PHASE 1 GEO-ENVIRONMENTAL GROUND INVESTIGATION
AT
LAND OFF
NANNY MARR ROAD, DARFIELD, BARNSLEY
ON BEHALF OF
PEVERIL SECURITIES LIMITED

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CONTENTS

1.0 EXECUTIVE SUMMARY

2.0 INTRODUCTION

- 2.1 General
- 2.2 Previous Site Investigations

3.0 BRIEF

4.0 LIMITATIONS OF INVESTIGATION WORK AND REPORT

5.0 THIRD PARTIES

6.0 SCOPE OF INVESTIGATION WORK

- 6.1 Walk Over Survey
- 6.2 Desk Study Documentation

7.0 FINDINGS

- 7.1 Description of the Site
- 7.2 Walk Over Survey
- 7.3 Geology
- 7.4 Site History
- 7.5 Waters and Flooding
- 7.6 Hazardous Installations, Landfill and Waste
- 7.7 Mining
- 7.8 Radon

8.0 CONCLUSIONS

- 8.1 General
- 8.2 Geology
- 8.3 Contaminated Land Legislative Framework
- 8.4 Sources of Contamination and Probable Contaminants
- 8.5 Pathways for Contamination
- 8.6 Targets of Contamination
- 8.7 Conceptual Model for Human Health Risk Assessment
- 8.8 Conceptual Model for Waters Risk Assessment
- 8.9 Preliminary Risk Assessment Summary
- 8.10 Scope of Intrusive Geo-Environmental Ground Investigation

9.0 RECOMMENDATIONS

APPENDICES

APPENDIX 1	SITE LOCATION PLANS AND AERIAL PHOTOGRAPH
APPENDIX 2	WALK OVER SURVEY PHOTOGRAPHS
APPENDIX 3	HISTORICAL ORDNANCE SURVEY MAPS
APPENDIX 4	ENVIRONMENTAL MAPS
APPENDIX 5	LANDMARK ENVIRONMENTAL REPORT
APPENDIX 6	EXTRACTS OF BGS GEOLOGICAL MAP, BGS BOREHOLE LOGS AND COAL AUTHORITY MINING REPORT
APPENDIX 7	EXTRACTS OF HPA AND BRE211 RADON ATLAS FOR ENGLAND AND WALES
APPENDIX 8	PROPOSED DEVELOPMENT PLAN

1.0 EXECUTIVE SUMMARY

1.1 Integra Consulting Engineers Ltd has been instructed by Peveril Securities Limited to undertake a Phase 1 geo-environmental ground investigation for land off Nanny Marr Road, Darfield, Barnsley. The Ordnance Survey national grid reference of the centre of the site is E441533, N404510.

1.2 It is the Clients' intention for the site to be developed into a mixed use development consisting of the erection of food retail units and associated parking with an area of residential development to the north for 35 dwellings. Consequently, the objectives of the report were to assess the probable geological and contaminated land conditions on and beneath the surface and to identify potential contaminants present at the site. A preliminary conceptual model was then to be developed to define the scope and extent of any further investigations deemed necessary.

1.3 The site is approximately 2.3 hectares in area and is located directly to the east of Nanny Marr Road, Darfield. The site currently consists of lightly vegetated land with trees and undulating topography with a Youth Centre located across the southern site section and is bound by housing on Coronation Street to the north, housing on Queen Street, Victoria Street and open land to the east, Barnsley Road to the south and Nanny Marr Road to the west.

1.4 The desk study carried out indicates that the site was developed from greenfield in the late 1930s into a school which was further expanded during the late 1940s and early 1960s prior to demolition in 2011. No significant off site uses were recorded in close proximity to the site.

1.5 After appraising the available historical and contemporary data including the BGS borehole information relating to the previous site investigation works, it is concluded that the site is at low risk of land contamination including ground gas.. Furthermore, no potential significant off site contaminative sources were recorded in proximity to the site.

1.6 Utilising the guidance stipulated in CIRIA 665 (2007) and CIRIA 552 (2001), the probability and consequence of the identified potential ground gas sources at the development is considered to result in a low level of risk. It is recommended that the site is assessed in accordance with the CL:AIRE Research Bulletin RB 17: *A Pragmatic Approach to Ground Gas Risk Assessment* (2012) to determine the requirement for ground gas monitoring and / or ground gas protection measures. This is subject to agreement with the relevant regulatory authority. Following a review of BRE 211 and HPA / BGS radon reports no radon protective measures are considered necessary at the post development site.

1.7 As a result of the information gathered from this report, there is a low potential risk to human health including ground gas and controlled waters at the current and proposed site mainly due to a lack of a contamination sources identified at the site. However, due to the highly sensitive nature of the site t further appraisal utilising chemical testing along with targeted and spatial chemical testing of any potential contaminative sources recorded onsite will be required. Consequently, a Phase 2 environmental intrusive investigation is deemed necessary.

1.8 Due to geotechnical requirements, site investigation works should be undertaken in order to determine the ground conditions with a greater degree of certainty and allow design of the proposed residential and retail unit foundations, drainage, services and external areas to be undertaken, it is recommended that trial pits are constructed across the site to primarily determine the depth of the underlying bedrock, made ground thickness and constituents. Following this shell and auger boreholes should be undertaken utilising the trial pit information to allow in-situ geotechnical density tests to be undertaken where appropriate at the site. Depending on the demolition specification, it may be prudent to undertake intrusive works to determine the presence of underlying obstructions associated with historic foundations / ground obstructions.

1.9 It should be noted that, if any visual or olfactory evidence of contamination is encountered during remediation or construction work, then the Local Authority Environmental Health Officer and Environment Agency should be contacted immediately in order to agree any necessary remediation measures.

2.0 INTRODUCTION

2.1 General

This Phase 1 geo-environmental ground investigation and report (Revision A) has been prepared at the request of Peveril Securities Limited.

Instructions to proceed with the original report were received in September 2013. Desk study work was undertaken between 21 October and 14 November 2013. The walk over survey was carried out on 14 November 2013. This revision has been undertaken on the basis of an alteration to the proposed development and the Client in October 2014.

This Phase 1 report is to be used for submission to the Local Authority as part of a planning application as it is the Client's intention for the site to be developed into a mixed use development consisting of the erection of food retail units and associated parking with an area of residential development to the north for 35 dwellings.

The proposed development plan is contained within Appendix 8. It should be noted that this plan is not frozen and is subject to change at a later date.

2.2 Previous Site Investigations

It is understood that no previous site investigation reports have been undertaken at the site.

3.0 BRIEF

The brief was to carry out a Phase 1 geo-environmental ground investigation for land off Nanny Marr Road, Darfield, Barnsley. The extent of the site is shown on the aerial photograph and site plans contained in Appendix 1. The investigation was to include for the following studies:

a) A desk study involving examination of available geological maps, BGS borehole logs, historical Ordnance Survey maps, environmental maps, previous site investigation work (when available) and accessible historical records to assess the probable geological and contaminated land conditions on and below the site.

b) A walk over study of the site to ascertain any evidence of previous and current site uses that may have caused contamination of the ground and surface waters at the site. During the walk over survey, the topography of the site was to be noted along with any land features that could give an indication of probable sub-surface features and formations.

c) Identify probable contaminants that may be present at the site using current contaminated land guidance and identify potential receptors which could be at risk from potential contaminants.

d) Develop a conceptual model for the site to assess the potential risks of contamination and to undertake a preliminary risk assessment.

e) Determine whether further investigation and assessment is required.

f) Define the scope and extent of further investigations.

A detailed report was to be provided to summarise findings and recommendations.

4.0 LIMITATIONS OF INVESTIGATION WORK AND REPORT

Desk Study References

The desk study has been produced using historical Ordnance Survey maps and environmental maps available at the time the report has been produced. The environmental information used was the current information available at the time of writing but there is no absolute guarantee of accuracy.

Historical Ordnance Survey maps do not provide a comprehensive description of a site's history. They provide details of the site from a date prior to the publication of the map (i.e. a snapshot in time). The period between map editions can be substantial (i.e. several decades). Not all map series are available for every date range in many areas of the UK and therefore there will be gaps in this mapped record for some sites. Potentially contaminative land uses could have been present and removed during such periods and may therefore not form a part of this particular record. In addition, there will be potentially contaminative land uses which are not identified on the map records such as small scale storage / use of hazardous materials, illegal / unlicensed waste disposal activities etc.

Different map series identify different features utilising different symbols which can result in features that remain on site being removed from maps. Some features are also not mapped for security reasons i.e. airfields and other military installations. These areas are mostly shown as blank areas on historical maps.

Exploratory Holes

Where the spacing of exploratory holes for future intrusive investigation work has been presented as part of this report, the spacing has been determined to provide a reasonable indication of the general ground conditions and extent of land / groundwater contamination on the site but the number has ultimately been limited by commercial constraints. The ground conditions at the proposed exploratory holes are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between exploratory hole locations when preparing any assessments of the final foundation and land / groundwater remediation proposals.

Extent of Contamination Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection of the site if its presence is suspected.

Flooding

Flooding in this report is defined as flooding caused by the sea, ditches, rivers, streams, ponds, lakes, reservoirs and the like. It does not extend to flooding caused by surcharged piped drainage systems and investigations into flooding of this nature are excluded from this report.

5.0 THIRD PARTIES

This report has been prepared for the sole use of Peveril Securities Limited. It must not be copied or passed onto any third party or used for any purpose other than which it was prepared without the permission of the author. This report is copyright.

6.0 SCOPE OF INVESTIGATION WORK

6.1 Walk Over Survey

The site was visited during sunny and dry weather conditions and the objectives of the site walkover were, where applicable:

- to identify and assess visual and olfactory evidence of contamination e.g. staining of concrete / soils, odours, presence of gas protection measures etc;
- to identify locations of potential sources of contamination and assess their conditions i.e. tank location, presence / condition of secondary containment / bunds, location of fill points, process areas;
- to identify surrounding land uses and any potentially contaminating activities;
- to identify / verify the presence of potential receptors (on site and off site) which may be affected by identified sources;
- to obtain information on activities / procedures and standards of housekeeping etc.
- to assess site access and potential investigation locations and constraints.
- to assess any visual subsurface geotechnical features / anomalies e.g. foundations, made ground, subsidence etc

Photographs were taken of the site during the walkover survey and these photographs are contained in Appendix 2.

6.2 Desk Study Documentation

The following documents were obtained and examined during the desk study:

a) An aerial photograph of the site dated 2010. The photograph is contained in Appendix 1. It should be noted that the school noted on the aerial photograph was demolished since the photograph was taken with the exception of a small building utilised as a Youth Centre in the southern site section.

b) Historical Ordnance Survey maps as follows:

- 1:10560 dated 1854
- 1:2500 dated 1899
- 1:10560 dated 1894
- 1:2500 dated 1906
- 1:10560 dated 1906-1907
- 1:10560 dated 1931
- 1:2500 dated 1931
- 1:10560 dated 1938
- 1:10560 dated 1938-1948
- 1:10560 dated 1948
- 1:10000 dated 1955-1956
- 1:2500 dated 1962
- 1:10000 dated 1967
- 1:2500 dated 1971
- 1:1250 dated 1982
- 1:10000 dated 1980-1983
- 1:10000 dated 1989
- 1:1250 dated 1993
- 1:1250 dated 1993-1995
- 1:1250 dated 1996 (x2)
- 1:10000 dated 2006
- 1:10000 dated 2013

These maps are contained in Appendix 3.

c) Environmental maps obtained through Envirocheck as follows:

- Environment Agency and hydrological map dated 1999 - 2013
- Groundwater vulnerability map dated 1999
- Sensitive land uses map dated 1997 - 2013
- Summary maps showing locations of recorded waste sites, industrial land use sites and hazardous substances sites in adjacent areas.

These maps are contained in Appendix 4.

d) An environmental report obtained from Landmark, the environmental database company, which provides a list of recorded past and present activities at or adjacent to the site which could have an impact on the levels of contamination in the soils and groundwater at the site. This report is contained in Appendix 5.

e) The British Geological Survey (BGS) 1:10,000 solid and drift map (reference SE 40 SW). A part extract of the map covering the area under consideration is contained in Appendix 6. Fourteen BGS boreholes, constructed across the northern section of the site in 1971, were obtained - these borehole logs are contained in Appendix 6. The extracts have been copied under licence from the British Geological Society.

f) A Coal Authority mining Report for the site reference: 51000381808001. This report is contained within Appendix 6.

g) The Indicative Atlas of Radon for England and Wales published by the British Geological Survey and the Health Protection Agency was examined to assess the probable presence or otherwise of radon gas in the ground. Extracts of the relevant maps are contained in Appendix 7.

7.0 FINDINGS

7.1 Description of the Site

The site is approximately 2.3 hectares in area and is located directly to the east of Nanny Marr Road, Darfield as shown in the location plans in Appendix 1. The national Ordnance Survey grid reference for the centre of the site is E441533, N404510 and it is located at post code S73 9AB.

The site currently consists of lightly vegetated land with trees and undulating topography with a Youth Centre located across the southern site section and is bound by housing on Coronation Street to the north, housing on Queen Street, Victoria Street and open land to the east, Barnsley Road to the south and Nanny Marr Road to the west.

An aerial photograph of the site prior to works commencing is also contained in Appendix 1.

7.2 Walk Over Survey

During the walk over survey, the following features were noted relating to geology and contaminated land matters:

Geology

The site was noted to consist of lightly vegetated with the exception of sporadic trees across the western and central site sections which are noted to be mature and in excess of 10m in height.

The site ground was firm underfoot.

During the site walkover it was noted that the natural topography sloped from the western site boundary towards the eastern site boundary with the exception of areas disturbed by the previous onsite school development. For instance, cuttings into the natural strata are noted across the northern site section which has resulted in steep 2.5m to 3m high slopes.

Numerous service covers were noted across the site including drainage, gas etc although it is noted that the non-drainage services have been disconnected.

Contaminated Land

No potential contaminative sources were identified at the site.

Photographs taken during the walkover survey are contained in Appendix 2.

7.3 Geology

The BGS 1:10,000 geological map of the area shows the site to be underlain by Mexborough Rock (sandstone). No superficial deposits are noted on the map.

An extract of the geological map is contained in Appendix 6.

7.3.1 BGS Borehole Logs

Fourteen BGS borehole logs were obtained located across the northern section of the site. These boreholes were undertaken in August 1971 and are anticipated to be associated with the development of the school across this area. The topography recorded within these boreholes is noted to be uniform and recorded the following ground conditions:

- TOPSOIL / TARMAC to a depth of between 0.25m and 0.53m underlain by
- Light brown / brown, slightly clayey to very clayey, occasionally silty SAND with sandstone fragments to a depth of between 1.4m and 1.98m underlain by
- Weathered SANDSTONE to a depth of between 2.82m and 3.43m below ground level, where the boreholes are terminated.

No groundwater was recorded within any of the borehole constructions.

Standard Penetration Tests were undertaken within the boreholes and the sand recorded N-Values between 14 and 52 and the underlying sandstone recorded N-Values between 61 and 151. The N-Values typically increased with depth through each strata / borehole depth. The BGS borehole logs are contained in Appendix 6.

7.4 Site History

The site development history has been researched with reference to historical maps and street plans. These are included in Appendix 3 to this report and the principal observations, divided into site and off site history are summarised below.

Site History

Dates	Site Features
1854 - 1938	The site is noted to be open land with a footpath located across the site from the south west to the eastern site boundary. By 1906, the northern site section is noted to be allotment gardens and the southern section by 1931 is noted as a recreational field.
1938 - 2011	The southern and central site section is noted to have been developed as a school (Darfield Foulstone) with an access road crossing the central section of the site running west to east. By 1962, further expansion of the school has occurred across the southern section. By 1948, the northern section of the site is noted as a football ground which by 1982 was redeveloped into an extension of the existing school to the south with associated earthworks recorded. An electrical sub-station is noted in 1971 on the southern extremity of the site.
2011 - 2013	With the exception of a Youth Centre the site buildings have been demolished.

Off Site History

The majority of the off site history consisted of rural and more recently residential land, with the exception of:

- A ‘works’ located approximately 130m east of the site.

7.5 Waters and Flooding

Environmental data relevant to the site and its immediately surrounding area has been obtained from sources available in the public domain. In addition, an environmental report was obtained from Landmark, the commercial suppliers of environmental data. The Landmark report and associated maps that have been inspected are presented in Appendices 4 and 5 and the principal observations in relation to waters and flooding can be summarised as follows:

Flooding

- The site is located within an area designated as Flood Zone 1.

Surface Water

- The nearest surface water feature is located approximately 390m east and relates to the River Dearne.
- No surface water abstraction points are noted within influence of the site.
- The River Dearne is classified as a River Quality C and Biological Quality Grade D approximately 440m east of the site.

Hydrogeology

- The site is underlain by bedrock which is classified as a high permeability Secondary A (minor) aquifer of intermediate leaching potential.
- The site is not located within 1km of a Source Protection Zone.
- There are no groundwater abstraction points within 1km of the site.

Pollution Incidents to Controlled Waters

- No recent significant pollution incidents have occurred to controlled waters within 250m of the site.

7.6 Hazardous Installations, Landfill and Waste

The following information relating to hazardous installations, landfill and waste obtained from the Landmark report, published information and the walkover survey can be summarised as follows:

- The site is located approximately 150m north of a Substantiated Pollution Incident in January 2005 relating to an 'impact to land of construction materials and potentially asbestos waste'.
- The site is located approximately 150m north of a Scrapyard noted to be associated with metal scrap. No liquid wastes are authorised at the site.
- A former BGS mineral site is noted to be located approximately 160m south west of the site utilised for the removal of the underlying bedrock (Mexborough Rock).
- There are no Local Authority Pollution Prevention and Controls (LAPPC) located within 250m of the site.

- There are no recorded historic landfills or registered contemporary landfills sites within 250m of the site.
- There are no contemporary potentially contaminative industrial land uses (including petrol filling stations) within 250m of the site.

- BGS Estimated Soil Chemistry indicated the following concentrations of the selected determinands across the site envelope:
    - Arsenic <15mg/kg
    - Cadmium <1.8mg/kg
    - Chromium 40 – 60mg/kg
    - Lead <150mg/kg
    - Nickel 15 – 30mg/kg

7.7 Mining

7.7.1 Coal / Fireclay Mining

A Coal Authority Mining Report was obtained as the site lies within a recognised coalfield. The report states that the site is in the likely zone of influence from workings in 7 No. seams of coal at a depth of 230m to 720m depth, and last worked in 1988. Any ground movement from these coal workings should have stopped by now.

A damage notice or claim for alleged subsidence damage was made in April 1995 for a fissure on a sports area of Darfield Foulstone High School. However, the claim was rejected.

There is no current Stop Notice delaying the start of remedial works or repairs to the property. There are a further 7 claim(s) within 50 metres of the property boundary that do not match the property address.

7.7.2 Brine Extraction

The site lies outside a recognised salt / brine extraction area.

7.8 Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies in an area where <1% of homes are affected by radon at or above the Action Level. Consequently, the site requires no radon protective measures.

Map 14 of the Indicative Atlas of Radon in England and Wales contains information on the region in which the site is located and is presented in Appendix 7.

8.0 CONCLUSIONS

8.1 General

As a result of undertaking a walkover survey of the site and reviewing the documented historical activities including the BGS borehole information relating to the previous site investigation works, it is concluded that the site is at low risk of land contamination including ground gas and low to moderate risk of potential geotechnical discontinuities resulting from previous site use could affect the proposed development.

Proposed Development

As stated in section 2.1 of this report, it is the Clients' intention that the proposed development will consist of erection of food retail units and associated parking with an area of residential development to the north for 35 dwellings.

The proposed development plan is contained within Appendix 8.

8.2 Geology

The desk study carried out indicates that the site is anticipated to be underlain by an unknown thickness of made ground which is anticipated to consist of demolition materials and re-worked natural strata (sand) underlain by brown, clayey sand to a depth of approximately 2m underlain by weathered sandstone.

In order to determine the ground conditions with a greater degree of certainty and allow design of the proposed residential and retail unit foundations, drainage, services and external areas to be undertaken, it is recommended that trial pits are constructed across the site to primarily determine the depth of the underlying bedrock, made ground thickness and constituents. Following this shell and auger boreholes should be undertaken utilising the trial pit information to allow in-situ geotechnical density tests to be undertaken where appropriate at the site.

Depending on the demolition specification, it may be prudent to undertake intrusive works to determine the presence of underlying obstructions associated with historic foundations / ground obstructions.

8.3 Contaminated Land Legislative Framework

The assessment of contaminated soils is carried out within the current legal framework, which is based upon the Environmental Protection Act Part 2A and current national planning guidelines. Under this framework, the potential contamination of a proposed development site is a material planning consideration. In addition, land that is deemed harmful to human health or has the potential to pollute waters can be designated as contaminated land and appropriate remediation can be enforced by the Local Authority.

Following the "Way Forward" report undertaken by Department for Environment, Food and Rural Affairs (DEFRA) a new approach to land contamination was issued by DEFRA and the Environment Agency (EA). Two documents have been produced which supersede the previous Contaminated Land Reports (CLR) 7 – 10. The two reports are 'Human health toxicological assessment of contaminants in soil' (formerly CLR 9) and 'Updated technical background to the CLEA model' (formerly CLR 10) and other supporting documentation including revised toxicological reports.

Broadly, the approach consists of preparation of conceptual models to illustrate how potential contamination (source) can reach (through a pathway) humans or receptors (targets). As a result of these conceptual models, each of which are site specific, a risk analysis can be carried out to determine the frequency of testing to establish levels of source contamination, possible mobility of those contaminants and the potential hazards those mobilised contaminants could cause to human receptors. In addition to direct human receptors, water courses, aquifers and agricultural resources must be considered as these are potential indirect pathways to humans.

The government is part way through the publication of a number of updated toxicological reports and associated updated Soil Guideline Values which give guidance on acceptable soil contamination for a limited number of contaminants and further authoritative guidance on the toxicity of other contaminants for risk assessment purposes. As of March 2009, updated toxicological reports and revised Soil Guideline Values have been published for the following determinands:

- Arsenic
- Nickel

- Selenium
- Benzene
- Toluene
- Ethylbenzene
- Mercury (elemental, methyl and inorganic)
- Xylene (O, M and P)
- Cadmium
- Phenol
- Dioxins, furans etc.

Where no updated toxicological reports or Soil Guideline Values are available, the existing toxicological reports and associated Soil Guideline Values will naturally be used to classify the risk and toxicity posed by the selected determinands. In addition, where updated Soil Guideline Values and/or toxicological reports are not available, guidance is available from the Environment Agency on acceptable methods of assessing human health risks utilising recognised methodology developed in the UK and abroad. The means available to assess human health risks and to be utilised on this site are as follows:

Assessment	**Means**
Production of conceptual models	Human health toxicological assessment of contaminants in soil and Contaminated Land Report 11
Scope of contamination testing	Human health toxicological assessment of contaminants in soil (2009) and DEFRA Industry Profiles
Contamination sampling rates	Contaminated Land Report 4
Laboratory testing	MCERTS Accreditation
Acceptable contamination levels for Arsenic, Nickel, Mercury, Selenium, Ethylbenzene, Toluene, Benzene, Cadmium, Phenol and Xylenes	Updated Published Soil Guideline Value Reports (March 2009 onwards)
Acceptable contamination levels for Chromium and Lead.	Current Published Soil Guideline Value Reports (2002 – 2004)
Acceptable levels for other contaminants except cyanide and except where the conceptual model includes dermal absorption	LQM CIEH (2nd Edition 2009) / CL:AIRE (GAC January 2010)
Acceptable contamination levels for cyanide and where the conceptual model includes dermal absorption	Updated technical background to the CLEA model
Assessment of Total Petroleum Hydrocarbons within the above framework as adopted by the Environment Agency	Total Petroleum Hydrocarbon Criteria Working Group and updated technical background to the CLEA model
Acceptable contamination levels for selected aqueous determinands	Environmental Quality Standards (EQS), UK Drinking Water Standards (UK DWS) and The River Basin Management Plans.

8.4 Sources of Contamination and Probable Contaminants

The site was developed from greenfield in the late 1930s into a school which was further expanded during the late 1940s and early 1960s prior to demolition in 2011. These site uses are considered not to present a significant potential contaminative land-use.

Evidence obtained from the historical Ordnance Survey maps, the Envirocheck report and anecdotal evidence indicates that:

- The northern section of the site was subject to earthworks, although the works are anticipated to have involved the natural superficial deposits and consequently are regarded to be of low contaminative potential
- A removed substation is noted in the southern extremity of the site.

The offsite scrap yard (which does not accept liquid wastes) and the substantiated pollution incident both located approximately 150m from the site and are not regarded as significant potential contaminative sources for the site due to a lack of proximity and contaminative potential.

It is likely that pesticides were utilised on-site associated with the allotment gardens in the 1900s, however due to the age of the potential use and if used according to manufacturers instructions the use of such should not have resulted in any significant contamination legacy.

There is no evidence to suggest notable use of hydrocarbon storage on site.

8.5 Pathways for Contamination

<u>Waters</u>

The site is typically overlain by high permeability brown, clayey sand consequently the vertical migration of potential unrecorded contamination towards the underlying Secondary A aquifer is regarded as the principal pathway.

Site Occupants

The pathways along which contamination could potentially reach the targets on site during use and after completion of development works are detailed in 'Updated Technical Background to the CLEA Model' (Environment Agency 2009) and can be summarised as follows:

a) Ingestion of soil directly and indoor dust *
b) Consumption of home grown produce and attached soil
c) Inhalation of soil dust (indoor and outdoor)
d) Dermal contact with soil (indoor and outdoor)
e) Inhalation of soil vapours (indoor and outdoor)
f) Oral background
g) Inhalation background

** Treated as one pathway*

For the southern 'commercial / industrial' section of the site, pathway b) above, consumption of home grown produce and attached soil, is not regarded as applicable. Furthermore, depending on the type on contamination and hardstanding nature of the site, it may ultimately be appropriate to remove further pathways from the conceptual model.

With respect to the 'commercial / industrial' scenario the exposure pathways (dermal, oral background and indirect / direct ingestion) for the identified contaminative sources are effectively eliminated through the hard landscaped nature of the site, negating any direct or indirect contact between any contamination and the current / proposed site occupants. However, the dermal, oral and ingestion exposure pathways are still present for ground workers, service pipes (permeation) and within the proposed minor areas of soft landscaping. Accordingly, these exposure pathways have been included within the site conceptual model but are not considered to be significant. The aforementioned pathways can be negated, hence removed from the site conceptual model if appropriate Personal Protective Equipment (PPE) is utilised by ground workers and appropriate service pipes are utilised. These exposure pathways are not deemed to be significant for the areas of proposed public open space.

8.6 Targets of Contamination

Targets for these pathways include the following:

a) Homeowners
b) Construction workers
c) The general public
d) Groundwater contained within Secondary A Aquifer (bedrock)
e) Subsurface plastic e.g. potable plastic water pipe
f) Building fabric e.g. concrete foundations etc

Due to the lack of proximity no surface water features are regarded as receptors at the site.

8.7 Conceptual Model for Human Health Risk Assessment

On the basis that minimal potential contaminative sources have been identified it is felt that the site is at low risk of widespread contamination which may effect the future development.

However, due to the historic presence of an electrical substation on the site targeted chemical testing should be undertaken together with spatial testing across the site. The spatial testing across the northern section (proposed residential) should be undertaken on an increased density than the southern section (proposed retail development) due to the increased proposed end use sensitivity.

The chemical testing suite will incorporate metals, semi-metals, inorganics, hydrocarbons including polycyclic Aromatic Hydrocarbons (PAHs).

PCBs will be tested for in the location of the former electrical sub-station.

Furthermore, asbestos testing will be undertaken from made ground deposits at the site.

CONTAMINANT	PATHWAY	RECEPTOR
Arsenic Barium Chromium total / $^{5+}$ Vanadium Beryllium Cadmium Copper Lead Nickel Zinc Boron Selenium Mercury Cyanide Total Petroleum Hydrocarbons Polycyclic Aromatic Hydrocarbons	Ingestion of contaminated soil and dust (indoor and outdoor)	Human occupant & construction worker
	Dermal contact with contaminated soil (outdoor and indoor)	
	Inhalation of contaminated dust (indoor and outdoor)	
	Consumption of home grown produce and attached soil	Human occupants consuming home-grown vegetables.
Sulphate Cyanide	Direct contact with building fabric	Fabric of buildings on and off site
	Consumption of home grown produce and attached soil	Human occupants consuming home-grown vegetables.
pH	Direct contact with building fabric	Fabric of buildings on and off site
Total Petroleum Hydrocarbons Polycyclic Aromatic Hydrocarbons	Inhalation of soil vapours (indoors and outdoors)	Human occupants & construction workers
	Permeation	Subterranean plastic service pipes
Asbestos	Inhalation of contaminated dust (indoor and outdoor)	Human occupants & construction workers

8.7.1 Conceptual Model for Ground Gas Risk Assessment

The site and adjacent off site areas contain potential ground gas sources in the form of:

- Off site suspected infilled BGS mineral site located approximately 160m south west
- Shallow made ground deposits (unknown constituents and quantity) risk
- Underlying coal measures

However, due to the presence of the overlying granular highly permeable deposits the off site sources, which are not regarded to be a significant source, are deemed to be of negligible risk due to the preference for vertical migration into atmosphere off site. Furthermore, the onsite made ground deposits (re-worked natural deposits) together with the coal measures (in excess of 200m) are not regarded to be significant sources of potential ground gas.

Utilising the guidance stipulated in CIRIA 665 (2007) and CIRIA 552 (2001), the probability and consequence of the identified potential ground gas sources at the development is considered to result in a low level of risk. It is recommended that the site is assessed in accordance with the CL:AIRE Research Bulletin RB 17: *A Pragmatic Approach to Ground Gas Risk Assessment* (2012) to determine the requirement for ground gas monitoring and / or ground gas protection measures. This is subject to agreement with the relevant regulatory authority.

If any previously unrecorded potential ground gas sources are recorded during the site investigation works, for instance organic soils (peat), then further appropriate ground gas monitoring will naturally be undertaken.

8.8 Conceptual Model For Waters Risk Assessment

On the basis that no significant widespread contamination is envisaged across the site the risk posed by contaminative sources is regarded as low.

Furthermore, the site is underlain by a Secondary A (minor) aquifer overlain typically by permeable brown, clayey sand which is underlain at shallow depth by bedrock (sandstone).

However, it is not anticipated that the site will contain significant concentrations of potentially detrimental determinants, it is proposed to validate this assertion by solid contamination testing of the made ground along with chemical testing of the underlying perched / shallow ground water (if within influence of the made ground).

CONTAMINANT	PATHWAY	RECEPTOR
Arsenic Barium Chromium Vanadium Beryllium Cadmium Copper Lead Mercury Nickel Zinc Boron Selenium Total Petroleum Hydrocarbons Polycyclic Aromatic Hydrocarbons pH Sulphate	Migration through ground vertically into groundwater (TBC)	Groundwater within Secondary A aquifer Discharges from groundwater, e.g. springs
	Overland flow and then migration through ground vertically into groundwater (TBC)	

8.9 Preliminary Risk Assessment Summary

Human Health and Waters

There is a low potential risk to controlled waters and human health including ground gas due to the lack of previous contaminative site uses and the anticipated relatively chemically inert nature of the made ground material across the site.

8.10 Scope of Intrusive Geo-Environmental Ground Investigation

The geo-environmental site investigation should include the excavation of trial pits across the site to enable environmental analysis and associated targeted chemical testing, geotechnical analysis and samples to be collected enabling the appraisal of the ground conditions to be undertaken. If deemed necessary due to the presence of shallow underlying bedrock, the installation of boreholes should be undertaken to obtain relevant insitu and exsitu testing / samples.

As discussed, chemical testing including solid and leachate testing should be undertaken on a spatial basis with targeted chemical testing where relevant.

Prior to undertaking site works, the nature and extent of the proposed environmental testing should be confirmed with the relevant Local Authority Environmental Health Officer and the Environment Agency based on proposed development plan contained within Appendix 8 or relevant plan.

9.0 RECOMMENDATIONS

9.1 As a result of the information gathered from this report, there is a low potential risk to human health including ground gas and controlled waters at the current and proposed site mainly due to a lack of a contamination sources identified at the site. However, due to the highly sensitive nature of the site together with potential unknowns it is deemed necessary to undertaken chemical testing across the site. Consequently, a Phase 2 environmental intrusive investigation is deemed necessary.

9.2 Due to geotechnical requirements, site investigation works should be undertaken in order to determine the ground conditions with a greater degree of certainty and allow design of the proposed residential and retail unit foundations, drainage, services and external areas to be undertaken, it is recommended that trial pits are constructed across the site to primarily determine the depth of the underlying bedrock, made ground thickness and constituents. Following this shell and auger boreholes should be undertaken utilising the trial pit information to allow in-situ geotechnical density tests to be undertaken where appropriate at the site. Depending on the demolition specification, it may be prudent to undertake intrusive works to determine the presence of underlying obstructions associated with historic foundations / ground obstructions.

9.3 Utilising the guidance stipulated in CIRIA 665 (2007) and CIRIA 552 (2001), the probability and consequence of the identified potential ground gas sources at the development is considered to result in a low level of risk. It is recommended that the site is assessed in accordance with the CL:AIRE Research Bulletin RB 17: *A Pragmatic Approach to Ground Gas Risk Assessment* (2012) to determine the requirement for ground gas monitoring and / or ground gas protection measures. This is subject to agreement with the relevant regulatory authority. Following a review of BRE 211 and HPA / BGS radon reports no radon protective measures are considered necessary at the post development site.

9.4 From the results of the geotechnical intrusive works, the type of foundation construction and associated capacities can be calculated and the type of highway and drainage constructions can be established.

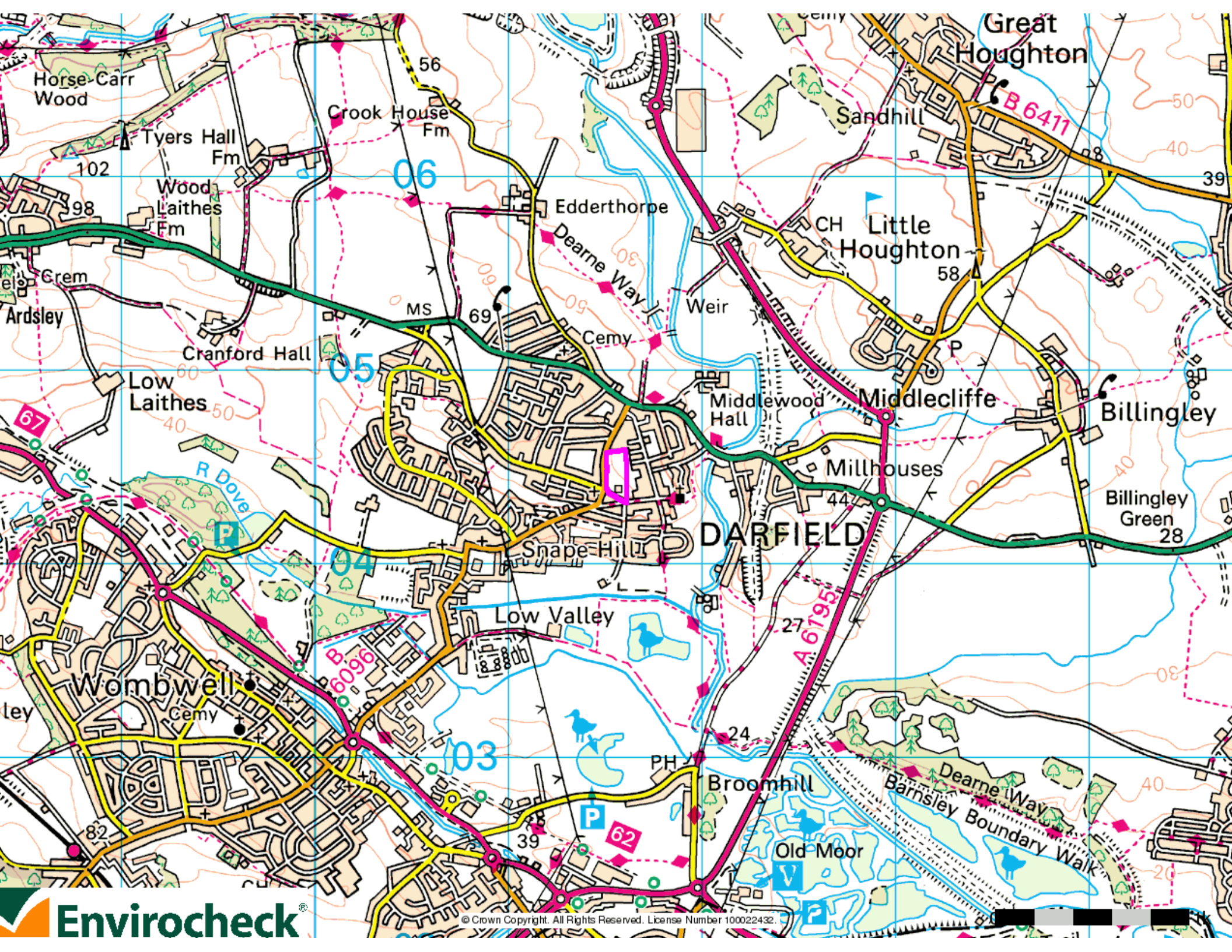
9.5 The nature and extent of the proposed targeted chemical and environmental testing should be confirmed with the relevant Local Authority Environmental Health Officer and the Environment Agency prior to undertaking works on site.

9.6 It should be noted that, if any visual or olfactory evidence of contamination is encountered during remediation or construction work, then the Local Authority Environmental Health Officer and Environment Agency should be contacted immediately in order to agree any necessary remediation measures.

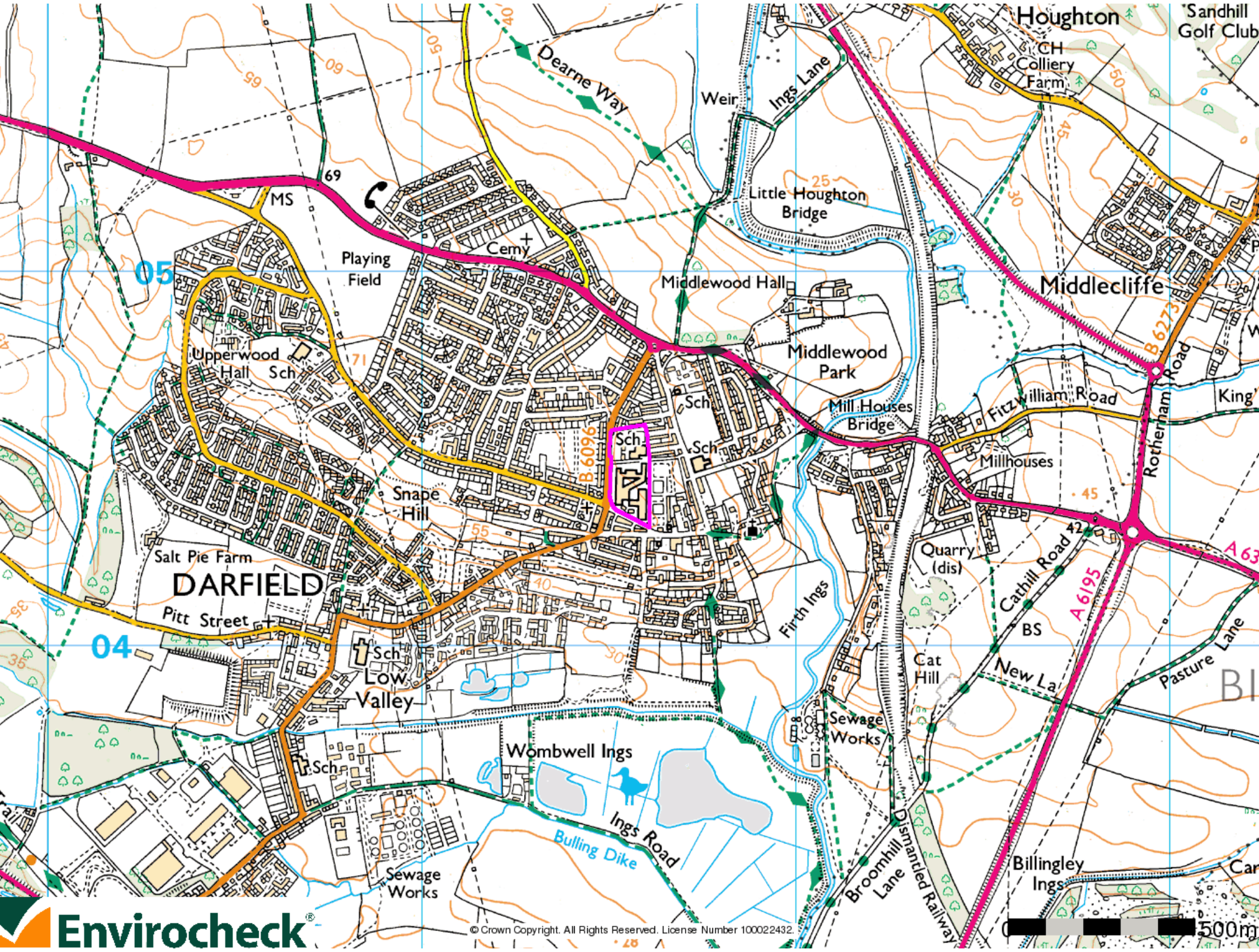
APPENDIX 1

SITE LOCATION PLANS AND AERIAL PHOTOGRAPH

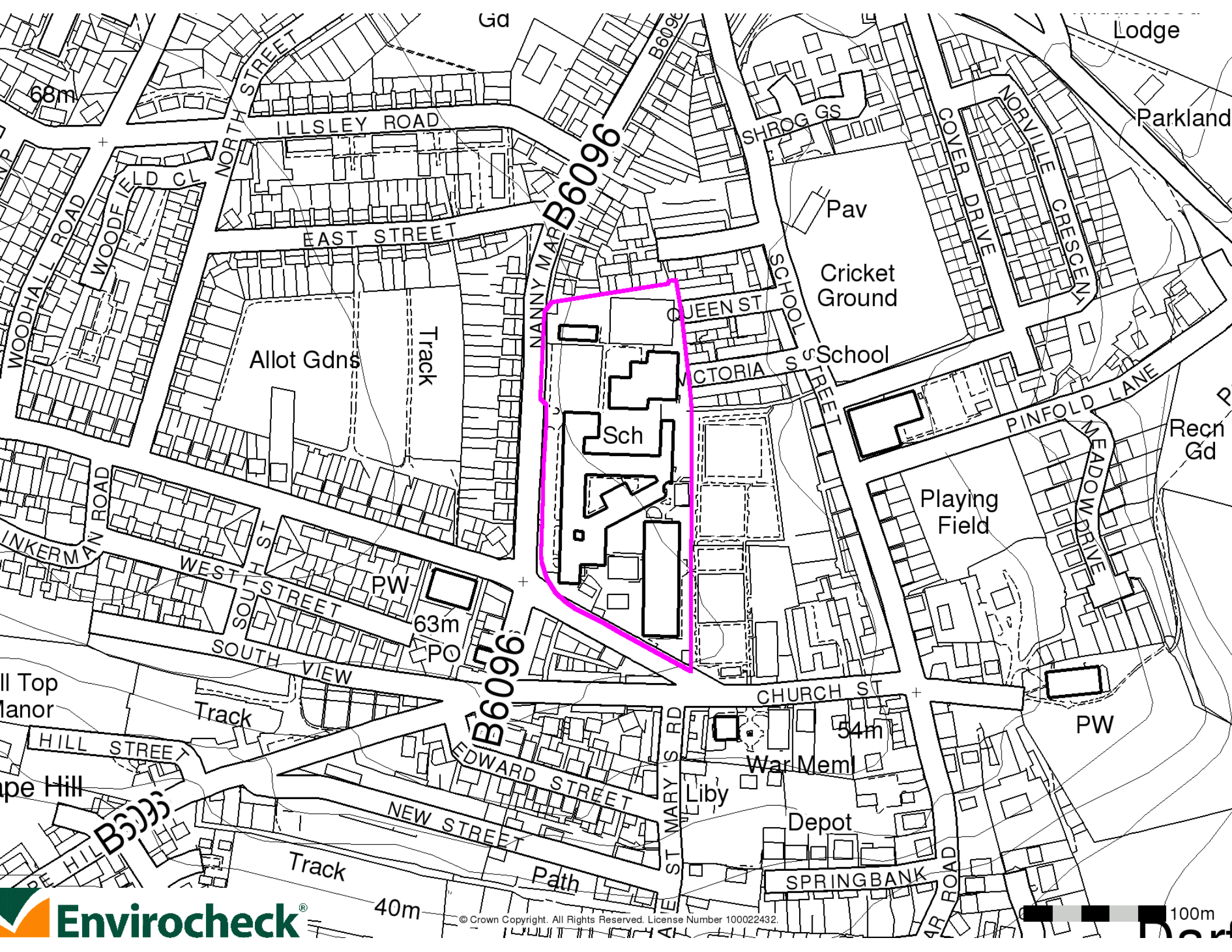

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Gd
Lodge
68m
NORTH STREET
ILLSLEY ROAD
B6096
SHROG GS
COVER DRIVE
NORVILLE CRESCENT
Parkland
WOODFIELD CL
WOODHALL ROAD
EAST STREET
Pav
Cricket Ground
NANNY MAR
QUEEN ST
SCHOOL
Allot Gdns
Track
Sch
School
VICTORIA STREET
PINFOLD LANE
Recn Gd
Playing Field
MEADOW DRIVE
INKERMAN ROAD
WEST ST
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CHURCH ST
PW
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Manor
Track
HILL STREET
54m
War Meml
EDWARD STREET
ST MARY'S RD
Liby
Depot
NEW STREET
B3133
Track
Path
SPRINGBANK
40m
100m
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APPENDIX 2

WALK OVER SURVEY PHOTOGRAPHS



Plate 1: Shows the western (left), northern and central site section. Trees are located across the western boundary and central site section. The majority of the site is lightly vegetated.



Plate 2: Shows the eastern (right), northern and central site section. The majority of the site is lightly vegetated and the natural topography slopes from west to east with man made undulations as a result of the previous site development.



Plate 3: Shows the man made topographical cutting on the northern site boundary which is approximately 2.5m to 3m lower than the land abutting to the west.



Plate 4: Shows the man made slope formed as part of the previous site use as a school prior to demolition noted in Plate 3 in the northern site section.



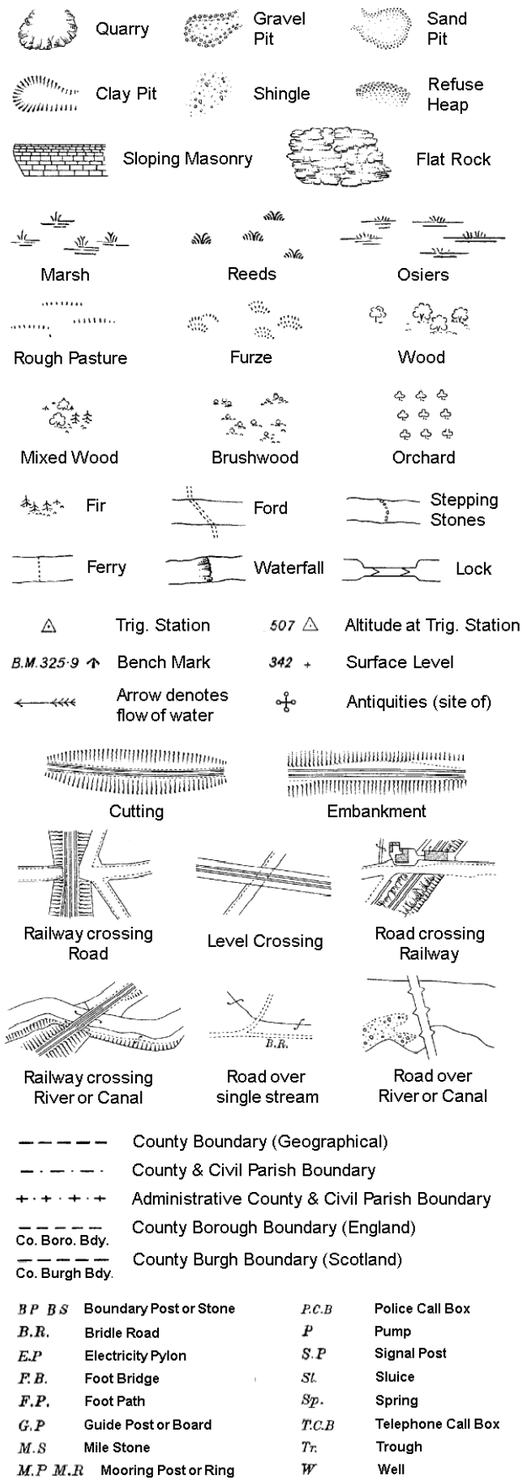
Plate 5: Shows the sole existing site structure (former Youth Centre) located across the southern site section.

APPENDIX 3

HISTORICAL ORDNANCE SURVEY MAPS

Historical Mapping Legends

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



County Boundary (Geographical)

County & Civil Parish Boundary

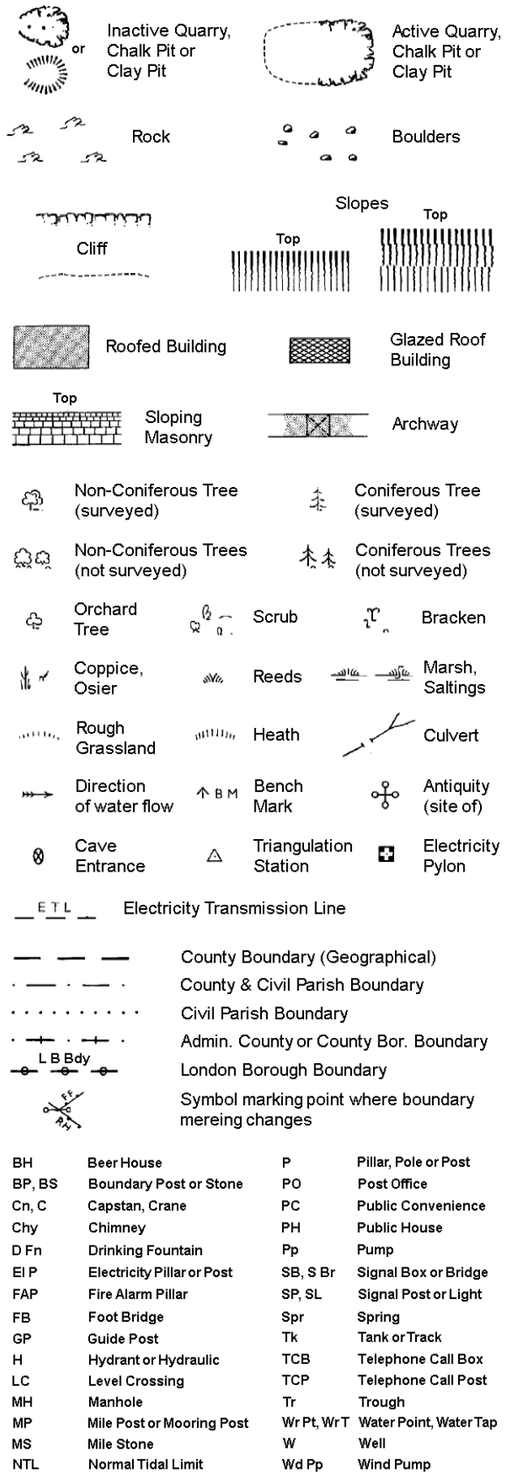
Administrative County & Civil Parish Boundary

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

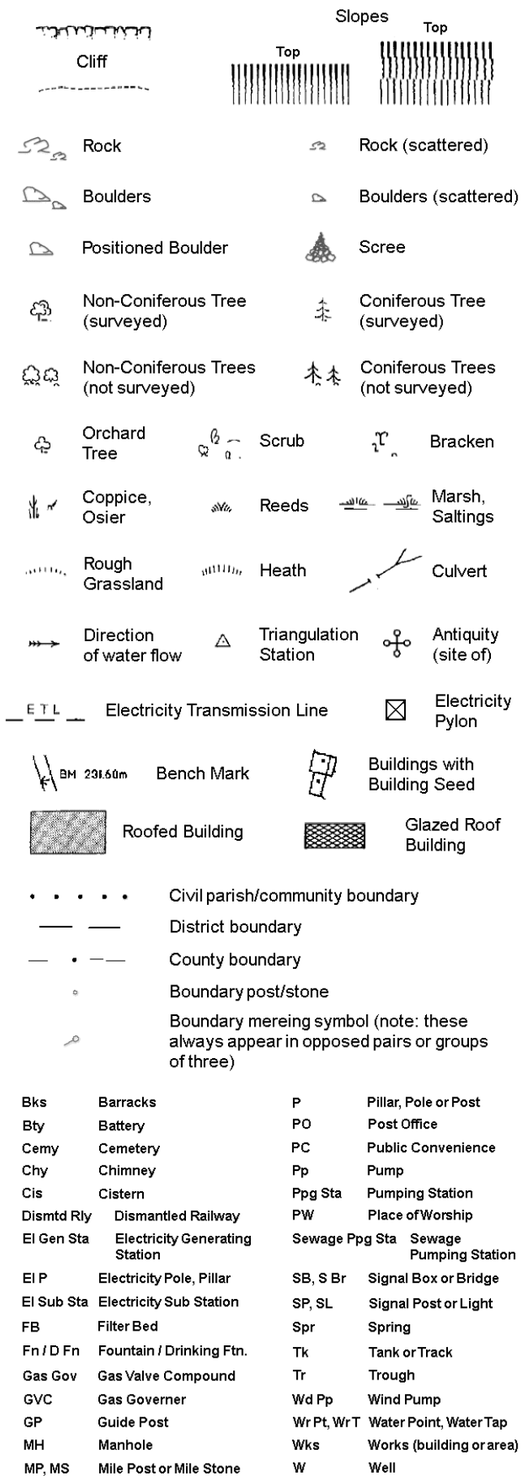
Admin. County or County Bor. Boundary

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)

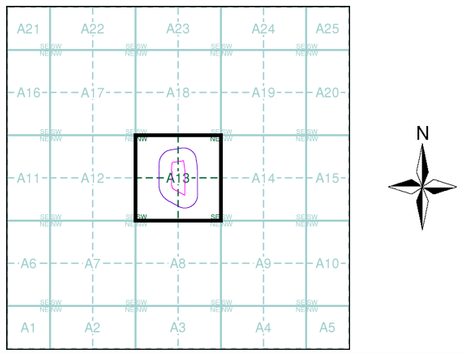
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity 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

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Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:2,500	1893	2
Yorkshire	1:2,500	1906	3
Yorkshire	1:2,500	1931	4
Ordnance Survey Plan	1:2,500	1962	5
Ordnance Survey Plan	1:2,500	1971	6
Ordnance Survey Plan	1:1,250	1982	7
Large-Scale National Grid Data	1:1,250	1993	8
Large-Scale National Grid Data	1:1,250	1993 - 1995	9
Large-Scale National Grid Data	1:1,250	1996	10
Large-Scale National Grid Data	1:1,250	1996	11

Historical Map - Segment A13



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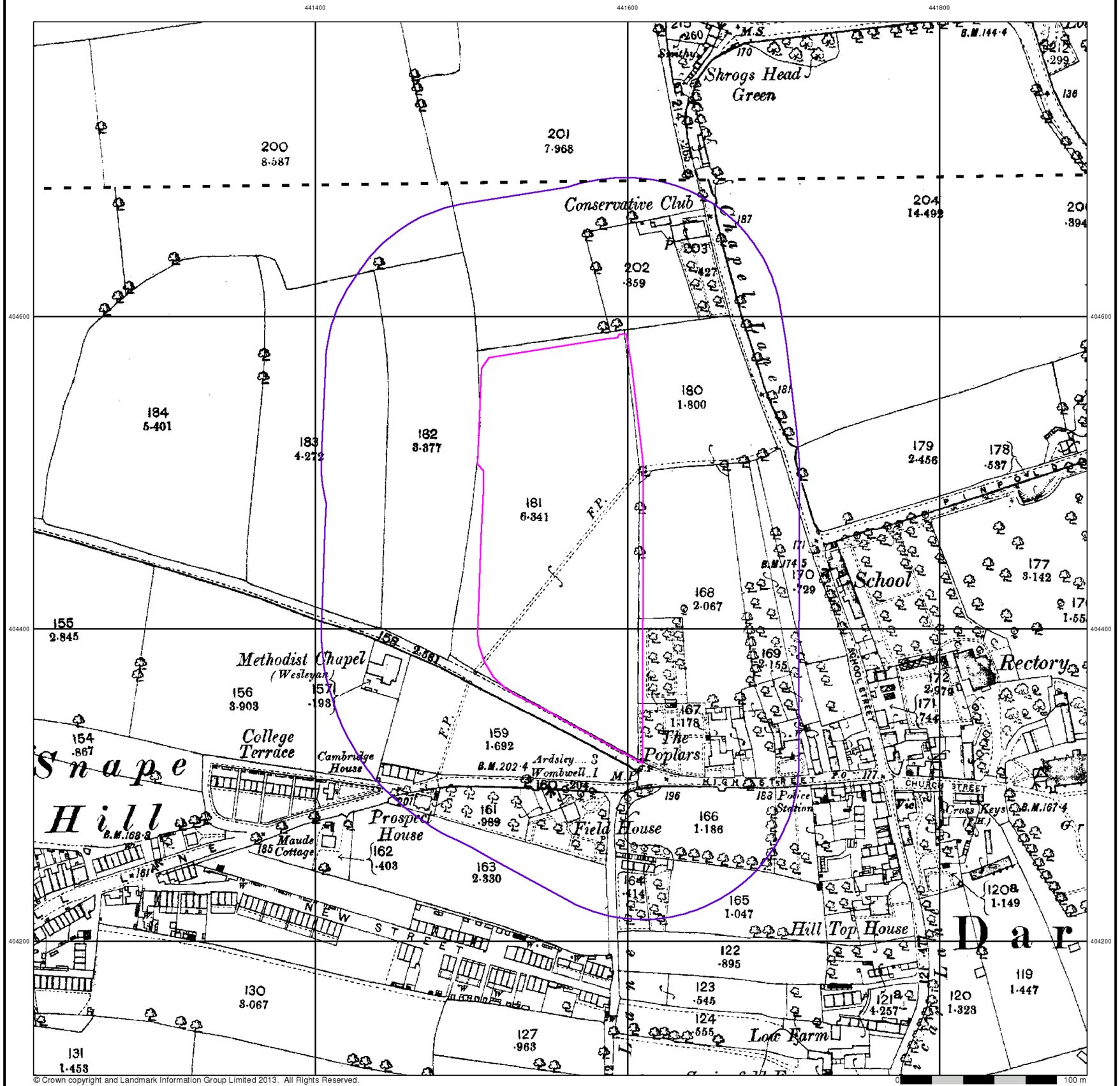
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Search Buffer (m):	100

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Yorkshire

Published 1893

Source map scale - 1:2,500

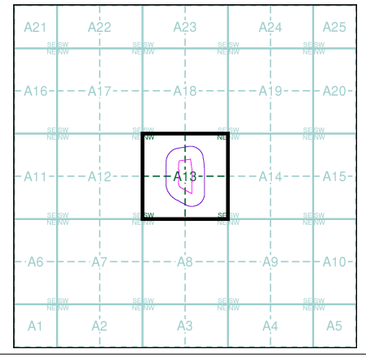
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Map Name(s) and Date(s)

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1893
1:2,500

275_14
1893
1:2,500

Historical Map - Segment A13



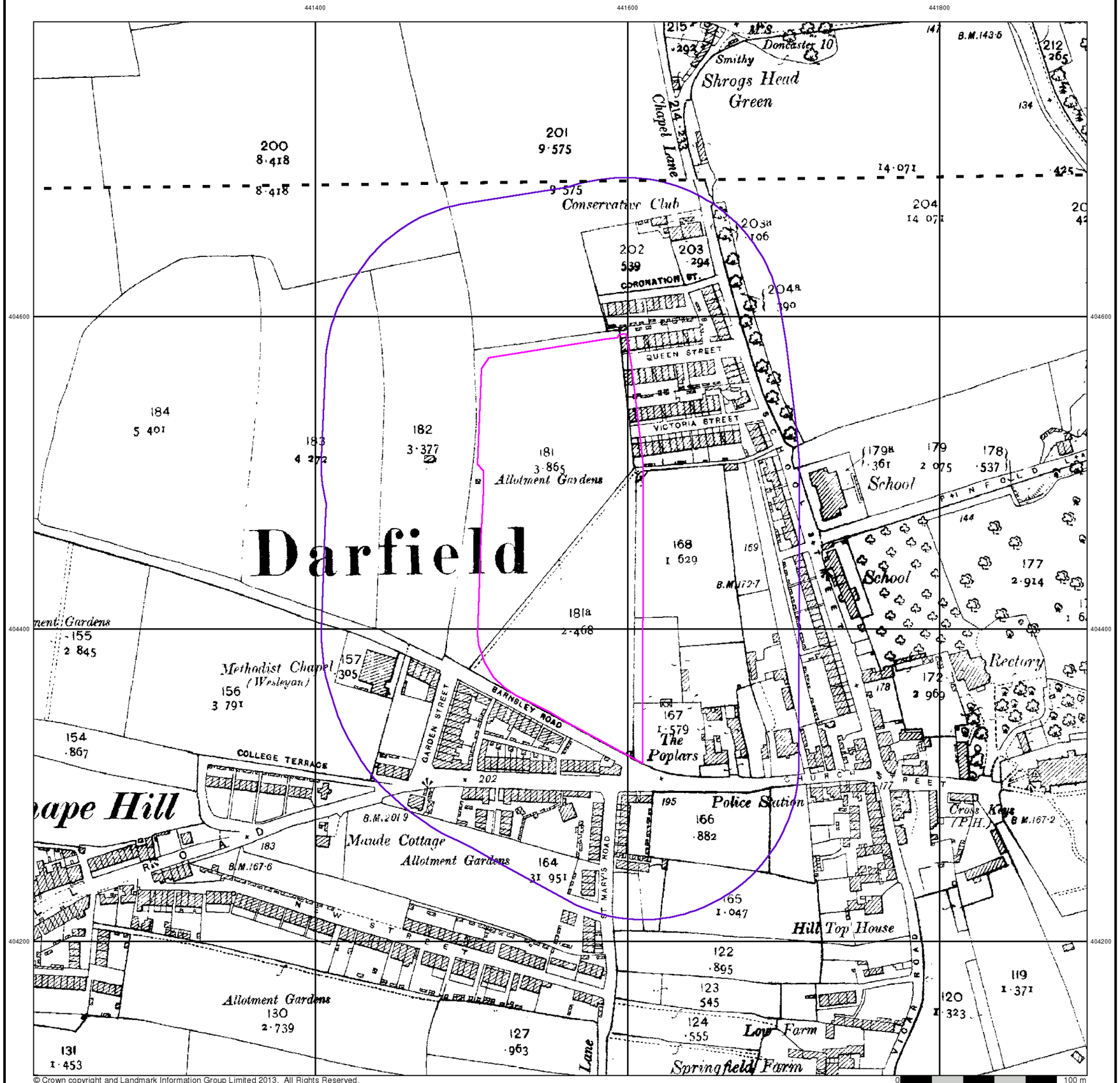
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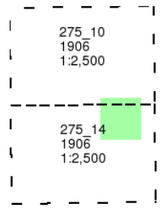
Yorkshire

Published 1906

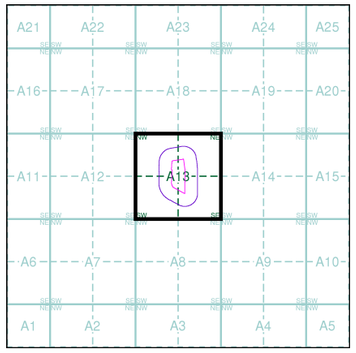
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Map Name(s) and Date(s)



Historical Map - Segment A13



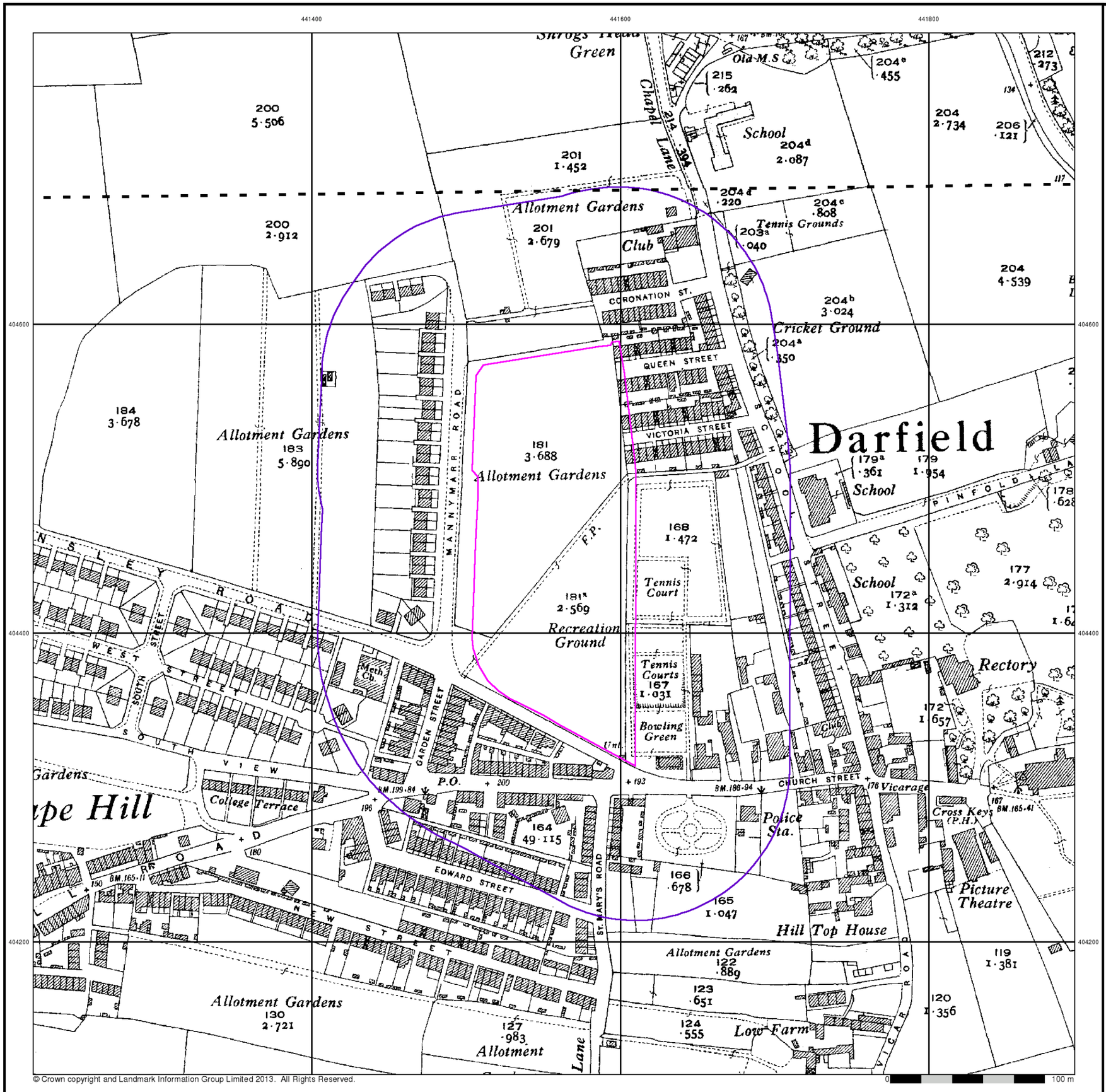
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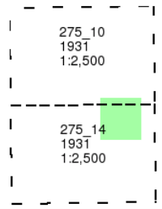
Yorkshire

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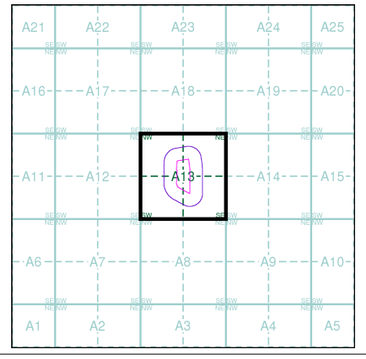
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Map Name(s) and Date(s)



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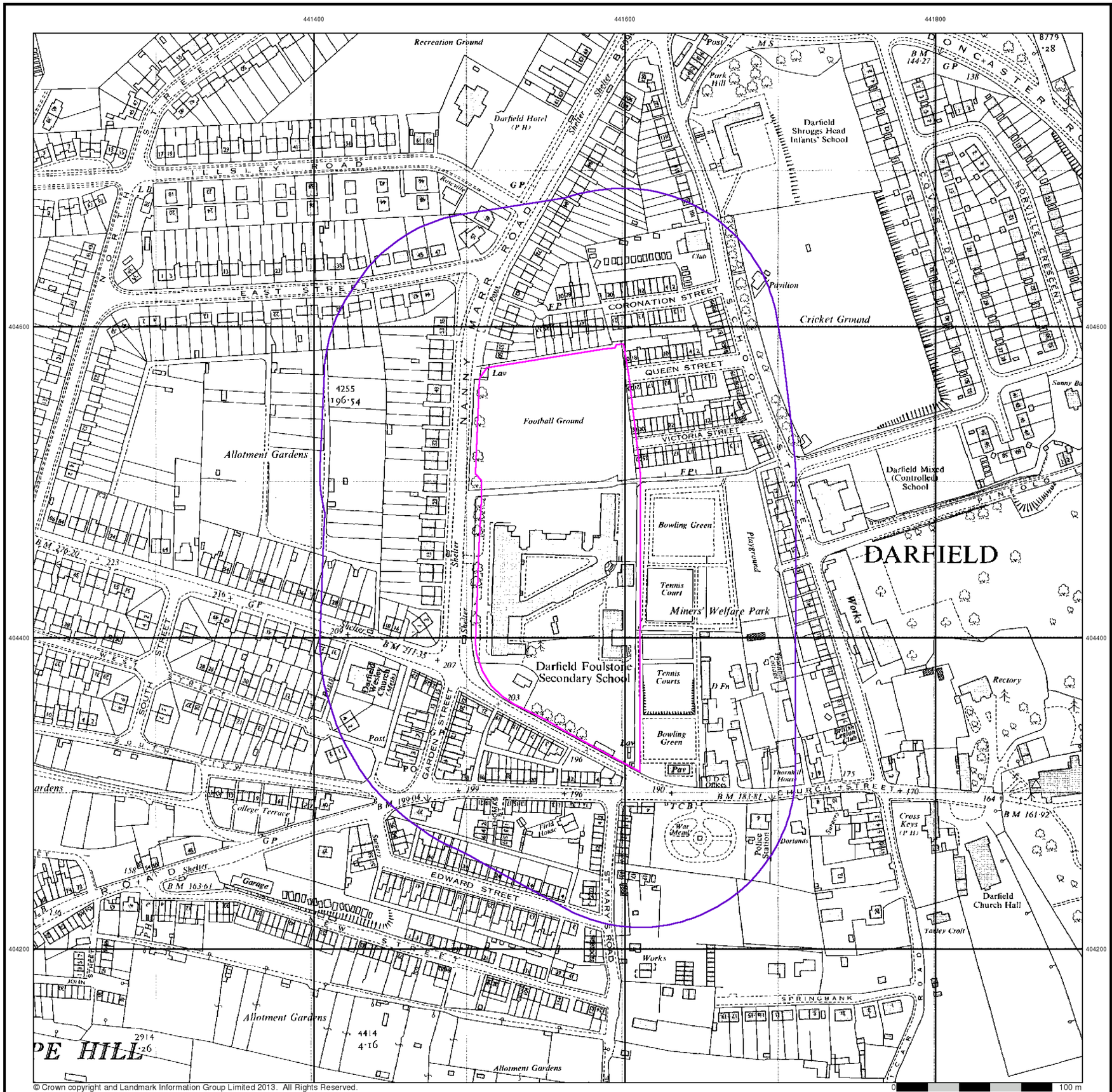


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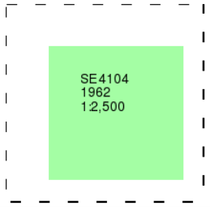
Ordnance Survey Plan

Published 1962

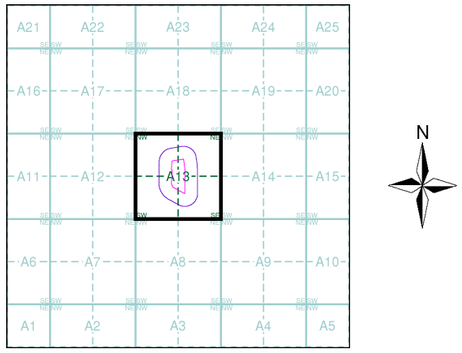
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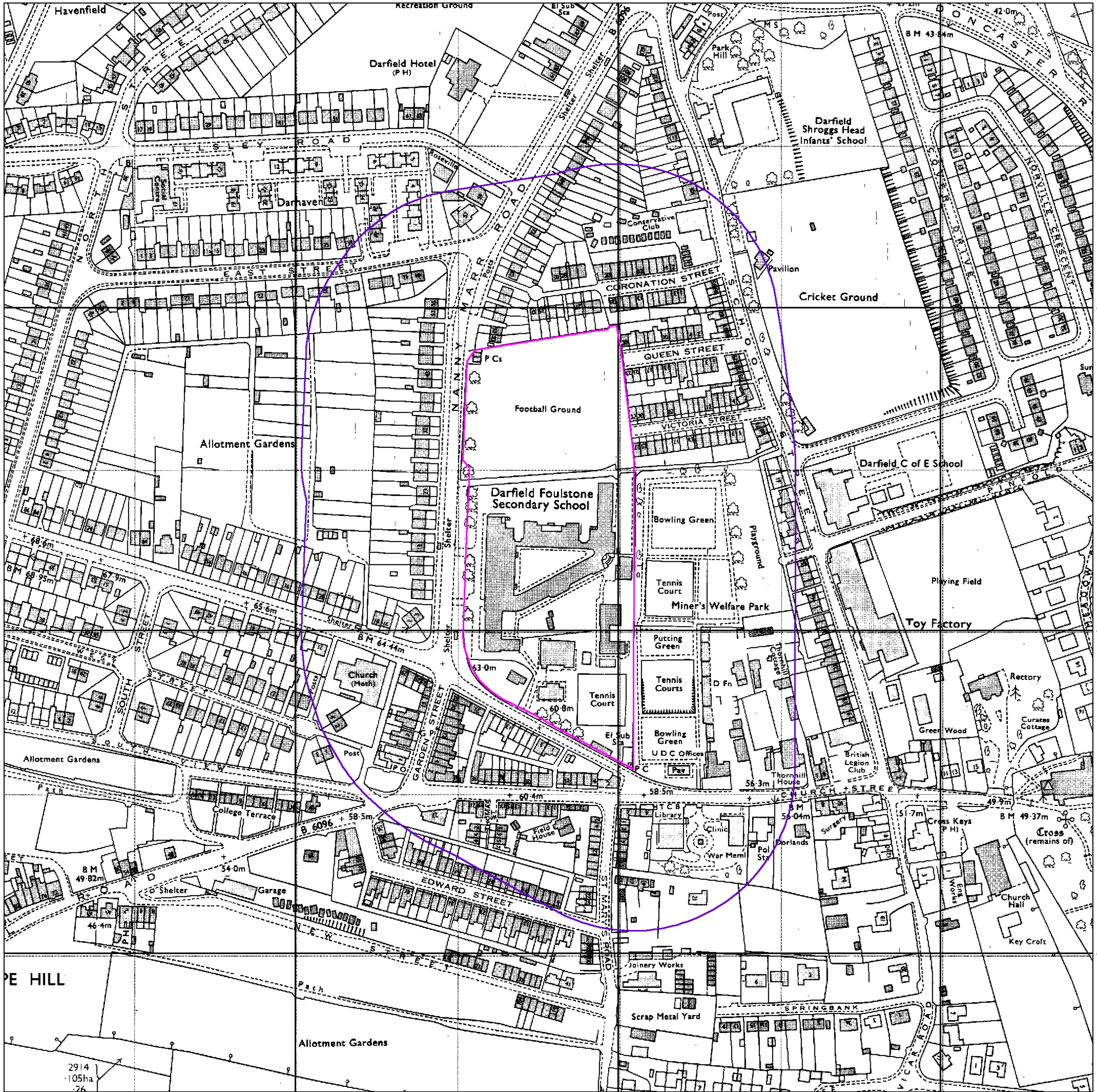
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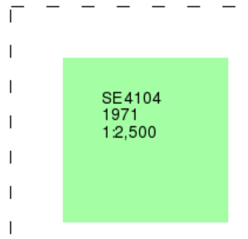
Ordnance Survey Plan

Published 1971

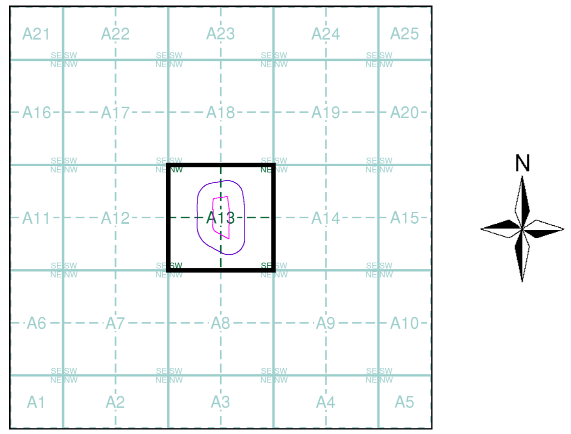
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Map Name(s) and Date(s)



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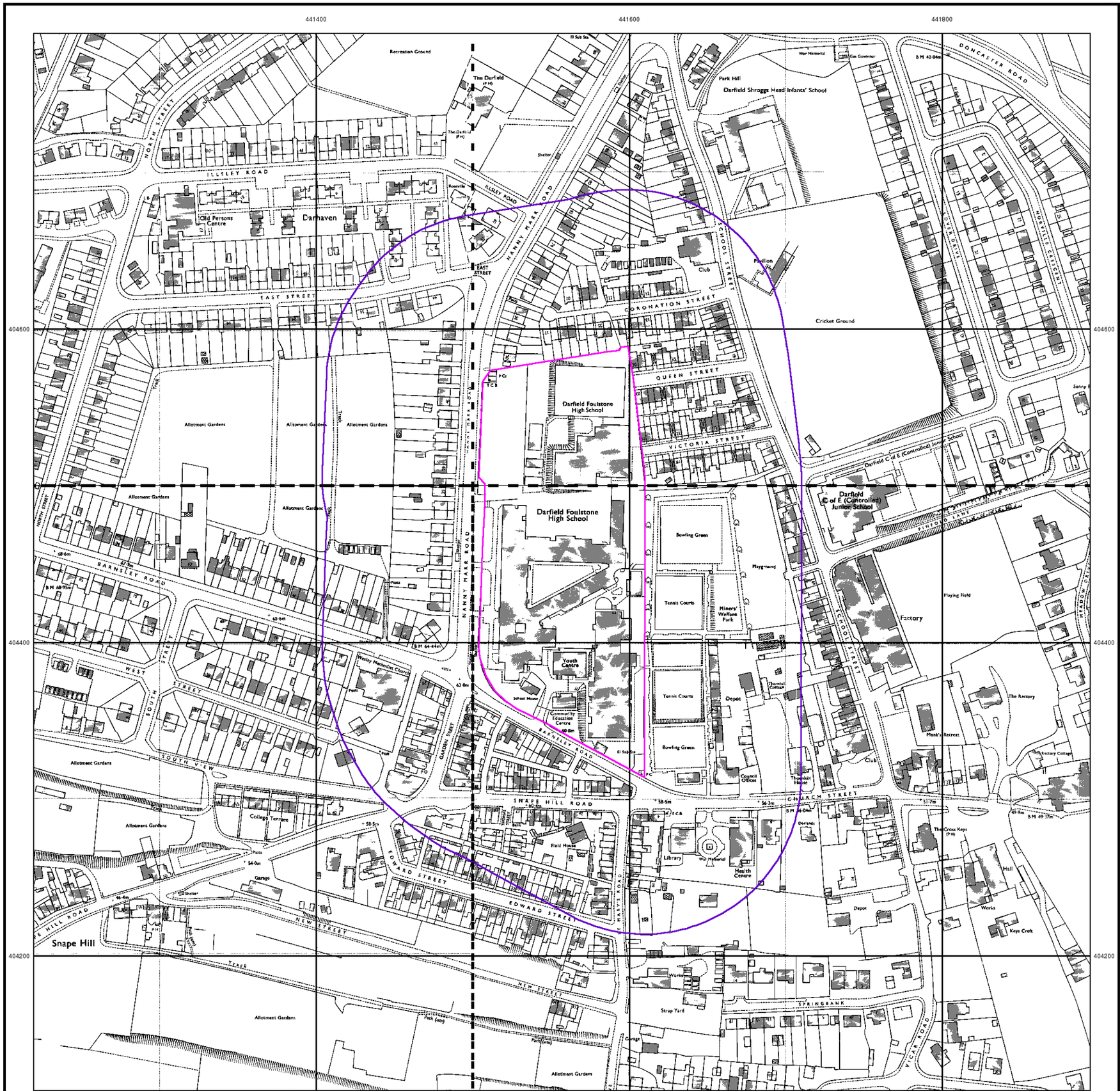
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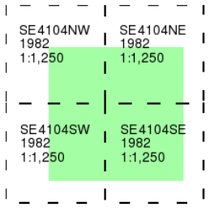
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Published 1982

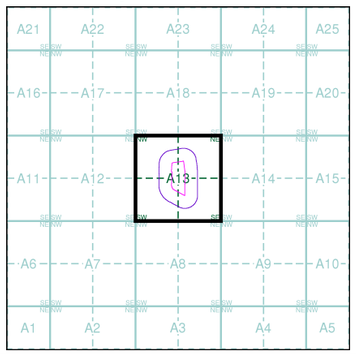
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Map Name(s) and Date(s)



Historical Map - Segment A13



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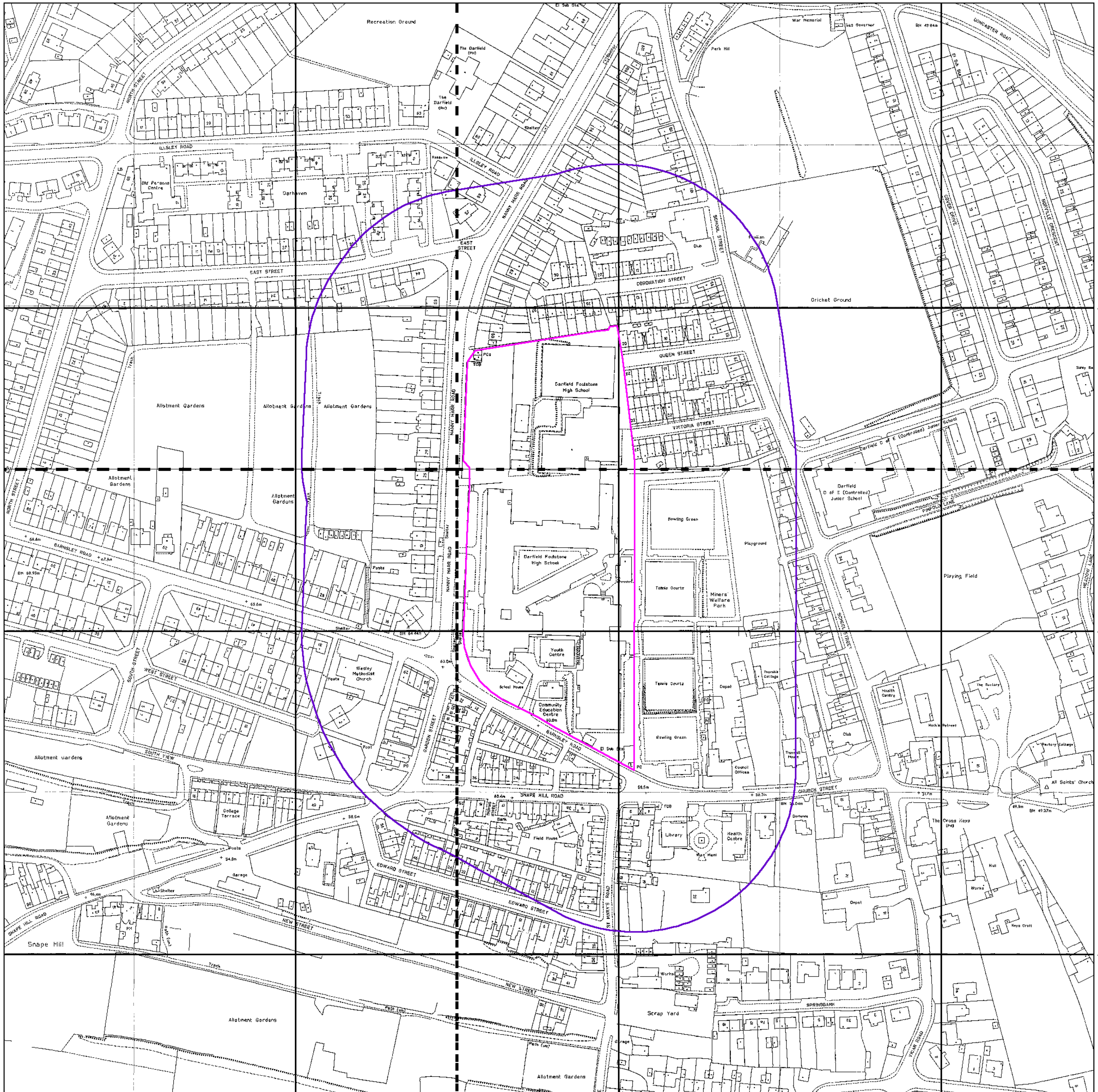
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Search Buffer (m):	100

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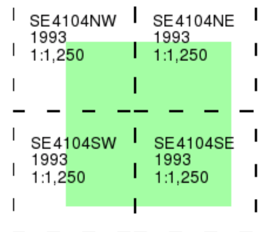
Large-Scale National Grid Data

Published 1993

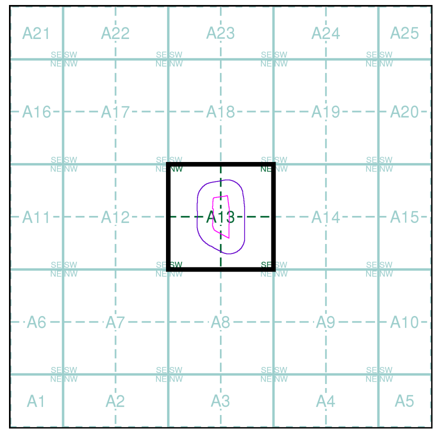
Source map scale - 1:1,250

'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



N

Order Details

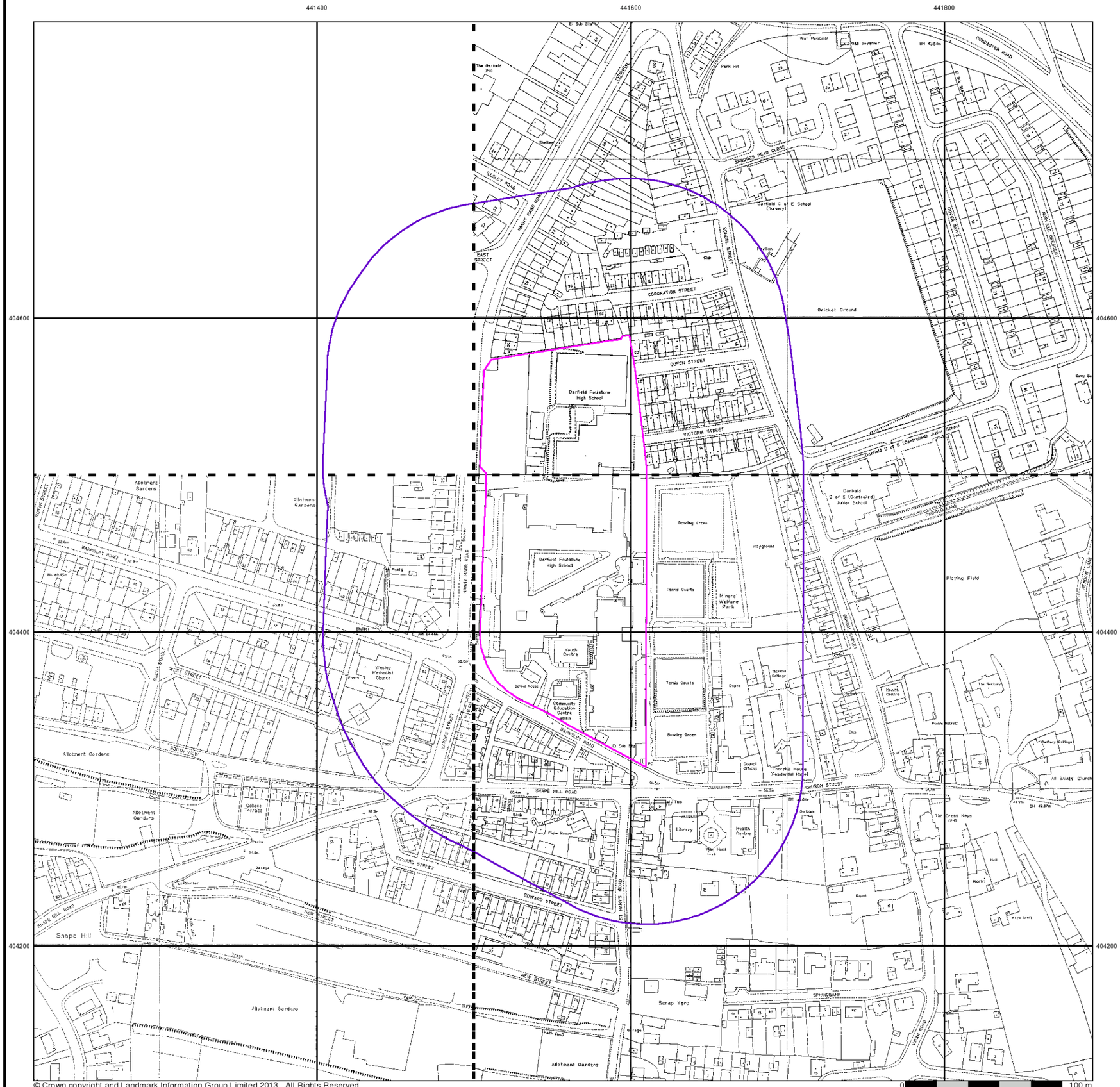
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Customer Ref:	2773
National Grid Reference:	441570, 404460
Slice:	A
Site Area (Ha):	2.45
Search Buffer (m):	100

Site Details

9, Nanny Marr Road, Darfield, Barnsley, S73 9AB

Landmark® Information Group

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Web: www.envirocheck.co.uk



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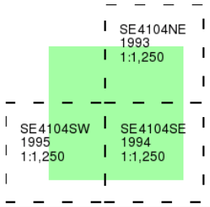
Large-Scale National Grid Data

Published 1993 - 1995

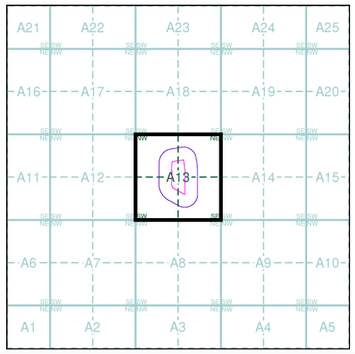
Source map scale - 1:1,250

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Historical Map - Segment A13



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