

**Persimmon Homes (East Wales)**

**Ty Mawr Manor, Gilwern**

**Outline Remediation Strategy Report**

11062/GNS/12/RSR

**CLIENT:** Persimmon Homes (East Wales)  
**PROJECT:** Ty Mawr Manor, Gilwern  
**TITLE:** Outline Remediation Strategy Report  
**JOB NO:** 11062  
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## **1.0 INTRODUCTION**

### **1.1 GENERAL**

Persimmon Homes are proposing to redevelop a site at Ty Mawr Manor, Gilwern for residential end-use.

Intégral Géotechnique (Wales) Limited were appointed as the Geotechnical Engineers to design and undertake site investigations at the site, which identified elevated concentrations of some contaminants associated with the former site use.

Subsequently, Intégral Géotechnique (Wales) Limited were appointed to prepare a detailed outline remediation strategy report for the site, in order to provide a clear set of remediation activities required to render the site acceptable for residential re-development.

The subsequent supervision and validation of the execution of the reclamation and remediation will be based upon the outline remediation strategy.

### **1.2 PROPOSED DEVELOPMENT**

The proposed development comprises thirty three residential properties, with private gardens, car parking areas and access roads.

The proposed layout is shown on Drawing No. 1210 EN-01 A by Hammond Architectural.

## **2.0 BACKGROUND**

### **2.1 SITE LOCATION AND DESCRIPTION**

The site is located to the north-east of Gilwern, at an approximate National Grid Reference of SO 255 155, see Figure 1.

The site is irregular in shape and occupies an area of approximately 1.9 hectares. The site is bounded to the north-east and west by a narrow track separating the site from agricultural land. To the south, the site is bound by residential development and a small training centre. A site plan is presented in Figure 2.

The southern area of the site contains buildings and garages which have previously been let out for light industrial use. Hardstandings associated with the light industrial use of the buildings cover much of the southern part of the site.

The central eastern area of the site was formerly occupied by Ty Mawr Manor. This building has been demolished and the demolition materials used to backfill the basement associated with the former building.

The central western part of the site is a bowl-like depression which lies approximately 3 to 4m below the adjacent ground levels to the south and east and approximately 5 to 6m below the adjacent ground levels to the north.

The western and northern parts of the site are generally overgrown areas which were formerly in use as garden areas. To the north of the site, several large greenhouse structures have previously been cleared.

Along the north-eastern and eastern margin, the site falls steeply to the floodplain of the River Usk.

Mature trees cover much of the western part of the site and along the the steep embankment to the east/north-east.

Several retaining structures cross the site. This is reflective of the steeply sloping nature of the previous site development.

## 2.2 AVAILABLE SITE INVESTIGATION DATA

Previous site investigations have been undertaken across the site, as detailed below. The information contained within these reports has been relied upon as part of this report.

- Intégral Géotechnique, January 2005. Land at Ty Mawr Manor, Gilwern (Ref. 9039/HP/MKG).
- Intégral Géotechnique, February 2007. Land at Ty Mawr Manor, Gilwern (Ref. 9820/AF/07).

A detailed review of the previous site investigation reports was recently carried out by Intégral Géotechnique for Persimmon Homes, as detailed below:

- Site Investigation Report No. 11062/RB/12/SI dated October 2012.

In order to gain a full and detailed appraisal of the site, this outline remediation strategy report should be read in conjunction with report No.11062/RB/12/SI.

### ***Soil Conditions Summary***

The ground conditions generally comprise a variable thickness of made ground over superficial materials of glacial drift. This ground profile was modified by the past development of the site and the light industrial development.

The industrial estate infrastructure remains. The former Ty Mawr Manor has been demolished, however the basement remains and has been backfilled with demolition materials.

**2.2 AVAILABLE SITE INVESTIGATION DATA (CONTINUED)**

A summary of the ground conditions encountered across the site is presented below in Table 1.

<b>TABLE 1 : SUMMARY OF GROUND CONDITIONS</b>		
Depth (m)		Stratum
From	To	
GL	0.0/>2.7	<p>MADE GROUND: Loose to medium dense silty SAND and GRAVEL with occasional brick and occasional demolition rubble.</p> <p>OR; (locally)</p> <p>Mostly demolition rubble (i.e. TPB)</p> <p>OR; (locally)</p> <p>Ashy SAND with some gravel, occasional brick, plastic, glass, ceramic, metal cans, concrete, cobbles and boulders, cement bound asbestos fragments (demolition rubble mixed with general waste – i.e. TPF)</p>
0.0/>2.7	>17.5/>25.0	<p>GLACIAL SILTS, SANDS AND GRAVELS: Variable loose to medium dense and medium dense red brown SAND and GRAVEL/sandy GRAVEL with occasional cobbles and boulders/silty clayey SAND/sandy SILT...</p> <p>Becoming medium dense to dense below 14.0/17.0m depth...</p> <p>...locally firm red brown silty CLAY (beneath southern part of site)</p>

Made ground materials were encountered beneath the majority of the site to a maximum depth of greater than 2.7m. The made ground materials generally comprise demolition materials within the eastern and central parts of the site, reworked natural materials in the southern, and locally northern, parts of the site and waste materials encountered locally within an infilled pit around trial it TPF in the southern part of the site.

## 2.2 AVAILABLE SITE INVESTIGATION DATA (CONTINUED)

Trial pit TPB, which was excavated within the footprint of the former Ty Mawr Manor in the eastern part of the site, encountered a concrete slab at 2.4m depth, representing the basement floor slab of the former building. The made ground materials down to the concrete slab comprised demolition materials including bricks, tiles, wood, metal, glass, concrete and masonry.

The trial pits, window samples and boreholes across the site, encountered superficial deposits comprising mostly silts, sands and gravels to a maximum depth of 25.0m beneath the site.

Particle size distribution analysis of representative samples of the superficial materials within the top m indicates that the shallow superficial materials are comprised of mostly sands and gravels or silty sandy gravels.

Deposits of clay were locally encountered within the southern part of the site around trial pit TPG. Atterberg tests indicate these clays to be of low plasticity.

Generally, the superficial materials were found to become dense at depths of between 14 and >25m. The base of the superficial materials was not confirmed within any of the boreholes across the site.

Groundwater was recorded at between 2.9m and 9.4m depth within the boreholes during drilling. No water strikes were recorded indicating that the groundwater is likely to represent perched water and the through flow of water within the superficial deposits is generally slow. No groundwater was recorded within the installations in BH1 and BH2 during the gas monitoring. Groundwater was recorded at 3.6m depth within the BH3 installation.

The groundwater conditions are based on observations made at the time of the fieldwork. It should be noted that groundwater levels may vary due to seasonal and other effects.

### 2.3 CONCEPTUAL SITE MODEL

As identified in the desk study, the historical land uses at the site has resulted in a list of potentially contaminative uses that include light industrial use and garages. Based on the results of the contamination testing of the made ground the following potential contaminant sources were identified within the shallow made ground:

- Metals, semi-metals, and inorganics within the shallow made ground
- Polyaromatic hydrocarbons (PAH) within the shallow made ground
- Petroleum Hydrocarbon spillages within the shallow made ground
- Asbestos within the shallow made ground.

Potential exposure pathways for the critical receptors (both human health and controlled waters) are listed below:

- Dermal contact with soil and/or soil derived dust
- Ingestion of soil and/or soil attached to home-grown produce
- Ingestion of home-grown produce
- Inhalation of soil derived dust
- Inhalation of vapours – indoor and outdoor air
- Leaching of contaminants from made ground to groundwater
- Transportation of contaminants within groundwater.

In addition, the following exposure pathways have also been considered:

- Ground gas generation and migration
- Building materials durability.

A conceptual exposure model has been reviewed and revised to reflect the findings of the site investigation and the results of the laboratory testing of soils, soil leachate, groundwater and gas monitoring, a copy of which is provided below:

**2.3 CONCEPTUAL SITE MODEL (CONTINUED)**

Table 2: Conceptual Exposure Model						
Source		Receptor	Pathway	Preliminary Active Pathway? (see Sect. 5.8)	Relevant Pollutant Linkage	Justification/ Mitigation
Origin	Contaminant					
Made Ground of unknown origin and historical land uses (light industrial use)	Metals, semi-metals, non-metals, PAH, petroleum hydrocarbons, Asbestos	Resident – human health	Dermal Contact with made ground/dust	✓	✓	Elevated concentrations of PAH compounds identified within the made ground – risk assess.
			Ingestion of soil and/or soil attached to home-grown produce	✓	✓	
			Ingestion of home-grown produce	✓	✓	
			Inhalation of dust	✓	✓	
			Inhalation of vapours – indoor/outdoor	✓	X	
	Metals, semi-metals, inorganics, PAH, petroleum hydrocarbons	Groundwater quality	Leaching from made ground	✓	X	No significantly elevated concentrations identified.
Metals, semi-metals, inorganics, PAH, petroleum hydrocarbons	Surface water quality	Transportation within groundwater	✓	X	No significantly elevated concentrations identified.	

**2.3 CONCEPTUAL SITE MODEL (CONTINUED)**

Source		Receptor	Pathway	Preliminary Active Pathway?	Relevant Pollutant Linkage	Justification/ Mitigation
Origin	Contaminant					
Made Ground of unknown origin and natural ground	Metals, semi-metals, non-metals, PAH, petroleum hydrocarbons	Building Materials Durability	Direct contact	✓	✓	Building materials will be in contact with made ground – risk assess
Ground Gas – organic, gas producing materials	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	✓	✓	Potential gas producing materials present. Gas monitoring programme ongoing – risk assess

### **3.0 REMEDIATION IMPLEMENTATION PLAN**

#### **3.1 REPORT OBJECTIVES**

A remediation strategy report is required in order to translate the findings and recommendations of the risk assessment, (as defined in Site Investigation Report No.11062/RB/12/SI) into a clear set of remediation activities for the site.

Our previous investigations identified elevated concentrations of total chromium, lead, several speciated polyaromatic hydrocarbons, and asbestos in the shallow made ground present across the site. Statistical analysis indicated that of these contaminants only benzo(a)pyrene and asbestos were problematic. Asbestos was only encountered at a single location TPF, and was contained in a piece of board with no single fibres being present. Remedial works are therefore required in order to render the site acceptable for residential re-development. Additionally, there are areas of the site that were inaccessible at the time of the site investigation works, due to buildings, etc. These areas will be investigated by grid sampling following demolition of the existing buildings. Allowances have therefore been made for dealing with any additional contamination encountered during this stage.

#### **3.2 REMEDIATION METHODOLOGY FOR IDENTIFIED POLLUTANT LINKAGES**

As appropriate, quantitative risk assessments will be made and for those contaminants of concern (COC), Generic Soil Assessment Criteria (GSACs) as provided by LQM and Atkins will be adopted, as specified in our site investigation report ref. 11062/RB/12/SI.

Review of the remedial methodologies will be a continuing process and will be subject to the findings of the proposed validation works, and if necessary quantitative risk assessments.

##### ***Soil***

In order to cut the pathway to the end users of the site, it will be necessary to provide a suitable capping system to effectively cut dermal, ingestion and inhalation of dust pathways to end users. Therefore, the placement of a minimum thickness of 600mm of clean imported subsoil/topsoil is required. The proposed cover system would provide a barrier between site end users and the made ground sourced contamination identified, subject to correct specification and installation.

### 3.2 REMEDIATION METHODOLOGY FOR IDENTIFIED POLLUTANT LINKAGES (CONTINUED)

In the areas where only a thin layer of made ground is present, this could either be capped as described, or excavated from beneath areas of private gardens and/or soft landscaping, thereby removing the potential risk.

Investigation, testing and treatment or removal of any unforeseen contamination hotspots may be required.

It is recommended that any asbestos containing materials, particularly those identified within the vicinity of TPF are removed off site to a suitable disposal facility.

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#### **Groundwater**

Groundwater sampling and testing has not been carried out as part of this investigation. However, based on the historical use of the site, the observation of the materials encountered and the results of the laboratory testing of the made ground, the potential risk to underlying groundwater is considered to be low.

There is a potential for encountering localised pockets of shallow perched water which may be impacted by local hydrocarbon sources such as sumps/tanks in areas of the site formerly inaccessible due to the presence of the existing buildings. It will be necessary to remediate any localised pockets of perched water impacted by hydrocarbon contamination identified in service trenches/excavations made during development of the site. This should be carried out by intercepting perched water within controlled drainage excavations and pumping contaminated waters to baffle fuel oil traps and silt traps prior to eventual discharge under licence to foul sewer.

#### **Ground Gas**

The results of the gas monitoring programme showed that methane gas was not detected during the monitoring period. A maximum carbon dioxide concentration of 9.7% and a maximum gas flow rate of <0.1l/hr were measured during the gas monitoring programme.

In accordance with CIRIA Report C665 a Gas Screening Value (GSV) of <0.0097l/hour has been calculated. The results of the gas monitoring programme correspond to gas characteristic situation 2/Amber 1. Gas characteristic situation 2/Amber 1 require the inclusion of a suitable gas protective membrane and a ventilated sub-floor void. In this instance, the gas protective membrane should provide suitable resistance to carbon dioxide.

### **3.2 REMEDIATION METHODOLOGY FOR IDENTIFIED POLLUTANT LINKAGES** (CONTINUED)

The radon report obtained from the BGS indicates that the site is in an area affected by Radon and requires full protective measures.

#### ***Japanese Knotweed and other invasive plant species***

No invasive plant species were identified during the site investigation works undertaken in 2005 and 2007. However, given the time lapse since having undertaken these works, it is recommended that an ecological survey is undertaken to identify the presence or absence of any invasive plant species. If any species are identified, it is recommended that a scheme detailing the eradication of these species is implemented.

### **3.3 PHASING OF THE REMEDIATION WORKS**

The works are to be undertaken in one phase, dependent on the build programme, which is not yet available. The remediation works will be undertaken under the supervision of Intégral Géotechnique (Wales) Limited.

A further qualitative and quantitative risk assessment of soil and/or groundwater contamination will be undertaken of the validation sampling data and groundwater sampling and analysis, if required. The review of these risk assessments will form the basis for any additional remedial works which may be required.

Site preparation and operational constraints will be covered by the appointed contractor's method statements. Site procedures for managing the remedial works in a manner that will not cause pollution to controlled waters will be covered in the appointed contractor's method statements, which will need to be submitted in discharge of the Conditions of Planning.

Due to the limited nature of the required remediation works it is envisaged that no specific remediation licences will be required to control the works. The conditions imposed under the planning process are considered adequate.

During the site remedial works, a reporting system between Intégral Géotechnique and the appointed contractor should be established to identify and report any occurrences of impacted perched water or soils, in order that controlled implementation of the planned remedial measures is undertaken in a controlled and supervised fashion.

## **4.0 REMEDIATION VALIDATION PLAN**

### **4.1 REPORT OBJECTIVES**

A remediation validation plan is required to detail the data gathering requirements necessary to demonstrate that the remediation meets the site remediation criteria. The remediation is to be carried out in accordance with the Implementation Plan, as detailed in Section 3.

### **4.2 REMEDIATION VERIFICATION METHODOLOGY AND DATA GATHERING REQUIREMENTS**

The site remediation will be verified by the following measures:

- Contamination remediation verification is to be achieved by either confirming the thickness of the cover system, testing the capping soils, or by confirming satisfactory removal of the thin layer of made ground. Compliance testing will be required for the imported soil at a frequency of four tests per 250m<sup>3</sup> of material imported to site and used in garden areas. Each plot to be assessed will require verification of the capping thickness and a photographic record kept. All soils should be compliant with the agreed SGVs/GSACs.
- Full details of the laboratory control requirements are to be appended to each report.
- Localised treatment of perched groundwater (if encountered) will be undertaken in order to remove any free phase product observed in excavations and trenches during development. This will be undertaken by pumping of impacted perched groundwater via a free phase separator into the off site drainage system.
- Confirmation of removal of the asbestos within the vicinity of TPF will be required and take the form of visual inspection and validation sampling.
- Additionally, there are areas of the site that were inaccessible at the time of the site investigation works, due to buildings, etc. These areas will be investigated by grid sampling following demolition of the existing buildings.
- Contractor certification of the eradication of Japanese Knotweed and other invasive plant species (if required subject to survey).
- The inclusion of a suitable gas protective membrane and a ventilated sub-floor void will be required. In this instance, the gas protective membrane should provide suitable resistance to carbon dioxide. Confirmation of installation of the membrane will be required.
- Full radon protection measures will be required in new dwellings. Confirmation of the protective measures having been installed will be required.

## 4.2 REMEDIATION VERIFICATION METHODOLOGY AND DATA GATHERING REQUIREMENTS

(CONTINUED)

### *Performance Testing Requirements*

Upon placement of the capping soils over the soft finished areas, a series of hand dug pits will be excavated to confirm an adequate thickness of inert tested soils is in place. These works are to be carried out as the soils are to be placed late in the development programme just prior to completion of the dwellings.

Monitoring of these works is to be maintained until the completion of the development.

We understand that as part of the development programme approximately 8000m<sup>3</sup> of imported materials will be brought onto site to raise site levels. As a minimum these materials will be subject to the following chemical analysis.

All soils and earthworks materials to be placed on site shall be tested as given below in Table 3:

<b>Table 3</b>			
Analysed Element/ Compound	Threshold Concentration Level (mg/kg)		Leachate Threshold Concentration (ug/l)
	Threshold	Reference	
			EQS Freshwater
Arsenic	32	DEFRA	50
Cadmium	10	DEFRA	5
Chromium (VI)	4.3	LQM	5
Lead	320	ATRISK	4
Mercury	1	DEFRA	1
Selenium	350	DEFRA	-
Boron (water soluble)	3	EA	2000
Copper	2330	LQM	1
Nickel	130	DEFRA	50
Zinc	3750	LQM	8
PAH (screening)	1	IG note 1	10
TPH (screening)	50	IG note 2	30
Phenols	420	DEFRA	-
Cyanide (total)	34	ATRISK	-
pH (#)	5.5 – 7.8	BRE/BS	-
Asbestos	presence	-	-

## 4.2 REMEDIATION VERIFICATION METHODOLOGY AND DATA GATHERING REQUIREMENTS

(CONTINUED)

### Notes

1. Total PAH greater than screening threshold to be speciated.
2. Total TPH greater than screening threshold subject to aliphatic/aromatic split.

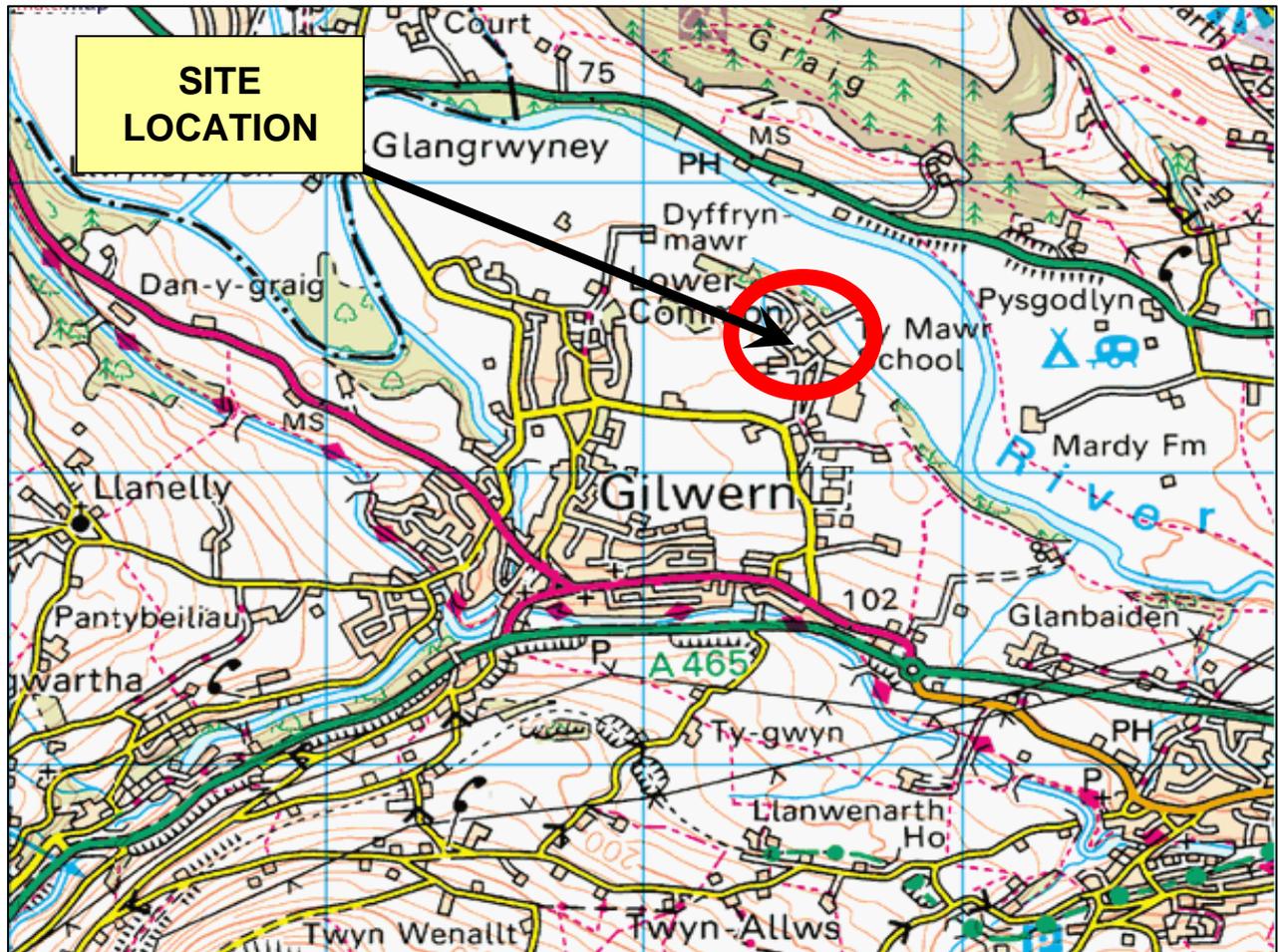
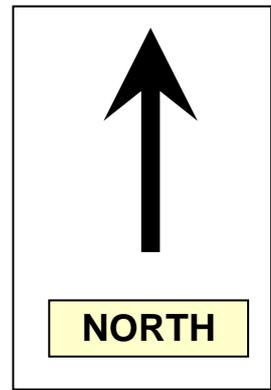
### ***Performance Testing Requirements***

The frequency of analysis will be dependent on where materials are to be used. For materials used in bulk filling and placed below the 600mm proposed site cap or beneath buildings and hard standings a frequency of one sample per 500m<sup>3</sup> should be acceptable for analysis. For materials to be used in residential garden areas and as part of the 600mm proposed capping solution four samples should be analysed per 250m<sup>3</sup>.

It should be noted that this remedial strategy provides a specification for the importation of soils based on its chemical nature. A specification of the physical properties of imported materials should also be provided.

The provenance of all imported materials should be verified prior to importation on to site.

## FIGURES



Approximate Scale = 1:25,000

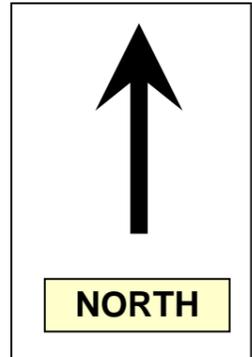
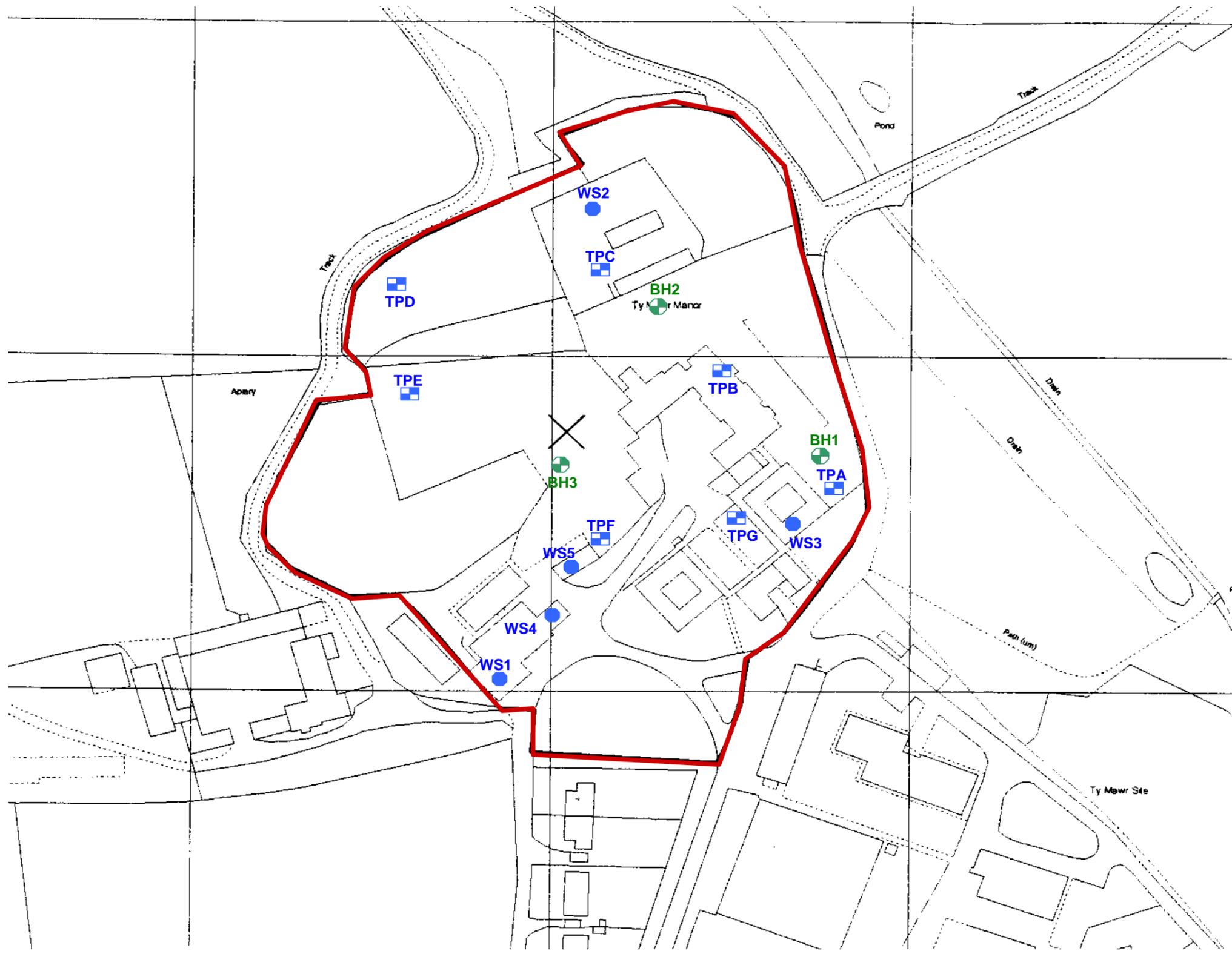
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**FIGURE 1 - SITE LOCATION**

**Ty Mawr Manor, Gilwern**

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**LEGEND**

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE LOCATION OF TRIAL PITS
- APPROXIMATE LOCATION OF WINDOW SAMPLE HOLES
- ⊕ APPROXIMATE LOCATION OF SHELL AND AUGER BOREHOLES

**Approximate Scale - 1:1,250**

**FIGURE 2 - SITE PLAN**

**Ty Mawr Manor, Gilwern**

**Intégral**

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