PROPOSED RESIDENTIAL REDEVELOPMENT

2-5 HIGHLAND SQUARE, CLIFTON

Phase I Assessment of Land Quality

PROJECT NO. P1891

WORK CODE 1

REPORT NO. P1891.1.1

REVISION 0

20th May 2024

PREPARED BY

Ground Investigation Limited

UNIT 3
WESTFIELD COURT
BARNS GROUND
KENN
CLEVEDON
BS21 6FQ

TEL: 01275 876903

EMAIL: mail@ground-investigation.com

ON BEHALF OF

S. F. Tebby & Son Limited

Ground Investigation Limited

DOCUMENT CONTROL

Project Title:	**Proposed Residential Redevelopment of 2-5 Highland Square, Clifton**
Document Title:	**Phase I Assessment of Land Quality**

Rev	**Date**	**Filename:**	P1891.1.1	
0	20/05/24	**Description:**	Revision 0	
			Prepared by	**Checked by**
		Name	[redacted]	
		Signature		

PROPOSED RESIDENTIAL REDEVELOPMENT

2-5 HIGHLAND SQUARE, CLIFTON

PHASE 1 ASSESSMENT OF LAND QUALITY

TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 Terms of Reference 1
1.2 Site Location 1
1.3 Proposed Development 1
1.4 Objectives and Scope of Work 1
1.5 Report Structure 2

2. DATA SOURCES, GENERAL INFORMATION & DESCRIPTION 3

2.1 General 3
2.2 Sources of Information 3
2.3 Site Description 3
2.4 Historical Ordnance Survey Mapping 4
2.5 Geology 5
2.6 Hydrology, Hydrogeology and Environmental Setting 6
2.7 Local Authority Information 7
2.8 Unexploded Ordnance Risk 7

3. GEOTECHNICAL CONSIDERATIONS 8

3.1 General 8
3.1.1 Excavations 8
3.1.2 Foundations and Ground Floor Slabs 9
3.1.3 External Areas 9
3.1.4 Drainage 10
3.1.5 Conclusion 10

4. POTENTIAL GEO-ENVIRONMENTAL HAZARDS 11

4.1 Introduction 11
4.2 Preliminary Conceptual Site Model 11
4.2.1 Possible Sources of Contamination 11
4.2.2 Receptors of Contamination and Migration Pathways 12
4.2.2.1 Receptors 12
4.2.2.2 Pathways 12
4.3 Preliminary Risk Assessment - Conclusions 13
4.3.1 Context 13
4.3.2 Potential Chronic Human Health Risks 13
4.3.3 Potential Acute Human Health Risks 14
4.3.4 Potential Risks from Hazardous Ground Gases 14
4.3.5 Potential Risks to Controlled Waters 14

5. RECOMMENDED INTRUSIVE INVESTIGATORY WORKS 16

5.1 General 16
5.1.1 Geotechnical Investigation 16
5.1.2 Contamination Assessment 16

PROPOSED RESIDENTIAL REDEVELOPMENT

2-5 HIGHLAND SQUARE, CLIFTON

PHASE 1 ASSESSMENT OF LAND QUALITY

FIGURES

1 Existing Layout
2 Proposed Layout

APPENDICES

A Historical Ordnance Survey Mapping
B Landmark Geology Report
C Landmark Envirocheck Report
D Bristol City Council Petroleum Officer Enquiry
E Unexploded Bomb Risk Map
F Photographs
G References

1. Introduction

1.1 Terms of Reference

Ground Investigation Limited has been commissioned by Aspect360 Limited, the Planning Consultants acting on behalf of the Client, S.F. Tebby & Son Limited, to carry out a Phase 1 Assessment of Land Quality in the context of the proposed residential redevelopment of 2-5 Highland Square in Clifton, Bristol.

This assessment incorporates a desk-based preliminary geo-environmental risk assessment, together with a preliminary geotechnical appraisal of the ground conditions in the context of foundation design and construction.

This report presents the findings of the desk-based research, together with preliminary consideration of the likely geo-environmental and geotechnical issues which could affect the proposed development of the site, based on the historical, geological and environmental data examined.

The preliminary risk assessment (PRA) presented within this report is expected to be submitted to the Local Authority in support of a planning application for the proposed development.

1.2 Site Location

The site comprised the former premises of S.F. Tebby & Son Limited, a vehicle repair garage located on the southwestern side of Highland Square in Clifton, Bristol, BS8 2YB. The approximate National Grid reference at the centre of the site is E357360, N174670.

The existing site layout is presented as the base to Figure 1. More detailed information concerning the site interior and its boundaries is included within Section 2.3 of this report, based on a site walkover.

1.3 Proposed Development

The proposed development is expected to comprise the erection of a three-storey apartment building containing 6 No. residential units.

The planned building will include a new pedestrian access and yard area with plant beds and bicycle / bin storage, in addition to private external terraces at first and second floor levels.

The proposed site layout is presented as the base to Figure 2.

1.4 Objectives and Scope of Work

The main objectives of the study undertaken are summarised as follows:

(i) Examine factual historical, geological and geo-environmental data relating to the site and its immediately surrounding area.

(ii) Identify potentially significant geo-environmental and geotechnical hazards on the basis of the information examined.

(iii) Provide a preliminary assessment of the potential risk from ground contamination in the context of the site history and proposed development.

(iv) Provide preliminary guidance concerning geotechnical conditions and discuss the potential foundation options for the proposed development.

(v) Make recommendations for further intrusive investigatory works where appropriate.

1.5 Report Structure

This report is presented in five sections, the contents of which are summarised below:

- **Section 1** introduces the report and identifies the site location, summarises the proposed development, and outlines the objectives of the study and the general scope of work.

- **Section 2** presents the sources of information consulted and summarises the findings of the desk-based research, including a site description based on information gathered during a walkover survey.

- **Section 3** considers the findings of the desk-based research in the context of potential geo-environmental hazards affecting the proposed development.

- **Section 4** considers the anticipated ground conditions at the site in the context of the engineering design and construction of the proposed development.

- **Section 5** makes recommendations for the further intrusive investigatory works necessary to provide information for engineering design purposes, and to assess potential geo-environmental hazards at the site.

2. Data Sources, General Information & Description

2.1 General

The desk study has examined information relating to the historical and present-day land uses in the vicinity of the site, together with geological, hydrogeological and environmental conditions from a variety of sources. This section of the report identifies the principal sources of data that have been consulted.

The information furnished by this desk study is referred to in subsequent sections where it is significant, or has relevance, to consideration of the various issues addressed by this report.

2.2 Sources of Information

The principal sources of information consulted by the desk study are summarised as follows.

(i)	Present-day Ordnance Survey mapping.	(Ref. 1)
(ii)	Geological mapping.	(Ref. 2)
(iii)	Historical Ordnance Survey mapping.	(Appendix A)
(iv)	Landmark Geology Report.	(Appendix B)
(v)	Landmark Envirocheck Report.	(Appendix C)
(vi)	Bristol City Council Petroleum Officer enquiry.	(Appendix D)
(vii)	Unexploded Bomb Risk Map.	(Appendix E)

2.3 Site Description

A site walkover was undertaken by an experienced geologist on 24th April 2024 to supplement the findings of the desk-based research. Significant observations made during the walkover are noted below.

The study site comprises the former vehicle servicing and repair garage of S.F. Tebby & Son, located at the southwestern end of Highland Square. It is irregular in plan, extending to an area of c.0.05 Ha, with maximum dimensions of c.17 m northeast-southwest by c.15 m northwest-southeast, tapering slightly towards the southwest.

According to present-day Ordnance Survey mapping, the approximate elevation on-site is c.85-90m AOD, with ground levels falling moderately towards the southeast.

The existing two-storey height garage is of traditional masonry construction with a combination of flat, mono- and dual-pitched roof elements. The garage consists of three interconnected units, each with a roller shutter door for vehicular access and separate pedestrian entrances. The central and southern units have an office and an apartment at first floor level respectively; the latter space was not accessed during the walkover.

Each unit has a concrete ground floor slab, the internal floor levels stepping down in line with the slope of the surrounding land. In this regard, the slab level in the northern unit is c.1.3 m and c.1.8 m higher than the central and southern units respectively, albeit either falling or rising slightly to the

northeast at grade with the adjacent carriageway. Where visible, the slabs appeared to be in good condition with no obvious evidence of disrepair observed. Shallow drainage channels lead to a small drain in the rear of the northern unit and another small drain was visible in the toilet cubicle at the rear of the southern unit.

Historically, the northern and southern units contained ramps and were used for vehicle repairs and servicing. The central unit was used for MOT testing and includes the remnant of a roller brake tester set into the concrete slab (since infilled) and a small office space.

The premises are no longer operational as a garage and are currently being let for storage purposes, with two cars owned by the Client kept in the northernmost units, whilst various household items and office furniture are stored on the ground floor levels of the middle and southern units, plus the first floor space above the middle unit.

Some apparent hydrocarbon staining was noted on the concrete slab adjacent to the pedestrian entrance within the northern unit. The Client advised that there was formerly a container in this area in which used oil was kept prior to off-site disposal.

Other bulk storage facilities include an existing, albeit empty, oil tank elevated within the rear of the middle unit. The tank is rectangular and of steel construction. It is understood that it previously held paraffin, which was cleaned out and the tank repurposed when the Client moved into the premises in the 1970s.

Furthermore, the Client notified GI of an underground fuel tank within the entrance of the southern unit, which was cleaned and decommissioned with concrete infill some years ago. Anecdotally, the works were checked and signed off by a third party, however the Client does not have any records to confirm this aspect.

The site is bound to the northwest, southwest and southeast by residential properties, with the site boundaries marked by party walls in those directions. To the west is a small private car park area and associated row of garages accessed via the residential property to the northwest. Highland Square borders the site to the northeast, with on-street parking adjacent to the garage, the square is enclosed by other residential properties, a public house and an electricity substation compound, with Worrall Road adjacent to the southeast at lower level.

Selected photographs illustrating the observations made during the site walkover are presented in Appendix F.

2.4 Historical Ordnance Survey Mapping

Previous land uses, as inferred from an examination of the historical Ordnance Survey (OS) mapping (Appendix A), together with other information in the public domain, are summarised below:

- The earliest published OS mapping dating from 1882 indicates the site as developed, perhaps divided into 4 narrow structures, however, the exact usage is unknown (although anecdotally was once stables). The southeast end of Highland Square is undeveloped, but many of the surrounding streets are characterised by rows of terraced housing. An old quarry is located around 150 m west and other groundworkings c.220m west on Clifton / Durdham Down and c.230 m northeast. A Bristol Water Works Company reservoir is located c.350 m northwest on Durdham Down.

- The subsequent map edition from 1903 shows a tramway running along Black Boy Hill (later Whiteladies Road) c.45 m east and extending onto Upper Belgrave Road, c.125 m north. A

small structure has been erected in the old quarry workings to the west, whilst further buildings have been constructed on the previously vacant parcel of Highland Square, 10 m east, as well as on Worrall Road, 15 m south. The site itself remains unchanged.

- By 1916, a garage is shown c.80 m northeast on Whiteladies Road and an 'engine house' c.140 m northeast (previously in the location of a pump).

- No significant changes are shown on the following 1921 and 1938 small-scale mapping.

- The southern two units on-site are labelled as a 'garage' by 1951, the northernmost units perhaps residential. An electricity substation is located close to the entrance of Quarry Steps, c.125 m west. Several 'ruins' are recorded within 100 m of the study site, the nearest being c.15 m east, plus two parcels of seemingly cleared land 20 m northwest and 10 m east. The tramway is no longer shown on Whiteladies Road, although the tramway garage remains. Queen Victoria Maternity Hospital is located c.180 m northeast on site of a former 'Convalescent Home'.

- No significant changes are shown on the 1963 map, however many of the former ruins appear to have been cleared by 1972. A garage is located on Quarry Steps, c.70 m west, and another on Lower Redland Road, c.170 m east. The old quarry workings further west are being used as a car park. An electricity substation has been constructed on Highland Square c.20 m northeast. A day hospital and clinic is located 120 m east on Grove Road.

- Land use changes on the 1982 mapping include the construction of a block of flats on previously vacant land at Quarry Steps, c.40 m northwest and the redevelopment of former residential land with St. John's Primary School, c.20 m south. The garage on Whiteladies Road is now operating as a petrol filling station.

- No significant changes are noted on the subsequent large-scale mapping during the 1990s, other than the construction of Worrall Mews within the old quarry c.160 m west.

- Review of Google Earth imagery from 1999 to present-day does not appear to show any significant land use changes within close proximity of the study site, which remains in its current configuration.

In summary, the site's history prior to construction of the garage is unknown, however, some structures (possibly stables) were already present on-site by the time of the earliest OS mapping. It was subsequently repurposed as a vehicle repair garage by the early 1950s, perhaps in combination with some residential usage. The surrounding area has largely remained residential, with some isolated commercial and industrial usage, including quarrying, energy features, and garages and / or filling stations.

2.5 Geology

The following information relating to the geology of the site has been obtained from multiple sources, including the relevant British Geological Survey (BGS) geological sheet (Ref. 2), the Landmark Geology Report and the Envirocheck Report (Appendices B and C), as summarised below:

- Both the geological mapping sheet and the Geology Report indicate the site to be directly underlain by the Clifton Down Limestone Formation of Carboniferous age; described by the BGS as: *"Splintery dark grey calcite and dolomite mudstones, pale grey oolitic, dark grey bioclastic and oncolitic limestones and some mudstones. Scattered cherts and silicified fossils in lower half. Sandy limestone at base…"*.

- Approximately 10 m south of the site, the Clifton Down Limestone is overlain by younger deposits of the Mercia Mudstone Group (Marginal Facies), which may well extend onto the study site as a thin mantle of cohesive and / or granular soils. The BGS Lexicon gives the following description for these strata: *"Variable, typically consisting of conglomerate and / or breccia with clasts derived locally from rocks lying immediately below the unconformable base of these deposits. The matrix generally consists of finer-grained rock fragments...Where these deposits overlie Carboniferous limestones…both the matrix and limestone clasts are commonly dolomitized ("Dolomitic Conglomerate").".*

- No superficial or Made Ground deposits are mapped below the study site, however, some thin Made Ground / disturbed ground is anticipated given the previous development of the study site. It should be noted in this context that where such artificial or superficial deposits are relatively thin, or of low areal extent, they would not be expected to be recorded on mapping of the scale examined.

- Isolated areas of 'Worked Ground' within 250 m of the study site correspond to historic limestone quarrying and lead workings. The nearest such instance is c.40 northwest and was largely redeveloped for residential use prior to the earliest OS mapping; a section of the old quarry face, some 10-12 m in height is still visible from Quarry Steps suggesting perhaps only limited infilling of these workings.

- According to the Envirocheck Report, the site is located within an intermediate probability radon area, necessitating the inclusion of basic radon protection measures in the construction of new dwellings and extensions.

- Based on the available geological mapping, the ground conditions underlying the site are ascribed a 'low' hazard potential for ground dissolution. It should be noted in this regard that the Envirocheck dataset does not list any known natural cavities within 500 m of the study site.

- Either 'very low' or 'negligible' hazard potential is attributed to other ground stability issues, including collapsible ground, compressible ground, landslides, running sand and shrink-swell clay. However, given the proximity of the overlying Marginal Facies the potential hazard from shrink-swell clays could possibly be greater than indicated, if these strata extended onto the study site.

- The Clifton Down Limestone is not identified by the BRE (Ref. 3) as potentially containing elevated levels of pyrite, however the Mercia Mudstone Group is listed as sulphate-bearing strata. Any superficial deposits, including Made Ground, may contain elevated pyrite and / or sulphate, depending on their origin.

2.6 Hydrology, Hydrogeology and Environmental Setting

Key points from the Envirocheck Report (Appendix C) relating to the hydrology, hydrogeology and environmental setting of the site are summarised as follows:

- The bedrock geology is classified as a Principal Aquifer, however the site does not lie within a source protection zone (SPZ) nor are there any licensed water abstractions within a 1.5 km radius of the site.

- There are no surface water courses mapped within proximity of the study site; the nearest surface water feature is an unnamed river c.780 m northeast. The River Avon is c.1.2 km west. Additionally, there are no discharge consents are recorded within 500 m of the study site.

- The site is not reported as being located within an area with a risk of flooding from rivers or the sea and not within an area benefitting from flood defences. However, it is within an area with limited potential for groundwater flooding to occur at the surface, according to BGS flood data. Further consideration of the risk or consequences of flooding is not within the scope of this report.

- There is a single Local Authority Pollution Prevention and Control (PPC) entry relating to a petrol filling station on Whiteladies Road, c.85 m northeast.

- The site is not located within any designated sensitive land use areas; however, Quarry Steps, located c.35 m west, is a designated Site of Special Scientific Interest (geological conservation).

- There are no licensed waste facilities, including landfill sites, within a 500 radius of the study site, nor does the Envirocheck report list any recorded mineral sites (which may have been infilled) in proximity to the study site. Nearby areas of historic groundworkings have been redeveloped for residential end uses, and it is unclear if any backfilling may have taken place prior to redevelopment.

- As expected in an urban area, there are multiple active and inactive local contemporary trade directory entries listed within a 250 m radius of the site include petrol filling stations, garage and vehicle repair services, dry cleaners, printers, commercial cleaning services, pest and vermin control specialist, various retailers and distributors, a hospital, a marine engineers and furniture manufacturer and repairer.

2.7 Local Authority Information

Gi have made an enquiry to the Petroleum Enforcement Officer at Bristol City Council (BCC) regarding the underground petroleum tank on the premises. The Council responded that the department have *"no record of storage of petroleum or decommissioned tanks at this address"*, acknowledging that their records, which were inherited from Avon Fire and Rescue in 2007, may be incomplete (associated correspondence presented in Appendix D).

2.8 Unexploded Ordnance Risk

The post-World War Two (WWII) OS mapping showed the study site to be in close proximity to several ruined buildings, therefore an unexploded bomb risk map was obtained via Zetica Limited's unexploded ordnance (UXO) website (see Appendix E). The map indicates the site to be in a defined 'High Risk' area with regards to unexploded bomb hazard, as is much of the Bristol urban area.

Given the presence of buildings on-site throughout WWII, it seems unlikely that any UXO landing within the site or any associated UXO entry holes would go unnoticed, however it would be prudent to commission a Preliminary UXO Risk Assessment in order to confirm the threat level at the site, and undertake further detailed assessment and / or mobilise on-site support if required, prior to commencing any intrusive investigation or groundworks.

3. Geotechnical Considerations

3.1 General

This section of the report considers the ground conditions in the context of the engineering design and construction of new structures and provides preliminary guidance concerning the design of foundations and ground floor slabs.

Based on the likely presence of shallow limestone bedrock, as indicated by the geological mapping, and perhaps only modest thickness of Made Ground, it is expected that it would be possible to utilise traditional spread foundations for the proposed development, where new foundations are required. The same would likely be the case, if subsoils of the Marginal Facies, that are mapped close to the south, extend beneath the site.

Within ground conditions of this type, where competent bedrock is present at shallow depth, consolidation settlement is unlikely to be a significant factor. However, it should be noted that there is an elevation difference of c.1.8 m between the upper and lower unit ground floor slab levels which step down the slope and therefore the potential for greater thickness of Made Ground to be present locally cannot be discounted.

The application of additional loads from new structures could potentially trigger a change in equilibrium and therefore induce settlement within these unconsolidated deposits, acknowledging that any Made Ground or natural subsoils will have been subject to surcharge loading over a considerable length of time by the existing garage. Differential settlement could be a factor where new or existing foundations span between strata of differing compressibility e.g. clay and limestone, although no obvious evidence of structural distress was observed within the existing units which suggests the existing foundations may be within homogeneous materials, or as is likely the case, on limestone bedrock.

Due to the proximity of neighbouring buildings, which share party walls with the existing garage units, the stability of these structures is likely to be a key consideration for any groundworks on-site and in the design and construction of any new foundations for the apartment block.

Given the above, several geotechnical factors relating to the site and underlying ground conditions will influence the design and construction of the new apartment block. These factors would need to be addressed by appropriate intrusive investigatory works, necessary to provide the detailed information required, e.g. for party wall issues.

It is possible, however, on the basis of the findings of the desk-based research completed, to make some preliminary comments concerning the geotechnical aspects of the proposed works.

3.1.1 Excavations

The desk-based research has established that the site is likely to be underlain by Made Ground, followed by Clifton Down Limestone bedrock at shallow depth; perhaps sandwiching a thin mantle of cohesive and / or granular soils of the Mercia Mudstone Marginal Facies.

The shallow Made Ground would generally be expected to be excavated using conventional plant, albeit with a potential requirement for breaking equipment to penetrate hard construction and / or remove obstructions, such as buried tanks or associated bases.

The Made Ground and, if present, the Marginal Facies deposits have the potential to be heterogeneous, comprising a mix of particle sizes, which could lead to problems with excavation stability or overbreak where coarser constituents are removal from trench sides by the physical action of excavation.

Deeper excavations extending into the anticipated limestone bedrock, if required, would likely prove arduous, requiring heavy machinery and breaking equipment, which could prove problematic in a built-up area such as the study site. Excavation would likely be controlled in part by fracturing along existing discontinuities, such that a degree of overbreak would be anticipated.

Excavations within shallow subsoils would be expected to be battered back to a suitably shallow angle of repose to be assessed based on the findings of the intrusive investigation, however, special care will need be taken to avoid undermining adjacent party walls and thereby the stability of neighbouring properties.

Consideration may need to be afforded to the control of perched groundwater or possible contamination, for example including hydrocarbon free product associated with the decommissioned petroleum tank, subject to the findings of the intrusive investigation.

3.1.2 Foundations and Ground Floor Slabs

As discussed above, the site is likely to be underlain by shallow limestone bedrock, beneath a modest thickness of Made Ground and / or Marginal Facies subsoils.

Given the above, it is considered that traditional spread foundations are likely to be appropriate to support new loadings. It is anticipated that new strips or pads would be taken down through any Made Ground or natural subsoils and founded within / onto the limestone bedrock which is expected to underlie the site at shallow depth, or perhaps into the Marginal Facies, if present and suitably homogenous materials are encountered.

Spread foundations would need to be designed by an experienced and suitably qualified engineer who should select appropriate design parameters and working loads based on the findings of the subsequent intrusive investigation.

Assurances would need to be sought from prospective contractors concerning the potential environmental impact of the works, including reference to the potential for vibration or displacement damage to any nearby structures during demolition or groundworks, particularly if founded on shallow footings. In this regard, it may be prudent to consider whether any underpinning works could be required. Excavations would need to be undertaken in such a way as to mitigate the potential risk of creating contaminant migration pathways.

Given the likely underlying ground conditions, the use of either ground-bearing or suspended ground floor slabs, the latter with an appropriately dimensioned underfloor void, could be utilised for traditional building types, subject to the findings of an intrusive investigation. In this context it should be noted that the site lies within and area where basic radon protection is required. Such measures may be more practical to install in conjunction with a suspended floor slab.

Intrusive investigatory works would be required to confirm the underlying shallow depth ground conditions, obtain existing foundation / party wall details and inform the design of traditional foundations.

3.1.3 External Areas

Pavements should be engineered on the basis of the intrusive investigation findings, making reference

to CBR test data, incorporating an appropriate sub-base thickness and sufficient articulation to mitigate surface deterioration, together with any influence on their drainage characteristics. It should be appreciated that differential settlement could also potentially occur across localised hard spots.

3.1.4 Drainage

No specific details have been provided with regards to the proposed drainage strategy for the new development, however, the proposed ground floor plan indicates 'SUDS planters' and permeable paving in external areas, presumably with discharge directly into the underlying natural soils / rock. Acknowledging that it would be unusual for soakaways to be constructed within 5.0 m of any buildings, particularly careful consideration will need to be afforded to the design of the drainage system and the advice of a specialist drainage consultant may need to be sought.

The suitability of sustainable drainage could also be impacted by the presence of any significant soil contamination, depending on the findings of subsequent intrusive works, as discussed in more detail in Section 4 below.

Subject to engineering advice and the approval of the regulators, the most practical solution may be to connect the new surface water drainage system to the existing public sewer network.

3.1.5 Conclusion

Given the above, the potential geotechnical issues relating to any Made Ground, if present, and the stability of neighbouring structures in the context of any new groundworks would need to be addressed and fully evaluated on the basis of a comprehensive and detailed intrusive ground investigation.

4. Potential Geo-Environmental Hazards

4.1 Introduction

It is appropriate to consider the findings of the desk-based research using a risk assessment approach, consistent with the requirements of the LCRM framework (Ref. 4), whereby a conceptual site model is developed, on the basis of the relationship between potential contamination sources, pathways and receptors, taking into consideration the available information concerning the site history, geology, hydrology, hydrogeology and environmental setting.

This section of the report provides a preliminary assessment of the level of risk posed by ground contamination in the context of the proposed development, based on the findings of the initial desk-based research.

It will be necessary for the preliminary conceptual site model described in the following section to be extended and refined in light of the findings of any subsequent intrusive investigatory works and laboratory analyses.

4.2 Preliminary Conceptual Site Model

4.2.1 Possible Sources of Contamination

It is possible to make the following comments in relation to possible sources of contamination at the site on the basis of the desk-based research and site inspection undertaken.

- The site comprises the former premises of a vehicle testing centre and repair garage, which is the main driver for considering potential risks from ground contamination.

- Potential contaminants of concern would include a wide range of elements and compounds such as trace metals, heavy metals, asbestos and organic compounds, most notably petroleum hydrocarbons in the context of the former garage.

- There is evidence of historic bulk fuel and oil storage facilities at the site. An elevated oil tank was observed in the rear of the central unit (understood to be empty) and the Client advised of a decommissioned underground petroleum tank within the front of the southern unit. Some hydrocarbon staining was also noted towards the front of northern unit, the former location of a waste oil container. The movement and parking of vehicles also introduces a limited risk of hydrocarbon contamination, associated with leakage from vehicles etc, however, this presents a low risk in comparison with the bulk hydrocarbon storage.

- The site lies within a predominantly residential area, albeit with a history of limestone quarrying and lead mining. No evidence of any such workings on-site has been highlighted by the desk-based research, therefore it is considered unlikely that the site would be underlain by any significant thickness of Made Ground; however, given the level changes on-site some fill may be present locally, the nature and contamination status of which is unknown.

- Other, isolated, commercial or industrial land uses are either fairly small scale, e.g. electricity substations, or at greater distance so as not to warrant further consideration in the context of this assessment.

- Made Ground underlying the site is likely to be relatively shallow, such that it would not necessarily be considered to present a significant ground gas risk, however, there are several either infilled or partially infilled quarries (nearest mapped c.40 m northwest) in proximity to the study site which would constitute a potential source of hazardous ground gases, dependent on the nature of any infill materials.

- Additionally, due to the underlying bedrock geology, the site lies within an area with elevated radon potential, necessitating the inclusion of radon gas protection measures within new dwellings.

- Whilst the original structures on-site (shown on the late 1800s OS mapping) pre-date the widespread use of asbestos as a building material, and the subsequent iterations of the mapping do not appear to indicate any significant changes to the building layout, the potential presence of asbestos containing materials (ACM) cannot be discounted on the basis of later alterations or upgrades throughout the 1900s to present-day. It is possible that ACMs, if contained within the building fabric of any earlier structures, may have migrated into subsoils during any uncontrolled demolition / internal reconfiguration of historic building elements.

4.2.2 Receptors of Contamination and Migration Pathways

4.2.2.1 Receptors

The following potentially sensitive human health and environmental receptors should be considered for a development of the type proposed, making reference to the accompanying desk-based research:

- Future site users, including the occupiers of, and visitors to, the residential units.

- Site construction and maintenance workers.

- The general public and occupiers of neighbouring land, including users of the adjacent roads and surrounding residential and commercial properties.

- The underlying groundwater within the Principal Aquifers (Clifton Down Limestone and Marginal Facies).

- Buried concrete.

4.2.2.2 Pathways

The following potential contaminant migration pathways would ordinarily be considered for a development of the type proposed:

- Inhalation of airborne particulate matter or vapours from contaminated soil in outdoor or indoor air.

- Ingestion of contaminated soil or groundwater directly, by deliberate consumption, indirectly, by for example eating or smoking with dirty hands, and by ingestion of fugitive dust.

- Dermal contact with contaminated soil or groundwater, possibly leading to absorption of contaminants into the body through the skin, and / or causation of skin conditions such as dermatitis.

- Leaching of water infiltrating through contaminated soils, which can transport soluble contaminants into groundwater.

- Migration of contaminated groundwater either laterally or vertically, dependent on the permeability of the ground, together with other factors such as the presence of preferential pathways and / or man-made voids.

- Migration of ground gases or volatile hydrocarbon vapours either laterally or vertically through permeable or voided ground and accumulation within unprotected buildings.

- Damage to building materials by direct contact with aggressive ground conditions, or in association with its coastal setting, for example sulphate attack on concrete and / or hydrocarbon attack on plastics, for example water supply pipes.

4.3 Preliminary Risk Assessment - Conclusions

4.3.1 Context

This preliminary assessment considers potential soil contamination risks associated with the construction of the proposed residential development on the basis of the findings of this desk-based research.

It should be noted that the proposed residential redevelopment will comprise predominantly building and hardstanding cover, albeit with small areas of soft landscaping. Whilst much of the underlying Made Ground, if present, would be encapsulated, the source-receptor linkages with regards to the dermal contact and ingestion pathways remain locally.

The presence of smaller enclosed spaces at ground floor level will need to be considered in the context of the potential risks posed by hazardous ground gases within indoor airspace; although the requirement for radon protection measures may also offer some mitigation in this regard.

In respect of chronic human health risks arising from the presence of contaminated soils following completion of the proposed development, acknowledging the aforementioned considerations, in general, only slightly increased risk will be realised when compared to the site as existing.

4.3.2 Potential Chronic Human Health Risks

Any encountered Made Ground is considered the most significant possible source of potential contaminants of concern, either due to being residually contaminated at placement or through subsequent use of the site as a garage. Whilst much of the site surface will be encapsulated by new hardstanding and building cover, there are could be some localised human health risks resulting from dermal contact with, or ingestion of, contaminated soils that could arise in areas where new soft landscaping is proposed.

However, these areas are relatively small in the context of the overall site and it is considered that the risk could be mitigated by the importation of certified clean topsoil / subsoil together with a geotextile membrane to prevent soil mixing, for in-ground planters. Furthermore, the risk would be negligible if, for example, the in-ground planters have sealed bases, or raised planters were placed on entirely hard surfaced construction.

As such, the only remaining plausible pathway would be the inhalation of indoor air, which is mitigated to an extent by the design of new ground floor slabs and installation of a radon membrane

within the proposed apartment block, although appropriate assessment should be undertaken with regards to other hazardous ground gases.

4.3.3 Potential Acute Human Health Risks

The potential for acute human health risks to impact on the construction workforce, together with the general public and occupiers of surrounding properties should be considered in the context of the pre-construction health and safety plan prepared by the building or groundworks contractor.

Whilst potential acute human health risks are currently mitigated by the hard surfaced construction of the garage units, it should be appreciated that the replacement of the existing hard surfacing and / or any penetrations required for new foundations, other groundworks and drainage engineering works, could expose underlying potentially contaminated soils, particularly around any buried tanks or along existing drainage routes. This should be taken into consideration in the specification of appropriate PPE and it should be ensured that effective suppression of particulate matter is put in place during any earthworks activities.

Despite the apparent age of the existing structures on-site, the potential presence of asbestos within any Made Ground soils cannot be discounted and any bulk soil handling operations should be treated with care.

4.3.4 Potential Risks from Hazardous Ground Gases

Considering potential ground gas sources, the underlying natural deposits of the Clifton Down Limestone and / or Marginal Facies would not be considered to present a source of hazardous ground gases.

Any Made Ground soils, if encountered beneath the site, could potentially present a hazardous ground gas risk, dependent on their composition. However, only modest thicknesses of Made Ground are anticipated to underlie the site and in the absence of any significant volume of organic or potentially putrescible content, would be unlikely to contribute to an onerous ground gas regime.

Similarly, any deep fill associated with nearby quarried land; although it should be noted that the closest quarry workings are indicated as ‘Worked Ground’ on the geological mapping, which suggests no or limited infilling has taken place. This is corroborated by the observations during the site walkover, where a 10-12 m high quarry face was viewed from Quarry Steps.

The historic garage usage is a potential source of hydrocarbon contamination. The facility was operational from at least the early 1950s until 2022 (current ownership since the 1970s) and given the above- and underground storage of fuel and oil on-site, it is likely that fuels or oils were lost into the ground through spillages or leaks, despite the level of care taken by the Client. Whilst much of these mobile hydrocarbons are likely to have degraded over time, there remains the potential for residual hydrocarbon contamination to remain in the soils on-site and pose a vapour risk to occupiers of the redeveloped site.

Based on the Envirocheck Report, the site lies within an area where basic radon protection is required.

For a traditional building type, as proposed, it would be necessary to investigate and assess potential ground gas risks, potentially leading to a requirement for protective measures to be installed.

4.3.5 Potential Risks to Controlled Waters

The underlying Principal Aquifer within the Clifton Down Limestone has been identified as the most sensitive controlled waters receptor (also the aquifer designation given to the Marginal Facies).

However, the site is not located within a SPZ, nor any there any groundwater abstractions within influencing distance of the study site.

As discussed above, the proposed apartment block will retain some existing foundations, for example party walls to neighbouring properties, along with the construction of new foundations. Given the anticipated modest thickness of Made Ground, it is likely that a traditional spread foundation will be utilised and consequently significant, deep migration pathways for mobile contaminants are unlikely to be formed, acknowledging that the groundwater table within the Clifton Down Limestone is expected to be at significant depth given the site's elevated location.

It may be that any Made Ground or, if present, Marginal Facies soils include lower permeability, cohesive horizons which would inhibit the vertical movement of any perched mobile contaminants. As only modest thicknesses of these deposits are anticipated, foundation / formation excavations through these materials into the underlying limestone bedrock could potentially liberate mobile contaminants / perched water contamination held at impermeable layer boundaries with movement into excavations and consequent risk to the aquifer, particularly due to the fractured or jointed limestone rock structure.

This is certainly the case in proximity to the underground fuel tank, which could have leaked into the surrounding soils, acknowledging that no details are known of the condition of the tank at the time of its decommissioning. Whilst removal of the tank and associated infrastructure along with the excavation of any contaminated soils is likely to be preferred in the context of reducing the risk to controlled waters from residual hydrocarbon contamination, consideration will need to be afforded to the proximity of neighbouring properties and risk of undermining adjacent foundations.

The proposed SUDS drainage should be carefully considered on the basis of the findings of the intrusive investigation, to avoid any surface water, which would otherwise be collected by the existing drainage, to permeate into potentially contaminated soils or leach / mobilise contaminants from the Made Ground.

Based on the aforementioned considerations, depending on the outcome of the recommended intrusive investigation, the use of SUDS drainage would be subject the approval of the regulatory authorities and the requirements around the removal of any existing tanks would need to be agreed with the Local Authority.

5. Recommended Intrusive Investigatory Works

5.1 General

It will be necessary to supplement this desk-based research with a suitable Phase 2 intrusive ground investigation in order to provide the geotechnical information necessary for design purposes, together with an appropriate level of assessment of potential contamination risks.

Making reference to the information provided in Section 2.8 above, the level of UXO risk at the site should be confirmed prior to commencing with any the Phase 2 investigation works.

5.1.1 Geotechnical Investigation

Several investigative techniques could be suitable in order to provide information for foundation design purposes, given the anticipated shallow depth of limestone bedrock. The exploratory holes would likely extend down through the Made Ground (and Marginal Facies) to the competent bedrock strata of the Clifton Down Limestone Formation. The exploratory hole positions would need to reflect the location of the proposed structure.

The Clifton Down Limestone bedrock is likely to be within the depths achievable by a tracked mini-excavator, enabling observation of the in-situ soils and rock, or the exposure of other features such as buried tanks or foundations. Strength testing could be completed using a Pilcon hand vane for measuring apparent cohesion within fine-grained subsoils horizons and basic CBR tests could also be undertaken using a handheld Mexecone penetrometer in order to provide parameters for pavement / hard surface design purposes. Infiltration testing could also be completed within the pits to inform drainage design.

Shallow, hand excavated trial pits, typically up to a maximum depth of c.1.2 m, would be the most suitable means of providing information relating to existing foundations and party walls. These would generally be excavated using conventional hand tools supplemented by a pneumatic breaker.

Acknowledging the amount of disturbance made by mechanically excavated trial pits, small diameter dynamically sampled boreholes formed using a tracked Archway Dart rig would initially be an efficient method of gaining information relating to the shallow depth soils with disturbed samples recovered in plastic liners. However, it should be noted that this drilling technique would not penetrate the competent limestone bedrock and may refuse on, or be deflected by, buried obstructions, albeit would provide an indication of the underlying bedrock profile based on refusal depths. Standard Penetration Tests (SPTs) would typically be undertaken at regular intervals within the boreholes to confirm the strength / density of the soils and enable bearing capacity and ground floor slab design to be considered.

Were deeper boreholes to be required, penetrating into the limestone bedrock, this would necessitate the use of more costly rotary drilling methods.

Samples should be collected from the boreholes for laboratory tests to confirm engineering parameters for design purposes, including for example, classification tests to establish soil plasticity.

5.1.2 Contamination Assessment

Potential contamination risks within the Made Ground and other deposits could be assessed concurrently the geotechnical investigation works detailed above. Although it should be acknowledged that dynamic sampling techniques would not be suitable for exposing large features, such as

underground tanks, however, could provide early cost-effective information on the contamination status of the underlying shallow Made Ground soils, for example.

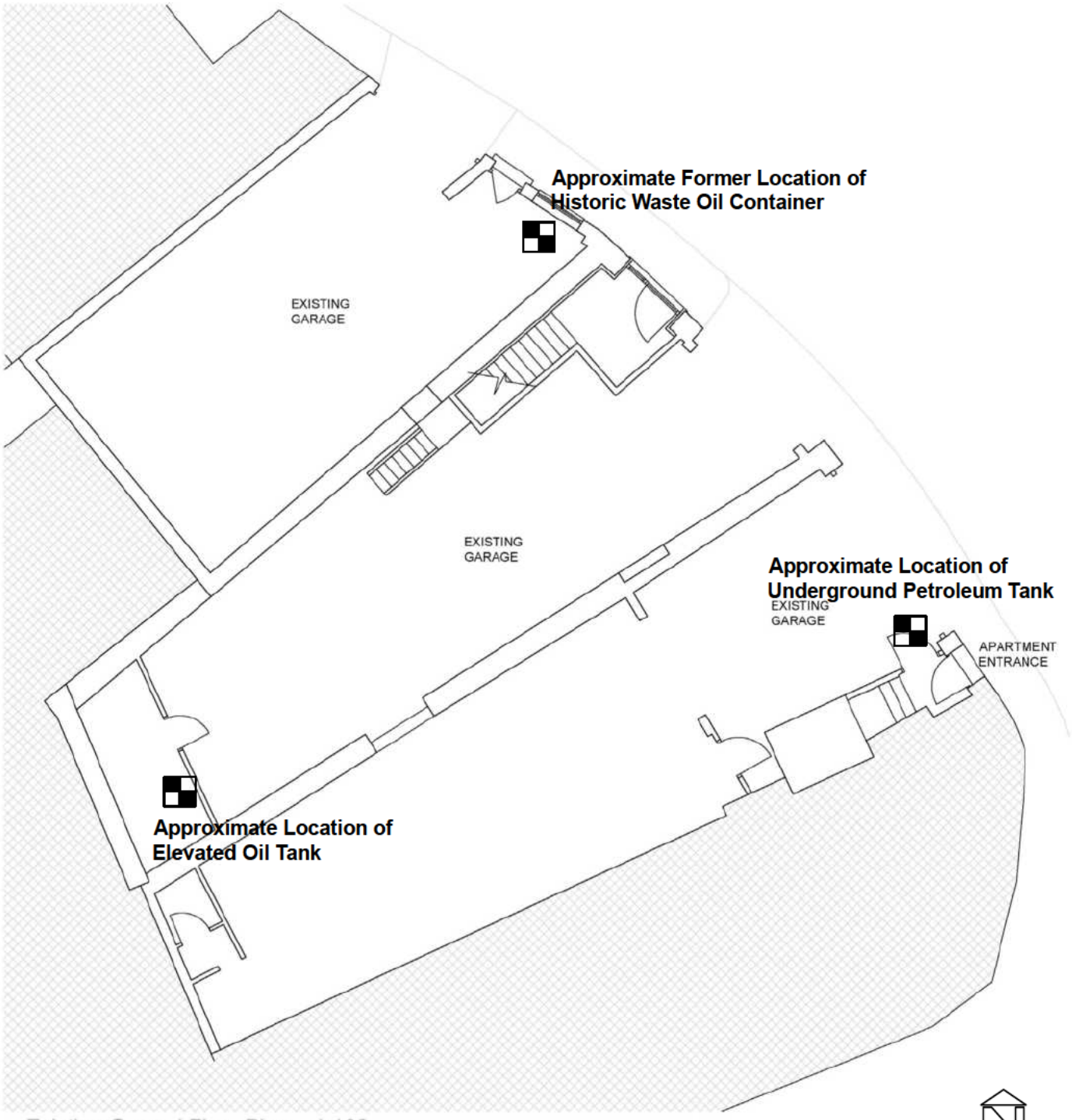
If necessary, these boreholes could be installed with ground gas / groundwater monitoring wells and a regime of monitoring put in place, which would not be the case for machine or hand dug trial pits.

Samples of the encountered soils and / or groundwater recovered from the boreholes (or trial pitting works) should be submitted to a UKAS accredited laboratory for chemical analysis.

Scheduling of the laboratory analyses should take into consideration both the physical findings of the intrusive investigatory works and the desk-based research described in this report, affording particular consideration to the presence of the types of Made Ground material present. Depending on the investigation findings, the analytical suite would be expected to include an extensive range of chemical contaminants, including, for example, metals, PAHs, TPHs, VOCs, cyanides, sulphate and pH, together with asbestos screening.

Further, more extensive testing or detailed assessment, e.g. to expose any buried fuel infrastructure, could be required for the proposed residential development, subject to consideration by the Local Authority regulators in the context of the planning system.

FIGURES



Existing Ground Floor Plan 1:100

Ground Investigation
Unit 3, Westfield Court, Barns Ground, Kenn,
Clevedon, BS21 6FQ
Tel: 01275 876903 **Fax:** 01275 879662
Email: mail@ground-investigation.com

Site: 2-5 Highland Square, Clifton	
Client: S.F. Tebby & Son Limited	
Project ID: P1891	Scale: NTS
Filename: P1891.Fig1.dwg	

FIGURE 1

Existing Site Layout

Proposed Ground Floor Plan 1:100

Ground Investigation
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
Tel: 01275 876903 **Fax:** 01275 879662
Email: mail@ground-investigation.com

Site: 2-5 Highland Square, Clifton	
Client: S.F. Tebby & Son Limited	
Project ID: P1891	Scale: NTS
Filename: P1891.Fig2.dwg	

FIGURE 2

Proposed Site Layout

APPENDIX A

Historical Ordnance Survey Mapping

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Gloucestershire

Published 1882 - 1883

Source map scale - 1:500

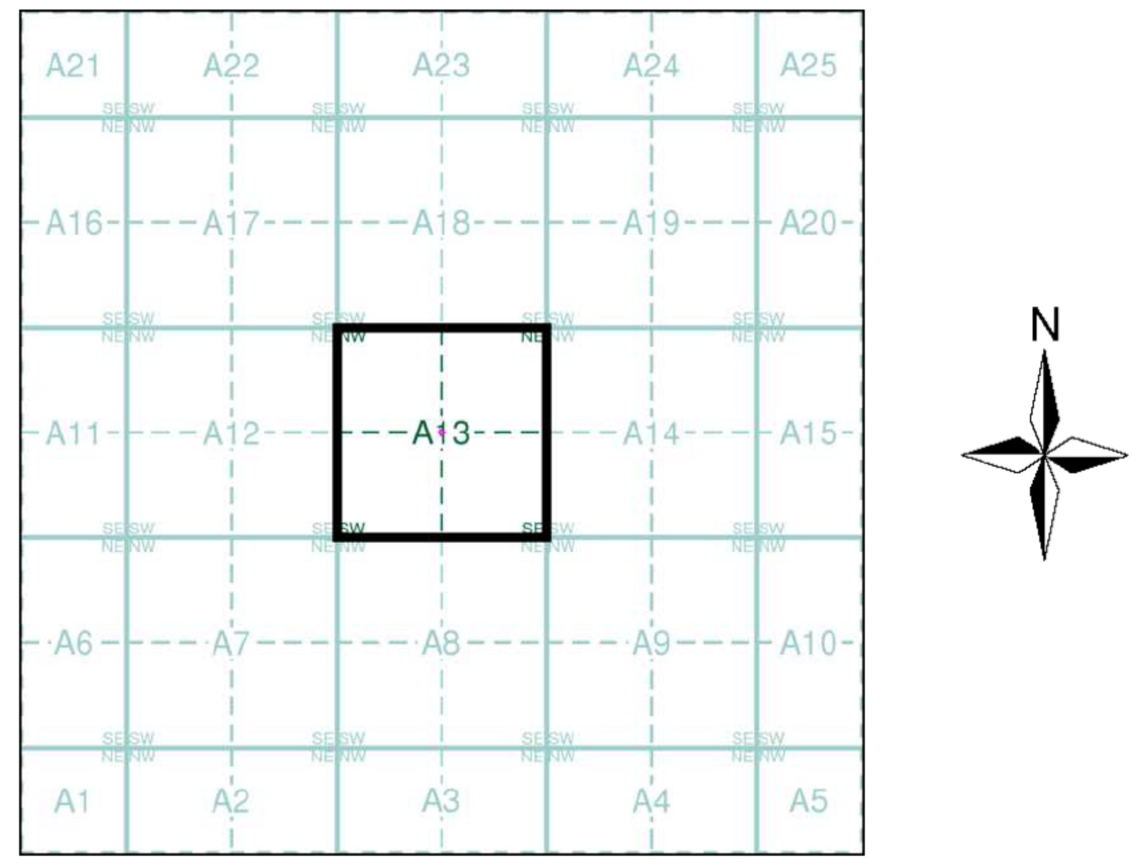
The 1:500 scale Ordnance Survey mapping was introduced in 1855 as a replacement for the 1:528 scale and to compliment the 1:2500 scale that had been implemented in 1853. By 1895, the 1:500 scale covered most towns over a population of about 4000 at the time of survey, although very few towns were mapped more than once at this scale, and none have been since 1910. The 1:500 scale gives particular emphasis to such features as lamp posts, man holes, arched passages and minor building projections. Also often featured are divisions between tenements, interior ground floor layouts of public buildings, and on earlier plans, the functions of the various parts of larger industrial premises are also indicated. Content of the plans does vary however, from one town to the next in terms of, for example, the completeness of railway tracks and the coverage of public buildings.

Please note: Due to the partial coverage of Historical Town Plans, it is possible that not all segments within an order will contain mapping. Only the segments that have Town Plan coverage will be generated.

Map Name(s) and Date(s)

071_12_016 1882 1:500	071_12_017 1882 1:500
071_12_021 1882 1:500	071_12_022 1882 1:500
071_16_001 1883 1:500	071_16_002 1883 1:500

Historical Town Plan - Segment A13



Order Details

Order Number: 343897617_1_1
Customer Ref: P1891
National Grid Reference: 357360, 174670
Slice: A
Site Area (Ha): 0.03
Search Buffer (m): 0

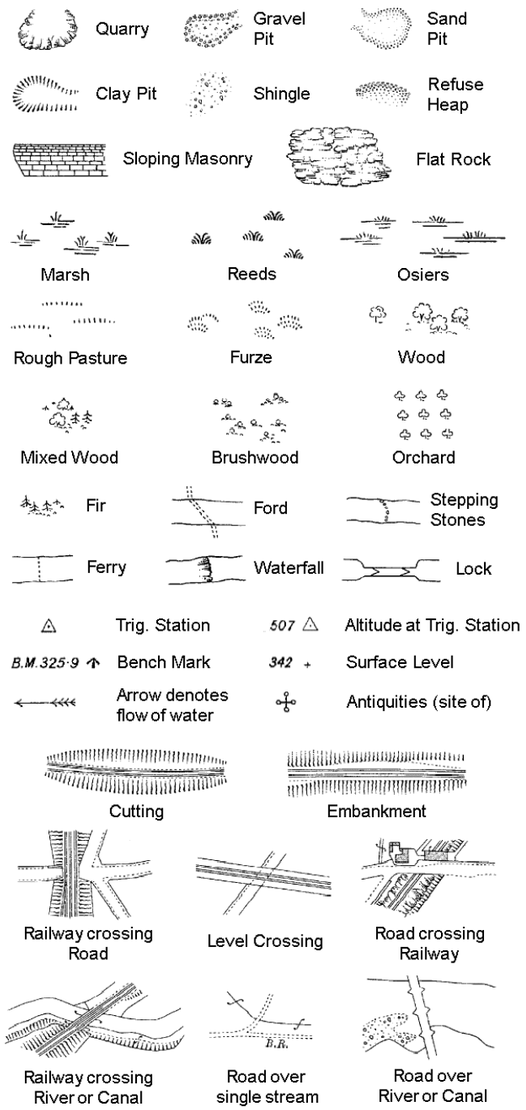
Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

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

Historical Mapping Legends

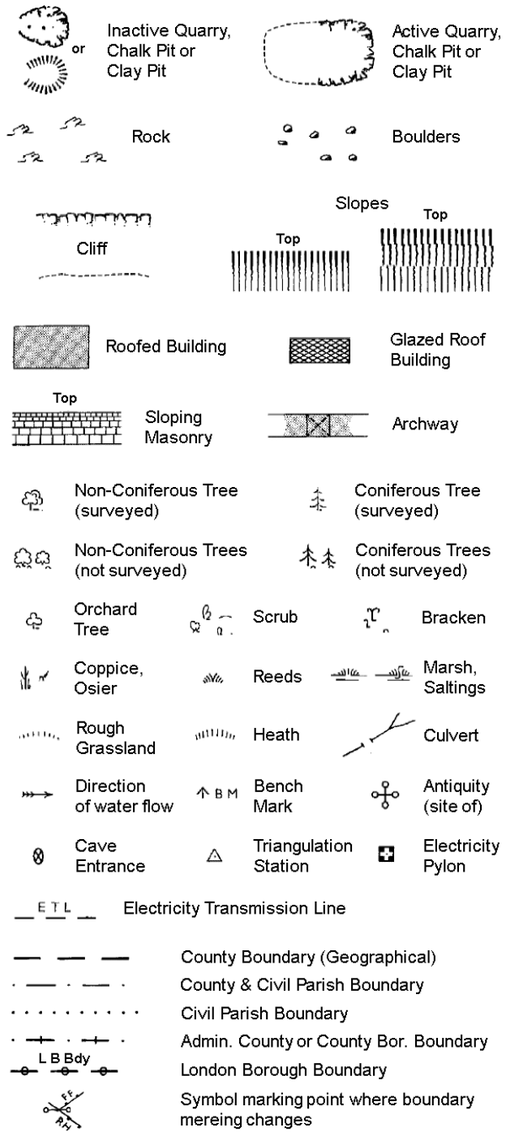
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



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

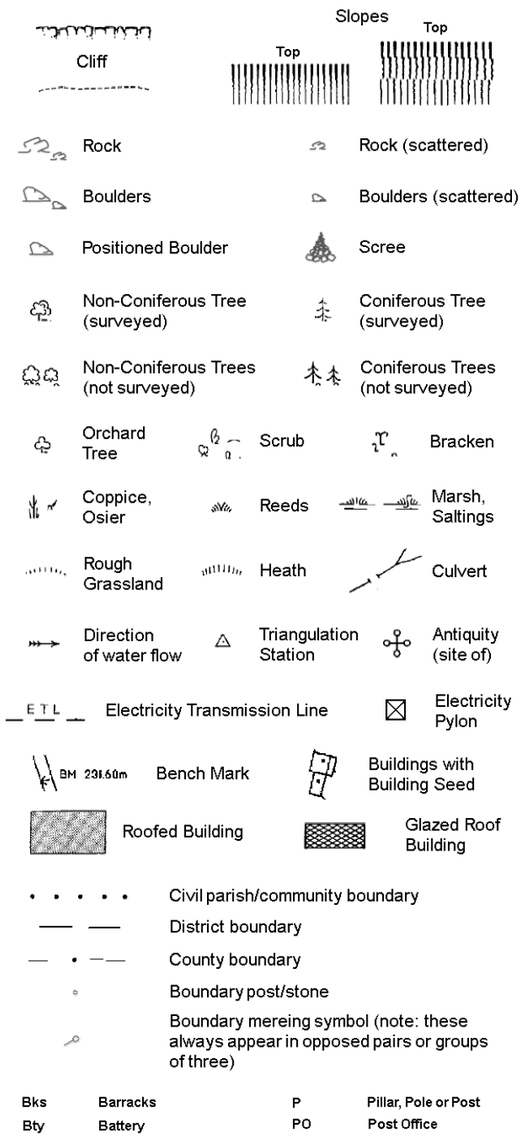
Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



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)

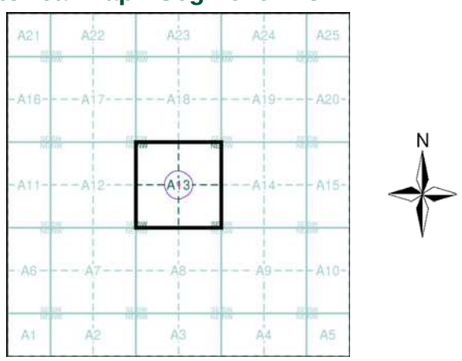
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity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

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Gloucestershire	1:2,500	1883 - 1885	2
Gloucestershire	1:2,500	1903	3
Gloucestershire	1:2,500	1916 - 1918	4
Ordnance Survey Plan	1:1,250	1951 - 1952	5
Ordnance Survey Plan	1:2,500	1952	6
Additional SIMs	1:2,500	1963	7
Ordnance Survey Plan	1:1,250	1968 - 1972	8
Ordnance Survey Plan	1:2,500	1970	9
Additional SIMs	1:1,250	1982 - 1990	10
Additional SIMs	1:1,250	1990	11
Large-Scale National Grid Data	1:1,250	1992	12
Large-Scale National Grid Data	1:1,250	1996	13

Historical Map - Segment A13

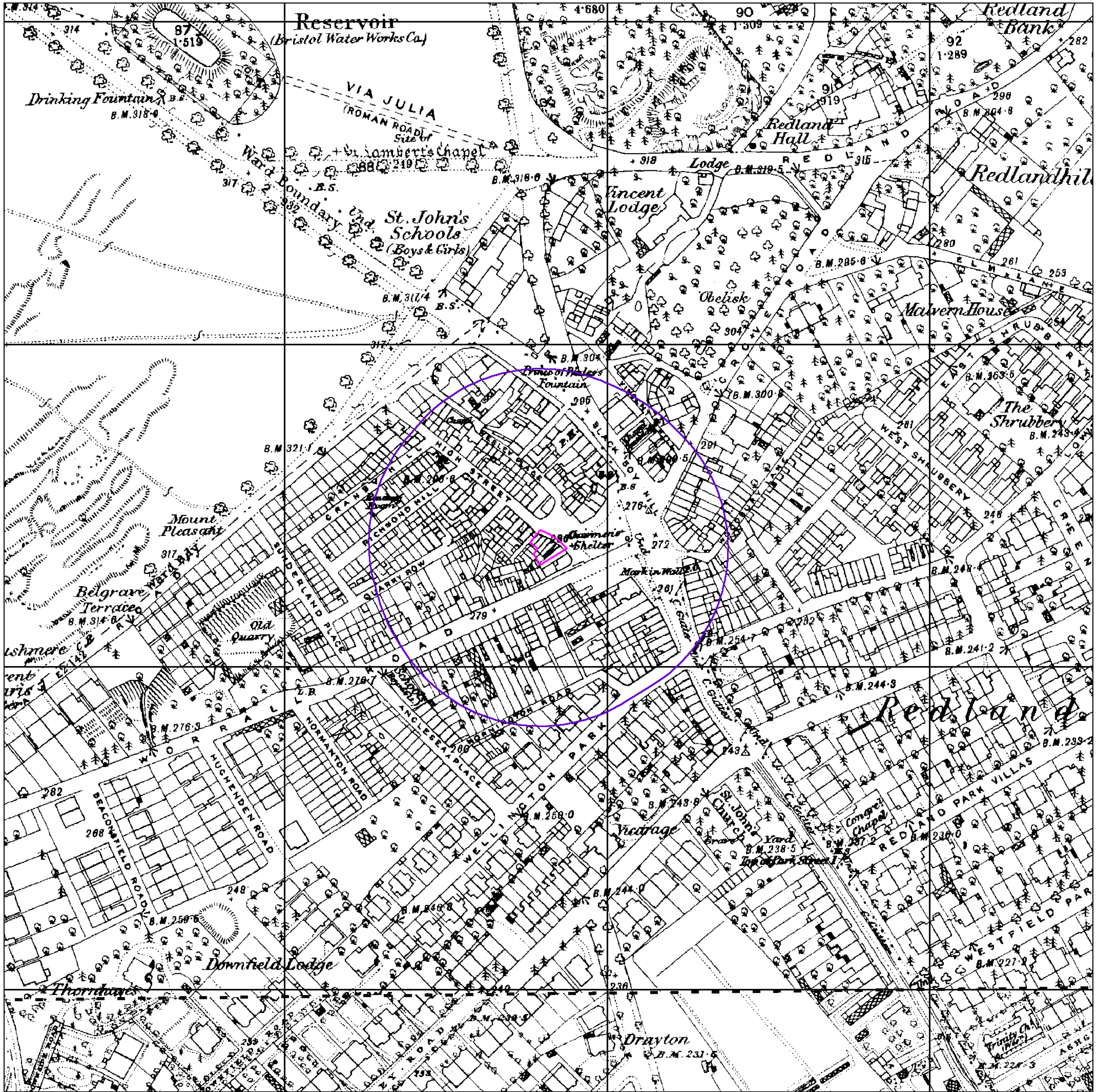


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



© Crown copyright and Landmark Information Group Limited 2024. All Rights Reserved.

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

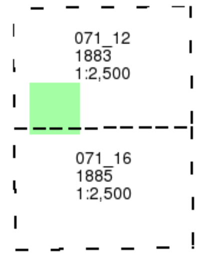
Gloucestershire

Published 1883 - 1885

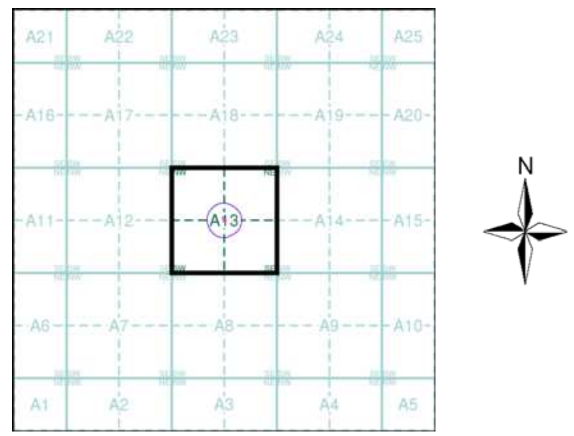
Source map scale - 1:2,500

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)



Historical Map - Segment A13



Order Details

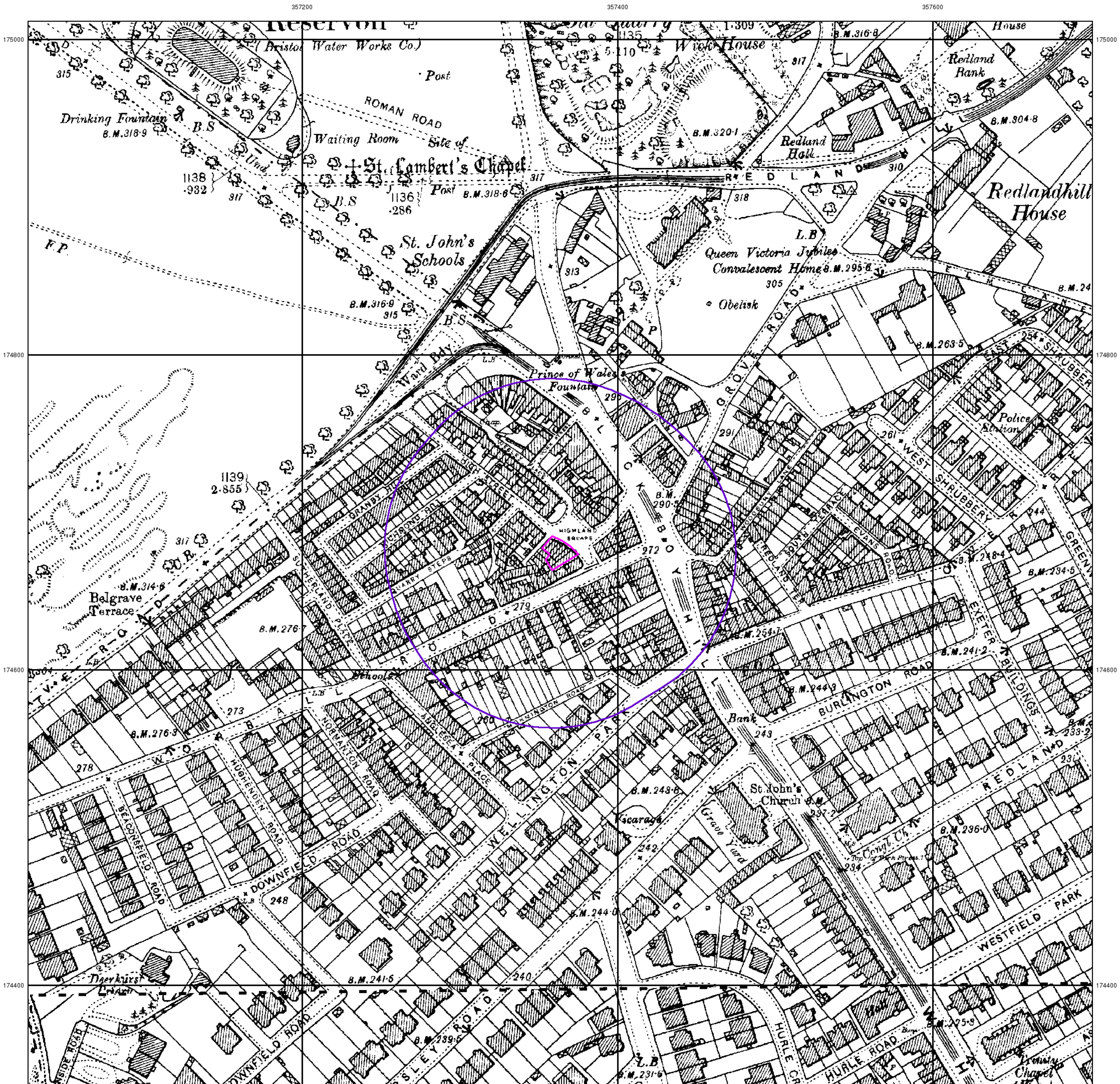
Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

Landmark INFORMATION GROUP

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



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

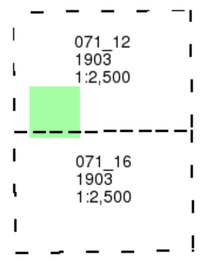
Gloucestershire

Published 1903

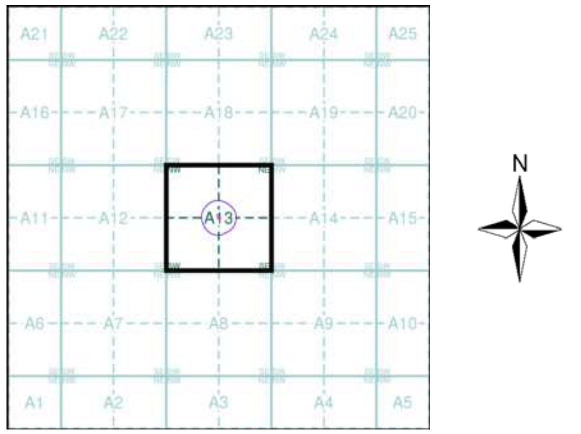
Source map scale - 1:2,500

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)



Historical Map - Segment A13

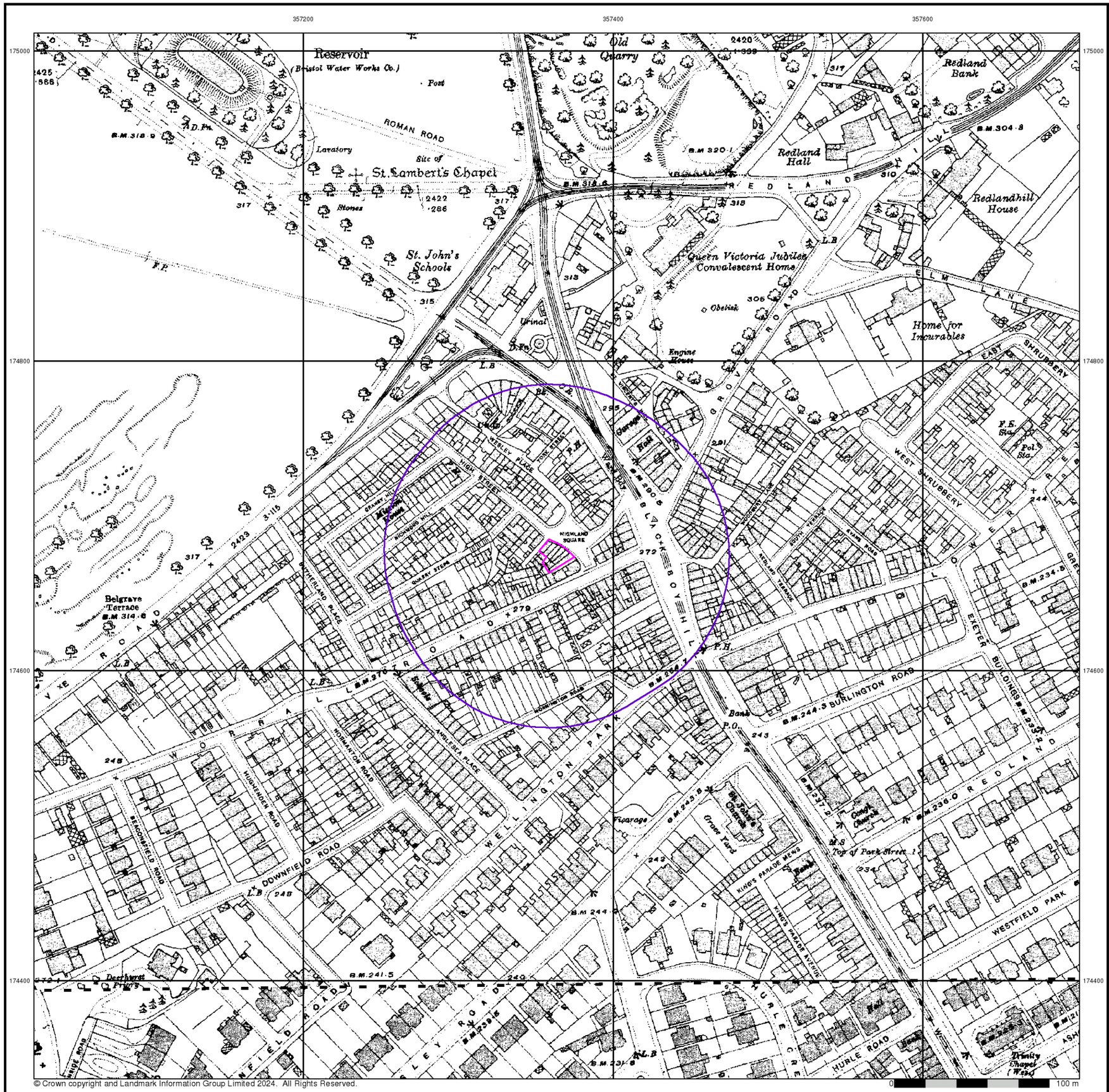


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Gloucestershire

Published 1916 - 1918

Source map scale - 1:2,500

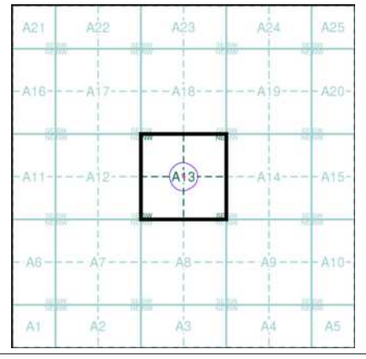
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. 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)

071_12
1916
1:2,500

071_16
1918
1:2,500

Historical Map - Segment A13

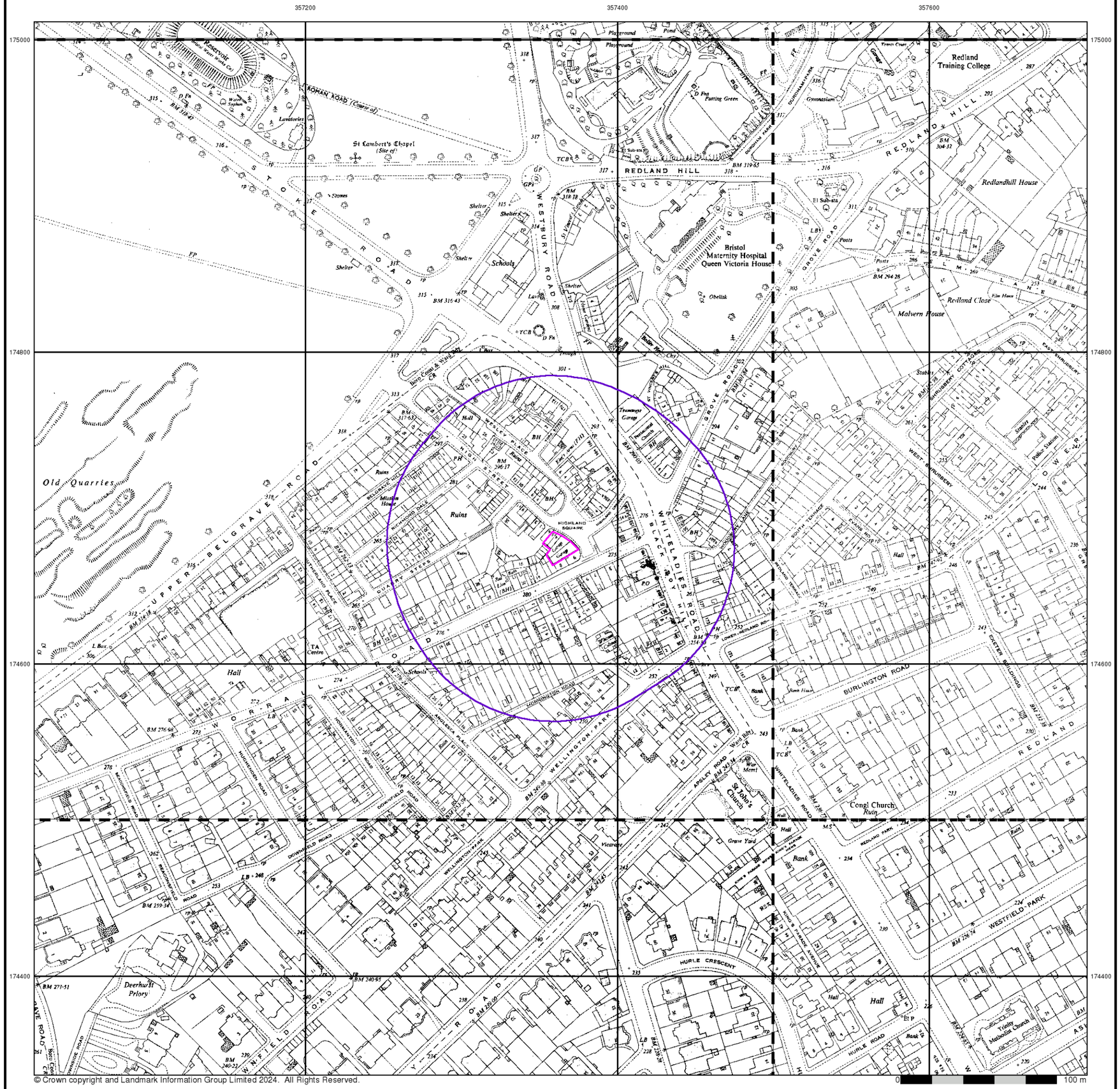


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

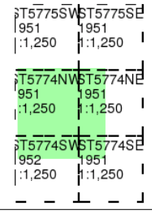
Ordnance Survey Plan

Published 1951 - 1952

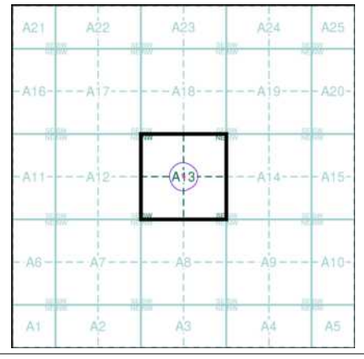
Source map scale - 1:1,250

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)



Historical Map - Segment A13

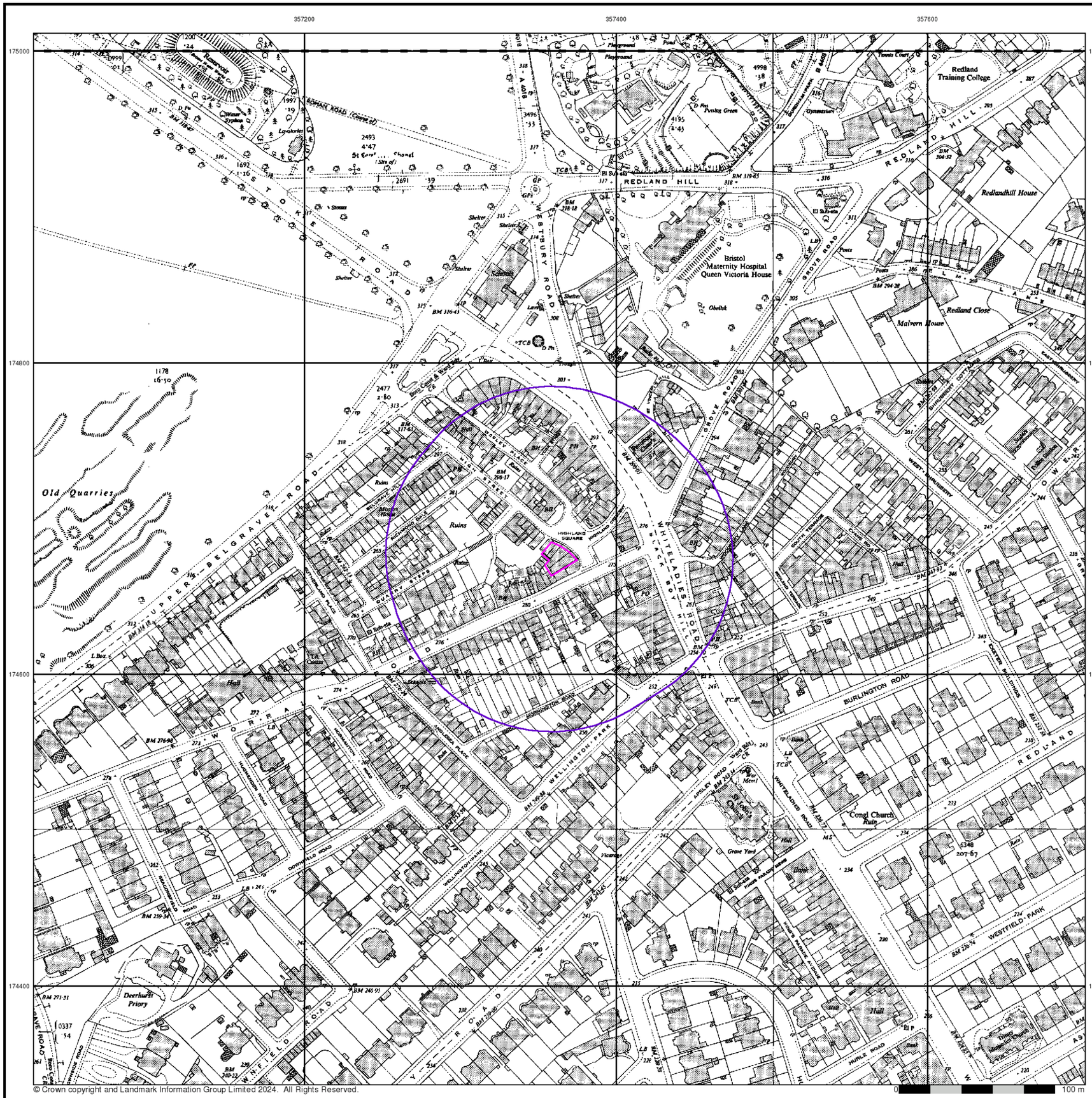


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Ordnance Survey Plan

Published 1952

Source map scale - 1:2,500

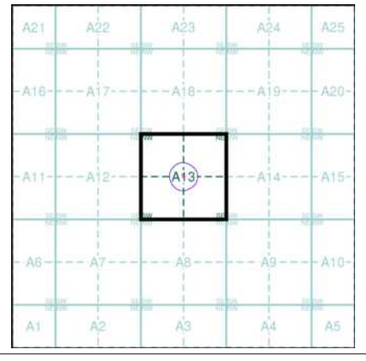
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. 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)

ST5775
1952
1:2,500

ST5774
1952
1:2,500

Historical Map - Segment A13

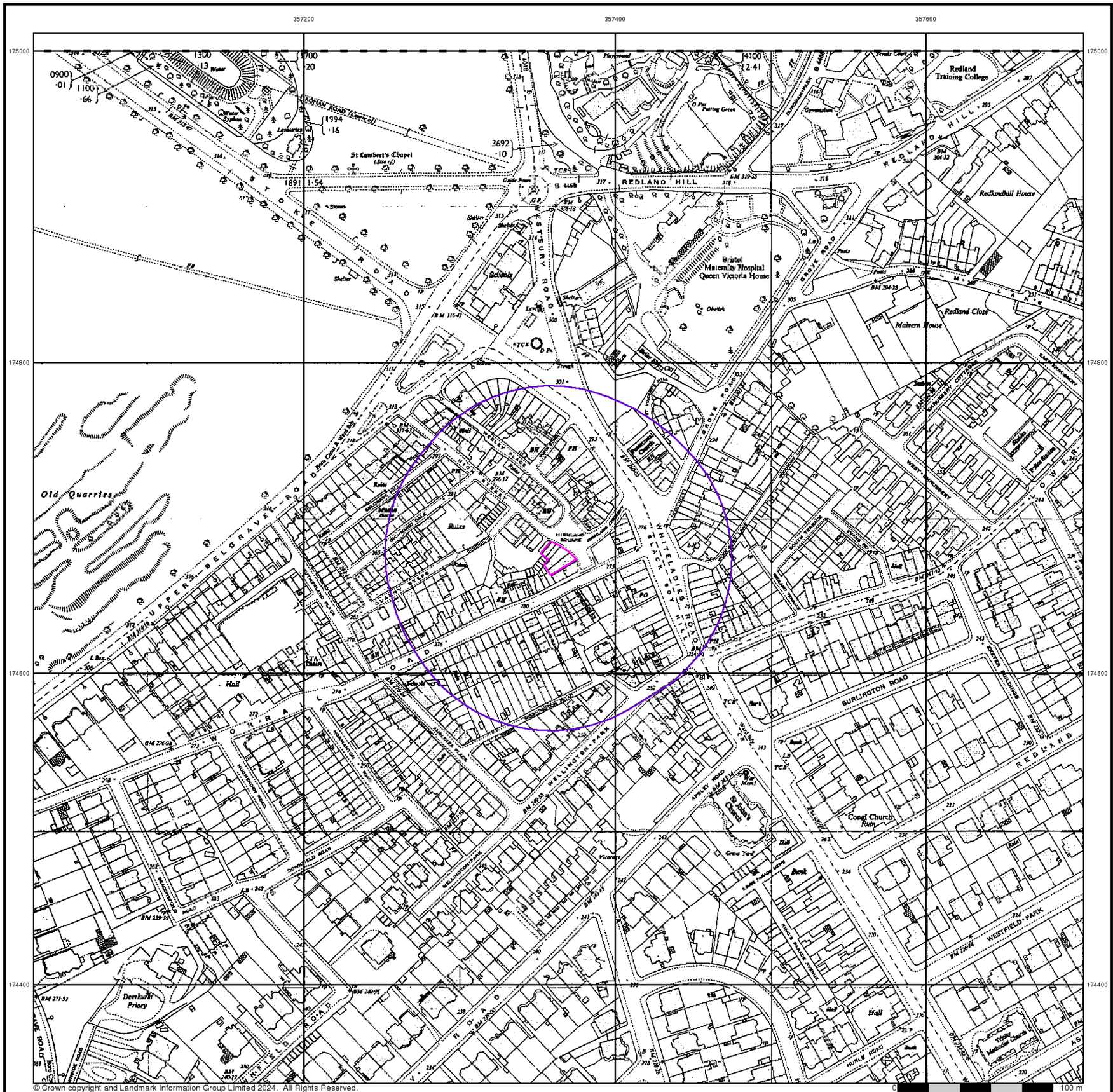


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

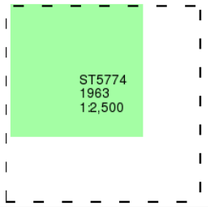
Additional SIMs

Published 1963

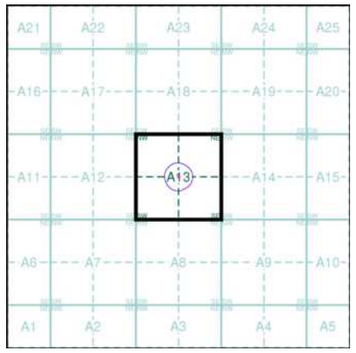
Source map scale - 1:2,500

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

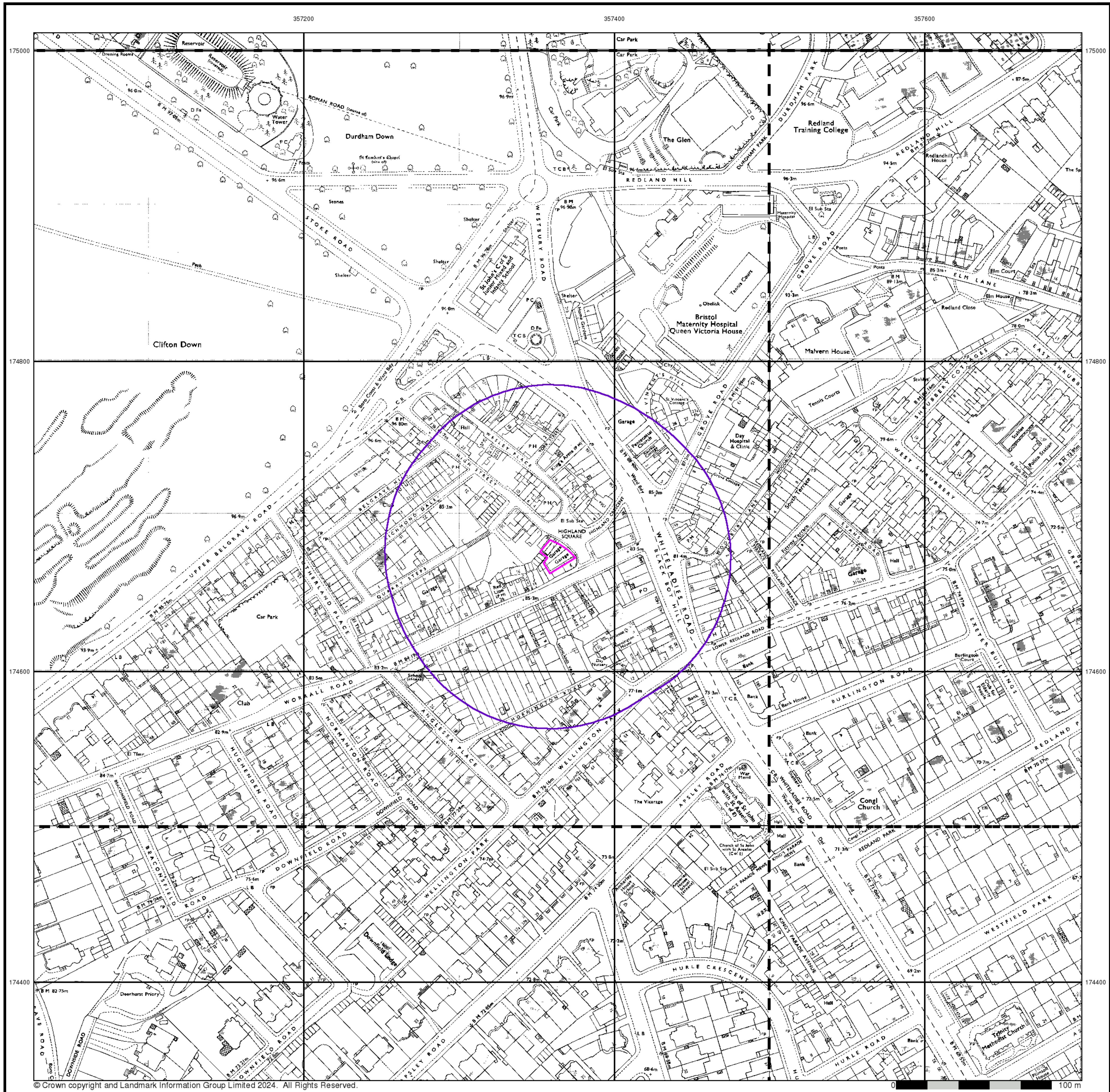


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



0 100 m

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

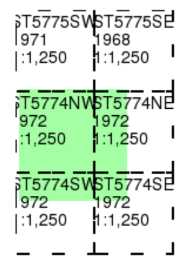
Ordnance Survey Plan

Published 1968 - 1972

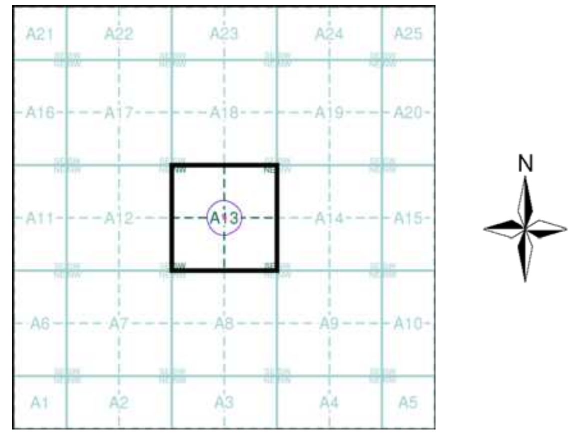
Source map scale - 1:1,250

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)



Historical Map - Segment A13



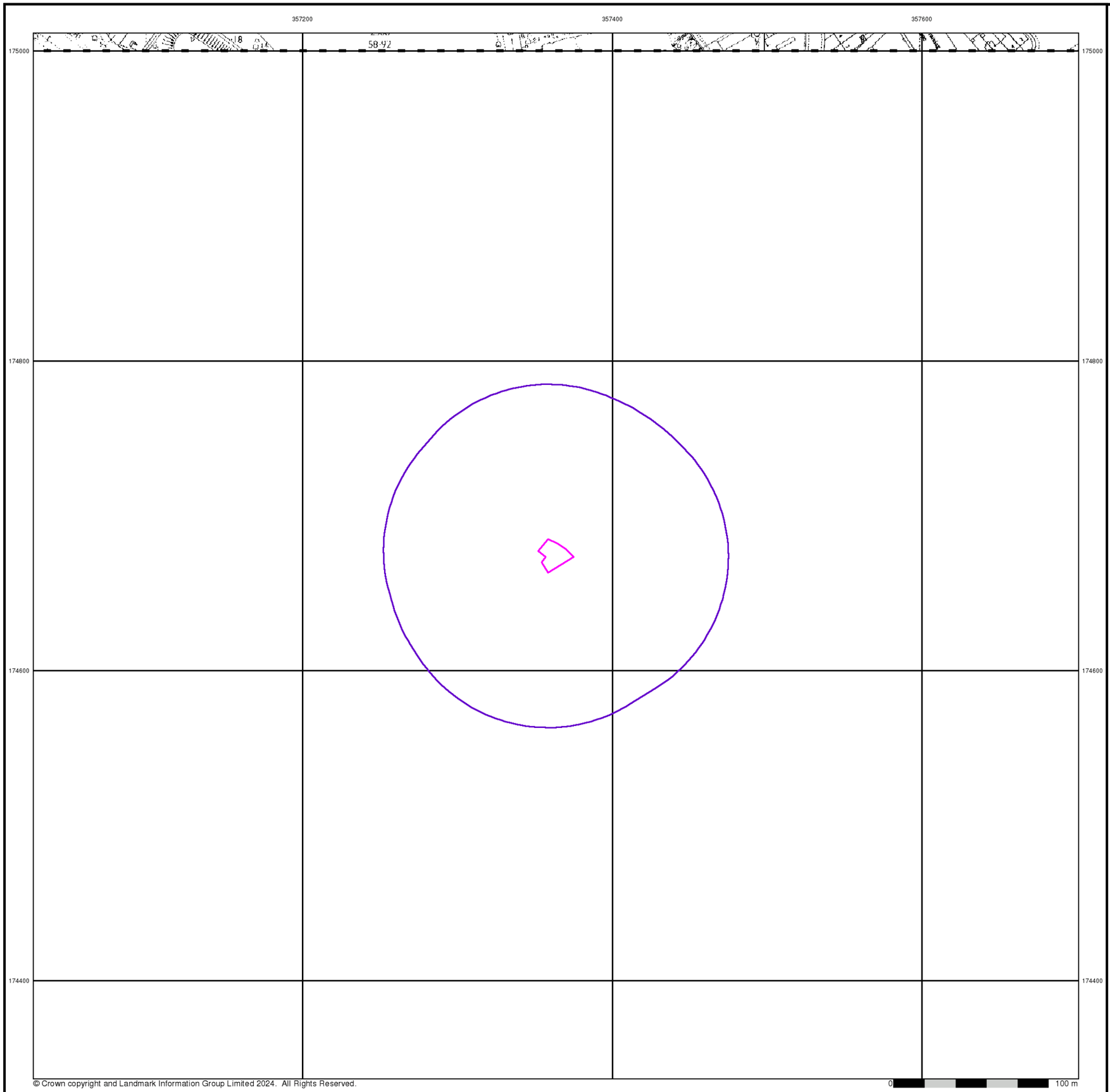
Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

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



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

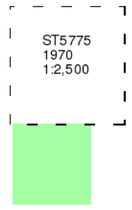
Ordnance Survey Plan

Published 1970

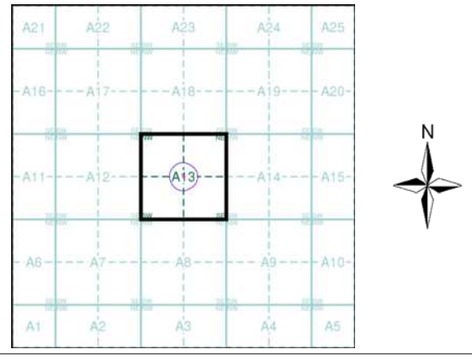
Source map scale - 1:2,500

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)



Historical Map - Segment A13



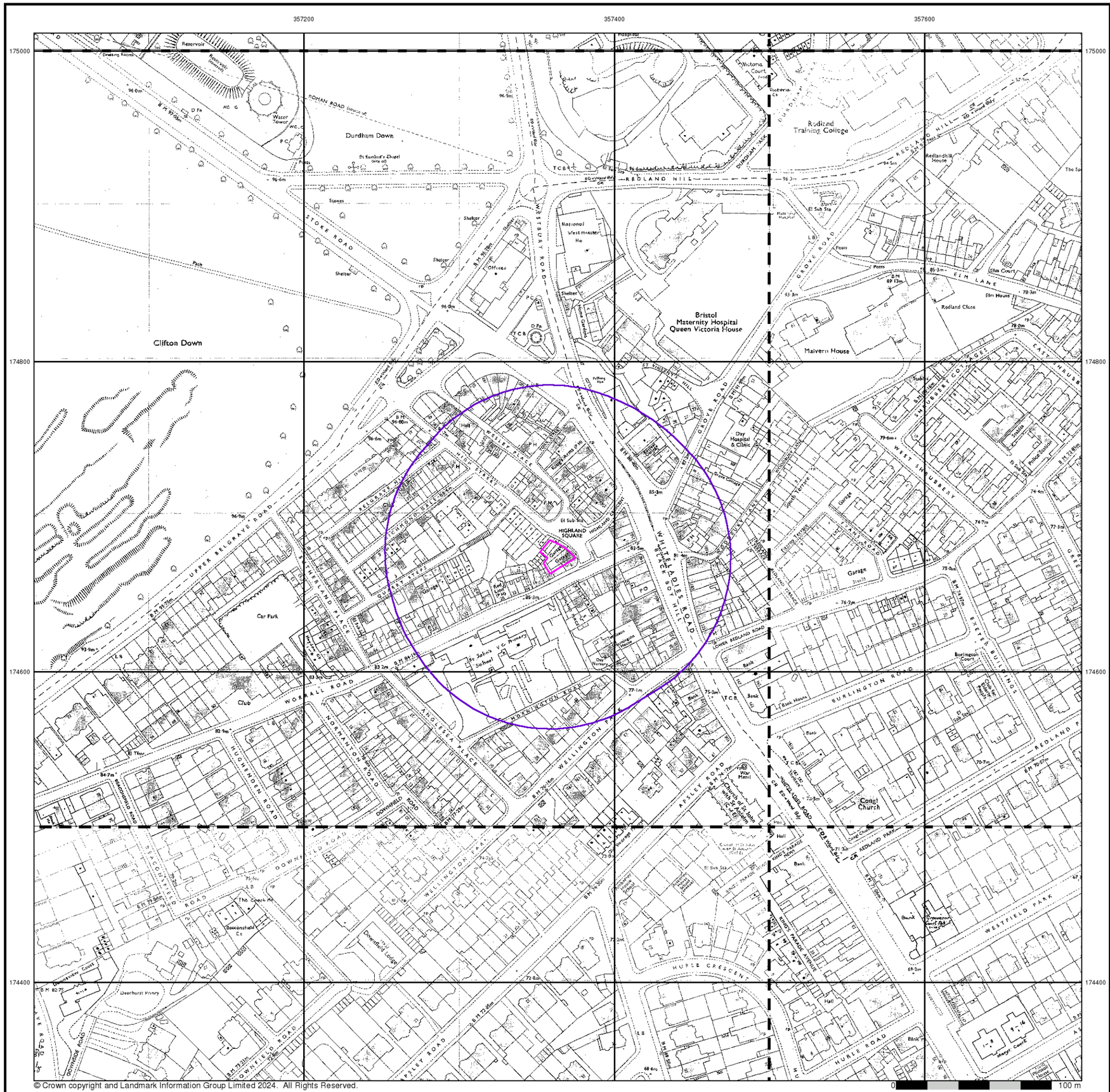
Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

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



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

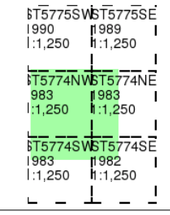
Additional SIMs

Published 1982 - 1990

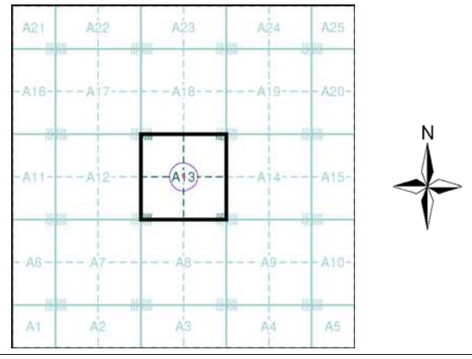
Source map scale - 1:1,250

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

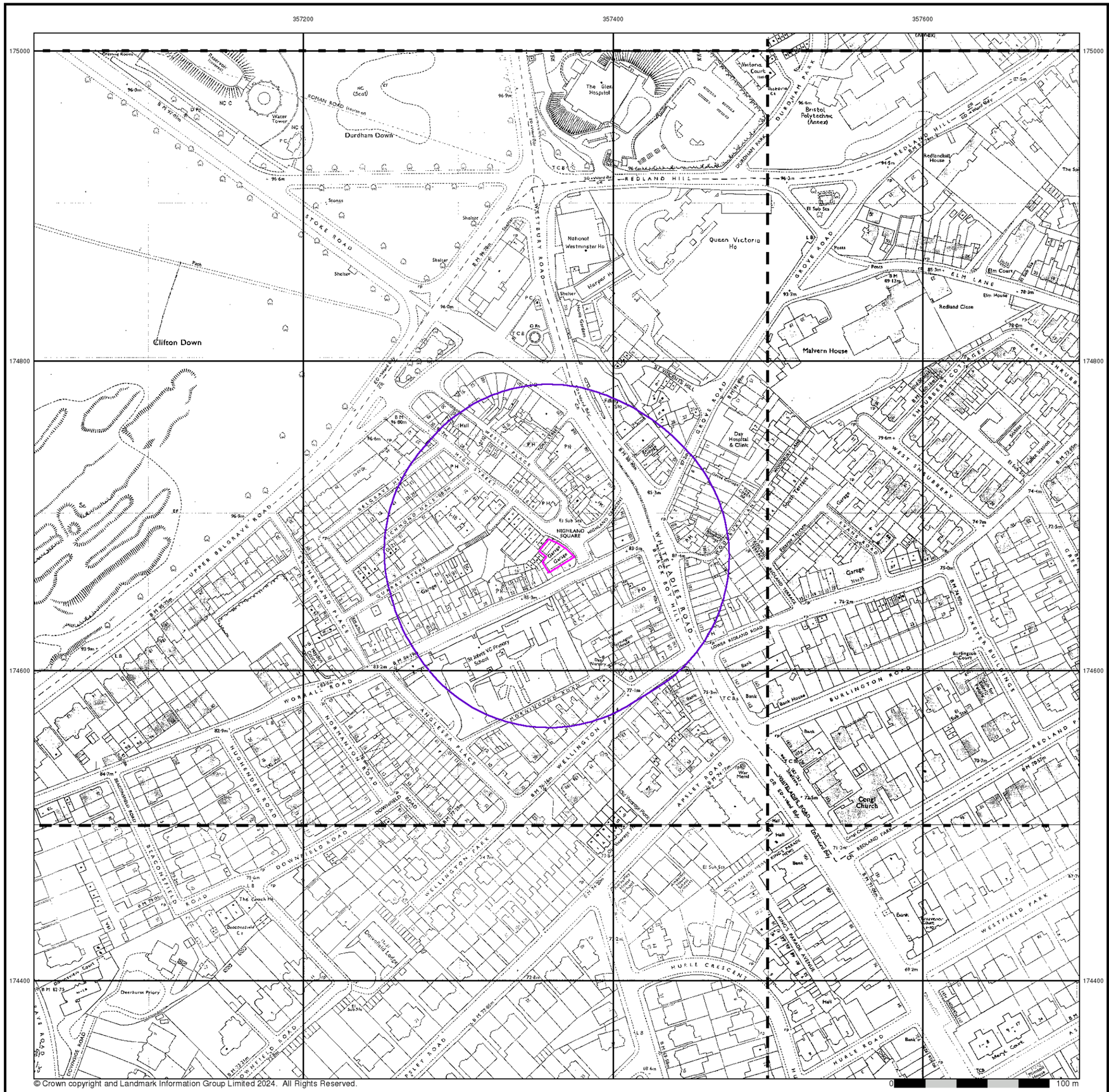


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

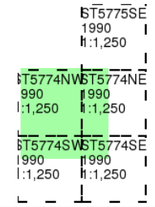
Additional SIMs

Published 1990

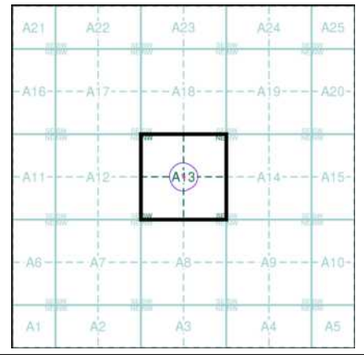
Source map scale - 1:1,250

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



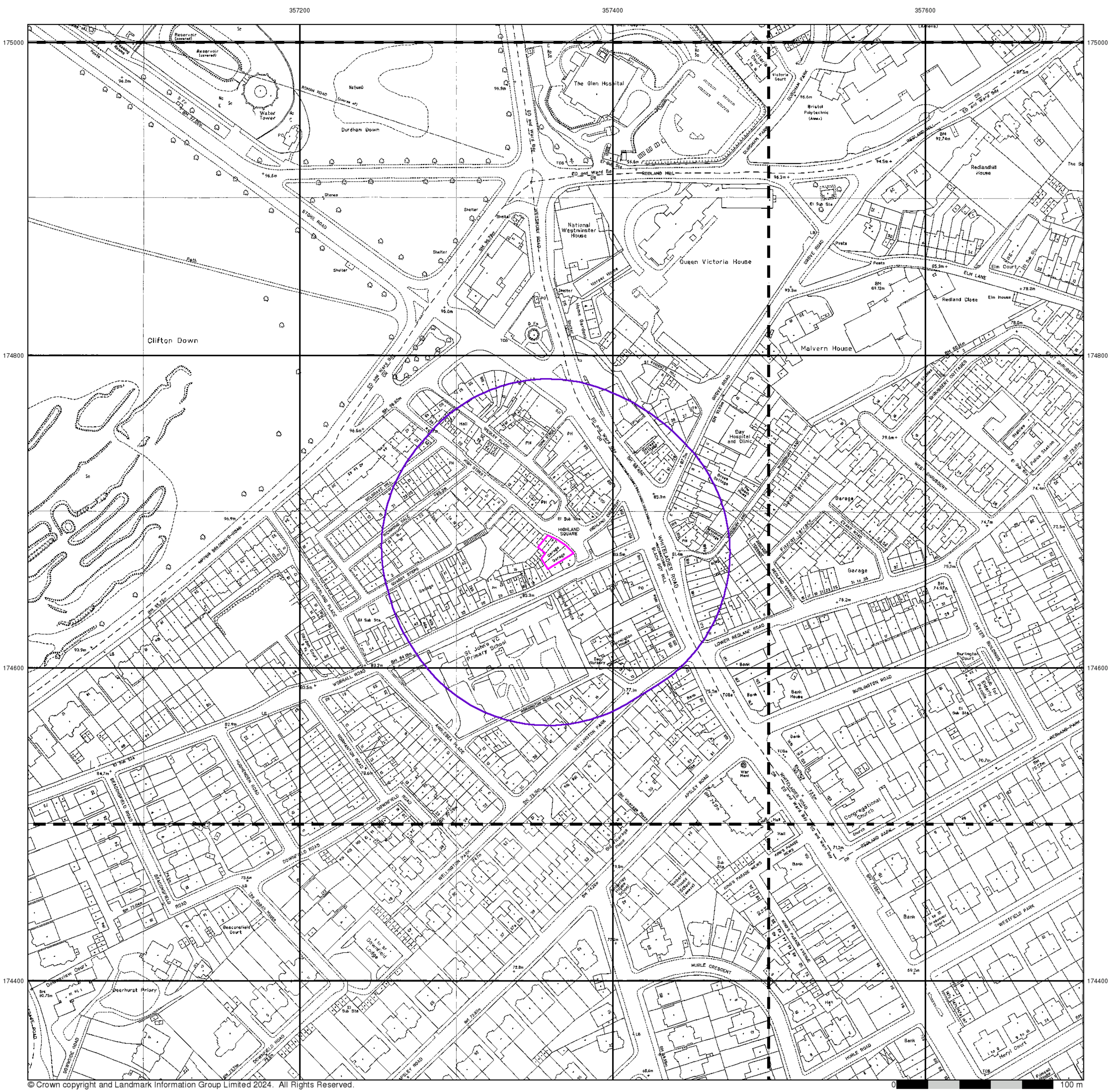
Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

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



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

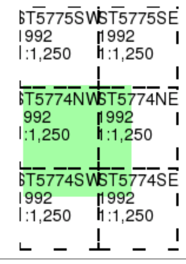
Large-Scale National Grid Data

Published 1992

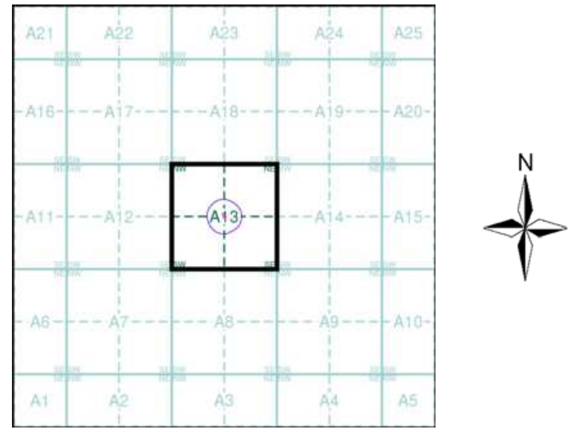
Source map scale - 1:1,250

'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



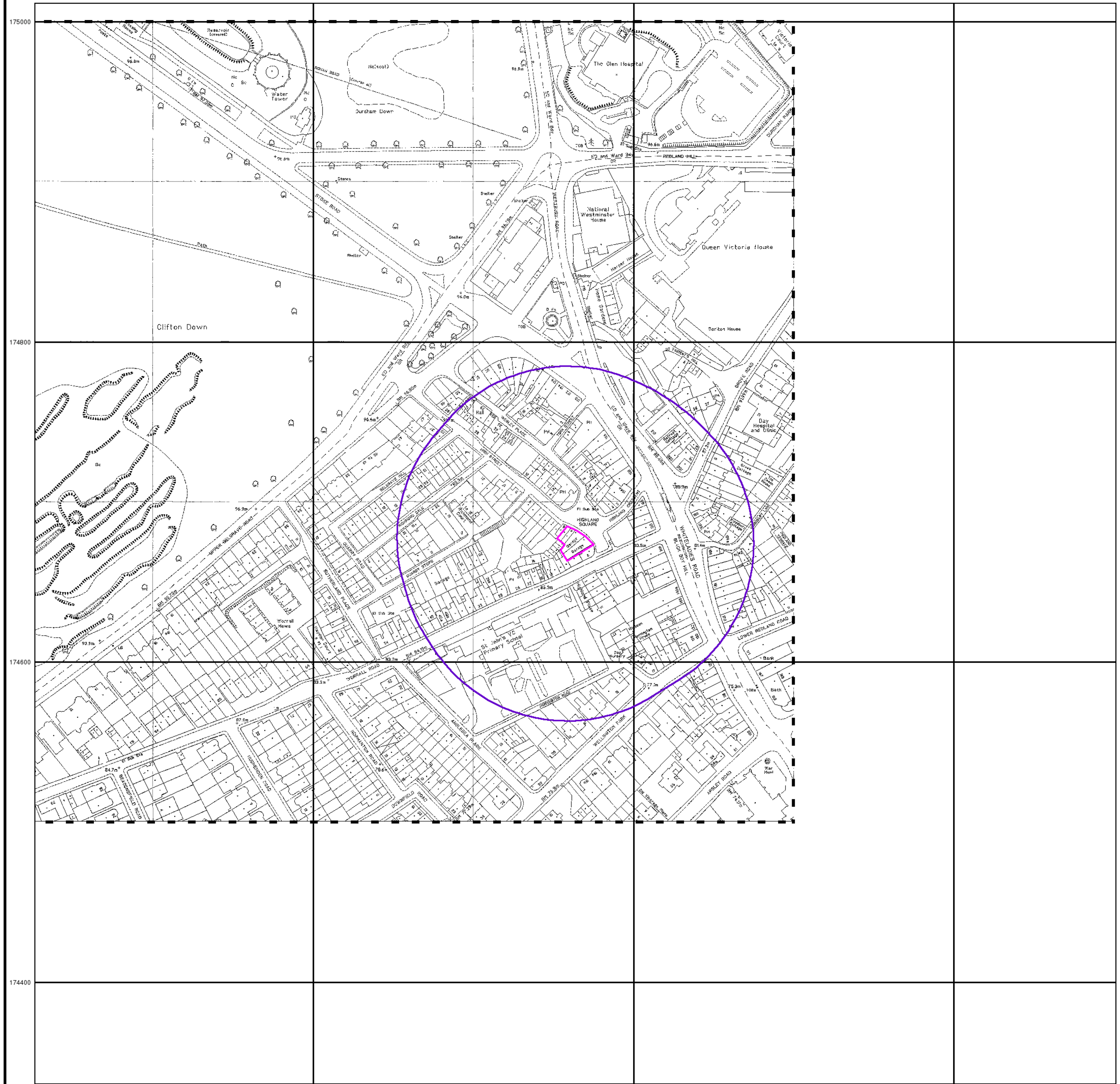
Order Details

Order Number: 343897617_1_1
Customer Ref: P1891
National Grid Reference: 357360, 174670
Slice: A
Site Area (Ha): 0.03
Search Buffer (m): 100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

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



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Large-Scale National Grid Data

Published 1996

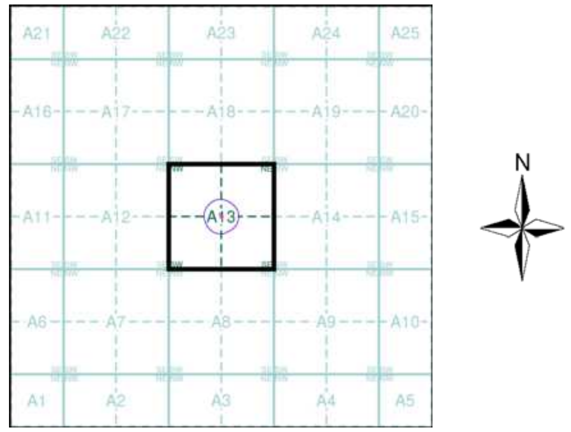
Source map scale - 1:1,250

'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)

ST5774NW
1996
1:1,250

Historical Map - Segment A13



Order Details

Order Number: 343897617_1_1
Customer Ref: P1891
National Grid Reference: 357360, 174670
Slice: A
Site Area (Ha): 0.03
Search Buffer (m): 100

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

APPENDIX B

Landmark Geology Report

Geology 1:10,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene
	WMGR	Infilled Ground	Artificial Deposit	Holocene - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Holocene - Holocene

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	TFD	Tidal Flat Deposits	Clay and Silt	Holocene - Saalian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	RLS	Rugby Limestone Member	Limestone and Mudstone, Interbedded	Sinemurian - Hettangian
	WBCT	Westbury Formation and Cotham Member (Undifferentiated)	Mudstone	Rhaetian - Rhaetian
	WCT	Wilmcote Limestone Member	Limestone	Hettangian - Rhaetian
	LPMB	Langport Member	Limestone	Rhaetian - Rhaetian
	SASH	Saltford Shale Member	Mudstone	Hettangian - Rhaetian
	BAN	Blue Anchor Formation	Mudstone	Rhaetian - Norian
	MMG	Mercia Mudstone Group	Mudstone	Rhaetian - Early Triassic
	MMMF	Mercia Mudstone Group (Marginal Facies)	Conglomerate	Triassic - Triassic
	RESA	REDCLIFFE SANDSTONE MEMBER	Sandstone	Triassic - Triassic
	QSG	Quartzitic Sandstone Formation	Sandstone	Yeadonian - Pendleian
	BRL	Black Rock Limestone Subgroup	Dolomitised Limestone and Dolomite	Chadian - Courceyan
	BRL	Black Rock Limestone Subgroup	Limestone	Chadian - Courceyan
	AVO	Avon Group	Mudstone and Limestone, Interbedded	Courceyan - Courceyan
	AVO	Avon Group	Limestone	Courceyan - Courceyan
	SHB	Shirehampton Formation	Limestone, Argillaceous Rocks and Subordinate Sandstone, Interbedded	Courceyan - Courceyan
	OHL	Oxwich Head Limestone Formation	Limestone and Mudstone, Interbedded	Brigantian - Asbian
	CDL	Clifton Down Limestone Formation	Limestone	Holkerian - Arundian
	CDM	Clifton Down Mudstone Formation	Dolomite-Mudstone	Arundian - Arundian
	GCO	Goblin Combe Oolite Formation	Limestone, Ooidal	Arundian - Arundian
	CHSA	Cromhall Sandstone Formation	Sandstone	Brigantian - Arundian
	GUO	Gully Oolite Formation	Limestone, Ooidal	Chadian - Chadian
	POB	Portishead Formation	Sandstone and Mudstone	Famennian - Famennian
	WBCO	Woodhill Bay Congomerate	Conglomerate	Famennian - Famennian
	UORS	Upper Old Red Sandstone	Conglomerate	Late Devonian - Late Devonian
	BLNS	Black Nore Sandstone Formation	Sandstone	Early Devonian - Early Devonian
	Fault			

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Geology 1:10,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:10,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around a site. This mapping may be more up to date than previously published paper maps.

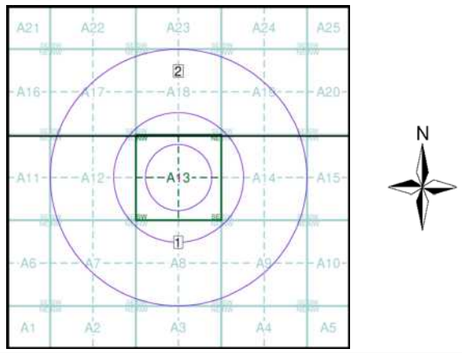
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page.

Please Note: Not all of the layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:10,000 Maps Coverage

Map ID:	1	**Map ID:**	2
Map Name:	ST57SE	**Map Name:**	ST57NE
Map Date:	1995	**Map Date:**	1995
Bedrock Geology:	Available	**Bedrock Geology:**	Available
Superficial Geology:	Available	**Superficial Geology:**	Available
Artificial Geology:	Available	**Artificial Geology:**	Available
Faults:	Available	**Faults:**	Available
Landslip:	Available	**Landslip:**	Available
Rock Segments:	Available	**Rock Segments:**	Not Available

Geology 1:10,000 Maps - Slice A



Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	1000

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Artificial Ground and Landslip

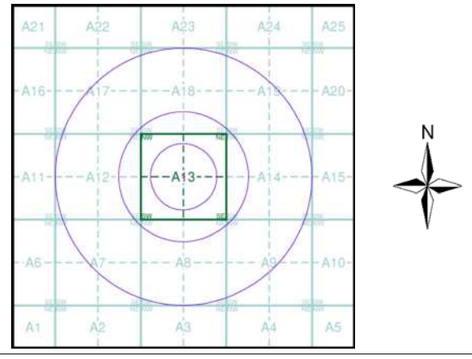
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A

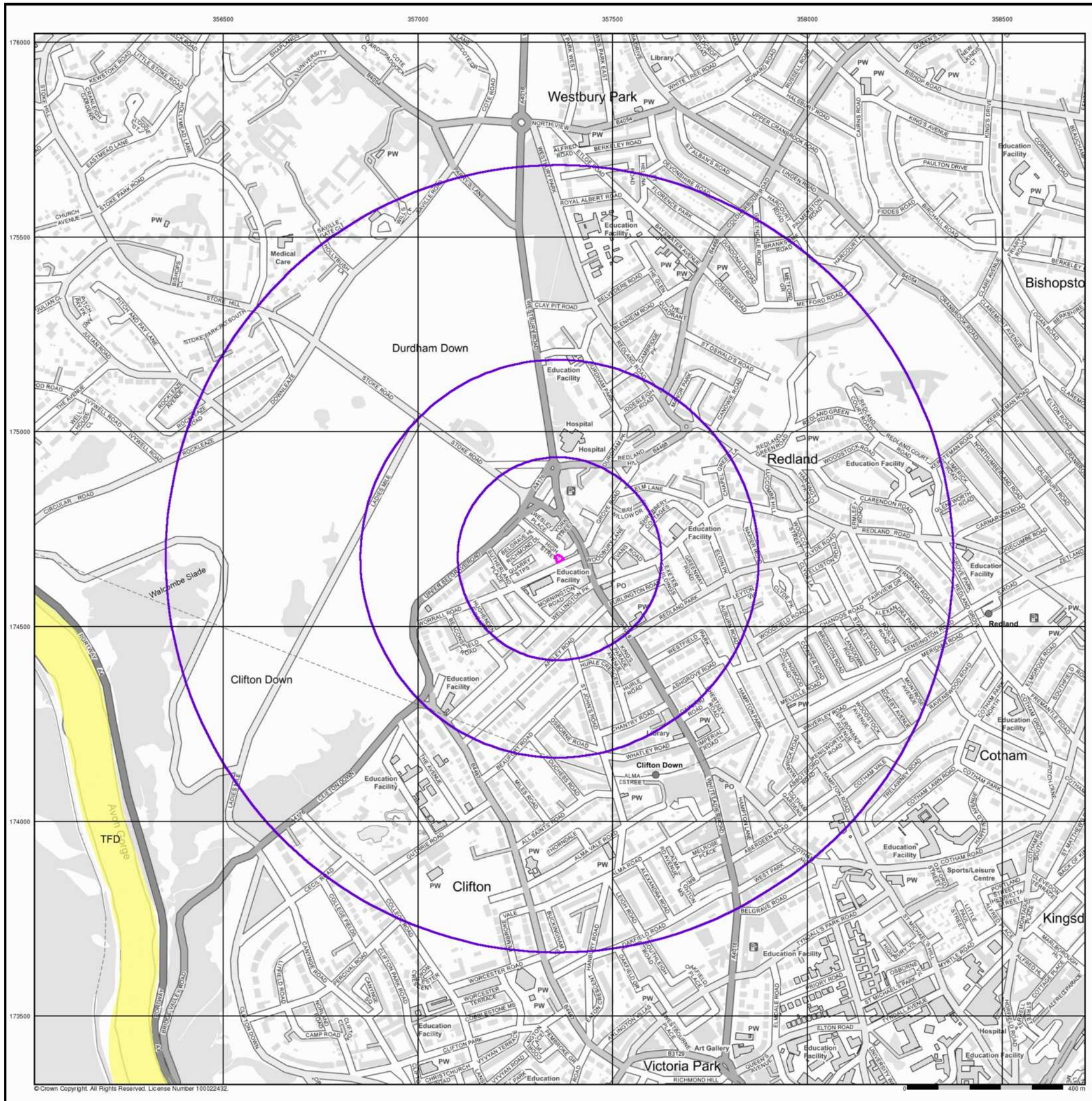


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	1000

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



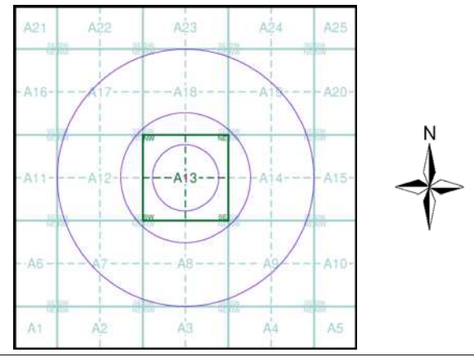
Superficial Geology

BGS 1:10,000 Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	1000

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB

Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Bedrock and Faults

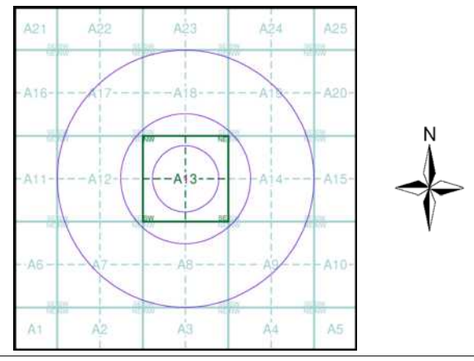
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults and thin beds mapped as lines such as coal seams and mineral veins. These are not restricted by age and could relate to features of any of the 1:10,000 geology datasets.

Bedrock and Faults Map - Slice A

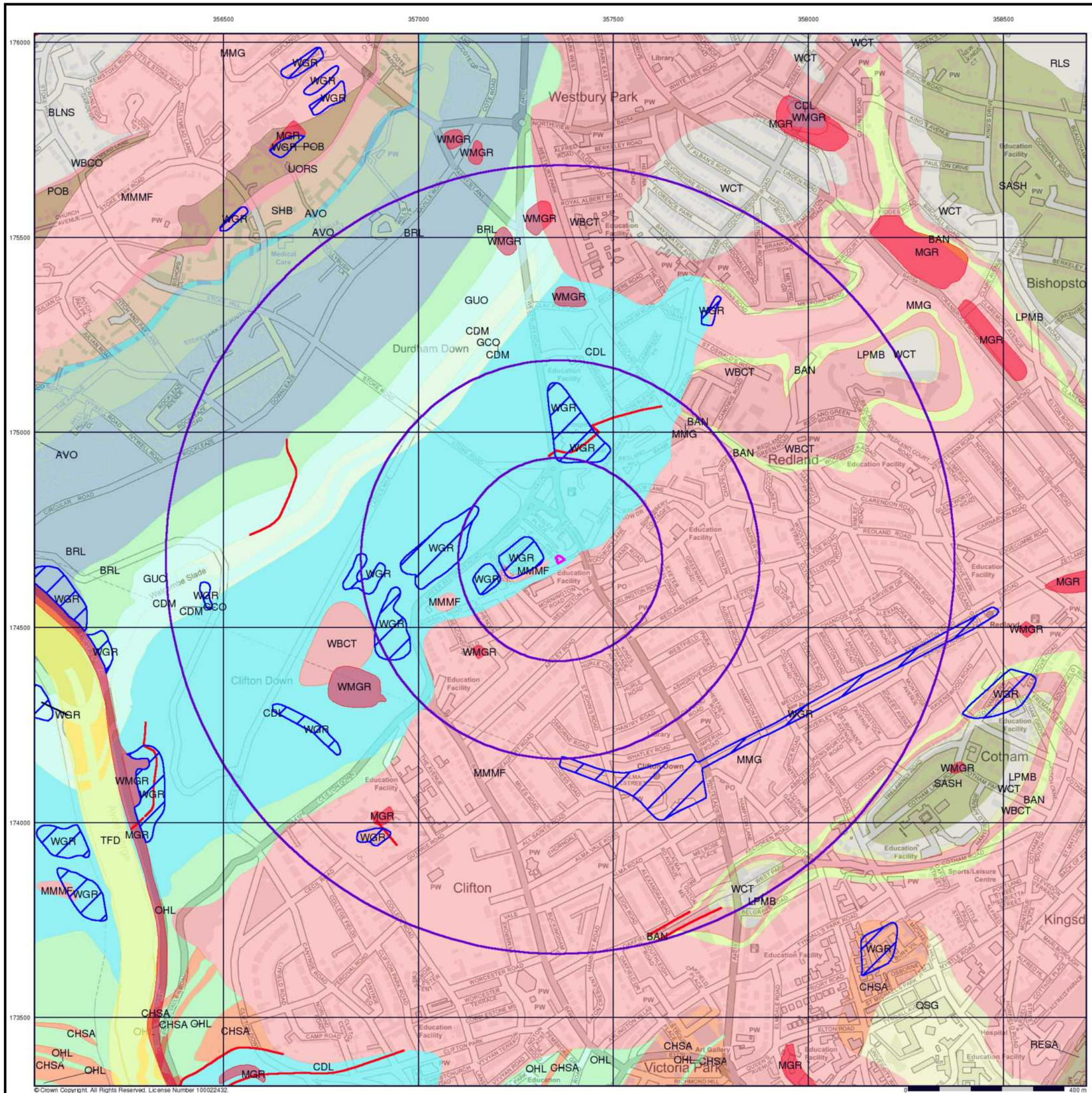


Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	1000

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB



Ground Investigation
www.ground-investigation.com
Unit 3, Westfield Court, Barns Ground, Kenn, Clevedon, BS21 6FQ
☎ 01275 876903

Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

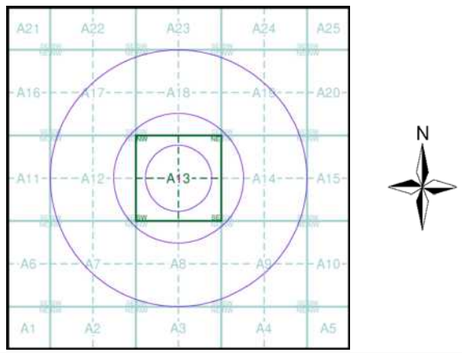
Additional Information

More information on 1:10,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



Order Details

Order Number:	343897617_1_1
Customer Ref:	P1891
National Grid Reference:	357360, 174670
Slice:	A
Site Area (Ha):	0.03
Search Buffer (m):	1000

Site Details

S F Tebby & Son, 2-5, Highland Square, Clifton, BRISTOL, BS8 2YB