GeoDyne

Geotechnical &
Environmental
Consultants

Monks House Lane West
Spalding

Combined Phase I Desk Study and Phase II Exploratory Investigation For Seagate Homes

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Project No: D44118		**Date: 14th March 2025**	
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Comments			

EXECUTIVE SUMMARY

GEOTECHNICAL CONSIDERATIONS	
Ground Conditions	Made Ground was encountered within boreholes WS2 to WS6 which were all located in the southeastern portion of the site around the former and existing buildings. The Made Ground was encountered to depths of 0.40m and 1.20m begl. It should be noted that WS3 had no recovery between 0.40m and 2.00m due to a concrete obstruction being pushing down the sampling tube. A summary of the Made Ground soils encountered in the above exploratory holes is provided as follows: • Concrete surfacing (WS3 and WS6 only). • Grass over dark brown clay (WS4 and WS5 only). • Loose grey sandy gravel of concrete and brick (WS4 only). • Soft locally firm brown mottled dark grey, black and dark brown gravelly locally sandy clay. Gravel constituents comprised clinker, brick, concrete and coal (WS2, WS4 to WS6). Natural Topsoil was encountered at surface within all of the trial pits, soakaway pits and borehole WS1 to depths ranging between 0.30m and 0.50m begl, with an average thickness of approximately 0.36m. The Natural Strata encountered directly beneath the localised Made Ground or Natural Topsoil typically comprised the following drift deposits: • Firm light brown mottled orange-brown and light grey sandy SILT locally progressing into a silty SAND at depth; • Soft to firm light brown/orange-brown/light grey slightly silty (locally very silty) slightly sandy CLAY; • Loose to medium dense wet light grey slightly silty to silty SAND, locally with occasional pockets of clay and rare black organic staining. Within the Silt deposits, the Sand content appeared to vary markedly with depth, with some Silt soils appearing to contain significant quantities of Sand. However, the overall granular content of the Silt appeared relatively low with some of the Silt soils with a visually high sand content still appearing visibly cohesive in nature.
Foundation Design	Based on the evidence of our works and irrespective of proposed finished levels, a piled foundation solution is recommended for the proposed development. A programme of cable percussive boreholes with appropriate in-situ tests are recommended to assess the deeper ground conditions at the site to assist with the pile design. Advise from a specialist piling contractor should be sought by the Client, to confirm the depths of the piles and the most feasible and cost-effective type of pile to be used at the site. Based on visual observations during the course of our intrusive works, the near surface ground conditions across the site are variable with the presence of both cohesive and granular soils being encountered. This visual variability of the soils has been confirmed by the results of laboratory testing on representative samples with some of the visually cohesive soils being classed as having a medium volume change potential and the visually granular soils being classed as potentially non-shrinkable. The use of traditional shallow foundations (i.e. strips and rafts) within localised areas of the site may be potentially feasible. However, this would be subject to further intrusive works (potentially including plot-specific works) to obtain a greater density of exploratory holes across the site allowing for a more detailed assessment of the ground, which would enable a ground bearing pressure to be calculated. Any further works would need to be supplemented by in-situ field testing, laboratory soil testing and settlement calculations. However, given the presence of very low strength soils from circa 1.2m depth throughout the site, the presence of localised organic soils (and the potential for peat to be present within deeper soils), the presence of disturbed shallow ground around the existing buildings and the historical drainage ditch/small pond within the site, it is considered unlikely that areas of more favourable ground would be present. Therefore, there would be no guarantee that further intrusive works would enable strips, rafts or trench fill foundations to be utilised at the site. It should also be noted that the presence of water is also likely to result in a significantly reduced ground bearing pressure, which may not be sufficient to suit the loading characteristics of the proposed structures. We would note that deeper Made Ground than recorded during our intrusive works may be present in the southeastern extent of the site in the area of the existing buildings (e.g. the residential dwelling and the warehouse) which are proposed to be demolished in due course.
Floor Slab Design	A suspended slab may be adopted, which may be either a cast in-situ reinforced concrete slab or a pre-cast suspended floor with a clear ventilated void (i.e. beam and block). Ground bearing floor slabs should not be used where piled foundations are used in low strength soils due to the increased risk of differential settlement between the floor slab and building structure.

Ground Gas Precautions	Based on the information obtained during the desk study and intrusive site investigation works, no ground gas precautions relating to carbon dioxide or methane are considered to be required at the site.
Radon	No radon precautions are required at the site.
Building Near Trees	Foundation designs may require locally adjusting in accordance with NHBC Standards Chapter 4.2 'Building Near Trees' when building near existing, proposed or recently removed trees / hedgerows. The cohesive soils should be assumed to be of medium volume change potential for design purposes and the natural granular soils have been classified by the laboratory as non-plastic. However, at this stage it is recommended that allowance is made for medium volume change soils to be widespread throughout the site, unless proven otherwise by additional works. It will be the responsibility of the piling contractor to decide whether further plasticity index testing of the deeper soils are required as part of the recommended borehole works to assist with their pile design. It may be necessary to undertake an arborist survey is undertaken to identify the species and heights of the existing trees and hedges within influencing distance of the site, where appropriate.
Water	Based on the ground conditions encountered, excavations in excess of approximately 1.00-1.50m begl may encounter water ingress. Dewatering of excavations is considered more likely at the site if excavations are left open for a period of time (i.e. prior to the pouring of concrete and / or laying of drainage materials, for example) as water (held within the surrounding low permeability soils) will gradually seep / ingress into open excavations after relatively short periods. Excavations are also prone to instability. The low permeability soils at the site are also susceptible to standing water following periods of wet weather, which will increase the likelihood of needing to dewater. Whilst there may be no initial evidence of water seepage / ingress within the trial pits immediately upon completion of excavation, water eventually finds its way into the pits if they are left open for several minutes. We would note that groundwater levels may vary due to seasonal or other effects. Excavations within shallow soils may be susceptible to standing water following periods of wet weather.
Excavations / Stability	The trial pits and soakaways pits were initially generally stable but the sides became unstable when excavating generally beyond approximately 2.00m begl. This instability of the pit sides typically occurred below the depths where the water seepages were noted within natural Sand soils. In all the trial pits (28No.) and 1No. soakaway pit (SA4), this resulted in collapse of the pit sides. Due to the nature of the ground it is considered likely that instability and collapse of shallow foundations could occur when left open or when exposed to wet weather conditions. Casing was used during the drilling of the majority of the window sample boreholes (to depths of between 1m and 3m begl) as a precautionary measure. In view of the above, excavations during the proposed development works may require trench support, including for health and safety reasons. The assessment of excavations and provision of support will be the responsibility of the contractor on site. The natural soils are likely to be subject to deterioration and softening if excavations are left open and exposed to wet weather. Any softened soils should be removed from excavations prior to the pouring of concrete and foundation construction.
Sulphate Classification	Design Class DS-1/ACEC Class AC-1s. (BRE Spec. Digest 1:2005).
Coal Mining	No coal mining precautions or associated investigation works are required.
CBRs	The remoulded soaked CBR testing has revealed CBR values for the Natural Strata typically ranging between 0.2% and 0.9%, with a single result of 1.5%. These results are considered typical for the type of shallow soils encountered on site. No frost susceptible material should be within 450mm of the ground surface in road construction. The test results, together with consideration of the ground conditions encountered and described in this report, should be used by a Highways Design Engineer to determine the long term equilibrium CBR value appropriate for design purposes. In-situ testing along the line of proposed roads should be carried out to confirm pavement design parameters.
Surface Water Drainage	The in-situ testing undertaken has revealed that traditional soakaways are considered not suitable for the site. The use of alternative shallow SUDS features may be suitable subject to further targeted testing. The Client's drainage Engineer should carefully consider the infiltration rate in relation to the drainage options for the site and should also consider the results in relation to the potential suitability for a permeable paving design, if required.
ENVIRONMENTAL CONSIDERATIONS	
Contamination Assessment	Human Health Based on the preliminary chemical contamination assessment undertaken, the soils at the site which comprised Made Ground, Topsoil and the Natural Strata may generally be considered to be uncontaminated for the proposed residential with plant uptake end-use.

	It should be noted that only two contamination tests were undertaken on the topsoil across the site (for approximately in excess of 40,000m^3 of Topsoil present on site). Therefore additional contamination testing should be undertaken of the topsoil to provide further assurance on the chemical suitability of the topsoil. Controlled Waters Given the low contaminant concentrations revealed by the testing undertaken, there are considered to be no specific risks posed to Controlled Waters by the findings of the laboratory analysis undertaken.
Remediation Proposals	Human Health No widespread specific remediation works will be required at the site. The provision of topsoil is considered necessary in proposed gardens and the area of public open space to provide a suitable growing media for plants and the existing topsoil on site is considered suitable for re-use within future development (subject to confirmatory testing). It may be necessary to increase the thickness of topsoil around the root balls of trees to suit the proposed planting regime. The physical suitability of the existing topsoil should be assessed by the developer. Whilst the existing topsoil is considered uncontaminated and suitable for re-use from a human health protection perspective, in the unlikely event that there is a requirement to import additional quantities of topsoil to the site, it will be necessary to test the topsoil at source to ensure it is suitably clean (prior to importation) in accordance with CLEA / generic guidance. Additional topsoil testing should be undertaken to provide further assurance on the chemical suitability of the topsoil due to the significant volume of topsoil present at the site. Any imported topsoil should also conform to BS3882: 2015 'Specification for topsoil', with respect to the presence of foreign objects, and ideally nutrient levels etc. The results of the chemical analysis on topsoil proposed for importation should be forwarded to the Local Authority (Environmental Health Officer) for approval (prior to importation). Similarly, if soils are proposed to be imported as part of the raising of site levels and are to be placed in proposed gardens and / or the area of public open space, it will be necessary to test the soils at source to ensure they are suitably clean (prior to importation) in accordance with CLEA / generic guidance. The results of the chemical analysis on soils proposed for importation should be forwarded to the Local Authority (Environmental Health Officer) for approval (prior to importation). Any soils brought onto site that are placed in gardens and / or the area of public open space that have not been tested at source may need to be subject to post-placement testing, subject to the requirements of the Local Authority (Environmental Health Officer) in accordance with the National Contaminated Land Officers Group (NCLOG) document entitled 'A Regulator's Guide to Cover Systems and their Verification' (2024).In the event of removing the concrete hardstanding beneath the former suspected above ground storage tank, careful observations should be undertaken on the soils beneath to identify any evidence of hydrocarbon contamination presence within the soils. If any evidence of impacted hydrocarbons soils are identified, the soils will required removing, with validation testing of the excavation sides and base (where physically practical to do so) should be undertaken in order to demonstrate that the in-situ soils do not contain contaminants in excess of appropriate screening values. All soils should be placed on hardstanding or an impermeable sheet prior to disposal. Once validation samples confirm that the remaining soils at the sides and base of excavation are chemically suitable with respect to hydrocarbon, the excavation may be infilled with inert granular fill materials. Controlled Waters No specific remediation in relation to Controlled Waters is considered to be necessary at the site.
Off Site Disposal & Waste Acceptance Criteria Testing	Excess uncontaminated soils (for example the Topsoil and the underlying Natural Strata) should be regarded as a potential asset and we would recommend that the re-use of excess uncontaminated soils on site or off-site is investigated in the first instance (subject to appropriate permits, plans and registrations etc). The Topsoil and the Natural Strata may be regarded as suitable for re-use within proposed garden areas as subsoil (to raise levels, as appropriate) or for landscaping / capping on alternative developments (subject to regulatory approval and the production of any necessary plans or permits) where surplus arisings are generated from the site and adequate control measures are in place. Should off-site disposal be required, the chemical testing regime can be different to the chemical testing required to assess the suitability of the soils for retention on site and the risks to human health and Controlled Waters. Therefore, Waste Acceptance Criteria (WAC) testing may be required to confirm disposal costs. It is recommended that, in the first instance, the soil test results (total concentrations) obtained for the soils proposed to be disposed of at landfill, are issued to the selected / preferred landfill operator(s) / waste disposal contractor for initial appraisal and formal classification purposes prior to removal.
GENERAL CONSIDERATIONS	
Construction Workers	It is recommended that construction personnel involved with direct contact with the soils at the site use appropriate PPE / RPE equipment together with hygiene facilities in accordance with general health and safety guidelines.

	The chosen Contractor should undertake the necessary Risk Assessments and Method Statements (RAMS) to determine the most appropriate protection required for safe working practices at the site. Appropriate consideration (by a suitably trained qualified professional) should be given to health and safety procedures for personnel working in asbestos contaminated soils, where encountered in the central western portion of the site. The requirement for RPE and other protective measures should be confirmed following the outcome of a risk assessment relating to asbestos.
Asbestos Survey & Demolition Rubble	It is recommended that a suitable asbestos survey is undertaken on all site buildings prior to demolition. Any ACMs encountered should be removed off-site by a suitably qualified contractor prior to redevelopment. The demolition rubble generated from the existing buildings may be suitable for use to raise levels (if necessary), subject to confirmatory testing.
Utilities	Prior to development of the site, we would recommend that a copy of this report is supplied to utility companies, and that their recommendations relating to appropriate supply pipes are adhered to. Based on the results of the soil sampling to enable an initial assessment of the likely requirements for the composition of the water supply pipework, all contaminant concentrations are below the PE threshold and the use of protective / barrier water supply pipes is considered not necessary.
Unforeseen Circumstances	Should any areas of potentially contaminated soil be encountered during site construction works we would recommend consultation with GeoDyne to ensure that our recommendations continue to apply.
Licenses etc	The Contractor/Developer is responsible for, and must ensure that, all necessary licenses, permits, plans, registrations and approvals are in place prior to commencing with the construction works at the site.
Statutory Consultation	In accordance with normal planning requirements, we would recommend that a copy of our report is issued by the Client to the Local Authority (and NHBC or other Warranty Provider, if necessary) for review / comment and approval prior to commencing with the development of the site.
Further Works	Based on the findings of the investigation to date, it is recommended that the following further works are undertaken at the site: • Undertaken further topsoil contamination testing to provide further assurance on the chemical suitability of the topsoil due to the significant volume (approximately 40,000m^3) of topsoil present at the site. • Potentially undertake plot-specific works to obtain a greater density of exploratory holes across the site allowing a more detailed assessment of the ground, which would enable a ground bearing pressure to be calculated. Any further works would need to be supplemented by in-situ field testing, laboratory soil testing and settlement calculations. However, there are no guarantees that further intrusive works would enable strips, rafts or trench fill foundations to be utilised at the site.

1.0 INTRODUCTION

1.1 Introduction

GeoDyne Limited has been appointed by the Client, Seagate Homes, to undertake a combined Phase I Desk Study & Phase II Exploratory Investigation on a parcel of land to the west of Monks House Lane, Spalding. A site location plan (Figure No. D44118/01) is included in Appendix I.

1.2 Project Understanding

We understand that it is proposed to demolish the existing buildings in the southeastern portion of the site and develop the entire site with low-rise residential properties with associated private gardens. There are 3No. attenuation basins also proposed for the central, northwestern and southwestern areas of the site. A proposed site layout, provided by the client, is presented in Appendix II of this report.

The foregoing understanding has formed the basis of our assessment. Where the proposed site end-use is not consistent with our current understanding, it would be necessary to review our assessment to ensure it continues to apply.

1.3 Objectives

The scope of works detailed herein have been designed to ascertain the key geotechnical and environmental issues pertaining to the proposed development.

1.4 Scope of Works

Based on the defined objectives of the works (detailed in Section 1.3), the scope of the Phase I Desk Study included the following:

- A site walkover.
- Review of available historical and contemporary Ordnance Survey publications relating to the site.
- Review of the sites geology, hydrology, hydrogeology and groundwater vulnerability.
- Review of the sites coal mining status.
- Review of the sites radon status.
- Commission of a full detailed Landmark Envirocheck Report relating to the site.
- Commission of Landmark geological mapping data.
- Initial consideration of unexploded bomb risk (by Zetica Bomb Risk Map).
- Production of a preliminary Conceptual Site Model (pCSM).

Phase II Exploratory Investigation works comprised:

- A sub-contracted sub-surface utility scan.
- A series of trial pits and window sampling boreholes within accessible areas of the site to provide an initial inspection of the near surface ground conditions for geotechnical and environmental purposes.
- Preliminary in-situ soakaway testing.
- Geotechnical and environmental soil testing.
- Revision of the pCSM.

1.5 Limitations

The conclusions and recommendations made in this report are limited to those that can be made based on the findings of the investigation. Where comments are made based on information obtained from third parties, GeoDyne Limited assumes that all third-party information is true and correct. No independent action has been undertaken to validate the findings of third parties.

This report has been prepared in accordance with our understanding of current good practice. However, changes to good practice, guidance or legislation may necessitate revision of this report after the date of issue.

GeoDyne Limited has prepared this report for the sole use and reliance of Seagate Homes, in accordance with our standard Conditions & Limitations (included in Appendix XV). This report may not be used or relied upon by any unauthorised third party without the explicit written agreement of GeoDyne Limited. Reliance may not be placed on our report until all invoices associated with the project have been paid.

2.0 SITE DESCRIPTION & HISTORY

2.1 Site Description

The site comprises a parcel of land located to the west of Monks House Lane, Spalding located around approximate Ordnance Survey National Grid reference 522850E, 322400N. The site covers an area of approximately 14.64 hectares.

At the time of our site visit, access onto the site was gained via a concrete surfaced roadway off Monks House Lane within the southeastern extent of the site. There are two derelict residential dwellings and a derelict warehouse building present within the southeastern extent of the site.

The concrete hardstanding extends from the entrance along the southern side of the warehouse building, extending southwards towards the open field and eastwards towards the dwellings. Macadam surfacing was present between the warehouse building and the dwellings.

On the southwestern corner of the warehouse building, a circular outline was present on the concrete hardstanding suggesting they may have been an above ground storage tank recently. However there was no visual evidence of hydrocarbon leakages on the immediate concrete hardstanding.

The remaining area of the site comprises open agricultural fields with a drainage ditch present in the southern extent of the site trending east-west together with drainage ditches present along the northern and western boundaries of the site.

There were overgrown hedges present along the eastern boundary in the southeastern extent of the site together with sporadic trees and overgrown hedges along the northern boundary.

The Annotated Site Plan in Appendix III of this report (Figure No. D44118/02) shows the main features of the site and immediate surrounding area. General views of the site are included on the plans in Appendix IV of this report (Figure Nos. D44118/03 and D44118/07).

An aerial photograph of the site, obtained from the Landmark Analysis tool commissioned as part of our works, is presented in Figure 1 on the next page, with the current OS mapping plan for the site and surrounding area presented in Figure 2. The site boundary is delineated in red.

Figure 1: Aerial photograph of the site (2025 image).

2.2 Site History

The historical and contemporary Ordnance Survey publications included within the Landmark Envirocheck Report have been reviewed by GeoDyne to establish the history of the site and its environmental setting. The historical Ordnance Survey maps are included as Appendix V of this report.

We would note that the boundary marked on the historical sheets within the Envirocheck Report appears to 'shift' on several of the maps due to scaling inaccuracies between maps of differing dates. This is a function of Envirocheck transposition algorithms.

The key findings of the historical search are summarised in Table 1.

TABLE 1 – HISTORICAL PUBLICATION DATA

Date	Features on Site	Features off Site
1880s	• The site comprises undeveloped fields. • A small structure is present in the sites southeastern extent. • There are drainage ditches present on site. One is located within the northern extent trending east-west. Another three are located in the southern extents of the site, one of which trending east-west extending beyond the sites western boundary. The other two connect to this one along the western and eastern boundaries, with both extending beyond the site southern boundary.	• Monks House Lane is present along the eastern boundary trending north-south. • A large drainage ditch is present along the sites northern boundary. • Another drainage ditch is present along the sites western boundary which connect to another drainage ditch immediately west of the site, which flows away from the site towards the west. • Monks House is shown to be present approximately 50m southeast of the site. • A strip of land with abundant trees and labelled as '*Ash Holt*' is shown approximately 50m west of the site.

TABLE 1 – HISTORICAL PUBLICATION DATA		
Date	**Features on Site**	**Features off Site**
	• A very small pond is located within the southeastern extent of the site adjacent the drainage ditch. • There are sporadic trees present predominantly along small sections of the drainage ditches.	• A small pond is located approximately 90m east of the site. • A pump is shown to be present approximately 110m southeast of the site. • '*Bourn Road*' (later spelt as '*Bourne Road*') is shown approximately 220m south of the site, trending east to west, with the junction on to '*Monks House Lane*' located approximately 210m south of the site.
1890s	• No maps available for viewing.	• No maps available for viewing.
1900s	• The small structure in the southeastern extent is no longer present. • A small section of the drainage ditch within the southeastern extent of the site has been infilled. • There are no trees present on site.	• The surrounding area remains essentially unchanged.
1910s	• No maps available for viewing.	• No maps available for viewing.
1920s	• No maps available for viewing.	• No maps available for viewing.
1930s	• The drainage ditch in the northern half together with the drainage ditches located along the western and eastern boundaries are no longer shown. • A track is present running along the northern edge of the drainage ditch in the southern extent to the eastern boundary of the site. • A small rectangular building is present in the southeastern extent of the site.	• The open fields to the sites immediately southwest are shown to have trees growing in a grid system. • The small pond to the sites east has increased in size. • There are Nurseries present approximately 20m east and 230m southeast of the site. • There are allotment gardens shown approximately 150m east and 250m south of the site.
1940s	• No maps available for viewing.	• No maps available for viewing.
1950s	• Two structures (likely to correspond to the dwellings and warehouse buildings) have been constructed in the sites southeastern extent of the site, north-northwest of the existing small structure.	• The surrounding area remains essentially unchanged.
1960s	• Additional structures have been developed in the southeastern extent of the site, with two small structures adjacent the existing small structure. • A small section of the drainage ditch in the southern extent has been infilled/culverted to provide access to two of the small structures. • Two rectangular structures to the immediate west of the warehouse building and north of the dwellings are labelled as a Nursery.	• A '*Playing Field*' is located approximately 20m east of the site. • Residential development has taken place approximately 20m east of the site and extending beyond. • A number of interconnecting small structures have been developed approximately 80m to120m north of the site and labelled as *'Nimmerdor Nurseries*'. • The pump to the sites southeast is no longer shown.
1970s	• The site remains essentially unchanged.	• The open fields growing trees to the sites southwest have halved in size with the closest edge being approximately 50m south of the site.
1980s	• Two of the small structures in the sites southeastern extent have been redeveloped with two structures replacing them. • The drainage ditch has been further infilled/culverted providing space for one of the small structures.	• The track has been extended along the eastern boundary of the site and exits in the southwestern corner of the site.

TABLE 1 – HISTORICAL PUBLICATION DATA		
Date	**Features on Site**	**Features off Site**
	• Two '*Movable Greenhouses'* have been constructed in the southeastern corner of the site which extend beyond the southern boundary. • Hard standing is present between the small structures and greenhouse buildings.	• '*Nimmerdor Nurseries*' has been further developed with the construction of two rectangular building approximately 20m north of the site. However, several small structures have been removed from approximately 120m north of the site. • Further residential development has taken place approximately 30m north and 50m east/northeast of the site. • The allotment garden to the sites east has been redeveloped into residential dwellings. • The pond to the sites east is no longer shown, suggesting it may have been infilled. • The open fields to the sites southeast are no longer shown to grow trees.
1990s	• The site remains essentially unchanged.	• A large rectangular structure has been built within the '*Nimmerdor Nurseries*' replacing the two rectangular buildings. • Th strip of land known as '*Ash Holt*' is no longer shown. • Further residential development has taken place approximately 30m east/southeast of the site. • The nursey to the sites east/northeast has been redeveloped into residential dwellings.
1999 Aerial Photography	• One of the '*Moveable Greenhouses*' is no longer present with the other one reduced to approximately 20% of its original size.	• The surrounding area remains essentially unchanged.
2000	• The site remains essentially unchanged.	• The nursey to the sites southeast has been redeveloped into residential dwellings.
2006	• The '*Moveable Greenhouse*' and the Nursey buildings are no longer shown to be present. • One of the small structures has reduced in size.	• '*Monks House Lane*' has been extended further north.
2024	• Two of the small structures are no longer present with one being replaced by a small square structure.	• A significant residential development has taken placed approximately between 200m and 1150m northeast.

2.3 Historic Aerial Photography

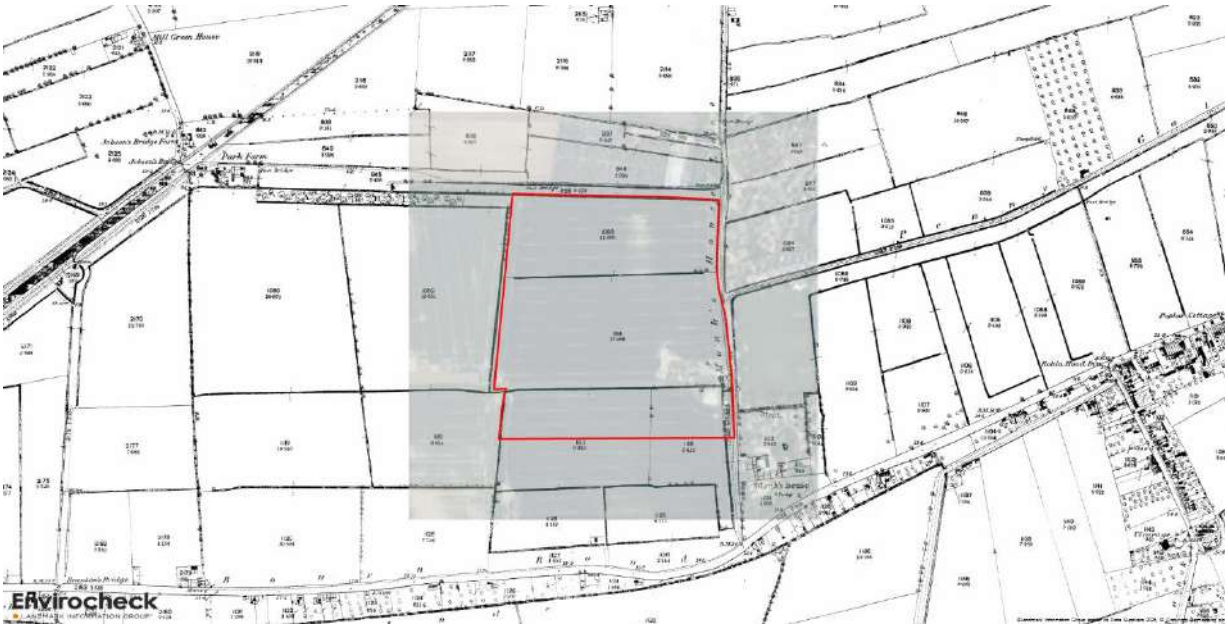
GeoDyne has managed to review historical aerial photographs from available online sources. An aerial image of the site in 2020 shows an aboveground storage tank immediately adjacent the warehouse southwestern corner. This was further evidenced during our walkover with a circular outline was present on the concrete hardstanding. It is not known whether this was for heating oil or water but there was no visual evidence of hydrocarbon leakages on the immediate concrete hardstanding.

2.4 Aerial Photography & Historical Map Overlays

As part of the commissioned Landmark report, the use of the Landmark Envirocheck Analysis tool was purchased to provide site specific aerial photographic imagery, and to provide the ability to undertake limited historical map overlay manipulation.

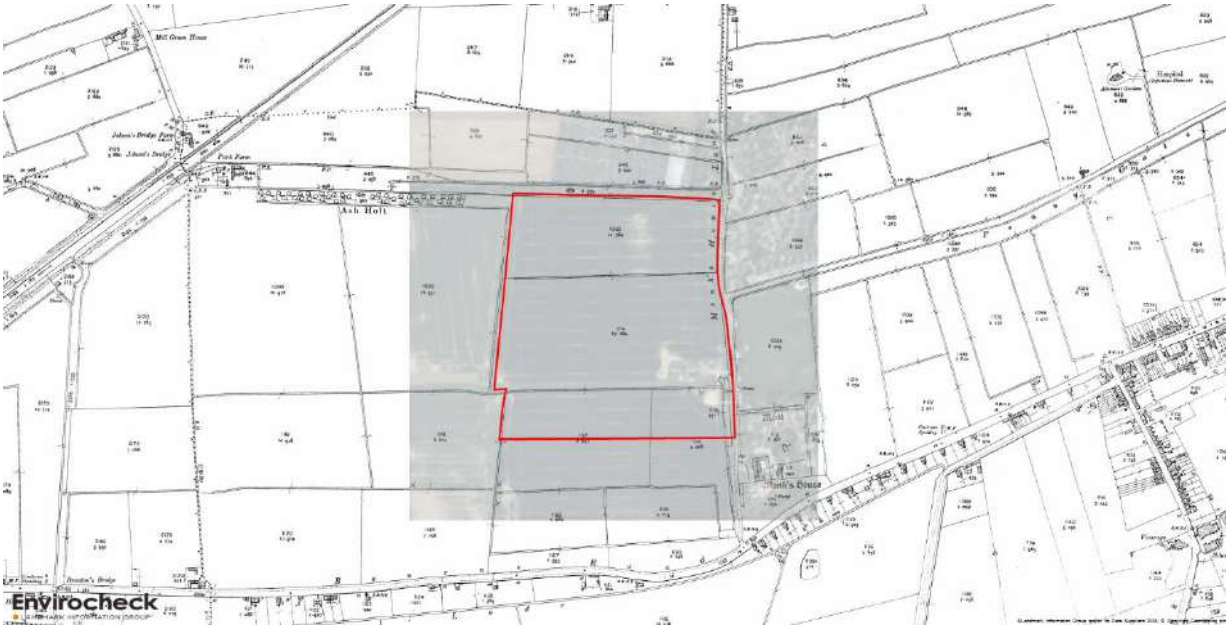
The following pictures (Figures 2, 3, 4, 5, 6 and 7) show overlays of the historical map publications from 1888-1889, 1904, 1931-1932, 1968-1969, 1982 and 2006, as shown on current aerial imagery.

Figure 2: Current Aerial Imagery Overlain with 1888-1889 Historical Map Data



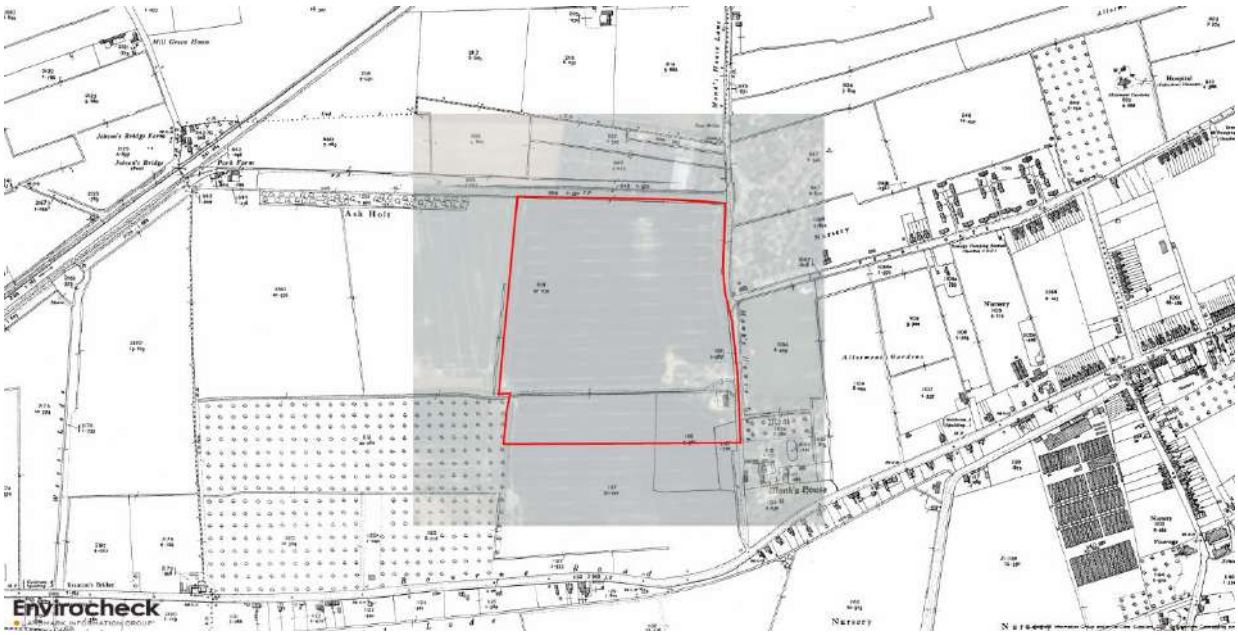
The site comprises part of an undeveloped fields. A small structure is present in the southeastern extent of the site.

Figure 3: Current Aerial Imagery Overlain with 1906 Historical Map Data.



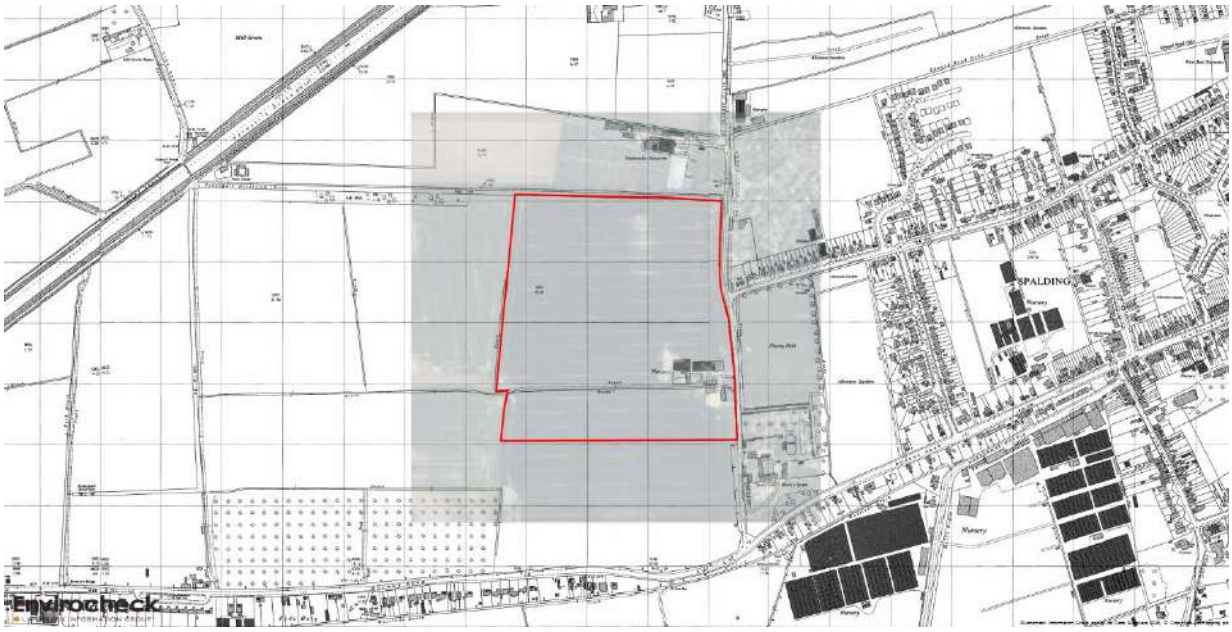
The small structure within the southeastern extent of the site is no longer present (presumably demolished).

Figure 4: Current Aerial Imagery Overlain with 1931-1932 Historical Map Data.



A small rectangular building is present in the southeastern extent of the site. Several drainage ditches located in the northern, southwest and southeast parts of the site are no longer shown. A track is present running along the northern edge of the drainage ditch in the southern extent.

Figure 5: Current Aerial Imagery Overlain with 1968-1969 Historical Map Data.

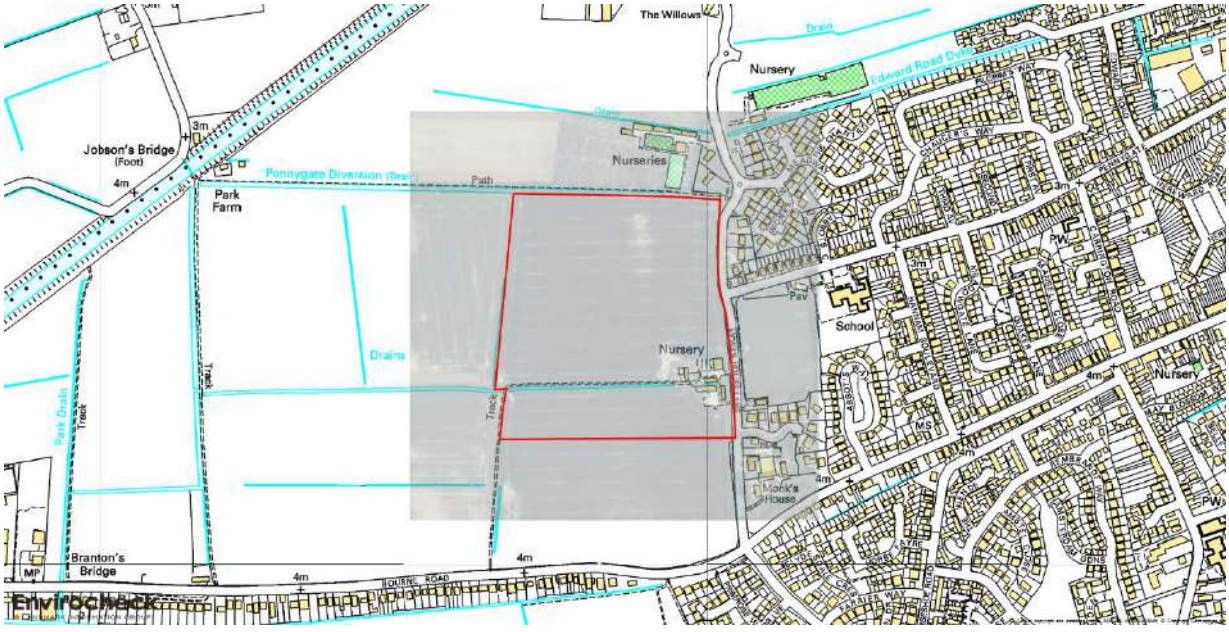


Further development has taken place in the southeastern extent of the site with the construction of residential dwellings, the warehouse building, nursey buildings and some additional small structures. A small section of the drainage ditches in the southeastern area has been infilled/culverted to provide access to some of the small structures.

Figure 6: Current Aerial Imagery Overlain with 1982 Historical Map Data.

Two large rectangular moveable greenhouses have been constructed in the southeastern extent of the site extending beyond the sites south boundary.

Figure 7: Current Aerial Imagery Overlain with 2006 10K Raster Map Data.



The moveable greenhouses and the nursey buildings are no longer present.

3.0 GEOLOGY & ENVIRONMENTAL SETTING

3.1 Geological References

The following geological publications were referred to:

- BGS 1:50000 Series Sheet 144 *'Spalding'* Solid and Drift Edition (1992).
- Landmark geological map sheets (included in Appendix VI).
- The BGS online interactive map viewer and Lexicon of Named Rock Units.
- The Coal Authority online interactive map viewer.
- Environment Agency website: www.environment-agency.gov.uk.

3.2 Geology

Superficial Drift Deposits

The site is indicated to be directly underlain by drift deposits comprising Tidal Flat Deposits, dated from the Quaternary period. The BGS Online Lexicon describes the Tidal Flat Deposits as follows: '*Tidal flat deposits, including mud flat and sand flat deposits, form extensive nearly horizontal marshy land in the intertidal zone that is alternately covered and uncovered by the rise and fall of the tide. They consist of unconsolidated sediment, mainly mud and/or sand. They may form the top surface of a deltaic deposit*'.

We would note that superficial deposits have the potential to alter rapidly in character and geotechnical properties both laterally and vertically over relatively short distances and may also be water bearing. Localised peat may also be present within these soils.

Bedrock Geology

The bedrock geology underlying the drift deposits across the site, is indicated to comprise the Oxford Clay Formation. The BSG Online Lexicon describes the Oxford Clay formation as comprising '*Silicate-mudstone, grey, generally smooth to slightly silty, with sporadic beds of argillaceous limestone nodules. Over most of the outcrop (except the Cleveland Basin, where only the upper part is present) it comprises a tripartite succession: lower part (Peterborough Member) silicate-mudstone, mainly brownish-grey, fissile, organic-rich ("bituminous"), with subordinate beds of pale to medium grey, blocky mudstone; middle part (Stewartby Member) silicate-mudstone, mainly pale to medium grey, smooth to slightly silty, blocky, with subordinate beds of silty shell-debris-rich mudstone; upper part (Weymouth Member) mudstone, mainly pale grey, calcareous, smooth, blocky*'.

3.3 Faults

No surface faults are indicated to be present within the boundary of the site or within the immediate vicinity of the site, on the geological maps viewed.

3.4 Man-Made Deposits

The geological publications do not show the presence of any man-made deposits (i.e. Made Ground, Worked Ground or Landscaped Ground) beneath or within likely potential influencing distance of the site.

3.5 Coal Mining Report

The site does not lie within an area requiring the commission of a coal mining report in accordance with The Coal Authority online interactive map viewer. No specific investigation or mitigation in relation to historical coal mining issues is therefore considered to be necessary at the site.

3.6 Unexploded Ordnance Risk

An initial Unexploded Bomb Risk Map search has been commissioned through Zetica UXO. The map (presented in Appendix VII of this report) indicates that the site is within a 'Low' risk area with regards to unexploded ordnance.

We would recommend that a detailed UXO desk study is undertaken prior to any enabling or construction works are undertaken.

3.7 Landmark Envirocheck Report

A Landmark Envirocheck report was commissioned to assist in ascertaining the environmental setting of the site. The full Envirocheck report is presented in Appendix VIII and has revealed the following key relevant information (details are only listed where they are within potential influencing distance , i.e. <250m, of the site).

A Landmark Mining and Ground Stability report was commissioned to expand on the data included within the Enviocheck report and is also presented within Appendix VIII.

3.7.1 Agency and Hydrological

Surface Water Features

The nearest surface water feature is indicated to be a drainage ditch onsite with another two drainage ditches present along the northern and western boundaries of the site.

Aquifer Status

The aquifer designation maps are presented in Appendix VIII and are based on geological mapping provided to Landmark by the British Geological Survey. Different aquifer classifications may be applied to superficial (drift) deposits (typically forming shallow perched groundwater units where present) and bedrock aquifers (which may contain regional groundwater units). Possible aquifer designations comprise Principal Aquifers, Secondary (A, B or Undifferentiated) Aquifers and Unproductive Strata.

The drift deposits of the Tidal Flat Deposits and the bedrock (Oxford Clay Formation) are both indicated to be designated as Unproductive Strata. Unproductive Strata are described by the Environment Agency as *'These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.'.*

Groundwater Vulnerability

The Groundwater Vulnerability map is presented in Appendix VIII and is based on data supplied by the Environment Agency.

The Groundwater Vulnerability map confirms that the combined superficial and bedrock Aquifer beneath the site is of being an '*Unproductive Aquifer*' with respect to flow through well connected fractures. The pollutant speed is indicated to be '*High*'. The thickness of superficial strata is indicated to be greater than 10m.

Source Protection Zone Status

The site is not shown to lie within a Source Protection Zone (SPZ), as designated by the Environment Agency. SPZs relate to the protection of groundwater resources principally for public drinking water supply.

Flood Risk Status

The site is located in an area at risk of extreme flooding from rivers or seas without defences.

The site is not indicated within an area affect by groundwater flooding.

The Landmark report indicates small areas within the eastern section of the site to be at low (1000 a year) risk of flooding from surface water (i.e. surface rainwater that does not readily drain via the drainage system or infiltrate into the ground).

The report does not constitute a flood risk assessment.

Water Abstractions

There are no Water Abstraction entries identified within a 250m radius of the site, in the Landmark report.

Pollution Incidents to Controlled Waters

There are 3No. entries (2No. Category 2 (Significant) and 1No. Category 3 (Minor)) in relation to pollution to controlled waters within a 250m radius of the site, in the Landmark report. All three incidents relate to an unknown pollutant into freshwater stream/river located 155m southeast, 189m southeast and 215m southeast.

Discharge Consents

There are 3No. entries in relation to discharge consent within a 250m radius of the site, in the Landmark report. The closest entry relates to sewage discharges (Domestic Property) into Land/Soakaway 102m southeast of the site.

Another entry relates to sewage discharges into freshwater/river (i.e. Tributary of River Glen) 188m southeast of the site.

The last entry relates to an unknown discharge into Land/Soakaway 190m southeast of the site.

3.7.2 Waste

Landfill Sites

There are no waste sites (i.e. current or historic landfill, waste transfer stations) identified on the site, or within a 250m radius of the site, in the Envirocheck report.

Potentially Infilled Land

There are 7No. entries relating to Potentially Infilled Land (Water) located between 7m and 221m to the sites northeast and east, dated either 1906 or 1938. Following a review of historical mapping, these features may correspond to historic small ponds.

3.7.3 Hazardous Substances

There are no sites associated with hazardous substances (i.e. sites dealing with explosives etc.) identified on the site, or within a 250m radius of the site, in the Envirocheck report.

3.7.4 Geological Issues

BGS Soil Chemistry

The BGS has prepared estimated soil concentration maps for several metals (including Arsenic, Lead, Nickel, Chromium and Cadmium), which are extrapolated from records available for use within their assessments.

Whilst potentially useful for the inference of Natural Metal Enrichment (NME) of the natural soils in a general locale, the data should not be used to inform any detailed decisions with regards to the chemistry of a particular site as it does not allow for anthropogenic effects. Estimates of the soil chemistry at the site indicate anticipated concentrations of Arsenic of <15mg/kg, Cadmium of <1.8mg/kg, Chromium of 60-90mg/kg, Lead <100mg/kg and Nickel of 15-30mg/kg.

Based on the information supplied in the Landmark Envirocheck Report, the site is indicated to be located in an area where significant NME of the underlying natural soils is not anticipated to be present. However, this is only applicable to the specific determinands listed above.

Coal Mining Affected Areas

The Landmark report reveals the site is not located within a coal mining affected area.

BGS Recorded Mineral Sites

There are no BGS recorded mineral sites indicated within the Landmark report.

Radon

The Envirocheck report states that '*The property is in a lower probability radon area (less than 1% of homes are estimated to be at or above the action level*'. The report further states that '*No radon protective measures are necessary in the construction of new dwellings or extensions'*. No specific mitigation in relation to radon issues are therefore required at the site.

BGS Borehole Records

There are 4No. BGS borehole records within a 250m radius of the site in the Landmark report. The closest 3No. records (TF22SW213, TF22SW214 and TF22SW215) contained the following ground conditions encountered:

- Stiff to firm dark brown silty CLAY to depths between 0.02m and 0.20m.
- Dark brown sandy clayey TOPSOIL to a depth of 0.40m.
- Stiff light grey to light brown sandy CLAY to depths between 0.50m and 0.90m.
- Firm pale grey, brown silty CLAY to a depth of 0.80m.
- Soft pale buff brown greyish SILT to a depth of 1.50m (not fully proven).
- Light brown to light grey SILT to depths between 1.40m and 1.70m (not fully proven).
- Soft to firm light brown, orange, reddish sandy SILT to a depth of 1.60m (not fully proven).

3.7.5 Landmark Mining and Ground Stability Report

A Landmark Mining and Ground Stability report was commissioned to expand on the data included within the Landmark report and is also present within Appendix VIII.

Extractive Industrial or Potential Excavations

There is 1No. entry relating to off-site extractive industries or potential excavations within a 250m radius of the site within the Landmark report. The entry relates to a pond located 82m southeast of the site and dated 1968.

Ground Stability Hazards

There is a 'Moderate' risk compressible and running sand ground stability hazards and a '*Low*' risk of shrinking or swelling clay ground stability hazards indicated across the site. The remaining ground stability hazards identified by the Landmark report that to the site (which include collapsible, ground dissolution and landslide ground stability hazards) are indicated to be either '*No Hazard*' or '*Very Low*'.

3.7.6 Industrial Land Use

Contemporary Trade Directory Entries & Points of Interest

The Landmark report indicates there are 4No. Contemporary Trade Entries and 5No. Points of Interest identified within a 250m radius of the site.

The Landmark report identifies Contemporary Trade Entries relating to car body repairs, commercial cleaning services, garage services and road haulage services located between 176m and 242m southeast, northeast and south of the site with all their status being inactive.

The Points of Interest relate to 3No. Commercial Services entries (i.e. vehicle repair, testing and servicing and distribution/haulage between 176m and 242m southeast and south) and 2No. Recreational and Environmental entries (i.e. Playgrounds located 76m east).

None of the above referenced features are considered to potentially impact on the site or the development proposals.

3.7.7 Sensitive Land Use

The site and immediate surrounding area are identified as being within a Nitrate Vulnerable Zone.

3.8 Land Use Assessment

As part of the land use assessment, reference has been made to the *'Desk Reference Guide to potentially Contaminative Land Uses'* produced by Mr P Syms and published jointly by the ISVA (The professional Society for Valuers and Auctioneers) in association with The Royal Institution of Chartered Surveyors (RICS) and the Chartered Institute of Environmental Health (CIEH).

We have also made reference to the Department for Environment, Food and Rural Affairs and the Environment Agency Contaminated Land Report CLR8 '*Potential Contaminants for the Assessment of Land*' (March 2002). Although now formally withdrawn, this document identifies key contaminants which may potentially be present at a site as a result of a given historical land use and is considered useful as a desk based ready reference guide.

3.8.1 On Site Assessment

At the time of our works, two derelict residential dwellings with associated overgrown gardens together with a derelict warehouse building were present within the southeastern portion of the site. To the immediate east of the dwellings and south of the warehouse building, concrete hardstanding was present. The remainder of the site comprised open arable fields.

Historically, the site comprised predominantly undeveloped fields with small structures present within the southeastern extent of the site on the earliest historical maps (i.e. 1880s). Between 1930s and 1980s, the sites southeastern extent underwent various redevelopments including the construction of the residential dwellings, warehouse, small structures and greenhouses. However by the early 2000s the small structures and greenhouses had been demolished. An suspected above ground storage tank has historically been present adjacent the warehouse southwestern corner. The site has remained unchanged since.

The geological publications indicate the site is directly underlain by superficial Tidal Flat Deposits. Bedrock geology comprising the Oxford Clay Formation underlies the superficial deposits beneath the site. Both the superficial deposits and the bedrock geology have been classified as unproductive aquifers.

Based on the desk study enquiries, no radon protective measures are necessary in the construction of new dwellings and/or extensions. In addition, no significant on-site sources of potentially hazardous ground gases have been identified.

Based on the information obtained from the desk study and our walkover of the site, potential contamination that may be present could include:

- Metals or metalloids associated with any potential Made Ground beneath the site.
- Polycyclic Aromatic Hydrocarbons (PAHs) from any ashy inclusions and/or carbonaceous inclusions in the near surface soils.
- Hydrocarbons (TPHs) associated with the above ground storage tank adjacent warehouse building.
- Pesticides associated with growing produce within the arable fields.
- Asbestos potentially within any Made Ground potentially associated with former structures.

3.8.2 Off Site Assessment

Based on the information obtained from our desk study works, no off-site sources of potentially significant chemical contamination have been identified.

The surrounding area of the site has historically been open arable fields with multiple drainage ditches present. Since the earliest historically maps (i.e. 1880s) there has been steady development (predominantly residential but has included allotment and nurseries) taken place since the 1930s to the east and southeast of the site.

There appears to be no significant off-site sources of potential hazardous ground gases within potential influencing distance of the site.

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

4.1 General

The DEFRA publication '*Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance*' (dated April 2012) states the following with regards to the production of a Conceptual Site Model (CSM) for a site:

'*The process of risk assessment involves understanding the risks presented by land, and the associated uncertainties. In practice, this understanding is usually developed and communicated in the form of a "conceptual model"*'. The development of a CSM is typically undertaken in an iterative process, reflecting the changes in understanding as more detailed site information becomes available.

In developing a CSM, and specifically in the context of land contamination, consideration needs to be given to three essential elements; which form the basis of any risk present. The statutory guidance sections 3.8 and 3.9 (April 2012) states the following:

(a) '*A "contaminant" is a substance which is in, on or under the land and which has the potential to cause significant harm to a relevant receptor, or to cause significant pollution of controlled waters.*
(b) A "receptor" is something that could be adversely affected by a contaminant, for example a person, an organism, and ecosystem, property, or controlled waters...
(c) A "pathway" is a route by which a receptor is or might be affected by a contaminant.

The term "contaminant linkage" means the relationship between a contaminant, a pathway and a receptor.' For a contaminant linkage to be plausible, all three elements need to be present.

In undertaking a risk assessment and deriving a CSM for the purposes of the redevelopment of a site (i.e. planning and development control) reference has been made to both the Model Procedures for the Management of Land Contamination, as well as the National Planning Policy Framework (NPPF, dated July 2018).

The preliminary CSM should identify the hazards (source of potential contamination) and should set out the potential pollutant linkages with a view to identifying the nature and magnitude of the potential risks to receptors.

In order to undertake the foregoing assessment, consideration is required with respect to the probability or likelihood of the linkage occurring and the severity and significance of the potential consequences; taking account the nature of the pollutant linkage and the potential severity of the hazard and the sensitivity of the receptor within the context of the proposed land use (in consideration of the planning regime).

Consideration of consequence/severity, probability/likelihood and risk has been based on the following guidance documentation:

- CIRIA C552 '*Contaminated Land Risk Assessment, A Guide to Good Practice*', 2001.
- EA R&D publication 66 '*Guidance for the Safe Development of Housing on Land Affected by Contamination*', 2008.

4.2 Classification of Consequences

In order to apply a consequence classification to a particular potential pollutant linkage, it is first necessary to define the terminology used within the classification system. The following terminology and definitions detailed in Table 2 have been adopted within our assessment, based on the guidance referenced in Section 4.1.

TABLE 2 – CLASSIFICATION OF CONSEQUENCES

Classification	Definition
Severe	• Acute risks to human health. • Short-term risk of pollution of controlled waters or significant impact on controlled waters; e.g. large-scale pollution or very high levels of contamination. • Catastrophic damage to buildings or property (such as building explosion causing collapse). • Ecological system effects – immediate risks of major damage which is likely to result in irreversible substantial adverse changes in the functioning of the ecosystem or harm to a species of special interest that endangers the long-term maintenance of the population.
Medium	• Chronic risks to human health. • Pollution of sensitive water resources (such as leaching of contaminants into controlled waters) causing a significant effect on water quality. • Ecological system effects – Immediate risks of significant damage which may result in substantial adverse changes to the ecosystems functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. • Significant damage to buildings, structures and services (for example foundation damage or rendering the building unsuitable for habitation).
Mild	• Non-permanent health effects to human health (i.e. exposure is unlikely to lead to 'significant harm' in the context of Part 2A of the Environmental Protection Act 1990. • Pollution of controlled waters or non-sensitive water resources (for example non-classified groundwater) that results in a short-lived effect to water quality or a marginal effect on amenity value, agriculture or commerce. • Minor damage to buildings, structures and services. • Ecological system effects – Minor or short-term damage which is unlikely to result in substantial adverse changes to the ecosystems functioning or harm to a species of special interest. • Substantial damage to non-sensitive environments (such as arable farmland for example).
Minor	• No measurable effects on human health including non-permanent health effects to human health that are easily preventable by appropriate use of PPE/RPE. • Minor pollution of controlled waters including non-sensitive water resources with no discernible effects on water quality or ecosystems. • Minor damage to non-sensitive environments (including arable farmland for example). • Easily repairable effects of damage to buildings, structures, services or the environment (for example discolouration of concrete, loss of plants in a landscaping scheme etc.).

4.3 Classification of Probability

Once the possibility of a pollutant linkage has been established (noting that probability classification does not apply when there is no possibility of a linkage being present), the probability should be classified in accordance with Table 3.

TABLE 3 – CLASSIFICATION OF PROBABILITY

Classification	Definition	Likelihood
High Likelihood	There is a pollutant linkage and an event is highly likely to occur in the short-term, and is almost inevitable over the long-term OR there is evidence at the receptor of harm or pollution occurring.	>95% likelihood of Consequence Occurring
Likely	There is a pollutant linkage and it is probable that an event will occur. It is not inevitable, but possible in the short-term and likely over the long-term.	50 – 95% likelihood of Consequence Occurring
Low Likelihood	There is a pollutant linkage and circumstances are possible under which an event could occur. It is by no means certain that even over a longer period such an event would take place, and less likely in the short-term.	5 – 49% likelihood of Consequence Occurring

TABLE 3 – CLASSIFICATION OF PROBABILITY		
Classification	**Definition**	**Likelihood**
Unlikely	There is a pollutant linkage and it is improbable that an event would occur even in the very long-term.	<5% likelihood of Consequence Occurring

4.4 Classification of Risk

In order to establish the relevant risk term applicable to the identified pollutant linkage, one of the risk phrases identified within Table 4 must be adopted, with the definitions of each risk term detailed within Table 5.

TABLE 4 – RISK CLASSIFICATION MATRIX (BASED ON C552 CIRIA, 2001)					
		Consequence of Risk			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible or No Potential Risk

TABLE 5 – RISK CLASSIFICATION DEFINITIONS (BASED ON C552 CIRIA, 2001)	
Very High	There is a high probability that severe harm will arise to a designated receptor from an identified hazard OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, there is a low likelihood that such harm would be severe, or if any harm were to occur it is more likely that the harm would be mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Moderate/Low	It is possible that harm could arise to a receptor. However, a combination of likelihood and consequence results in a risk that is above low but is not of sufficient concern to be classified as moderate. It can be driven by cases where there is an acute risk which carries a severe consequence, but where the exposure is unlikely. Such harm would at worst normally be mild. The risk is unlikely to present a substantial liability. Some limited further investigation may be required to clarify the risk and any associated liability. If subsequent remediation works are necessary, they are likely to be limited in extent.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Negligible	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is unlikely to be any worse than mild. No liability would be associated with such risks.
No Potential Risk	There is no potential risk or liability where no pollutant linkage has been established.

4.5 Contaminant [C] - Pathway [P] - Receptor [R] Considerations

The following CPR assessment has been undertaken based on the assumption that it is proposed to demolish the existing buildings in the southeastern portion of the site and develop the entire site with low-rise residential properties with associated private gardens.

4.6 Consideration of Potential Sources of Contamination [C]

Based on the findings of our desk study works, the potential key sources of contamination at the site that would require consideration for the derivation of a preliminary CSM would be the following:

TABLE 6 – SUMMARY OF POTENTIAL CONTAMINANT SOURCES

Areas of Potential Concern (APCs)	Associated Contaminants
Near Surface Soils (including Topsoil and potential Made Ground)	• Metals & Metalloids • PAHs • TPHs • Pesticides • Asbestos

4.7 Consideration of Potential Pathways [P]

The potential pathways at the site are primarily:

- Direct ingestion of soil (either directly or as soil particles attached to produce).
- Inhalation of fugitive dust and vapours.
- Direct skin contact with the ground.
- Direct ingestion of home-grown produce.
- Direct ground contact with construction materials (including supply pipes).
- Vertical and lateral migration of contamination.

4.8 Consideration of Potential Receptors [R]

The potential receptors at the site are:

- The final end users (residents - typically long term (chronic) exposure) and site visitors – (typically short term (acute) exposure).
- The construction personnel (i.e. site workers) involved with the development of the site (typically short term (acute) exposure).
- Neighbouring properties (off-site receptors).
- Controlled Waters (i.e. underlying groundwater and nearby surface waters).
- Buildings and construction materials (including buried utilities).

In preparing this CSM, it has been assumed that construction personnel involved with the development of the site (typically short term (acute) exposure) will adopt all necessary personal protective equipment (PPE and RPE etc.) and conform to health and safety requirements of their site-specific Risk Assessments and Method Statements (RAMS). Site workers have therefore not been included within the following table, as the adoption of these appropriate mitigation measures will result in an overall low risk of exposure to the C-P-R linkages identified.

4.9 Preliminary Risk Assessment / Conceptual Site Model

Our preliminary conceptual model of possible pollutant linkages, applicable to the proposed site usage and based on our current understanding, is summarised in Table 7.

TABLE 7 – PRELIMINARY RISK ASSESSMENT SUMMARY TABLE
DESK STUDY

Potential Contaminant Source [C]	Potential Pathway(s) [P]	Potential Receptor [R]	Probability of CPR Linkage	Consequence of CPR Linkage	Risk Level	Comments / Justification
Near Surface Soils (including Topsoil and potential Made Ground)	Direct contact, ingestion or inhalation of fugitive dust and vapours	End users	Low Likelihood	Medium	Moderate/Low	No Made Ground is indicated from geological mapping to be present on the site. However, man-made deposits are anticipated to be present beneath the southeastern extent of the site associated with the residential property, warehouse and former structures. No potentially significant historical contaminative land uses have been identified at the site. An above ground storage tank was historically present immediately adjacent to the southwestern corner of the warehouse building. It is not known whether this was for the storage of water or heating oil, but no hydrocarbon spillages/leakages were identified during the walkover. End users are likely to come into contact with the in-situ soils within areas of soft landscape (i.e. private gardens and open space). Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.
	Plant uptake / soil attached to home grown produce	End users	Low Likelihood	Medium	Moderate/Low	No Made Ground is indicated from geological mapping to be present on the site. However, man-made deposits are anticipated to be present beneath the southeastern extent of the site associated with the residential property, warehouse and former structures. No potentially significant historical contaminative land uses have been identified at the site. An above ground storage tank was historically present immediately adjacent to the southwestern corner of the warehouse building. It is not known whether this was for the storage of water or heating oil, but no hydrocarbon spillages/leakages were identified during the walkover. Growing vegetables for private consumption within private gardens may be anticipated at the site. Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.

TABLE 7 – PRELIMINARY RISK ASSESSMENT SUMMARY TABLE DESK STUDY						
Potential Contaminant Source [C]	**Potential Pathway(s) [P]**	**Potential Receptor [R]**	**Probability of CPR Linkage**	**Consequence of CPR Linkage**	**Risk Level**	**Comments / Justification**
Near Surface Soils (including Topsoil and potential Made Ground) Cont.						
	Vertical and lateral migration	Neighbouring properties	Low Likelihood	Mild	Low	No Made Ground is indicated from geological mapping to be present on the site. However, man-made deposits are anticipated to be present beneath the southeastern extent of the site associated with the residential property, warehouse and former structures. No potentially significant historical contaminative land uses have been identified at the site. An above ground storage tank was historically present immediately adjacent to the southwestern corner of the warehouse building. It is not known whether this was for the storage of water or heating oil, but no hydrocarbon spillages/leakages were identified during the walkover. Any potential spillage/leakage from the above ground storage tank is likely to be relatively localised. Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.
Near Surface Soils (including potential Made Ground) Cont.	Leaching of contaminants through unsaturated zone and/or vertical and lateral migration	Controlled Waters	Low Likelihood	Mild	Low	No Made Ground is indicated from geological mapping to be present on the site. However, man-made deposits are anticipated to be present beneath the southeastern extent of the site associated with the residential property, warehouse and former structures. No potentially significant historical contaminative land uses have been identified at the site. An above ground storage tank was historically present immediately adjacent to the southwestern corner of the warehouse building. It is not known whether this was for the storage of water or heating oil, but no hydrocarbon spillages/leakages were identified during the walkover. Any potential spillage/leakage from the above ground storage tank is likely to be relatively localised. The site does not lie within a SPZ. Drainage ditches were noted to be present within the southern extent and along the northern and western boundaries of the site. The drift deposits and the bedrock underlying the site are as 'Unproductive Strata'. Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.

TABLE 7 – PRELIMINARY RISK ASSESSMENT SUMMARY TABLE DESK STUDY						
Potential Contaminant Source [C]	**Potential Pathway(s) [P]**	**Potential Receptor [R]**	**Probability of CPR Linkage**	**Consequence of CPR Linkage**	**Risk Level**	**Comments / Justification**
	Direct contact or contact with vapours	Plastic buildings products (e.g. water supply pipes) and buried concrete	Low Likelihood	Medium	Moderate/Low	No Made Ground is indicated from geological mapping to be present on the site. However, man-made deposits are anticipated to be present beneath the southeastern extent of the site associated with the residential property, warehouse and former structures. No potentially significant historical contaminative land uses have been identified at the site. An above ground storage tank was historically present immediately adjacent to the southwestern corner of the warehouse building. It is not known whether this was for the storage of water or heating oil, but no hydrocarbon spillages/leakages were identified during the walkover. Further consideration of this potential linkage should be provided during the course of the Phase II Exploratory Investigation works.

The foregoing preliminary conceptual model highlights the potential plausible pollutant linkages that may relate to the site and would therefore require addressing by appropriate Phase II Exploratory Works. The information contained within the conceptual model should be confirmed and revised upon completion of an appropriate intrusive investigation, as detailed in the following sections.

5.0 GROUND INVESTIGATION

5.1 Introduction

Sub-Surface Utility Avoidance Scan

Prior to the commencement of our intrusive works, a sub-contracted sub-surface utility scan of proposed exploratory hole locations was undertaken to attempt to avoid buried services during the intrusive works. Based on the results of the service scan and taking account of the requirement to avoid buried services, the exploratory holes were positioned to maximise the amount of information obtained at the site.

It should be noted that it was not possible to advance exploratory holes inside the dilapidated outbuildings in the southeastern portion of the site for health and safety reasons and due to the height restriction of the building roofs. In view of this, exploratory holes were advanced in close proximity to the buildings, where access permitted.

Trial Pitting and Soakaway Works

A total of 28No. trial pits (designated TP1 to TP28) were excavated at the site between 20th and 24th January 2025. The trial pits were mechanically excavated to depths ranging between 2.00m and 3.20m below existing ground level (begl).

A total of 7No. soakaway test pits (designated SA1 to SA7) were excavated at the site between 20th and 24th January 2025. The soakaway test pits were mechanically excavated to depths ranging between 1.00m and 1.40m begl.

Window Sample Borehole Works

A total of 6No. window sampling boreholes (designated WS1 to WS6) were advanced at the site on 27th January 2025. The boreholes were advanced to depths ranging between 2.00m and 5.00m begl.

Exploratory Hole Locations/Logs

The approximate locations of the exploratory holes are indicated on the plan presented in Appendix IX of this report (Figure No. D44118/08). The exploratory hole logs are presented in Appendix X of this report.

5.2 Ground Conditions

The general ground conditions encountered during the exploratory works may be summarised as follows.

5.2.1 Topsoil

Topsoil was encountered at surface within all of the trial pits, soakaway pits and WS1 to depths ranging between 0.30m and 0.50m begl, with an average thickness of approximately 0.36m.

A plan showing the thickness of the Topsoil in each of the exploratory holes is presented in Appendix XI of this report (Drawing No. D44118/09).

5.2.2 Made Ground

Made Ground was encountered within boreholes WS2 to WS6 which were all located in the southeastern portion of the site around the former and existing buildings. The Made Ground was encountered to depths of 0.40m and 1.20m begl. It should be noted that WS3 had no recovery between 0.40m and 2.00m due to a concrete obstruction being pushing down the sampling tube.

A summary of the Made Ground soils encountered in the above exploratory holes is provided as follows:

- Concrete surfacing (WS3 and WS6 only).
- Grass over dark brown clay (WS4 and WS5 only).
- Loose grey sandy gravel of concrete and brick (WS4 only).
- Soft locally firm brown mottled dark grey, black and dark brown gravelly locally sandy clay. Gravel constituents comprised clinker, brick, concrete and coal (WS2, WS4 to WS6).

A plan showing the depth of the Made Ground in each of the exploratory holes (where locally encountered) is presented in Appendix XI of this report (Drawing No. D44118/09). It is anticipated that further Made Ground will be present in the areas around the existing buildings and beneath the existing concrete hardstanding.

5.2.3 Natural Strata

Tidal Flat Deposits

The Natural Strata encountered directly beneath the localised Made Ground or Natural Topsoil typically comprised the following drift deposits:

- Firm light brown mottled orange-brown and light grey sandy SILT locally progressing into a silty SAND at depth;
- Soft to firm light brown/orange-brown/light grey slightly silty (locally very silty) slightly sandy CLAY;
- Loose to medium dense wet light grey slightly silty to silty SAND, locally with occasional pockets of clay and rare black organic staining.

Within the Silt deposits, the Sand content appeared to vary markedly with depth, with some Silt soils appearing to contain significant quantities of Sand. However, the overall granular content of the Silt appeared relatively low with some of the Silt soils with a visually high sand content still appearing visibly cohesive in nature.

5.3 Visual & Olfactory Evidence of Soil Contamination

We would note that no obvious visual or olfactory evidence of significant soil contamination was identified during the course of the site works (such as hydrocarbons or visible fragments of asbestos, for example).

This included window sample borehole WS6 targeted to the location of the small above ground storage tank in the southeastern portion of the site (on the southwestern corner of the derelict warehouse building). There was no obvious evidence of any staining to the external concrete hardstanding, which could indicate potential small historical spillages (i.e. oils, for example).

The localised Made Ground in the far southeastern portion of the site around the existing residential dwelling and warehouse together with the concrete hardstanding included fragments of clinker, brick, concrete and coal.

5.4 Water

Water was encountered within the majority of the exploratory holes during their excavation / drilling. The water was encountered from depths ranging between 1.15m to 2.70m begl, with an average depth of approximately 2.00m begl.

The majority of the water observations were recorded as seepages within the trial pits within the silty Sand strata at depth. These seepages typically collected as standing water at the base of the pit upon completion of the excavation.

It should be noted that the long term monitoring of groundwater levels has not been carried out and therefore, due to the relatively low permeability of the soils, the steady groundwater level across the site may be shallower than the recorded seepage levels in the trial pits.

5.5 Stability

The trial pits and soakaways pits were initially generally stable in the short term but the sides became unstable when excavating generally beyond approximately 2.00m begl. This instability of the pit sides typically occurred below the depths where the water seepages were noted within natural Sand soils. In all the trial pits (28No.) and 1No. soakaway pit (SA4), this resulted in collapse of the pit sides.

Due to the nature of the ground it is considered likely that instability and collapse of shallow foundations could occur when left open or when exposed to wet weather conditions.

Casing was used during the drilling of the majority of the window sample boreholes (to depths of between 1m and 3m begl) as a precautionary measure.

5.6 Plates

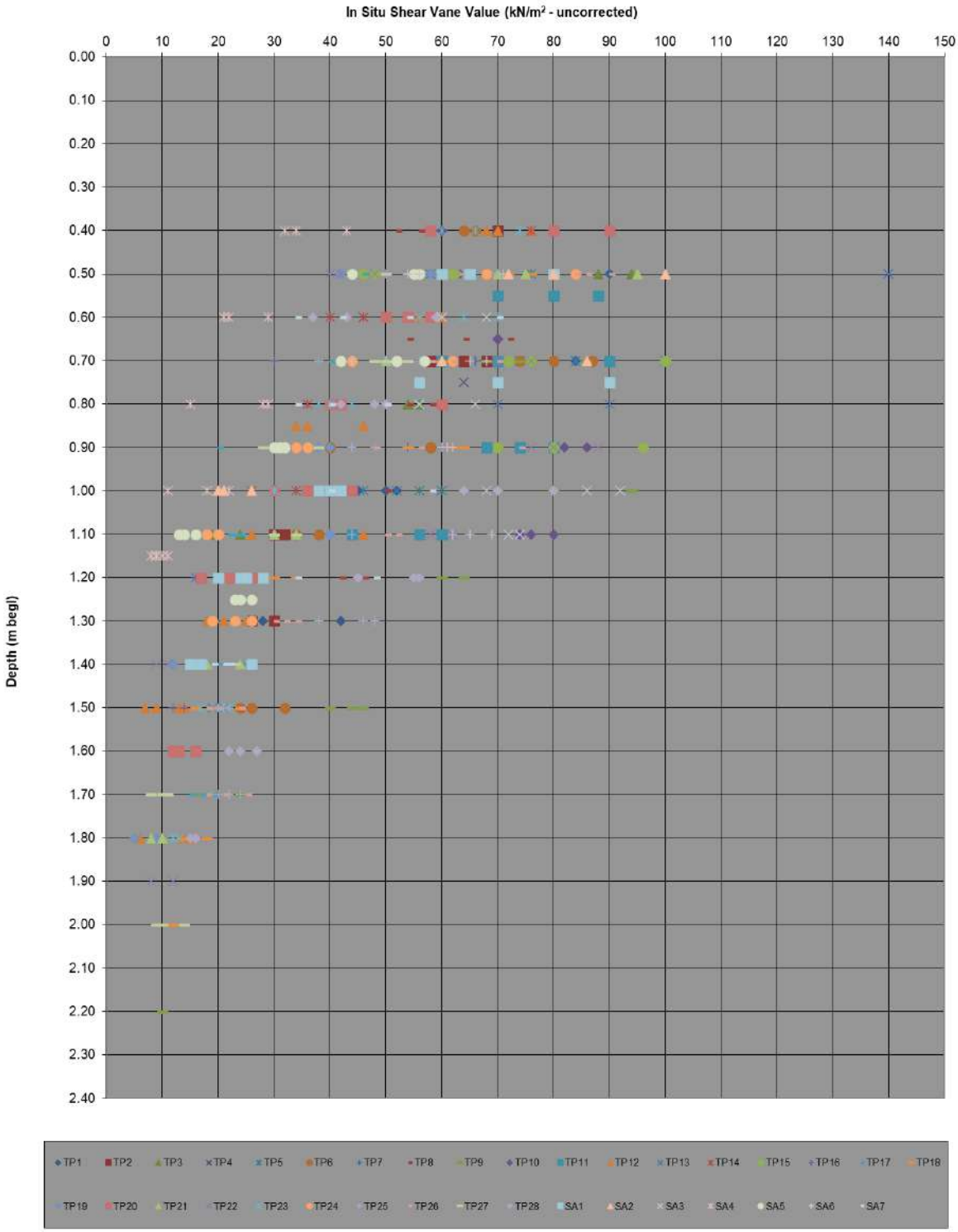
A photographic record of the exploratory investigation was obtained during the intrusive works. Selected photographs are presented in the Plates included in Appendix XII of this report (Plate Nos. D44118/P1 to D44118/P39).

5.7 Shear Vane Values

In-situ shear vane testing was undertaken within the natural Clay soils within the trial pits and selected window sample boreholes at various depths ranging between 0.40m and 2.60m begl. The results revealed soil shear strength values of between 5kN/m^2 and 140kN/m^2.

A chart showing the shear vane values in relation to depth recorded in the trial pits is provided on the following page for information. Individual shear vane results are provided on the exploratory hole logs included in Appendix X of this report.

Chart D44118/01
Monks House Lane West, Spalding
Shear Vane Values Vs Depth (m begl)



5.8 In-situ Soakaway Testing

Preliminary soakaway testing was carried out at 7No. locations (SA1 to SA7) across the site. The approximate locations of the soakaway pits are included on the plan presented in Appendix IX (Figure No. D44118/08) of this report. The positions of the soakaway test pits included targeting the proposed SUDS Attenuation Basins in the central, northwestern and southeastern portions of the site, together with locations in the vicinity of the proposed plots for general coverage.

Taking into account the presence of water ingress within the trial pits (from depths between 1.15m and 2.70m begl – an approximately average of 2.00m) together with pit side instability with increased depth, the soakaway test pits were terminated at relatively shallow depths of 1.00m and 1.40m begl respectively. Testing was carried out over four days between 21st and 24th January 2025, with one test in each pit, typically extending over a circa 6 hour monitoring period. It should be noted that soakaway pit SA1 side walls collapsed after 100 minutes of monitoring.

The results of the in-situ testing are summarised in Table 8 with the soil infiltration rate calculation sheets presented in Appendix XIII of this report.

TABLE 8 – SUMMARY OF INFILTRATION RATES

Soakaway Reference	Drop in Water Level (m)	Test Period (minutes)	Preliminary Infiltration Rate
SA1	0.08	98	Insufficient drop in water level
SA2	0.01	200	Insufficient drop in water level
SA3	0.14	360	Insufficient drop in water level
SA4	0.12	334	Insufficient drop in water level
SA5	0.22	344	Insufficient drop in water level
SA6	0.11	320	Insufficient drop in water level
SA7	0.06	253	Insufficient drop in water level

An insufficient drop in water level occurred in all soakaway pits to enable the calculation of a soil infiltration rate. The maximum drop in water level was recorded in SA5 where water levels dropped 22cm over a circa 7 hour period and the rate of drop was noted to be reducing with time. Therefore, it is considered that a majority of the drop in water level (in all pits) was largely due to absorption of water into the surrounding soils rather than infiltration through the soils.

6.0 LABORATORY TESTING & CONTAMINATION ASSESSMENT

6.1 Introduction

As part of our works, a suite of geotechnical laboratory soils testing has been undertaken, which comprised the following:

- 6 No. Plasticity Index tests.
- 3 No. Particle Size Distribution tests.
- 9 No. Water soluble sulphate tests.
- 31 No. pH tests.
- 3 No. Remoulded CBR Tests.

In addition, environmental soil testing was carried out on visually representative samples recovered from the exploratory holes. The testing strategy was based on the land use assessment and preliminary CSM derived by the desk study works, and was considered sufficient to enable an initial assessment of the chemical status of the soils. The following testing has been undertaken as part of our works:

- 11 No. Contamination suites (including metals and speciated Polycyclic Aromatic Hydrocarbons, along with Total Organic Carbon on 11 No. samples).
- 2 No. Speciated Total Petroleum Hydrocarbons (TPH) by Criteria Working Group (CWG) method tests (including aliphatic / aromatic carbon fractions, BTEX & MTBE).
- 8 No. Organochlorine pesticide screens.
- 8 No. Organophosphorus pesticide screens.
- 3 No. Asbestos tests.

In addition to the above, the following testing was undertaken to enable an assessment of the requirements for potable water supply pipes at the site:

- 5 No. Anglian Water Suites.

All laboratory soil test results are included in Appendix XIV.

6.2 Geotechnical Soil Test Results

Water Soluble Sulphate/pH

Water soluble sulphate testing was undertaken on nine samples obtained during the site works. The testing revealed water soluble sulphate concentrations of <1mg/l SO_4 and 90mg/l SO_4 within the samples analysed. The pH values of the samples of soils analysed (excluding topsoil) ranged between 8.14 and 8.87.

In accordance with the Building Research Establishment publication Special Digest 1 '*Concrete in Aggressive Ground*' (2005) the highest sulphate concentration should be used to indicate the Design Sulphate Class (i.e. 90mg/l SO_4), together with the lowest pH values (8.14).

Therefore, in accordance with Special Digest 1:2005 the site falls into Design Sulfate Class DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1s. This classification has been made based on the assumption of a brownfield location with generally static groundwater conditions (i.e. low permeability shallow soils) beneath the site.

Plasticity Index Tests

A total of 6 No. Plasticity Index tests have been undertaken on selected samples of the near surface Natural Strata obtained during the site works. In accordance with NHBC standards Chapter 4.2 *'Building Near Trees'* and BRE Digest 240 *'Low-rise buildings on shrinkable clay soils: Part 1'* (1993) the reported PI values may be modified based on the portion of the sample passing the 425μm sieve.

The results of the PI analysis are summarised in Table 9.

TABLE 9 – SUMMARY OF PLASTICITY INDEX (PI) DATA

Sample Ref.	Reported PI Value (%)	Portion <425μm (%)	Modified PI Value (%)	Volume Change Potential
TP1, 0.50m (SILT)	NA	NA	NA	Non-Plastic
TP2, 2.20m (SAND)	NA	NA	NA	Non-Plastic
TP10, 0.50m (SILT)	17	100	17	Low
TP13, 0.60m (CLAY)	21	100	21	Medium
TP26, 0.50m (SILT)	27	100	27	Medium
SA2, 0.50m (CLAY)	26	100	26	Medium

The testing has revealed that the cohesive soils analysed may be regarded as being of low to medium volume change potential.

The testing has also revealed that the samples tested from TP1 (at 0.50m begl) comprising slightly sandy SILT and from TP2 (at 2.20m begl) comprising very silty SAND may be classified as non-plastic.

As stated in Section 5.2.3, from a visual perspective some of the excavated natural soils appeared to vary markedly in composition with depth.

Particle Size Distribution (PSD) Tests

Particle Size Distribution (PSD) tests were undertaken on selected samples of the near surface Silt obtained during the site works which was noted to contain varying amounts of sand / silt. The results revealed the granular content of this soil type (i.e. Sand) to be between 66% and 69%, with a fine particles (Silt / Clay) content of between 31% and 34%, within the three samples tested. The testing also revealed that the fine particles comprised a Silt content of between 24% and 25% and a Clay content of between 6% and 9%. This generally confirms the visual descriptions of these soil type.

It should be noted that the fines content of all three of the samples tested below 35% which would be regarded as potentially non-shrinkable.

Summary of PI and PSD Testing

Based on a combination of the visual description of the variable soils and the visual behavioural characteristics of the variable soils, together with the results of the laboratory testing, soils of a medium volume change potential should be assumed for design purposes in the first instance.

Remoulded Soaked California Bearing Ratio (CBR) Testing

Remoulded soaked California Bearing Ratio testing was undertaken on 5 No. samples of shallow Natural Strata across the site. The results of the remoulded CBR results are summarised in Table 10. CBR values for the top and bottom of the remoulded soaked sample are recorded.

TABLE 10 – SUMMARY OF LABORATORY CBR TEST RESULTS					
Sample Ref.	Depth (m begl)	Final Moisture Content (%) Sample Top	Final Moisture Content (%) Sample Bottom	CBR Value (%) Sample Top	CBR Value (%) Sample Bottom
TP3 (SILT)	0.50 – 1.00	23.7	23.7	0.8	1.5
TP9 (SILT)	1.00	25.9	25.0	0.6	0.8
TP22 (SILT)	0.50 – 1.00	23.4	22.8	0.3	0.7
TP25 (SILT)	0.50 – 1.00	24.8	24.8	0.7	0.9
SA1 (SILT)	0.50 – 1.00	25.9	25.4	0.2	0.4

6.3 Contamination Assessment Rationale

We understand that it is proposed to demolish the existing buildings in the southeastern portion of the site and develop the entire site with low-rise residential properties with associated private gardens. There are 3No. attenuation basins also proposed for the central, northwestern and southwestern areas of the site. Based on this development proposals, we have adopted a residential with plant uptake end-use scenario for the purposes of the contamination assessment as a preliminary conservative approach.

6.3.1 Assessment Methodology

In order to undertake a Generic Quantitative Risk Assessment (GQRA) we have adopted the Suitable for Use Levels (S4ULs) published by LQM/CIEH in their publication referenced: Nathanail, C.P., McCaffrey, C. Gillett, A.G., Ogden, R.C. and Nathanail, J.F, 2015. '*The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham. All rights reserved.*' In the absence of an S4UL screening value, we have made reference to the Category 4 Screening Levels (C4SLs) published by DEFRA.

In consideration of the available generic land uses utilised in the derivation of the adopted screening criteria, we have adopted a residential with plant uptake end-use scenario for the purposes of our assessments.

For assessment purposes, we have adopted a policy whereby determinands within the dataset are individually compared to the relevant screening value (i.e. individual S4ULs). Where determinands within the dataset are less than the appropriate screening value, the determinand is considered to be present at an acceptable concentration and no further assessment is required. Additional comment, statistical assessment or further Detailed Quantitative Risk Assessment (DQRA) may be provided where elevated values are revealed.

6.3.2 Selection of Soil Organic Matter (SOM) Content

The SOM content and soil type are used to provide an assessment of the applicability of the screening values adopted (the S4UL values are typically based upon SOM of 1%, 2.5% and 6%, as applicable, with all metals derived utilising 6% SOM as standard).

Where available at Tier 1 level, determinands have in the first instance been compared to screening values adopting a conservative SOM of 1%.

Where the determinand exceeds the relevant screening value at 1% SOM, a site-specific SOM may be adopted as appropriate to derive more site-specific screening values and the dataset reassessed.

6.4 Sampling Strategy

The sampling strategy for the site was primarily to retrieve visually representative soil samples from a selection of locations that provide an initial coverage across the entire site area (where access allowed). The sampling strategy was based on a review of the historical, geological and environmental information obtained from the Desk Study enquiries and the current and proposed site setting, together with the ground conditions encountered during our Phase II exploratory works.

Specific areas of concern were identified at the site with respect to ground contamination, namely the areas of the existing and former buildings and the small above ground storage tank in the southeastern portion of the site. Therefore, it was considered appropriate to position the exploratory holes to provide general coverage including targeting these specific areas, taking account of the presence of known buried services.

Table 11 summarises the reasoning behind the exploratory hole positions.

TABLE 11 – REASONING FOR EXPLORATORY HOLE LOCATION

Exploratory Hole Reference	Reasoning Behind Location
TP2 to TP28, SA1, SA2, SA4 and SA7	General site coverage.
TP1, WS1 to WS5	Targeted to the former structures and adjacent to the existing buildings.
WS6	Targeted to the former above ground storage tank.
SA3, SA5 and SA6	Targeted to the proposed attenuation ponds

Key

TP – Trial Pit
WS – Window Sampling Borehole
SA – Soakaway Test Pit

The ground conditions encountered during our Phase II works revealed the presence of two distinct types of material, i) Made Ground, ii) Topsoil and iii) the underlying Natural Strata.

Representative samples of the soil types were obtained during our Phase II works, and subjected to chemical analysis for a suite of contaminants deemed appropriate based on the findings of the Desk Study enquiries. It is noted that the suite of contaminants detailed in Section 3.8.1 and Table 6 were considered to remain applicable as a chemical screen of the encountered soils following completion of the site investigation works.

6.5 Contamination Analysis

A total of eleven (11 No.) standard chemical contamination tests (including metals, speciated PAHs and TOC) were carried out on selected samples of the Made Ground (2No.), Topsoil (2No.) and underlying Natural Strata (7No.) obtained during the site works. Eight samples of the topsoil were also subject to testing for the presence of pesticides.

In addition, two samples of Made Ground and one sample of Topsoil were also subjected to asbestos analysis.

For initial assessment purposes, the laboratory test results have been individually compared against appropriate Tier 1 GACs.

6.6 Contamination Soil Test Results

6.6.1 Made Ground

The contamination assessment for the Made Ground analysed at the site is summarised in Table 12.
Please note that screening values have only been used for determinands where they are present at concentrations in excess of the LOD on at least one occasion.

TABLE 12 – SUMMARY OF TIER 1 GAC ASSESSMENT (RESIDENTIAL WITH PLANT UPTAKE END-USE) MADE GROUND

Contaminants – Potentially Harmful to Human Health	No. of Samples Tested	Concentration Range (mg/kg)	Tier 1 GAC (mg/kg)	Tier 1 GAC Exceeded (Yes/No) & No. of Exceedances (n/2)
Metals				
Arsenic	2	5 – 6	37 S4UL	No
Chromium III	2	5 – 8	910 S4UL	No
Copper	2	1 – 3	2400 S4UL	No
Lead	2	4 – 5	200 C4SL	No
Mercury	2	0.45 – 0.52	40 S4UL	No
Nickel	2	5 – 8	130 S4UL	No
Zinc	2	15 – 20	3700 S4UL	No
PAHs				
Benzo(a)anthracene	2	<0.10 – 0.25	7.2 S4UL	No
Benzo(a)pyrene	2	<0.10 – 0.34	2.2 S4UL	No
Benzo(b)fluoranthene	2	<0.10 – 0.41	2.6 S4UL	No
Benzo(ghi)perylene	2	<0.10 – 0.19	230 S4UL	No
Benzo(k)fluoranthene	2	<0.10 – 0.16	77 S4UL	No
Chrysene	2	<0.10 – 0.34	15 S4UL	No
Fluoranthene	2	<0.10 – 0.58	280 S4UL	No
Indeno(123-cd)pyrene	2	<0.10 – 0.21	27 S4UL	No
Phenanthrene	2	<0.10 – 0.23	95 S4UL	No
Pyrene	2	<0.10 – 0.53	620 S4UL	No
TPHs				
Aliphatic C16-C35	2	<2 – 35	65000 S4UL	No
Aromatic C12-C16	2	<1 – 3	140 S4UL	No
Aromatic C16-C21	2	<1 – 5	260 S4UL	No
Aromatic C21-C35	2	<1 - 396	1100 S4UL	No

Key
S4UL – CIEH/LQM Suitable 4 Use Levels (2015). Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3026. All rights reserved.
C4SL – value for Lead taken from DEFRA publication SP1010 and based on a residential (with home-grown produce) end-use.

The data within Table 12 may be summarised below.

Asbestos

In addition to the foregoing contamination assessment, two samples of the Made Ground were subject to asbestos analysis. The results revealed that no asbestos (loose fibres or bulk fragments) was detected in the any of the samples analysed.

Further Comments

All remaining determinands assessed within the Made Ground were present at individual concentrations below the Limit of Detection of the method of analysis adopted by the laboratory and / or below the appropriate Tier 1 GAC based on a residential with plant uptake end-use.

6.6.2 Topsoil

The contamination assessment for the Topsoil analysed at the site is summarised in Table 13 below.

Please note that screening values have only been used for determinands where they are present at concentrations in excess of the LOD on at least one occasion.

TABLE 13 – SUMMARY OF TIER 1 GAC ASSESSMENT (RESIDENTIAL WITH PLANT UPTAKE END-USE) TOPSOIL				
Contaminants – Potentially Harmful to Human Health	**No. of Samples Tested**	**Concentration Range (mg/kg)**	**Tier 1 GAC (mg/kg)**	**Tier 1 GAC Exceeded (Yes/No) & No. of Exceedances (n/2)**
Metals				
Arsenic	2	10 – 11	37 S4UL	No
Cadmium	2	0.6 – 0.8	11 S4UL	No
Chromium III	2	16	910 S4UL	No
Copper	2	20 – 26	2400 S4UL	No
Lead	2	19 – 28	200 C4SL	No
Nickel	2	15	130 S4UL	No
Zinc	2	61 – 80	3700 S4UL	No
Key S4UL – CIEH/LQM Suitable 4 Use Levels (2015). Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3026. All rights reserved. C4SL – value for Lead taken from DEFRA publication SP1010 and based on a residential (with home-grown produce) end-use.				

All determinands assessed (including speciated PAHs and Pesticides) within the Topsoil were present at individual concentrations below the Limit of Detection of the method of analysis adopted by the laboratory and / or below the appropriate Tier 1 GAC based on a residential with plant uptake end-use.

Asbestos

In addition to the foregoing contamination assessment, a sample of the Topsoil was subject to asbestos analysis. The results revealed that no asbestos (loose fibres or bulk fragments) was detected in the sample analysed.

6.6.3 Natural Strata

The contamination assessment for the Natural soils analysed at the site is summarised in Table 14.

Please note that screening values have only been used for determinands where they are present at concentrations in excess of the LOD on at least one occasion.

TABLE 14 – SUMMARY OF TIER 1 GAC ASSESSMENT (RESIDENTIAL WITH PLANT UPTAKE END-USE) NATURAL STRATA				
Contaminants – Potentially Harmful to Human Health	**No. of Samples Tested**	**Concentration Range (mg/kg)**	**Tier 1 GAC (mg/kg)**	**Tier 1 GAC Exceeded (Yes/No) & No. of Exceedances (n/2)**
Metals				
Arsenic	7	<1 – 14	37 S4UL	No
Cadmium	7	<0.5 – 1.0	11 S4UL	No
Chromium III	7	6 – 19	910 S4UL	No
Copper	7	1 – 20	2400 S4UL	No
Lead	7	3 – 41	200 C4SL	No
Mercury	7	0.22 – 18.2	40 S4UL	No

TABLE 14 – SUMMARY OF TIER 1 GAC ASSESSMENT (RESIDENTIAL WITH PLANT UPTAKE END-USE) NATURAL STRATA				
Contaminants – Potentially Harmful to Human Health	**No. of Samples Tested**	**Concentration Range (mg/kg)**	**Tier 1 GAC (mg/kg)**	**Tier 1 GAC Exceeded (Yes/No) & No. of Exceedances (n/2)**
Nickel	7	5 – 22	130 S4UL	No
Zinc	7	16 – 127	3700 S4UL	No
PAHs				
Anthracene	7	<0.10 – 0.18	2400 S4UL	No
Benzo(a)anthracene	7	<0.10 – 0.80	7.2 S4UL	No
Benzo(a)pyrene	7	<0.10 – 1.22	2.2 S4UL	No
Benzo(b)fluoranthene	7	<0.10 – 1.41	2.6 S4UL	No
Benzo(ghi)perylene	7	<0.10 – 0.96	230 S4UL	No
Benzo(k)fluoranthene	7	<0.10 – 0.58	77 S4UL	No
Chrysene	7	<0.10 – 1.13	15 S4UL	No
Dibenzo(ah)anthracene	7	<0.10 – 0.16	0.24 S4UL	No
Fluoranthene	7	<0.10 – 2.28	280 S4UL	No
Indeno(123-cd)pyrene	7	<0.10 – 0.95	27 S4UL	No
Phenanthrene	7	<0.10 – 0.45	95 S4UL	No
Pyrene	7	<0.10 – 1.93	620 S4UL	No

Key
S4UL – CIEH/LQM Suitable 4 Use Levels (2015). Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3026. All rights reserved.
C4SL – value for Lead taken from DEFRA publication SP1010 and based on a residential (with home-grown produce) end-use.

All determinands assessed for the Natural Strata were present at individual concentrations below the Limit of Detection of the method of analysis adopted by the laboratory and / or below the appropriate Tier 1 GAC based on a residential with plant uptake end-use.

6.7 Contamination Assessment Summary

Human Health

Contamination testing was carried out on selected samples of the localised Made Ground, the Topsoil and the Natural Strata.

Based on the chemical contamination assessment undertaken, the soils at the site which comprised Made Ground, Topsoil and the Natural Strata may generally be considered to be uncontaminated for the proposed residential with plant uptake end-use.

Controlled Waters

The soil test results have revealed the absence of any significant potentially mobile contamination (such as hydrocarbons). The soils at the site which comprised Made Ground, Topsoil and the Natural Strata may generally be considered to be uncontaminated. It is therefore the opinion of GeoDyne that the recorded concentrations are unlikely to pose a significant risk to Controlled Waters given the relatively low environmental sensitivity of the site.

6.8 Anglian Water Testing

Based on previous experience of sites within the Lincolnshire area, it was considered a possibility that Anglian Water may classify parts of the site as a *'Brownfield'* site for their assessment purposes, based on the presence of localised Made Ground within the exploratory holes and the presence of a man-made track that passes through the site, with the remainder of the site designated as *'Greenfield'*.

It is our opinion that based on the findings of the desk study and the ground conditions encountered during our Phase II works, the entire site should not simply be classed as brownfield, as the evidence from our exploratory holes indicates that the majority of the site is greenfield.

In view of the above, samples of the Made Ground and the Natural Strata were obtained from the site to enable an initial assessment of the likely requirements for the composition of the water supply pipework.

As required by Anglian Water, soil samples should be obtained from depths of a minimum of 500mm below ground level and tested for a suite of contaminants deemed appropriate based on the guidance detailed within Anglian Water document entitled *'Information for developers about contaminated land and ground condition assessment'* dated November 2023. The purpose of the testing was to determine the presence of possible contaminants at the site and assess whether PE pipes would be sufficient for the site or whether protective / barrier water supply pipes would be necessary at the site.

The samples selected for specific testing were obtained from TP16 (Natural Stata), TP25 (Natural Strata), SA2 (natural Strata), WS2 (Made Ground) and WS5 (Made Ground). Based on the current proposed layout, these sampling points are situated approximately within the 15m corridor of the proposed roads / likely pipeline routes.

The testing included the following:

- Total phenols.
- Volatile organic compounds (VOCs).
- Semi-volatile organic compounds (SVOCs).
- Speciated Total Petroleum Hydrocarbons (TPH) by Criteria Working Group (CWG) method tests (including aliphatic / aromatic carbon fractions, BTEX & MTBE).

All laboratory soil test results are included in Appendix XIV of this report.

The results have been examined in relation to the Anglian Water threshold values. The contamination assessment for the samples obtained at the site is summarised in Table 15.

TABLE 15 – ANGLIAN WATER SUITE DATA ASSESSMENT

Parameter Group	No. of Samples Tested	Concentration Range (mg/kg)	PE Threshold (mg/kg)	PE Threshold Exceeded (Yes or No)	Protective / Barrier Pipes Required (Yes or No)
Total VOCs	5	All results below LOD (<0.01)	0.5 AW	No	No
Total BTEX + MTBE	5	All results below LOD (<0.01)	0.1 AW	No	No
Total SVOCs (excluding PAHs)	5	<0.100 - 0.174	2 AW	No	No
EC5-EC10 Aliphatic & Aromatic Hydrocarbons	5	All results below LOD (<0.01)	2 AW	No	No
EC10-EC16 Aliphatic & Aromatic Hydrocarbons	5	All results below LOD (<1)	10 AW	No	No
EC16-EC40 Aliphatic & Aromatic Hydrocarbons	5	<1 – 478	500 AW	No	No

TABLE 15 – ANGLIAN WATER SUITE DATA ASSESSMENT					
Parameter Group	**No. of Samples Tested**	**Concentration Range (mg/kg)**	**PE Threshold (mg/kg)**	**PE Threshold Exceeded (Yes or No)**	**Protective / Barrier Pipes Required (Yes or No)**
Total Phenols	5	All results below LOD (<0.2)	2 AW	No	No
Cresols and Chlorinated Phenols	5	All results below LOD (<0.1 or <0.5)	2 AW	No	No

Key

LOD – Laboratory Limit of Detection.
AW – Values taken from Pipe Selection Table within Anglian Water guidance document *'Investigation for developers about contaminated land and ground condition assessment'* dated November 2023, which is reproduced from UKWIR publication *'Guidance for the selection of water supply pipes to be used in Brownfield sites'*, (2010).
Total Phenols includes a sum of phenols, cresols, xylenols and resorcinol.

Based on the results of the soil sampling detailed herein, all contaminant concentrations are below the PE threshold and the use of protective / barrier water supply pipes at the site is considered not necessary.

7.0 REVISED CONCEPTUAL SITE MODEL

7.1 Introduction

In accordance with the approach detailed within Section 4.0, the Conceptual Site Model (CSM) for the site should be refined following acquisition and collection of additional data following completion of the site investigation works.

As a result of the site investigation, the potential contaminant linkages have been re-assessed to reflect the findings of the investigations and risk assessments completed.

Our revised assessment following the acquisition and collection of information from the site investigation works is provided in Table 16.

TABLE 16 – REVISED RISK ASSESSMENT SUMMARY TABLE PHASE II EXPLORATORY INVESTIGATION							
Potential Contaminant Source [C]	**Potential Pathway(s) [P]**	**Potential Receptor [R]**	**Probability of CPR Linkage**	**Consequence of CPR Linkage**	**Risk Level**	**Comments / Justification**	**Residual Risk After Remedial / Mitigation Measures**
Near Surface Soils (including Made Ground, Topsoil and Natural Strata)	Direct contact, ingestion or inhalation of fugitive dust and vapours	End users	Unlikely	Medium	Low	Phase II Exploratory Investigation works have revealed the Made Ground, Topsoil and Natural Strata may be regarded as uncontaminated. End users may come into contact with the in-situ soils if exposed at surface.	Low – as per 'Risk Level'. No remedial / mitigation measures required.
	Plant uptake / soil attached to home grown produce	End users	Unlikely	Medium	Low	Phase II Exploratory Investigation works have revealed the Made Ground, Topsoil and Natural Strata may be regarded as uncontaminated.	Low – as per 'Risk Level'. No remedial / mitigation measures required.
	Vertical and lateral migration	Neighbouring properties	Unlikely	Mild	Negligible	No sources of potential mobile hydrocarbon contamination have been identified during the intrusive works and there was no obvious visual or olfactory evidence of any significant contamination (i.e. hydrocarbon impacted soils, for example).	Negligible – as per 'Risk Level'. No remedial / mitigation measures required.
	Leaching of contaminants through unsaturated zone and/or vertical and lateral migration	Controlled Waters	Unlikely	Mild	Negligible	The soil test results (chemical analysis) are considered to be low and do not represent a significant risk to Controlled Waters. No sources of potential mobile hydrocarbon contamination have been identified and there was no obvious visual or olfactory evidence of any significant contamination (i.e. hydrocarbon impacted soils, for example).	Negligible – as per 'Risk Level'. No remedial / mitigation measures required.
	Direct contact or contact with vapours	Plastic buildings products (i.e. water supply pipes) and buried concrete	Unlikely	Medium	Low	Contamination testing has not revealed concentrations of contaminants which may pose a risk to buried services. Design Class DS-1/ACEC Class AC-1s (BRE Spec. Digest 1:2005).	Low – as per 'Risk Level'. No remedial / mitigation measures required.

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Site Summary

At the time of our site visit, access onto the site was gained via a concrete surfaced roadway off Monks House Lane within the southeastern extent of the site. There are two derelict residential dwellings and a derelict warehouse building present within the southeastern extent of the site.

The concrete hardstanding extends from the entrance along the southern side of the warehouse building, extending southwards towards the open field and eastwards towards the dwellings. Macadam surfacing was present between the warehouse building and the dwellings.

On the southwestern corner of the warehouse building, a circular outline was present on the concrete hardstanding suggesting they may have been an above ground storage tank recently. It is not known whether the tank stored heating oil or water but there was no visual evidence of hydrocarbon leakages on the immediate concrete hardstanding.

The remaining area of the site comprises open agricultural fields with a drainage ditch present in the southern extent of the site trending east-west together with drainage ditches present along the northern and western boundaries of the site.

There were overgrown hedges present along the eastern boundary in the southeastern extent of the site together with sporadic trees and overgrown hedges along the northern boundary.

The site comprised predominantly undeveloped fields with small structures present within the southeastern extent of the site on the earliest historical maps (i.e. 1880s). Between 1930s and 1980s, the sites southeastern extent underwent various redevelopments including the construction of the residential dwellings, warehouse, small structures and greenhouses. However by the early 2000s the small structures and greenhouses had been demolished.

The site is indicated on the geological mapping of the area to be underlain by drift deposits comprising the Tidal Flat Deposits beneath the site. The bedrock geology underlying the drift deposits at the site is indicated to comprise the Oxford Clay Formation.

8.2 Geotechnical Information

8.2.1 Ground Conditions

Made Ground was encountered within boreholes WS2 to WS6 which were all located in the southeastern portion of the site around the former and existing buildings. The Made Ground was encountered to depths of 0.40m and 1.20m begl. It should be noted that WS3 had no recovery between 0.40m and 2.00m due to a concrete obstruction being pushing down the sampling tube.

A summary of the Made Ground soils encountered in the above exploratory holes is provided as follows:

- Concrete surfacing (WS3 and WS6 only).
- Grass over dark brown clay (WS4 and WS5 only).
- Loose grey sandy gravel of concrete and brick (WS4 only).
- Soft locally firm brown mottled dark grey, black and dark brown gravelly locally sandy clay. Gravel constituents comprised clinker, brick, concrete and coal (WS2, WS4 to WS6).

A plan showing the depth of the Made Ground in each of the exploratory holes (where locally encountered) is presented in Appendix XI of this report (Drawing No. D44118/08). It is anticipated that further Made Ground will be present in the areas around the existing buildings and beneath the existing concrete hardstanding.

Natural Topsoil was encountered at surface within all of the trial pits, soakaway pits and borehole WS1 to depths ranging between 0.30m and 0.50m begl, with an average thickness of approximately 0.36m.

The Natural Strata encountered directly beneath the localised Made Ground or Natural Topsoil typically comprised the following drift deposits:

- Firm light brown mottled orange-brown and light grey sandy SILT locally progressing into a silty SAND at depth;
- Soft to firm light brown/orange-brown/light grey slightly silty (locally very silty) slightly sandy CLAY;
- Loose to medium dense wet light grey slightly silty to silty SAND, locally with occasional pockets of clay and rare black organic staining.

Within the Silt deposits, the Sand content appeared to vary markedly with depth, with some Silt soils appearing to contain significant quantities of Sand. However, the overall granular content of the Silt appeared relatively low with some of the Silt soils with a visually high sand content still appearing visibly cohesive in nature.

8.2.2 Foundation Design

Based on the evidence of our works and irrespective of proposed finished levels, a piled foundation solution is recommended for the proposed development. A programme of cable percussive boreholes with appropriate in-situ tests are recommended to assess the deeper ground conditions at the site to assist with the pile design. Advise from a specialist piling contractor should be sought by the Client, to confirm the depths of the piles and the most feasible and cost-effective type of pile to be used at the site.

Based on visual observations during the course of our intrusive works (and as mentioned in Section 5.2), the near surface ground conditions across the site are variable with the presence of both cohesive and granular soils being encountered. This visual variability of the soils has been confirmed by the results of laboratory testing on representative samples with some of the visually cohesive soils being classed as having a medium volume change potential and the visually granular soils being classed as potentially non-shrinkable.

The use of traditional shallow foundations (i.e. strips and rafts) within localised areas of the site may be potentially feasible. However, this would be subject to further intrusive works (potentially including plot-specific works) to obtain a greater density of exploratory holes across the site allowing for a more detailed assessment of the ground, which would enable a ground bearing pressure to be calculated. Any further works would need to be supplemented by in-situ field testing, laboratory soil testing and settlement calculations.

However, given the presence of very low strength soils from circa 1.2m depth throughout the site, the presence of localised organic soils (and the potential for peat to be present within deeper soils), the presence of disturbed shallow ground around the existing buildings and the historical drainage ditch/small pond within the site, it is considered unlikely that areas of more favourable ground would be present. Therefore, there would be no guarantee that further intrusive works would enable strips, rafts or trench fill foundations to be utilised at the site. It should also be noted that the presence of water is also likely to result in a significantly reduced ground bearing pressure, which may not be sufficient to suit the loading characteristics of the proposed structures.

We would note that deeper Made Ground than recorded during our intrusive works may be present in the southeastern extent of the site in the area of the existing buildings (e.g. the residential dwelling and the warehouse) which are proposed to be demolished in due course.

8.2.3 Floor Slab Design

A suspended slab may be adopted, which may be either a cast in-situ reinforced concrete slab or a pre-cast suspended floor with a clear ventilated void (i.e. beam and block). Ground bearing floor slabs should not be used where piled foundations are used in low strength soils due to the increased risk of differential settlement between the floor slab and building structure.

8.2.4 Ground Gas Precautions

No ground gas monitoring was considered to be necessary at the site. Therefore, based on the information obtained during the desk study and intrusive site investigation works, no ground gas precautions relating to carbon dioxide or methane are considered to be required at the site.

8.2.5 Radon

No radon precautions are required at the site.

8.2.6 Building Near Trees

Foundation designs may require locally adjusting in accordance with NHBC Standards Chapter 4.2 *'Building Near Trees'* when building near existing, proposed or recently removed trees / hedgerows. The cohesive soils should be assumed to be of medium volume change potential for design purposes and the natural granular soils have been classified by the laboratory as non-plastic. However, at this stage it is recommended that allowance is made for medium volume change soils to be widespread throughout the site, unless proven otherwise by additional works.

It will be the responsibility of the piling contractor to decide whether further plasticity index testing of the deeper soils are required as part of the recommended borehole works to assist with their pile design.

It may be necessary to undertake an arborist survey is undertaken to identify the species and heights of the existing trees and hedges within influencing distance of the site, where appropriate.

8.2.7 Water

Water was encountered within the majority of the exploratory holes during their excavation / drilling. The water was encountered from depths ranging between 1.15m to 2.70m begl, with an average depth of approximately 2.00m begl.

The majority of the water observations were recorded as seepages within the trial pits within the silty Sand strata at depth. These seepages typically collected as standing water at the base of the pit upon completion of the excavation.

It should be noted that the long term monitoring of groundwater levels has not been carried out and therefore, due to the relatively low permeability of the soils, the steady groundwater level across the site may be shallower than the recorded seepage levels in the trial pits.

Based on the ground conditions encountered, excavations in excess of approximately 1.00-1.50m begl may encounter water ingress. Dewatering of excavations is considered more likely at the site if excavations are left open for a period of time (i.e. prior to the pouring of concrete and / or laying of drainage materials, for example) as water (held within the surrounding low permeability soils) will gradually seep / ingress into open excavations after relatively short periods. Excavations are also prone to instability (see Section 8.2.8).

The low permeability soils at the site are also susceptible to standing water following periods of wet weather, which will increase the likelihood of needing to dewater.

The site is underlain by Tidal Flat Deposits and these deposits extend across much of South Lincolnshire and into Cambridgeshire. These soils are typically of generally low permeability. The soils encountered in trial pits advanced within these deposits generally become damper / water bearing with depth.

Whilst there may be no initial evidence of water seepage / ingress within the trial pits immediately upon completion of excavation, water eventually finds its way into the pits if they are left open for several minutes.

We would note that groundwater levels may vary due to seasonal or other effects. Excavations within shallow soils may be susceptible to standing water following periods of wet weather.

8.2.8 Excavations / Stability

The trial pits and soakaways pits were initially generally stable but the sides became unstable when excavating generally beyond approximately 2.00m begl. This instability of the pit sides typically occurred below the depths where the water seepages were noted within natural Sand soils. In all the trial pits (28No.) and 1No. soakaway pit (SA4), this resulted in collapse of the pit sides.

Due to the nature of the ground it is considered likely that instability and collapse of shallow foundations could occur when left open or when exposed to wet weather conditions.

Casing was used during the drilling of the majority of the window sample boreholes (to depths of between 1m and 3m begl) as a precautionary measure.

In view of the above, excavations during the proposed development works may require trench support, including for health and safety reasons. The assessment of excavations and provision of support will be the responsibility of the contractor on site.

The natural soils are likely to be subject to deterioration and softening if excavations are left open and exposed to wet weather. Any softened soils should be removed from excavations prior to the pouring of concrete and foundation construction.

8.2.9 Sulphate Classification

In accordance with BRE Special Digest 1 (2005), the site falls into Design Sulphate Class DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1s. Therefore, an appropriate concrete mix should be adopted in accordance with BRE Special Digest 1 for all buried concrete in contact with the shallow soils.

However, these test results should be regarded as preliminary and should be supplemented by a programme of more comprehensive testing to enable a more robust data set to be obtained for the variety of different soil types beneath the site. The soil types encountered within the exploratory holes consisted of Made Ground, naturals soils comprising Sand, Silt and Clay. Further testing is also likely to include an assessment of the deeper soils (including the bedrock of the Oxford Clay Formation), which was not encountered during our intrusive works but could be encountered by piles and has the potential to be pyritic as indicated in BRE Special Digest 1:2005.

Further testing should enable a piling contractor to determine the concrete classification for the site based on the likely need for a piled foundation solution. It is understood that concrete mixes used during construction/formation of piles are inherently more resistant to sulphate attack.

8.2.10 Coal Mining

No coal mining precautions, or associated investigation works are required at the site.

8.2.11 California Bearing Ratios (CBRs)

The remoulded soaked CBR testing has revealed CBR values for the Natural Strata typically ranging between 0.2% and 0.9%, with a single result of 1.5%. These results are considered typical for the type of shallow soils encountered on site.

No frost susceptible material should be within 450mm of the ground surface in road construction.

The test results, together with consideration of the ground conditions encountered and described in this report, should be used by a Highways Design Engineer to determine the long term equilibrium CBR value appropriate for design purposes. In-situ testing along the line of proposed roads should be carried out to confirm pavement design parameters.

8.2.12 Surface Water Drainage

The in-situ testing undertaken has revealed that traditional soakaways are considered not suitable for the site. The use of alternative shallow SUDS features may be suitable subject to further targeted testing.

The Client's drainage Engineer should carefully consider the infiltration rate in relation to the drainage options for the site and should also consider the results in relation to the potential suitability for a permeable paving design, if required.

8.3 Environmental Considerations

8.3.1 Soil Contamination Assessment

Human Health

Based on the preliminary chemical contamination assessment undertaken, the soils at the site which comprised Made Ground, Topsoil and the Natural Strata may generally be considered to be uncontaminated for the proposed residential with plant uptake end-use.

It should be noted that only two contamination tests were undertaken on the topsoil across the site (for approximately in excess of 40,000m^3 of Topsoil present on site). Therefore additional contamination testing should be undertaken of the topsoil to provide further assurance on the chemical suitability of the topsoil.

Controlled Waters

Given the low contaminant concentrations revealed by the testing undertaken, there are considered to be no specific risks posed to Controlled Waters by the findings of the laboratory analysis undertaken.

8.3.2 Remediation Proposals

Human Health

Based on the testing undertaken, no widespread specific remediation works will be required at the site. The provision of topsoil is considered necessary in proposed gardens and the area of public open space to provide a suitable growing media for plants and the existing topsoil on site is considered suitable for re-use within future development (subject to confirmatory testing). It may be necessary to increase the thickness of topsoil around the root balls of trees to suit the proposed planting regime. The physical suitability of the existing topsoil should be assessed by the developer.

Whilst the existing topsoil is considered uncontaminated and suitable for re-use from a human health protection perspective, in the unlikely event that there is a requirement to import additional quantities of topsoil to the site, it will be necessary to test the topsoil at source to ensure it is suitably clean (prior to importation) in accordance with CLEA / generic guidance.

Additional topsoil testing should be undertaken to provide further assurance on the chemical suitability of the topsoil due to the significant volume of topsoil present at the site.

Any imported topsoil should also conform to BS3882: 2015 *'Specification for topsoil'*, with respect to the presence of foreign objects, and ideally nutrient levels etc. The results of the chemical analysis on topsoil proposed for importation should be forwarded to the Local Authority (Environmental Health Officer) for approval (prior to importation).

Similarly, if soils are proposed to be imported as part of the raising of site levels and are to be placed in proposed gardens and / or the area of public open space, it will be necessary to test the soils at source to ensure they are suitably clean (prior to importation) in accordance with CLEA / generic guidance. The results of the chemical analysis on soils proposed for importation should be forwarded to the Local Authority (Environmental Health Officer) for approval (prior to importation).

Any soils brought onto site that are placed in gardens and / or the area of public open space that have not been tested at source may need to be subject to post-placement testing, subject to the requirements of the Local Authority (Environmental Health Officer) in accordance with the National Contaminated Land Officers Group (NCLOG) document entitled *'A Regulator's Guide to Cover Systems and their Verification'* (2024).

It should be noted that in the event of removing the concrete hardstanding beneath the former suspected above ground storage tank, careful observations should be undertaken on the soils beneath to identify any evidence of hydrocarbon contamination presence within the soils.

If any evidence of impacted hydrocarbons soils are identified, the soils will required removing, with validation testing of the excavation sides and base (where physically practical to do so) should be undertaken in order to demonstrate that the in-situ soils do not contain contaminants in excess of appropriate screening values. All soils should be placed on hardstanding or an impermeable sheet prior to disposal. Once validation samples confirm that the remaining soils at the sides and base of excavation are chemically suitable with respect to hydrocarbon, the excavation may be infilled with inert granular fill materials.

Controlled Waters

No specific remediation in relation to Controlled Waters is considered to be necessary at the site on the basis of the available information.

8.3.3 Re-use of Existing Soils

The uncontaminated soils may be regarded as suitable for re-use (from a chemical contamination perspective) within proposed gardens or areas of soft landscape as topsoil and subsoil respectively, or to raise levels (as appropriate). Excess arisings (topsoil and natural soils) are also considered suitable as landscaping / capping on alternative developments (subject to regulatory approval and the production of any necessary plans or permits) where surplus arisings are generated from the site.

Additional topsoil testing should be undertaken to provide further assurance on the chemical suitability of the topsoil due to the significant volume of topsoil present at the site.

8.3.4 Off Site Disposal & Waste Acceptance Criteria Testing

Excess uncontaminated soils (for example the Topsoil and the underlying Natural Strata) should be regarded as a potential asset and we would recommend that the re-use of excess uncontaminated soils on site or off-site is investigated in the first instance (subject to appropriate permits, plans and registrations etc).

The Topsoil and the Natural Strata may be regarded as suitable for re-use within proposed garden areas as subsoil (to raise levels, as appropriate) or for landscaping / capping on alternative developments (subject to regulatory approval and the production of any necessary plans or permits) where surplus arisings are generated from the site and adequate control measures are in place.

Should off-site disposal be required, the chemical testing regime can be different to the chemical testing required to assess the suitability of the soils for retention on site and the risks to human health and Controlled Waters. Therefore, Waste Acceptance Criteria (WAC) testing may be required to confirm disposal costs. It is recommended that, in the first instance, the soil test results (total concentrations) obtained for the soils proposed to be disposed of at landfill, are issued to the selected / preferred landfill operator(s) / waste disposal contractor for initial appraisal and formal classification purposes prior to removal.

8.4 General Considerations

8.4.1 Construction Workers

It is recommended that construction personnel involved with direct contact with the soils at the site use appropriate PPE / RPE equipment together with hygiene facilities in accordance with general health and safety guidelines.

The chosen Contractor should undertake the necessary Risk Assessments and Method Statements (RAMS) to determine the most appropriate protection required for safe working practices at the site.

Appropriate consideration (by a suitably trained qualified professional) should be given to health and safety procedures for personnel working in asbestos contaminated soils, where encountered in the far southern portion of the site. The requirement for RPE and other protective measures should be confirmed following the outcome of a risk assessment relating to asbestos, as discussed in Section 8.4.2.

A copy of this report should be included in the site health and safety file, and site workers should be made fully aware of the sites setting.

8.4.2 Asbestos Survey & Demolition Rubble

The existing structures at the site have the potential to include asbestos containing materials (ACMs). It is recommended that a suitable asbestos survey is undertaken on all site buildings prior to demolition / conversion. Any ACMs encountered should be removed off-site by a suitably qualified contractor prior to redevelopment.

The demolition rubble generated from the existing buildings may be suitable for use to raise levels (if necessary), subject to confirmatory testing.

8.4.3 Utilities

Prior to development of the site, we would recommend that a copy of this report is supplied to utility companies, and that their recommendations relating to appropriate supply pipes are adhered to.

Based on the results of the soil sampling detailed herein to enable an initial assessment of the likely requirements for the composition of the water supply pipework, all contaminant concentrations are below the PE threshold and the use of protective / barrier water supply pipes is considered not necessary.

8.4.4 Unforeseen Circumstances

Should any areas of potentially contaminated soil be encountered during site construction works we would recommend consultation with GeoDyne to ensure that our recommendations continue to apply. This includes maintaining a watching brief during removal of the floor slabs to the former workshop-type buildings. Any potentially contaminated soils should be left in-situ and subjected to further assessment, to potentially include further chemical testing and risk assessment.

The following procedure should be adhered to if any areas of previously unidentified suspected contamination are encountered during the development of the site:

i. Suspected contaminated material will remain in-situ.
ii. GeoDyne to be notified. We will then undertake a visual assessment of the possible contamination, followed by appropriate sampling/testing (as necessary).
iii. If necessary, contamination will then be treated or removed from site. All necessary remediation works should be validated by testing in accordance with an approved strategy, with the relevant Regulators informed accordingly.

8.4.5 Licenses, Permits, Registrations, Plans and Approvals

The Contractor / Developer is responsible for, and must ensure that, all necessary licenses, permits, plans, registrations and approvals are in place prior to commencing with the construction works at the site.

These may include any Materials Management Plans (MMPs), Site Waste Management Plans (SWMPs) and / or Environmental Permits / Exemptions as necessary to enable the completion of the proposed works. Any MMP should be accompanied by a Qualified Person Declaration (QPD) and will require verification in due course.

8.4.6 Statutory Consultation

In accordance with normal planning requirements, we would recommend that a copy of our report is issued by the Client to the Local Authority (and NHBC or other Warranty Provider, if necessary) for review / comment and approval prior to commencing with the development of the site.

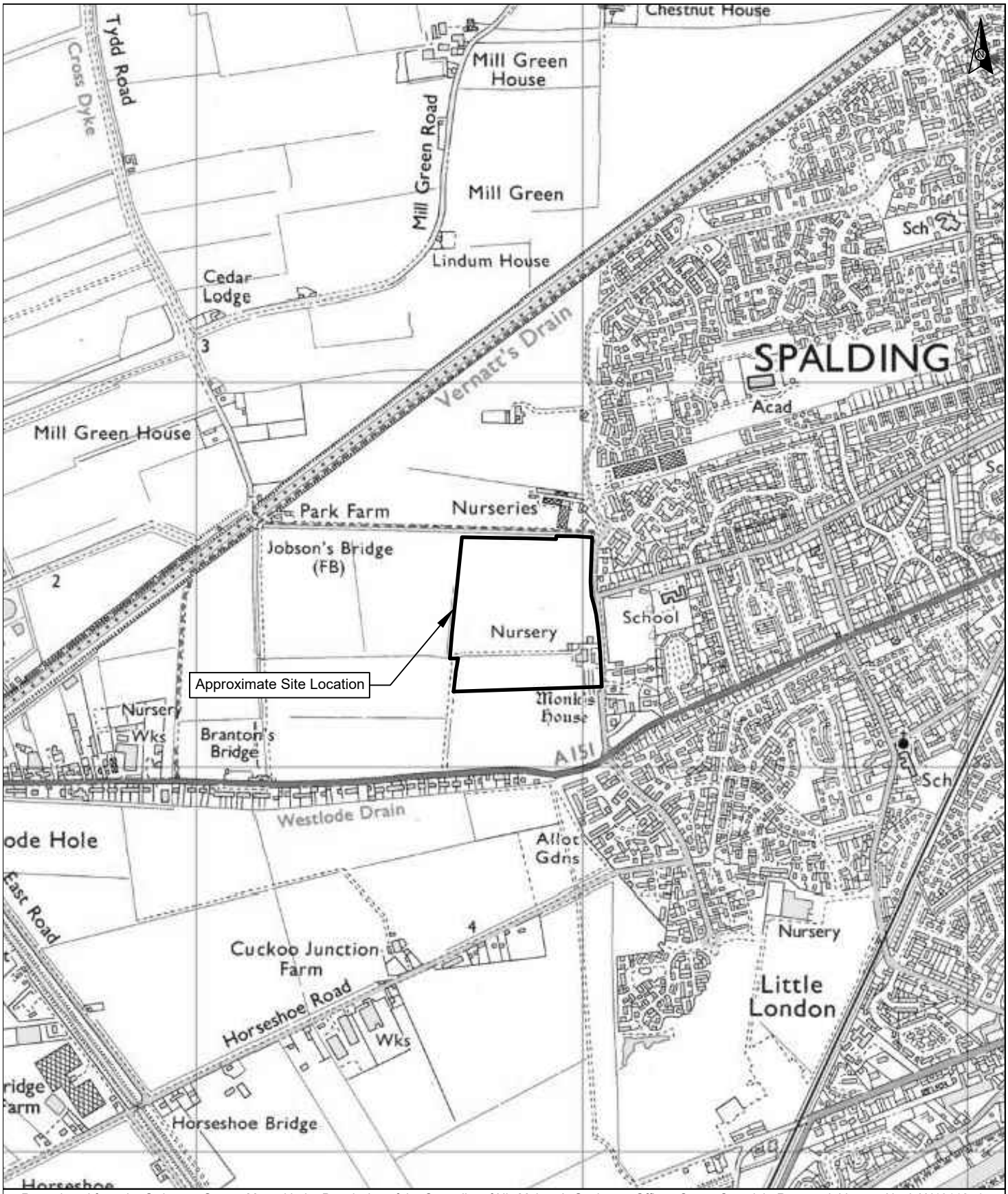
8.4.7 Further Works

Based on the findings of the investigation to date, it is recommended that the following further works are undertaken at the site:

- Undertaken further topsoil contamination testing to provide further assurance on the chemical suitability of the topsoil due to the significant volume (approximately 40,000m^3) of topsoil present at the site.
- Potentially undertake plot-specific works to obtain a greater density of exploratory holes across the site allowing a more detailed assessment of the ground, which would enable a ground bearing pressure to be calculated. Any further works would need to be supplemented by in-situ field testing, laboratory soil testing and settlement calculations. However, there are no guarantees that further intrusive works would enable strips, rafts or trench fill foundations to be utilised at the site.

APPENDIX I

Site Location Plan
(Figure No. D44118/01)



Project No.	D44118	Drawn By	ACH
Client	Seagate Homes	Checked By	RS
		Approved By	PK
Project	Monks House Lane West, Spalding	Scale	NTS
		Date Drawn	30/01/2025
Title	Site Location Plan	Revision	
		Figure No.	D44118/01

GeoDyne
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Derby 01332 290 798
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www.geodyne.co.uk

APPENDIX II

Proposed Development Layout

MONKS HOUSE LANE - WEST

NOTES:

All dimensions to be checked on site prior to construction or off-site fabrication by the Contractor, his Sub-contractor or Supplier.

Do not scale plans - use figure or grid dimensions where given.
Any deviation from the drawing is to be reported to the originator immediately.

IF IN DOUBT ASK !

N

House Breakdown (Phases 1 & 2)

1 Bed Houses	16
2 Bed Houses	51
3 Bed Houses	70
4 Bed Houses	21
5 Bed Houses	2
Total =	160

HYBRID APPLICATION

Total Site Area	- 35.47acres/ 14.35 Hectares
Detailed Area	- 14.61 Acres
Outline Area	- 20.86 Acres

Rev	Notes	Date	By
P05	Amendments to Layout following Seagate Review	18.02.25	MD
P04	Changes to layout following Seagate Review	16.01.25	MD
P03	Changes to layout following Seagate Review	15.01.25	MD
P02	House Type Legend added to plan	20.11.24	MD
P01	First Issue	29.07.24	MD

SEAGATE HOMES

Project:
PROPOSED RESIDENTIAL DEVELOPMENT,
MONKS HOUSE LANE WEST
SPALDING, LINCS.

Drawing:
MASTERPLAN

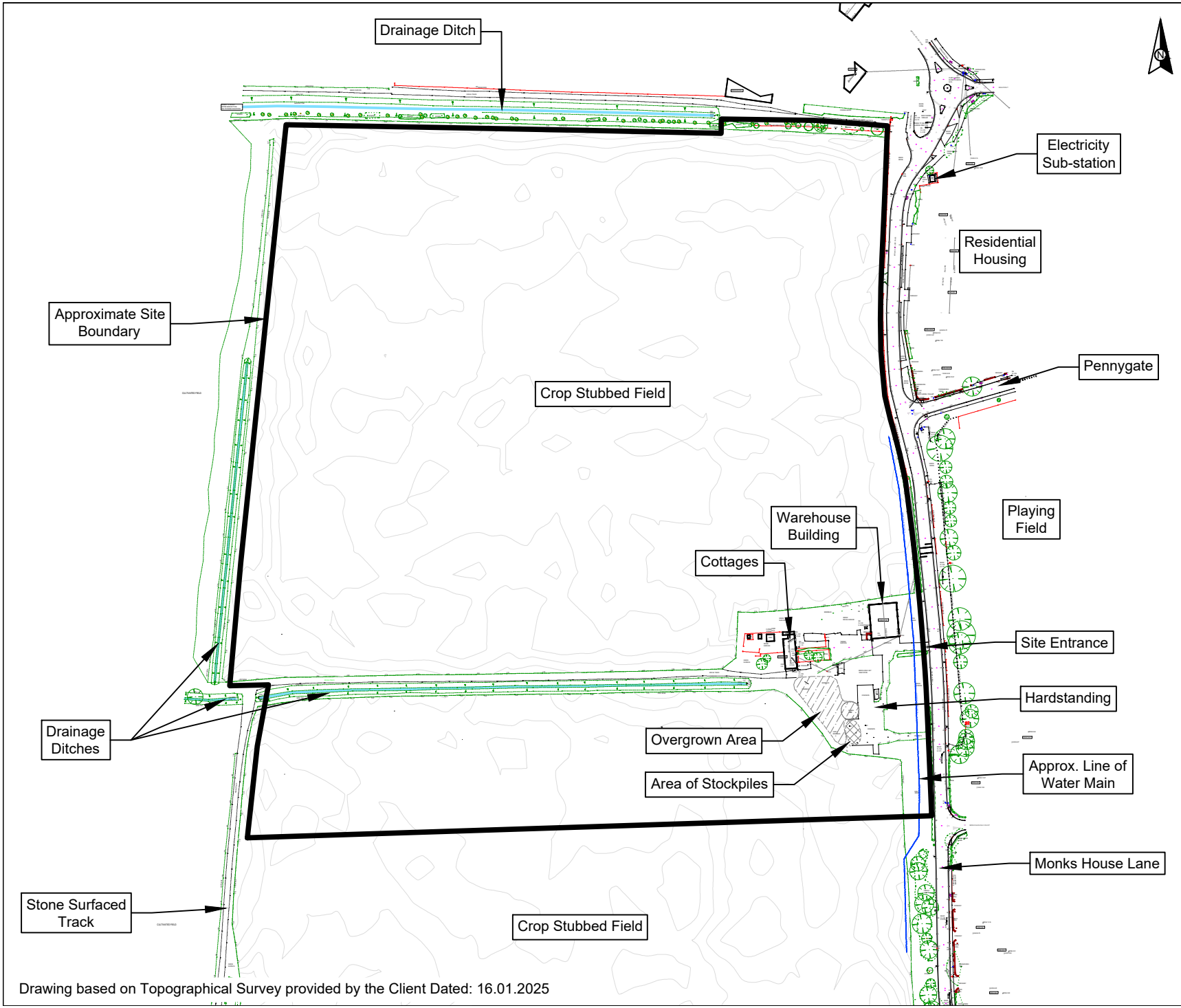
Drawn: MD
Date: 29.07.2024
Status: PRELIMINARY
Scale: 1:1000 @A1
Drawing Number: 10034-SGH-MP-AR-1000
Issue: P05

Scale : 1:1000 0 20 50 100

MASTER PLAN

APPENDIX III

Annotated Site Plan
(Figure No. D44118/02)



Drawing based on Topographical Survey provided by the Client Dated: 16.01.2025

Project No.	D44118
Client	Seagate Homes
Project	Monks House Lane West, Spalding
Title	Annotated Site Plan
Drawn By	ACH
Checked By	RS
Approved By	PK
Scale	NTS
Date Drawn	30/01/2025
Revision	
Figure No.	D44118/02

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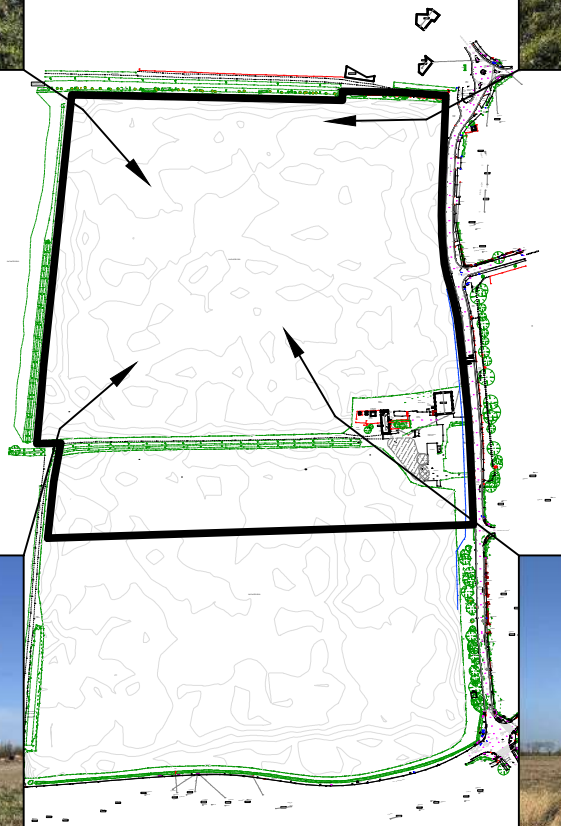
APPENDIX IV

Site Plans Showing General Site Views
(Figure No. D44118/03 & D44118/07)



Drawing based on Topographical Survey provided by the Client Dated: 16.01.2025

Project No.	D44118
Client	Seagate Homes
Project	Monks House Lane West, Spalding
Title	Site Plan and General Views of Site
Drawn By	ACH
Checked By	RS
Approved By	PK
Scale	NTS
Date Drawn	30/01/2025
Revision	
Figure No.	D44118/03

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Drawing based on Topographical Survey provided by the Client Dated: 16.01.2025

Project No.	D44118
Client	Seagate Homes
Project	Monks House Lane West, Spalding
Title	Site Plan and General Views of Site
Drawn By	ACH
Checked By	RS
Approved By	PK
Scale	NTS
Date Drawn	30/01/2025
Revision	
Figure No.	D44118/04

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Drawing based on Topographical Survey provided by the Client Dated: 16.01.2025

Project No.	D44118
Client	Seagate Homes
Project	Monks House Lane West, Spalding
Title	Site Plan and General Views of Site
Drawn By	ACH
Checked By	RS
Approved By	PK
Scale	NTS
Date Drawn	30/01/2025
Revision	
Figure No.	D44118/05

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Drawing based on Topographical Survey provided by the Client Dated: 16.01.2025

Project No.	D44118
Client	Seagate Homes
Project	Monks House Lane West, Spalding
Title	Site Plan and General Views of Site
Drawn By	ACH
Checked By	RS
Approved By	PK
Scale	NTS
Date Drawn	30/01/2025
Revision	
Figure No.	D44118/06

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Drawing based on Topographical Survey provided by the Client Dated: 16.01.2025

Project No.	D44118
Client	Seagate Homes
Project	Monks House Lane West, Spalding
Title	Site Plan and General Views of Site
Drawn By	ACH
Checked By	RS
Approved By	PK
Scale	NTS
Date Drawn	30/01/2025
Revision	
Figure No.	D44118/07

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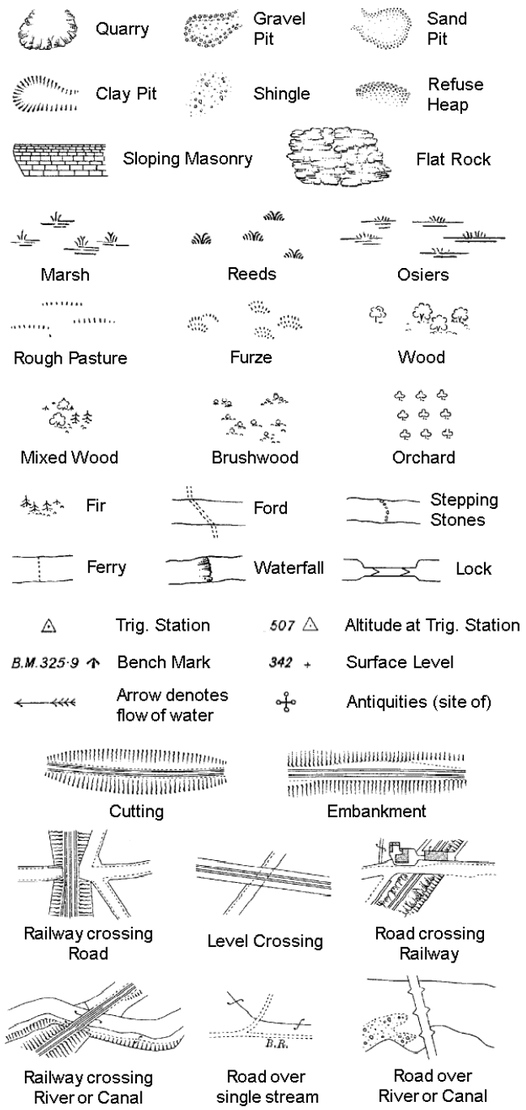
APPENDIX V

Historical Plans

Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



County Boundary (Geographical)

County & Civil Parish Boundary

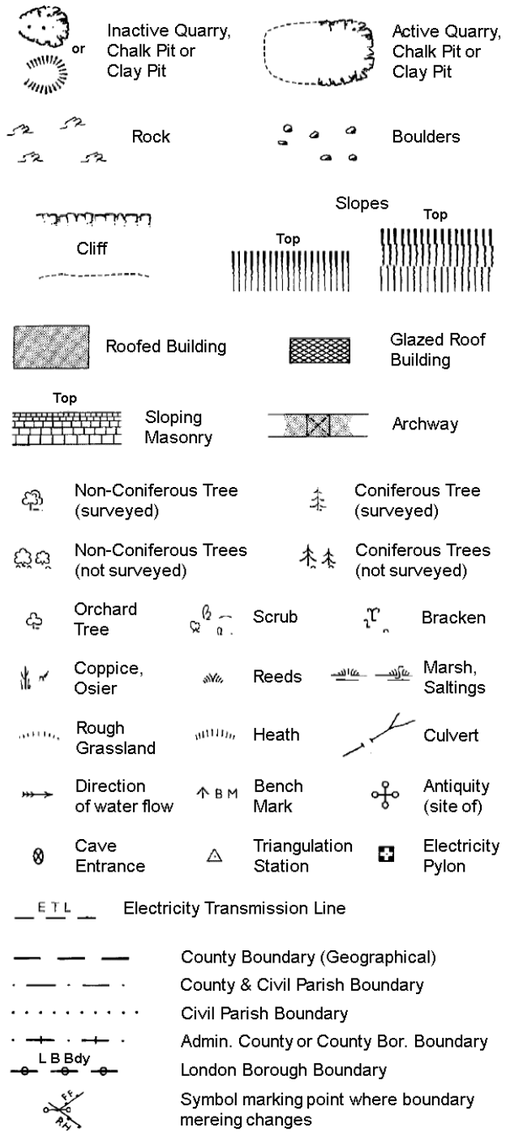
Administrative County & Civil Parish Boundary

Co. Boro. Bdy. County Borough Boundary (England)

Co. Burgh Bdy. County Burgh Boundary (Scotland)

B P B S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



County Boundary (Geographical)

County & Civil Parish Boundary

Civil Parish Boundary

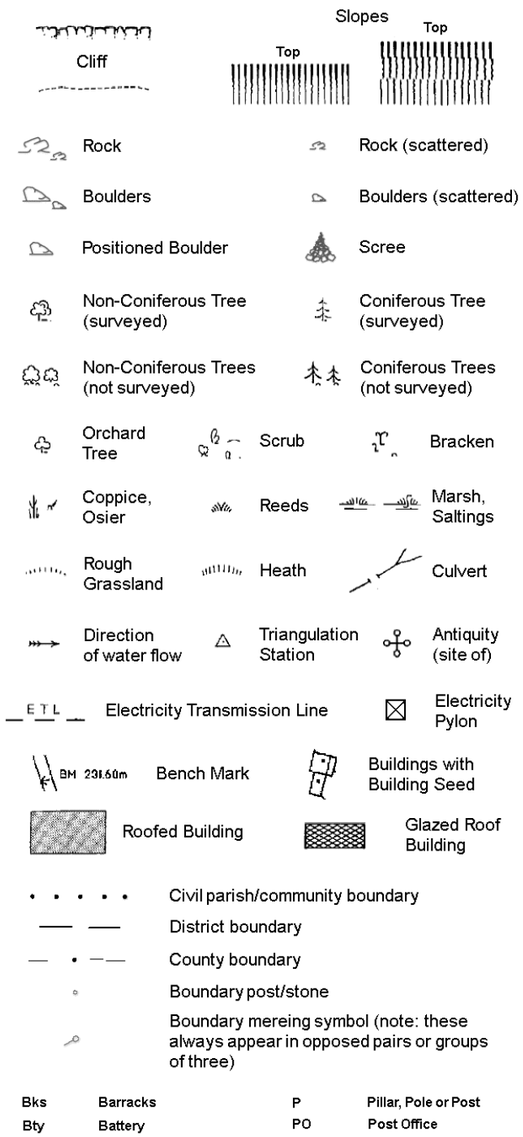
Admin. County or County Bor. Boundary

L B Bdy London Borough Boundary

Symbol marking point where boundary mereing changes

BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



Civil parish/community boundary

District boundary

County boundary

Boundary post/stone

Boundary mereing symbol (note: these always appear in opposed pairs or groups of three)

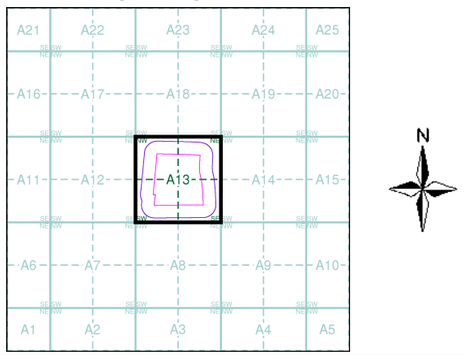
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

GeoDyne

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Lincolnshire	1:2,500	1889	2
Lincolnshire	1:2,500	1904	3
Lincolnshire	1:2,500	1931 - 1932	4
Ordnance Survey Plan	1:2,500	1968	5
Additional SIMs	1:2,500	1977 - 1987	6
Ordnance Survey Plan	1:2,500	1980 - 1983	7
Ordnance Survey Plan	1:2,500	1983	8
Additional SIMs	1:2,500	1983 - 1992	9
Additional SIMs	1:2,500	1986	10
Additional SIMs	1:2,500	1989	11
Additional SIMs	1:2,500	1992	12
Large-Scale National Grid Data	1:2,500	1995	13
Historical Aerial Photography	1:2,500	1999	14

Historical Map - Segment A13



Order Details

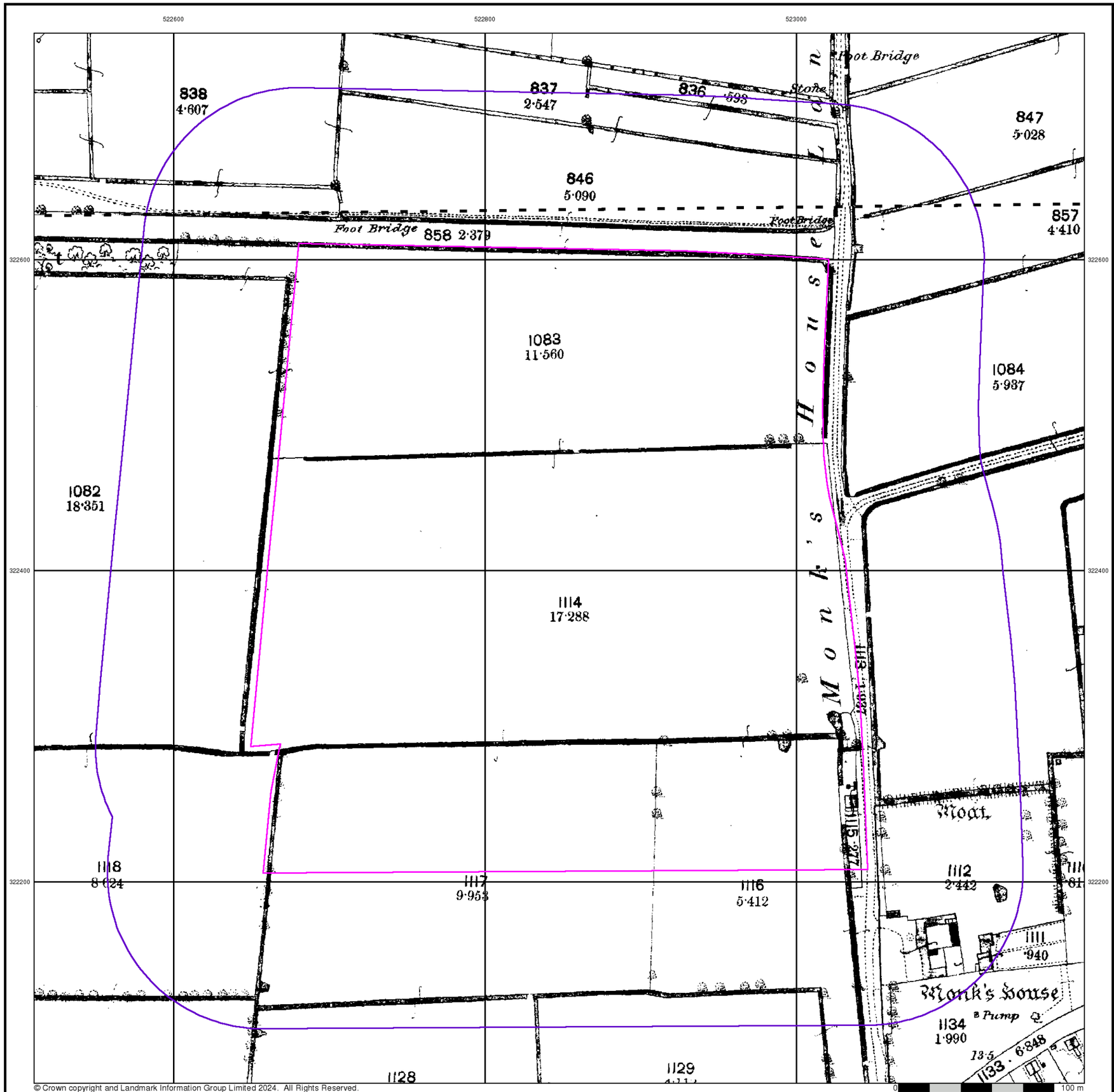
Order Number:	365720650_1_1
Customer Ref:	D44118
National Grid Reference:	522850, 322400
Slice:	A
Site Area (Ha):	14.64
Search Buffer (m):	100

Site Details

Monks House Lane West, Spalding

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



GeoDyne

Lincolnshire

Published 1889

Source map scale - 1:2,500

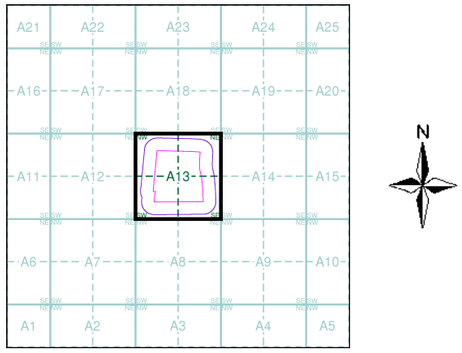
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

134_13
1889
1:2,500

142_01
1889
1:2,500

Historical Map - Segment A13



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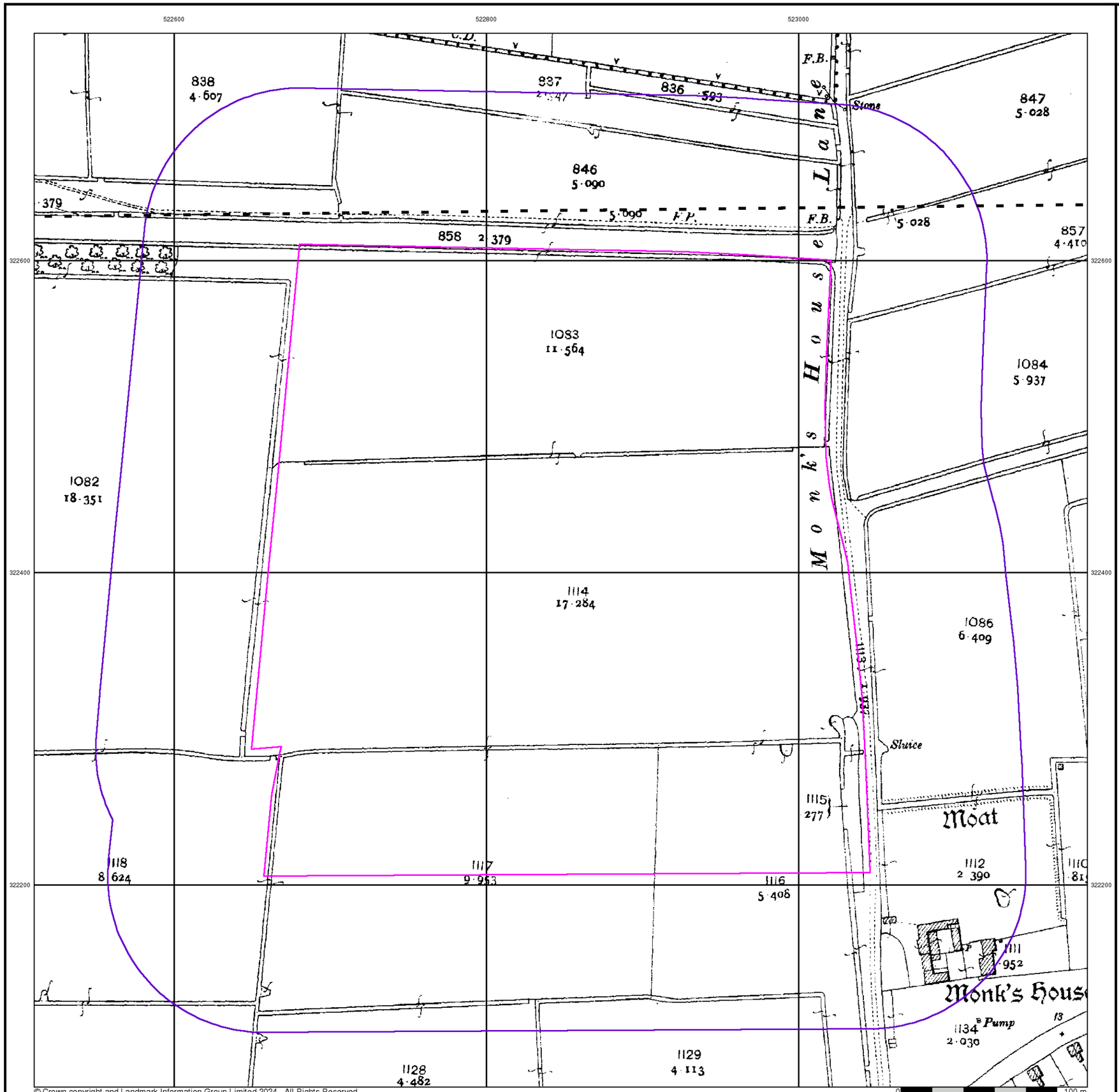


GeoDyne

Lincolnshire

Published 1904

Source map scale - 1:2,500

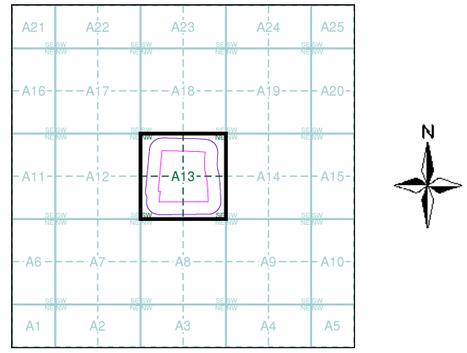
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

134_13
1904
1:2,500

142_01
1904
1:2,500

Historical Map - Segment A13



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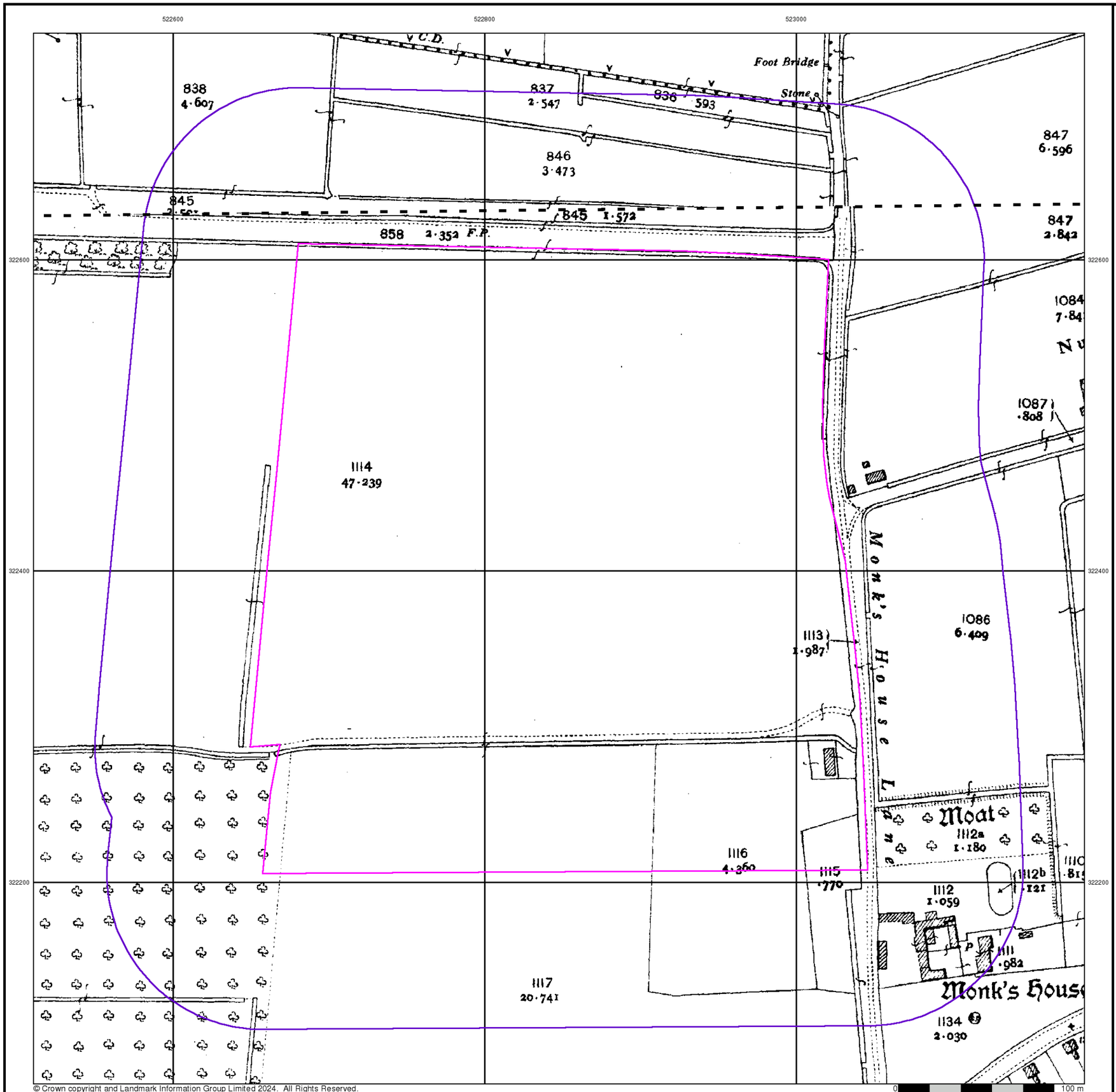

GeoDyne

Lincolnshire

Published 1931 - 1932

Source map scale - 1:2,500

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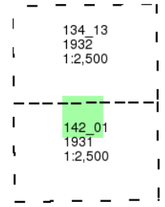
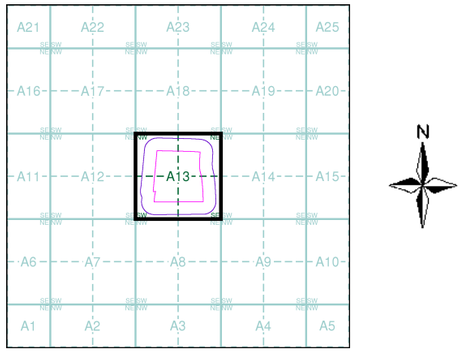


Historical Map - Segment A13



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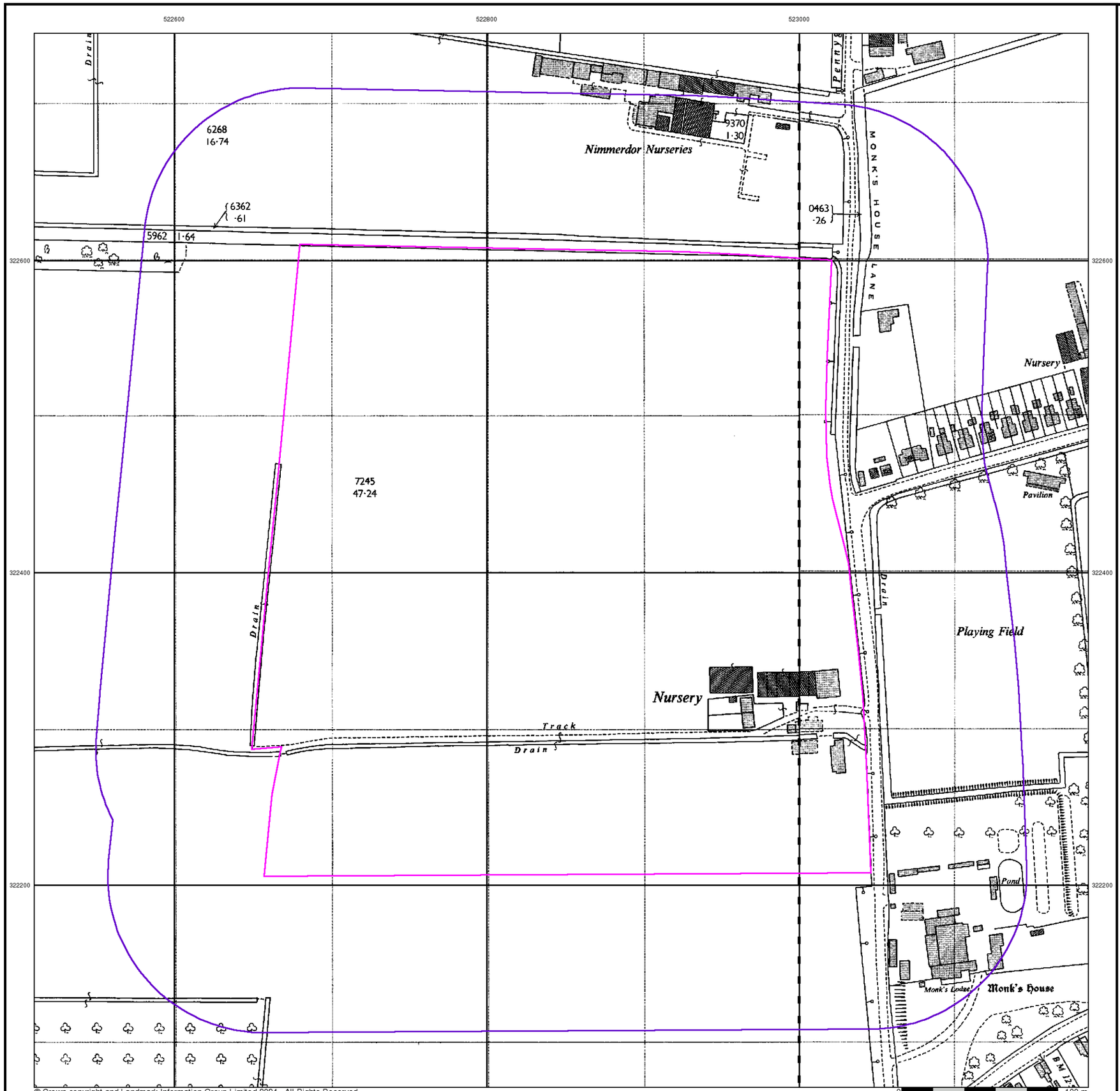

GeoDyne

Ordnance Survey Plan

Published 1968

Source map scale - 1:2,500

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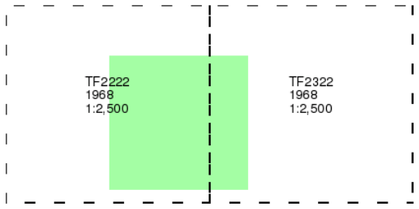
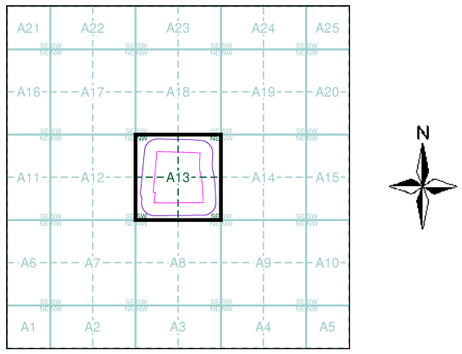


Historical Map - Segment A13



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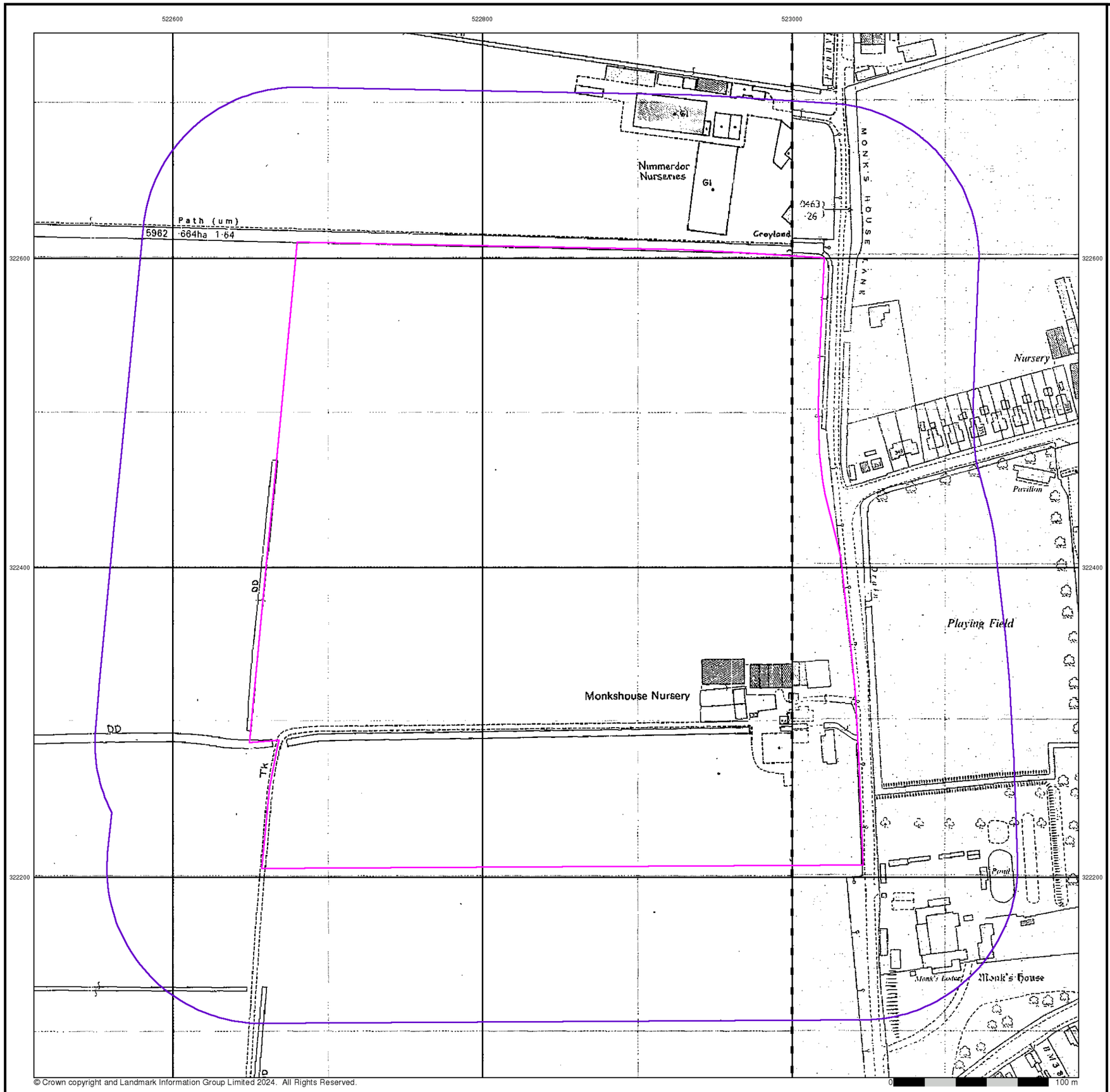


GeoDyne

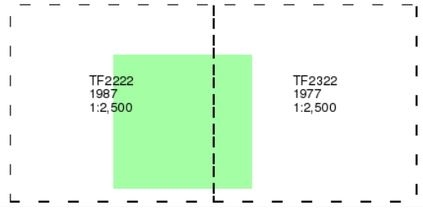
Additional SIMs

Published 1977 - 1987

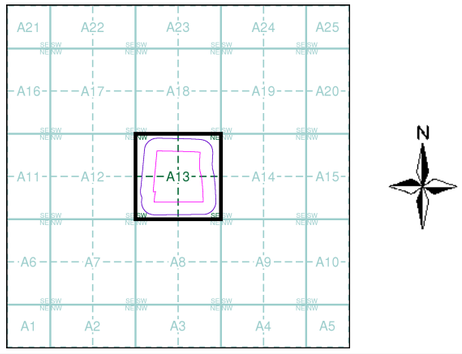
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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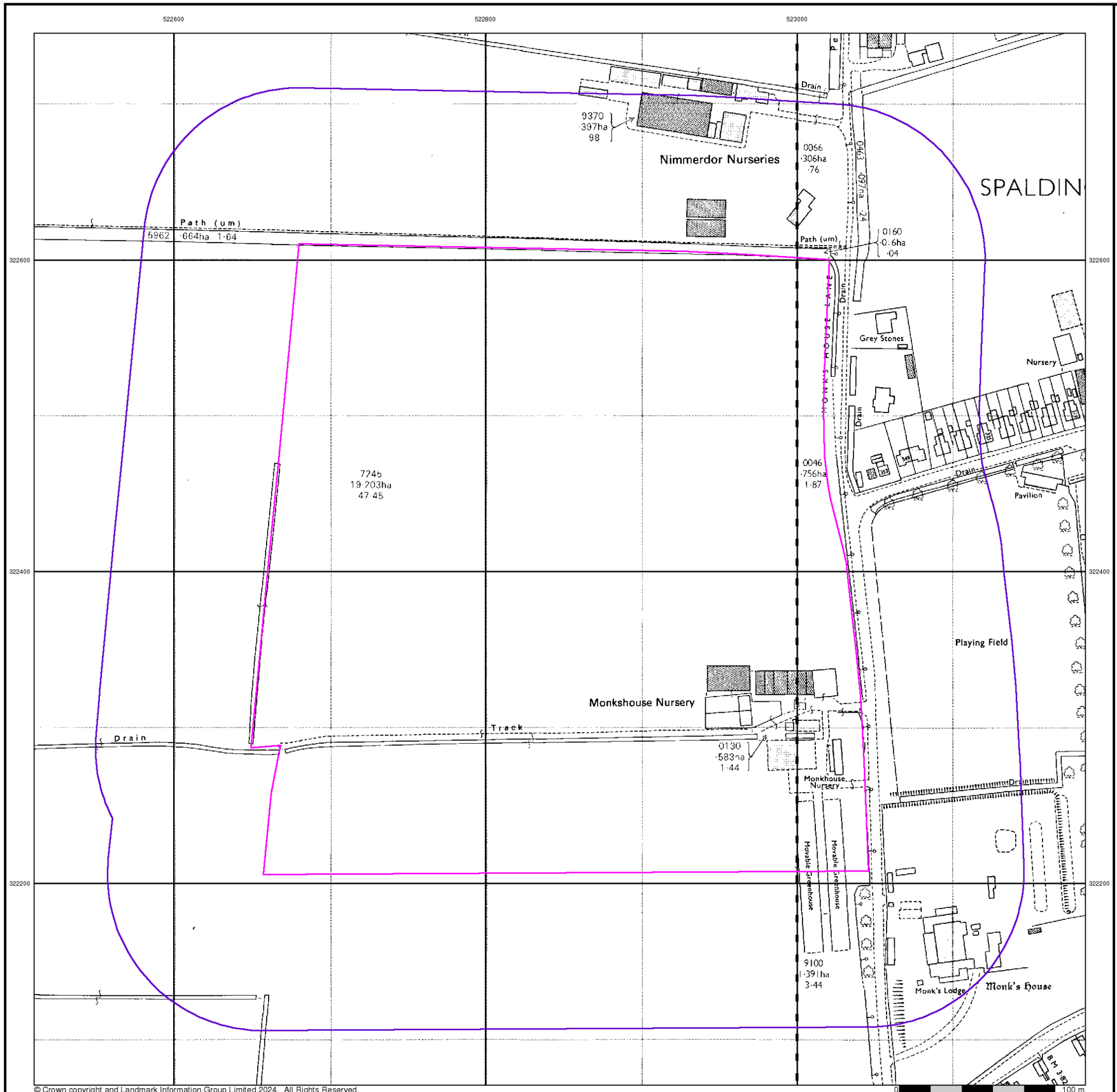

GeoDyne

Ordnance Survey Plan

Published 1980 - 1983

Source map scale - 1:2,500

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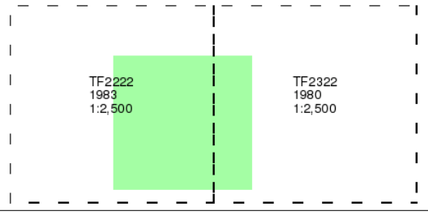
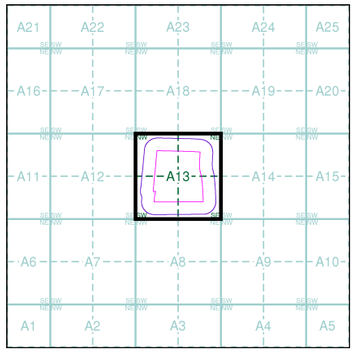


Historical Map - Segment A13



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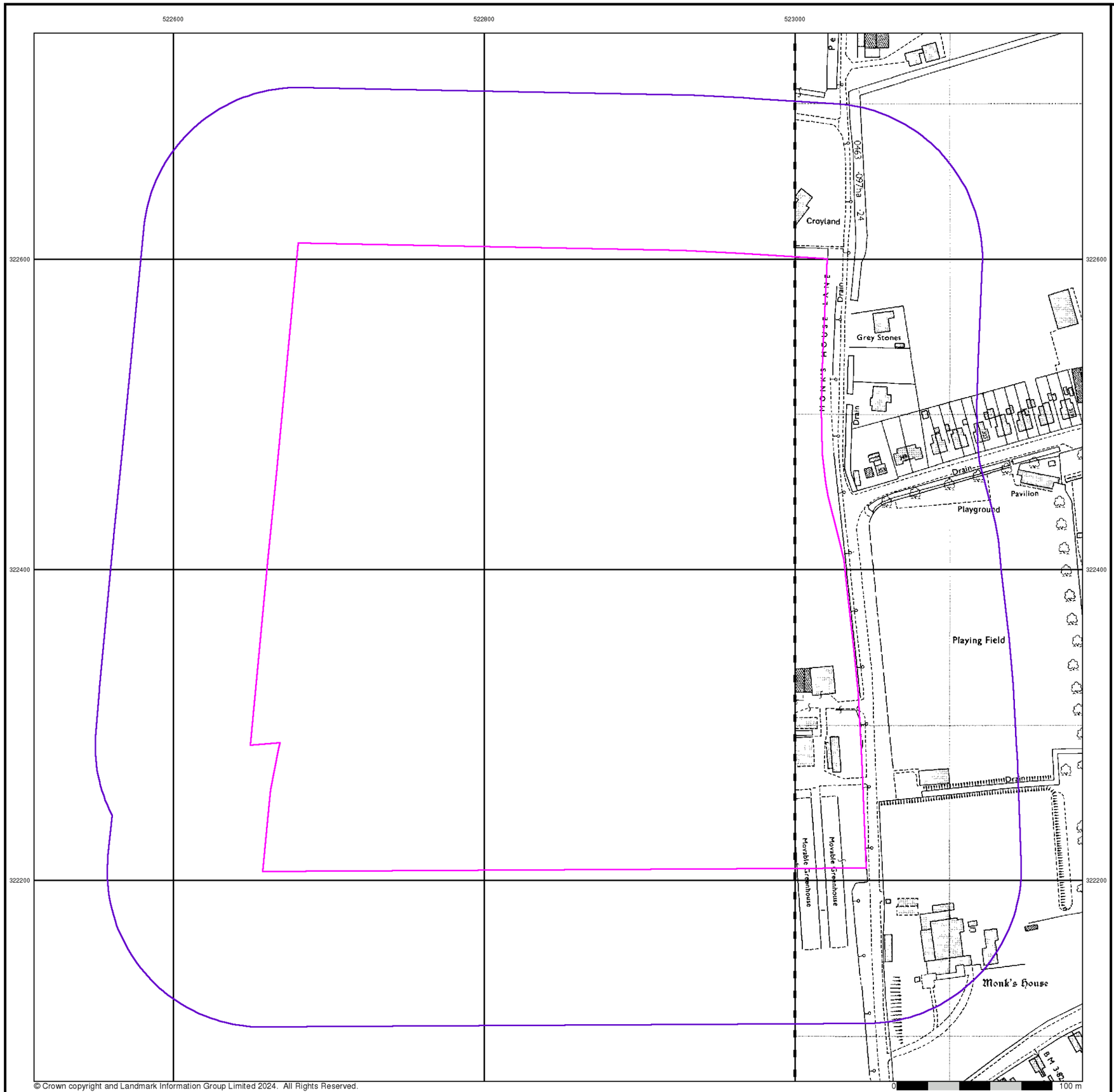

GeoDyne

Ordnance Survey Plan

Published 1983

Source map scale - 1:2,500

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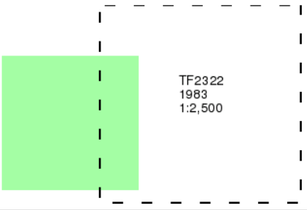
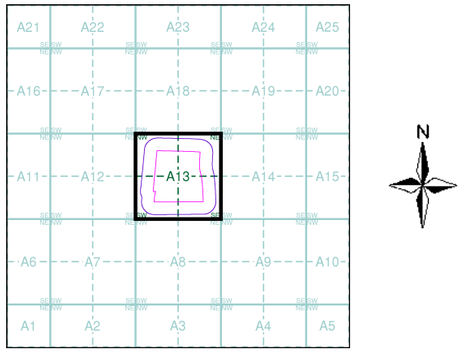


Historical Map - Segment A13



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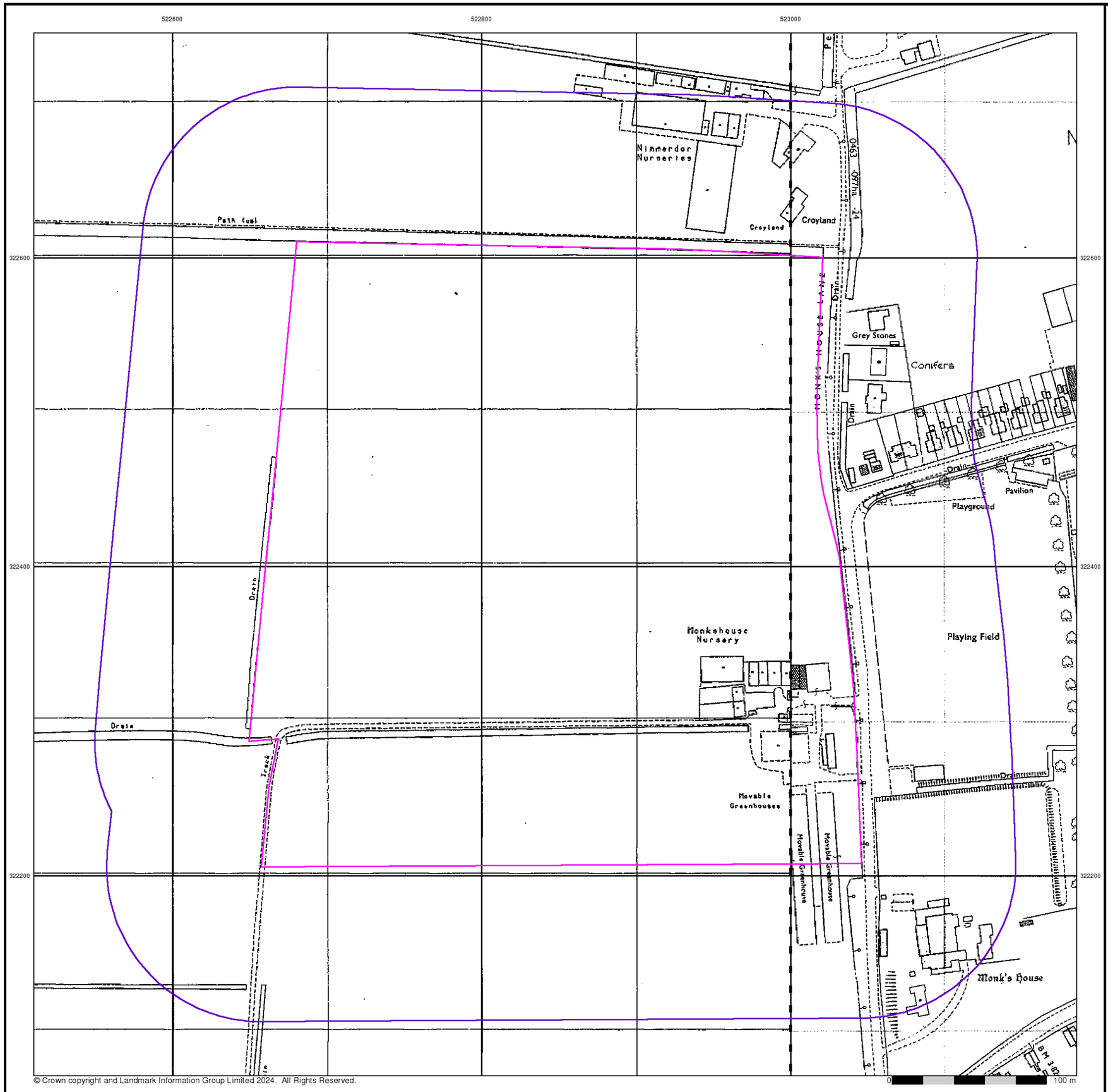


GeoDyne

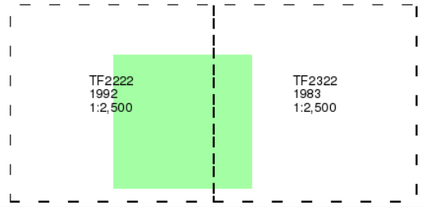
Additional SIMs

Published 1983 - 1992

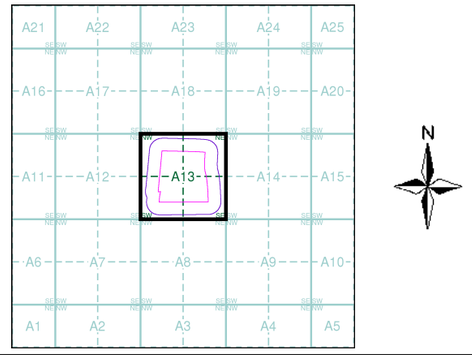
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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GeoDyne

Additional SIMs

Published 1986

Source map scale - 1:2,500

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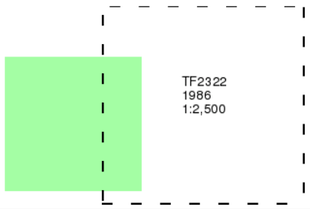
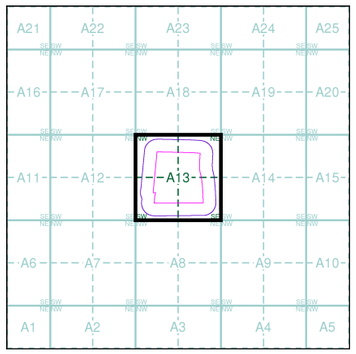


Historical Map - Segment A13



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GeoDyne

Additional SIMs

Published 1989

Source map scale - 1:2,500

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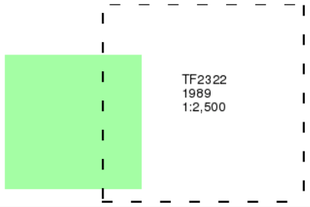
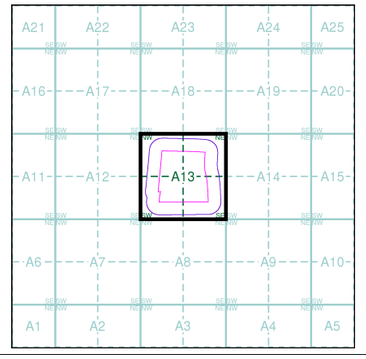


Historical Map - Segment A13



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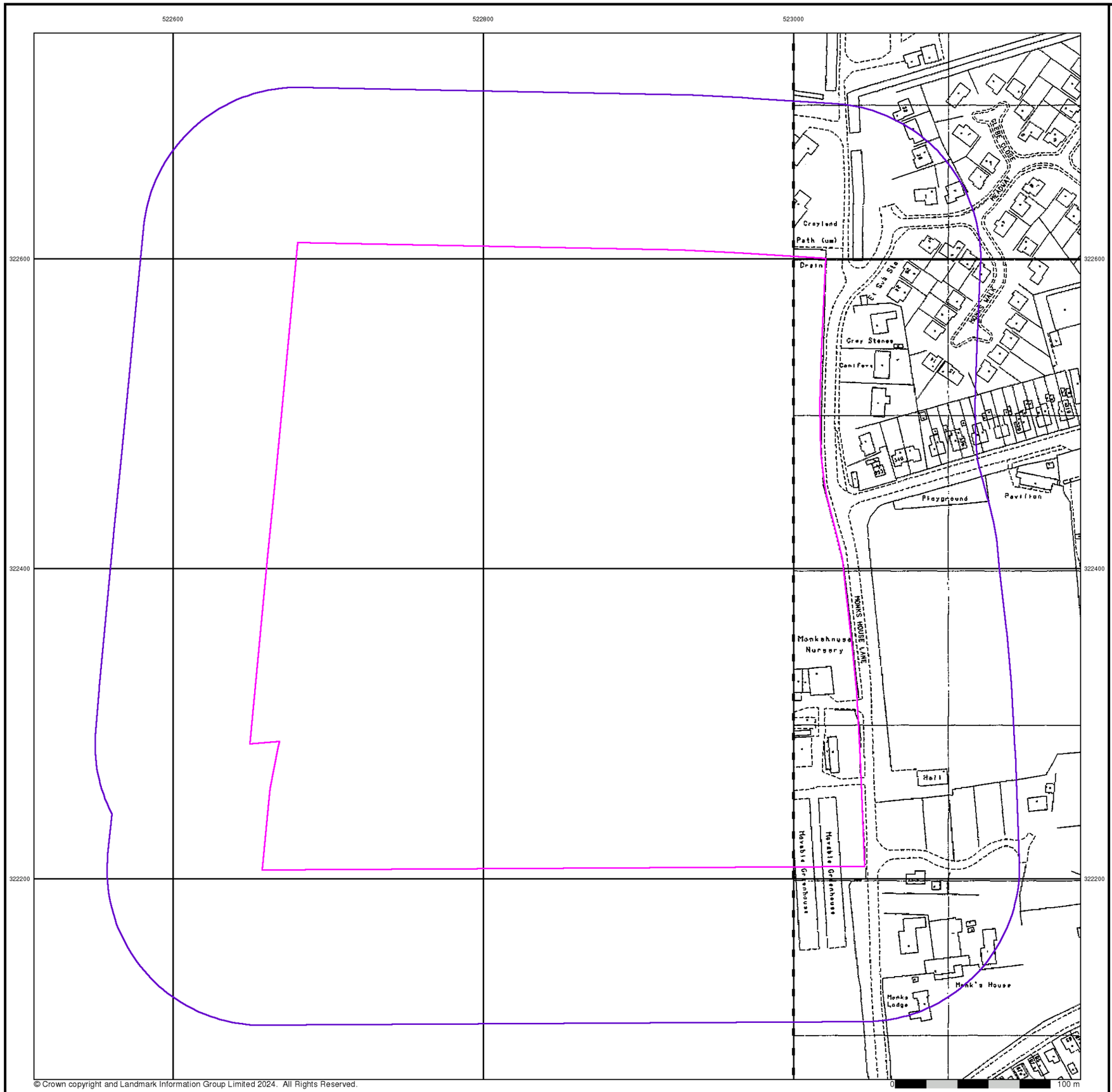


GeoDyne

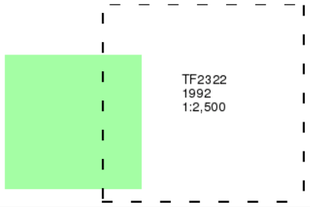
Additional SIMs

Published 1992

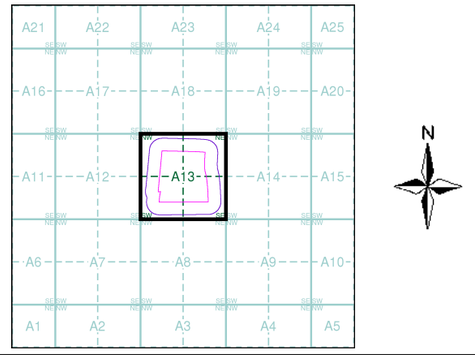
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



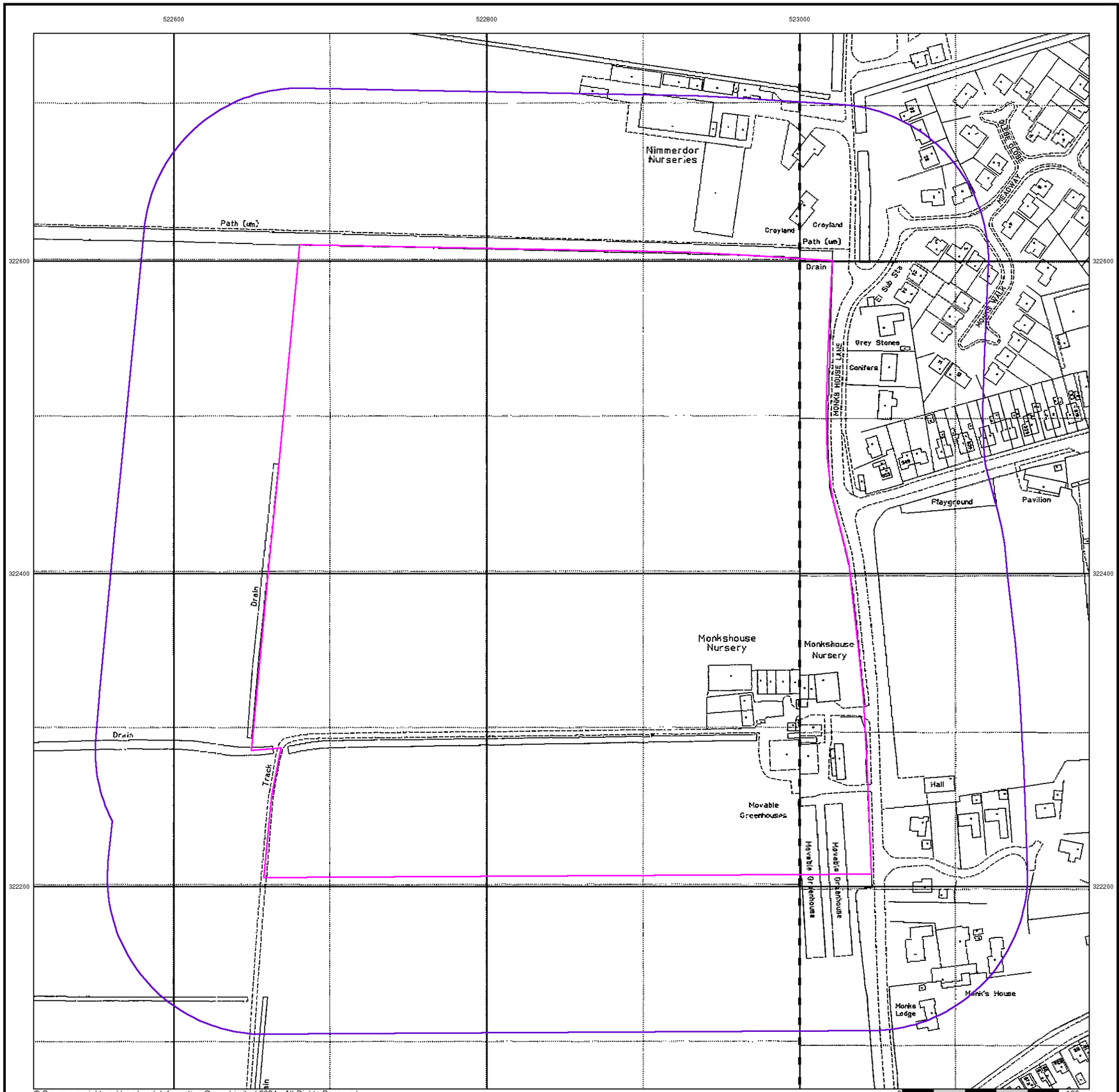
Order Details

Order Number:	365720650_1_1
Customer Ref:	D44118
National Grid Reference:	522850, 322400
Slice:	A
Site Area (Ha):	14.64
Search Buffer (m):	100

Site Details

Monks House Lane West, Spalding

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



GeoDyne

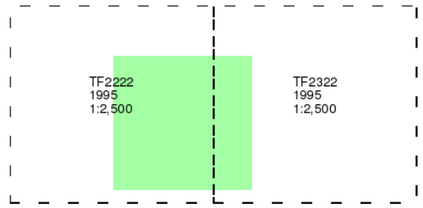
Large-Scale National Grid Data

Published 1995

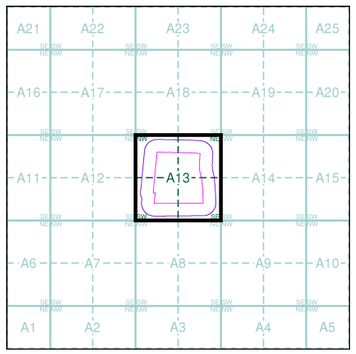
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



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