

# PRELIMINARY DESKTOP STUDY

Site Investigation for a New Three-Story Steel Framed  
Building



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2309713

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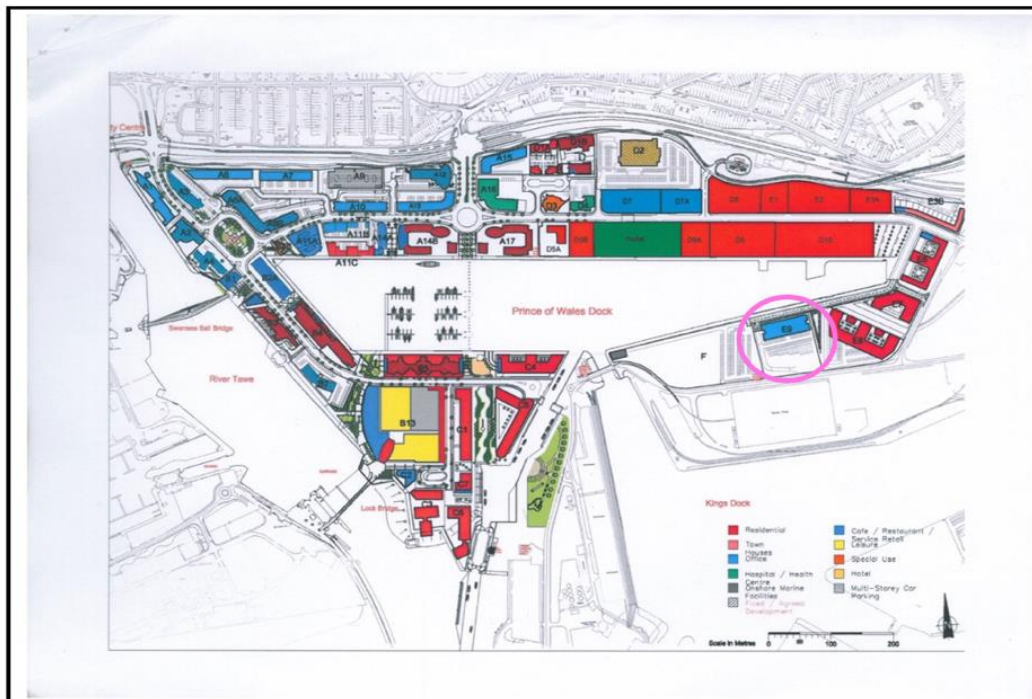
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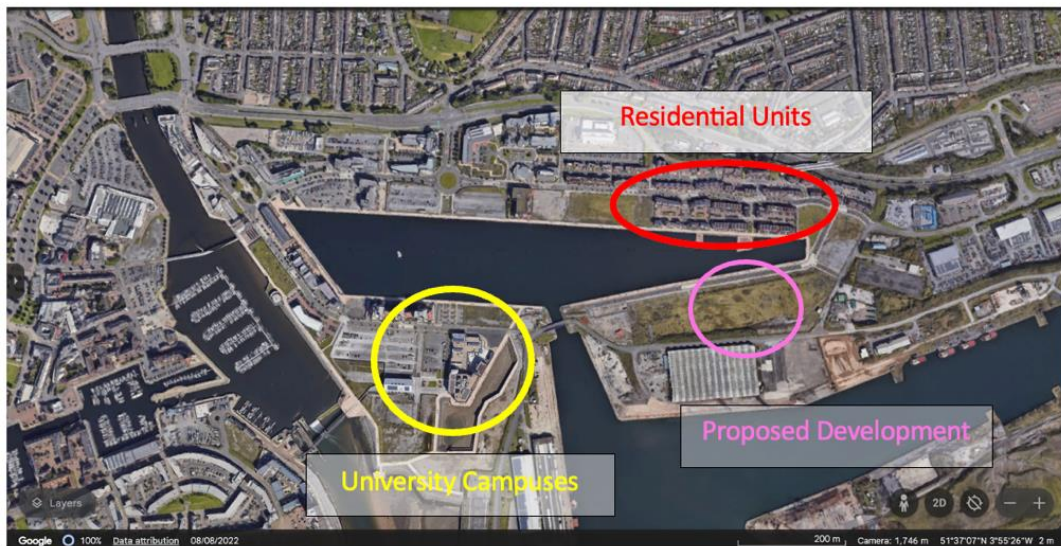
## 1. INTRODUCTION

### 1.1 The Site

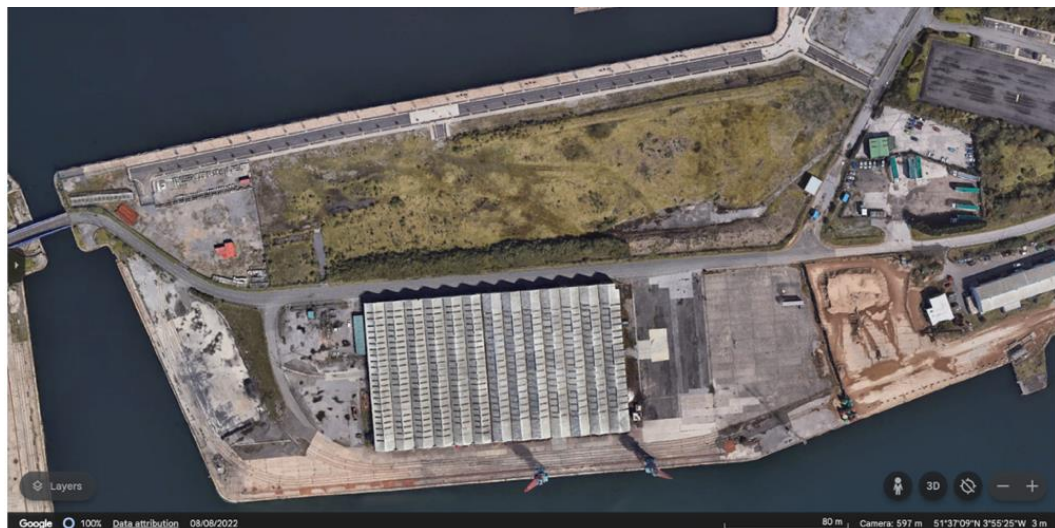
The proposed development of a new three-story steel framed building for Trinity Saint David University (UWTSD) is located on the South-East perimeter of the Prince of Wales Dock (PoWD) (*figure 1.1*). The resurrection of the building will provide 10 lecture rooms and 4 lecture theatres that will support 130 students. The development will be adjacent to multiple residential units; however, these units are not yet constructed although residential units exist in the North-East of PoWD and university campuses to the West (*figure 1.2*). The site has road access from the North and sufficient development space with limited traffic and pedestrian activity (*figure 1.3*).



(Figure 1.1: The master plan. Location of proposed development 'E9')



(Figure 1.2: A Google Earth image of the Prince of Wales Dock)



(Figure 1.3: A magnified Google Earth image of the proposed development site)

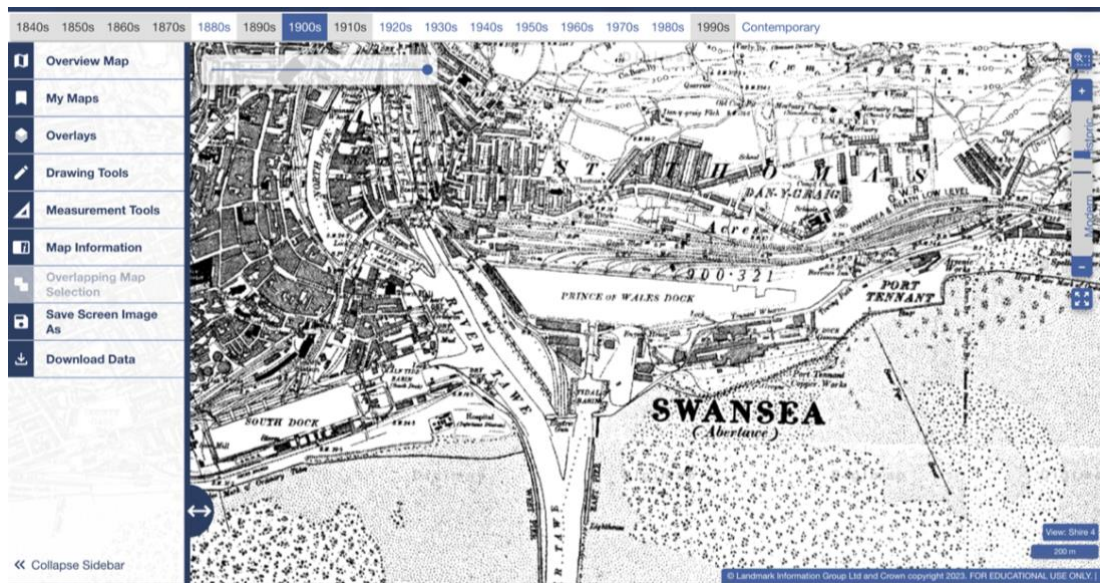
## 1.2 History

During the industrial revolution Swansea became a global copper capital, producing over 65% of the world's copper until the industrial decline in the 20<sup>th</sup> century. Consequently, Swansea's ports were heavily developed to facilitate the export of copper, including the development of polluting industries along the docklands. The PoWDs strategical and production significance resulted in heavy bombardment during the Second World War. Despite the industrial decline and bombardment, the dock remained standing and has undergone significant redemption to facilitate infrastructural development.

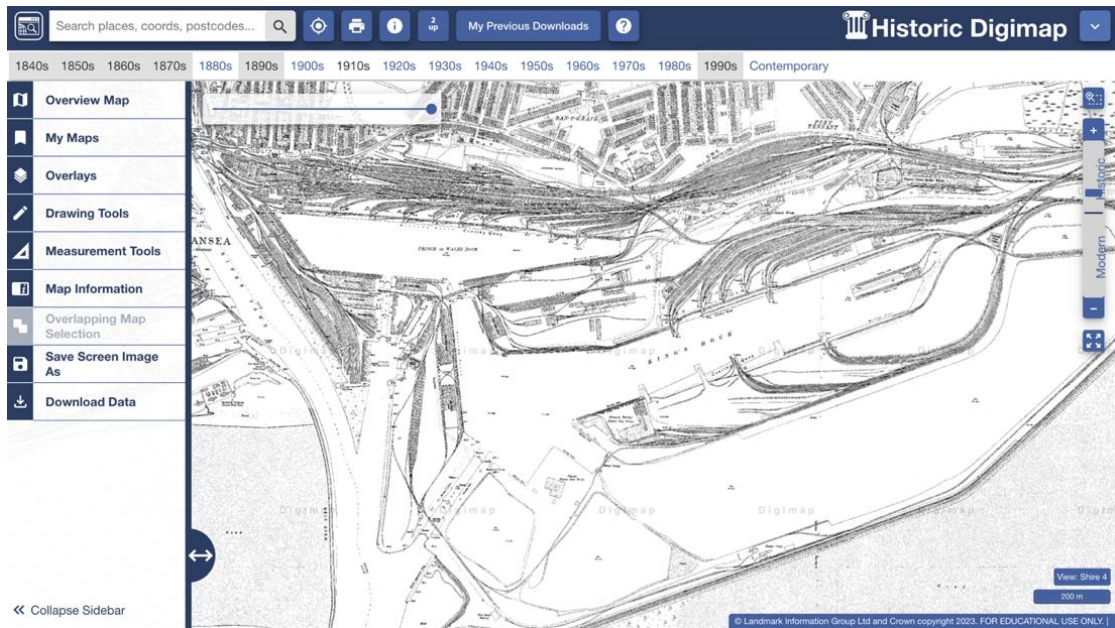
By utilising Digimap (2023) the development of PoWD can be examined. The PoWD was not formed in the 1870s, instead Fabians Bay created an enclosed body of salt and fresh water from the discharging River Tawe (*figure 1.4*). During the 1880s PoWD was constructed (*figure 1.5*), which was later followed by the establishment of two new docks to the South-East of PoWD (*figure 1.6*). Post-Second World War the physical perimeters of the docklands remained undisturbed although the overlying infrastructure was heavily bombarded (*figure 1.7*), and with the collapse of the metal industry in the 1960s the docklands became a contaminated wasteland that eventually was backfilled to contain the remains of the industrial past. Notwithstanding the irreconcilable conversion of present land use, the physical layout of the PoWD appears widely unaltered since the 1910s (*Figure 1.8*).



(Figure 1.4: Digimap of PoWD location in 1870s)



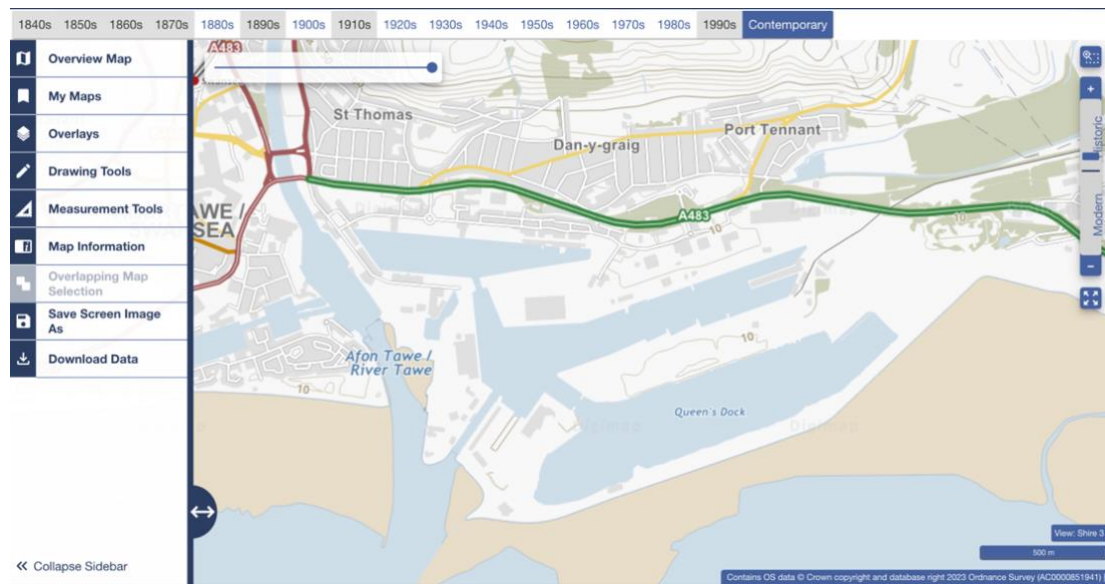
(Figure 1.5: Digimaps of PoWD 1900s)



(Figure 1.6: Digimap of PoWD and new dock developments 1910s)



(Figure 1.7: Digimap of PoWD 1950s)



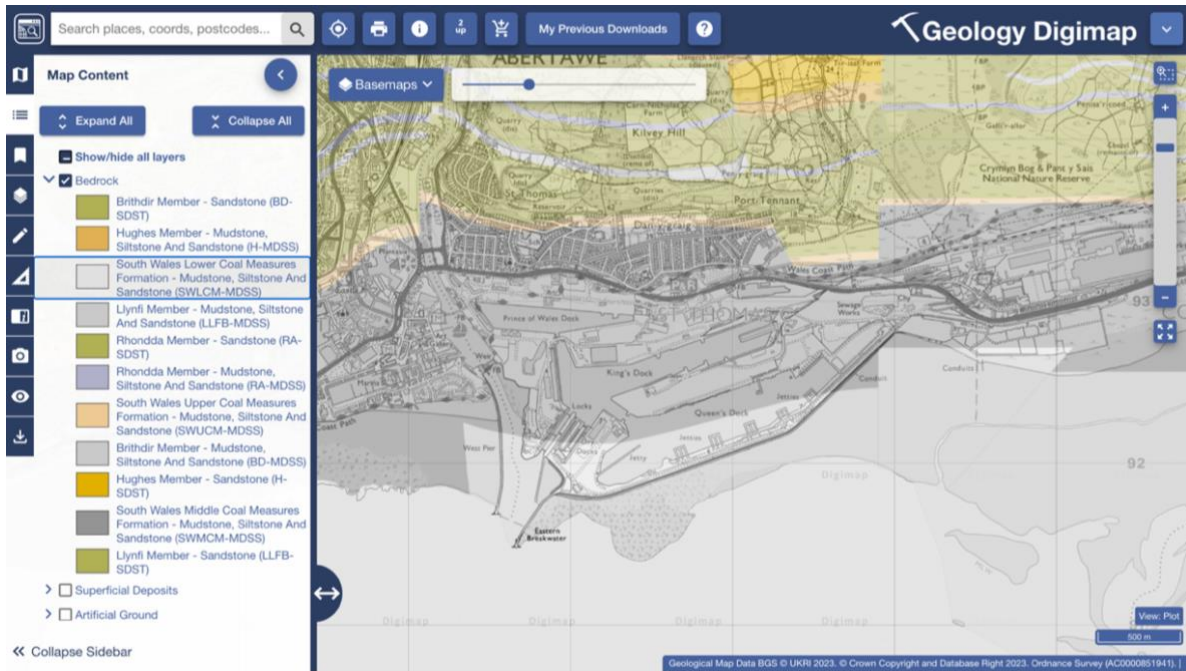
(Figure 1.8: Digimap of PoWD 2023)

## 2. GEOLOGY

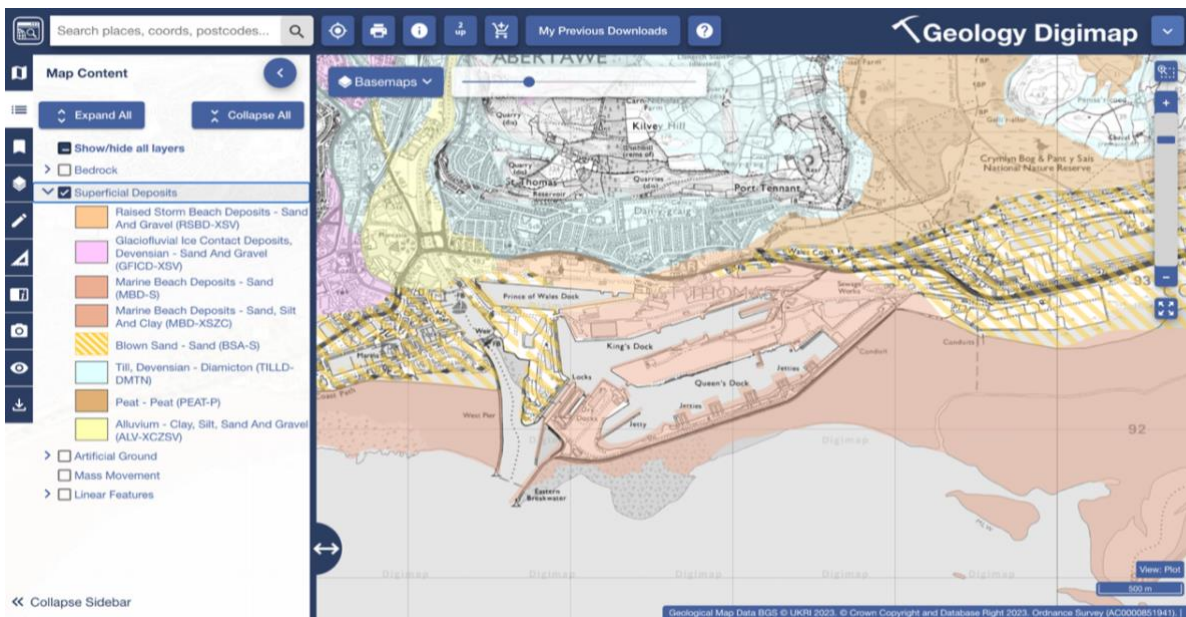
Digimap also provides an accurate description of the underlying geology. The PoWD bedrock comprises of mudstone, siltstone, and sandstone with coal measure formation (*figure 2.1*), which if laid uneven presents stability issues. Naturally, the superficial deposits which overlay the older rock formation are of marine origin (sand, silt, and clay) (*figure 2.2*). These superficial deposits have the capacity to retain high volumes of water, but despite this, Swansea successfully built upon the reclaimed land through landscaping, infilling, and backfilling to create artificial made land (*figure 2.3*).

The publication of *Barclay (2011)* described the subterranean environment of Swansea which follows on from the British Geological Survey (*BGS*). His publication defines the terminology of *figure 2.3*, as the '*landscaped ground*' is the reclaimed land, that has been exposed to mineral smelting and chemical waste (made ground), and finally been filled or partially backfilled to contain the contaminated land post-industrial use which presents its own hazards that will be later outlined.

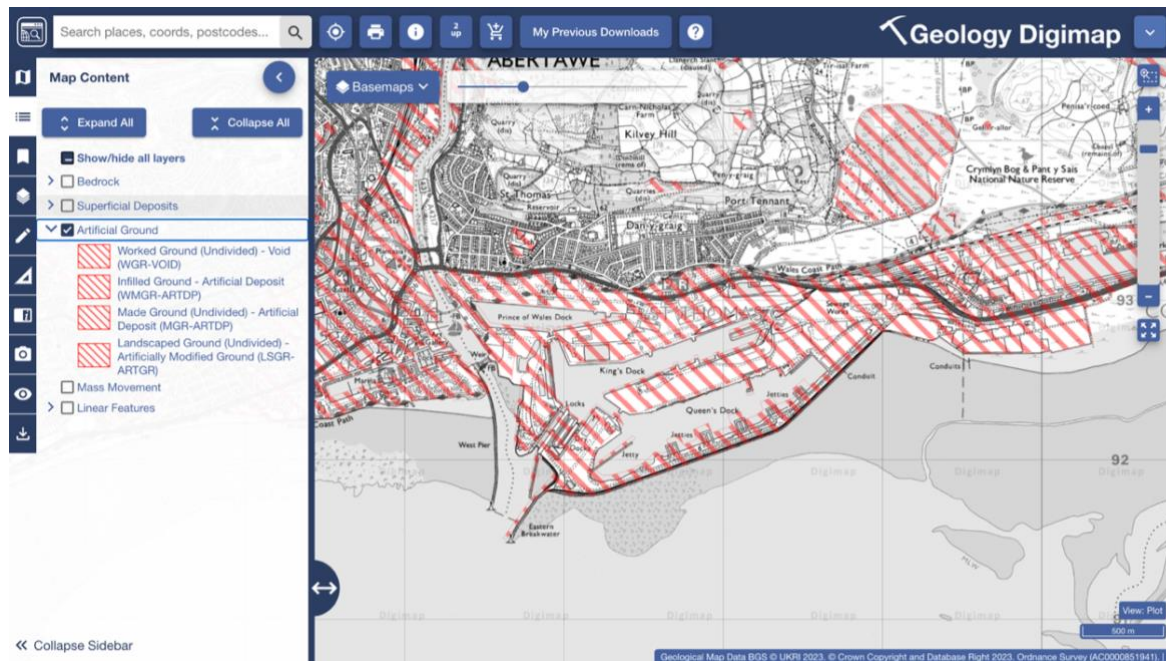
Finally, the proposed development sits 6 meters above sea level (*figure 2.4*) which provides a barrier for potential floods, but more significantly the site could be affected by subterranean runoff from Kilvey Hill (190m) which would saturate the underlying deposits and potentially cause instability. For further guidance to build on unstable ground consult the *Welsh Government (2017a)* '*Building regulations guidance: Part A (structural safety)*'.



(Figure 2.1: Digimap of PoWD bedrock formation)



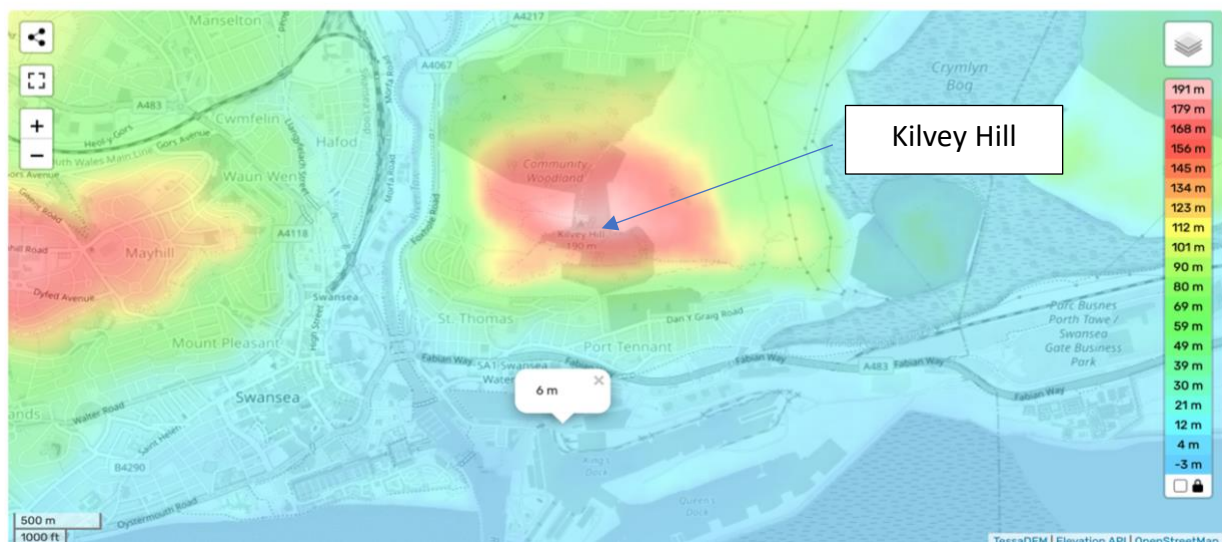
(Figure 2.2: Superficial deposits of PoWD)



(Figure 2.3: Artificial ground of the PoWD)

## Wales topographic map

Click on the map to display elevation.



(Figure 2.4: Topographic map of the PoWD and the surrounding area from 'topographic-map.com')

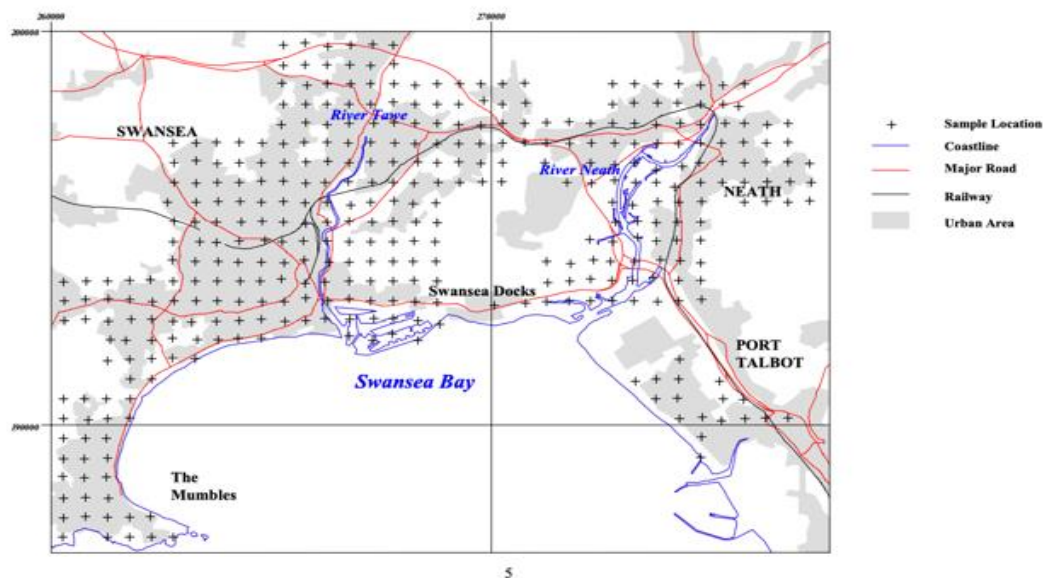
### 3. RISK TO DEVELOPMENT

#### 3.1 Contamination

The proposed site is highly contaminated given its industrial past. The BGS released a geochemical soil survey report (*Morley and Ferguson 2001*) which sampled a vast area of Swansea including the PoWD (*figure 3.1*). Regarding the PoWD, background levels sampled arsenic, cadmium, chromium, and cobalt connected to oil, fuel, and chemical processing. Additionally, present are elevated levels of copper and tin ores.

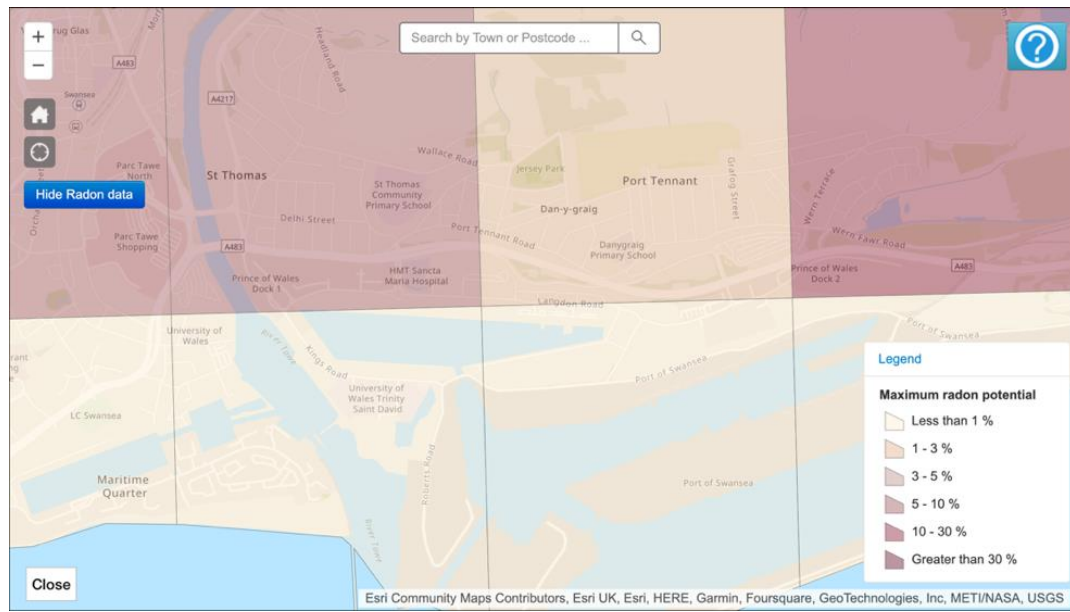
The made ground is especially susceptible to contamination. Metal work spoil was used to raise the Tawe floodplain level, slag was used as hardcore, and contaminated land was sealed with uncontaminated till deposits (*Waters et al., 2005*) which could remerge during excavation.

For further guidance on contamination refer to *Welsh Government (2017b) 'Building Regulations Guidance: Part C (Resistance to Contaminants and Moisture)'*.



(Figure 3.1: Geochemical soil sample area from Morley and Ferguson 2001)

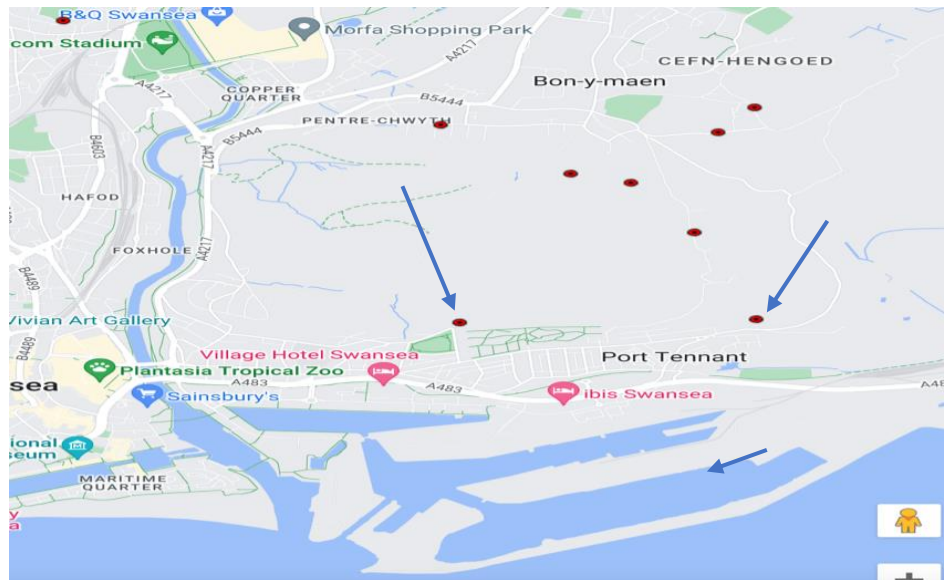
Radon potential is low according to the UK Government radon risk map (*figure 3.2*) for the site, increasing significantly to the North of PoWD. Despite the elevated risk not encompassing the development site, the proximity is close enough to raise awareness of increased potential and relevant testing methods should be implemented. For guidance on radon view 'UK National Radon Action Plan 2018'.



(Figure 3.2: UK Government Radon Map for PoWD)

### 3.1 Mining

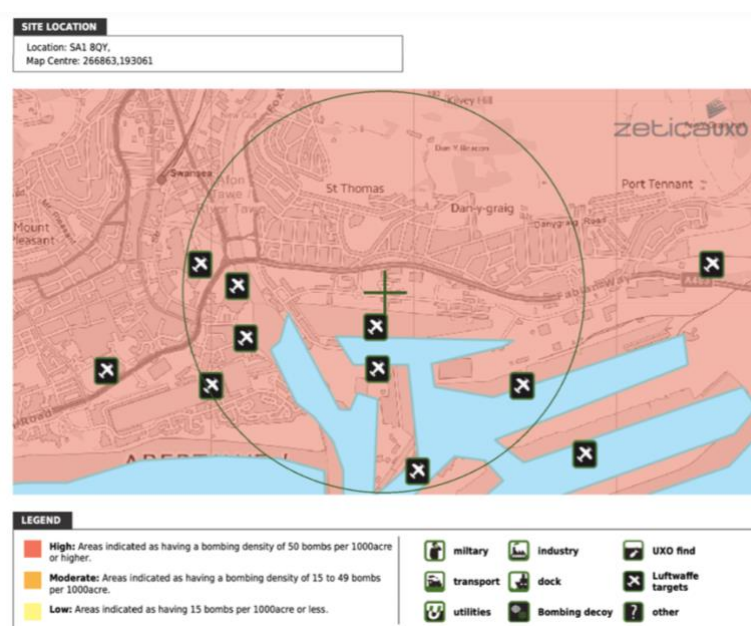
No mining exists on-site, however two former coal mines are present North of docklands which closed in 1880 and 1891 (*Northern Mine Research Society*).



(Figure 3.3: Locations of existing mines)

### 3.2 Unexploded Bombs (UXO)

The PoWD falls in a high-risk area for potential UXOs (*figure 3.4*), there should be a thorough risk assessment and investigation into the site before construction commences.



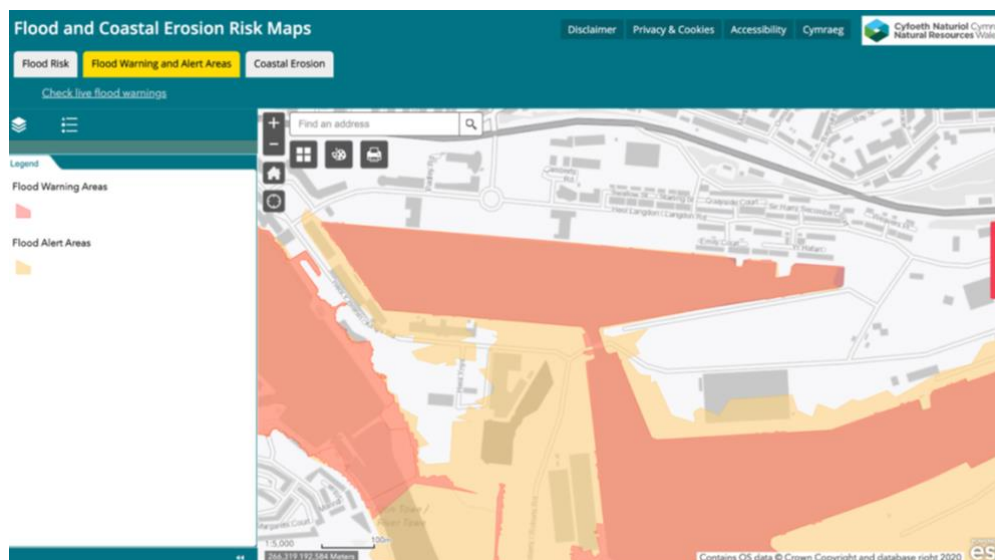
(Figure 3.4: Zetica UXO map of PoWD)

### 3.1 Floods

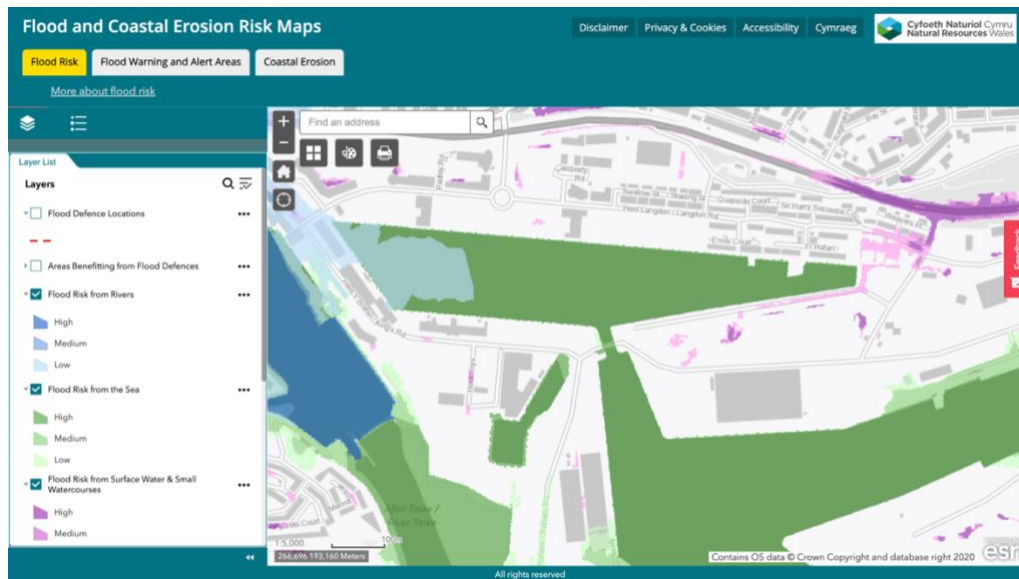
The precise location of the building does not fall within a flood warning zone (*figure 3.5*), however the proximity of site to adjacent warning zones does pose a risk not only to the proposed building but also the transportation routes. If affected, this could halt construction and accessibility post-construction. Furthermore, the risk map is not pin-point precise therefore the new building may fall within a flood warning zone.

Figure 3.6 however does place the site at high risk from surface water and small watercourses. Surrounding sites are under risk of flooding from the sea and River Tawe, and potentially if the PoWD became surcharged with river and sea surge this could increase the potential for the PoWD to overflow. Climate change could exacerbate future flood risk.

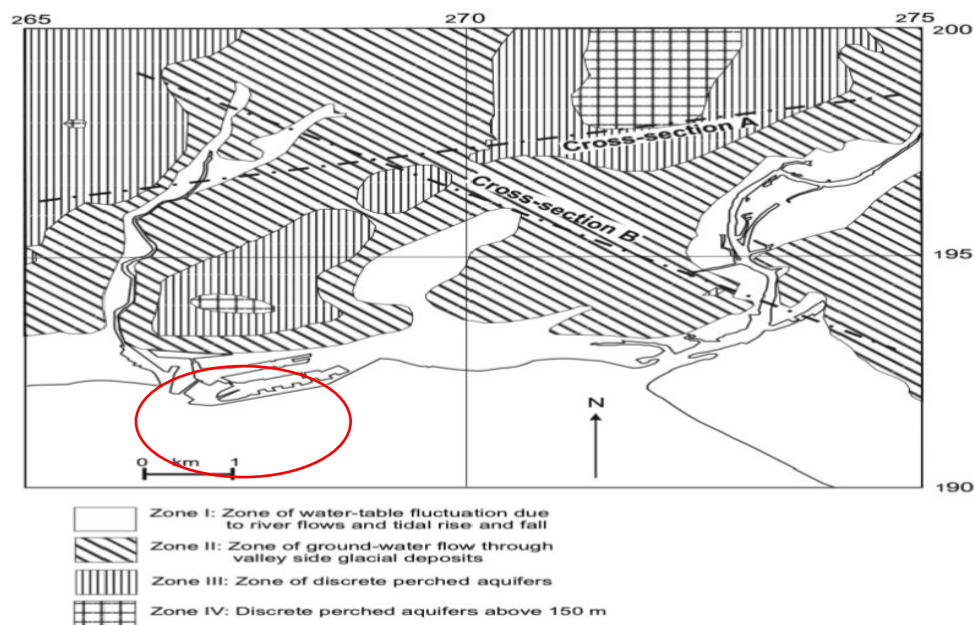
Moreover, the water table of the ground beneath the PoWD will fluctuate substantially because of the hydrological influences of the tide and River Tawe (*figure 3.7*), however this could be offset by the low permeability and high retention of the underlying tidal flat/marine deposits (*table 3.1*) which would influence soil stability.



(Figure 3.5: Flood alert map for PoWD)



(Figure 3.6: Flood risk map for PoWD)



(Figure 3.7: Extent of water table fluctuation underneath PoWD from Waters et al., 2005)

Table 3.1: Permeability of the underlying soil type from Waters et al., 2005)

| Unit                                          | Description                                                                                                                                                                 | Distribution                                                           | Thickness  | Permeability |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------|--------------|
| <b>Peat</b>                                   | Dark brown, compressible organic-rich clay and silt with abundant waterlogged plant material                                                                                | Areas between the river valleys, present day Coastal zone and offshore | 1-3 m      | High         |
| <b>Alluvium</b>                               | Soft, brown-grey, mottled, locally organic, silts, silty clays, silty sands and silty or sandy gravels, and may include bedded or imbricated silty sands and cobbly gravels | Swansea Valley and Upper Neath Valley                                  | up to 5 m  | Moderate     |
| <b>Tidal flat/Marine deposits</b>             | Soft, blue clay and silt with organic debris and thin peat lenses                                                                                                           | Intertidal zone and lower Neath Valley                                 | up to 15 m | Low          |
| <b>Beach deposits and blown sand</b>          | Well-sorted, unconsolidated, dark grey to brown sand, locally with shells                                                                                                   | Coastal zone                                                           | up to 6 m  | High         |
| <b>Glaciofluvial Sheet Deposits</b>           | Brown, poorly-sorted clayey sands and gravels to moderately well-sorted pebble and cobble gravels with a coarse sand matrix and scattered boulders                          | Swansea Valley, Neath valley, Coastal zone and offshore                | up to 6 m  | High         |
| <b>Glaciolacustrine Deposits</b>              | Dark grey, laminated silt and clay with lenses and layers of sand                                                                                                           | Swansea Valley                                                         | up to 25 m | Low          |
| <b>Till/Glacial deposits undifferentiated</b> | Stiff to hard, brown-grey silty sandy clay with gravel and boulders, and lenses of brown gravel with sand                                                                   | Base of Swansea Valley and interfluvial, high ground areas.            | up to 15 m | Moderate     |

## 4. PREVIOUS SITE INVESTIGATIONS

Figure 3.8 gives geographical context to previous site investigations.

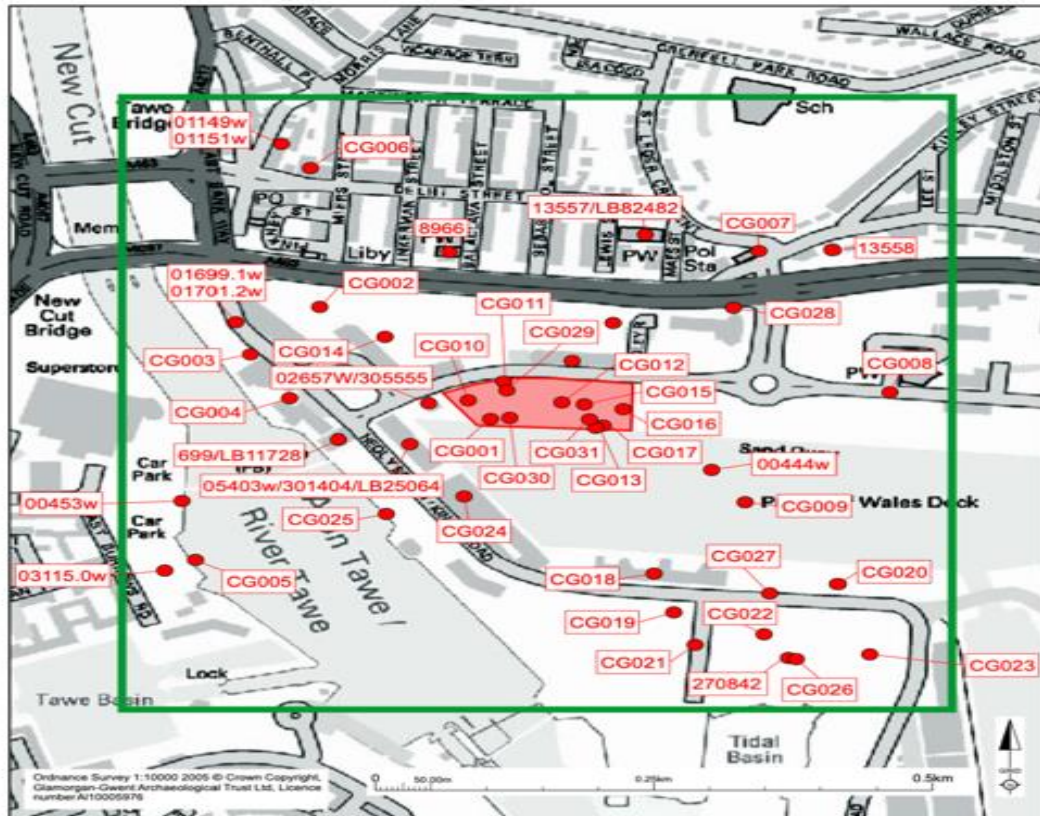


*(Figure 3.8: Geographical locations of previous site investigations)*

### 4.1 Canolfan Glandŵr PoWD

*(Bowen 2011)*

The site investigation suspected an underlying geology of alluvium deposits from the River Tawe and carboniferous coal measures. Archaeological deposits were located, dated at the Bronze Age, Iron Age, Roman, and Scandinavian cultures. Furthermore figure 4.1 presents the 48 archaeological buildings in the PoWD area that could have been impacted by the construction.



## 4.2 Langdon Road

(Shobbrook, 2018)

Prior to the housing development on Langdon Road an archaeological report was necessary before development. Mudstone, siltstone, and sandstone underlays the superficial beach deposits. The site was divided into 19 plots, where the existing sandy-clay soil level rests between 1.7-1.8m below current levels. Coal deposits were found at 0.7m below current ground level along with industrial waste such as concrete, slag, and tarmac. Former pits, building rubble and railway sleepers were also discovered where backfill occurred to contain contamination and waste. No archaeological interests were located at the site digs.

### 4.3 QI Building UWTSD

*(neccontracts.com)*

The top 1.8m of soil was removed due to contamination, which could be consistent with the 1.7-1.8m backfill that occurred on Langdon Road to conceal industrial waste. The substructure design comprised of concrete piles as a foundation with the lower building formed with rebar concrete frames and the upper formed with steel frames.

### 4.4 CISM Building Bay Campus

*(Sambrook, 2019)*

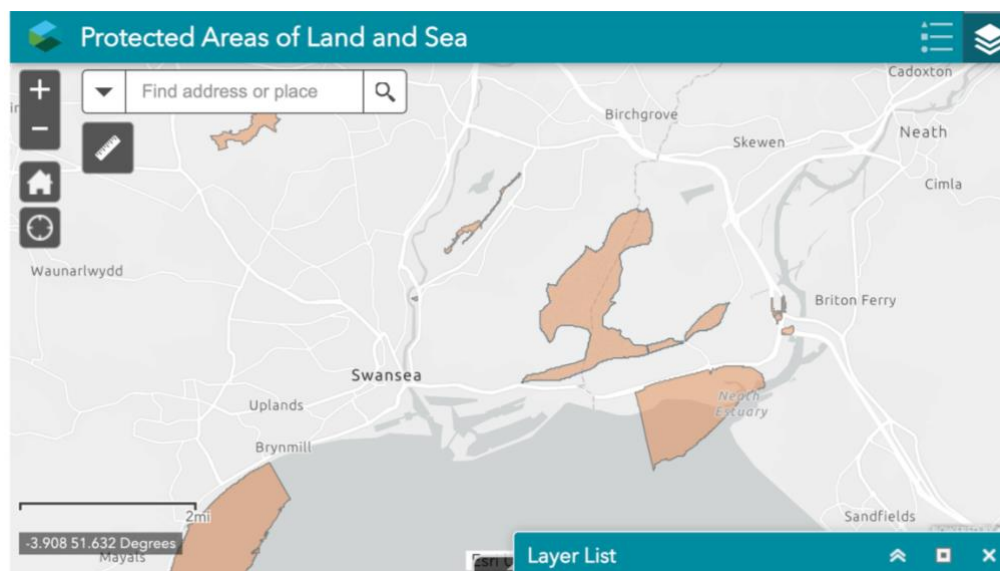
Borehole investigations (*Appendix 1*) found made ground varied between 2-4m. Underneath the made ground lay a sandy profile (8-13m), stiff clay (3-5m), and finally a weak grey mudstone bedrock was struck at 20m below ground level. Groundwater fluctuated between depths of 0.5-5.4m which would cause instability concerns due to the shallow water table and sandy soils.

The backfill and made ground created a low-bearing capacity of soil, especially with the shallow groundwater. Geological deposits such as hard sandstone could produce obstructions for excavation/foundations, along with the possible contamination below the redemption works.

## 5. CONSIDERATE CONSTRUCTION

### 5.1 Site of Specific Scientific Interest (SSSI)

The proposed site does not sit within an SSSI, however SSSIs are present to the North-East of PoWD (*figure 5.1*). The construction site is not within the SSSI boundaries therefore consent will not be required (*Natural Resources Wales 2019*), however given the nature of the work and susceptibility to South-Westerly winds plus the proximity to the sea there is potential for substances to travel hydrologically and airborne therefore refer to the appropriate guidance on building control measures.



(Figure 5.1: SSSIs surrounding PoWD from Natural Resources Wales 2023)

### 5.2 Social

The location presents social considerations that must be accounted for early in the construction planning to limit social disturbance to residents and students. Noise will have to be controlled where possible and any noise omitted outside of 7:30am to 6pm will require a permit (*South Wales Police*).

Access provides logistical difficulties regardless of direction (*figure 5.2*). The Easterly access appears the better access, unlike the central and Western accesses which require transportation through areas of high pedestrian activity such as places of work, a university campus, and residential units. Furthermore, any Western access would require vehicles to travel across the connecting bridge that might not be facilitate the heavy loads.

Regardless of access, suitable and sufficient safety measures must be implemented to ensure compliance with safe construction practise for employees and pedestrians (*HSE 2015a; HSE 2015b*).



(Figure 5.2: Red = access routes off the main road, blue = services and places of work, green = university campus, purple private hospital, gold = residential units)

### 5.3 Services

There are no overhead powerlines obstructing development, however potential underground services are undetermined. For further guidance on underground services *National Underground Assets Register (NUAR)* launched by the UK Government (2023) will assist in sub-terranean services. Additionally, Dŵr Cymru can provide underground water and sewage maps for £6. Note that the docklands might not be documented as these were private lands controlled by Associated British Ports. Furthermore, the construction will have to comply with the *Welsh Government Sustainable Drainage Statutory Guidance (SuDS)*

(Welsh Government 2019) and ‘The Building Regulation: Part H Drainage and Waste Disposal’ (Welsh Government 2017c), especially due to the nature of the contamination risks.

## 6. SUMMARY OF THE MAIN RISKS

Based off the evidence provided, this report assumes that the biggest challenges to the development would be the underlying ground of the PoWD including the geology that will accommodate the bearing load of the structure and any influencing factors such as water table fluctuations. Additional excavation investigations will be necessary to identify any buried industrial remains, level of soil contamination, underground services, and any UXOs.

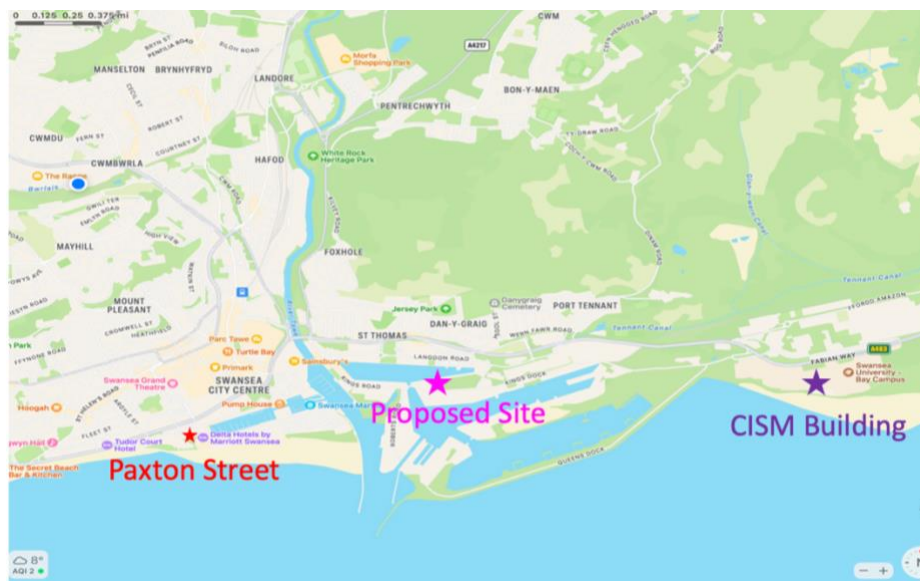
Construction traffic and disturbance will have to be minimised to respect residents, students, and other users of the PoWD along with consideration to environmental factors such as SSSIs and SuDS. Post-construction an effective water defence system must allow effective water drainage and protection against potential floods from sea level rise or sudden changes in PoWD water level.

## 7. FOUNDATION RECOMMENDATION

Consideration to the applied ground loading, the ground conditions, the geographical location of the site, and access for the required plant to instate the foundations are required (Poulos 2016). To understand the soil conditions, it will be necessary to implement a soil investigation through a sufficient number (determined by the geotechnical advisor) of borehole samples (Chudley et al., 2020). Furthermore, the construction design must conform to the ‘dead and imposed loads BS 6399-1:1996’, ‘wind loads BS 6399-2:1997’, ‘Imposed roof loads BS 639903:1998’ (Welsh Government 2017a), the relevant safety regulations as of BS 8008:1996+A1:2008 for excavations and BS ISO 10381-3 for excavations on contaminated land. Ultimately, if all considerations are accounted the foundations will

successfully transfer the load of the building to the subsoil with equal settlement and no differential movement (*Chudley et al., 2020*).

There is no existing available borehole investigation for the intended site, therefore this report utilises borehole investigations (*figure 7.1*) from the CISM building, and Paxton Street (*Appendix 2*).



(Figure 7.1: Map of borehole records of surrounding sites)

Figure 7.2 displays a visual comparison of the borehole investigations, where all depths correspond horizontally to ease comparison. Evidently, the top layer comprises of made ground at maximum depths of  $\sim 4.95\text{m}$ , until the geology changes to a gravelly/sandy make-up at maximum depths of  $15.50\text{m}$ . Made ground and gravelly sands do not provide sufficient bearing capacity, therefore to exceed these depths piles are required. Beyond these depths lay clay at  $\sim 8.00\text{--}20.30\text{m}$ , clays are prone to expansion and contraction especially under hydraulic influences. Considering the marine environment these clays are likely to experience expansion and contraction, therefore this report proposes that the mudstone layer at  $\sim 18.50\text{m}$  depth could provide the ideal bearing capacity.

However, it is important to note that the  $N$  values of the mudstone samples taken at the two sites differ by 50n therefore this is an assumed assumption and sufficient borehole investigations are required to determine the depth. Additionally, the high-water table located at the sites (0.50-5.70m) and the use of driven piles for the QI building located 0.2 miles from the development site reinforces the need for an end-baring concrete reinforced piled foundation. Caution should be taken as it is possible that the excavation will encounter harder boulders and cobbles.

Furthermore, capping the connected strip piles to distribute the weight of the building evenly would eliminate any discrepancies to the vertical alignment of the pile as it was driven down and reduce the risk of differential settlement. Capping will connect the pile to the building, providing greater stability against the strong offshore South-Westerly winds and the dead and implied loading of the building. Potentially, the site could consider soil improvement techniques such as removal and replacement of soils (*Swan 2007*) to improve the almost certain polluted topsoil layer as was the case during the construction of the QI building.

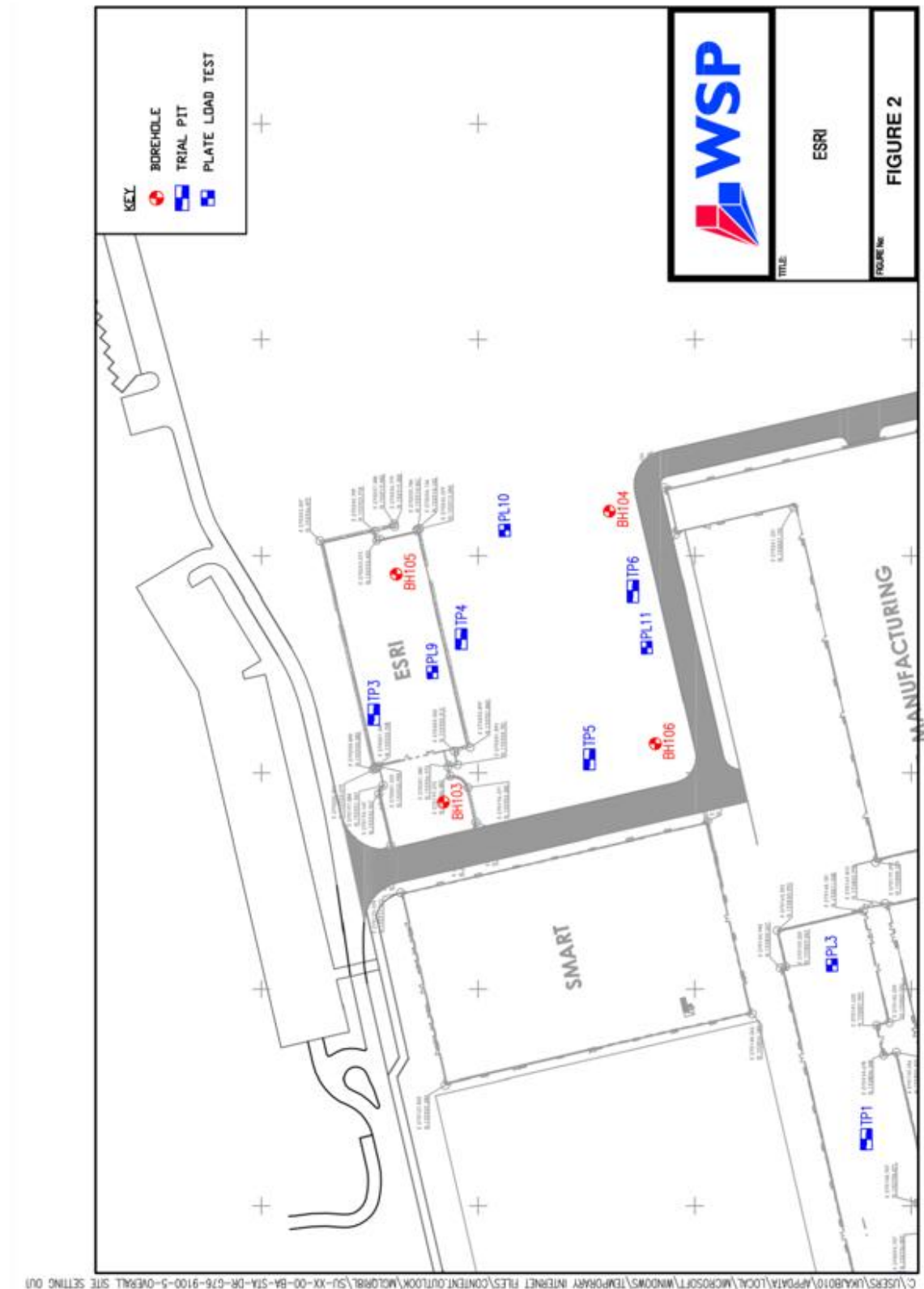
| Borehole Investigations |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             |                                                                           |    |                                                                                                      |
|-------------------------|----|----------------------------------------------------|-----------------------------------------------------|----|--------------------------------------------------------------|----------------------------------------------------|----|-----------------------------------------------------------------------------|---------------------------------------------------------------------------|----|------------------------------------------------------------------------------------------------------|
| Depth to base (m)       |    |                                                    | Depth to base (m)                                   |    |                                                              | Depth to base (m)                                  |    |                                                                             | Depth to base (m)                                                         |    |                                                                                                      |
| m                       | mm |                                                    | m                                                   | mm |                                                              | m                                                  | mm |                                                                             | m                                                                         | mm |                                                                                                      |
| Paxton street           |    |                                                    | BH103                                               |    |                                                              | BH104                                              |    |                                                                             | BH105                                                                     |    |                                                                                                      |
| MADE GROUND; ashes      |    |                                                    | MADE GROUND; gravelly fine-medium sand with cobbles |    |                                                              | MADE GROUND; gravelly fine-medium sand and cobbles |    |                                                                             | MADE GROUND; gravelly fine-medium sand with cobbles and boulders (<300mm) |    |                                                                                                      |
| 0                       | 50 |                                                    | 0                                                   | 80 |                                                              | 0                                                  | 80 |                                                                             | 0                                                                         | 80 |                                                                                                      |
| 1                       | 50 | MADE GROUND; loose, light grey pine-medium sand    | 1                                                   |    | MADE GROUND; fine sandy gravel with some cobbles             | 1                                                  |    | MADE GROUND; brown sandy gravel with some cobbles                           | 1                                                                         |    | MADE GROUND; brown sandy gravel with some cobbles                                                    |
| 2                       | 55 | MADE GROUND; grey sand and soft sand clay          | 2                                                   |    |                                                              | 2                                                  | 50 |                                                                             | 2                                                                         | 50 |                                                                                                      |
|                         |    | MADE GROUND; Soft sand clay with brick shale       |                                                     |    |                                                              |                                                    |    | SAND; fine-medium; dense; gravelly. Aeolian                                 |                                                                           |    | SAND; loose-dense gravelly fine-medium, cobbles. Aeolian                                             |
| 3                       | 50 |                                                    | 3                                                   | 20 |                                                              | 3                                                  |    |                                                                             | 3                                                                         |    |                                                                                                      |
| 4                       | 95 | MADE GROUND; dense brick, ashes, sand, and clay    | 4                                                   |    | SAND; dense gravelly fine-medium with cobbles. Aeolian       | 4                                                  |    |                                                                             | 4                                                                         |    |                                                                                                      |
|                         |    | GRAVEL; very dense and sandy; traces of sandy clay |                                                     |    |                                                              |                                                    |    |                                                                             |                                                                           |    |                                                                                                      |
| 5                       |    |                                                    | 5                                                   |    |                                                              | 5                                                  |    |                                                                             | 5                                                                         |    |                                                                                                      |
| 6                       |    |                                                    | 6                                                   |    |                                                              | 6                                                  | 20 |                                                                             | 6                                                                         |    |                                                                                                      |
| 7                       |    |                                                    | 7                                                   |    | SAND; dense fine-medium sand with some aeolian sand. Aeolian | 7                                                  |    | SAND; very loose-loose very silty with some cobbles subangular to sandstone | 7                                                                         |    |                                                                                                      |
| 7                       | 95 | SAND; very dense with some gravel                  |                                                     |    |                                                              |                                                    |    |                                                                             |                                                                           |    |                                                                                                      |
|                         |    | BOULDER CLAY; gravelly, stiff                      | 8                                                   | 60 |                                                              | 8                                                  |    |                                                                             | 8                                                                         | 30 |                                                                                                      |
| 8                       |    |                                                    |                                                     |    | SAND; medium-dense and very silty fine (Fluvio-glacial till) |                                                    |    |                                                                             | 9                                                                         |    | SAND; medium-very dense, silty fine, with many cobbles. Surrounded by sandstone. Fluvio-glacial till |
| 9                       |    |                                                    | 9                                                   |    |                                                              | 9                                                  |    |                                                                             | 10                                                                        |    |                                                                                                      |
| 10                      |    |                                                    | 10                                                  | 45 |                                                              | 10                                                 | 10 |                                                                             | 10                                                                        |    |                                                                                                      |
| 11                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 11                                                                        |    |                                                                                                      |
| 12                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 12                                                                        |    |                                                                                                      |
| 13                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 13                                                                        |    |                                                                                                      |
| 14                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 14                                                                        |    |                                                                                                      |
| 15                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 15                                                                        | 50 |                                                                                                      |
| 16                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 16                                                                        |    | CLAY; slightly sandy, gravelly. Gravel surrounded by fine-medium sandstone, siltstone, and mudstone  |
| 17                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 17                                                                        |    |                                                                                                      |
| 18                      | 50 |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 18                                                                        |    |                                                                                                      |
| 19                      |    | GREY MUDSTONE                                      |                                                     |    |                                                              |                                                    |    |                                                                             | 19                                                                        |    |                                                                                                      |
| 20                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 20                                                                        | 30 |                                                                                                      |
| 21                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             | 20                                                                        | 50 | MUDSTONE; extremely weak (lower coal measures)                                                       |
| 22                      |    |                                                    |                                                     |    |                                                              |                                                    |    |                                                                             |                                                                           |    |                                                                                                      |

(Figure 7.2: A simplified borehole comparison of Paxton Street and the CISM Building (BH103-106). Full details of the investigations are available in the appendix)

WORD COUNT. 2497

## 8. APPENDIX

### 8.1 CSMI Borehole Investigation



|                                                                                                                |                                       |                         |                                                          |                      |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------|----------------------------------------------------------|----------------------|
| <br>wsp<br>Telephone:<br>Fax: | <b>BOREHOLE LOG</b>                   |                         | Hole No.<br><b>BH103</b>                                 |                      |
|                                                                                                                | Project<br><b>Fabian Way, Swansea</b> |                         | Sheet<br><b>1 of 2</b>                                   |                      |
| Job No<br><b>37721</b>                                                                                         | Client<br><b>Leadbitter</b>           |                         | Date<br><b>02-07-13<br/>04-07-13</b>                     |                      |
| Contractor / Driller<br><b>Apex</b>                                                                            | Method/Plant Used<br><b>Dando CP</b>  | Logged By<br><b>MCL</b> | Co-Ordinates (NGR)<br><b>E 70196.000<br/>N 92922.000</b> | Ground Level (m AOD) |

| SAMPLES & TESTS |      |                                        |            |             |               |       | STRATA       |                   |                                                                                                                                                                                                                                                                                          |        | Install / Backfill |            |
|-----------------|------|----------------------------------------|------------|-------------|---------------|-------|--------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------|------------|
| Depth           | Type | Test Result                            | PID (ppmV) | HSV (kN/m2) | P-Pen (kN/m2) | Water | Elev. (mAOD) | Depth (Thickness) | Description                                                                                                                                                                                                                                                                              | Legend | Geology            | Dia. 50 mm |
|                 |      |                                        |            |             |               |       |              | 0.80              | MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles. Gravel is subangular fine to coarse of sandstone and concrete. Cobbles are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat).                                  |        | MG                 |            |
| 1.00            | SPT  | 3,6,11<br>25,25,0<br>N=61/<br>0.225(C) |            |             |               |       |              | (2.40)            | MADE GROUND comprising greyish brown and dark brown fine sandy GRAVEL with some cobbles (5-20%). Gravel is angular to subangular fine to coarse of iron-ore slag, sandstone, red brick and calcareous shell fragments. Cobbles are subangular of iron-ore slag, sandstone and red brick. |        | MG                 |            |
| 2.00            | SPT  | 6,6,8<br>7,7,7<br>N=29(C)              |            |             |               |       |              | 3.20              |                                                                                                                                                                                                                                                                                          |        |                    |            |
| 3.00            | SPT  | 2,3,8<br>11,17,11<br>N=47(S)           |            |             |               |       |              |                   | Dense light brown gravelly fine to medium SAND with many cobbles. Gravel is subangular to subrounded fine to coarse fine to medium of sandstone and calcareous shell fragments. Cobbles are rounded of yellowish brown sandstone (Aeolian Sand).                                         |        |                    |            |
| 4.00            | SPT  | 3,6,12<br>12,9,10<br>N=43(S)           |            |             |               |       |              | (2.80)            |                                                                                                                                                                                                                                                                                          |        | AEOLD              |            |
| 5.00            | SPT  | 4,5,10<br>12,12,13<br>N=47(S)          |            |             |               |       |              | 6.00              |                                                                                                                                                                                                                                                                                          |        |                    |            |
| 6.00            | SPT  | 3,2,2<br>3,5,6<br>N=16(S)              |            |             |               |       |              | (2.60)            | Medium dense to dense light brown fine to medium SAND with some calcareous shell fragments (Aeolian Sand).                                                                                                                                                                               |        | AEOLD              |            |
| 7.50            | SPT  | 5,6,8<br>9,16,15<br>N=48(S)            |            |             |               |       |              | 8.60              |                                                                                                                                                                                                                                                                                          |        |                    |            |
| 9.00            | SPT  | 2,2,3<br>3,3,3<br>N=12(S)              |            |             |               |       |              | (1.85)            | Medium dense to dense grey and dark grey very silty fine SAND (Fluvio-Glacial Till).                                                                                                                                                                                                     |        | GT                 |            |

| Boring Progress |      |                                                                                                                                                       |            |             |           | Water Strikes                                                                                                                                                                    |       |        |         |          |        |
|-----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|---------|----------|--------|
| Date            | Time | Depth                                                                                                                                                 | Casing Dpt | Dia. (mm)   | Water Dpt | Date                                                                                                                                                                             | Time  | Strike | Minutes | Standing | Casing |
|                 |      |                                                                                                                                                       |            | 200         |           | 03-07-13                                                                                                                                                                         |       | 2.50   | 20      | 1.00     | 2.50   |
|                 |      |                                                                                                                                                       |            |             |           | 03-07-13                                                                                                                                                                         | 15.45 | 5.30   |         |          | 10.00  |
| Chiselling      |      |                                                                                                                                                       |            | Water Added |           | General Remarks<br>Borehole location obtained using hand-held GPS - accurate to approximately 5m.<br><br>Log is DRAFT status and subject to review following laboratory testing. |       |        |         |          |        |
| From            | To   | Hours                                                                                                                                                 | Tool       | From        | To        |                                                                                                                                                                                  |       |        |         |          |        |
| 0               | 0.5  | 0.45                                                                                                                                                  | Hammer     | 0           | 1         |                                                                                                                                                                                  |       |        |         |          |        |
| 1               | 1.6  | 0.45                                                                                                                                                  | Hammer     |             |           |                                                                                                                                                                                  |       |        |         |          |        |
| Scale 1:62.5    |      | Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |            |             |           |                                                                                                                                                                                  |       |        |         |          |        |

08 WSP BH LOG 37721-FABIAN WAY, SWANSEA.GPJ WSPTEMPLATE1.03.GDT 14/8/13

08 WSP BH LOG 37221-FABIAN WAY. SWANSEA.GPJ WSPETEMPLATE1.03.GDT 14/8/13

General Remarks  
Borehole location obtained using hand-held GPS - accurate to approximately 5m.  
Log is DRAFT status and subject to review following laboratory testing.

|                                                                                                                |  |                                                   |  |           |  |                            |  |                      |  |
|----------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------|--|-----------|--|----------------------------|--|----------------------|--|
| <br>wsp<br>Telephone:<br>Fax: |  | <h1 style="text-align: center;">BOREHOLE LOG</h1> |  |           |  | Hole No.                   |  | BH104                |  |
|                                                                                                                |  |                                                   |  |           |  | Sheet                      |  | 1 of 2               |  |
| Job No                                                                                                         |  | Client                                            |  |           |  | Date                       |  |                      |  |
| 37721                                                                                                          |  | Leadbitter                                        |  |           |  | 04-07-13<br>05-07-13       |  |                      |  |
| Contractor / Driller                                                                                           |  | Method/Plant Used                                 |  | Logged By |  | Co-Ordinates (NGR)         |  | Ground Level (m AOD) |  |
| Apex                                                                                                           |  | Dando CP                                          |  | MCL       |  | E 70269.000<br>N 92884.000 |  |                      |  |

| SAMPLES & TESTS |      |                                        |            |             |               |       | STRATA       |                   |                                                                                                                                                                                                                                                                                                                     |        | Install / Backfill<br>Dia.<br>50 mm |         |
|-----------------|------|----------------------------------------|------------|-------------|---------------|-------|--------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------------------|---------|
| Depth           | Type | Test Result                            | PID (ppmV) | HSV (kN/m2) | P Pen (kN/m2) | Water | Elev. (mAOD) | Depth (Thickness) | Description                                                                                                                                                                                                                                                                                                         | Legend |                                     | Geology |
| 1.00            | SPT  | 25,25,25<br>0,0,0<br>N=25/<br>0.015(C) |            |             |               |       |              | (0.80)            | MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles and occasional boulders (up to 300mm diameter). Gravel is subangular fine to coarse of sandstone and concrete. Cobbles and boulders are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat). |        | MG                                  |         |
| 1.00-1.50       | B    |                                        |            |             |               |       |              | (1.70)            | MADE GROUND comprising dark brown and greyish brown sandy GRAVEL with some cobbles. Gravel is angular to subangular fine to coarse of red brick iron ore slag concrete and sandstone. Cobbles are subangular of iron ore slag and sandstone.                                                                        |        | MG                                  |         |
| 2.00            | SPT  | 25,25,0<br>0,0,0<br>N=0/<br>0(C)       |            |             |               |       |              | 2.50              |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 2.00-2.50       | B    |                                        |            |             |               |       |              |                   | Medium dense light brown gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of sandstone and calcareous shell fragments (Aeolian Sand).                                                                                                                                                |        |                                     |         |
| 3.00            | SPT  | 1,1,3<br>4,4,6<br>N=17(S)              |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 3.00-3.50       | B    |                                        |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 4.00            | SPT  | 2,2,1<br>2,4,6<br>N=13(S)              |            |             |               |       |              | (3.70)            |                                                                                                                                                                                                                                                                                                                     |        | AEOLD                               |         |
| 4.00-4.50       | B    |                                        |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 5.00            | SPT  | 2,3,3<br>3,3,5<br>N=14(S)              |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 5.00-5.50       | B    |                                        |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 6.00            | SPT  | 3,3,3<br>4,5,7<br>N=19(S)              |            |             |               |       |              | 6.20              |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 6.00-6.50       | B    |                                        |            |             |               |       |              |                   | Very loose to loose grey and dark grey very silty fine SAND with some cobbles. Cobbles are subangular of sandstone approximately 100-130mm diameter (Fluvio-Glacial Till).                                                                                                                                          |        |                                     |         |
| 7.50            | SPT  | 1,1,1<br>1,1,1<br>N=4(S)               |            |             |               |       |              | (3.90)            |                                                                                                                                                                                                                                                                                                                     |        | GT                                  |         |
| 7.50-8.00       | B    |                                        |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 9.00            | SPT  | 2,2,2<br>2,3,2<br>N=9(S)               |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 9.00-9.50       | B    |                                        |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |
| 9.50-10.00      | B    |                                        |            |             |               |       |              |                   |                                                                                                                                                                                                                                                                                                                     |        |                                     |         |

| Boring Progress |       |       |            |           |           | Water Strikes |      |        |         |          |        |
|-----------------|-------|-------|------------|-----------|-----------|---------------|------|--------|---------|----------|--------|
| Date            | Time  | Depth | Casing Dpt | Dia. (mm) | Water Dpt | Date          | Time | Strike | Minutes | Standing | Casing |
| 04-07-13        | 16.30 | 10.00 | 9.00       | 200       | 3.3       | 04-07-13      |      | 2.50   | 20      | 2.00     |        |

| Chiselling |     |       |        | Water Added |      |
|------------|-----|-------|--------|-------------|------|
| From       | To  | Hours | Tool   | From        | To   |
| 0          | 1.6 | 0.45  | Hammer | 1           | 1.50 |
| 2          | 2.5 | 1     | Hammer |             |      |

|              |  |                                                                                                                                                       |
|--------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scale 1:62.5 |  | Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |
|--------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                |  |
|--------------------------------------------------------------------------------|--|
| General Remarks                                                                |  |
| Borehole location obtained using hand-held GPS - accurate to approximately 5m. |  |
| Log is DRAFT status and subject to review following laboratory testing.        |  |

08 WSP BH LOG 37221-FABIAN WAY, SWANSEA.GPJ WSPTEMPLATE1.03.GDT 14/8/13

DRAFT

08 WSP BH LOG 37221-FABIAN WAY, SWANSEA.GPJ WSPTEMPLATE1.03.GDT 14/8/13

|                                                                                                                |  |                                |  |                  |  |                                                  |  |
|----------------------------------------------------------------------------------------------------------------|--|--------------------------------|--|------------------|--|--------------------------------------------------|--|
| <br>wsp<br>Telephone:<br>Fax: |  | <b>BOREHOLE LOG</b>            |  |                  |  | Hole No.<br><b>BH105</b>                         |  |
|                                                                                                                |  | Project<br>Fabian Way, Swansea |  |                  |  | Sheet<br>1 of 3                                  |  |
| Job No<br>37721                                                                                                |  | Client<br>Leadbitter           |  |                  |  | Date<br>05-07-13<br>10-07-13                     |  |
| Contractor / Driller<br>Apex                                                                                   |  | Method/Plant Used<br>Dando CP  |  | Logged By<br>MCL |  | Co-Ordinates (NGR)<br>E 70248.000<br>N 92938.000 |  |
|                                                                                                                |  |                                |  |                  |  | Ground Level (m AOD)                             |  |

| SAMPLES & TESTS |      |                                         |            |             |               |       | STRATA       |                    |                                                                                                                                                                                                                                                                                                                     |        | Install / Backfill<br>Dia. 50 mm |         |
|-----------------|------|-----------------------------------------|------------|-------------|---------------|-------|--------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------|---------|
| Depth           | Type | Test Result                             | PID (ppmV) | HSV (kN/m2) | P Pen (kN/m2) | Water | Elev. (mAOD) | Depth (Thick-ness) | Description                                                                                                                                                                                                                                                                                                         | Legend |                                  | Geology |
| 1.00            | SPT  | 15,10,25<br>25,0,0<br>N=50/<br>0.045(C) |            |             |               |       |              | (0.80)             | MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles and occasional boulders (up to 300mm diameter). Gravel is subangular fine to coarse of sandstone and concrete. Cobbles and boulders are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat). |        | MG                               |         |
| 1.00-2.00       | B    |                                         |            |             |               |       |              | (1.70)             | MADE GROUND comprising greyish brown and dark brown fine sandy GRAVEL with some cobbles (5-20%). Gravel is angular to subangular fine to coarse of iron-ore slag, sandstone, red brick and calcareous shell fragments. Cobbles are subangular of iron-ore slag, sandstone and red brick.                            |        | MG                               |         |
| 2.00            | SPT  | 50,0,0<br>0,0,0<br>N=0/<br>0(C)         |            |             |               |       |              | 2.50               |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 2.00-2.50       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 3.00            | SPT  | 2,2,2<br>2,2,3<br>N=9(S)                |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 3.00-3.50       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 4.00            | SPT  | 2,3,5<br>12,12,16<br>N=45(S)            |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 4.00-4.50       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 5.00            | SPT  | 3,3,9<br>11,11,12<br>N=43(S)            |            |             |               |       |              | (5.80)             |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 5.00-5.50       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 6.00            | SPT  | 5,5,7<br>7,10,10<br>N=34(S)             |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 6.00-6.50       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 7.50            | SPT  | 3,5,2<br>4,2,3<br>N=11(S)               |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 7.50-8.00       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 9.00            | SPT  | 2,2,2<br>2,4,4<br>N=12(S)               |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |
| 9.00-9.50       | B    |                                         |            |             |               |       |              |                    |                                                                                                                                                                                                                                                                                                                     |        |                                  |         |

| Boring Progress |       |       |            |           |           | Water Strikes |       |        |         |          |        |
|-----------------|-------|-------|------------|-----------|-----------|---------------|-------|--------|---------|----------|--------|
| Date            | Time  | Depth | Casing Dpt | Dia. (mm) | Water Dpt | Date          | Time  | Strike | Minutes | Standing | Casing |
| 05-07-13        | 16.30 | 3.00  | 3.00       |           | 2         | 10-07-13      | 07.45 | 3.30   |         |          | 19.00  |
|                 |       |       |            |           |           | 09-07-13      | 16.05 | 5.40   |         |          | 19.00  |
|                 |       |       |            |           |           | 08-07-13      | 16.00 | 5.49   |         |          | 11.50  |
|                 |       |       |            |           |           | 09-07-13      | 07.45 | 5.50   |         |          | 11.50  |

| Chiselling |     |       |        | Water Added |    | General Remarks |                                                                                                                                                           |
|------------|-----|-------|--------|-------------|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| From       | To  | Hours | Tool   | From        | To |                 |                                                                                                                                                           |
| 1          | 1.5 | 1     | Hammer | 0           | 4  |                 | Borehole location obtained using hand-held GPS - accurate to approximately 5m.<br>Log is DRAFT status and subject to review following laboratory testing. |
| 1.5        | 2   | 1     | Hammer |             |    |                 |                                                                                                                                                           |
| 2          | 2.5 | 1     | Hammer |             |    |                 |                                                                                                                                                           |

|              |                                                                                                                                                       |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scale 1:62.5 | Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|

08 WSP BH LOG 37721-FABIAN WAY, SWANSEA.GPJ WSPTEMPLATE1.03.GDT 14/8/13

|                                                                                                                |                                                       |                  |                                                  |                      |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------|--------------------------------------------------|----------------------|
| <br>wsp<br>Telephone:<br>Fax: | <b>BOREHOLE LOG</b><br>Project<br>Fabian Way, Swansea |                  | Hole No.<br><b>BH105</b>                         |                      |
|                                                                                                                |                                                       |                  | Sheet<br>2 of 3                                  |                      |
| Job No<br>37721                                                                                                | Client<br>Leadbitter                                  |                  | Date<br>05-07-13<br>10-07-13                     |                      |
| Contractor / Driller<br>Apex                                                                                   | Method/Plant Used<br>Dando CP                         | Logged By<br>MCL | Co-Ordinates (NGR)<br>E 70248.000<br>N 92938.000 | Ground Level (m AOD) |

| SAMPLES & TESTS |      |                                        |           |             |               |       | STRATA       |                                                                                                 |                                                                                                                                                                                 |        |         | Install / Backfill |  |
|-----------------|------|----------------------------------------|-----------|-------------|---------------|-------|--------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------|--------------------|--|
| Depth           | Type | Test Result                            | PH (ppmV) | HSV (kN/m2) | P Pen (kN/m2) | Water | Elev. (mAOD) | Depth (Thickness)                                                                               | Description                                                                                                                                                                     | Legend | Geology | Dia. 50 mm         |  |
| 10.50           | SPT  | 8,10,25<br>25,0,0<br>N=50/<br>0.072(S) |           |             |               |       |              |                                                                                                 | Medium dense in places very dense greyish brown and dark grey silty fine SAND with many cobbles. Cobbles are subrounded of quartzitic sandstone (Fluvio-Glacial Till).          |        | GT      |                    |  |
| 10.50-11.00     | B    |                                        |           |             |               |       |              | ...between 13.8-15.50mbgl: rounded medium to coarse gravel of quartzitic sandstone. (continued) |                                                                                                                                                                                 |        |         |                    |  |
| 12.00           | SPT  | 25,25,25<br>0,0,0<br>N=25/<br>0.02(S)  |           |             |               |       |              | (7.20)                                                                                          |                                                                                                                                                                                 |        |         |                    |  |
| 12.00-12.50     | B    |                                        |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        |         |                    |  |
| 13.50           | SPT  | 2,3,5<br>5,7,8<br>N=25(C)              |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        | GT      |                    |  |
| 13.50-14.00     | B    |                                        |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        |         |                    |  |
| 15.00           | SPT  | 3,5,5<br>8,8,10<br>N=31(C)             |           |             |               |       |              | 15.50                                                                                           |                                                                                                                                                                                 |        |         |                    |  |
| 15.00-15.50     | B    |                                        |           |             |               |       |              |                                                                                                 | Stiff dark brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to medium of yellowish brown sandstone, dark grey siltstone and mudstone (Glacial Till). |        |         |                    |  |
| 16.50           | SPT  | 9,7,9<br>12,15,15<br>N=51(S)           |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        | GT      |                    |  |
| 16.50-17.00     | B    |                                        |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        |         |                    |  |
| 18.00           | SPT  | 7,9,15<br>20,20,10<br>N=65(S)          |           |             |               |       |              | (4.80)                                                                                          |                                                                                                                                                                                 |        |         |                    |  |
| 18.00-18.50     | B    |                                        |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        |         |                    |  |
| 19.50           | SPT  | 5,6,8<br>12,11,20<br>N=51(S)           |           |             |               |       |              |                                                                                                 |                                                                                                                                                                                 |        |         |                    |  |

| Boring Progress |       |                                                                                                                                                       |            |             |           | Water Strikes                                                                                                                                                                                           |      |        |         |          |        |
|-----------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------|----------|--------|
| Date            | Time  | Depth                                                                                                                                                 | Casing Dpt | Dia. (mm)   | Water Dpt | Date                                                                                                                                                                                                    | Time | Strike | Minutes | Standing | Casing |
| 08-07-13        | 16.30 | 11.50                                                                                                                                                 | 10.50      | 200         | 5.5       |                                                                                                                                                                                                         |      |        |         |          |        |
| 09-07-13        | 16.30 | 19.00                                                                                                                                                 | 19.00      |             | 5.5       |                                                                                                                                                                                                         |      |        |         |          |        |
| Chiselling      |       |                                                                                                                                                       |            | Water Added |           | <div>General Remarks</div> <div>Borehole location obtained using hand-held GPS - accurate to approximately 5m.</div> <div>Log is DRAFT status and subject to review following laboratory testing.</div> |      |        |         |          |        |
| From            | To    | Hours                                                                                                                                                 | Tool       | From        | To        |                                                                                                                                                                                                         |      |        |         |          |        |
| 11.5            | 12    | 1                                                                                                                                                     | Hammer     |             |           |                                                                                                                                                                                                         |      |        |         |          |        |
| 12              | 12.50 | 1                                                                                                                                                     | Hammer     |             |           |                                                                                                                                                                                                         |      |        |         |          |        |
| 12.5            | 12.7  | 0.30                                                                                                                                                  | Hammer     |             |           |                                                                                                                                                                                                         |      |        |         |          |        |
| Scale 1:62.5    |       | Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |            |             |           |                                                                                                                                                                                                         |      |        |         |          |        |

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|                                                                                                                |                                |                      |                                                  |
|----------------------------------------------------------------------------------------------------------------|--------------------------------|----------------------|--------------------------------------------------|
| <br>wsp<br>Telephone:<br>Fax: | <b>BOREHOLE LOG</b>            |                      | Hole No.<br><b>BH105</b>                         |
|                                                                                                                | Project<br>Fabian Way, Swansea |                      | Sheet<br>3 of 3                                  |
| Job No<br>37721                                                                                                | Client<br>Leadbitter           |                      | Date<br>05-07-13<br>10-07-13                     |
| Contractor / Driller<br>Apex                                                                                   | Method/Plant Used<br>Dando CP  | Logged By<br>MCL     | Co-Ordinates (NGR)<br>E 70248.000<br>N 92938.000 |
|                                                                                                                |                                | Ground Level (m AOD) |                                                  |

| SAMPLES & TESTS |      |                                        |            |             |               |       | STRATA       |                   |                                                                                                                                     |                                                                                     | Install / Backfill |            |
|-----------------|------|----------------------------------------|------------|-------------|---------------|-------|--------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------|------------|
| Depth           | Type | Test Result                            | PID (ppmV) | HSV (kN/m2) | P Pen (kN/m2) | Water | Elev. (mAOD) | Depth (Thickness) | Description                                                                                                                         | Legend                                                                              | Geology            | Dia. 50 mm |
| 19.50-20.00     | B    |                                        |            |             |               |       |              | 20.30             |                                                                                                                                     |  | GT                 |            |
| 20.50           | SPT  | 25.25,25<br>0.0,0<br>N=25/<br>0.005(S) |            |             |               |       |              | 20.50             | Extremely weak grey MUDSTONE recovered as clayey angular to subangular fine to medium gravel sized fragments (Lower Coal Measures). |  | SWLCM              |            |

|                 |       |                                                                                                                                                       |             |           |           |                                                                                                                                                                              |      |        |         |          |        |
|-----------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------|----------|--------|
| Boring Progress |       |                                                                                                                                                       |             |           |           | Water Strikes                                                                                                                                                                |      |        |         |          |        |
| Date            | Time  | Depth                                                                                                                                                 | Casing Dpt  | Dia. (mm) | Water Dpt | Date                                                                                                                                                                         | Time | Strike | Minutes | Standing | Casing |
| 10-07-13        | 16.30 | 20.50                                                                                                                                                 | 20.50       | 100       | 5.5       |                                                                                                                                                                              |      |        |         |          |        |
| Chiselling      |       |                                                                                                                                                       | Water Added |           |           | General Remarks<br>Borehole location obtained using hand-held GPS - accurate to approximately 5m.<br>Log is DRAFT status and subject to review following laboratory testing. |      |        |         |          |        |
| From            | To    | Hours                                                                                                                                                 | Tool        | From      | To        |                                                                                                                                                                              |      |        |         |          |        |
|                 |       |                                                                                                                                                       |             |           |           |                                                                                                                                                                              |      |        |         |          |        |
| Scale 1:62.5    |       | Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |             |           |           |                                                                                                                                                                              |      |        |         |          |        |

08 WSP BH LOG 37721-FABIAN WAY, SWANSEA.GPJ WSPTEMPLATE1.03.GDT 14/8/13

|                                                                                                                |                                       |                         |                                                          |                      |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------|----------------------------------------------------------|----------------------|
| <br>wsp<br>Telephone:<br>Fax: | <b>BOREHOLE LOG</b>                   |                         | Hole No.<br><b>BH106</b>                                 |                      |
|                                                                                                                | Project<br><b>Fabian Way, Swansea</b> |                         | Sheet<br><b>1 of 1</b>                                   |                      |
| Job No.<br><b>37721</b>                                                                                        | Client<br><b>Leadbitter</b>           |                         | Date<br><b>10-07-13<br/>12-07-13</b>                     |                      |
| Contractor / Driller<br><b>Apex</b>                                                                            | Method/Plant Used<br><b>Dando CP</b>  | Logged By<br><b>MCL</b> | Co-Ordinates (NGR)<br><b>E 70205.000<br/>N 92862.000</b> | Ground Level (m AOD) |

| SAMPLES & TESTS |      |                                        |            |             |               |       | STRATA       |                   |                                                                                                                                                                                                                                                                                                                     |        |         | Install / Backfill |
|-----------------|------|----------------------------------------|------------|-------------|---------------|-------|--------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------|--------------------|
| Depth           | Type | Test Result                            | PID (ppmV) | HSV (kN/m2) | P.Pen (kN/m2) | Water | Elev. (mAOD) | Depth (Thickness) | Description                                                                                                                                                                                                                                                                                                         | Legend | Geology | Dia. 50 mm         |
|                 |      |                                        |            |             |               | 1     |              | (0.80)            | MADE GROUND comprising yellowish brown gravelly fine to medium SAND with many cobbles and occasional boulders (up to 300mm diameter). Gravel is subangular fine to coarse of sandstone and concrete. Cobbles and boulders are subangular and tabular of fine to medium grained sandstone and concrete (Piling Mat). |        | MG      |                    |
| 1.00            | SPT  | 3,2,4<br>4,4,4<br>N=16(S)              |            |             |               |       |              | (1.20)            | MADE GROUND comprising dark brown and greyish brown sandy GRAVEL with some cobbles. Gravel is angular to subangular fine to coarse of red brick iron ore slag concrete and sandstone. Cobbles are subangular of iron ore slag and sandstone.                                                                        |        | MG      |                    |
| 1.00-1.50       | B    |                                        |            |             |               |       |              | 2.00              |                                                                                                                                                                                                                                                                                                                     |        |         |                    |
| 2.00            | SPT  | 2,6,12<br>25,25,0<br>N=62/<br>0.225(S) |            |             |               |       |              | (0.60)            | MADE GROUND comprising brown slightly gravelly SAND. Gravel is subangular to subrounded medium to coarse of quartzitic sandstone and red brick. Black subangular fine gravel sized fragments of coal measure observed throughout horizon.                                                                           |        | MG      |                    |
| 2.00-2.50       | B    |                                        |            |             |               |       |              | 2.60              |                                                                                                                                                                                                                                                                                                                     |        |         |                    |
| 3.00            | SPT  | 25,25,0<br>0,0,0<br>N=0/<br>0(C)       |            |             |               |       |              | (0.60)            | MADE GROUND comprising reinforced concrete (buried concrete foundation slab).                                                                                                                                                                                                                                       |        | MG      |                    |
| 3.20-3.50       | ES   |                                        |            |             |               |       |              | 3.20              |                                                                                                                                                                                                                                                                                                                     |        |         |                    |
|                 |      |                                        |            |             |               |       |              | (0.80)            | MADE GROUND comprising dark grey and black fine to medium SAND impacted with hydrocarbon. Strong HC odour noted.                                                                                                                                                                                                    |        | MG      |                    |
|                 |      |                                        |            |             |               |       |              | 4.00              |                                                                                                                                                                                                                                                                                                                     |        |         |                    |
|                 |      |                                        |            |             |               |       |              | (0.50)            | Probably medium dense light brown gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of sandstone and calcareous shell fragments (Aeolian Sand).                                                                                                                                       |        | AEOLD   |                    |
|                 |      |                                        |            |             |               |       |              | 4.50              |                                                                                                                                                                                                                                                                                                                     |        |         |                    |

| Boring Progress |          |                                                                                                                                                       |                  |             |           | Water Strikes                                                                                                                                                                                                                                          |      |        |         |          |        |
|-----------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------|----------|--------|
| Date            | Time     | Depth                                                                                                                                                 | Casing Dpt       | Dia. (mm)   | Water Dpt | Date                                                                                                                                                                                                                                                   | Time | Strike | Minutes | Standing | Casing |
| 10-07-13        | 16.30    | 2.00                                                                                                                                                  | 2.00             | 200         | 1.00      | 10-07-13                                                                                                                                                                                                                                               |      | 0.50   |         |          | 1.00   |
| 11-07-13        | 16.30    | 4.50                                                                                                                                                  | 4.50             |             | 1.5       | 11-07-13                                                                                                                                                                                                                                               |      | 4.50   |         |          | 4.50   |
| Chiselling      |          |                                                                                                                                                       |                  | Water Added |           | General Remarks<br>Borehole location obtained using hand-held GPS - accurate to approximately 5m.<br><br>Log is DRAFT status and subject to review following laboratory testing.<br><br>Borehole terminated due to potential hydrocarbon contamination |      |        |         |          |        |
| From            | To       | Hours                                                                                                                                                 | Tool             | From        | To        |                                                                                                                                                                                                                                                        |      |        |         |          |        |
| 2.6<br>3        | 3<br>3.2 | 1<br>0.45                                                                                                                                             | Hammer<br>Hammer | 0           | 0.5       |                                                                                                                                                                                                                                                        |      |        |         |          |        |
| Scale 1:62.5    |          | Notes: All dimensions in metres. Logs should be read in accordance with the provided Key. Descriptions are based on visual and manual identification. |                  |             |           |                                                                                                                                                                                                                                                        |      |        |         |          |        |

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## 8.2 Paxton Street Borehole Investigation

|                                                                                                                                                                                                                                                     |  |                                               |  |                                                    |  |                                                                                |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------|--|----------------------------------------------------|--|--------------------------------------------------------------------------------|--|
| <b>DRILLING METHOD</b><br>Percussion 200 mm dia. to 15.0 m<br>"Open hole" rotary drilling From 15.0 m to 22.0 m                                                                                                                                     |  | <b>GROUND LEVEL</b><br>+ 9.18 m O.D.          |  | <b>GRID REFERENCE</b><br>SS 65399228<br>SS69SE 345 |  | <b>BOREHOLE NUMBER</b><br>2                                                    |  |
| <b>MACHINE</b><br>Dando<br>"Investigator"                                                                                                                                                                                                           |  | <b>COKE BARREL AND BIT DESIGN</b>             |  | <b>ORIENTATION</b><br>Vertical                     |  | <b>SITE</b><br>PROPOSED NEW COUNTY HALL<br>PAXTON STREET SWANSEA               |  |
| <b>SOIL SAMPLES</b><br>DEPTH AND TYPES                                                                                                                                                                                                              |  | <b>DRILLING AND CASING PROGRESS</b>           |  | <b>WATER RECOVERY % AND Q.M. LEVEL</b>             |  | <b>R. Q. D.</b>                                                                |  |
|                                                                                                                                                                                                                                                     |  |                                               |  |                                                    |  | <b>CORE RECOVERY % AND SIZE</b>                                                |  |
|                                                                                                                                                                                                                                                     |  |                                               |  |                                                    |  | <b>DESCRIPTION OF STRATA</b>                                                   |  |
|                                                                                                                                                                                                                                                     |  |                                               |  |                                                    |  | <b>THICKNESS</b>                                                               |  |
|                                                                                                                                                                                                                                                     |  |                                               |  |                                                    |  | <b>O.D. LEVEL</b>                                                              |  |
|                                                                                                                                                                                                                                                     |  |                                               |  |                                                    |  | <b>SYMBOLIC LOG</b>                                                            |  |
| 1.00 P N= 8                                                                                                                                                                                                                                         |  | 5.2.75                                        |  |                                                    |  | MADE GROUND consisting of ashes. 0.50 5.18                                     |  |
| 1.50 P N= 6                                                                                                                                                                                                                                         |  |                                               |  |                                                    |  | MADE GROUND consisting of loose, light grey fine-medium sand. 1.00 6.68        |  |
| 3.00 P N= 9                                                                                                                                                                                                                                         |  |                                               |  |                                                    |  | MADE GROUND consisting of grey sand with layers of soft sandy clay 1.05 7.68   |  |
| 4.00 P N= 75 for 150 mm                                                                                                                                                                                                                             |  |                                               |  |                                                    |  | MADE GROUND consisting of soft red-brown sand clay with brick shale. 0.95 6.63 |  |
| 5.00 P N= 105 for 225 mm                                                                                                                                                                                                                            |  |                                               |  |                                                    |  | MADE GROUND consisting of dense bricks, ashes, sand and clay. 1.45 5.68        |  |
| 6.00 P N= 75 for 150 mm                                                                                                                                                                                                                             |  | 6.2.75<br>7.1.75<br>10.2.75<br>11.2.75<br>5.7 |  |                                                    |  | Very dense brown sandy GRAVEL with traces of sandy clay 2.05 4.23              |  |
| 7.00 P N= 77                                                                                                                                                                                                                                        |  |                                               |  |                                                    |  | Very dense brown SAND with some gravel. 0.95 2.18                              |  |
| 8.00 P N= 34                                                                                                                                                                                                                                        |  |                                               |  |                                                    |  | Stiff grey-brown gravelly BOULDER CLAY 1.23 1.23                               |  |
| 9.00 P N= 67                                                                                                                                                                                                                                        |  |                                               |  |                                                    |  | 3.05                                                                           |  |
| 10.00 P N= 65                                                                                                                                                                                                                                       |  |                                               |  |                                                    |  | Borehole continued to 22.0 m.                                                  |  |
| <b>REMARKS</b> Borehole drilled by STRATA SURVEYS Ltd Cheshire. Scale 1:50 Sheet 1 of 3<br>P = Standard penetration Test<br>N = Number of blows for 300 mm (unless otherwise stated)<br>Water a.m. Level<br>Borehole chiselled from 4.0 m to 15.0 m |  |                                               |  |                                                    |  |                                                                                |  |
| WEST GLAMORGAN COUNTY COUNCIL                                                                                                                                                                                                                       |  |                                               |  | COUNTY ENGINEER AND SURVEYOR'S DEPT.               |  |                                                                                |  |

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