rubber sheets for roof waterproofing*

BS EN 12730 : 2015 *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of resistance to static loading*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

BS ISO 2782 : 2006 *Rubber, vulcanized or thermoplastic — Determination of permeability to gases*

BS ISO 15105-1 : 2007 *Plastics — Film and sheeting — Determination of gas — transmissions rate — Differential-pressure methods*

BS 1928 : 2000 *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of watertightness*

EN 12691 : 2018 *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of resistance to impact*

EN 13967 : 2012 + A1 : 2017 *Flexible sheets for waterproofing — Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet — Definitions and characteristics*

ISO 2782 : 1995 *Rubber, vulcanized or thermoplastic — Determination of permeability to gases*

MOAT 27 : 1983 *General directive for the assessment of roof waterproofing systems*

Conditions of Certificate

Conditions

1 This Certificate:

- relates only to the product that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

3 This Certificate will be displayed on the BBA website, and the Certificate Holder is entitled to use the Certificate and Certificate logo, provided that the product and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product
- actual installations of the product, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to UKCA marking and CE marking.

6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product which is contained or referred to in this Certificate is the minimum required to be met when the product is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

British Board of Agrément

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clientservices@bbacerts.co.uk
www.bbacerts.co.uk

Declaration of Performance

Unique identification code of the product-type:

1.	Product name	Colour
	Visqueen Gas Barrier	Blue/Silver

2.	Intended use	for damp proofing in buildings
3.	Name, registered trade name or registered trade mark and contact address of the manufacturer as set out in article 11 (5)	Visqueen Heanor Gate Industrial Estate, Derbyshire, DE75 7RG
4.	Name and contact address of the authorised representative who has received a mandate for the tasks set out on Article 12 (2):	Not relevant
5.	System or systems for assessment and verification of constancy of performance of the construction product in accordance with Annex V	System 2+
6.	a. In the case of a declaration of performance concerning a construction product that is covered by a harmonised standard	EN 13967:2017
	Notified body/ies	0836, 0809
6	b. In case of a declaration of performance concerning a construction product for which a European Technical Assessment was issued	Not relevant

7. Declaration performance

7	Essential Characteristics	Performance	Harmonised Technical Specification
	Reaction to Fire	F	EN 13967:2017
	Water tightness	Pass	
	Resistance to Impact	150mm	
	Resistance to static loading	20Kg	
	Durability against heat ageing	Pass	
	Durability against chemicals	Pass	

To view all test results, refer to Visqueen Gas Barrier datasheet

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

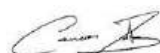
Signed for and on behalf of the manufacturer by:

Place

Signature

Date

Derbyshire, UK



17/12/2020

Cameron Yates
Technical Product Manager



**GP®
TITANFLEX®**

GP® TITANFLEX® is a loose laid multi-layer, low polyethylene membrane. GP® TITANFLEX® is specifically designed, manufactured and tested and certified to perform as a methane, carbon dioxide, radon, ground gas, VOC air & moisture and hydrocarbon protection system. GP® TITANFLEX® is used as a loose laid membrane for the gas/VOC protection of ground level structures.

Features and benefits:

- Can be a fully welded system.
- Exceptional chemical resistance.
- Long term durability - performance is guaranteed for the lifetime of the building.
- Conform with the latest codes of practice as published by BRE, CIRIA and BSI.
- High resistance to ground gases.

Part of the GP® TITANTECH® family of membranes, the GP® TITANFLEX® is a high performance, hydrocarbon barrier, manufactured from a unique HDPE resin. The primary membrane has excellent chemical resistance and is ideal for use on sites affected by hydrocarbon and VOC contamination. It will also effectively prevent the ingress of a number of other harmful gases, including radon, methane and carbon dioxide.

Accessory Products

- GP® TITAN Tape
- GP® TITANTECH® DPC
- GP® TITAN Overtape
- 300TT

Physical Properties

Thickness	0.5 mm
Width	2 m
Length	50 m
Weight	500 g/m ²

Gas Permeability

Methane	0.13
Carbon Dioxide	3.01
Radon	1 x 10 ⁻¹²

Compliance and Certification

CE MARK - EN13967:2012
NHBC Standards Compliant
B58485:2015 +A1 2019 Accordant
CIRIA C748 Accordant
BBA Certified - Certificate No. 18/5581 P1

Specification Clauses

Uniclass 2015 - PR_25_57_65_90
Plastic Sheets
CAWS - J40/145 Loose laid weldable polyethylene gas retardant damp proofing
J40/140 loose laid plastics or rubber sheet gas retardant damp proofing
D21/350 Gas retardant membrane

Certifications



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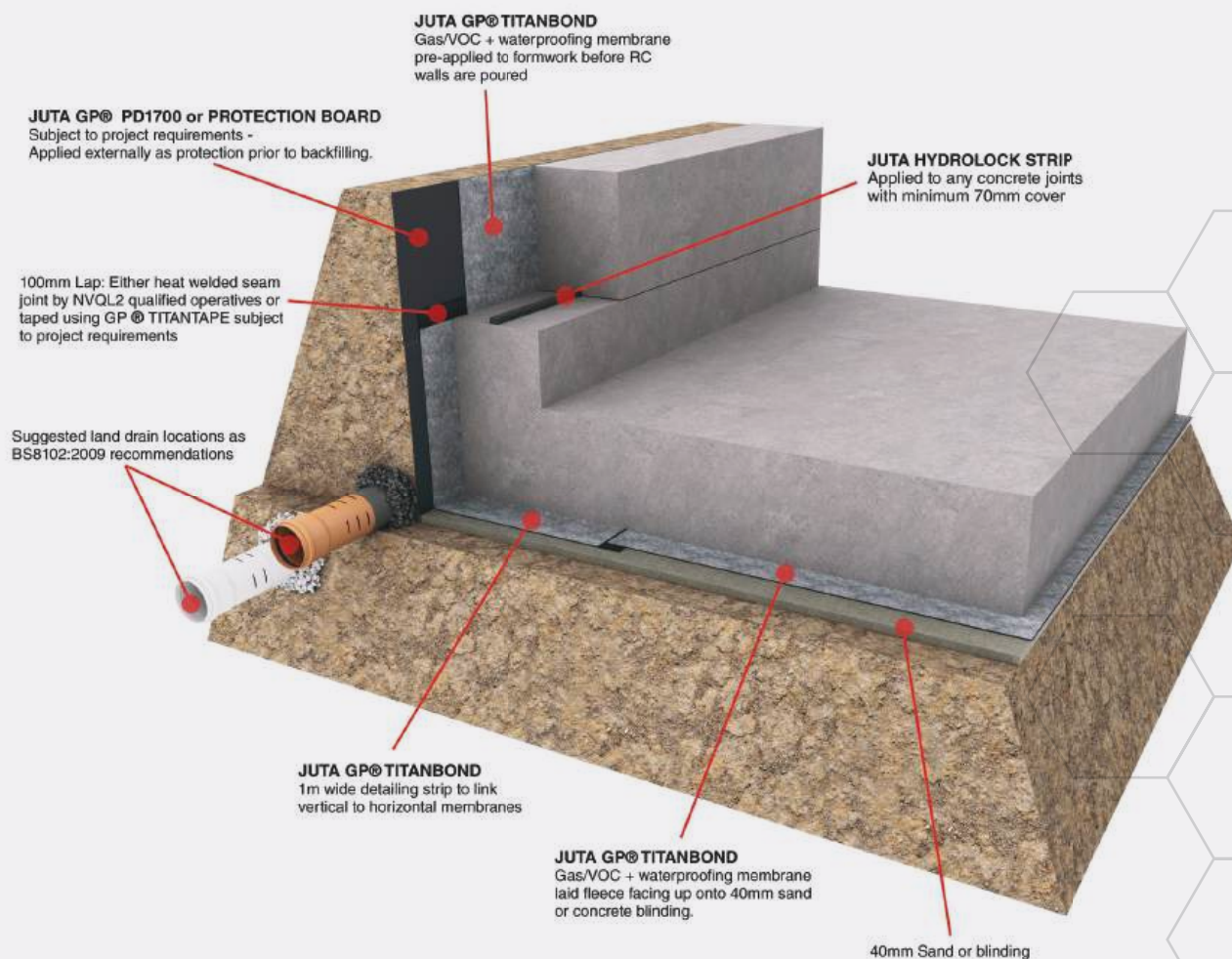
Rev 2024



GP® TITANFLEX® Vapour Permeability 100% Concentration

Benzene	< 3.6 mg /m ² / day	Vinyl Chloride	< 0.05 mg /m ² / day
Toulene	< 13.8 mg /m ² / day	Trichlorothene (TCE)	< 54.7 mg /m ² / day
Ethyl Benzene	< 2.7 mg /m ² / day	tetrachlorothene (PCE)	< 26.2 mg /m ² / day
Xylenes (M,P,O)	< 7.7 mg /m ² / day	Napthalene	< 0.0006 mg /m ² / day
Hexane	< 0.6 mg /m ² / day	CIS-1,2-Dichloroethylene	< 1.1 mg /m ² / day

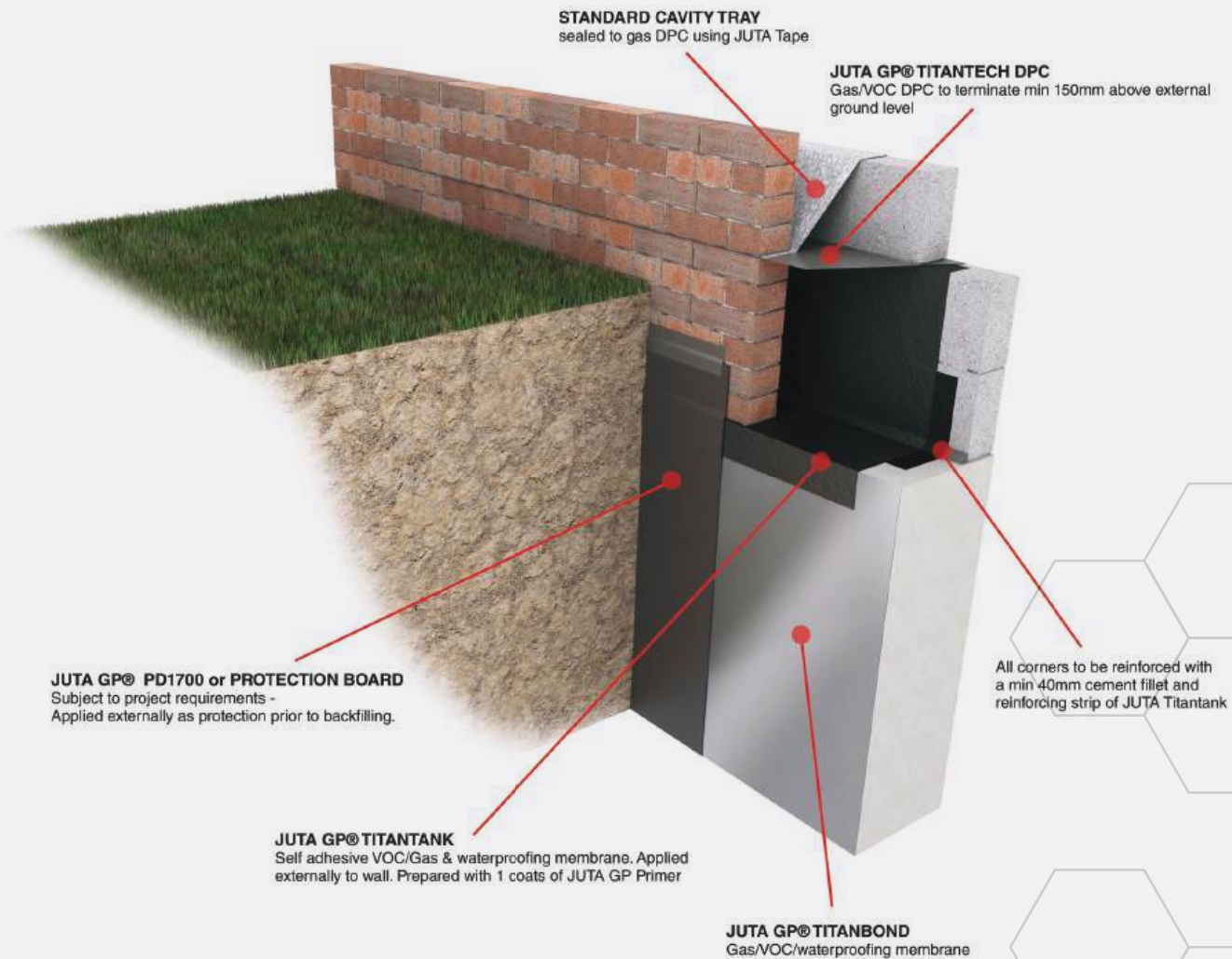
Standard Detail - Slab / Wall Kicker Joint



Various typical details available on request. Please contact **technical@juta.co.uk** for further information



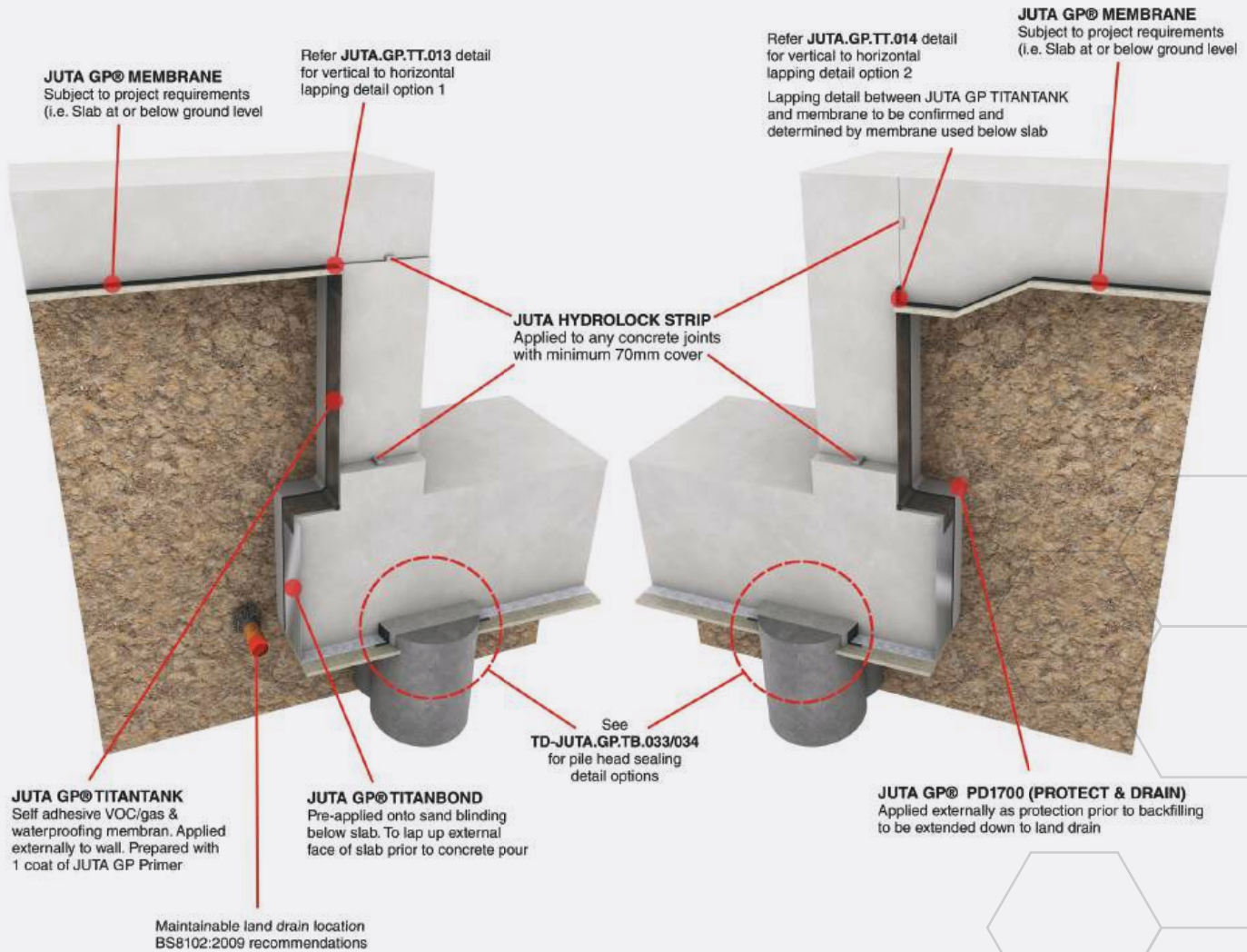
Standard Detail - Head of Retaining Wall



Various typical details available on request. Please contact **technical@juta.co.uk** for further information



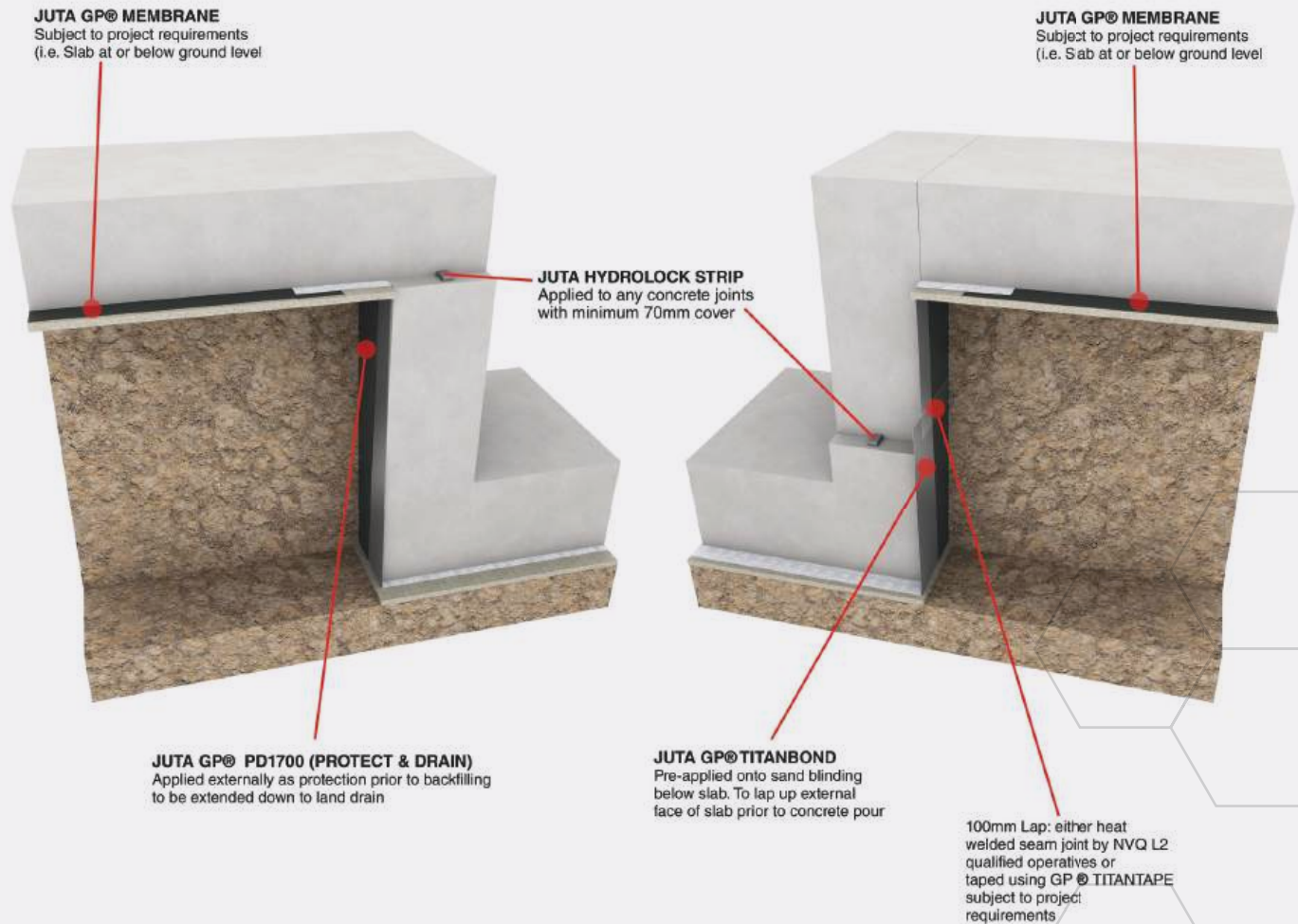
Standard Detail - Typical Piled Pit



Various typical details available on
request. Please contact
technical@juta.co.uk for further
information



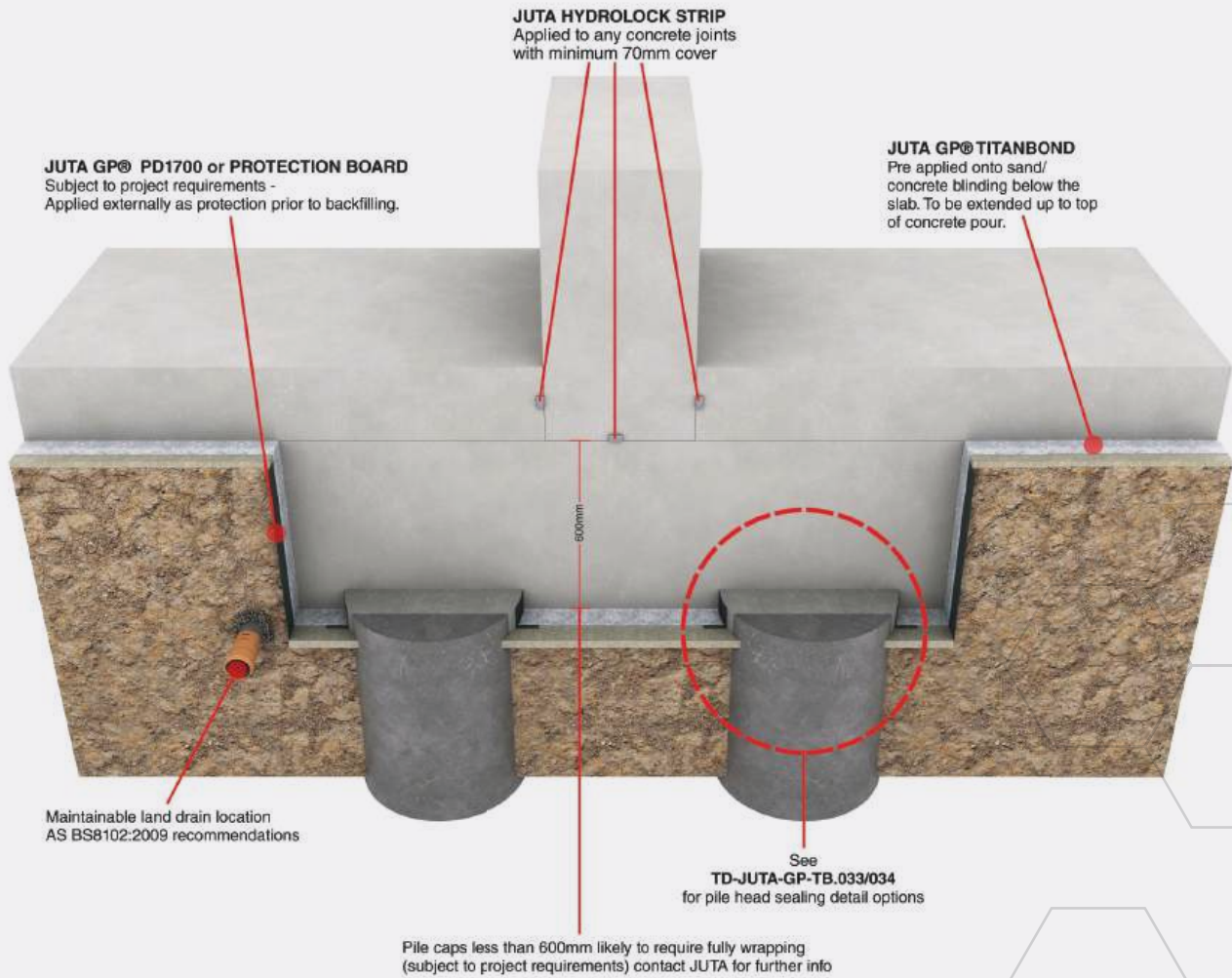
Standard Detail - Typical RC Pit



Various typical details available on
request. Please contact
technical@juta.co.uk for further
information



Standard Detail - Typical Capping Beam



Various typical details available on
request. Please contact
technical@juta.co.uk for further
information



**GP®
TITANFLEX®**

GP® TITANFLEX® gas and hydrocarbon barrier is a multi-layer, polyethylene membrane. GP® TITANFLEX® is specifically designed, manufactured, tested and certified to perform as a methane, carbon dioxide, radon ground gas, VOC, Air moisture and hydrocarbon protection system.

TITANTECH®

For developers of brownfield and contaminated sites the TITANTECH® family of products represent a major step forward in safeguarding projects against gaseous and chemical contamination.

GP® TITANFLEX® complies with the latest codes of practice as published by BRE, CIRIA (C748) and BSI (BS8485:2015). Suitable for use as ground gas/hydrocarbon protection for NHBC, Green, Amber 1, Amber 2 and Red site characterisations.

Handling

Roll weights can be in excess of 20kg and hence appropriate care and equipment is required for unloading and handling.

Storage

Rolls of GP® TITANFLEX® should be stored on stable/level ground and stacked not more than five rolls high, with no other material stacked on top. The rolls can be stored outdoors when packaged, but should be protected from exposure to UV.

Installation

GP® TITANFLEX® should be installed in accordance with the product installation guidelines, and in accordance with best practice.

Thickness	0.5 mm
Width	2 m
Length	50 m
Weight	500 g/m ²

Certifications



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Rev 2024



Feature	Characteristics	Test Method	GP® TITANFLEX®
Physical Properties	Thickness	EN 1849-2	0.5 mm
	Width	EN 1849-2	2 m
	Length	EN 1849-2	50 m
	Weight	EN 1849-2	500 g/m ²
Hydraulic Press	Water Vapour Transmission Rate	EN 1931	0.11 - 0.18 g/m ² /day
	Water Tightness (60 kPa)	EN 1928	Pass
	Water Tightness (196 kPa - 20 m Water Head) (Basement Application)	EN 1928	Pass
Mechanical Properties	Resistance to Static Load	EN 12730-B	≥ 20 kg
	Puncture Resistance	EN 12236	≥ 2.0 kN
	Tensile Strength (MD)	EN 12311-1	> 550 N/50mm
	Tensile Strength (CMD)	EN 12311-1	> 400 N/50mm
	Tensile Elongation (MD/CMD)	EN 12310-1	> 550 %
	Tear Resistance (MD/CMD)	EN 12310-1	> 300 N
	Resistance to Impact	EN 12691-B	650 mm
	Reaction to Fire	EN 13501-1	E Class
	Resistance to Artificial Ageing	EN 1296/EN 1928	Pass
	Resistance to Chemicals	EN 1296/EN 1928	Pass
Compliance and Certification	CE Mark - EN13967:2012		
	NHBC Standards Compliant		
	CIRIA C748 Compliant		
	BS 8485:2015 Compliant		
Vapour Permeability 100% Concentration	Transmission Rate of Benzene	EN ISO 15105-2	< 3.6 mg/m ² /day
	Transmission Rate of Toluene	EN ISO 15105-2	< 13.8 mg/m ² /day
	Transmission Rate of Ethyl Benzene	EN ISO 15105-2	< 2.7 mg/m ² /day
	Transmission Rate of Xylenes (M,P,O)	EN ISO 15105-2	< 7.7 mg/m ² /day
	Transmission Rate of Hexane	EN ISO 15105-2	< 0.6 mg/m ² /day
	Transmission Rate of Vinyl Chloride	EN ISO 15105-2	< 0.05 mg/m ² /day
	Transmission Rate of Trichloroethene (TCE)	EN ISO 15105-2	< 54.7 mg/m ² /day
	Transmission Rate of Tetrachloroethene (PCE)	EN ISO 15105-2	< 26.2 mg/m ² /day
	Transmission Rate of Naphthalene	EN ISO 15105-2	< 0.0006 mg/m ² /day
	Transmission Rate of CIS-1,2-Dichloroethylene	EN ISO 15105-2	< 1.1 mg/m ² /day
Gas Permeability	Methane Permeability	EN ISO 15105-1	0.13 ml/m ² /day/atm
	Methane Permeability (Jointed)	EN ISO 15105-1	1.00 ml/m ² /day/atm
	Carbon Dioxide Permeability	EN ISO 15105-1	3.01 ml/m ² /day/atm
	Vinyl Chloride Gas Permeability	EN ISO 15105-1	0.04 ml/m ² /day/atm
	Radon Permeability	K124/02/95	1.0 x 10 ⁻¹² m ² /S
	Hydrogen Sulphide Permeability	EN ISO 15105-1	< 0.16 ml/m ² /day/atm



Feature	Characteristics	Test Method	GP® TITANFLEX®
Durability and Chemical Resistance	Chemical Resistance - Sulfuric ACID (10% Solution of Sulfuric Acid (H ₂ SO ₄)) 50° For 56 Days	EN 14414-A	TENSILE STRENGTH RETAINED 100% RESULT - PASS
	Chemical Resistance - BASIC (Calcium Hydroxide Saturated Suspension) 50° For 56 Days	EN 14414-B	TENSILE STRENGTH RETAINED 100% RESULT - PASS
	Chemical Resistance - SOLVENTS (35% Diesel, 35% Paraffin, 30% Oil Hd30 (Vol)) 50° For 56 Days	EN 14414-C	TENSILE STRENGTH RETAINED >80% RESULT - PASS
	Chemical Resistance - SYNTHETIC LEACHATE (Mixture of 14 Acids, Chlorides, Sulphates & Phosphates) 50° For 56 Days	EN 14414-D	TENSILE STRENGTH RETAINED 100% RESULT - PASS
	Resistance to Leaching - HOT WATER (Deionised Water) 50° For 56 Days	EN 14415-A	TENSILE STRENGTH RETAINED 100% RESULT - PASS
	Resistance to leaching - AQUEOUS ALKALINE (Saturated Calcium Hydroxide) 50° For 56 Days	EN 14415-B	TENSILE STRENGTH RETAINED 100% RESULT - PASS
	Resistance to Leaching - ORGANIC ALCOHOL (30% Methanol, 30% Isopropanol, 40% Glycol) 50° For 56 Days	EN 14415-C	TENSILE STRENGTH RETAINED 100% RESULT - PASS
	Chemical Resistance - BENZENE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 95% (MD), 102% (CMD) RESULT - PASS
	Chemical Resistance - TOLUENE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 94% (MD), 91% (CMD) RESULT - PASS
	Chemical Resistance - ETHYL BENZENE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 99% (MD), 97% (CMD) RESULT - PASS
	Chemical Resistance - XYLENES - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 91% (MD), 106% (CMD) RESULT - PASS
	Chemical Resistance - TCE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 99% (MD), 93% (CMD) RESULT - PASS
	Chemical Resistance - PCE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 93% (MD), 93% (CMD) RESULT - PASS
	Chemical Resistance - NAPHTHALENE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 101% (MD), 93% (CMD) RESULT - PASS
	Chemical Resistance - HEXANE - 100% Saturated Concentration	EN 14414-D (MOD)	TENSILE STRENGTH RETAINED 99% (MD), 104% (CMD) RESULT - PASS



JUTA UK

Please contact JUTA
UK Directly for more
information on
GP® TITANFLEX®

Jointing and Sealing

GP® TITANFLEX® can be heat welded or taped, with jointing carried out by competent personnel with suitable qualifications in accordance with best practice. GP® TITANFLEX® should be overlapped by at least 100mm. If taping joints, only suitable tape must be used, ensuring application with a silicone roller to remove trapped air. JUTA pre-formed details, or self adhesive gas membrane are available for sealing around protuberances.

Accessory Products

- GP® DPC
- GP® Tape
- GP® Self Adhesive Membrane (SAM)
- GP® Primer
- GP® Top Hats and Preformed Corners
- GP® Protection Fleece
- GP® Void Vent (24/40mm)

