

FloodSmart Plus



Flood Consequence Assessment

Site Address

Former Ynysgau Chapel
Wyndham Street
Troedyrhiw
Merthyr Tydfil
CF48 4JY

Date

2023-08-07

Report Status

FINAL

Grid Reference

307176, 202248

Site Area

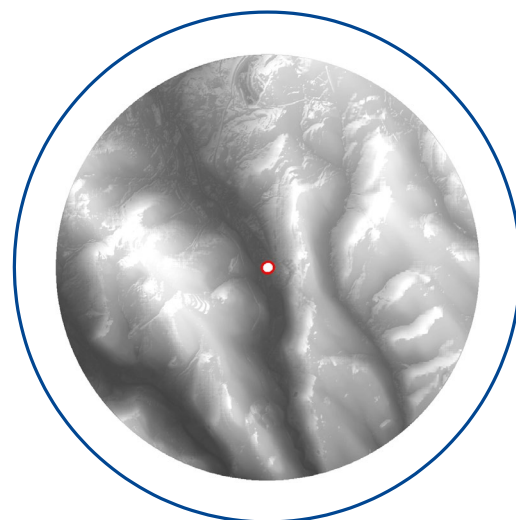
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Report Prepared for

Justin McCarthy

Report Reference

79721R1



RISK – Very Low to Moderate

The Site is mapped within NRW's Flood Zones 1, 2 and 3 (Very Low-High probability) associated with the River Taff. An analysis of the model data indicates that the Site has a Very Low to Low risk of fluvial flooding. Surface water (pluvial) flood risks are Very Low. Groundwater flood risks are Negligible to Moderate and flooding risks from artificial sources (i.e. canals, reservoirs and sewers) are Very Low. Mitigation measures are recommended in this report to reduce the risks to an acceptable level over the lifetime of the development.

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1. Executive summary



The Planning Policy Wales (PPW) 11th edition (2021) and Technical Advice Note 15 (TAN 15) (2004) requires Flood Consequence Assessments (FCA) to review flooding from all potential sources. A review has been undertaken of national environmental data sets to assess the potential flood risk to the Site. The review is provided within this concise interpretative report written by an experienced GeoSmart consultant.

It should be noted the TAN15 (2004) is anticipated to be updated in the near future, and a new Flood Map for Planning will be published at the same time to support this. The new Flood Map for Planning will supersede the NRW's Development Advice Map (DAM) and the conclusions of this report may change as a result. However, this is yet to be implemented and this report is based upon TAN15 (2004) and DAM.

Site analysis

Source of Flood Risk	Baseline*	After Mitigation**
River (fluvial) flooding	Very Low to Low	Very Low
Sea (coastal/tidal) flooding	Very Low	N/A
Surface water (pluvial) flooding	Very Low	N/A
Groundwater flooding	Negligible to Moderate	Negligible
Other flood risk factors present	Yes (Reservoir Breach)	N/A
Is any other further work recommended?	Yes	Yes (see below)

*BASELINE risks have been calculated for the whole Site, using national risk maps, including the benefit of NRW flood defences. **FINAL RISK RATING Includes a detailed analyses of flooding risks over the lifetime of the proposed development, including allowances for climate change AND assumes recommended mitigation measures are implemented. N/A indicates where mitigation is not required.

Summary of existing and proposed development

The Site is currently disused, and was formerly used within a public worship capacity as a chapel. Development proposals comprise the demolition of the disused chapel, and construction of two new two-storey, semi-detached residential dwellings with associated access, parking and landscaping. Access to the dwellings would be through two north east-facing doorways above minimum ground levels on Site.

The Site plans did not provide any ground level measurements or surveys within the existing buildings, due to structural issues which did not permit entry into the Site. However, the existing and proposed building elevation drawings indicate the ground levels will be lowered, so they are similar to those adjacent to the north of the Site. Site proposals and LiDAR data indicate the ground levels on the Site would be levelled to approximately 139.68 mAOD, with Finished Floor Levels (FFL) assumed 150mm above this at 139.83 mAOD.

Summary of flood risks

The flood risks from all sources have been assessed as part of this report and are as follows:

- No historical flooding is understood to have previously occurred at the Site, though a flood event related to the exceedance of the capacity of the nearby watercourse has occurred approximately 160 m north of the Site at the closest point.

River (fluvial) and Sea (Estuarine/Coastal) flooding

- According to NRW's Flood Map for Planning, the Site is located partially within fluvial Flood Zones 1, 2, and 3. These Flood Zones include an allowance for climate change, but do not take account of any flood defences.
- A basic assessment indicates the maximum contour height compared with the Flood Zone 3 (1 in 100 year plus climate change undefended event) extent is 141.92 mAOD. However, as this has been estimated using the maximum contour across a relatively steep area of the Site, this level is likely to be a coarse overestimate of the actual flood level.
- Raised embankments are located approximately 180 m to the west of the Site but would not provide significant protection to the Site due to the local topography. The NRW's Development Advice Map (DAM) confirms the majority of the Site is located within DAM Zone B and partially within DAM Zone C2 (in the north of the Site). The DAM Zones do not allow for climate change and indicate the Site does not benefit from significant flood defence infrastructure. The extent of DAM Zone C2 is situated along a contour line of approximately 140.07 mAOD, though with a degree of variance due to the coarse resolution of the mapping.

However, detailed modelled data obtained from the NRW for the River Taff Modelling Study (JBA Consulting, 2017) which does consider the presence of flood defences indicates the Site would not be anticipated to flood in the 1 in 100 year plus 25% climate change allowance scenario.

The detailed model data is therefore not reflective of the Flood Map for Planning and DAM Zone designations.

- According to the NRW's Flood Risk Assessment Wales (FRAW) map, which considers the type, condition and crest height of flood defences, the Site has a risk of flooding ranging from Very Low to Low from the nearby watercourse, the River Taff. The FRAW mapping aligns with the NRW's detailed River Taff Modelling study (2017).
- Modelled flood data obtained from the NRW has been analysed in line with the most up to date guidance on climate change to confirm a maximum "design" flood level at the Site.

The Flood Map for Planning Flood Zones which account for climate change, indicate the flood level may be up to 141.92 mAOD in a 1 in 100 year plus climate change event. However, detailed modelling indicates the defended 100 year plus CC event flood level would be 138.83 mAOD.

In this event, the Site would not be anticipated to experience flooding, as the Site is at a higher elevation (139.57 to 142.22 mAOD) than both the flood level and the land to the north of the Site.

In a 1 in 1000 year return period flood event, the anticipated flood level on the Site would be 140.07 mAOD, compared to minimum ground levels of 139.68 mAOD. Access to the Site would be located to the east of the proposed building, at an elevation of c. 139.83 mAOD.

Surface water (pluvial) flooding

- According to NRW's Flood Risk Assessment Wales (FRAW) mapping, the Site has a Very Low risk of flooding from surface water and small watercourses.

Groundwater flooding

- Groundwater Flood Risk screening data indicates there is a variable potential risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event, ranging from Negligible to Moderate.
- The groundwater level may be influenced by the adjacent river levels with the 1 in 1000 year level estimated to be 140.07 mAOD at the Site, compared with Site ground levels of 139.57 to 142.22 mAOD.

Artificial sources of flooding

- The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:
 - The NRW's Risk of Flooding from Reservoir map confirms the Site is at risk of reservoir flooding. The potential for a breach of a reservoir to occur and flooding affecting the Site is low.
 - Ordnance Survey (OS) data confirms there are no canals near to the Site.
 - The Strategic Flood Consequence Assessment (SFCA) (WHS, 2018) indicates that there are no recorded instances of sewer flooding at or within the vicinity of the Site.

The risk of flooding from artificial sources is considered to be Very Low.

Recommendations for flood mitigation are provided below, based upon the flood risk identified at the Site and TAN15 (2004) requirements for residential 'Highly Vulnerable' development:

- *Developer is required to demonstrate that the site is designed to be flood free for the lifetime (A1.5) of development for either a 1 in 100 chance (fluvial) flood event, or a 1 in 200 chance (tidal) flood event including an allowance for climate change (depending on the type of flood risk present) in accordance with table A1.14. In addition, for tidal breach flood events, an escape route should be practical in all conditions. Finish floor levels (FFL) of highly vulnerable developments should be set 0.30m above the maximum flood level.*

GeoSmart Comment: Analysis of the detailed model data for the Site does demonstrate the development would be flood free during a 1 in 100 year (fluvial) present day and future (25%) climate change events.

- *In respect of the residual risk to the development, it should be designed so that over its lifetime (A1.5) in an extreme (1 in 1000 chance) event there would be less than 600mm of water on access roads and within properties, the velocity of any water flowing across the development would be less than 0.3 m/second on access roads and 0.15m/second in properties, and the maximum rate of rise of floodwater would not exceed 0.1m/hour. (see table A1.15).*

GeoSmart Comment: Analysis demonstrates that the road access northeast of the Site, is at a lower elevation, and would be affected by flood depths of up to and exceeding 0.90 m, and velocities of up to 1.05 m/s, during a 1 in 1000 year event.

Site proposals indicate the ground levels on the Site would be levelled to approximately 139.68 mAOD, the 1000 year flood level is 140.07 mAOD, which could experience flooding depths of up to 0.39m (within the 0.6m tolerance) and the velocity is likely to be reduced. Safe pedestrian access would also be available though, to the south east of the Site along Wyndham Street, with no flooding anticipated in this event. This would satisfy the requirements of A1.15 of TAN15 (2004).

Recommendations

Recommendations for flood mitigation are provided below, based upon the proposed development and the flood risk identified at the Site.

- Ground levels on the existing Site are between 139.57 and 142.22 mAOD.
- The Finished Floor Levels (FFL) of the proposed dwellings are estimated from plans to be 139.83 mAOD. External ground levels will be levelled at c. 139.68 mAOD.
- The 1 in 1000 year flood level and DAM Zone C2 flood extent match the 140.07 mAOD contour, and there is a moderate groundwater risk.
- The Flood Map for Planning Flood Zones which account for climate change, indicate the maximum contour of the flood extent may be up to 141.92 mAOD in a 1 in 100 year plus climate change event, although this is estimated from the maximum contour height, which may be an overestimation of the actual flooding level. The detailed modelling from

the River Taff modelling study indicates the defended 100 year plus CC event flood level would be 138.83 mAOD, which would not impact the Site.

- The Site is already 0.85m above the detailed modelled 100 year plus climate change event and therefore complies with A1.14 of TAN15 (2004). However, in order to ensure flooding does not occur in a 1 in 1000 year event or from groundwater emergence, it is recommended that on-Site ground levels are set to at least 140.07 mAOD and FFLs of the proposed buildings are set 300mm above this to at least 140.37 mAOD.
 - This would also ensure the Site is located above the height of DAM Zone C2, to ensure the proposed development would satisfy TAN15.
- A Flood Warning and Evacuation Plan (FWEP) is recommended to ensure persons using the Site can evacuate safely on receipt of a Flood Warning.
 - Occupants of the Site should also be signed up to receive NRW Flood Alerts and Flood Warnings.
- The ongoing management and maintenance of existing and any proposed drainage networks, under the riparian ownership of the developer, should be undertaken in perpetuity with the development.
- A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff over the lifetime of the proposed development.

GeoSmart recommend the mitigation measures discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Planning Authority as part of the planning application.

2. Introduction



Background and purpose

A Site-specific flood consequence assessment has been undertaken, to assess the flood risk to and from the development Site. This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development, as defined in the PPW (2021), and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage flood risk to the development was undertaken.

This report has been prepared with reference to the Technical Advice Note (TAN) 15 (2004) which supplements the PPW (2021).

The general approach of PPW, supported by TAN15, is to advise caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is, in order of preference, to:

- Direct new development away from those areas which are at high risk of flooding; and
- Where development is considered to be in high-risk areas (Zone C) only those developments which can be justified on the basis of the tests outlined in Section 6 and Section 7 are located within such areas.

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

A thorough review of a commercially available flood risk report and NRW supplied data has been undertaken, indicating potential sources of flood risk to the Site from rivers and tidal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from NRW and a review of the Merthyr Tydfil Strategic Flood Consequence Assessment (SFCA) (WHS, 2018) are used to ascertain local flooding issues and, where appropriate, identify information to support a Justification test and Assessment of Flood Consequences required as part of the PPW (2021).

The existing and future flood risk to and from the Site from all flood sources is assessed in line with current best practice using the best available data. The risk to the development has been assessed over its expected lifetime, including appropriate allowances for the impacts of climate change. Residual risks that remain after the flood risk management and mitigation measures are implemented, are considered with an explanation of how these risks can be managed to keep the users of the development safe over its lifetime.

An indication of whether the Site will potentially increase flood risk elsewhere is provided, including where the proposed development increases the building footprint at the Site. A drainage strategy to control runoff can be commissioned separately if identified as a requirement within this report.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions, we can offer no guarantee as to its validity and a proportionate programme of Site investigations would be required to fully verify these findings.

The basemap used is the OS Street View 1:10,000 scale; however, the Site boundary has been drawn using BlueSky aerial imagery to ensure the correct extent and proportion of the Site is analysed.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Table 1. Datasets consulted to obtain confirmation of sources of flooding and risk

Source of flooding	Datasets consulted			
	Commercial Flood Maps	Local Policy & Guidance Documents*	Natural Resources Wales	OS Data
Historical	X	X	X	
River (fluvial) / Sea (tidal/coastal)	X	X	X	
Surface water (pluvial)	X	X	X	

Source of flooding	Datasets consulted			
	Commercial Flood Maps	Local Policy & Guidance Documents*	Natural Resources Wales	OS Data
Groundwater	X	X		
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*Local guidance and policy, referenced in Section 6, has been consulted to determine local flood conditions and requirements for flood mitigation measures.

Local policy and guidance

For this report, several documents have been consulted for local policy and guidance and relevant information is outlined below:

Merthyr Tydfil Strategic Flood Consequence Assessment (WHS, 2018):

- 3.4.1 River Taff** The River Taff is the largest watercourse in Merthyr Tydfil. With the exception of the Merthyr Vale site, the NRW flood map for the River Taff is largely based on low resolution JFLOW modelling data, which often produces conservative flood extents in comparison to detailed 1D/2D hydraulic modelling as smaller watercourses and culverts are usually not represented in the model.
- 3.5 Flood Defences** There are limited flood defences shown on the NRW flood map throughout the Merthyr Tydfil area, with no formal defences present in the central Merthyr Area or Abercanaid. Formal defences are shown along the left bank of the River Taff downstream of Troedyrhiw to protect the existing High School from flooding. Downstream of the school, formal defences are shown along the right bank of the Taff that prevent flooding at Aberfan Road, as well further downstream at Cottrell Street. Aberfan Road and Cottrell Street therefore lie in an Area Benefitting from Defences (ABD). It is worth noting the informal defences are not shown on the NRW flood map.
- Reservoir Flooding** There are several reservoirs in the Taff catchment upstream of Merthyr Tydfil in the Brecon Beacons, such as Cantref Reservoir (Taff Fawr), Llwyn on Reservoir (Taff Fawr), Pontsticill Reservoir (Taff Fechan) and Upper and Lower Neuadd Reservoirs (Taff Fechan). The reservoir flood maps are held by NRW and are included in the "Long Term Flood Risk" online map available on the NRW website. However, it is noted

that reservoir flooding is a rare event with a very low probability of occurrence. Current reservoir regulation, which has been further enhanced by the Flood and Water Management Act (2010), ensures that all reservoirs are properly maintained and monitored in order to detect and repair any problem.

Guidance

Strategic Flood Consequence Assessments are carried out by local authorities, in consultation with Natural Resources Wales, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (PPW, 2021).

3. Site analysis



Site information

The Site is located in Former Ynysgau Chapel, Wyndham Street, Merthyr Tydfil, CF48 4JY in a setting of residential land use at National Grid Reference SO 07177 02249.

Figure 1. Aerial imagery of the Site (BlueSky, 2023)

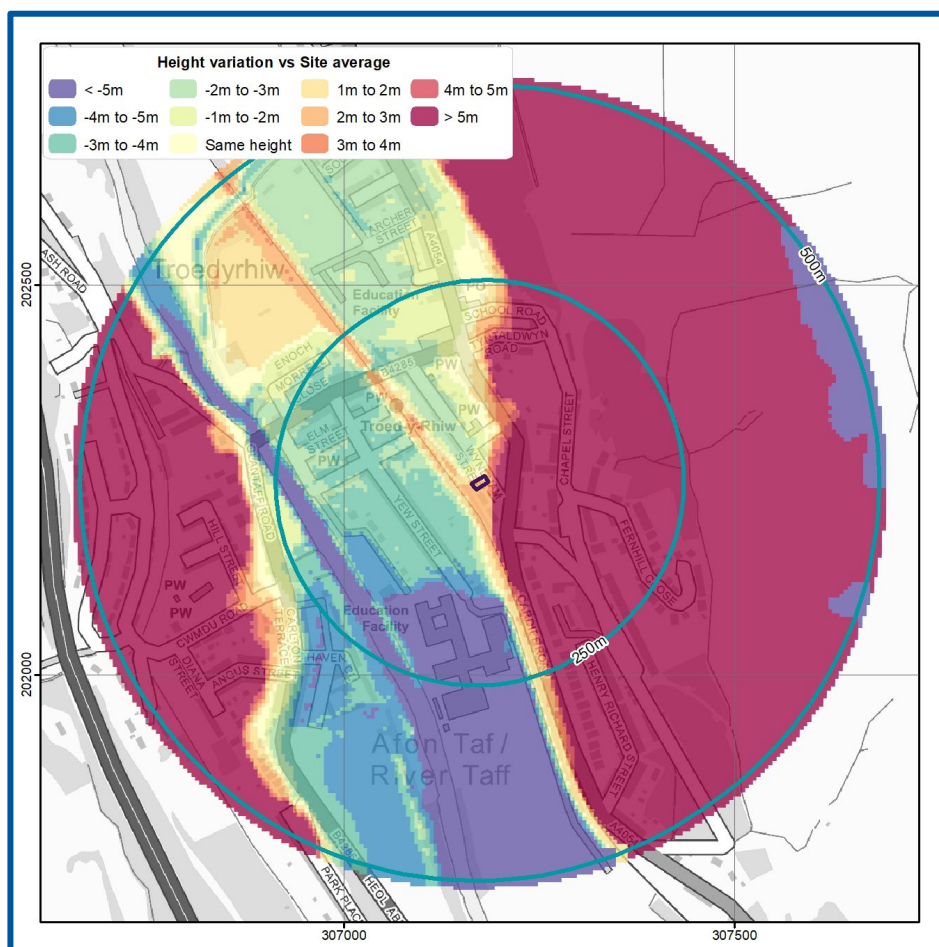


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Figure 2, overleaf, indicates ground levels within 500m of the Site fall in a south westerly direction. A raised north-south railway line is located c 10 m west of the Site, at a higher elevation than the Site.

The general ground levels on the Site are between 139.57 and 142.22 mAOD with the Site falling in a northerly direction. This is based on NRW elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ± 0.15 m (Appendix B).

Figure 2. Site Location and Relative Elevations (GeoSmart, 2023)



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Development

The Site is currently disused, and was formerly used within a public worship capacity as a chapel.

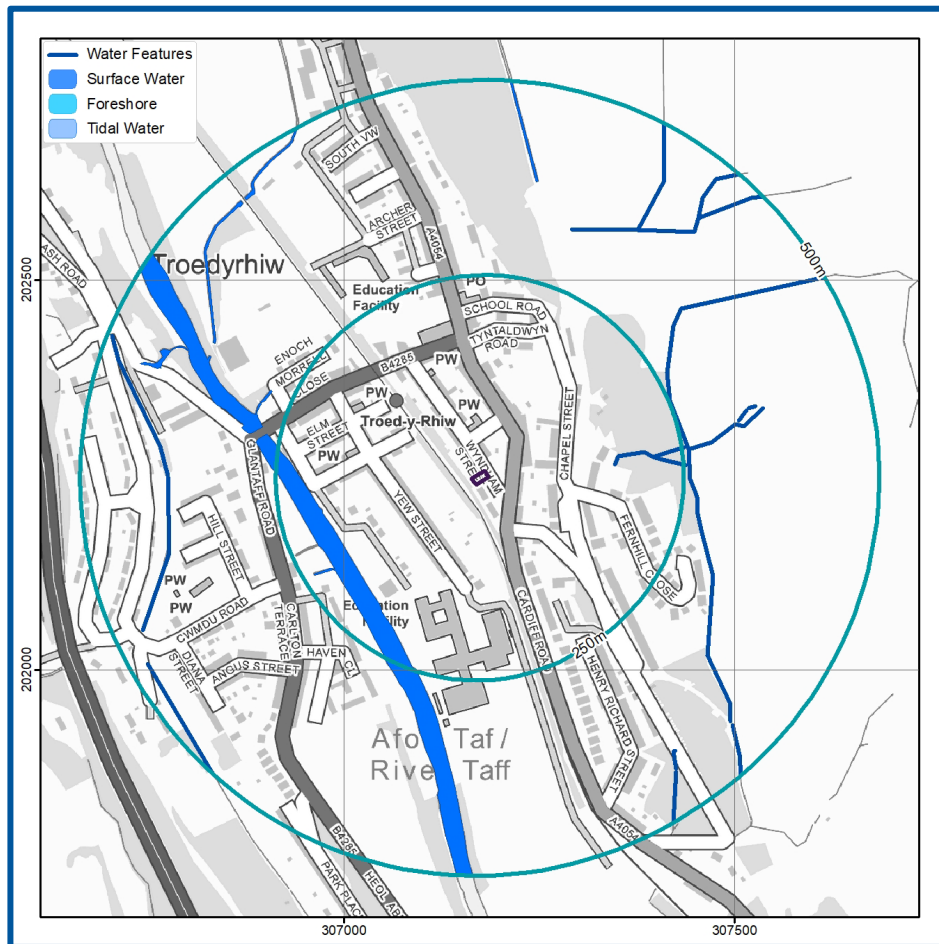
Development proposals comprise the demolition of the disused chapel, and construction of two new two-storey, semi-detached residential dwellings with attic floor space. Site plans are included within Appendix A.

The effect of the overall development will result in an increase in number of occupants and/or users of the Site and will result in the change of use, nature or times of occupation. According to Figure 2 of TAN 15 (2004), the vulnerability classification of the existing development is Highly Vulnerable and proposed development is Highly Vulnerable. The estimated lifespan of the development is 100 years.

Hydrological features

According to Ordnance Survey (OS) mapping included in the following figure, there are numerous surface water features within 500 m of the Site.

Figure 3. Surface water features (OS, 2023)



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At its closest point, the River Taff is located approximately 200 m west of the Site.

Multiple drainage ditches and small watercourses are located nearby the Site with the closest located approximately 230m to the east of the Site.

Proximity to relevant infrastructure

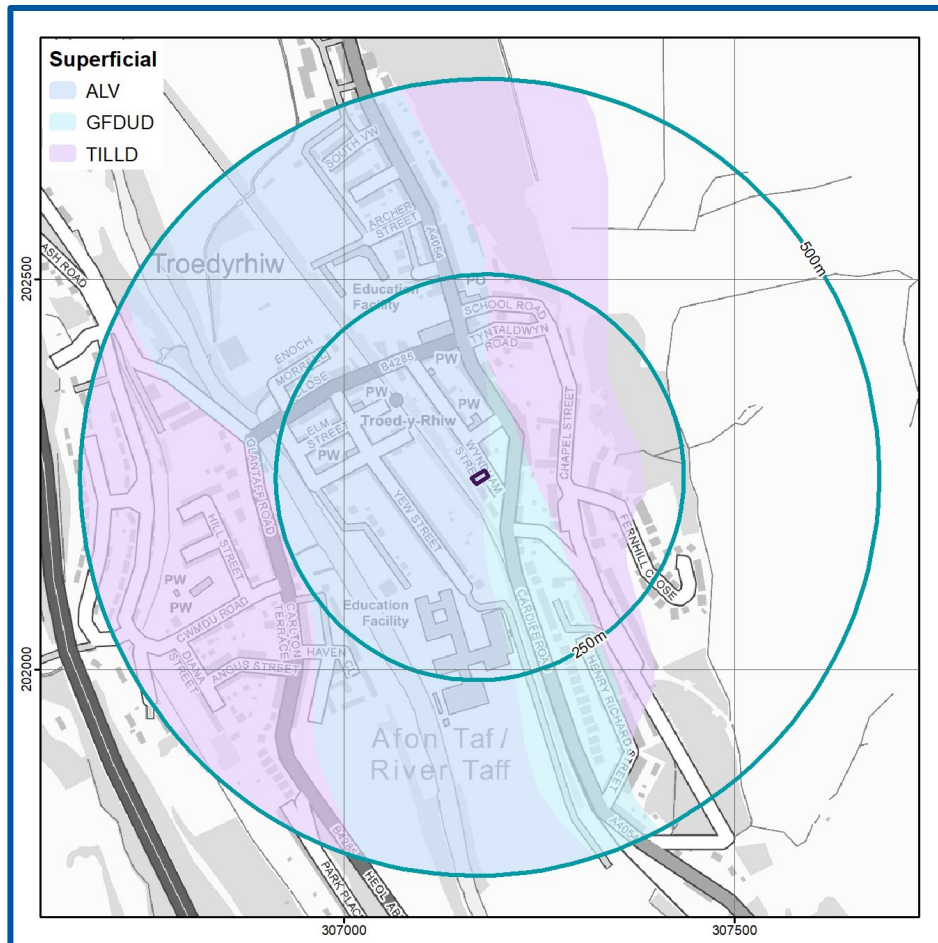
There are two bridges across the River Taff within the vicinity of the Site, with the closest located downstream of the Site approximately 280 m to the north west.

A railway line is located within 15 m of the western boundary of the Site at its closest point, at a higher elevation than the Site.

Hydrogeological features

British Geological Survey (BGS) mapping indicates the underlying superficial geology (Figure 4) consists of Alluvium (ALV), which is classified as a Secondary (A) Aquifer (BGS, 2023). Within 250 m of the Site, there are multiple boundaries between the ALV deposits, the Devensian Glaciofluvial deposits (GFDUD) (Secondary Undifferentiated Aquifer), and the Devensian Diamicton-Till deposits (TILLD) (Secondary Undifferentiated Aquifer).

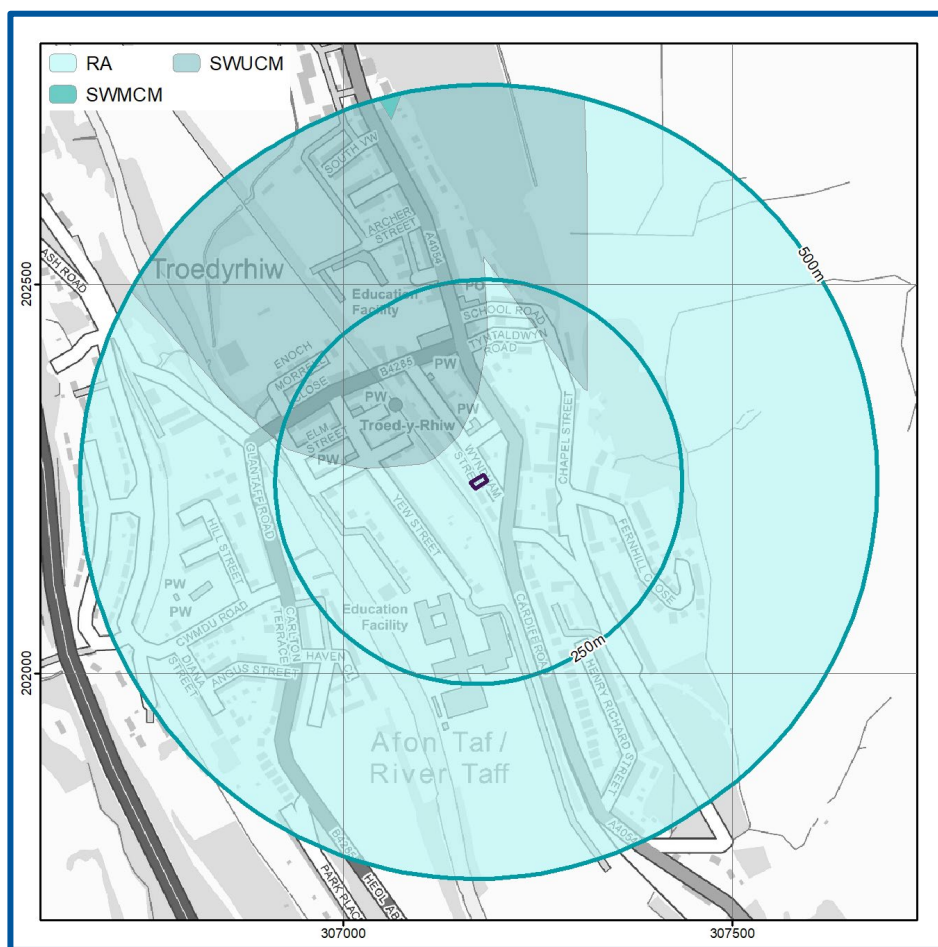
Figure 4. Superficial Geology (BGS, 2023)



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BGS mapping indicates the underlying bedrock geology (Figure 5, overleaf) consists of the Rhondda Member sandstones (RA), which is classified as a Secondary (A) Aquifer. Within 100 m of the Site, there is a boundary to the north with the South Wales Upper Coal Measure (SWUCM), also classified as a Secondary (A) Aquifer (BGS, 2023).

Figure 5. Bedrock Geology (BGS, 2023)



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Geological conditions

A review of the BGS borehole database (BGS, 2023) indicates that there are no relevant boreholes within the vicinity of the Site from which the mapped geology can be inferred.

Groundwater

As there are no relevant boreholes within the vicinity of the Site, groundwater levels are unknown under the Site.

4. Flood risk to the development



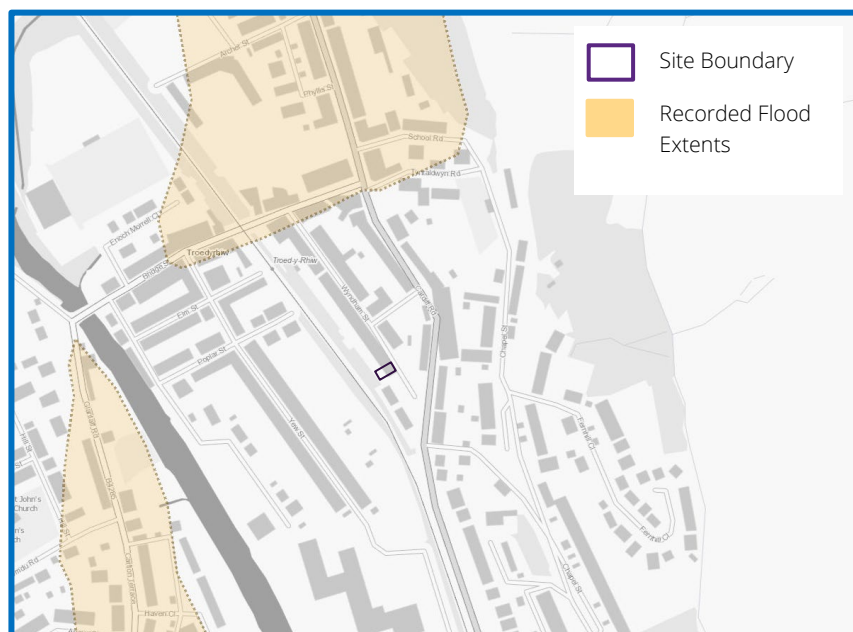
Historical flood events

According to the NRW's Recorded Flood Extents Map (Figure 6) and the SFCA (WHS, 2018), no historical flood events have been recorded at the Site. However, one recorded flood event has occurred within 250 m of the Site:

- On 27/12/1979, the channel capacity of the River Taff was exceeded, causing flooding approximately 160 m north of the Site at its closest point (NRW, 2023). The return period of this flood is not indicated.

The purpose of historical flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean flooding has never occurred on-Site or that flooding will never occur at the Site.

Figure 6. Historic Flood Event Outline (NRW, 2023)



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Rivers (fluvial) / Sea (coastal) / Estuarine (tidal) flooding

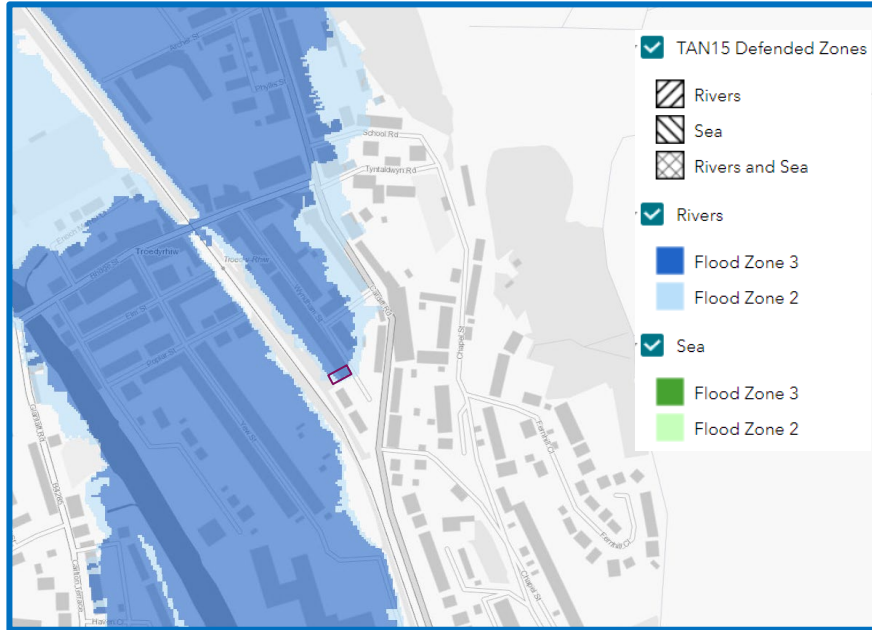
The predominant risk at the Site is from flooding from rivers, termed as fluvial flooding. The Site is located in an inland location and the risk of flooding from coastal and tidal processes are therefore considered to be Negligible.

River (fluvial) flooding occurs during times of heavy rainfall or snow melt when watercourses' capacity can be exceeded, over topping the banks and flood defences.

Flood Zones Map

According to the NRW's Flood Map for Planning (Figure 7), the Site is located partially within fluvial Flood Zones 1, 2 and 3 (approximately 10%, 30%, and 60% of site area, respectively), and is therefore classified as having a Very Low to High probability of fluvial flooding from the River Taff.

Figure 7. NRW Flood Zone mapping (NRW, 2023)



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Please note these Flood Zones are not presently used for planning purposes, but instead provide an indicative extent for the 1 in 100 year / 1 in 200 year and 1 in 1000 year fluvial and tidal events, respectively, and they also include an allowance for climate change.

The above Flood Zones will become live once the revised version of TAN15 is published in the future. The Development Advice Map (DAM) is currently the most up to date mapping for planning purposes in line with TAN15 (2004).

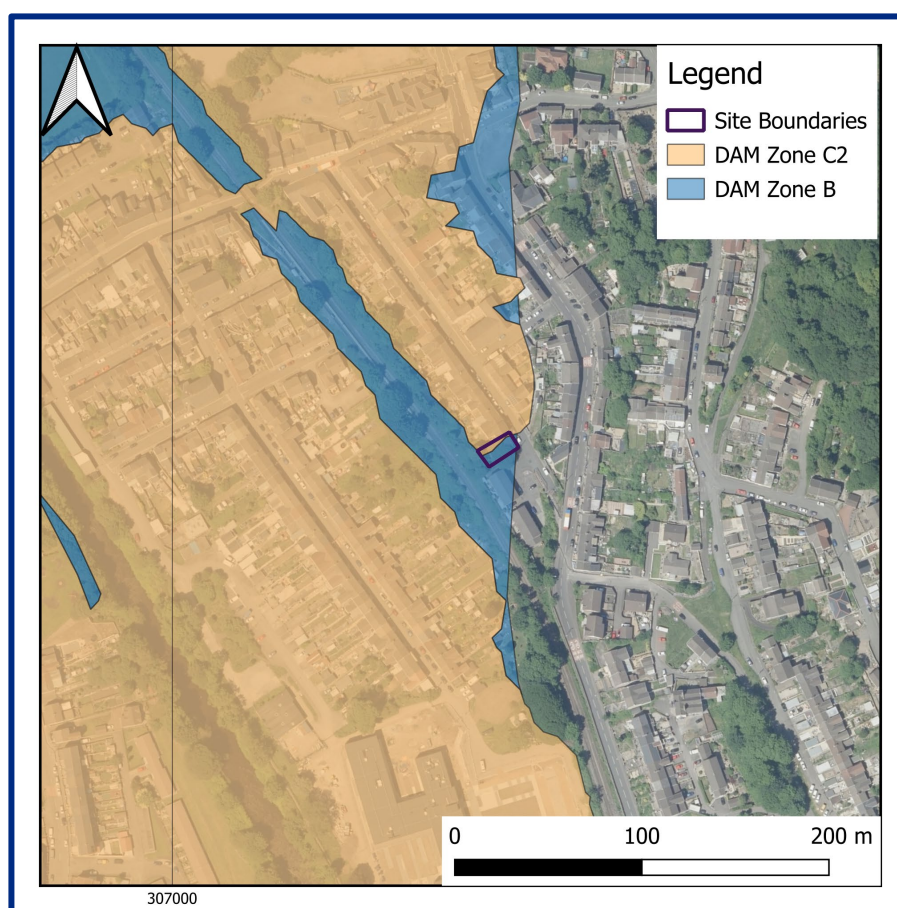
Development Advice Map

The NRW's Development Advice Map (DAM) confirms the Site is located partially (approximately 40% of the Site area, to the north) within DAM Zone C2 and partially within DAM Zone B (the remaining 60% to the south) (TAN15, 2004).

Table 1. Development Advice Map Classification

Description of Zone	Zone
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1
Areas of the floodplain without significant flood defence infrastructure.	C2

Figure 8. Development Advice Map (NRW, 2023)



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Flood defences

Guidance

Sites that are located close to flood defences are likely to be zones where rapid inundation will occur in the event of the flood defences being overtopped or breached. A Site located close to flood defences (within 250 m) may require a more detailed FCA subject to local topography.

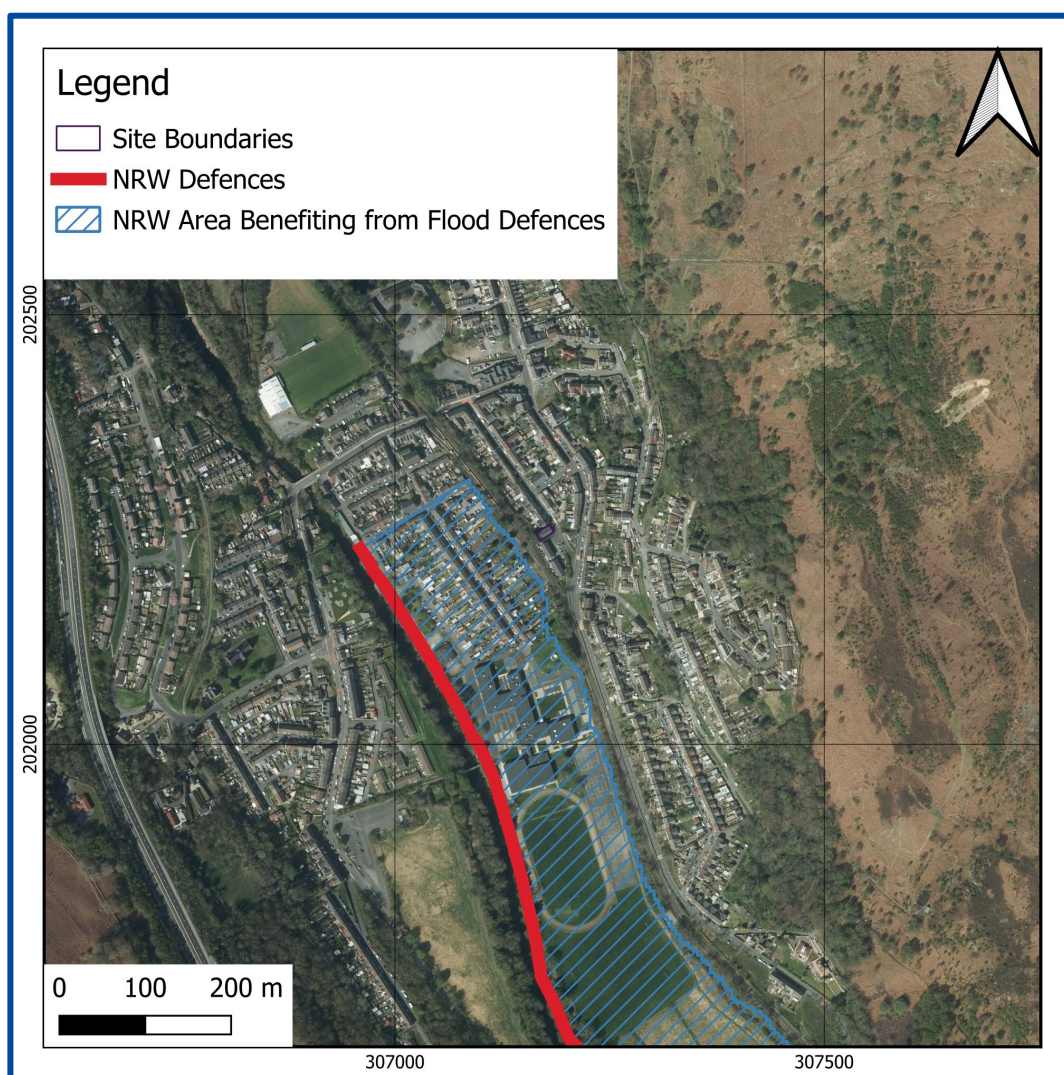
Existing flood defences

- According to NRW's Flood Map for Planning (Figure 7), the Site is not located within a TAN15 Defended Zone for fluvial flooding.
- There are raised embankments along the eastern bank of the River Taff, located approximately 180 m west of the Site boundaries at the closest point, at an elevation of approximately 137.3 mAOD.

Information from the NRW relating to the flood defences is outlined below.

- The flood defences in place for this area are designed to defend up to a 1 in 25 year flood event.
- The minimum crest level of the raised embankments is not indicated.
- The NRW classifies their current condition as "Poor (Condition Grade: 4)".

Figure 9. Location of flood defences mapping (NRW, 2023)



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Flood Risk including the benefit of defences

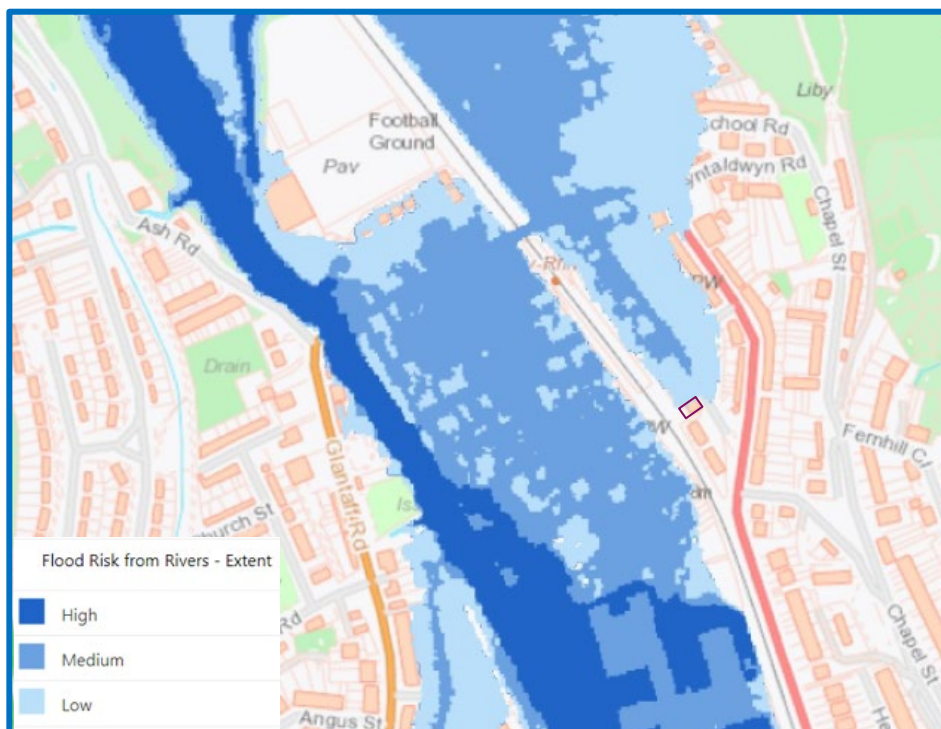
The Flood Risk Assessment Wales (FRAW) maps were published in the Summer of 2020.

The FRAW mapping includes consideration of flood defences that have been built to protect against flooding from rivers and the sea. The defences shown provide different levels of flood protection and this is recognised in the risk classification shown in the Flood Risk Assessment Wales (FRAW) map.

The FRAW maps indicate:

- The risk from Rivers is Very Low to Low.
- The risk from the Sea is Very Low.
- The risk from Surface Water and Small Watercourses is Very Low.

Figure 10. Rivers – FRAW Risk Map (NRW 2023)



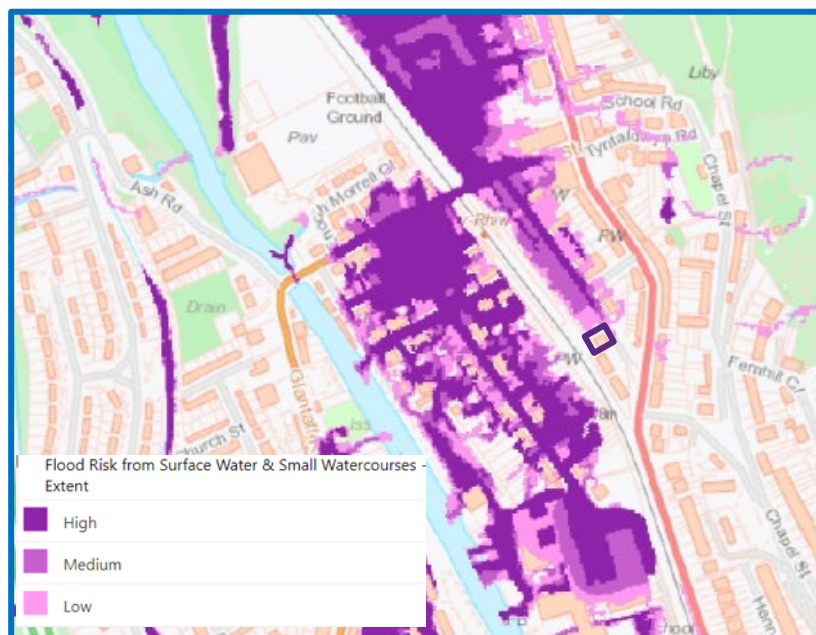
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Figure 11. Sea – FRAW Risk Map (NRW 2023)



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Figure 12. Surface Water and Small Watercourses – FRAW Risk Map (NRW 2023)



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National Flood Hazard Maps

The National Flood Hazard (NFH) maps were published in the Summer of 2020, these show results for an undefended scenario which means the modelling and mapping process explicitly excluded any flood defences.

NFH maps have been included in order to understand the risk of flooding in a worst-case undefended scenario. As the Site does not benefit significantly from defences, the risk shown by the NFH maps would be representative of the risks for the Site.

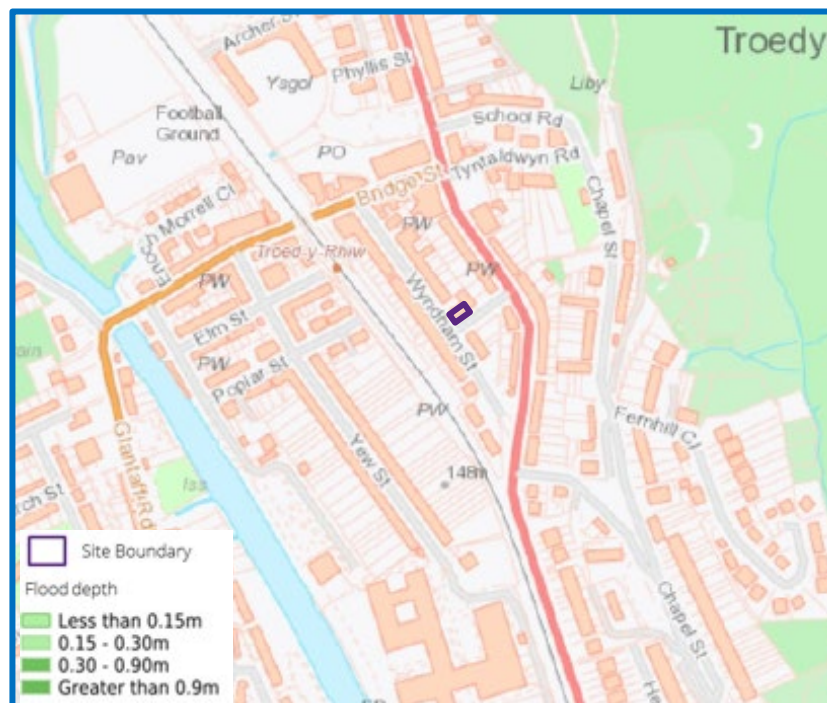
The fluvial flood risk maps indicate that the Site would be unlikely to be affected by flooding from the 1 in 1000 year event. However, flooding would be anticipated in the lower elevation neighbouring properties north of the Site, which could experience flood depths of up to and exceeding 0.9 m.

Road access to the Site would be impacted in both the 1 in 100 year and 1 in 1000 year flood scenarios, with flood depths of up to 0.9 m, and up to and exceeding 0.9 m respectively. Flood-free Pedestrian access would be available to the south east along Wyndham Street.

Due to the coarseness of the mapping resolution, it is possible that the Site would be within the flood extent for the 1 in 1000 year flood scenario. It can be assumed that the Site is at a Very Low to Low risk of fluvial flooding.

National Flood Hazard – Tidal Flood Risk

Figure 15. 1 in 1000 year (Low risk) map for tidal flooding (NRW, 2023)



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The tidal flood risk maps indicate that the Site would not be affected by flooding from the sea in the 1 in 1000 scenario.

Model data

As the Site is located within the NRW's fluvial floodplain, modelled flood elevation data was obtained from NRW and has been used to assess flood risk and to provide recommendations for mitigation for the proposed development.

Defended and limited undefended (for the 1 in 100 and 1000 year without climate change scenarios only) modelled data from the River Taff Modelling Study (JBA Consulting, 2017) has

been extracted from the 2D floodplain data provided at the Site.¹ The data is provided in Table 2 below.

Table 2. EA present day modelled flood data

Ground levels on-Site (mAOD)	Modelled Flood Levels (mAOD)				
	1 in 100 year (Defended)	1 in 100 year (Undefended)	1 in 200 year (Defended)	1 in 1000 year (Defended)	1 in 1000 year (Undefended)
139.57 to 142.22	138.14	138.75	139.09	140.07	140.08
Flood depths (m)	No flooding anticipated	No flooding anticipated	No flooding anticipated	Up to 0.50	Up to 0.51

As shown in Table 2, the Site would be impacted by fluvial flooding in the 1 in 1000 year overtopping flood scenario, with flood depths of up to 0.51 m. The Finished Floor Levels (FFL) of the proposed dwellings are estimated from plans to be 139.83 mAOD, and so would be expected to experience flood depths of up to 0.25 m in the 1 in 1000 year event.

Figure 16, overleaf, confirms the locations where the flood depths indicated in Table 2 were sampled. Each vector point approximately represents the closest extent of each flood event to the Site.

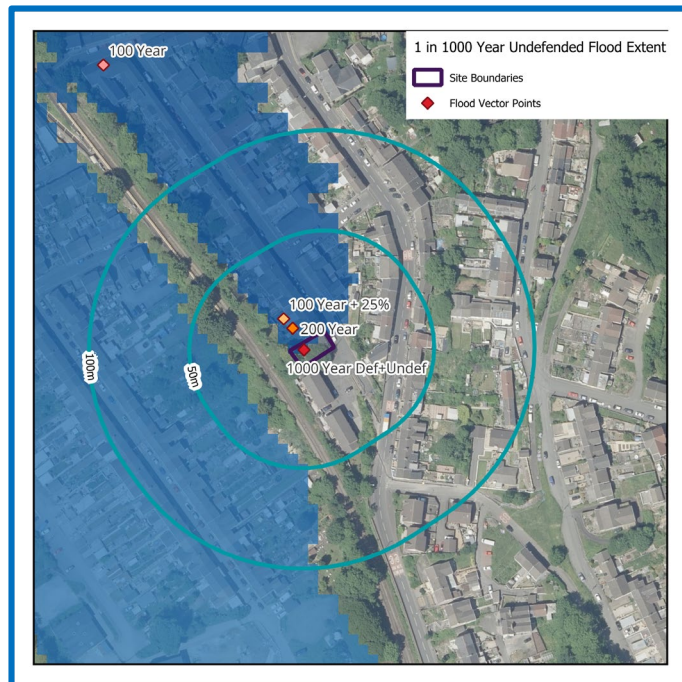
¹ The accuracy of the modelled flood levels are not known. These are dependent on the accuracy of input datasets such as LiDAR data, used to model the impacts of flooding within the 2D domain. Confirmation of the accuracy of the modelled flood data can be obtained separately from Natural Resources Wales.

Figure 16. Flood depth sampling locations



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Figure 17. Modelled 1 in 1000 year flood extent (NRW, 2023)



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Climate change factors

In accordance with the Welsh Government's Climate Flood Consequences Assessments: Climate change allowances guidance (2021), allowances should be made for the impact of increased river and sea levels and flows to the proposed development.

Due to recent changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes, unless the guidance stipulates this is the correct allowance to use (depending on the river basin and development proposals).

As the Site is located within the Severn River Basin and the proposed development is classed as More Vulnerable, where the proposed lifespan is 100 years, the Central (25%) allowances have been used to determine a suitable climate change factor to apply to river data.

The modelling report (JBA Consulting, 2017) provides a 25% climate change allowance scenario, which is included in Table 3 below. It is noted that the model data provided by NRW includes only the defended scenario for a 1 in 100 year plus 25% climate change flood event.

However, the protection that the flood defences would provide the Site in such an event would be minimal, as they are rated to defend from up to a 1 in 25 year flood and so would be overtopped.

Table 3. Flood levels plus climate change allowances

Ground levels on-Site (mAOD)	Modelled Flood Levels (mAOD)	
	1 in 100 year	1 in 100 year plus 25% 2080 central allowance for climate change flood level (mAOD)
139.57 to 142.22	138.14	138.83
Flood depths (m)	No flooding anticipated	No flooding anticipated

The modelled flood levels indicate that the Site would not be anticipated to be impacted by a 1 in 100 year plus 25% climate change flood scenario, as shown in Figure 18 overleaf.

Figure 18. Modelled defended 1 in 100 year with 25% climate change allowance flood depths (NRW, 2023)



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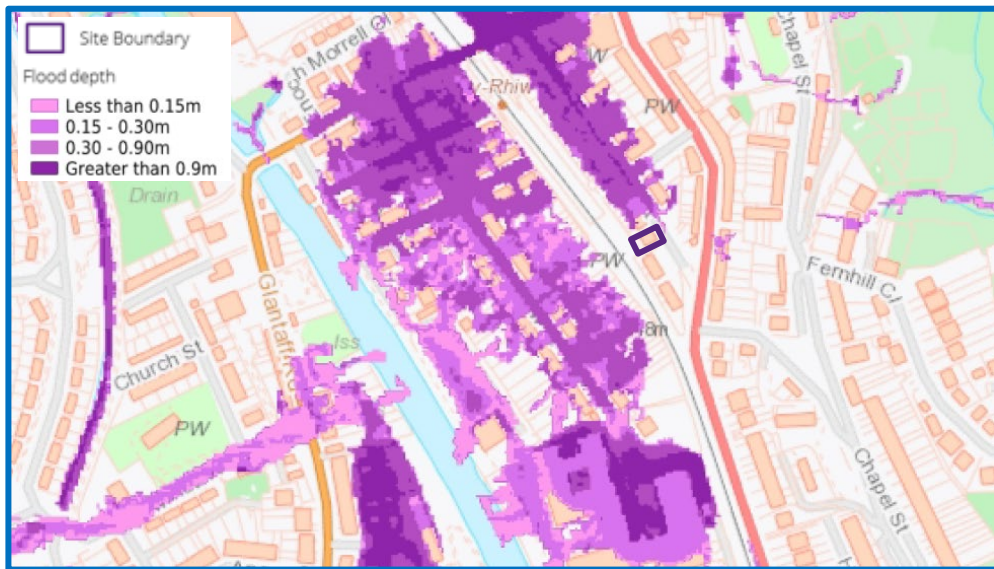
Surface water (pluvial) flooding

Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and tidal floodplains.

The SFCA does not indicate reported incidents of historical surface water flooding within 100 m of the Site (WHS, 2018).

According to the National Flood Hazard Map's Flood Risk from Surface Water and Small Watercourses flood mapping (Figure 19, overleaf), the Site has a Very Low risk of pluvial flooding.

Figure 19. NRW low surface water risk Hazard map (NRW, 2023)



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Guidance

According to NRW's surface water flood risk map the Site is at:

- Very Low risk - chance of flooding of less than 1 in 1000 (0.1%).

Figure 19 indicates the extent and depth of flooding in multiple modelled flood scenarios. Flooding would not impact the Site in the Low risk (1 in 1000 year) flood scenario, due to the ground levels of the Site being raised relative to the adjacent properties to the north.

Flooding depths of up to 0.90 m would impact the access routes to and from the Site in the 1 - 0.1% AEP (Low) risk event, restricted primarily to the northern side of Wyndham Street.

In the 3.3 - 1% AEP (Medium) risk and 1 - 0.1% AEP (Low) risk events, access to the Site would be significantly impacted, with flood depths of up to and exceeding 0.90 m along Wyndham Street blocking access to Cardiff Road. However, occupants could still evacuate from the area via pedestrian access to the southeast and onto Cardiff Road.

Climate change may lead to an increase in rainfall intensity which affects river levels, land and urban drainage systems. Rainfall intensity for small and urban catchments may increase from 5 to 20% (central estimate) or 10 to 40% (upper estimate) over the period to 2115 (NRW, 2023).

Any existing and proposed on-Site surface water drainage systems should be designed and maintained appropriately to manage the run-off over the lifetime of the proposed development.

A Site-specific assessment has been undertaken to refine the groundwater risk screening information on the basis of Site-specific datasets (see Section 3) including BGS borehole data, and the NRW's fluvial and tidal floodplain data (where available) to develop a conceptual groundwater model. The risk rating is refined further using the vulnerability of receptors including occupants and the existing and proposed Site layout, including the presence of basements and buried infrastructure. The presence of any nearby or on-Site surface water features such as drainage ditches, which could intercept groundwater have also been considered.

The risks are higher for basements, buried infrastructure and soakaway systems which may be affected by high groundwater levels. However, it is understood there are no existing basements and a basement is not proposed as part of the development.

According to a review of the hydrogeology (Section 3), the Site is likely underlain by permeable superficial deposits above permeable bedrock. Groundwater levels may rise in the bedrock and superficial aquifers in a seasonal response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years.

Groundwater levels may also rise in the bedrock and superficial aquifer in response to high river events due to the potential hydraulic continuity with the nearby River Taff.

It is noted groundwater flooding may occur in response to prolonged high water levels, bypassing flood defences even if overtopping does not occur.

The design of the property should consider the groundwater pathway through permeable formations.

Despite the presence of an aquifer the Site would only be at risk of groundwater flooding if the water table reaches the base of the Site development or the ground surface when groundwater seepage could lead to overland flow and ponding.

According to a review of the hydrogeology (Section 3), there are no nearby boreholes from which the underlying groundwater depth can be inferred.

The groundwater level may be influenced by the adjacent river levels though, with the 1 in 1000 level estimated to be 140.07 mAOD upon the Site, compared with ground levels of 139.57 to 142.22 mAOD.

The SFCA does not indicate any reported incidents of historical ground water flooding within 50 m of the Site (WHS, 2018).

Spring lines have not been identified within close proximity to the Site. However, multiple spring lines are located within 500 m of the Site, with the closest being located c. 350 m to the east. (Ordnance Survey mapping, 2023)

The local topography and drainage are such that the development threshold is likely to be higher than the area where groundwater emerges in adjacent low points.

The hydrogeological characteristics suggest there is potential for a groundwater table beneath the Site.

The baseline groundwater flood risk rating is Negligible to Moderate, but on the basis of the site-specific assessment the groundwater flood risk is considered to be Negligible to Low.

Low Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels. Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels. A rise in peak river levels will lead to a response of increased groundwater levels in adjacent aquifers subject to the predicted climate change increases in peak river level for the local catchment.

The impact of climate change on groundwater levels beneath the Site is linked to the predicted risk in both peak river levels and also the variation in rainfall recharge, which is uncertain.

Flooding from artificial sources

Artificial sources of flood risk include waterbodies or watercourses that have been amended by means of human intervention rather than natural processes. Examples include reservoirs (and associated water supply infrastructure), docks, sewers and canals. The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, sewer, canal, flood storage areas, etc.)

Sewer flooding

The SFCA (WHS, 2018) has identified no recorded instances of flooding as a result of surcharging sewers.

Guidance

Properties classified as “at risk” are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period. Records held by the sewage utility company provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

Canal failure

According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.

Water supply infrastructure

Water supply infrastructure is comprised of a piped network to distribute water to private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.

If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier, Welsh Water.

Culverts and bridges

The blockage of watercourses or structures by debris (that is, any material moved by a flowing stream including vegetation, sediment and man-made materials or refuse) reduces flow capacity and raises water levels, potentially increasing the risk of flooding. High water levels can cause saturation, seepage and percolation leading to failure of earth embankments or other structures. Debris accumulations can change flow patterns, leading to scour, sedimentation or structural failure.

Culverts and bridges have not been identified within 50 m of the Site and the SFCA has not identified any historic drainage issues within the Site area (WHS, 2018).

Reservoir flooding

According to the NRW's Flood Risk from Reservoirs mapping, the Site is at risk of flooding from reservoirs (Figure 21) (NRW, 2023).

The Site is considered to be at risk of flooding from the following reservoirs:

- Beacons
- Pontsticill (Taf Fechan)
- Cantref
- Llwyn-On

Figure 21. NRW Flood Risk from Reservoirs Flooding (NRW, 2023)



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Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m³ of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (NRW, 2023).

5. Flood risk from the development



Floodplain storage

Where flood storage from any source of flooding is to be lost as a result of development, on-Site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on Site, it may be acceptable to provide it off-Site if it is hydraulically and hydrologically linked.

The loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure or where the source of flood risk is solely tidal.

The development is located partially within fluvial Flood Zone 3 and involves an increase in building footprint but would not be impacted by the 1 in 100 year plus 25% climate change event. Therefore, there would be no displacement of flood water in the design flood event and compensatory flood storage is not required.

Drainage and run-off

Based on the topography and low surface water flood risk upon the Site, interference or interaction with overland flow paths and inflows from off-Site is considered unlikely.

The potential surface water run-off generated from the Site during a 1 in 100 year return period should be calculated, using FEH 2013 rainfall data from the online Flood Estimation Handbook (FEH), developed by NERC (2009) and CEH (2016).

The PPW (2021) recommends the effects of climate change are incorporated into FRA's and the recently updated climate change guidance (published in 2016 and updated in 2021) confirms the requirements for inclusion within FRA's.

As the proposed development is residential, the lifespan of the development and requirements for climate change should allow up to the 2115 scenario.

Table 4. Climate change rainfall allowances

Dee river basin district	Total potential change anticipated by the 2020s	Total potential change anticipated by the 2050s	Total potential change anticipated by the 2080s
Upper end	20%	30%	45%
Central	10%	15%	20%

A separate assessment of surface water runoff may be required, as the Statutory requirements in Wales are to include a SuDS strategy, where development proposals are

greater than 100m² in size. This is to ensure surface water runoff is managed in accordance with the Welsh Statutory requirements over the lifetime of the proposed development.

Sustainable Drainage System (SuDS)

It is recommended that attenuation of run-off is undertaken on-Site to compensate for proposed increases in impermeable surface areas. Attenuation may comprise the provision of storage within a Sustainable Drainage System (SuDS). SuDS can deliver benefits from improving the management of water quantity, water quality, biodiversity and amenity. Potential SuDS options are presented in the table below, subject to further investigation:

Table 5. SuDS features which may be feasible for the Site

Option	Description
Rainwater harvesting	Rainwater harvesting can collect run-off from the roofs for use in non-potable situations, using water butts for example.
Permeable paving	Permeable pavements can be used for driveways, footpaths and parking areas to increase the amount of permeable land cover. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2007) will improve water quality due to their filtration capacity. Plastic geocellular systems beneath these surfaces can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles.

6. Suitability of the proposed development



The information below outlines the suitability of proposed development in relation to national and local planning policy.

National policy and guidance

The aims of the national planning policies TAN15 (2004) and PPW (2021) are achieved through application of the Justification Test and by assessing Flood Consequences. The key requirements of these are outlined below:

Guidance

Justification Test: New developments should be directed away from Zone C and towards suitable land in Zone A, or Zone B where river or coastal flooding will be less of an issue. In Zone C the tests outlined in sections 6 and 7 of TAN15 will be applied, recognizing, however, that highly vulnerable development and Emergency Services in Zone C2 should not be permitted. All other new development should only be permitted within Zones C1 and C2 if determined by the planning authority to be justified in that location.

Assessing Flood Consequences: If a development proposal in Zone C1 or in C2, and if it is defined as being of low vulnerability, it would meet the test outlines in section 6. However, it should be noted that those developments would be more likely to flood and appropriate mitigation would need to be planned accordingly. This section applies to Zone C, and those parts of Zone B where flooding has been identified as a material consideration to allow for localised problems.

Assessing whether a development should proceed or not will depend upon whether the consequences of flooding of that development can be managed and reduced to a level which is acceptable for the nature/type of proposed development, including its effects on existing development.

The proposed Site use is residential and is classified as “Highly Vulnerable” development. The Site is located partially within the Development Advice Map (DAM) Zone C2, and partially within Zone B. Recommendations are to raise the ground levels so they are higher than 140.07 mAOD, to ensure the Site is located above the DAM Zone C2 and 1000 year flood level.

Table 6. Flood risk vulnerability and flood zone compatibility (taken from TAN15, 2004)

DAM Zone	Development Type	Planning Requirements	Acceptability Criteria	Development Advice
A	Emergency Services, highly vulnerable	Justification test not applicable	No increase in flooding elsewhere	No constraints relating to river or coastal

	development, less vulnerable development, other	Refer to surface water requirements		flooding, other than to avoid increasing risk elsewhere
B	Emergency services & Highly vulnerable development	- If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Escape/Evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Generally suitable for most forms of development. Assessments where required, are unlikely to identify consequences that cannot be overcome or managed to an acceptable level. It is unlikely, therefore, that these would result in a refusal of planning consent on the grounds of flooding.
	Less vulnerable development	Refer to surface water requirements	- Occupiers aware of flood risk - No increase in flooding elsewhere	
	Other	Refer to surface water requirements	No increase in flooding elsewhere	
C1	Emergency services, highly vulnerable development, less vulnerable development	- Application of justification test including acceptability of consequences - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Plan allocations and applications for all development can only proceed subject to justification in accordance to section 6 of TAN 15 and acceptability of consequences in accordance to section 7 and Appendix 1 of TAN 15

	Other	- Application of acceptability of consequences (TAN 15 section 7 and Appendix 1) - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Desirable if effective flood warning and evacuation routes/procedure provided depending on nature of proposal - No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix 1 of TAN 15
C2	Emergency services, highly vulnerable development	The flooding consequences associated with Emergency Services and highly vulnerable developments are not considered to be acceptable. Plan allocations should not be made for such developments and planning applications not proposed		
	Less vulnerable development	- Application of justification test (section 6 of TAN 15), including acceptability of consequences (section 7 and Appendix 1 of TAN 15) - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures	Plan allocations or applications for less vulnerable development can only proceed subject to justification in accordance with section 6 of TAN 15 and acceptability of consequences in accordance with section 7 and Appendix 1 of TAN 15
	Other	- Application of acceptability of consequences (section 7 and Appendix 1 of TAN 15) - Refer to surface water requirements	- Flood resistant design - No increase in flooding elsewhere - Acceptable consequences for nature of use - Occupiers aware of flood risk - Effective flood warning provided - No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix 1 of TAN 15.

*Recommendations are to raise ground levels above the DAM Zone C2 and 1 in 1000 year flood event level, to ensure the proposals are in line with TAN15.

The following Justification and Acceptability Criteria are relevant to the highly vulnerable developments.

Justification Criteria:

- 1) Should be located only in an area of flood risk which is developed and served by significant infrastructure, including flood defences (Zone C1 of the DAM).

Geosmart Comment: The Site is located partially within Zone C2 of the DAM, and does not benefit significantly from flood defences. Although recommendations in this report are to ensure ground levels are set above DAM Zone C2 and the 1 in 1000 year flood event.

- 2) Its location is necessary to assist a local authority regeneration initiative or Strategy, or contribute to key employment objectives, necessary to sustain an existing settlement or region.

Geosmart Comment: N/A due to development proposals.

- 3) The site meets the definition of previously developed land (i.e. it is not a Greenfield site) and concurs with the aims of Planning Policy Wales (i.e. the presumption in favour of sustainable development).

Geosmart Comment: The proposed development is upon previously developed land.

- 4) A Flood Consequence Assessment has been produced to demonstrate that the potential consequences of a flood event up to the extreme flood event (1 in 1000 chance of occurring in any year) have been considered and meet the criteria below in order to be considered acceptable.

Geosmart Comment: This FCA confirms that the potential consequences of a flood event can be reduced through flood mitigation measures up to a 1 in 1000 year flood event.

Acceptability Criteria (has to meet all):

Q. Flood defences must be shown by the developer to be structurally adequate particularly under extreme overtopping conditions (i.e. that flood with a 1 in 1000 chance of occurring in any year).

GeoSmart Comment. The Site does not benefit significantly from flood defences, and no flood defences are proposed as part of the development.

Q. The cost of future maintenance for all new/approved flood mitigation measures, including defences must be accepted by the developer and agreed with the Environment Agency (now Natural Resources Wales).

Geosmart Comment: The cost of flood defences would not be relevant in this instance, as none are proposed. Recommended FFLs and flood resilience measures would be maintained as part of the development structure.

Q. The developer must ensure that future occupiers of the development are aware of the flooding risks and consequences.

Geosmart Comment: All future occupants of the building should be notified of the flood risk.

Q. Effective flood warnings are provided at the site.

GeoSmart Comment. All occupants should be signed up for NRW Flood Warnings and Alerts.

Q. Escape/evacuation routes are shown by the developer to be operational under all conditions.

GeoSmart Comment. Access to the east and south east are unimpeded in a 1 in 1000 year flood event.

Q. Flood emergency plans and procedures produced by the developer must be in place.

Geosmart Comment: A flood emergency plan should be developed for the Site.

Q. The development is designed by the developer to allow the occupier the facility for rapid movement of goods/possessions to areas away from floodwaters.

Geosmart Comment: Pedestrian access to the Site would be anticipated to be unimpeded by flooding in the 1 in 1000 year event. In a worst case scenario, possessions could be held safely upon the first or attic floors. FFLs of the building will be set above the 1 in 100 year plus CC event.

Q. Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood.

Geosmart Comment: Flood resilience measures are recommended as part of this report.

Q. No flooding elsewhere.

GeoSmart Comment. As the Site would not be impacted by the 1 in 100 year plus 25% climate change flood event, there would be no displacement of flood waters caused by the development and so no increase in flood risk to other properties.

Q. Developer is required to demonstrate that the site is designed to be flood free for the lifetime (A1.5) of development for either a 1 in 100 chance (fluvial) flood event, or a 1 in 200 chance (tidal) flood event including an allowance for climate change (depending on the type of flood risk present) in accordance with table A1.14.

GeoSmart Comment. Analysis of the Site does demonstrate that the development would be flood free during a 1 in 100 year plus 25% climate change fluvial flooding event.

Q. In respect of the residual risk to the development it should be designed so that over its lifetime (A1.5) in an extreme (1 in 1000 chance) event there would be less than 600mm of water on access roads and within properties, the velocity of any water flowing across the development would be less than 0.3 m/second on access roads and 0.15m/second in properties, and the maximum rate of rise of floodwater would not exceed 0.1m/hour (see table A1.15).

GeoSmart Comment. Analysis of the Site demonstrates that the road access to the north of the Site at a lower elevation would be affected by flood depths of up to and exceeding 0.90 m, at velocities of up to 1.05 m/s, during a 1 in 1000 year event. This does not satisfy the requirements of A1.15 of TAN15 (2004). However, pedestrian access would be available to the south east of the Site along Wyndham Street, with no flooding anticipated in this event.

As ground levels would be levelled as part of development proposals, the risk of flooding in a 1 in 1000 year event would likely be diminished due to the raising of minimum ground level.

7. Resilience and mitigation



Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the mitigation measures outlined within this section of the report are likely to help protect the development from flooding.

Sea (coastal/tidal) flood mitigation measures

As the Site is not identified as being at risk of flooding from the sea, mitigation measures are not required.

Rivers (fluvial) flood mitigation measures

The Site is located within an area that is affected by flooding from rivers, Table 7 confirms the flood depths associated with the area proposed for development:

Table 7. Flood levels compared to ground levels in the area proposed for development

Ground levels in area proposed for development (mAOD)	Modelled Flood Levels (mAOD)			
	1 in 100 year	1 in 100 year plus 25% CC	1 in 200 year	1 in 1000 year
139.57 to 142.22	138.14	138.83	139.09	140.07
Flood depths (m)	No flooding anticipated	No flooding anticipated	No flooding anticipated	Up to 0.50

Raising minimum floor levels

The vulnerability classification of the Site and the Flood Zone means proposals for the Site require mitigation for highly vulnerable developments.

In this instance, although the Site would not be anticipated to flood in a 1 in 100 year plus 25% climate change scenario, external ground levels should be set higher than DAM Zone C2 and 1 in 1000 year flood level of 140.07 mAOD. Finished Floor Levels (FFL) of the buildings should be set 0.30 m above 140.07 mAOD.

If these mitigation measures are implemented this could reduce the flood risk to the development from Very Low/Low to Very Low.

Surface water (pluvial) flood mitigation measures

As the Site is not identified as being at risk of pluvial flooding, mitigation measures are not required. However, as the development proposals are greater than 100 m² in area, in accordance with the Welsh Statutory requirements a SuDS strategy should be developed. This is to ensure surface water runoff is managed over the lifetime of the proposed development.

Groundwater flood mitigation measures

It is likely the flood mitigation measures recommended for river/sea risk will reduce the groundwater flood risk at the development. However specific groundwater measures that may also be considered for the Low risk identified include:

- Waterproof tanking of the ground floor
- Interceptor drains
- Automatic sump to extract flood water
- Non-return flap valves on the proposed foul and surface water sewer lines

If these mitigation measures are implemented this could reduce the flood risk to the development from Negligible/Moderate to Negligible.

Reservoir flood mitigation measures

According to NRW data, the Site is considered to be at risk of flooding from the following reservoirs:

- Beacons
- Pontsticill (Taf Fechan)
- Cantref
- Llwyn-On

Although the risks posed by reservoirs cannot be quantified, the likelihood of a reservoir breach occurring in the UK is considered to be very low due to the high level of maintenance carried out upon these reservoirs.

If a breach did occur there would be a relatively high rate and onset of flooding, thus it is unlikely that safe access could be achieved unless a long warning period was provided. Therefore, occupants should get to the highest level of the building as possible and contact the emergency services.

Other flood risk mitigation measures

As the Site is not identified as at risk from other sources, mitigation measures are not required.

Residual flood risk mitigation measures

The risk to the Site has been assessed from all sources of flooding and appropriate mitigation and management measures proposed to keep the users of the development safe over its lifetime. There is however a residual risk of flooding associated with the potential for failure of mitigation measures if regular maintenance and upkeep isn't undertaken. If mitigation measures are not implemented or maintained, the risk to the development will remain as the baseline risk.

Further flood mitigation information

More information on flood resistance, resilience and water entry can be found here: http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

www.knowyourfloodrisk.co.uk

Emergency evacuation – safe access / egress and safe refuge

Emergency evacuation to land outside of the floodplain should be provided if feasible. Where this is not possible, 'more vulnerable' developments and, where possible, development in general (including basements), should have internal stair access to an area of safe refuge within the building to a level higher than the maximum likely water level. An area of safe refuge should be sufficient in size for all potential users and be reasonably accessible to the emergency services.

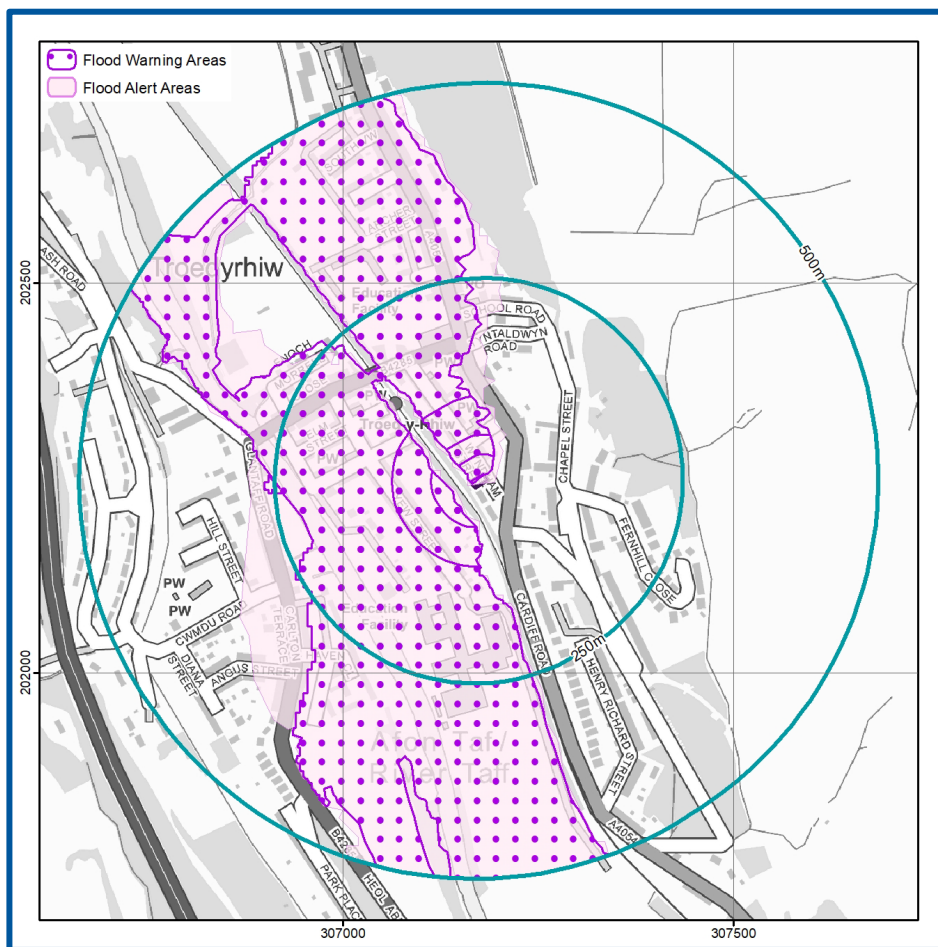
Emergency evacuation from the development and the Site should only be undertaken in strict accordance with any evacuation plans produced for the Site, with an understanding of the flood risks at the Site including available mitigation, the vulnerability of occupants and preferred evacuation routes.

Flood warnings

The NRW operates a flood warning service in all areas at risk of flooding; this is available on their website: <https://www.gov.uk/check-flood-risk>. The Site is located within an NRW Flood Alerts area (ref:103WAFtaf) and Warning coverage area (ref:103WAFtaf) so is able to receive alerts and warnings (Figure 21, overleaf). All warnings are also available through the NRW's 24-hour Floodline Service number 0345 988 1188, quick-dial 197102.

The NRW aims to issue Flood Warnings 2 hours in advance of a flood event. Flood Warnings can provide adequate time to enable protection of property and evacuation from a Site, reducing risk to life and property.

Figure 22. NRW Flood Warning Coverage for the local area (NRW, 2023).



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Emergency evacuation

Where possible, a safe access and egress route with a 'very low' hazard rating from areas within the floodplain to an area wholly outside the 1 in 100 year flood event including an allowance for climate change should be demonstrated.

Based on the EA's Flood Zone Map the closest dry evacuation area within Flood Zone 1 is south-east along Wyndham Street (adjacent to the Site). It is advised that evacuation from the premises would be the preferred option in a flood event if safe to do so. It is recommended that residents prepare to evacuate as soon as an NRW Flood Warning is issued in order to completely avoid flood waters.

On-Site refuge

Evacuation should be the primary action in preference, however safe refuge could be sought at first floor level in a worst-case scenario.

Other relevant information

A Flood Warning and Evacuation Plan (FWEP) is recommended, and occupants should be signed up to receive NRW's Flood Alerts and Warnings.

Registration to the Natural Resource Wales flood warning scheme can be done by following this link: <https://www.gov.uk/sign-up-for-flood-warnings>.

It is recommended that main communication lines required for contacting the emergency services, electricity sockets/meters, water supply and first aid stations and supplies are not compromised by flood waters. Where possible these should all be raised above the extreme flood level.

8. Conclusions and recommendations



Table 8. Risk ratings following Site analysis

Source of Flood Risk	Baseline ¹	After analysis ²	After Mitigation ³
River (fluvial) flooding	Very Low to Low		Very Low
Sea (coastal/tidal) flooding	Very Low		N/A
Surface water (pluvial) flooding	Very Low		N/A
Groundwater flooding	Negligible to Moderate		Negligible
Other flood risk factors present	Yes (Reservoir Breach)		N/A
Is any other further work recommended?	Yes	Yes	Yes (see below)

1 BASELINE risks assigned for the whole Site, using national risk maps, including the benefit of NRW flood defences.

2 AFTER ANALYSIS modification of risk assessment based on detailed site-specific analysis including some or all of the following: flood model data, high resolution mapping, building location, access routes, topographic and CCTV surveys. Reasons for the change in classification are provided in the text.

3 AFTER MITIGATION risks include risks to the proposed development / asset and occupants if mitigation measures recommended in this report are implemented, including the impacts of climate change.

*N/A indicates where mitigation is not required.

The table below provides a summary of where the responses to key questions are discussed in this report. Providing the recommended mitigation measures are put in place it is likely that flood risk to this Site will be reduced to an acceptable level.

The majority of the Site is located in DAM Zone B, but the Site is also partially located within DAM Zone C2 and the development is classed as Highly Vulnerable, which will require review and discussion of mitigation measures with the Local Authority. It should be noted that in a 1 in 1000 year modelled event, the building access would not be impacted from the east of the Site and FFL's are recommended to be raised 300mm above average ground levels.

Table 9. Summary of responses to key questions in the report

Key sources of flood risks identified	Rivers, Groundwater (see Section 4).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes (see Section 7).
Is any further work recommended?	Yes (see exec summary and Section 7)

9. References and glossary



References

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Welsh Government (2021). Flood Consequence Assessments: Climate change allowances. Accessed from: https://gov.wales/sites/default/files/publications/2021-09/climate-change-allowances-and-flood-consequence-assessments_0.pdf on 01/08/23.

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Welsh Government (2021). Technical Advice Note 15: Development, Flooding and Coastal Erosion (not currently used to inform national policy, will be implemented in June 2023).

Glossary

General terms

BGS	British Geological Survey
NRW	National Resource Wales
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 100 year return period scenario.
Dry-Island	An area considered at low risk of flooding (e.g. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (e.g. Flood Zone 2 and 3)
Flood resilience	Flood resilience or wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is $\pm 0.25\text{m}$ for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFCA	Strategic Flood Consequence Assessment. This is a brief flood risk assessment provided by the local council

SuDS

A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a Site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDS Approval Board (SABs).

Aquifer Types

Principal aquifer

These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

Secondary A aquifer

Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Secondary B aquifer

Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

Secondary undifferentiated

Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type due to the variable characteristics of the rock type.

Unproductive Strata

These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2023 BlueSky copyright and database rights 2023
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Flood Zone/RoFRS/Historic Flooding/Pluvial/Surface Water)	Natural Resource Wales copyright and database rights 2023

Features/Reservoir/ Flood Alert & Warning)	Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2023) Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2023
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2023 Natural Resource Wales copyright and database rights 2023

10. Appendices



Appendix A



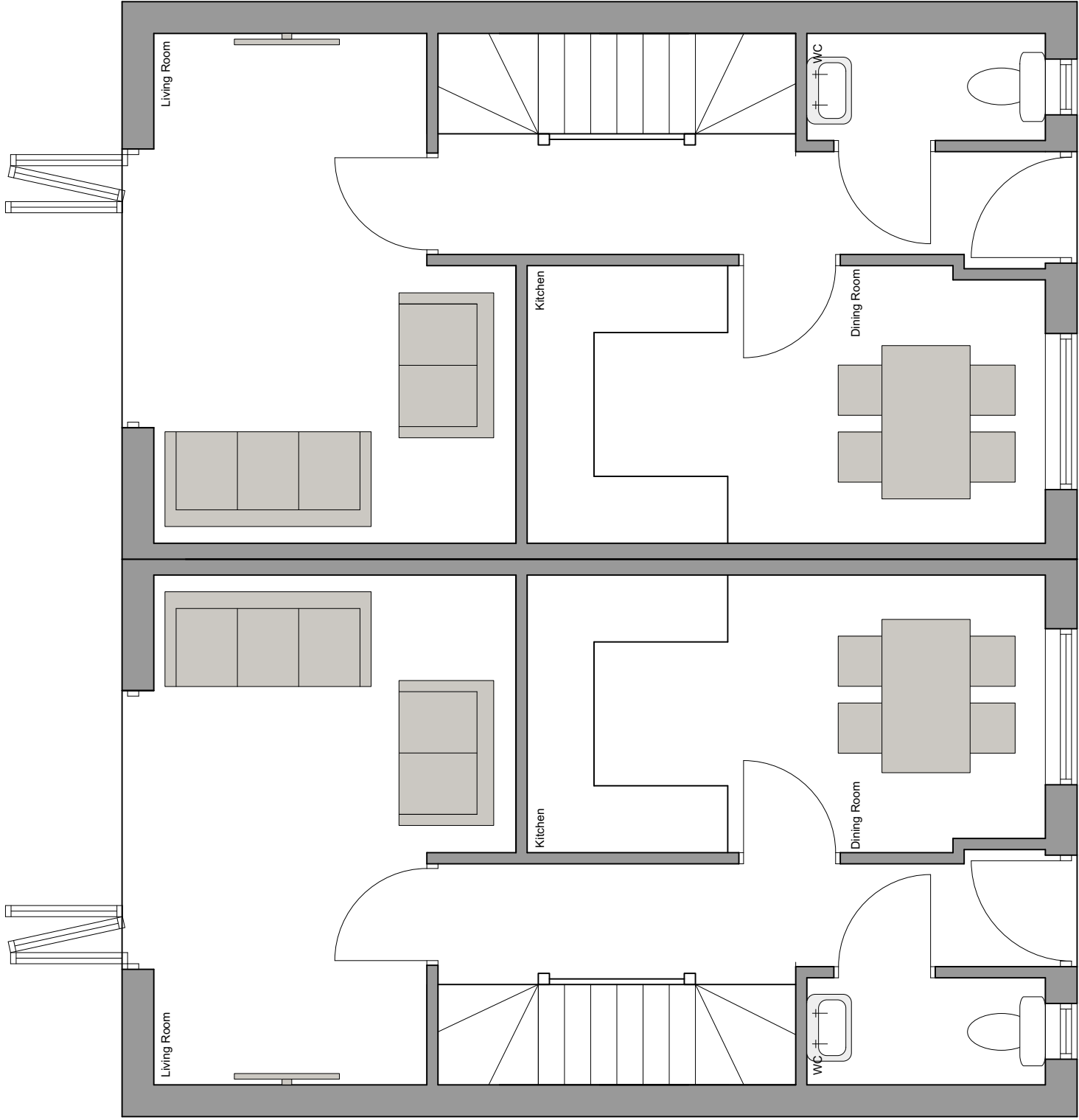
Site plans



George and Co.

Wyndham Street,
Troedyrhiw,
Merthyr Tydfil,
CF48 4JY

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planning	1:50@A3	May 23	CG
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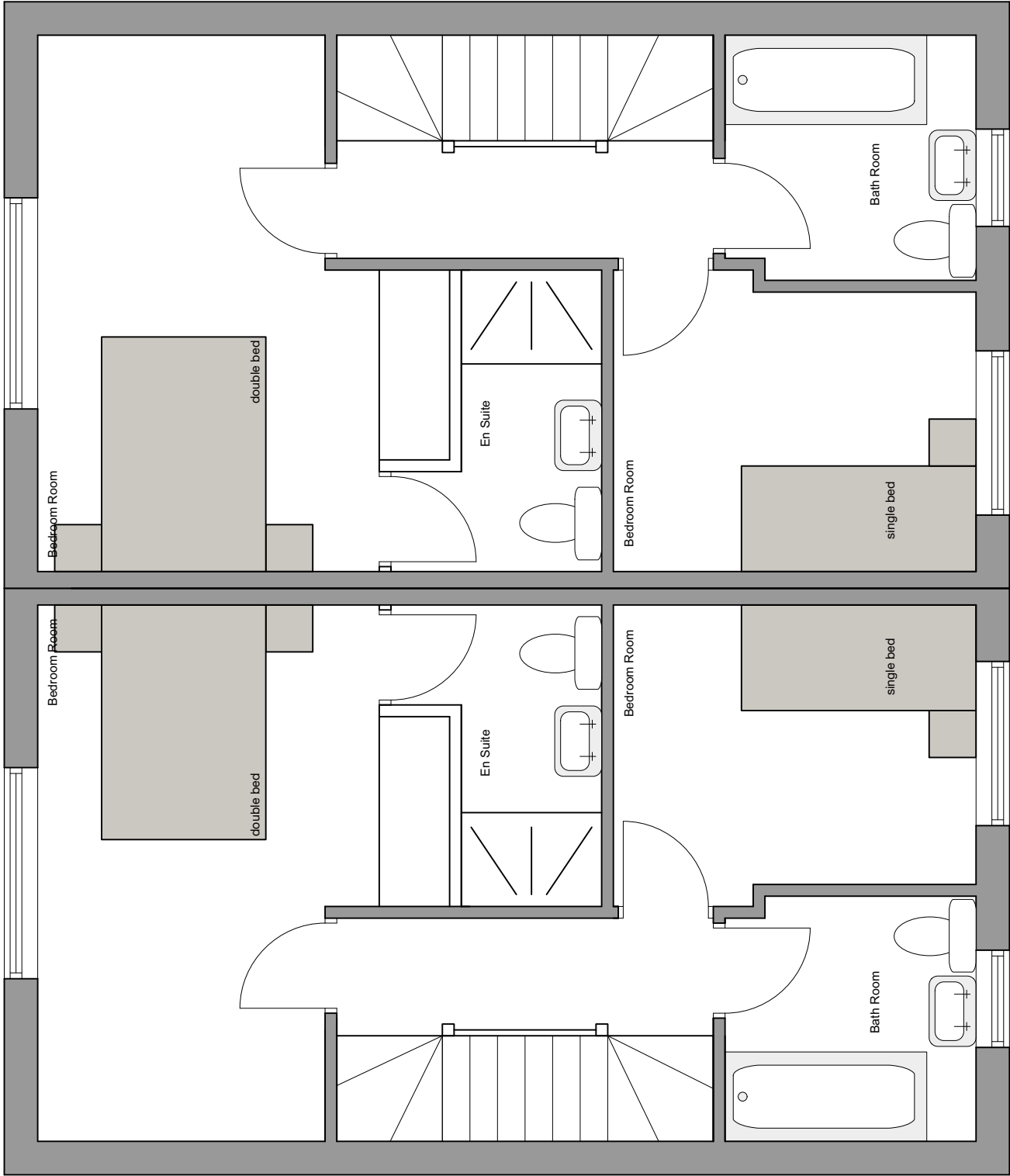


PROPOSED GROUND FLOOR PLAN

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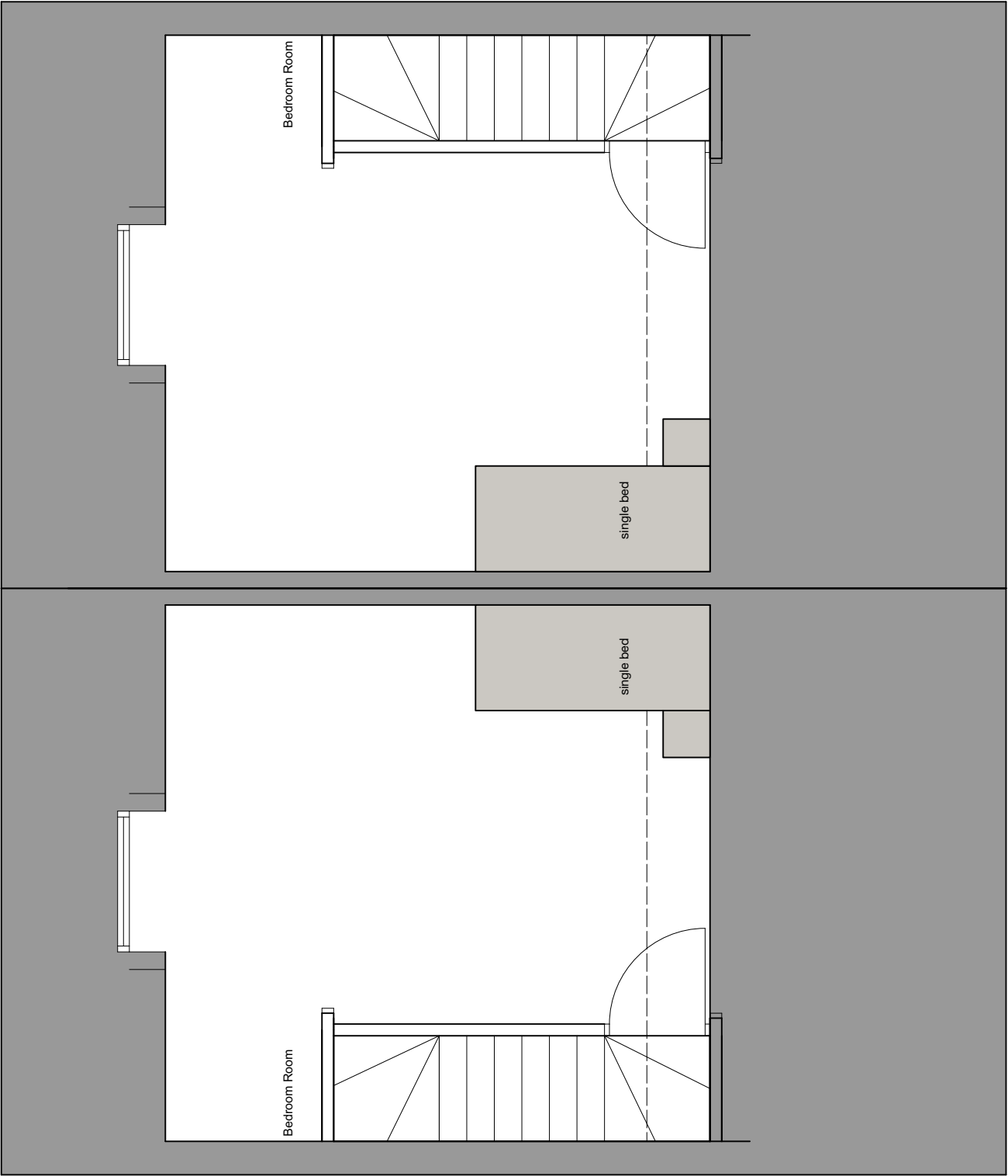


PROPOSED FIRST FLOOR PLAN

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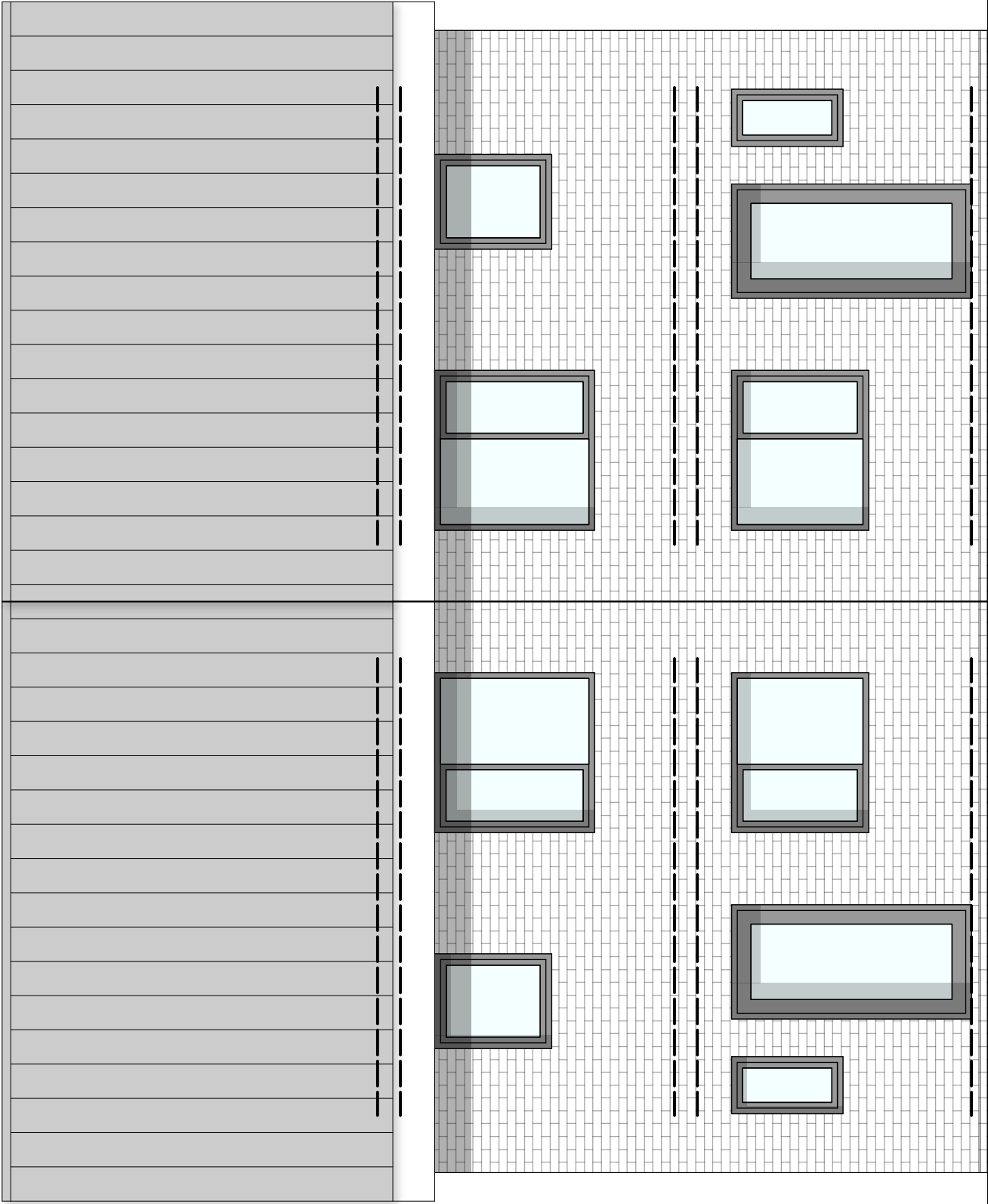
PROPOSED ATTIC FLOOR PLAN



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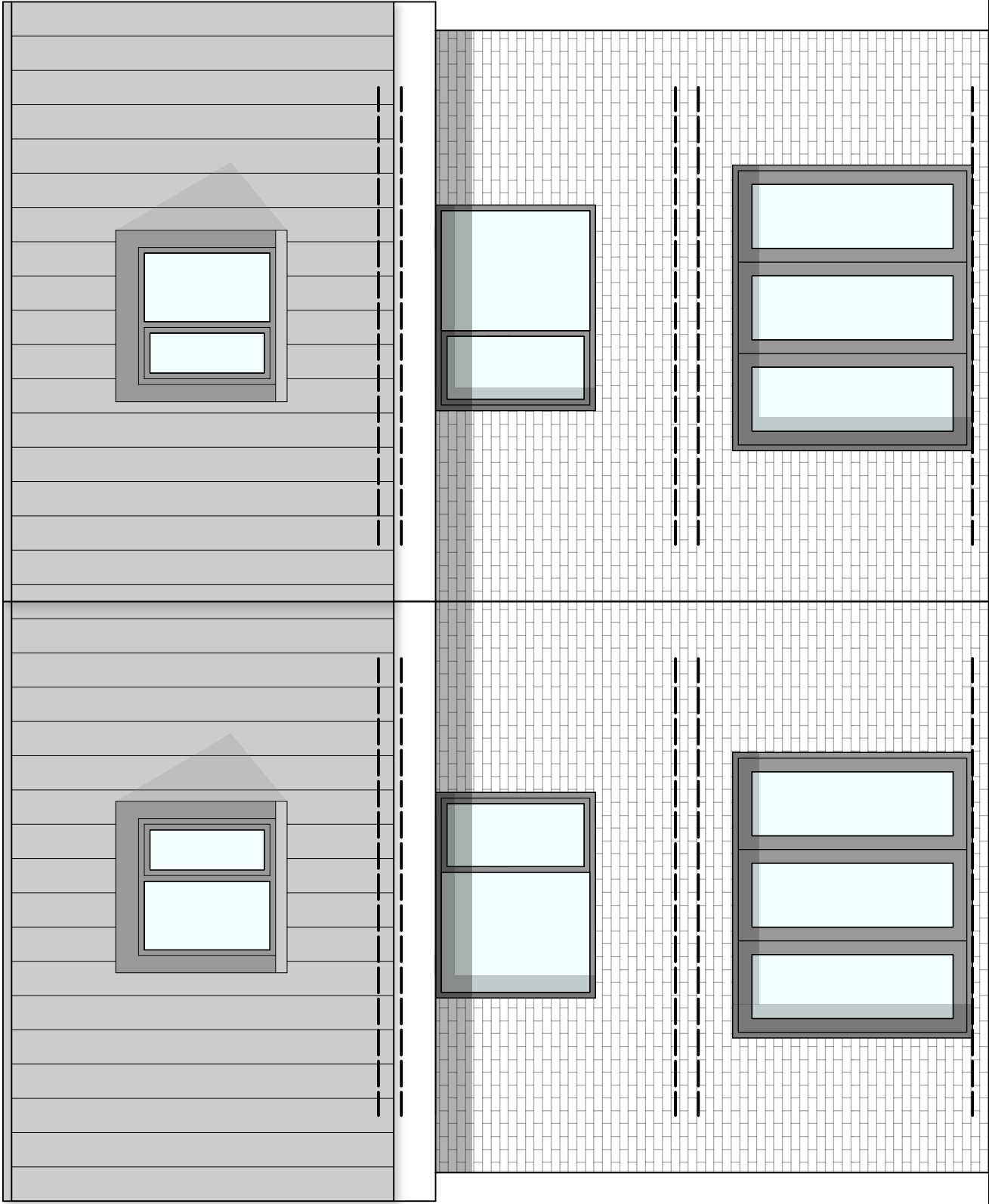
PROPOSED FRONT ELEVATION



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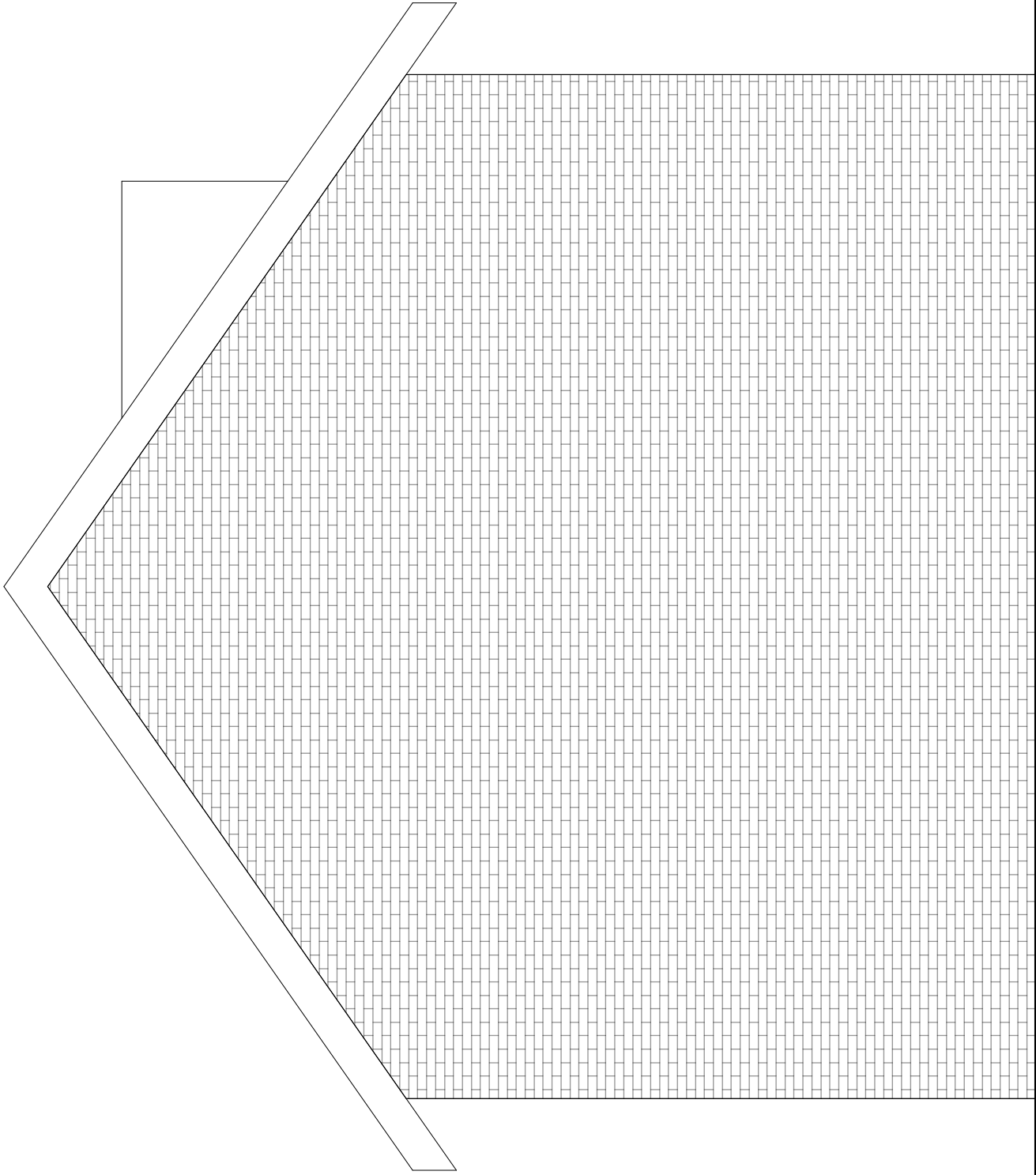


PROPOSED REAR ELEVATION

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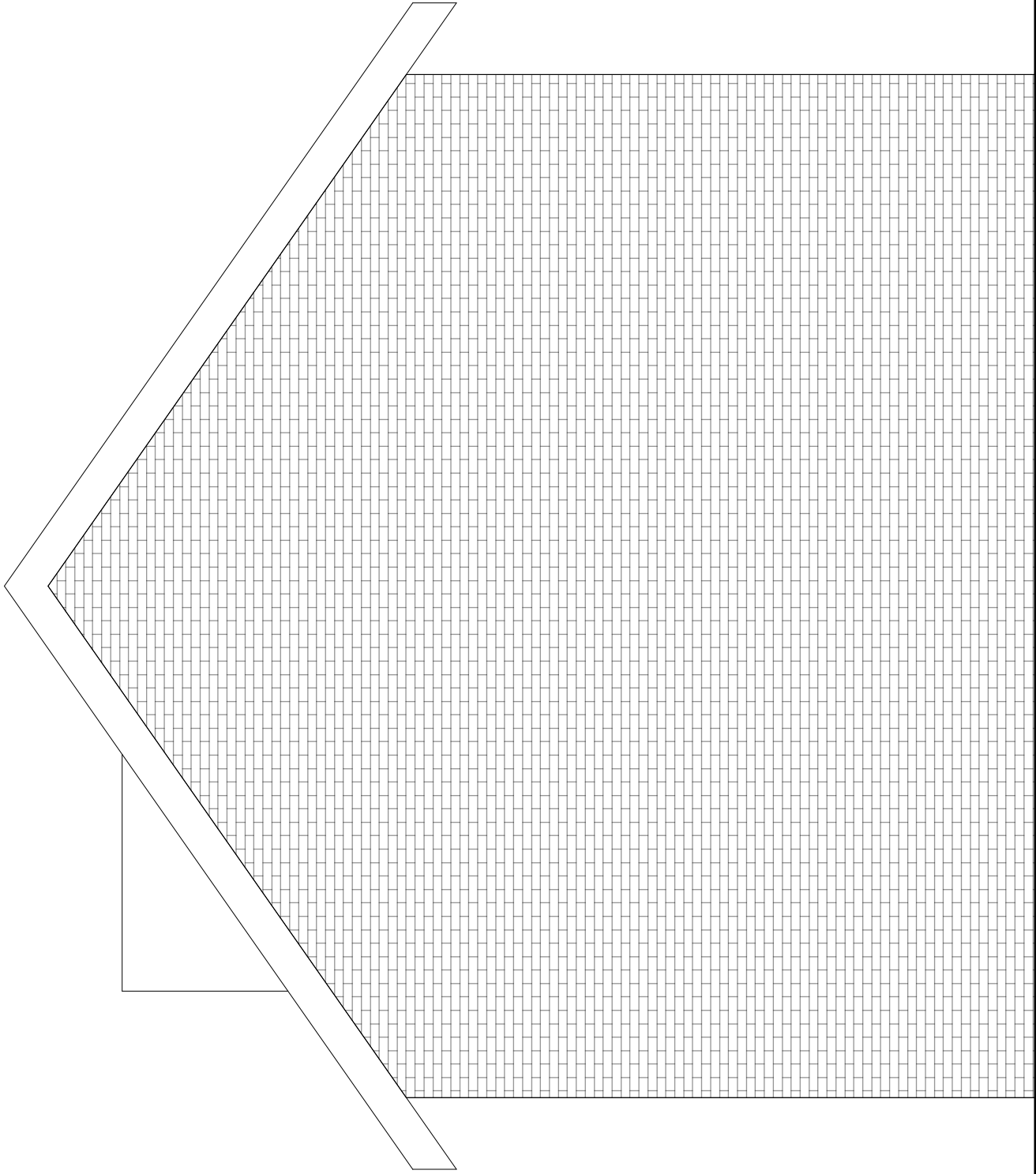
PROPOSED SIDE ELEVATION



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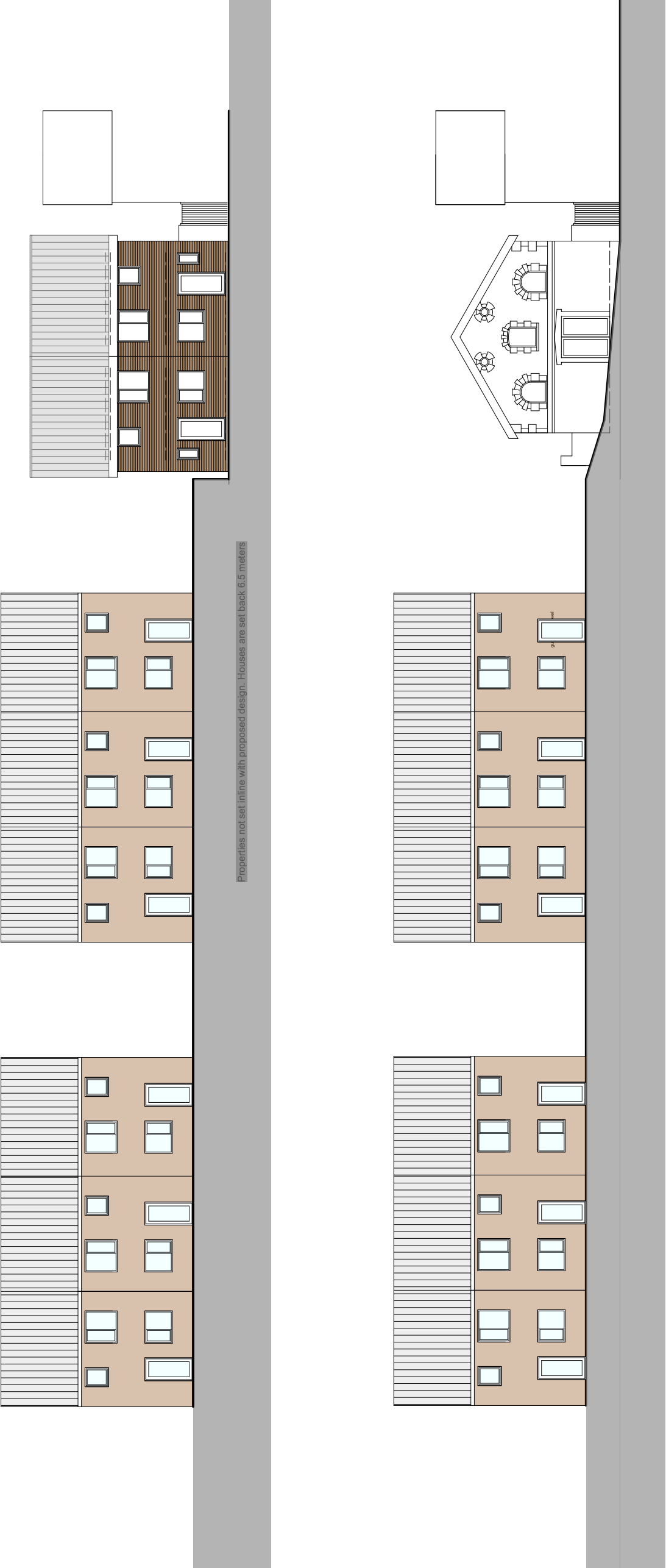
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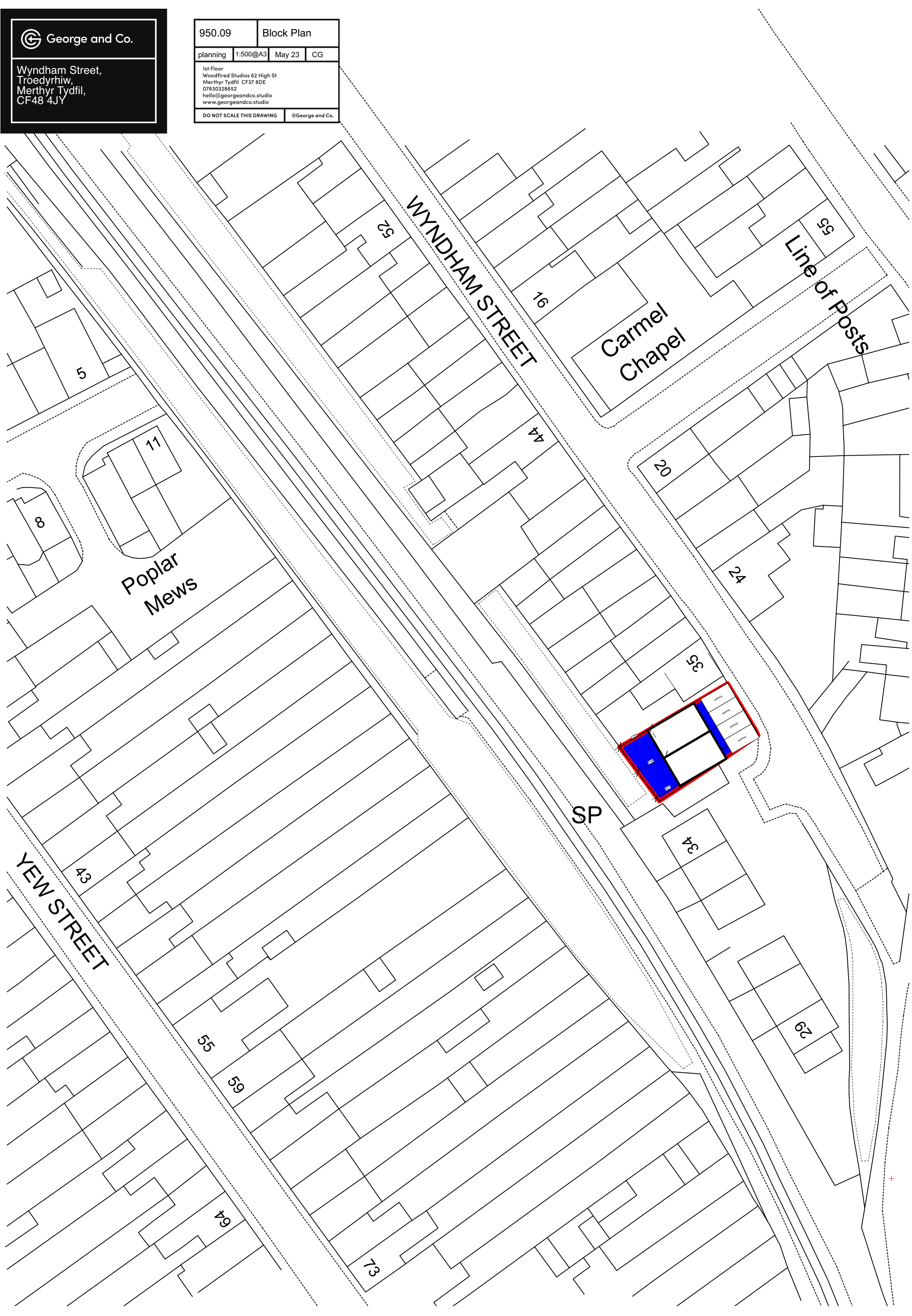




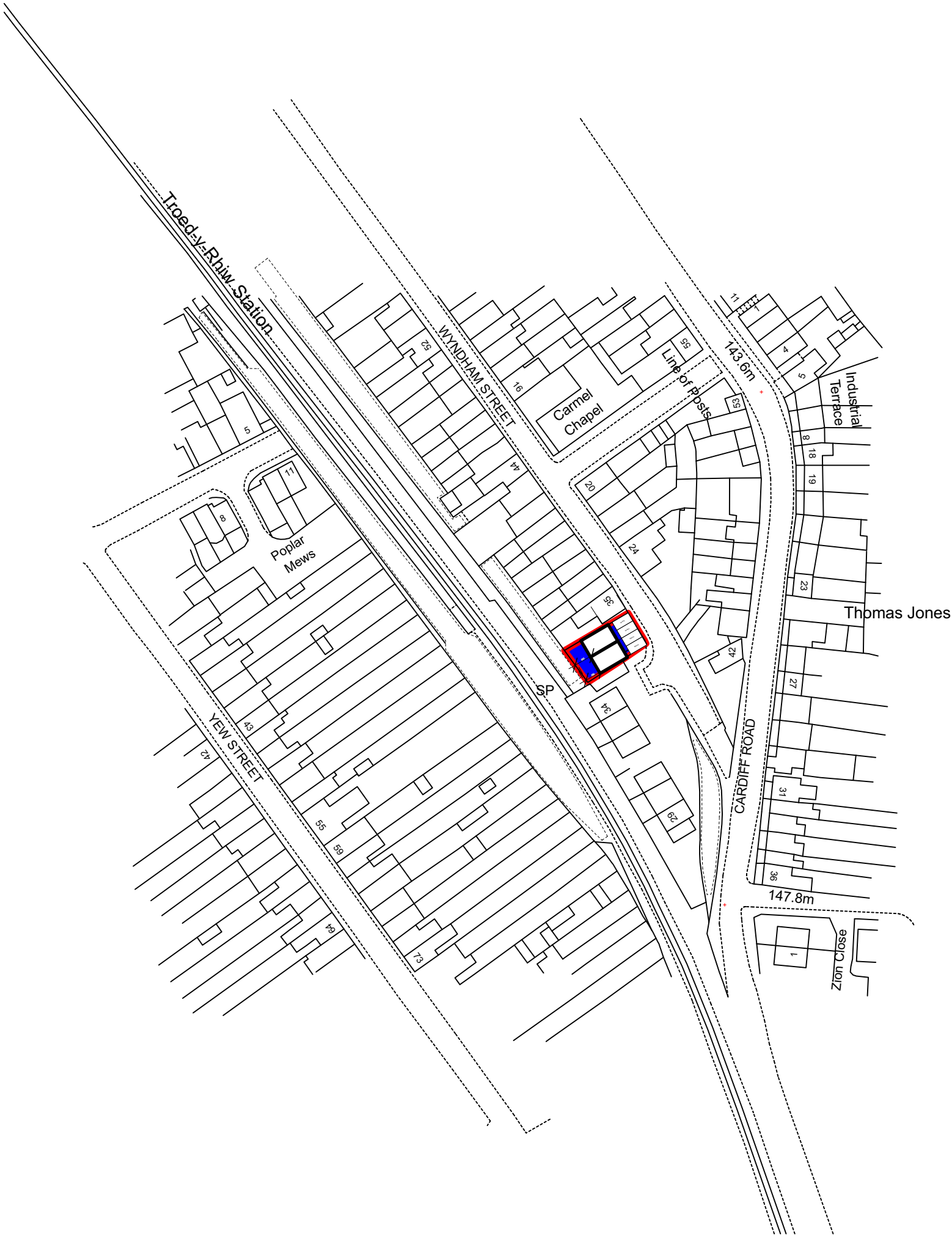
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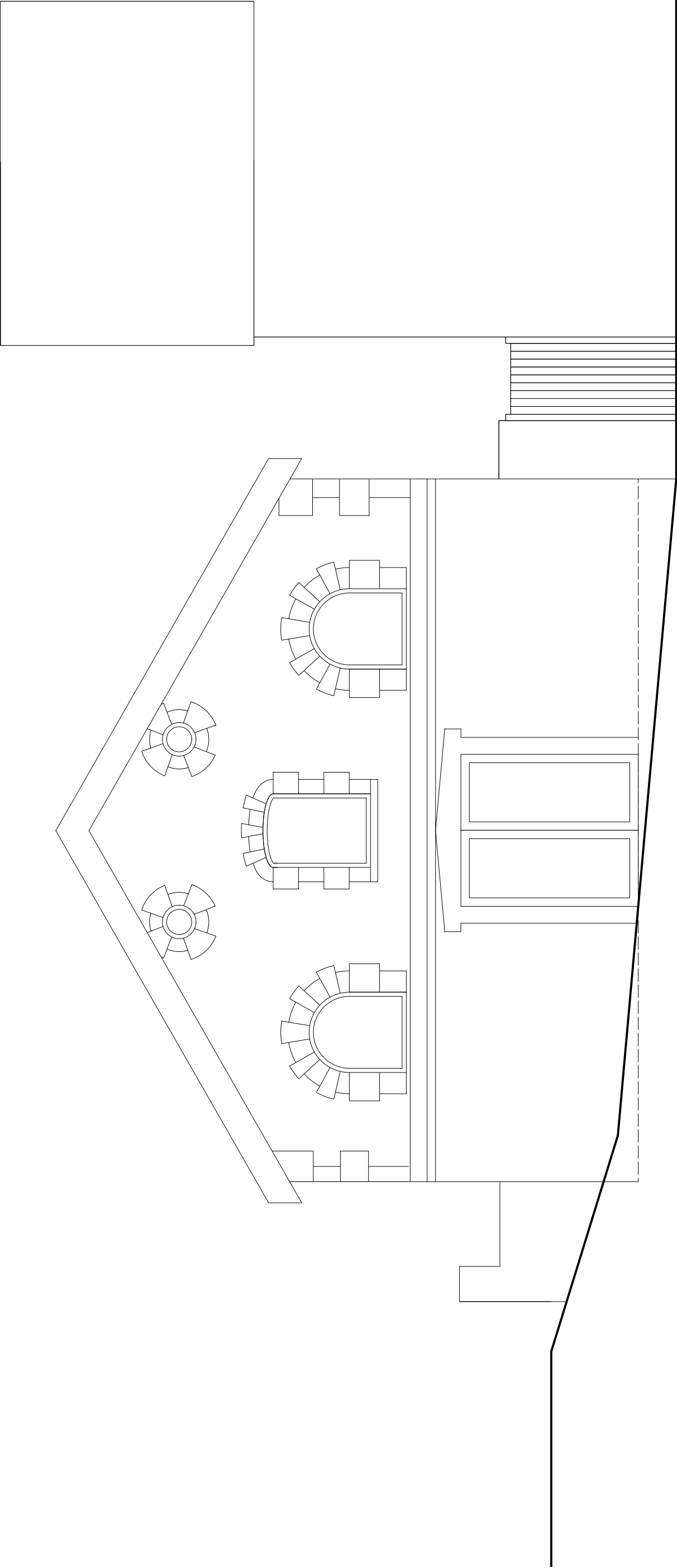




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EXISTING FRONT ELEVATION (due to the structure not being safe we was unable to measure the internal)



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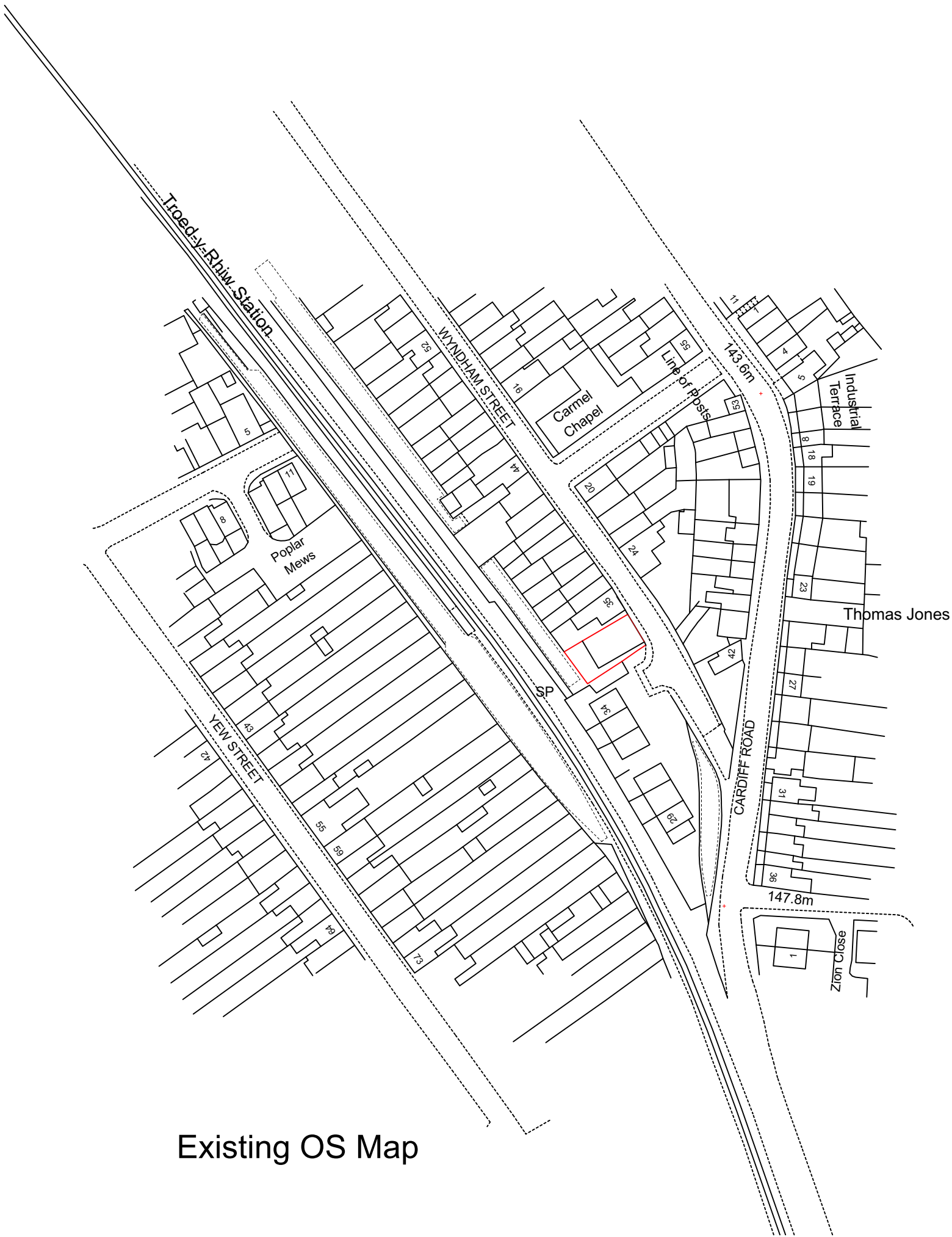
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Existing Block Plan



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Existing OS Map

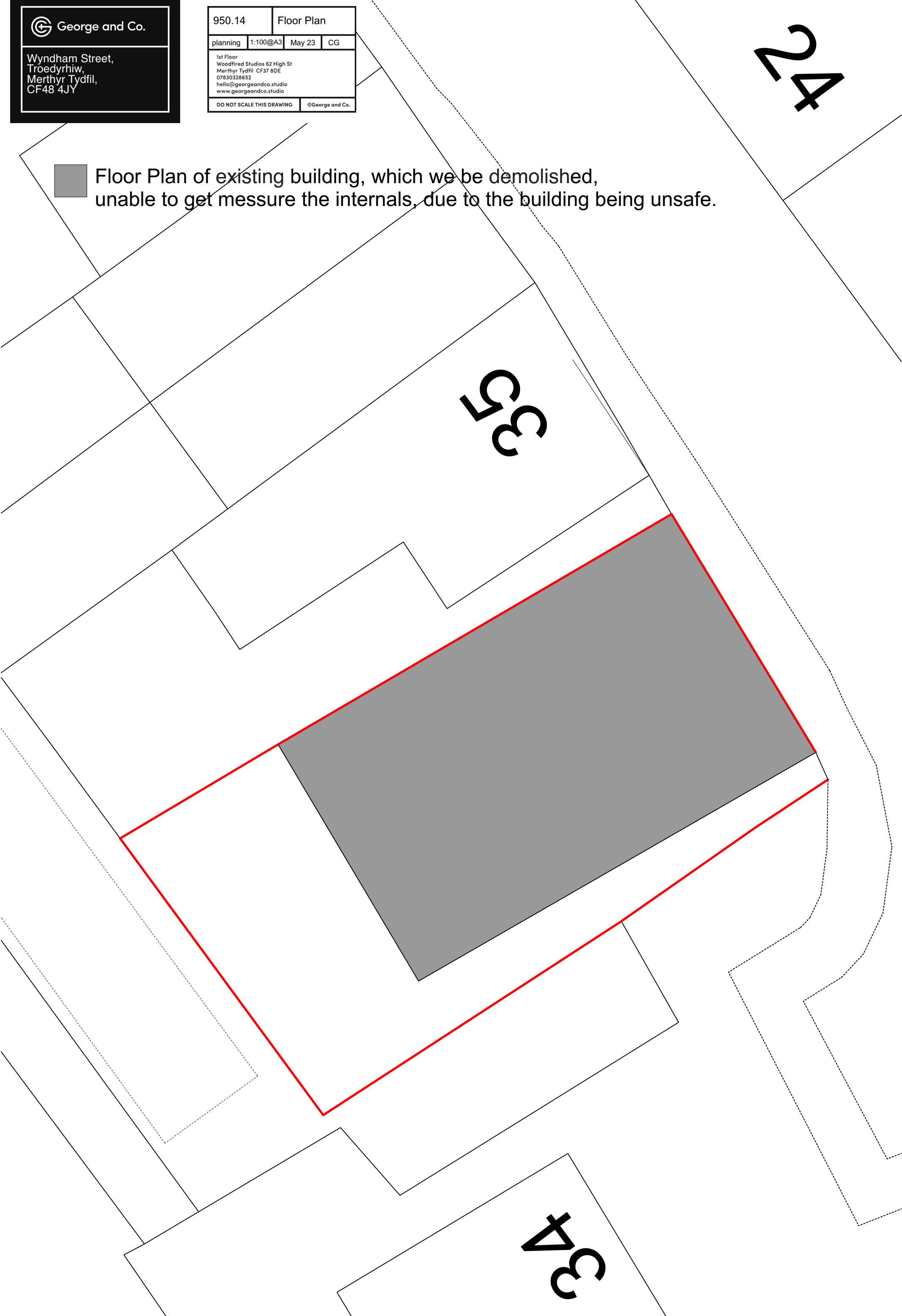
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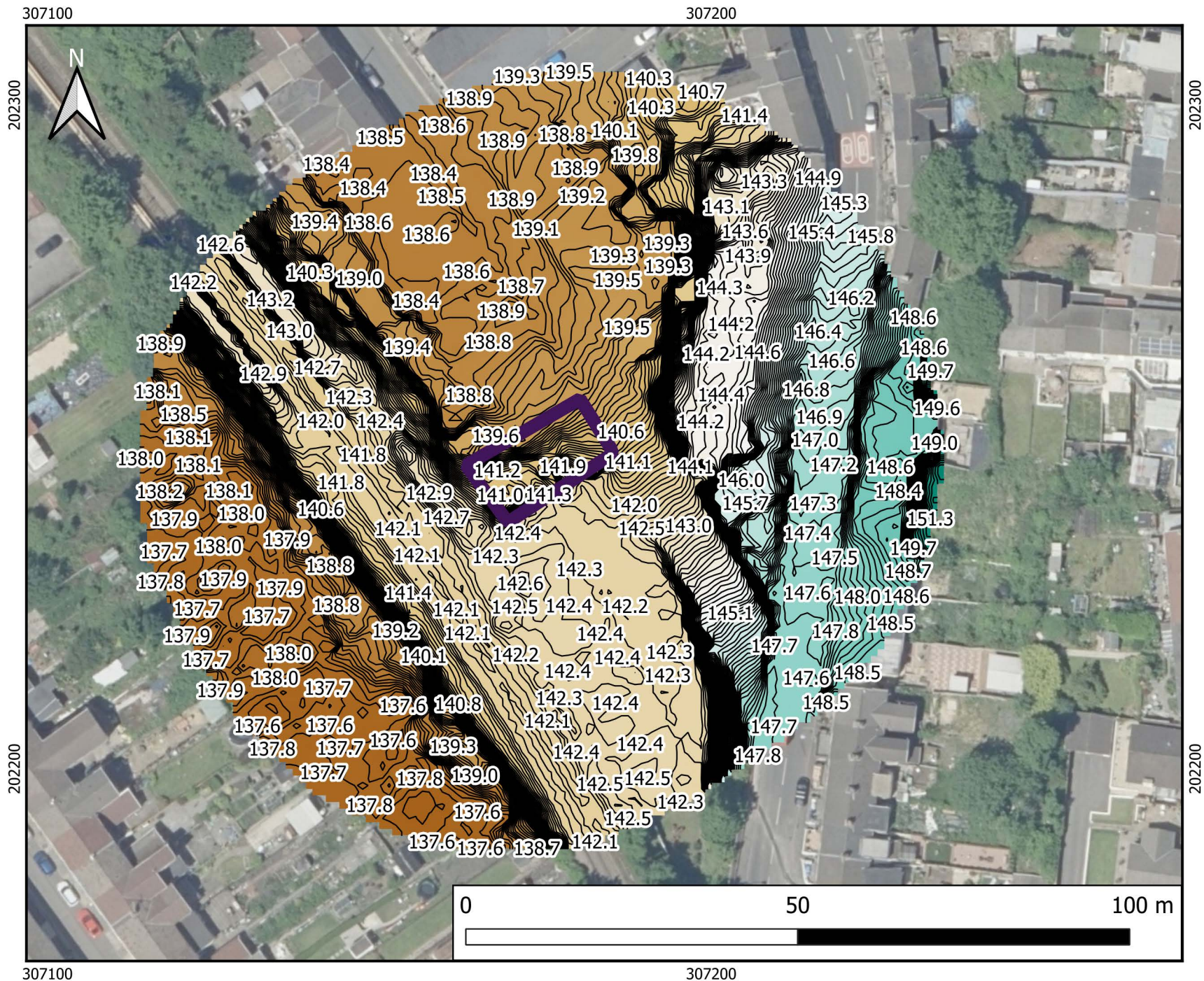
Floor Plan of existing building, which we be demolished,
unable to get messure the internals, due to the building being unsafe.



Appendix B



Natural Resource Wales LiDAR ground elevation data



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Martin Lucass

Commercial Director

GeoSmart Information Limited

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