Flo

Consulting Engineers

Project_

Residential Development at Tormead, 27 Dene Road, Northwood London, HA6 2BX

Title_

Basement Impact Assessment and Surface Water Management Report

Project No_

797

Date_

June 2022

Revision_

D

Author: Mark Symonds, Issue Date: 20.06.2022

Contents

Appendices

1. Introduction

Flo Consult UK Ltd have prepared this basement impact assessment (for lower ground floor) and surface water management report for a new residential development at Tormead, 27 Dene Road, Northwood, which is in the London Borough of Hillingdon.

London Bourgh of Hillingdon (LBH) council need to be satisfied that the granting of planning permission will address impact of the new lower ground floor to the surrounding areas, and to ensure that the surface water from the development is managed so that the risk of flooding to the site and neighbouring land / properties is not increased.

The Basement Impact assessment principles has been prepared to the requirements of LBH Policy DMHD 3 of the Local Plan: Part 2 (2020), which advises that the Council will require an assessment of the schemes impact on drainage, flooding, groundwater conditions and structural stability. The Council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability. Developers will be required to demonstrate by methodologies appropriate to the site that proposals will avoid adversely affecting drainage and run off and cumulative impacts upon structural stability.

The surface water management principles has also been prepared to the requirements of the local planning policies of the London Plan (2021) Policy SI 13; Greater London Authority: Sustainable Design and Construction Supplementary Planning Guidance – Mayor of London (2014); and LBH Preliminary Flood Risk Assessment (May 2011); LBH Local Planning Policy LPP1 (2012) Policy EM6; LBH Local Planning Policy LPP2 (Main Modification 2019) Policy DMEI 9.

2. National and Local Policies and Guidance

2.1. National Planning Policy Framework (NPPF) and National Planning Practice Guidance (NPPG)

The NPPF (July 2021) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. This document is used to form this surface water management report, with particular attention to Paragraphs 153 to 158 Planning for Climate Change, and Paragraphs 159 to 169 Planning for Flood Risk.

NPPG, Paragraph 051 states that sustainable drainage systems (SuDS) are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible, where they provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban run-off at source; and to combine water management with green space with benefits for amenity, recreation, and wildlife.

Further to this NPPG, Paragraph 080 states that the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable which (in order) are into the ground (infiltration); to a surface water body; to a surface water sewer, highway drain, or another drainage system; to a combined sewer.

2.2. LBH Local Plan Part 2 Policy DMHD 3: Basement Development

a) *When determining proposals for basement and other underground development, the Council require an assessment of the scheme's impact on drainage, flooding, groundwater conditions and structural stability. The Council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability. Developers will be required to demonstrate by methodologies appropriate to the site that their proposals:*

   i. *avoid adversely affecting drainage and run-off or causing other damage to the water environment;*

   ii. *avoid cumulative impacts upon structural stability or the water environment in the local area;*

b) *Schemes should ensure that they:*

   i. *do not harm the amenity of neighbours;*

   ii. *do not lead to the loss of trees of townscape or amenity value;*

   iii. *do provide satisfactory landscaping, including adequate soil depth;*

   iv. *do not harm the appearance or setting of the property or the established character of the surrounding area, for example through the introduction of front lightwells; and*

   v. *do protect important archaeological remains.*

c) *The Council will not permit basement schemes which include habitable rooms and other sensitive uses in areas prone to flooding.*

d) *The Council will not permit basement schemes in Listed Buildings and will not permit them in Conservation Area locations where their introduction would harm the special architectural or historic character of the area.*

2.3. LBH Local Plan Part 2 Policy DMEI 9: Management of Flood Risk

a) *Development proposals in Flood Zones 2 and 3a will be required to demonstrate that there are no suitable sites available in areas of lower flood risk. Where no appropriate sites are available, development should be located on the areas of lowest flood risk within the site. Flood defences should provide protection for the lifetime of the development. Finished floor levels should reflect the Environment Agency's latest guidance on climate change.*

2.4. LBH Local Plan Part 2 Policy DMEI 10: Water Management Efficiency and Quality

a) *Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).*

b) *All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.*

c) *Rain Gardens and non-householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.*

d) *Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.*

e) *Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.*

f) *Developments should be drained by a SuDs system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.*

2.5. The London Plan (March 2021) Policy SI 13

A. *Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.*

B. *Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:*

   1) *rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)*
   2) *rainwater infiltration to ground at or close to source*
   3) *rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)*
   4) *rainwater discharge direct to a watercourse (unless not appropriate)*
   5) *controlled rainwater discharge to a surface water sewer or drain*
   6) *controlled rainwater discharge to a combined sewer.*

C. *Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.*

D. *Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.*

3. General Site Setting and Description

3.1. Site Location

The development site is located in a residential area of Northwood, which is approximately 750m north-west of Northwood underground station, and as detailed in Appendix A, is bound by Dene Road to the north; residential dwellings leading onto Foxdell to the east; residential dwellings leading onto Green Lane to the south; and further residential dwellings leading on Firs Walk to the east.

The address of the site is Tormead, 27 Dene Road, Northwood, London, with the nearest postcode being HA6 2BX, and the co-ordinates of the centre of the site being: Easting: 508780, Northing: 191710.

3.2. Existing Site

As detailed on the existing site plans in Appendix B, the development site currently consists of a detached building towards the central / northern areas, with parking / driveway to the north of site (between Dene Road and detached building); a garage, storerooms and courtyard to the west; patio / terrace areas to the rear of the building (south of site); and soft-landscaped garden areas remaining areas throughout the site.

3.3. Topography

In terms of topography, the existing plans (Appendix B) show the site to have a general fall from north to south, with the levels along the northern boundary (at driveway entrance to Dene Road) being approximately 82.50m AOD; the ground floor level of the detached building being approximately 80.50m AOD; and the levels along the southern boundary being approximately 77.00m AOD.

3.4. Description of Development

The proposed development plans are shown in Appendix C. The development description is as follows:

Up to 2.5 storey extension to main building to provide 4 self-contained flats and redevelopment of existing coach house building to provide 1 maisonette unit with associated parking, cycle and bin storage, and landscape works.

The existing driveway/parking area will be expanded to accommodate additional parking spaces for the new flats with a new site access formed. In terms of landscaping, the mature planting to the front of the building will be enhanced by new planting whilst the area of communal garden to the rear outside of the proposed extension will be redesigned.

3.5. Waterbody / Rivers

There are no known waterbodies / rivers near to the development site, with the nearest waterbody being an unnamed watercourse approximately 1 km to the south.

3.6. On-Site Drainage and Public Sewers

The Thames Water sewer plans in Appendix D identify a foul water sewer within Dene Road (directly north of the site) flowing from west to east; a foul water sewer to the south-west of the development site flowing from north to south; and separate foul and surface water sewers within Foxdell (25m east of site) flowing from west to east.

The on-site drainage networks are unknown, but as there are no surface water sewers in the direct vicinity of the site, it is believed that the surface water run-ff from the detached building, driveway, garage, storerooms, courtyard and terrace area discharge to a soakaway system to the south of the site (following topography).

3.7. Development Areas

The overall area of the development site is approximately **3,870m² / 0.387 ha**.

The pre-development site consists of the detached building, driveway, garage, storerooms, courtyard and terrace areas which equates to approximately 1,250m² / 0.125 ha, with the surface water run-off from these areas are believed to discharge to a soakaway system to the south of the site.

The remaining grassed / soft landscaping areas equate to approximately 2,620m² / 0.262 ha, with the surface water discharging off the site at a natural / greenfield run-off rate.

In terms of the greenfield run-off rate calculations, the detached building, driveway, garage, storerooms, courtyard and terrace areas are to be taken into consideration, which will equate to an urban factor for the site of **0.32** (0.125 ha / 0.387 ha).

The surface water run-off from the new residential building, car park and terrace area equates to 1,200m² / 0.120 ha, with the surface water run-off discharging to a below ground drainage network.

The surface water run-off from post development soft-landscaping and garden areas will continue to discharge off the site at a natural / greenfield rate, and will equate to 2,670m² / 0.267 ha.

As only the surface water run-off from the new residential building, car park and terrace areas are to discharge to a network only, the post development surface water management area will equate to **0.120 ha**.

4. Basement Impact Assessment - Desk Study

In line with requirements set out within LBH council guidance and best practice, when completing a basement impact assessment, the following section consists of a desk study utilising readily available information for the assessment site.

4.1. Site History

There is limited data with regards to the history of the site. However, due to the site being in a residential area a within a borough of London, it is believed that the has only ever been classified as agricultural and / or residential.

4.2. Geology

The data sourced from 'MAGIC' (as detailed in Figure 1 and Appendix E) identifies the site at the site to consist of 'slowly permeable seasonably west slightly acid but vase rich loamy and clayey soils'.

Figure 1 – 'MAGIC' Data – Geology

The geology at the development site can be determined by, and sourced from, the British Geological Survey (BGS) website. The BGS data shows the site to have no superficial deposits and a bedrock-strata consisting of London Clay formation.

The BGS data also shows public record borehole logs, within the same bedrock strata areas and within 100m radius of the development site. As detailed in Appendix F, the borehole logs within the same strata and 100m of the site show that the ground predominantly consists of silty clay.

There a no records of geological faults or landslip activities within 250m of the site boundary.

4.3. Hydrogeology

The data sourced from 'MAGIC' (as detailed in Figures 2 and 3 and Appendix E) identifies no aquifers in superficial deposits drifts, or any aquifers in the bedrock strata at the development site location.

Figure 2 – 'MAGIC' Data – Aquifer Designation Map (Superficial Drift)

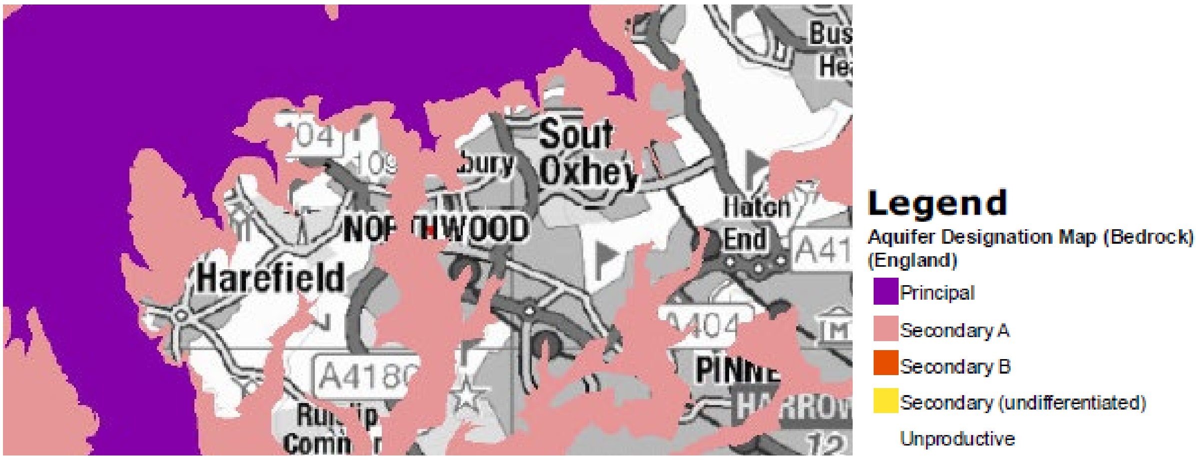


Figure 3 – 'MAGIC' Data – Aquifer Designation Map (Bedrock)

According to the 'MAGIC' map data, the development site is not located within a Source Protection Zone.

4.4. Hydrology and Flood Risk

The hydrology and flood risk information for the development site has been taken from Landmark Envirocheck flood map data (see Appendix G), which has used the flood map data produced by the Environment Agency (EA) and JBA consulting. A summary of the hydrology and flood risk at the development site is as follows:

Fluvial

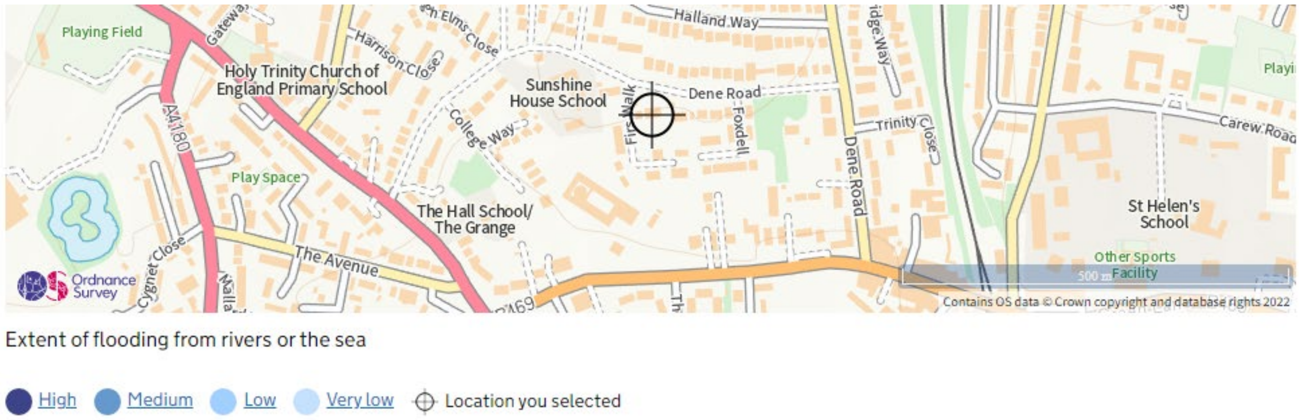


Figure 4 – EA Fluvial Flood Map

The Environment Agency flood maps (as detailed in Figure 4 and Appendix G) identify the site to be in Flood Zone 1, which is low probability of fluvial flooding (land having a less than 1 in 1,000 annual probability of river.

The Envirocheck (JBA) 75-year return period flood map indicates that there is no fluvial or coastal flooding at the development site location.

The Envirocheck (JBA) 100-year return period flood map indicates that there is no fluvial or coastal flooding at the development site location.

The Envirocheck (JBA) 200-year return period flood map indicates that there is no fluvial or coastal flooding at the development site location.

The Envirocheck (JBA) 1000-year return period flood map indicates that there is no fluvial or coastal flooding at the development site location.

The flood maps also indicate that there are no floodplains or flood storage areas within 250 of the development site.

Pluvial

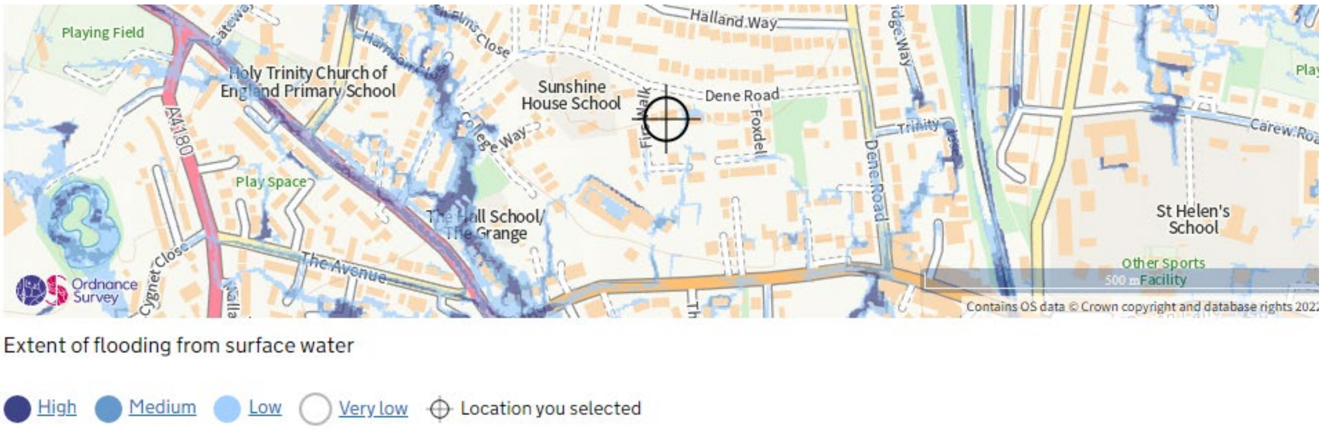


Figure 5 – EA Pluvial Flood Map

The pluvial flood map (Risk of Flooding from Surface Water) on the EA website (as detailed in Figure 5 and Appendix F) identifies that all the development areas to have a very low probability of pluvial / surface water flooding.

The Envirocheck (JBA) 75-year return period flood map indicates that there is no pluvial flooding at the development site location.

The Envirocheck (JBA) 200-year return period flood map indicates that there is no pluvial flooding at the development site location.

The Envirocheck (JBA) 1000-year return period flood map indicates that there is no pluvial flooding at the development site location.

The Envirocheck (EA/NRW) 30-year return period flood map indicates that there is no surface water / rainfall flood depths within the development boundary.

The Envirocheck (EA/NRW) 100-year return period flood map indicates that there is no surface water / rainfall flood depths within the development boundary.

The Envirocheck (EA/NRW) 1000-year return period flood map indicates that there is surface water / rainfall flooding to depths up to 0.15m at an isolated area north of the existing detached building.

The detailed flood maps indicate no pluvial flooding within the development site boundary for all storms up to and including the 100-year storm event, and minor isolated flooding for up to 1000-year storm event. Therefore, it is deemed that the probability of pluvial flooding is low.

Ground Water Flooding

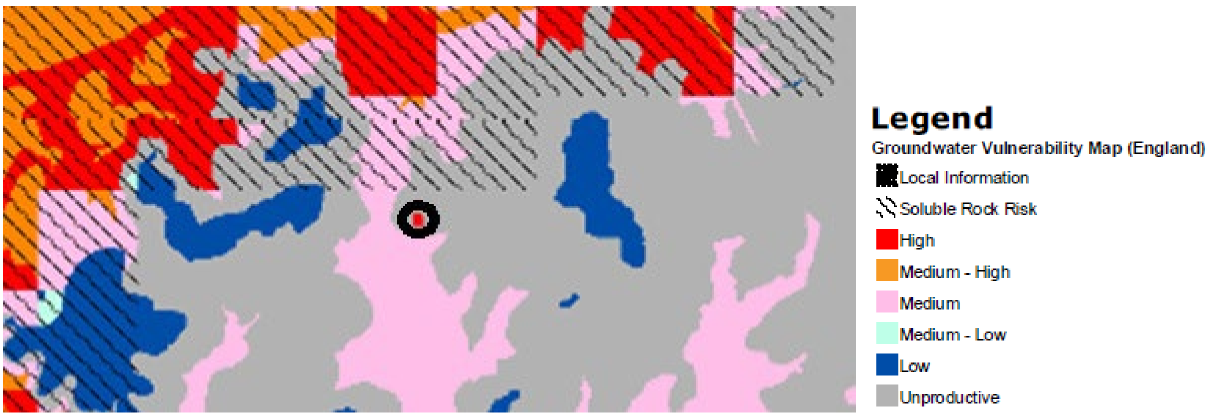


Figure 6 – 'MAGIC' Data – Groundwater Vulnerability Map

The data sourced from 'MAGIC' (as detailed in Figure 6 and Appendix G) identifies groundwater vulnerability at the development site is 'unproductive', meaning that the site is not vulnerable to any ground water flooding.

The Data sourced from Landmark Envirocheck (as detailed in Appendix G) shows ground water flood maps produced by the BGS and GeoSmart, which identifies the site to be outside any potential groundwater flood areas, and for the development site to have negligible risk of groundwater flooding.

Drains and Sewers

The nearest drains and sewers to the development site are in Dene Road to the north and in Foxdell to the east. The levels to the east of the site are lower than the development site, and there any flooding form drains or sewers within Foxdell will not flow towards the development site.

There are upstand kerbs along Dene Road, and the road has a gradient from west to east. Therefore, if flooding were to occur from the sewers or drains within Dene Road, the surface water will be contained within the kerbs and will flow along the road without discharging into the development site.

Therefore, based on this assessment, the probability of flooding in the development site from drains or sewers is deemed to be low.

Canals, Reservoirs and Other Artificial Sources

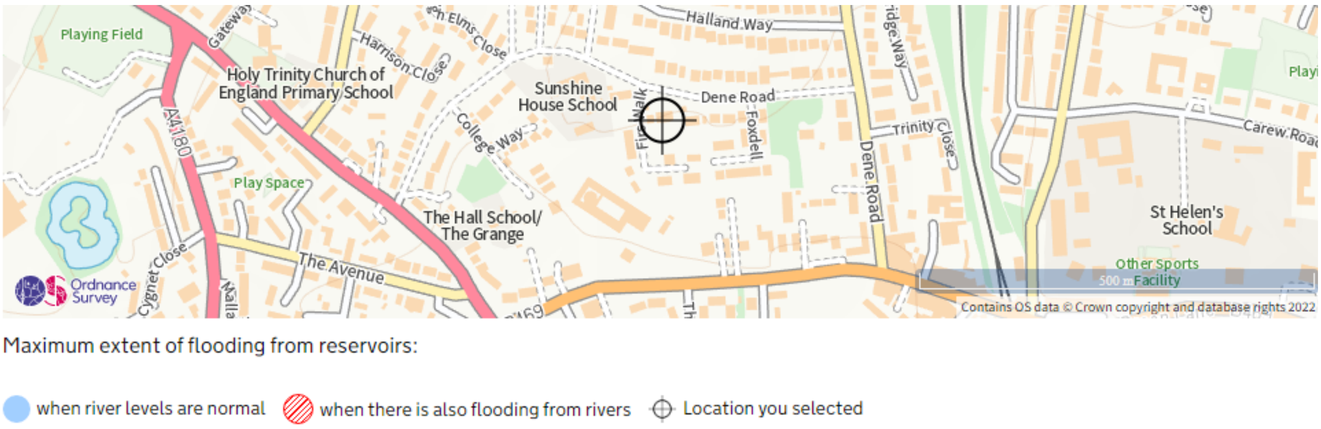


Figure 7 – EA Extent of Reservoir Flood Map

The Envirocheck (JBA) canal failure map (Appendix G) indicates that the site is in the canal failure coverage area, but will not flooding in the event of a canal failure.

The EA flood map in Figure 7 indicates that the development site is not the maximum extent of flooding in a reservoir flooding scenario.

Therefore, based on the data the probability of flooding from canals, reservoirs or other artificial sources is deemed to be low.

4.5. Ground Working

It is believed that there are no recorded historical or current surface ground working features identified within 250m of the site.

4.6. Mining and Other Ground Workings

There are no records of coal mining within 250m of the site.

4.7. Railways and Tunnels

There are no records of current or there is believed to be no historical railways within 250m of the site.

4.8. Radon Potential

According to the Health Protection Agency the site is not within a Radon Affected Area, as less than 1% of the properties are above the action level. Radon protection measures are not required.

4.9. Landfill and Waste Management Activity

It is believed that there are no landfill site/waste treatment or disposal sites within 250m of the site.

4.10. Environmentally Sensitive Sites

The development site is not located within any significant environmentally sensitive areas.

4.11. Industrial Land Use Information

It is believed that due to the development site location it has predominately been residential, and not used for industrial purposes.

5. Basement Impact Assessment – Preliminary Contamination Risk

The following paragraphs outline a Preliminary Risk Assessment (PRA) for the site based on the above desk study information as defined by DEFRA and the EA Model Procedures for the Management of Land Contamination, CLR11(2004).

Table 3 provides a Preliminary Conceptual Model (PCM) which considers the source-pathway-receptor linkages present alongside the likelihood, severity and risk level as defined within Table 1 and Table 2 below. The assessment of probability, a modified risk table, and certain consequence definitions are based on CIRIA C552 and CLR11.

Table 3 considers whether a pollution linkage is potentially present and provides a preliminary qualitative assessment of risk based on the information currently available. Where a possible linkage is identified, it does not necessarily mean that a significant risk exists but indicates that further information is required through appropriate site investigation to substantiate the conceptual model.

The PCM/PRA is based on a proposed residential end use.

Probability	Consequence,	Risk
High Likelihood- There is a pollution linkage and an event either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution	Very High – acute risk to the human health likely to result in significant harm. Risk of severe or irreversible effect on ground/surface water quality. Catastrophic damage to buildings / property.	Very High – there is a high potential that the source-pathway-receptor scenarios may give rise to harm to human health or the environment and remedial action is likely to be required.
Likely – there is a pollution linkage and all the elements are present, which means that it is probable an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.	High – Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality. Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependant environmental receptors.	High – it is likely that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, which may require remediation and/or control measures to mitigate risks
Low likelihood– there is a pollutant linkage and circumstances are possible for an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term	Moderate – Long term or short term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time. Reduced reliability of a supply at a groundwater or surface water abstraction source	Moderate – it is possible that the source-pathway-receptor scenarios may give rise to an impact on human health or the environment, however it is either relatively unlikely that such are would be severe, or if any harm were to occur it is more likely that harm would be mild.
Unlikely – there is a pollution linkage, but circumstances are such that it is doubtful that an event would occur even in the very long term.	Low – Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.) Slight effect on ground/surface water quality, reversible with time. Marginal reduced reliability of a supply at a groundwater or surface water abstraction source.	Low – it is possible that harm could arise at the source, however it is likely that they would at worst be mild.
		Very Low – it is unlikely that the source-pathway-receptor scenarios will give rise to an impact on human health or the environment.

Table 1 – Consequence, Probability and Risk

		Consequence			
		High	Moderate	Low	Very low
Probability	High Likelihood	Very High	High risk	Moderate risk	Moderate to low risk
	Likely	High risk	Moderate risk	Moderate to low risk	Low risk
	Low Likelihood	Moderate risk	Moderate to low risk	Low risk	Very low risk
	Unlikely	Moderate to low risk	Low risk	Very low risk	Very low risk

Table 2 – Estimation of Level of Risk by Comparison of Consequence and Probability

Source	Pathway	Receptor	Probability	Consequence	Risk	Comment
Potential contamination associated with the sites historical and current day use	Dermal contact, ingestion and inhalation of soils dust	Current Site Users	Unlikely	Low	Very Low Risk	Given the lack of significant sources of contamination present at the assessment site, the risk to current site users is considered **VERY LOW** in this instance.
		Adjacent Land Users	Unlikely	Low	Very Low Risk	Given the lack of significant sources of contamination present at the assessment site, the risk to adjacent site users is considered **VERY LOW** in this instance.
		Future Site Users	Unlikely	Low	Very Low Risk	Given the lack of significant sources of contamination present at the assessment site, the risk to future site users is considered **VERY LOW** in this instance.
	Vertical or horizontal migration of ground gas and vapours	Current Site Users	Unlikely	Low	Very Low Risk	A lack of significant sources of ground gas and potential vapours has been identified during this assessment, therefore the risk to current site users from the migration of ground gas is considered to be **VERY LOW**.
		Future Site Users	Unlikely	Low	Very Low Risk	A lack of significant sources of ground gas and potential vapours has been identified during this assessment, therefore the risk to future site users from the migration of ground gas is considered to be **VERY LOW**.
		Adjacent Land Users	Unlikely	Low	Very Low Risk	A lack of significant sources of ground gas and potential vapours has been identified during this assessment, therefore the risk to future site users from the migration of ground gas is considered to be **VERY LOW**.
	Vertical or horizontal migration of contamination via leaching into the underlying shallow groundwater;	Controlled Waters	Unlikely	Low	Very Low Risk	Given the lack of significant sources of contamination present at the assessment site, the risk to controlled water present within the ground beneath site is considered **VERY LOW** in this instance.

Table 3 – Preliminary Conceptual Model

Considering the current and proposed receptors on site, the potential pathways for contamination and the lack of identified sources of contamination, the risk to current and proposed site users has been deemed as **Very Low.**

6. Basement Impact Assessment - Screening

A screening process has been undertaken and the findings are described below

6.1. Summary of Land Stability Screening Process

Question	Response	Evidence
Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8)?	No	As detailed on the topographical survey, the site falls from north to south with no slopes and an average gradient of 1 in 12.
Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?	No	There will be localised slopes at 1 in 3 gradients to the rear of the new residential building within the soft landscaping area, but not at the development boundaries.
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	No	The neighbouring land has similar gradients to the development site, and there are no railway cuttings or other embankment features near to the development site
Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately1 in 8)?	No	The development site is not near a wider hillside setting.
Is the London Clay the shallowest strata at the site?	Yes	The assessed data from BGS and MAGIC identify the ground to have no superficial deposits, and ground that predominantly consists of London Clay.
Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained	No	No trees will be felled, and there will be root protection zones throughout the site. The proposed residential building footprint will be outside the root protection zones.
Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	No	There is no evidence of seasonal shrink-swell subsidence in the local area.
Is the site within 100m of a watercourse or a potential spring line?	No	The nearest watercourse is approximately 1 km south of the development site.
Is the site within an area of previously worked ground?	No	There is no know evidence that the site is in an areas that has previously been worked.
Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	No	The data from MAGIC show that there are no aquifers at the development site.
Is the site within 5m of a highway or pedestrian right of way?	Yes	Dene Road is adjacent to the northern site boundary. However, the highway or pedestrian right of ways are not within 5m of the proposed residential building.
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes	The adjacent / nearest property is more than from the proposed residential building, and therefore the basement will not affect the existing foundations.
Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	There are no known exclusion zones at the development site.

6.2. Summary of Surface Water and Flooding Screening Process

Question	Response	Evidence
Is the site located directly above an aquifer?	No	There are no aquifers below the development site
Will the proposed basement extend beneath the water table surface?	No	The assessed data in this report identifies groundwater vulnerability at the development site is 'unproductive', and a negligible risk of ground water flooding.
Is the site within 100m of a watercourse, well (used / disused) or potential spring line?	No	The nearest watercourse is approximately 1 km south of the development site, and there are no know spring lines
Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes	New SuDs drainage to be utilised. Restricted run-off rate to be a betterment of existing run off rates
As part of site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	Surface water to discharge will be to a combined water system to match existing surface water discharge destination
As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	Surface water to discharge will be to a combined water system to match existing surface water discharge destination
Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses?	No	There are no surface water overland flows or watercourses near the site that will be affected by the basement
Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	There are no surface water overland flows or watercourses near the site that will be affected by the basement
Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature.	No	The assessed flood map data identifies a low probability of flooding from all sources.

The above screening processes have identified the following issues of concern

- London Clay is the shallowest strata at the site
- An existing road is located along the northern site boundary to the south-east boundary of the site.
- An existing detached building is located close to the eastern boundary of the site.

No other significant issues concerning the proposed basement development and immediate surrounding area have been identified.

7. Basement Impact Assessment – Scoping

7.1. Introduction

The purpose of scoping is to assess in more detail any issues of concern identified in the screening process (i.e. where the answer is 'yes' or 'unknown' to any of the questions posed) to be investigated in the impact assessment. Potential hazards are assessed for each of the identified potential impact factors.

The scoping stage is furthermore to assist in defining the nature of the ground investigation required to assess the impact of the issues of concern identified in the screening process.

7.2. Potential Impacts

Potential impacts, identified from the screening process, are summarised in the table below.

Screening Question	Potential Impacts	Discussion
Is the London Clay the shallowest strata at the site?	Potential swell and shrinkage of London Clay at basement level	Site investigation to establish soil conditions. Effects mitigated at design stage such as raft foundations.
Is the site within 5m of a highway or pedestrian right of way?	Dene Road is located along the northern boundary of site, but more than 5m from new residential building.	Excavation of basement will not affect the structural integrity of road due to the distance exceeding 5m, and at approximately 18.00m.
Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Excavation of a basement could result in structural damage to adjoining properties or buried services.	Site investigation to establish conditions. Effects mitigated at design stage.

8. Basement Impact Assessment – Construction Methodology

8.1. Outline Temporary & Permanent Works Proposals

Based on the findings of the desktop ground investigation data, the main consideration will be how excavations are supported temporarily and permanently. The walls of the basement will act as retaining structures.

The choice of foundation will depend on the anticipated structural (foundation) loadings. Based on the ground investigation two options are considered suitable:

1. Strip, pad, or raft foundations
2. Piled foundations

If strip, pad, or raft foundations are used, temporary support will be essential to excavation sides to provide stability and also minimise risk on instability of structures (such as neighbouring buildings) and ground close to the site boundaries. Given the proximity of neighbouring properties it is unlikely that it will be possible to batter excavation slopes to provide stability, therefore vertically sided excavations will likely be required in the clay formation. These should be adequately supported using either a system of sheeting and shoring or sheet piling to provide stability.

Sheet piling may be used which would allow excavation, and could form a permanent part of the basement walls below ground. However, the sheet piles would need to be toed well into the underlying Clay Formation, to reduce settlements and resist uplift. Contiguous piled walls could be an option and combined with building foundations. These would also need to be taken down into the clay formation.

8.2. Ground Movement and Damage Impact Assessment

When the basement is excavated the reduction in pressure on the clay formation can give rise to heave as the clay content tries to expand vertically to be restored back to what it was prior to being compressed in the past. This heave will comprise an “immediate” elastic component which is expected to occur within the construction period, together with a long-term swelling movement which can take place over a period of many years.

In this instance we have assumed that a 4m deep basement will result in a net unloading of approximately 80kN/m2. Considering the loss of the “immediate” elastic component, the resulting long-term heave pressures are expected to equate to around 50-60% of the total unloading. Therefore, we would expect a design pressure of approximately 40-50kN/m2.

In this instance, if a raft foundation is proposed for the basement, it is likely that these pressures will be mitigated by the structural loading imposed by the proposed development.

Given the above information, and providing excavations are adequately supported, instability and damage to adjacent ground/structures will be kept to a minimum.

All excavations will require protection form the adverse effects of weather and in particular rainfall, which could cause softening of exposed excavation surfaces.

8.3. Control of Construction Works

All construction works should be supervised and carried out by suitably qualified personnel.

It is recommended any structures on adjacent sites, close to the site boundary, are monitored for signs of movement/instability during the construction period. A programme of monitoring should be included in the Construction Plan for the site.

It should be noted that the Council expects contractors to minimise noise nuisance, dust, debris, clean and safe pavements and driveways, safe movement of pedestrians, safeguarding access for emergency vehicles, avoidance of inconvenient construction times and sequences to local residents. The Council will use its powers under the Control of Pollution Act 1974 to control noise from demolition and construction sites.

As a general guide, the Council will limit the times at which demolition and construction can take place, such that any works which can be heard outside the site boundary must only be carried out: Monday to Friday 8.00am to 6.00pm; Saturday 8.00am to 1.00pm; and, not at all on Sundays, Public and Bank Holidays.

9. Basement Impact Assessment

This section of the report addresses the potential impacts identified in the scoping assessment and the relevant findings of the desktop ground investigation data and mitigation measures, where required.

9.1. Surrounding Structures

Potential Impacts:

Excavation of a basement could result in structural damage to the neighbouring dwellings or buried services.

Desktop Ground Investigation Data Findings:

There is a road located along the northern boundary of the site, but is 18.00m from the proposed excavation of the basement, and therefore will not be impacted.

There is a neighbouring dwellings to the west of the development boundary, but is more than 5m form the proposed basement at 6.00m at the closest point. However, vertically sided excavations will be required due to site restrictions; therefore, all excavations will require proper support during excavation.

Risk:

Low - Excavation could cause minor instability in adjacent structures unless adequately supported.

Mitigation Measures:

Construction methods to allow for suitable support of excavation sides. Monitoring of adjacent ground and structures for instability to be carried out during the construction period.

10. Basement Impact Assessment Summary / Conclusion

The assessed data has shown that

- no aquafers are below the development site;
- there is low ground water level at the development site with no / negligible risk of groundwater flooding;
- the site has a low risk of flooding from all other known sources including fluvial, pluvial, artificial sources etc;
- There are no below ground streams or watercourses near the new basement;
- There are no structures or roads within 5m of the new basement;

Therefore, based on the data set out in this report and the assessment made, it is deemed that the lower ground floor will be suitable with no impact on land within or outside the development boundary.

11. Surface Water Management Principles

11.1. Run-Off Destination

Surface water run-off is to discharge to one or more of the following in the order of priority shown: Discharge into the ground (infiltration); Discharge to a surface water body; Discharge to a surface water sewer, highway drain or other drain; Discharge to combined sewer.

11.2. The Management Train

A concept fundamental to implementing a successful SuDS scheme is the management train. This is a sequence of SuDS components that serve to reduce run-off rates and volumes and reduce pollution. The hierarchy of techniques that are to be used for the surface water management of the development are: Prevention - Prevention of run-off by good site design and reduction of impermeable areas; Source Control - Dealing with water where and when it falls (e.g. infiltration techniques); Site Control - Management of water in the local area (e.g. swales, detention basins); Regional Control - Management of run-off from sites (e.g. balancing ponds, wetlands).

11.3. Design Principles

The design principles for the surface water management of the development will be to: Ensure that people, property and critical infrastructure are protected from flooding; Ensure that the development does not increase flood risk off site; Ensure that SuDS can be economically maintained for the development.

11.4. Peak Surface Water Flow

The London Plan Policy SI 13 states: '*Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible'.*

Non-statutory technical standards for sustainable drainage systems states:

'S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100+year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event'.

Based on the above guidance, the proposed surface water drainage system will aim to restrict the surface water to a greenfield run-off rate.

11.5. Flood Risk

The drainage system will be designed so that, unless an area is designed to hold and/or convey water, flooding does not occur on any part of the site for a 1 in 30-year rainfall event. The drainage system will also be designed so that, unless an area is designed to hold and/or convey water, flooding does not occur during a 1 in 100-year rainfall event in any part of a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development. The design of the site will ensure that flows resulting from rainfall more than a 1 in 100-year rainfall event are managed in exceedance routes that avoid risk to people and property both on and off site.

11.6. Pollution

The SuDS design for the development site will ensure that the quality of any receiving water body is not adversely affected and preferably enhanced in accordance with Ciria SuDS Manual C753, Chapter 4.

12. Surface Water Run-Off Destination

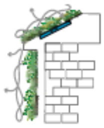
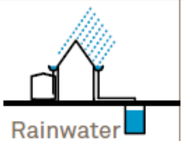
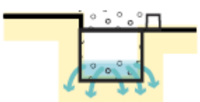
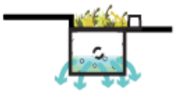
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

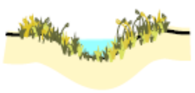
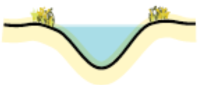
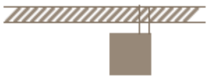
Run-Off Destination	Feasible	Description
Discharge to Ground	**Yes**	The BGS data identifies the site to predominantly consists of clay, and therefore is likely to have exceptionally low or no infiltration value. However, it is believed that the surface water run-off from the existing property currently discharge to a soakaway system, as there are no waterbodies, surface water sewers, or combined water sewers near the development site. Therefore, to appropriately manage the surface water run-off, it is proposed to restrict the surface water to the equivalent greenfield run-off rates, prior to discharging the restricted water to a field drain system. The surface water distributed to the garden area will replicate the natural state of the site, and therefore the surface water will not increase the risk of flooding to any areas near the site.
Discharge to Surface Water Body	No	There are no known waterbodies near the development site, with the nearest watercourse being approximately 1 km south of the development boundary. Therefore, the discharge to a surface waterbody is not feasible.
Discharge to Surface Water Sewer	No	There are no known surface water sewers in the direct vicinity of the development site, and therefore is not a feasible discharge destination.
Discharge to Highway Drain or Other	No	There are no know highway drains or other drains near the development site, and therefore discharge to a highway or other drain is not a feasible destination.
Discharge to Combined Water Sewer	No	There are no known combined water sewers in the direct vicinity of the development site, and therefore is not a feasible discharge destination.

13. SuDS Feasibility

To reduce the surface water run-off to the greenfield rate, SuDS methods are to be introduced to the post development design.

SuDS methods as per the Sustainable Drainage System (SuDS) hierarchy, and the Non-Statutory Technical Standards for Sustainable Drainage Systems – March 2015, that can be used are detailed below:

	Description	Setting	Required area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	 Building	Building integrated.
 Rainwater harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	 Building	Water storage (underground or above ground).
 Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	 Open space	Dependant on runoff volumes and soils.
 Filter Strip	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	 Open space	Minimum length 5 metres.
Permeable paving	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	 Street/open space	Can typically drain double its area.
 Bioretention area	A vegetated area with gravel and sand layers below designed to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	 Street/open space	Typically surface area is 5-10% of drained area with storage below.

	Description	Setting	Required area
 Swale	Swales are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	 Street/open space	Account for width to allow safe maintenancce typically 2-3 metres wide.
 Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	 Open space	Could be above or below ground and sized to storage need.
 Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	 Open space	Dependant on runoff volumes and soils.
 Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	 Open space	Typically 5-15% of drainage area to provide good treatment.
 Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	 Open space	Dependant on runoff volumes and soils.

The feasibility of the above SuDS methods for the post developed site are summarised in the table below:

SuDS Method	Feasible Use	Description
Green Roofs	No	The new residential building is to have pitched roofs, and therefore green roofs would not be advantageous, and therefore are not a feasible SuDS method.
Rainwater Harvesting	**Yes**	Rainwater harvesting for water re-use has not been considered for the development due to the cost of a dual pipe network. However, a water butt could be installed for at least one rainwater pipe (locations to be confirmed), so that the water can be used for irrigating the garden areas.
Soakaway	No	The assessed BGS data shows that the ground at the development site predominantly consists of clay, which is known to have an exceptionally low or no infiltration value. Therefore, based on the ground conditions the use of soakaways is not feasible.
Filter Strips	**Yes**	There is potential to install filter drains within the gardens of the residential building, which will take the surface water run-off from the terrace areas. Due to the ground conditions the filter drains will not

		infiltrate the surface water to ground, but will convey the surface water to the main drainage network, add biodiversity, and act as a pollutant control.
Permeable Paving / Surfacing	**Yes**	There is potential to install permeable paving to the proposed car park area to the north of the site. Due to the ground conditions the permeable paving / surfacing systems will not infiltrate the surface water to ground, but will convey the surface water to the main drainage network, add biodiversity, and act as a pollutant control. The permeable paving / surfing will not attenuate the restricted surface water due to the site topography.
Bioretention areas / Swales / Pond	No	The soft landscaping areas within the site will either consist of existing trees (with root perfection areas) and planting, or to be used for garden / amenity space. Therefore, as all the soft landscaping areas are to be used for planting or recreation, the use of bioretention areas, swales or ponds are not feasible.
Hardscape Storage	No	The external hard standing areas of the site are to be used for car park and terrace areas only. Therefore, there is limited areas for hardscape storage, and is not a feasible SuDs method.
Raised Planters	**Yes**	Raised planters can be installed at the rainwater down pipe location where practical. The surface water from the rainwater pipe will percolate through the raised planter prior to discharge to the main drainage network. This will treat the surface water at source and act as a pollutant control.
Raingardens	**Yes**	Raingardens can be formed in some of the landscape areas around the perimeter of the residential building. Surface water will discharge onto the raingardens from rainwater pipes. The raingardens will not attenuate the restricted surface water due to the site topography, but will treat the surface water at source and act as a pollutant control.
Underground Storage	**Yes**	The surface water management strategy will be to discharge the surface water run-off from the post development site at the greenfield rate. The greenfield rate will be at a lower rate than the surface water run-off rate, therefore there will be a requirement to have underground storage. This will prevent flooding for storm events up to the 1 in 30-year; and to suitable sized so that the volume of water during the 1 in 100-year storm event is kept a minimum at surface level, where it can be contained on site.

14. Development Greenfield Run-Off Rate and Volumes

To minimise the surface water run-off from the new development areas of the site, it is preferred that the post development surface water run-off be restricted to the equivalent greenfield run-off rate and volumes.

14.1. Greenfield Run-Off Rate

The Flood Estimation Handbook (FEH) is often used for the calculation of the greenfield run-off rate, however, relevant documents state that to calculate the greenfield run-off rates on small catchments less than 25km², the IH 124 QBAR equation (and the equation for the instantaneous time to peak for the unit hydrograph approach) is to be used. The IH method is based on the Flood Studies Report (FSR) approach and is developed for use on catchments less than 25km². It yields the Mean Annual Maximum Flood (QBAR). This reference also recommends the use Ciria C753 Table 24.2 to generate Growth Factors. These are used to convert QBAR to different return periods for different regions in the UK.

The input variables to establish QBAR are:

Return Period (years)	Results based on a range of return periods and the specified RP;
Area	Catchment Area (ha) which is adjusted to km2 for use in the equation;
SAAR	Average annual rainfall in mm (1941-1970) from FSR figure II.3.1;
Soil	Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively;
Urban	Proportion of area urbanised expressed as a decimal;
Region Number	Region number of the catchment based on FSR Figure I.2.4.

QBAR(l/s)

The output variables to establish QBAR are calculated using the following formula (equation yields m³/s):

QBAR = $0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

The IH 124 Variables (taken from FSR) that are specific to this site are as follows:

Area	=	50.00 ha (required area for calculation)
SAAR	=	690
Soil	=	0.450
Urban Factor	=	0.32
Region Number	=	6

The calculations in Appendix H, show the rate for 50.00ha is 352.0 l/s, but is to be reduced to reflect the surface water catchment area (0.120 ha) of the development site. Therefore, the QBAR (greenfield run-off) for the catchment area has been calculated to be:

QBAR = **0.84 l/s (7.04 l/s/ha)**

Ciria C753 Table 24.2 identifies the growth factors for each of the storm events, based on the known QBAR figure. The growth factors from the table vary depending on the site location. In this case hydrometric area (Region Number) is 6.

Based on the figures shown in the table, the growth factors, and the existing greenfield run-off rates for each of the storm events for the development areas of the site are as follows:

Storm Event	QBAR	Growth Factor (C753 Table 24.2)	Greenfield Run-off Rate
Q_1	0.84 l/s	0.85	**0.7 l/s**
Q_{30}	0.84 l/s	2.40	**2.0 l/s**
Q_{100}	0.84 l/s	3.19	**2.7 l/s**

14.2. Greenfield Run-Off Volume

The greenfield run-off volume for the 100-year, 6-hour storm event has also been calculated in the MicroDrainage software using the data from the Flood Estimation Handbook (FEH), with the results shown in Appendix H.

The FEH data and variables used to calculate the greenfield run-off volume at the development site locations are as follows:

Site Location = GB 508550 191300 TQ 08550 91300

C (1km) = -0.026

D1 (1km) = 0.308

D2(1km) = 0.339

D3 (1km) = 0.243

E (1km) = 0.311

F (1km) = 2.501

Areal Reduction Factor = 1.000

Area = 113.000 ha

SAAR = 675

CWI = 100.5

SPR Host = 49.23

URBTEXT = 0.32

Based on these variables, and the calculation results provided by the MicroDrainage computer software (Appendix F), the greenfield run-off volume for the overall catchment area is:

$Q_{100\ (6\text{-Hour})}$ = 42,347.458m³

This figure is for the catchment area of 113.000 ha, and is to be reduced to reflect the surface water catchment area of the development site which is 0.120 ha. Therefore, the greenfield run-off volume for the development catchment area has been calculated to be:

$Q_{100\ (6\text{-Hour})}$ = **44.97m³ (374.76m³/ha)**

15. Surface Water Management Calculations

15.1. Climate Change

The NPPF makes it a planning requirement to account for climate change in the proposed design. The recommended allowances are taken from the Environment Agency guidance (Table 2) summarised in Table 4 below.

Applies across all of England	Total change anticipated for the 2020's	Total change anticipated for the 2050's	Total change anticipated for the 2080's
Upper End	10%	20%	**40%**
Central	5%	10%	20%

The baseline year is 1961 to 1990. It is anticipated the life span of the new residential building will be approximately 80 years, and therefore will fall at least into the 2080's and will have rainfall intensity increase of 40%.

This increase in rainfall is to be taken into consideration for the surface water management of the proposed development site (100-year event), to ensure that the probability of flooding remains low.

15.2. Surface Water Network Calculations

The FEH data and variables used to calculate the required below ground drainage and attenuation volumes at the development site are as follows:

SW Catchment Area = 0.120 ha

Site Location = GB 508550 191300 TQ 08550 91300

C (1km) = -0.026

D1 (1km) = 0.308

D2(1km) = 0.339

D3 (1km) = 0.243

E (1km) = 0.311

F (1km) = 2.501

15.3. Surface Water Drainage Network

As shown on the below ground drainage layout drawing in Appendix I, the surface water drainage network will consist of 450mm diameter inspection chambers; 1200mm diameter manholes, 150mm a diameters pipes; 100mm diameter perforated pipes; permeable paving systems; raingardens; water butts; raised planters; a pollutant control chamber; a flow control chamber containing a hydro-brake; and a below ground attenuation tank in the form of cellular units.

The surface water run-off from the residential roof area will discharge to the network via raingardens, water butts, and raised planters; the surface water run-off from the parking area will discharge to the network via permeable paving / system; the surface water run-off from the terrace area will discharge to the network via permeable paving systems; and the surface water run-off from the footpath areas will discharge to the network via filter drains.

The main drainage network will flow towards the south of the site, where the surface water will pass through a flow control and restricted to the natural / equivalent greenfield rates of the site.

The restricted surface water will surcharge the drainage network, where the attenuation tank in the form of cellular units will attenuate the surface water to prevent flooding.

Surface water from the flow control chamber will be distributed to the garden areas to the south at the natural / greenfield rate. This will replicate the natural state of the site, and therefore the surface water will not increase the risk of flooding to any areas near the site.

15.4. Surface Water Run-Off Rate

For the surface water run-off from the entire development site to be at the greenfield run-off rate, the surface water run-off rate for catchment area of the site is to be restricted by a flow control to 0.7 l/s for the 1 in 1-year storm event; 2.0 l/s for the 1 in 30-year storm event, and 2.7 l/s for the 1 in 100-year storm event including 40% rainfall intensity increase (climate change).

An assessment of the suitable flow control opening, and subsequent surface water discharge needs to assessed, where Ciria document C753 – The SuDS Manual states that: *'the flow controls / orifice design should be designed so that it has simplicity on operation, and has resistance to clogging, blocking or mechanical failure'.*

The flow control (hydro-brake) therefore is to be a suitable diameter where the surface water run-off discharge from the development area of the site is at least the greenfield rates, and will be at a size where the likelihood of blockage and subsequent flooding is reduced.

For this development, and based on the guidance, the suitable / minimum size of the hydro-brake opening is deemed to be 41mm. As shown in the output calculation from the MicroDrainage computer software in Appendix J, if hydro-brake has a design head of 0.80m (base of control to top of cellular units), a design flow of 0.7 l/s (equivalent to the 1-year greenfield rate), and an opening of 41mm, the peak discharge rates for each storm event will be:

Strom	**-**	**Rate**	**-**	**Critical Storm Event**
Q_1	**-**	**0.6 l/s**	-	360-minute winter storm duration
Q_{30}	**-**	**0.6 l/s**	-	480-minute winter storm duration
$Q_{100 + CC}$	**-**	**0.7 l/s**	-	720-minute winter storm duration

A summary of the post development surface water run-off rates compared to the greenfield rates are as follows:

Greenfield Rate to Post Development Rate

Strom	**-**	**Greenfield**	**-**	**Post Dev**	**-**	**Difference**
Q_1	-	0.7 l/s	-	0.6 l/s	-	0.86 x Greenfield / 14% Reduction
Q_{30}	-	2.0 l/s	-	0.6 l/s	-	0.30 x Greenfield / 70% Reduction
Q_{100}	-	2.7 l/s	-	0.7 l/s	-	0.29 x Greenfield / 74% Reduction

The surface water run-off rates are between a 14% to 76% reduction of the natural / greenfield rates of the developed area of the site. Therefore, distributing the surface water at these rates across the garden area will not increase the risk of flooding, and is therefore acceptable.

15.5. Surface Water Run-Off Volume

The surface water run-off volumes for the post development site have also been calculated for 1 in 100-Year the 6-hour duration (Inc. 40% RII), based on the peak 100-year + 40% climate change surface water run-off rate, which is:

Q_{100}	-	0.70 l/s x 60 x 60 x 6	-	21,600 litres	-	**21.60m³**

A summary of the post development surface water run-off volume compared to the greenfield volumes are as follows:

Greenfield Volume to Post Development Volume

Strom	-	**Greenfield**	-	**Post Dev**	-	**Difference**
Q_{100}	-	44.97m³	-	21.60m³	-	0.48 x Greenfield / 52% Reduction

The surface water run-off volume is a 52% reduction of the natural / greenfield volume of the developed area of the site. Therefore, distributing this surface water volume across the garden area will not increase the risk of flooding, and is therefore acceptable.

15.6. Surface Water Attenuation Calculations

As the positively drained areas of the post development site are being restricted, there will be a requirement for below ground attenuation to prevent flooding.

Ciria SuDS Manual 2015, Paragraph 10.2.4 where it states that: *‘Exceedance flows (i.e. flows more than those for which the system is designed) should be managed safely in above-ground space such that risks to people and property are acceptable’.*

The surface water attenuation for the development site will be within the below ground attenuation tank in the form of cellular units within the garden area. As detailed in the MicroDrainage calculations (Appendix J) and surface water management layout (Appendix I) the attenuation structure and volume is as follows:

Cellular Units

Tank Length	-	12.00m²
Tank Width	-	10.00m²
Tank Area	-	120.00m²
Tank Depth	-	0.80m
Tank Porosity	-	0.95
Tank Volume	-	**91.20m³**

The MicroDrainage calculations (Appendix J) show that with the cellular unit volume, no flooding will occur for all storms up to and including the 1 in 100-year event + 40% climate change.

16. Maintenance Requirements

The extent of the drainage network and SuDS features for the development site are shown on the below ground drainage layout drawings in Appendix I. The drainage networks and SuDS methods are to be maintained and managed to ensure that the systems are working affectively, and subsequently reducing the risk of flooding on the site, and surrounding land.

The maintenance and management of the drainage network and SuDS features will be by contractors appointed by owners / occupiers of the new residential units, which will be part of the property deeds and / or rental agreements.

The management and maintenance will co-inside with agreement for the general management and maintenance of all communal and shared garden / amenity areas within the site.

Full legal details of a management and maintenance plan is to be confirmed once the development commences, but will include:

16.1. Drainage Networks

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from manholes (where may cause risk performance)	Monthly
Where rainfall into network from above, check surface or filter for blockage or silt, algae, or other matter by jetting	As required, but at least twice a year
Remove sediment from pipework by jetting.	Annually or as required
Repair/check all inlets, outlets, and overflow pipes	As required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually and after large storms

16.2. Attenuation Tank and Flow Control

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from tank and flow control chamber (where may cause risk performance)	Monthly
Where rainfall into tank and flow control manhole from above, check surface or filter for blockage or silt, algae, or other matter by jetting	As required, but at least twice a year
Remove sediment from upstream surface water network by jetting.	Annually or as required
Repair/check all inlets, outlets, and overflow pipes	As required
Inspect/check all inlets, outlets	Annually and after large storms

16.3. Permeable Surfacing, Raised Planters and Filter Drain

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from surface of filter drains, raised planters and of permeable surfacing (where may cause risk performance)	Monthly
Where rainfall infiltration into filter drains, raised planters and permeable surfacing, check surface for blockage or silt, algae, or other matter by jetting	As required, but at least twice a year

16.4. Rain Gardens

Operation	Frequency
Inspections to identify any areas not operating correctly, eroded areas, hydrocarbon pollution, blocked outlets, and silt accumulation. Record any areas that are ponding and where water is lying more than 48 hours.	Monthly
Collect and remove from the site all extraneous rubbish that is detrimental to the operation of the SUDS feature and appearance of the site, including paper, packaging materials, bottles, cans, and similar debris.	Monthly
Maintain grass within the specified range. Ensure that the soil and grass does not become compacted. Do not cut during periods of drought or when ground conditions or grass are wet.	As required, but at least twice a year
Scarifying and spiking	As required
Reinstate design levels, repair eroded areas or damaged areas by returfing and reseeding.	As required
Seed or sod bare eroded areas.	As required

16.5. Linked and Further Maintenance and Maintenance Activities

The maintenance of the drainage network and SuDS features are to be linked with the wider site maintenance plan. A log of all maintenance activities are to be kept, and made available to the local planning authority (LPA) and / or the Lead Local Flood Authority (LLFA) on request.

17. Surface Water Exceedance Design

In the unlikely event of an extreme storm greater than 100-year + 40% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur. Surface water flow paths to follow existing and proposed ground topography, where water will flow to the south of the site.

Flood water will flow away from the proposed building within the site, and due to the additional below ground attenuation (no attenuation at pre-development site), the flood flows will be less than the pre-development volume (regardless of storm event), and therefore will not increase food risk to any other areas or buildings.

18. Water Quality

The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment. The results below shows suitable water quality.

18.1. Building Roof Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level	=	**Very Low**
C753 Table 26.2 Pollution Hazard Index:		
Total Suspended Solid (TSS)	=	0.2
Metals	=	0.2
Hydrocarbons	=	0.05
Pollution Hazard Index	=	**0.45**

18.2. Building Roof Areas Pollutant Mitigation

Mitigation Measures: Raingardens and Raised Planters

The lowest of the Pollutant Mitigation Indices:		
Total Suspended Solid (TSS)	=	0.4
Metals	=	0.4
Hydrocarbons	=	0.4
SuDS Mitigation Indices	=	**1.20**

18.3. Parking Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level	=	**Low**
C753 Table 26.2 Pollution Hazard Index:		
Total Suspended Solid (TSS)	=	0.5
Metals	=	0.4
Hydrocarbons	=	0.4
Pollution Hazard Index	=	**1.30**

18.4. Parking Areas Pollutant Mitigation

Mitigation Measures: Permeable Paving

Permeable Paving Pollutant Mitigation Indices:		
Total Suspended Solid (TSS)	=	0.7
Metals	=	0.6
Hydrocarbons	=	0.7
SuDS Mitigation Indices	=	**2.00**

18.5. Terrace Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level	=	**Low**
C753 Table 26.2 Pollution Hazard Index:		
Total Suspended Solid (TSS)	=	0.5
Metals	=	0.4
Hydrocarbons	=	0.4
Pollution Hazard Index	=	**1.30**

18.6. Terrace Areas Pollutant Mitigation

Mitigation Measures: Permeable Paving

Permeable Paving Pollutant Mitigation Indices:		
Total Suspended Solid (TSS)	=	0.7
Metals	=	0.6
Hydrocarbons	=	0.7
SuDS Mitigation Indices	=	**2.00**

18.7. Footpath Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level	=	**Low**
C753 Table 26.2 Pollution Hazard Index:		
Total Suspended Solid (TSS)	=	0.5
Metals	=	0.4
Hydrocarbons	=	0.4
Pollution Hazard Index	=	**1.30**

18.8. Footpath Areas Pollutant Mitigation

Mitigation Measures: Filter Drains

Filter Drain Pollutant Mitigation Indices:		
Total Suspended Solid (TSS)	=	0.4
Metals	=	0.4
Hydrocarbons	=	0.4
SuDS Mitigation Indices	=	**1.60**

19. Development Management and Construction Phase

All existing drainage networks within the development area are to be maintained during construction. The pipe network, permeable surfacing sub-base, cellular units, and flow control chamber are to be the first part of the drainage network to be built. This will ensure that the surface water discharge is suitably restricted without pollutants or flooding.

19.1. Construction Environment Management Plan

Full details of the construction environment management plan (CEMP) has to be confirmed by the chosen contractor who have been appointed for the development. However, it will conform to the requirements of CIRIA 753 – The SuDS Manual – Chapter 31, and will include:

19.2. Construction Access

The main construction traffic will access the site from the existing site entrance from Dene Road (north of site).

19.3. Sediments and Traps

Sediment basins and traps are to be installed before any major site earthworks take place, with further sediment traps and silt fences being installed as the earthworks progresses. This will keep sediment contained on site at appropriate locations.

19.4. Run-Off Control Measures

Run-off control measures are to be used in conjunction with sediment traps to divert water around planned earthworks areas to remove silts. Any surface water upstream of the site is to be diverted around the development areas, and to discharge to the existing drainage system to the east of the site. The surface water run-off destination for the diverted surface water will continue as existing.

19.5. Main Surface Water Run-Off Systems

The main drainage network, SuDS features, flow control chamber, and outfall to the garden areas are to be built prior to any construction of site. Surface water from each of the phased area is to discharge to the new drainage network, where the water is adequately restricted, and water quality maintained before discharging to ground. Temporary inlet and outlet protection measures and appropriate silt traps are to be installed to prevent silt ingress into the main drainage network.

19.6. Clearing and Earthworks

Clearing and earthworks will only start when adequate erosion and sediment control measures are in place. Once the development areas are cleared, earthworks will follow immediately to ensure that the ground cover can be re-established quickly. Adjacent land to that being developed will be left undisturbed for as long as possible.

19.7. Surface Stabilisation Measures

Surface stabilisation measures will be applied to completed areas, channels ditches and other disturbed areas after the land is cleared and profiled. Permanent stabilisation measures will be installed as soon as possible after final profiling.

19.8. Construction of Permeable Surfacing

Construction of permeable paving is to be left to the later stages of construction. Unsuitable sediment is to be removed from surfacing prior to installation of sand binder layer and paving.

20. Conclusion / Summary

20.1. SuDS Principles and SW Discharge Destination

All feasible SuDS methods, and surface water discharge destination have been assessed, with the feasible SuDS methods being a permeable surfacing system, raised planters, raingardens, filter drains, attenuation tank, and a flow control chamber.

The surface water destination will be to ground via a field drainage system, with restricted surface water replicating natural state of the site.

20.2. Peak Flow Control

The surface water run-off rates are between a 14% to 76% reduction of the natural / greenfield rates of the developed area of the site. Therefore, distributing the surface water at these rates across the garden area will not increase the risk of flooding, and is therefore acceptable.

20.3. Volume Control

The surface water run-off volume is a 52% reduction of the natural / greenfield volume of the developed area of the site. Therefore, distributing this surface water volume across the garden area will not increase the risk of flooding, and is therefore acceptable.

20.4. Flood Risk within the Development

The cellular unit volume is suitably sized so that no flooding will occur for all storms up to and including the 1 in 100-year event + 40% climate change.

20.5. Surface Water Exceedance Design

In the unlikely event of an extreme storm greater than 100-year + 40% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur. Surface water flow paths to follow existing and proposed ground topography, where water will flow to the south of the site.

Flood water will flow away from the proposed building within the site, and due to the additional below ground attenuation (no attenuation at pre-development site), the flood flows will be less than the pre-development volume (regardless of storm event), and therefore will not increase food risk to any other areas or buildings.

20.6. Management and Maintenance

The maintenance and management of the drainage network and SuDS features will be by contractors appointed by owners / occupiers of the new residential units, which will be part of the property deeds and / or rental agreements. The management and maintenance will co-inside with agreement for the general management and maintenance of all communal and shared amenity areas within the site.

20.7. Water Quality

The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment. The mitigation indices is greater than the pollution hazard index, and therefore suitable water quality is achieved.

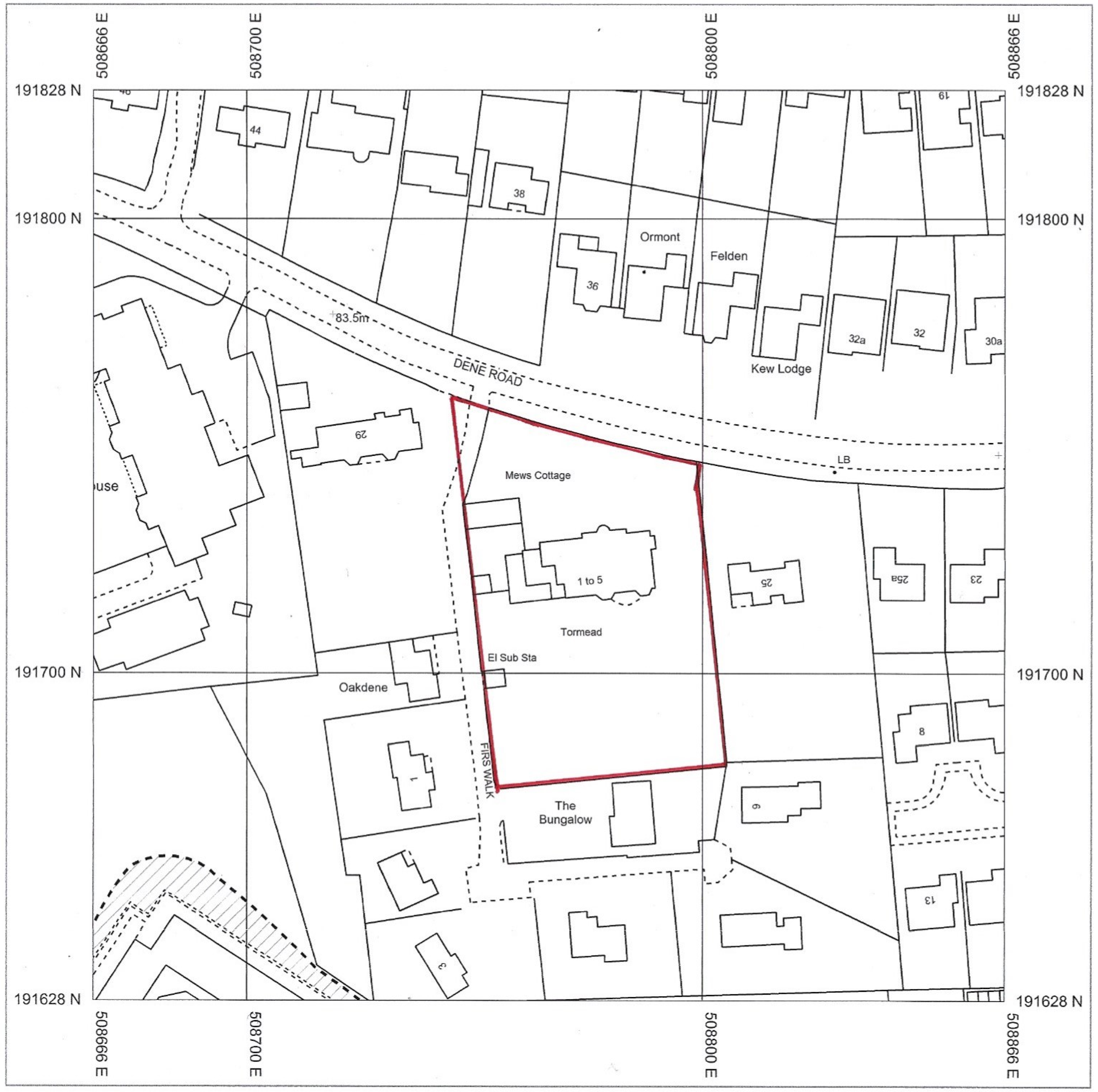
Appendix A

Site Location Plan

Mapping sourced from Ordnance Survey

N

Location Map



Produced 04/04/2014 from the Ordnance Survey National Geographic Database and incorporating surveyed revision available at this date. © Crown Copyright 2014

The representation of a road, track or path is no evidence of a right of way.

The representation of features as lines is no evidence of a property boundary.

0 20 40

Scale 1:1250

Supplied By: **MFS Reprographics Ltd**

Serial number: 001139563

Plot Centre Coordinates: 508766, 191728

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tormead'
27 Dene Road,
Northwood,
HA6 2BX

Drawing Title:
Location Plan

Client:
Mr P. Sandar

Scale : 1:1250

Date : May 2021

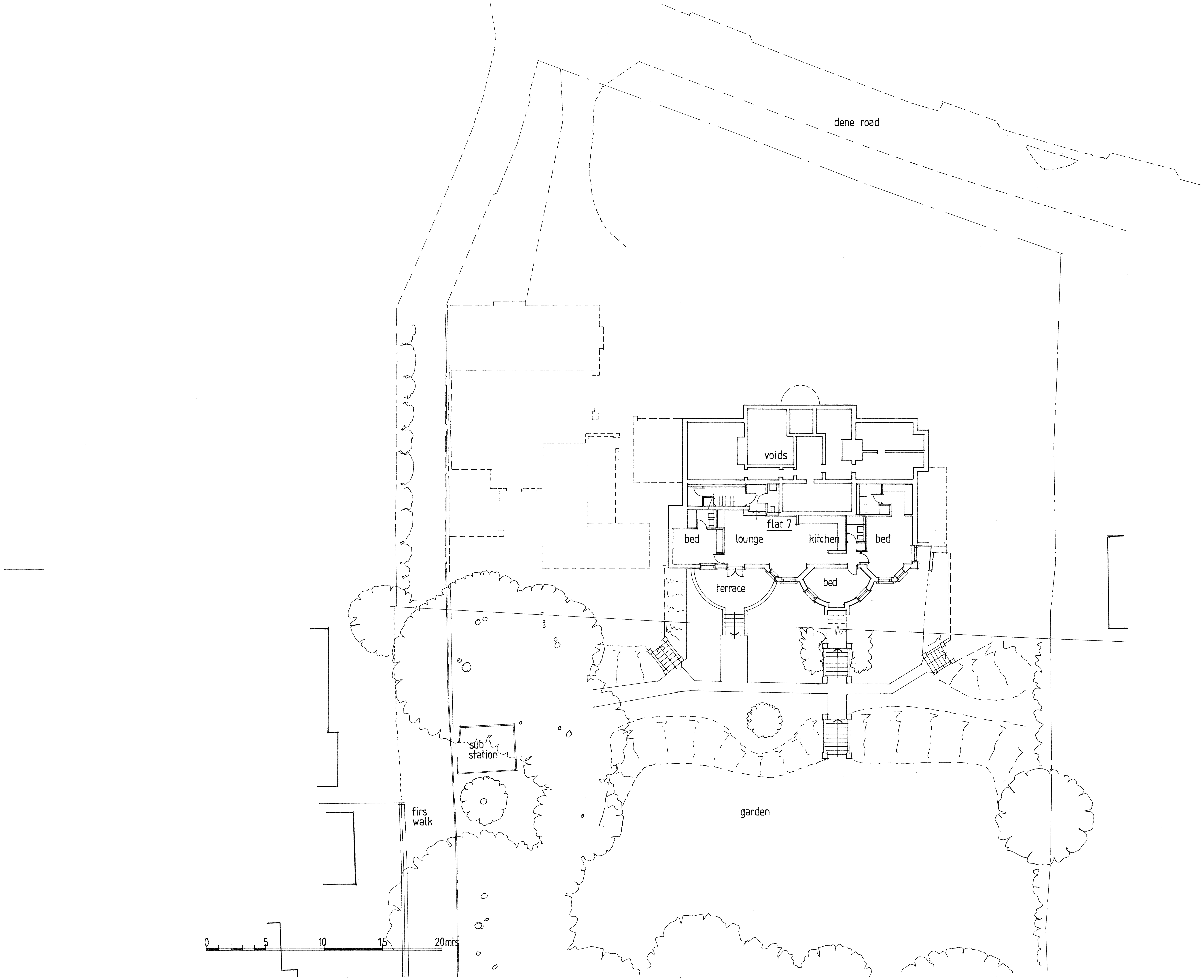
Drawn : A3 original

Drawing No. 635.21.01

Rev.

Appendix B

Existing Site Plans



GNP
Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

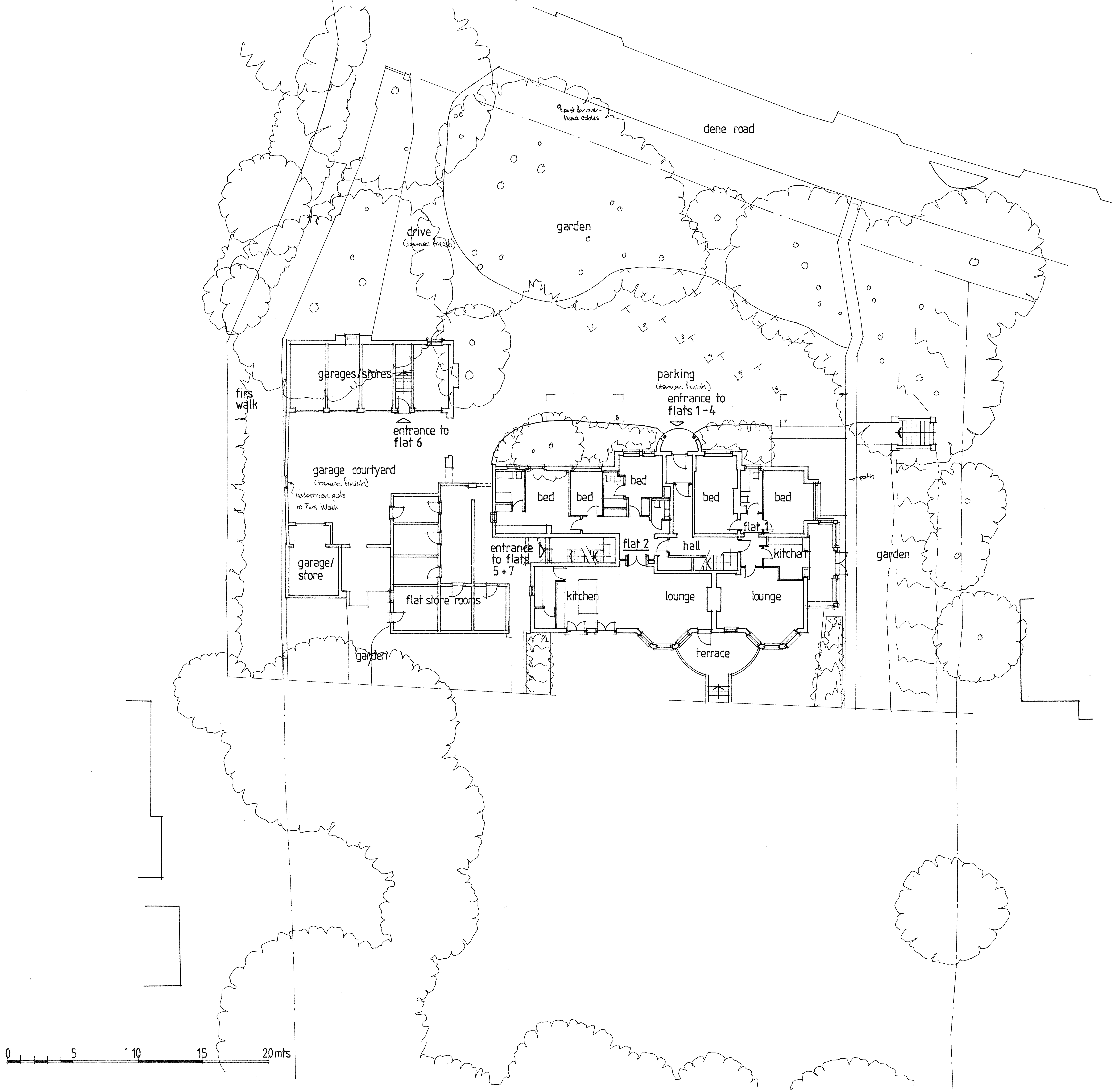
Project Title:
New Flats:
'Tormead'
27 Dene Road,
Northwood.
NA6 2BX

Drawing Title:
As Existing
Lower Ground Floor Plan

Client:
Mr P. Sander.

Scale : 1:200
Date : April 2018
Drawn : A2 original

Drawing No.	Rev.
635 · 18 · 02	



rev'A' - Jan'2022 - parking arrangement layout added (unmarked) + garage note revised.

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
New Flats:
'Tanwood'
27 Dene Road,
Nathwood
NA6 2BX

Drawing Title:
As Existing
Ground Floor Plan

Client:
Mr P. Sandar

Scale : 1:200
Date : April 2018
Drawn : A2 original

Drawing No	Rev
635.18.03	A

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:

New Flats:
'Tormead'
27 Dene Road,
Northwood.
HA6 2BX

Drawing Title:

As Existing
First Floor Plan

Client:

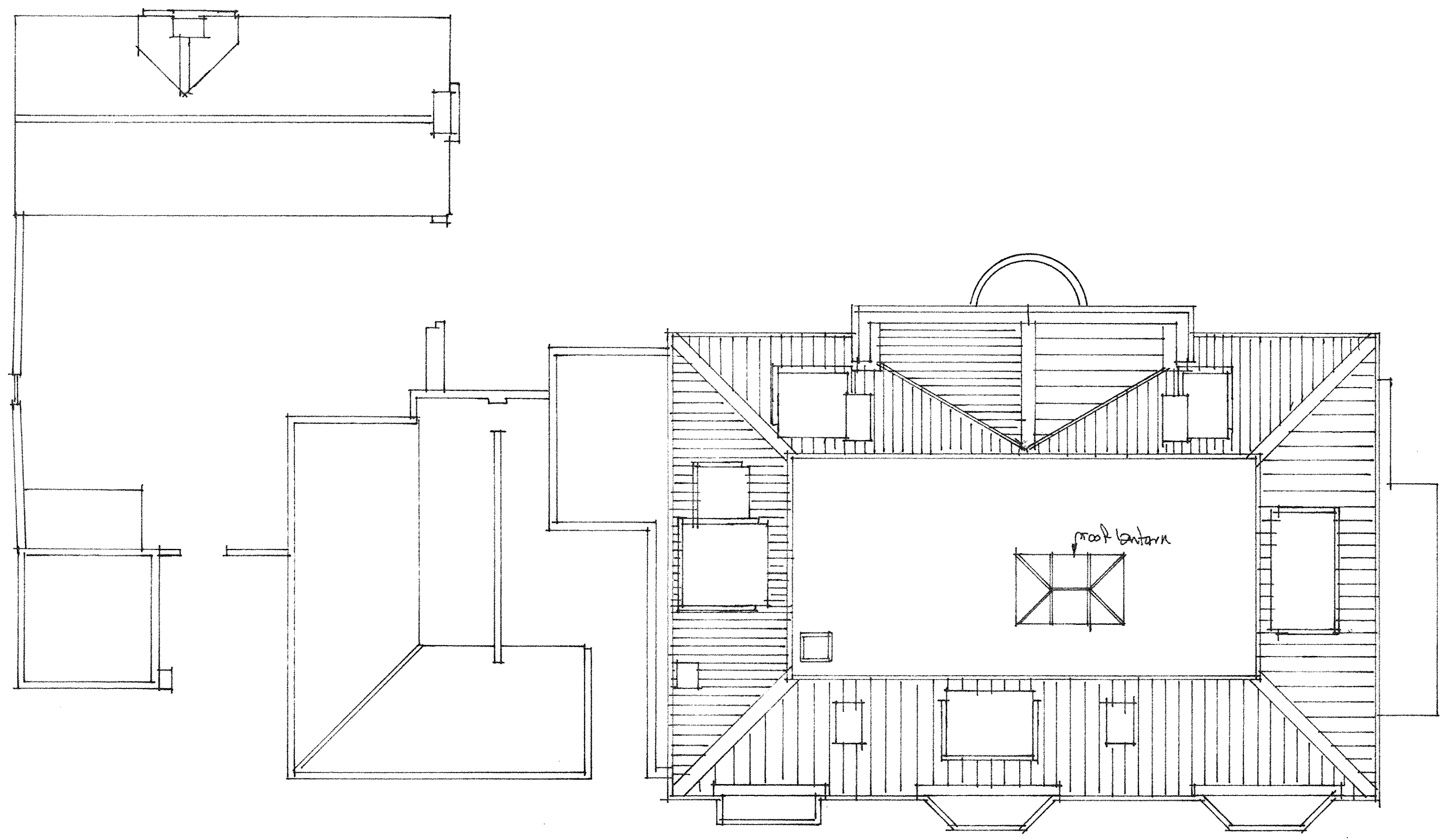
Mr P. Sander

Scale : 1:200

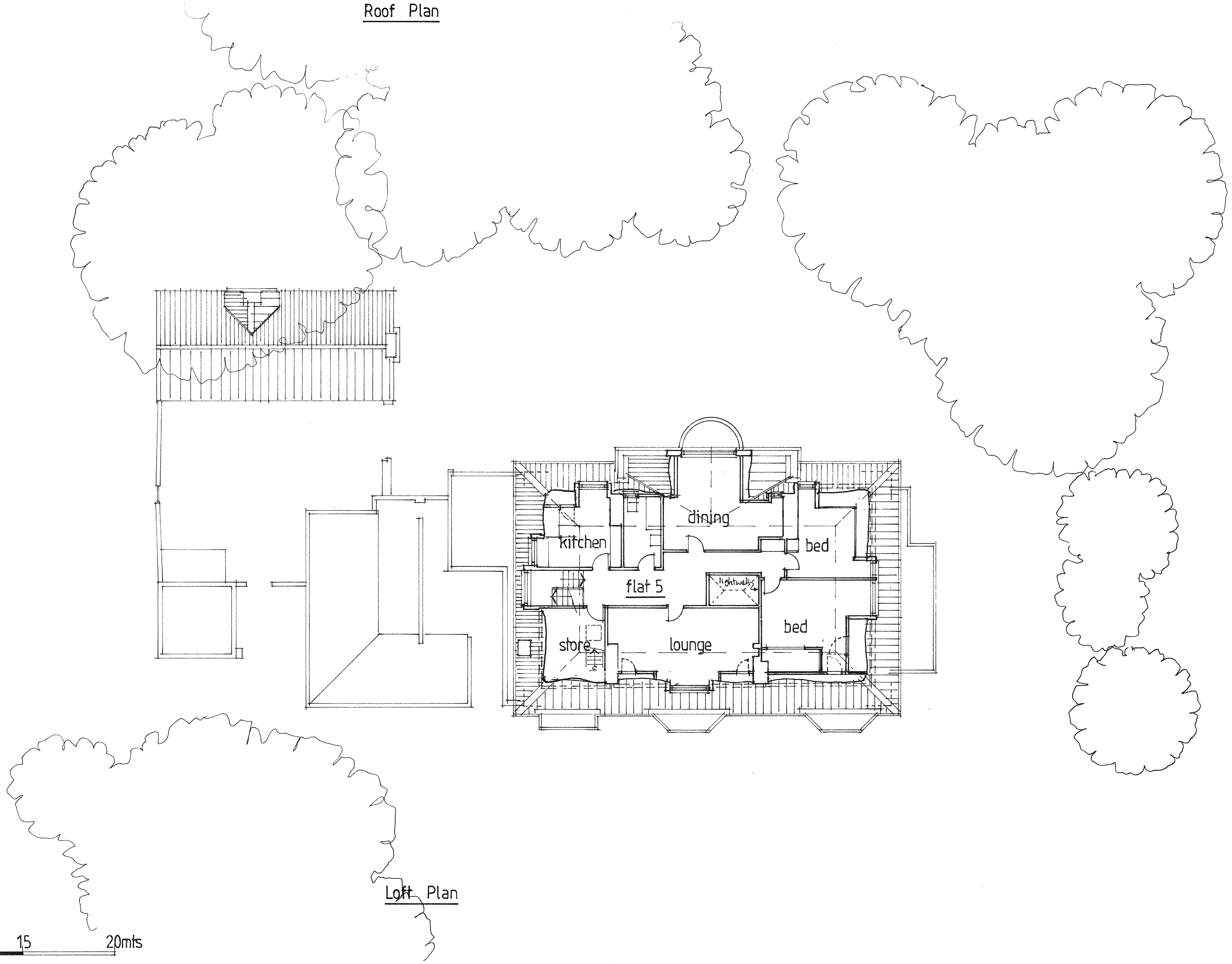
Date : April 2018

Drawn : A2 original

Drawing No.	Rev.
635 . 18 . 04	



Roof Plan



Loft Plan

rev'A' - May 2021 - loft + roof plan minor amendments.

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
New Flats:
'Tovmead'
27 Dene Road,
Northwood.
HA6 2BX

Drawing Title:
As Existing
Loft + Roof Plans

Client:
Mr P. Sandar

Scale : 1:200
Date : April 2018

Drawn : A2 original

Drawing No 635 . 18 . 05
Rev A

North Elevation

South Elevation

0 5 10 15 20mts

G N P

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tarmead'
27 Dane Road,
Northwood,
HA6 2BX

Drawing Title:
As Existing
Elevations 1

Client:
Mr P. Sayer

Scale :	Date :
1:200	May 2021

Drawn :
A2 original

Drawing No.	Rev
635.21.06	

East Elevation

West Elevation

0 5 10 15 20mts

GNP
Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tormead'
27 Dene Road,
Northwood.
HA6 2BX

Drawing Title:
As Existing
Elevations 2

Client:
Mr P. Sayer

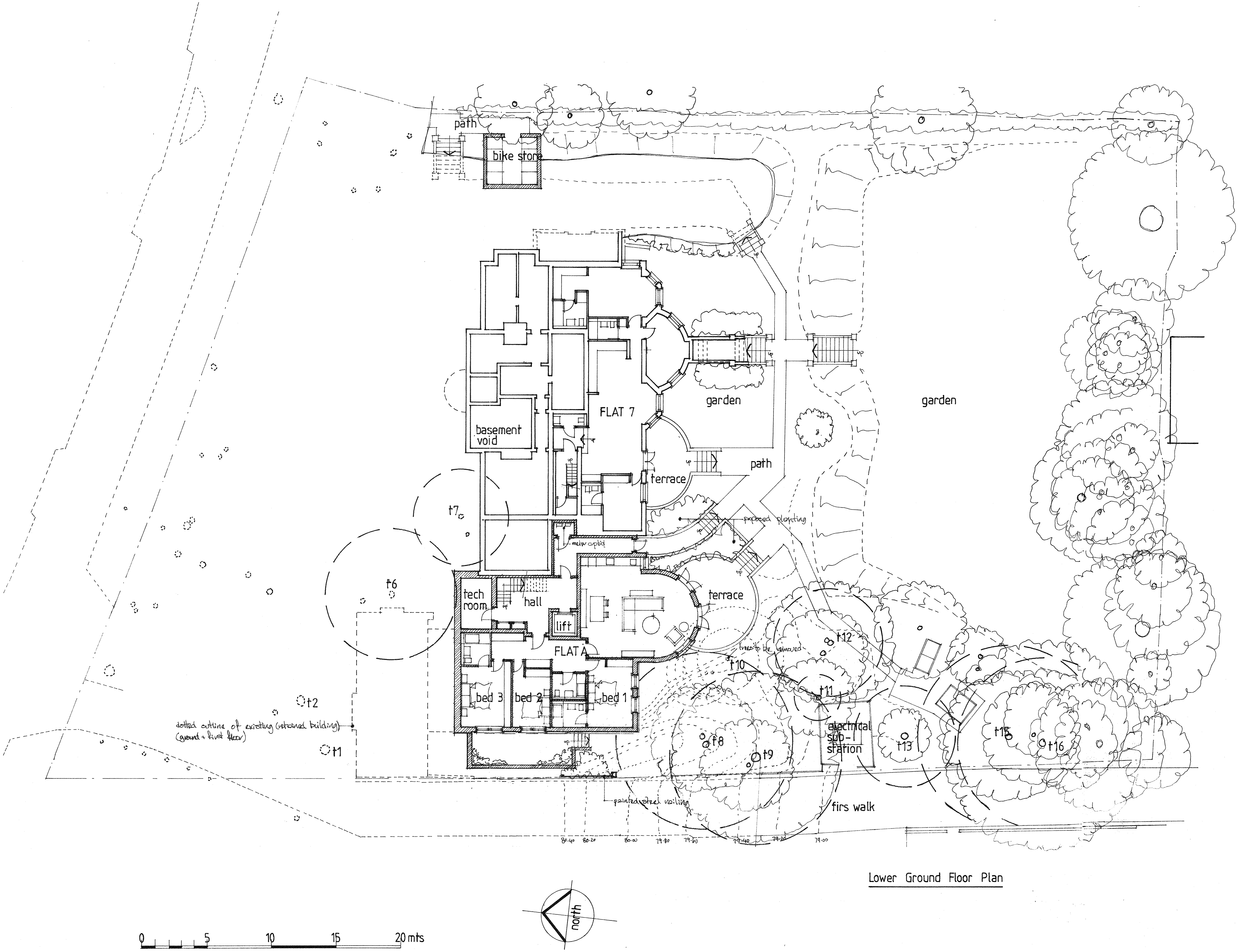
Scale : 1:200
Date : May 2021

Drawn :
A2 original

Drawing No: 635.21.07
Rev

Appendix C

Proposed Development Plans



rev 'B' - May 2022 - updated for preplanning report comments

rev 'A' - May 2021 - proposed extension hatched

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:

'Tormead'
27 Dene Road,
Northwood,
HA6 2BX

Drawing Title:

As Proposed -
Lower Ground Floor Plan

Client:

Mr. P. Sandor

Scale :	Date :
1:200	May 2021

Drawn :

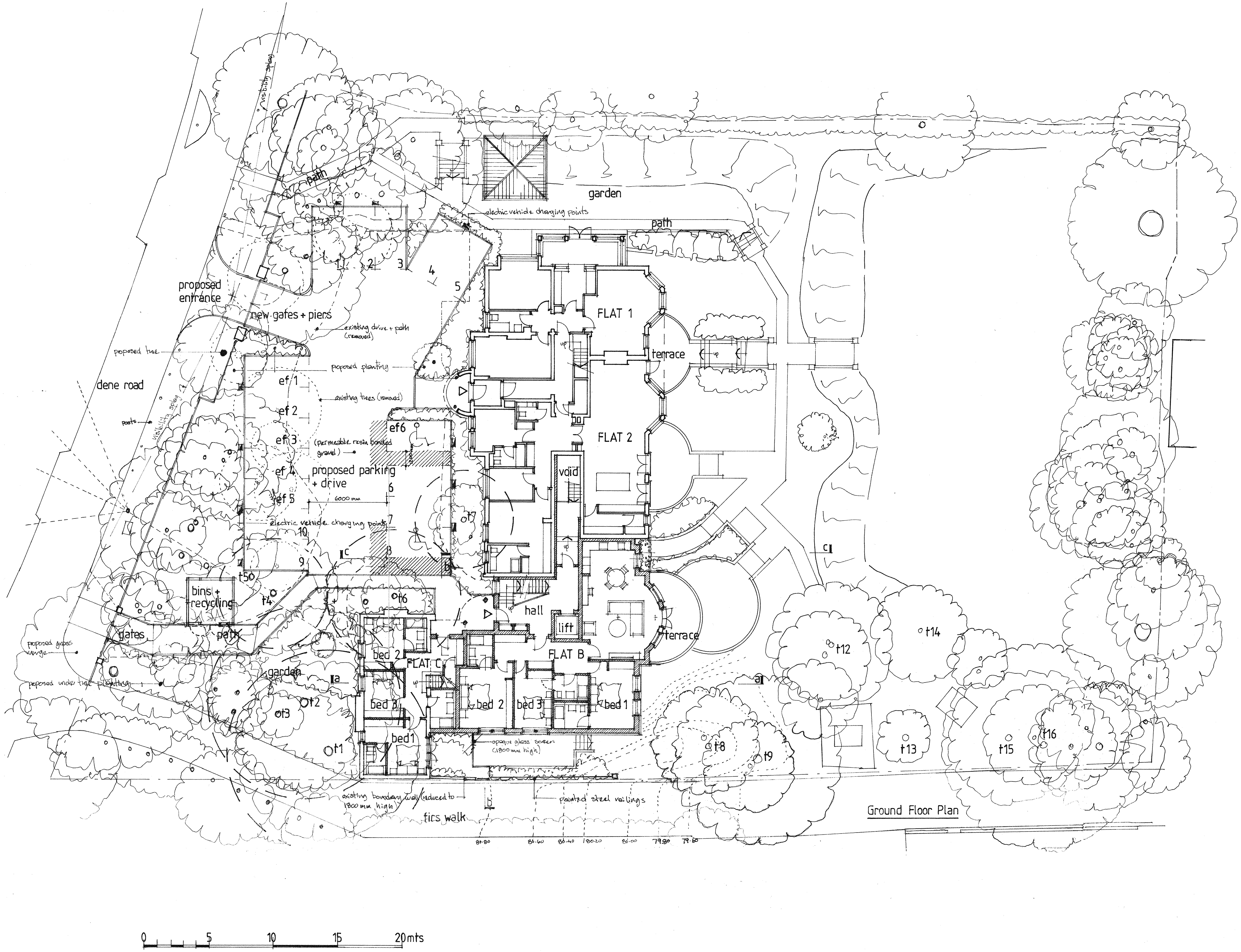
A2 original

Drawing No	Rev.
635 · 21 · 31	B

KEY

electric vehicle charging point (active)

ef 1 parking for existing flats



rev 'd' - May '22 - updated for pre-planning report comments

rev 'c' - Feb 22 - car park numbering revised.

rev 'B' - Jan 2022 - updated as Dec' 2021 pre planning scheme + electric vehicle charging points added

rev 'A' - May 2021 - proposed extension hatched

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tormead'
27 Dene Road,
Northwood,
HA6 2BX

Drawing Title:
As Proposed
Ground Floor Plan

Client:
Mr P. Sandar

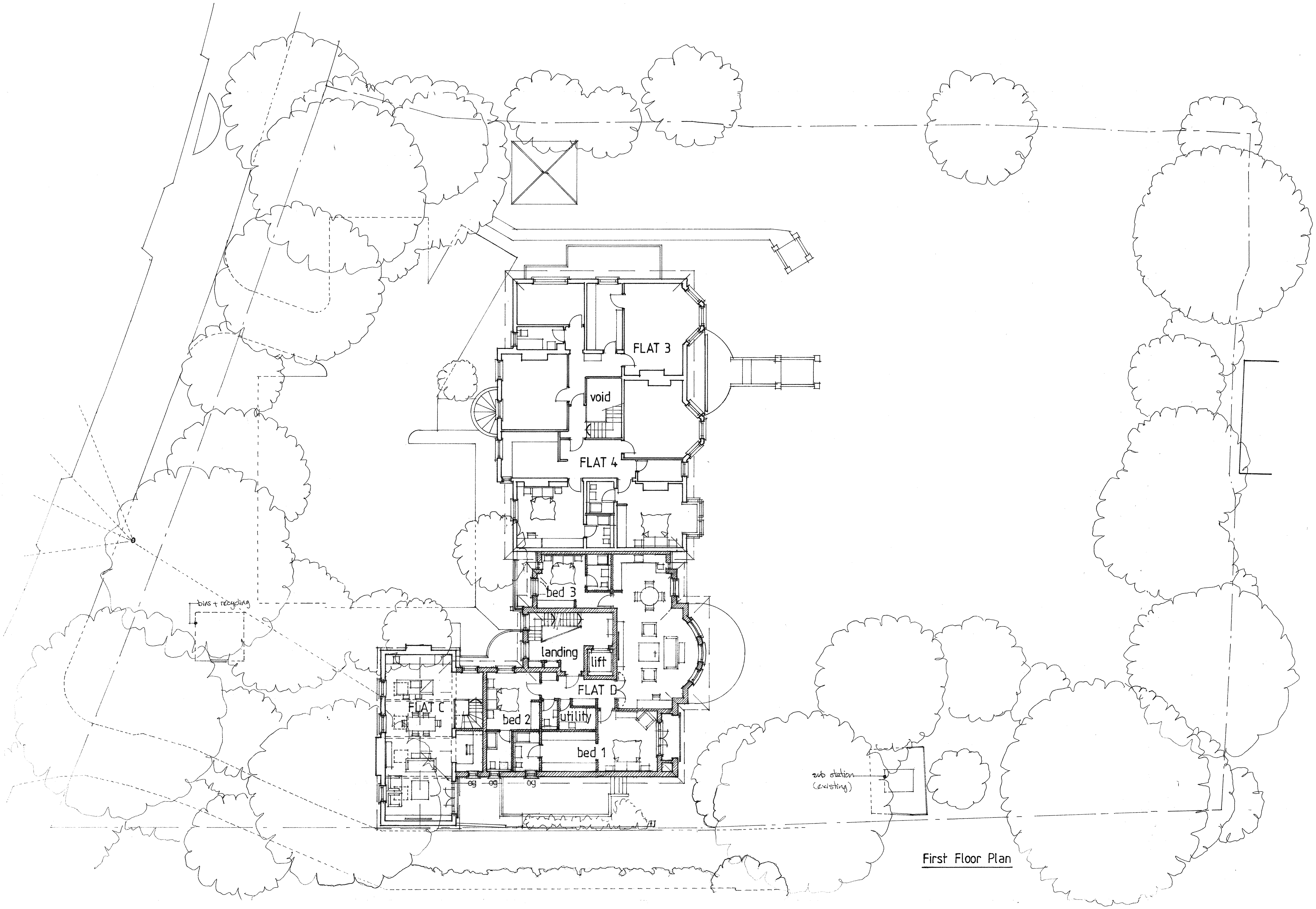
Scale :	Date :
1:200	May 2021

Drawn :
A2 original

Drawing No	Rev
635 . 21 . 32	D

KEY

og obscured glazed non opening window



0 5 10 15 20 mts

rev'C' - May '22 - updated for pre planning report comments

rev'B' - Jan 2022 - updated as Dec'2021 preplanning scheme

rev'A' - May 2021 - proposed extension hatched

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tormead'
27 Dene Road,
Northwood,
HA6 2BX

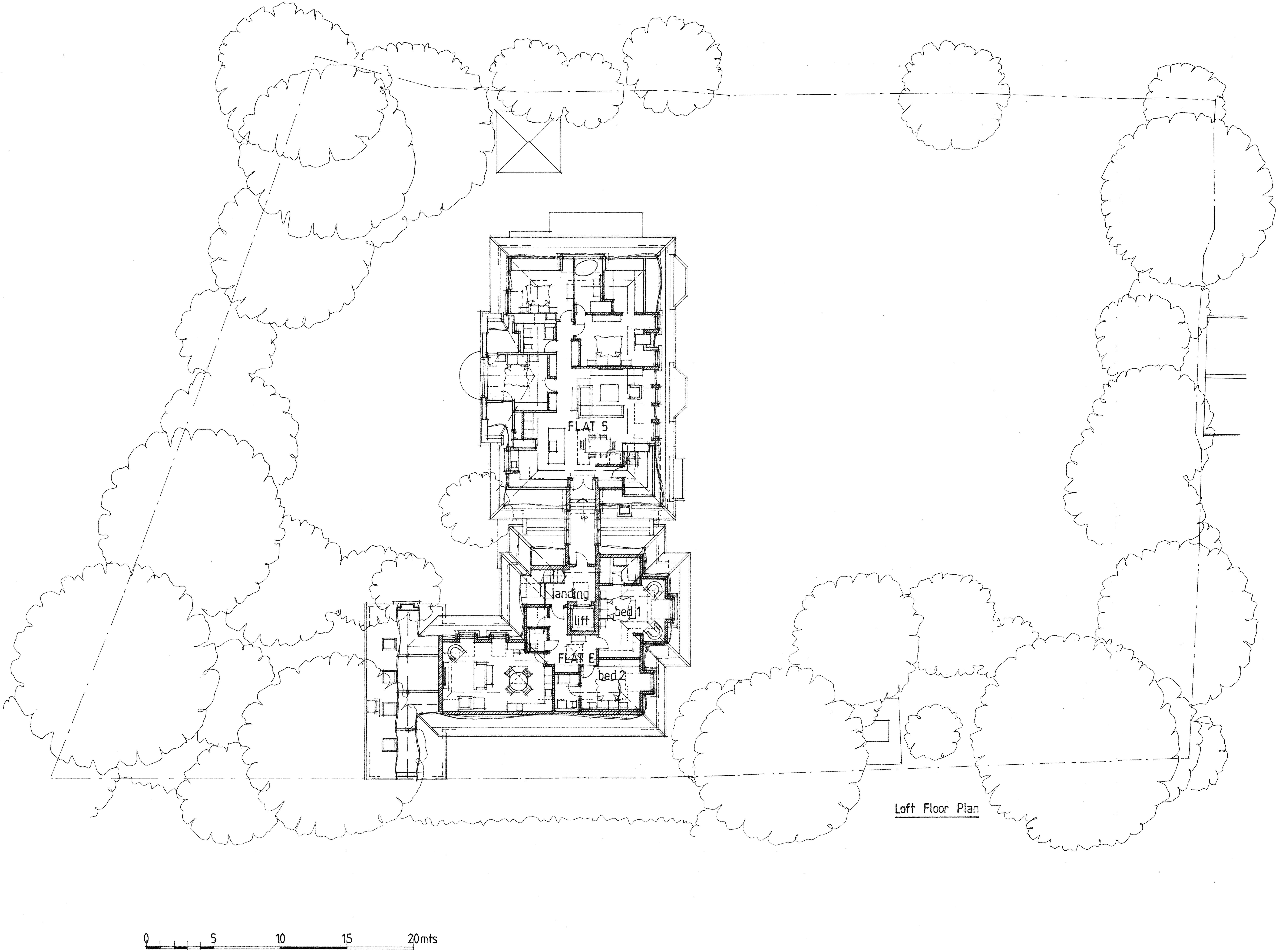
Drawing Title:
As Proposed
First Floor Plan

Client:
Mr P. Sander

Scale :	Date :
1:200	May 2021

Drawn :
A2 original

Drawing No	Rev
635·21·33	c



rev 'C' - May 2022 - updated for pre planning report comments
rev 'B' - Jan 2022 - updated as Dec 2021 preplanning scheme.

rev 'A' - May 2021 - proposed extension hatched + Flat 5 dormer revised

GNP

Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tarnead'
27 Dene Road,
Northwood,
HA6 2BX

Drawing Title:
AS Proposed
Loft Floor Plan

Client:
Mr P. Sandar

Scale : 1:200
Date : May 2021

Drawn : A2 original

Drawing No	Rev.
635.21.34	C

North Elevation

South Elevation

rev 'C' - May 2022 - updated for preplanning report comments

rev 'B' - Jan 2022 - updates as Dec '2021 preplanning scheme

rev 'A' - May 2021 - dormers to Flats (south) revised

GNP
Chartered Architects

4 Goodman Gardens.
Woughton on the Green.
Milton Keynes. MK6 3EP

Tel : 01908 200002

Project Title:
'Tormead'
27 Dene Road,
Northwood,
HA6 2BX

Drawing Title:
As Proposed Elevations

Client:
Mr P. Sondor

Scale : 1:200

Date : May 2021

Drawn : A2 original

Drawing No	Rev
635·21·37	C

Appendix D

Thames Water Asset Plans

Asset Location Search Sewer Map - ALS/ALS/24/2020_4277843

The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 508820,191714

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
761A	n/a	n/a
7702	n/a	n/a
761E	n/a	n/a
761B	n/a	n/a
761D	n/a	n/a
761C	n/a	n/a
861D	n/a	n/a
861E	n/a	n/a
861A	n/a	n/a
861B	n/a	n/a
8701	n/a	n/a
8601	76.25	74.85
8603	76.23	74.93
8602	76.15	74.7
8604	76.14	74.64
8702	79.09	77.61
8605	76.02	74.37

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Trunk Surface Water
- Trunk Foul
- Storm Relief
- Trunk Combined
- Vent Pipe
- Bio-solids (Sludge)
- Proposed Thames Surface Water Sewer
- Proposed Thames Water Foul Sewer
- Gallery
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Sludge Rising Main
- Proposed Thames Water Rising Main
- Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Dam Chase
- Fitting
- Meter
- Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Control Valve
- Drop Pipe
- Ancillary
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Outfall
- Undefined End
- Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

- Public/Private Pumping Station
- Change of characteristic indicator (C.O.C.I.)
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Operational Site
- Chamber
- Tunnel
- Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Gulley
- Culverted Watercourse
- Proposed
- Abandoned Sewer

Notes:

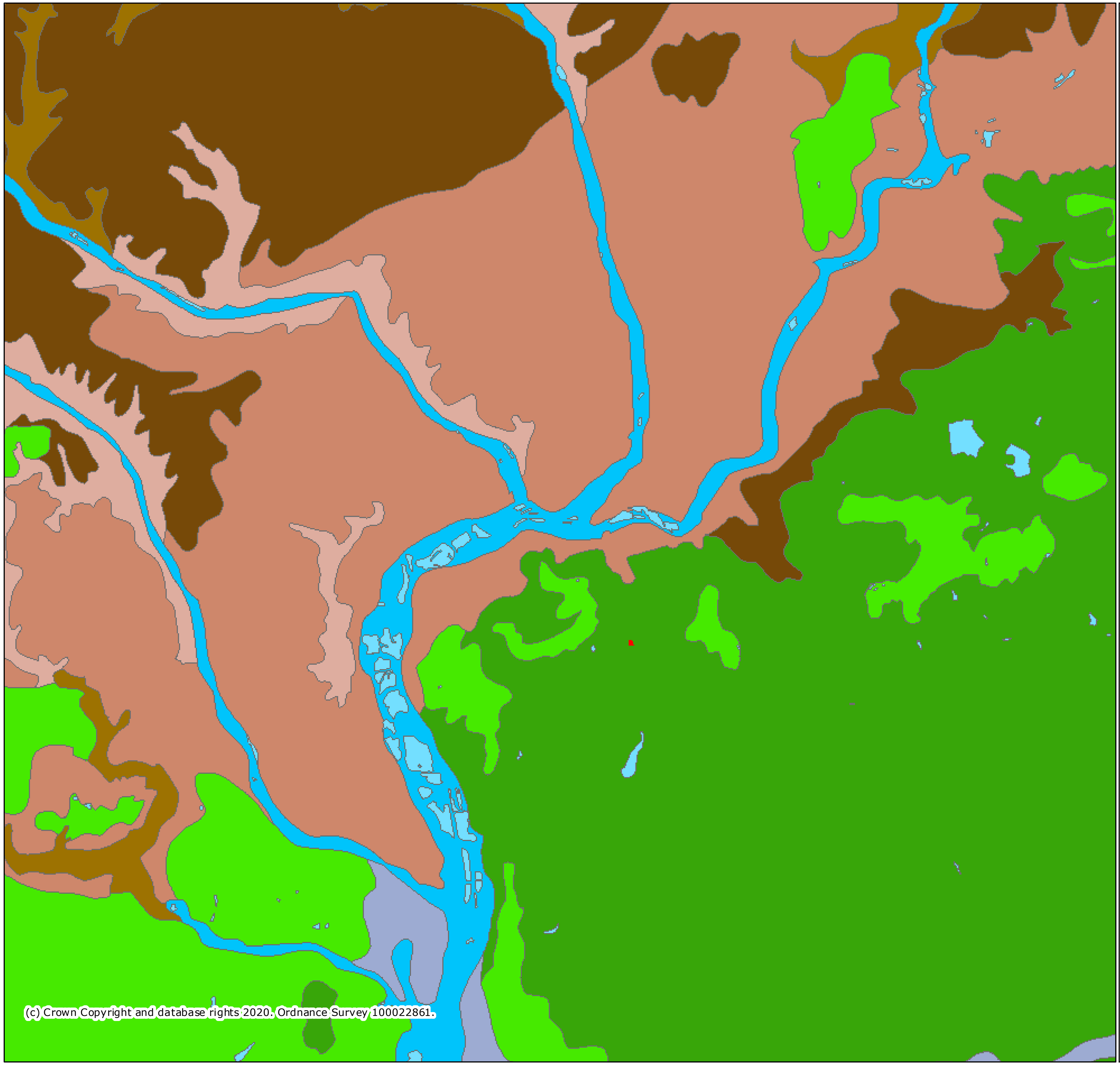
1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix E

MAGIC Geology and Hydrogeology Data

MAGIC

SOILS



Legend

Soilscape (England)

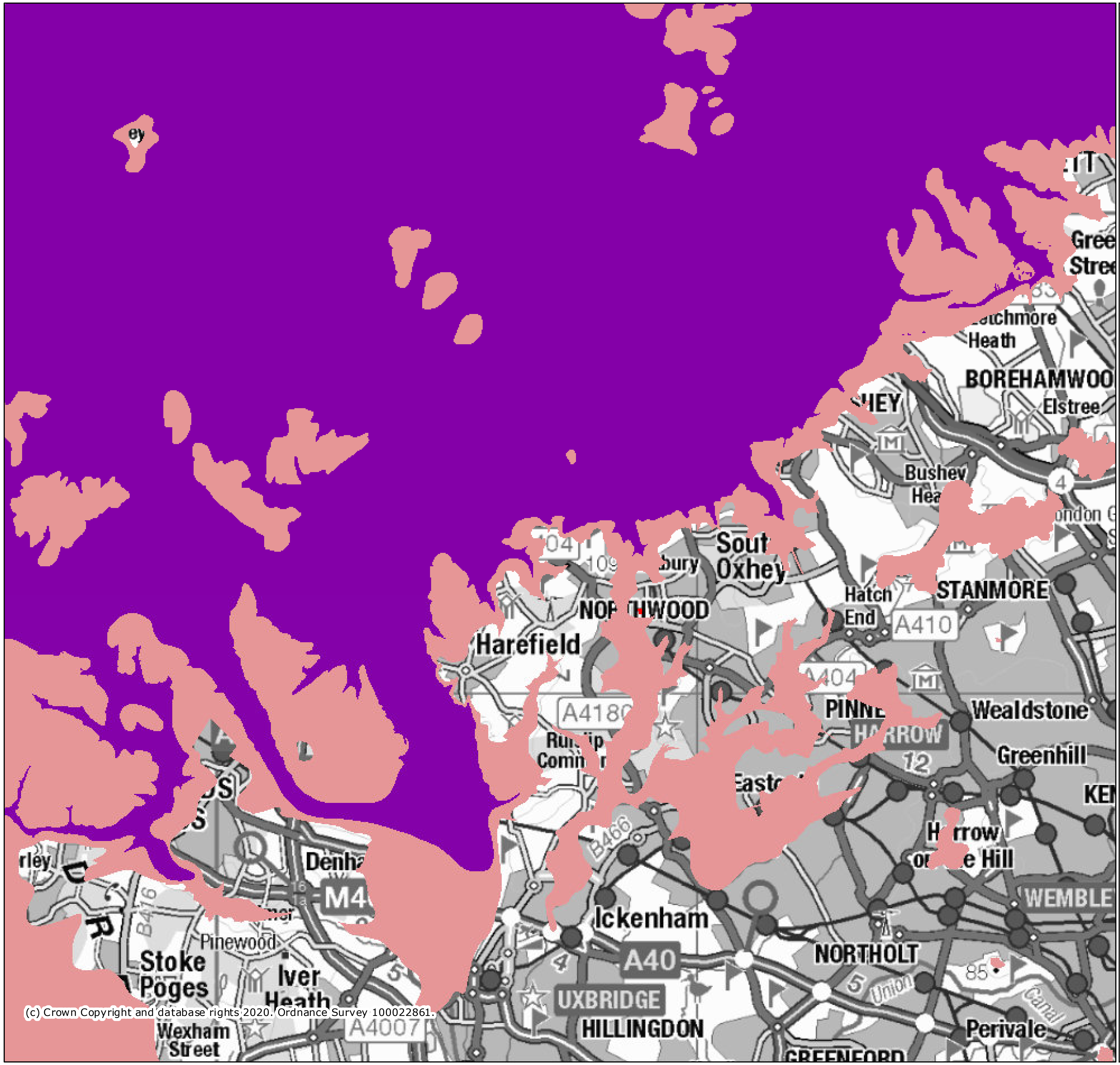
- 1 - Saltmarsh soils
- 2 - Shallow very acid peaty soils over rock
- 3 - Shallow lime-rich soils over chalk or limestone
- 4 - Sand dune soils
- 5 - Freely draining lime-rich loamy soils
- 6 - Freely draining slightly acid loamy soils
- 7 - Freely draining slightly acid but base-rich soils
- 8 - Slightly acid loamy and clayey soils with impeded drainage
- 9 - Lime-rich loamy and clayey soils with impeded drainage
- 10 - Freely draining slightly acid sandy soils
- 11 - Freely draining sandy breckland soils
- 12 - Freely draining floodplain soils
- 13 - Freely draining acid loamy soils over rock
- 14 - Freely draining very acid sandy and laomy soils
- 15 - Naturally wet very acid sandy and loamy soils
- 16 - Very acid loamy upland soils with a wet peaty surface
- 17 - Slowly permeable seasonally wet acid loamy and clayey soils
- 18 - Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
- 19 - Slowly permeable wet very acid upland soils with a peaty surface
- 20 - Loamy and clayey floodplain soils with naturally high groundwater
- 21 - Loamy and clayey soils of coastal flats with naturally high groundwater
- 22 - Loamy soils with naturally high groundwater
- 23 - Loamy and sandy soils with naturally high groundwater and a peaty surface
- 24 - Restored soils mostly from quarry and opencast spoil
- 25 - Blanket bog peat soils
- 26 - Raised bog peat soils
- 27 - Fen peat soils
- 28 - Sea
- 30 - UC
- 31 - Water

Projection = OSGB36
xmin = 484900
ymin = 183700
xmax = 529800
ymax = 204300

0 1.5 3
km

Map produced by MAGIC on 14 October, 2020.

Aquifer Map



Legend

Aquifer Designation Map (Bedrock) (England)

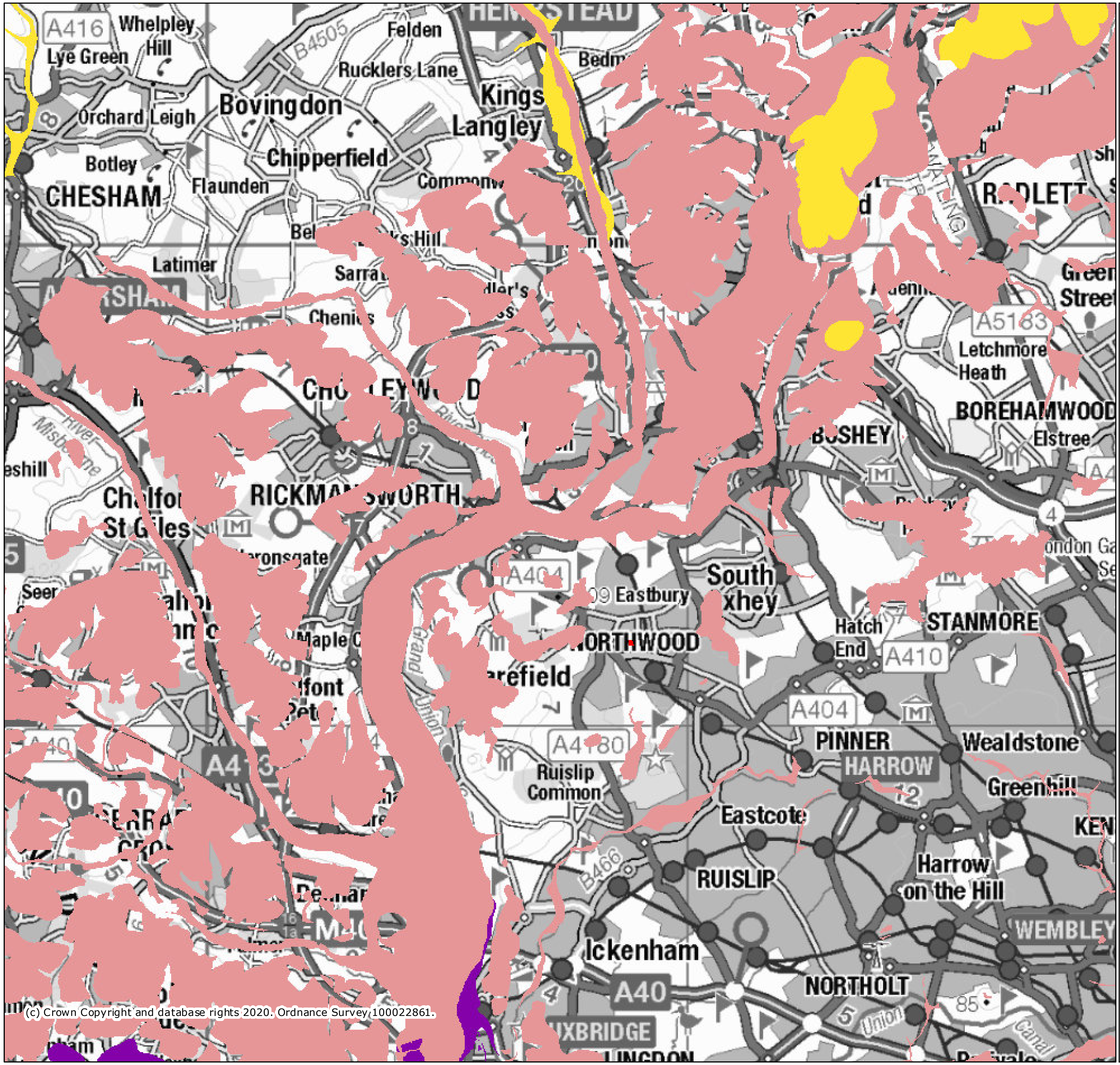
- Principal
- Secondary A
- Secondary B
- Secondary (undifferentiated)
- Unproductive

Projection = OSGB36
xmin = 484900
ymin = 182400
xmax = 529400
ymax = 204300

0 1.5 3
km

Map produced by MAGIC on 14 October, 2020.
 Some information in MAGIC is a snapshot of the information that is being maintained or continually updated by the originating organisation. Please refer to the metadata for details as information may be illustrative or representative rather than definitive at this stage.

Supeficial



Legend

Aquifer Designation Map (Superficial Drift) (England)

- Principal
- Secondary A
- Secondary B
- Secondary (undifferentiated)
- Unknown (lakes+landslip)
- Unproductive

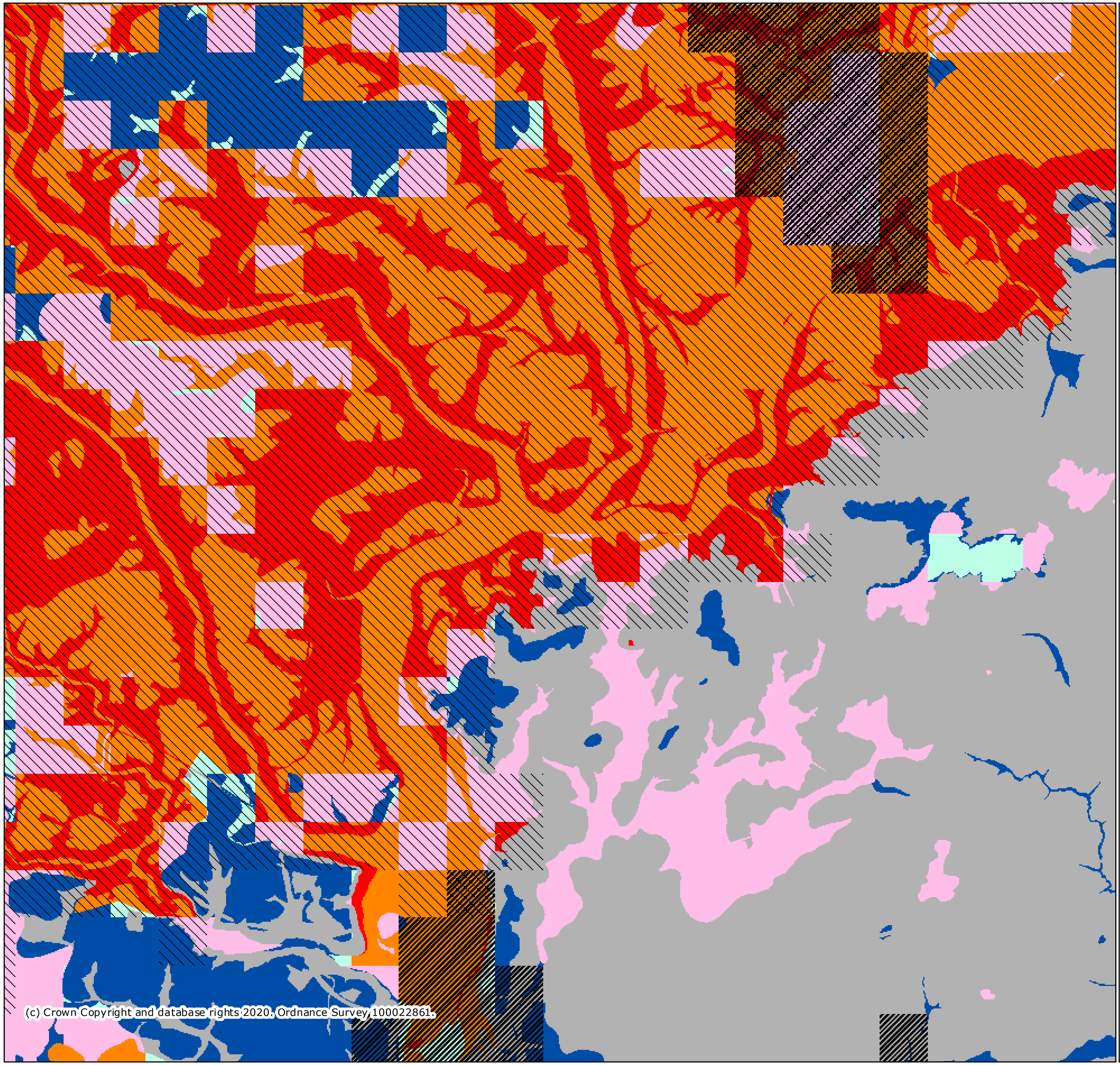
Projection = OSGB36
xmin = 484900
ymin = 183700
xmax = 529800
ymax = 204300

0 1.5 3
km

Map produced by MAGIC on 14 October, 2020.

MAGIC

GROUNDWATER



Legend

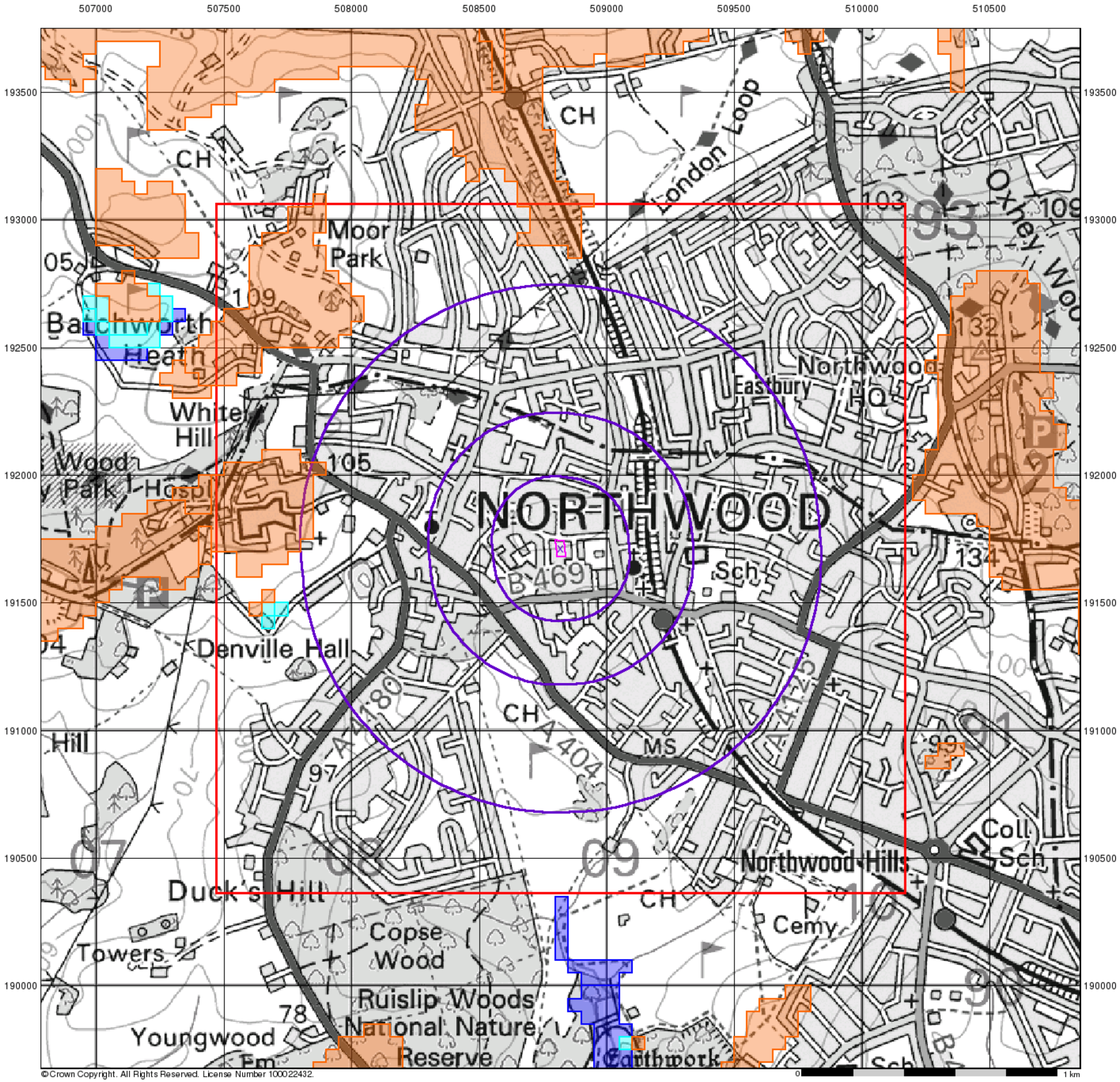
Groundwater Vulnerability Map (England)

- Local Information
- Soluble Rock Risk
- High
- Medium - High
- Medium
- Medium - Low
- Low
- Unproductive

Projection = OSGB36
xmin = 484900
ymin = 183700
xmax = 529800
ymax = 204300

0 1.5 3
km

Map produced by MAGIC on 14 October, 2020.
 Some information in MAGIC is a snapshot of the information that is being maintained or continually updated by the originating organisation. Please refer to the metadata for details as information may be illustrative or representative rather than definitive at this stage.



Envirocheck®

LANDMARK INFORMATION GROUP®

BGS Flood Data (1:50,000)

General

Specified Site
Specified Buffer(s)
Bearing Reference Point
Slice
Map ID

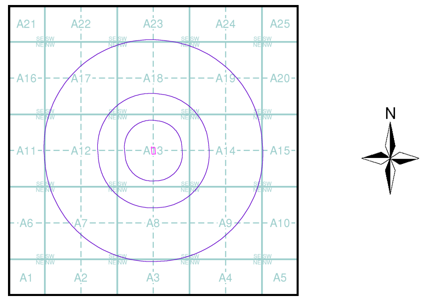
BGS Groundwater Flooding Susceptibility

Potential for Groundwater Flooding to Occur at Surface

Potential for Groundwater Flooding of Property Situated Below Ground Level

Limited Potential for Groundwater Flooding to Occur

BGS Flood Data Map - Slice A



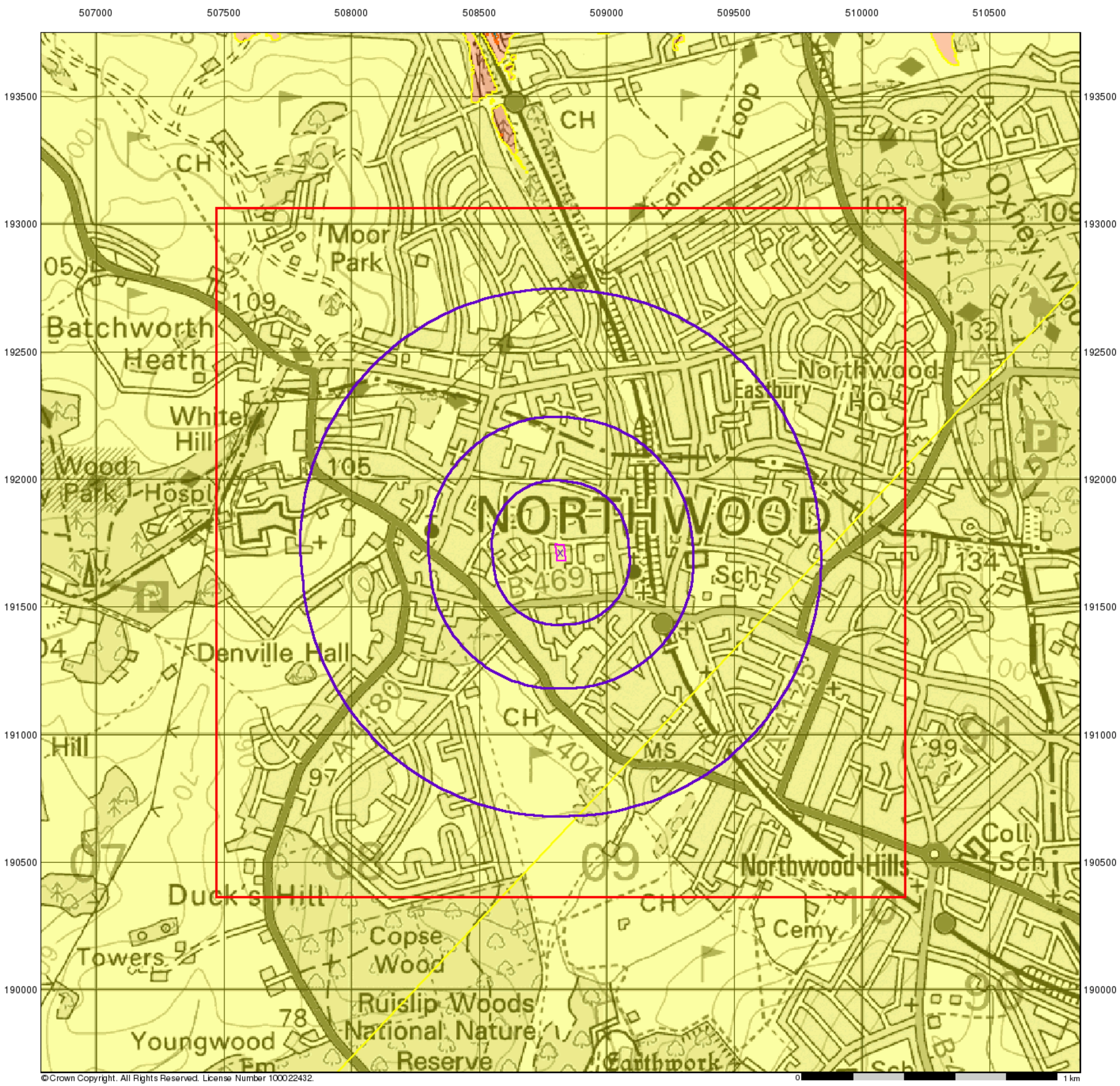
Order Details

Order Number: 262176555_1_1
Customer Ref: 656
National Grid Reference: 508820, 191710
Slice: A
Site Area (Ha): 0.22
Search Buffer (m): 1000

Site Details

Site at 508820, 191710

Landmark® INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck®

LANDMARK INFORMATION GROUP®

GeoSmart Information Groundwater Flood Map (1:50,000)

General

Specified Site
Specified Buffer(s)
Bearing Reference Point
Slice

GeoSmart Information Groundwater Flooding Risk

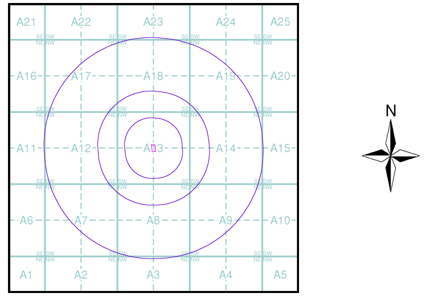
High Risk

Moderate Risk

Low Risk

Negligible Risk

GeoSmart Information Groundwater Flood Map - Slice A



Order Details

Order Number:	262176555_1_1
Customer Ref:	656
National Grid Reference:	508820, 191710
Slice:	A
Site Area (Ha):	0.22
Search Buffer (m):	1000

Site Details

Site at 508820, 191710

Appendix F

BGS Borehole Log Data

TQ 09SE/86

Contract Name 28 Halland Way, Northwood

Borehole No. 2 — Sheet 1 of 2

Method of boring: Light Cable Percussion
Diameter: 150mm
Ground level: OD ca + 80m
Start: 13.3.86
Finish: 14.3.86
NGR. 0876 9190

Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m O.D.)	Thickness (m)	Description of Strata	Legend
				0.10		0.10	*	
			J	0.65		0.55	(Soft to firm brown silty clay with traces of ash and brick occasional gravel	Made
13/3			U	1.70		1.05	(Soft dark grey silty clay with traces of decaying organic matter some ash, brick and gravel)	Ground
			J, U, J, U, J, U	6.30		4.60	Firm becoming stiff brown fissured silty CLAY with occasional small pockets and partings of orange-brown fine sand and silt, some blue grey reduction along fissures to about 4m, small pockets of selenite	
13/3			J, U, J, U, J	9.90		3.60	Stiff brown fissured silty CLAY with small pockets and partings of fine sand and silt numerous small pockets of selenite	

Notes * (Soft dark brown silty clay)

Terresearch Limited | **Report No.** S36/635 | **Appendix 1** | **Sheet** 3

Contract Name GREEN LANE, NORTHWOOD	**Borehole No.** HA2 **Sheet** 1 **of** 1

Method of boring	Hand auger	**Ground level**	71.0 m O.D. 0890
Diameter	100 mm nominal	**Start**	10.9.76 9186
		Finish	10.9.76

Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m O.D.)	Thickness (m)	Description of Strata
				0.15	70.95	0.15	Topsoil
			U* U*	1.00	70.10	0.85	Soft mottled light brown grey silty clay with numerous traces of organic material and some root fibres
			U* U* U* U*	2.73	68.37	1.73	Firm to very stiff light brown grey silty clay with traces of organic material
10/9							Bottom of Borehole

Notes

Terresearch Limited	**Report No.** S.26/875	**Appendix 1 Sheet** 4

Contract Name GREEN LANE, NORTHWOOD	**Borehole No.** HA1 **Sheet** 1 **of** 1

Method of boring Hand auger
Diameter 100 mm nominal
Ground level about 70.0 m O.D
Start 10.9.76 0890
Finish 10.9.76 9154

Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m O.D.)	Thickness (m)	Description of Strata
				0.15	69.85	0.15	Topsoil
				0.70	69.30	0.55	Soft mottled reddish brown silty clay with traces of organic material, root fibres and some fine sand partings
			U* U* U*	2.00	68.00	1.30	Stiff to very stiff mottled reddish brown silty clay with traces of organic material, root fibres and some fine sand partings
10/9			U*	2.43	67.57	0.43	Very stiff mottled greyish brown silty sandy clay with some traces of fine gravel
							Bottom of Borehole

Notes

Contract Name GREEN LANE, NORTHWOOD

Borehole No. HA1

Sheet 1 **of** 1

Method of boring Hand auger

Diameter 100 mm nominal

Ground level about 70.0 m O.D

Start 10.9.76 0890

Finish 10.9.76 9154

Daily progress	Water levels	In-situ tests	Samples	Depth (m)	Reduced level (m O.D.)	Thickness (m)	Description of Strata
				0.15	69.85	0.15	Topsoil
				0.70	69.30	0.55	Soft mottled reddish brown silty clay with traces of organic material, root fibres and some fine sand partings
			U* U* U*	2.00	68.00	1.30	Stiff to very stiff mottled reddish brown silty clay with traces of organic material, root fibres and some fine sand partings
10/9			U*	2.43	67.57	0.43	Very stiff mottled greyish brown silty sandy clay with some traces of fine gravel
							Bottom of Borehole

Notes

Appendix G

Envirocheck Flood Map Data