integra
consulting

Land at Longsight Road,

Balderstone BB2 7HZ

Proposed Employment / Industrial Development

Flood Risk Assessment & Outline Drainage Strategy

For: Specialist Diesels Ltd

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1.0 INTRODUCTION

Integra Consulting has been commissioned by Specialist Diesels Ltd to undertake a Flood Risk Assessment & Outline Drainage Strategy for the site at Longsight Road, Balderstone BB2 7HZ. This report has been prepared to accompany the outline planning application with all matters reserved except access, for an employment use (Class B2/B8), parking and associated works (refer to Appendix 5 for details).

The objective of this document is to identify potential flooding issues and drainage strategy together with any consequent implications on the proposed future development of the site.

The document has been undertaken in accordance with the pro-forma guidance contained in:

- Department for Communities and Local Government document 'National Planning Practice Guidance: Flood Risk and Coastal Change'

- Ribble Valley Borough Council Strategic Flood Risk Assessment Level 1 dated April 2017

- Ribble Catchment Flood Management Plan – Summary Report dated December 2009

- DEFRA / Environment Agency publication SC030219 'Rainfall Runoff Management for Developments' dated October 2013.

2.0 STANDARDS AND LIMITATIONS

This report has been prepared solely for use by Specialist Diesels Ltd.

It shall not be relied upon or transferred to any other party without the prior written authorisation of Integra Consulting.

The findings and opinions in the report are based on information derived from a variety of different sources. Integra Consulting do not accept any liability for the accuracy or otherwise of any information provided by third parties.

It should be noted that some of the aspects considered in this study may be subject to change with time. Therefore, if the development is delayed or postponed, consideration may need to be given to reviewing such issues to confirm that no changes have taken place, either at the site or within relevant legislation.

Further consultations with statutory bodies are likely as the scheme progresses. It should be noted that even where responses have been received from Regulators, these could be subject to change at a later date.

3.0 CURRENT SITUATION

3.1 Site Location and Description

The circa 4.2 hectare site is located in Balderstone, circa 975m north west of Mellor at National Grid reference 364590, 431472 as shown on the site location plan in Appendix 1.

Longsight Road forms the north western boundary to this greenfield site with open fields to the south west and north east and a tributary to the River Ribble extending along the south western site boundary flowing from north east to south west (refer to Appendix 2). This tributary is designated as 'ordinary watercourse' and hence comes under the jurisdiction of Lancashire County Council Lead Local Flood Authority. The River Ribble itself lies circa 3km north of the site.

The site broadly falls towards its western boundary / south western corner with levels varying from circa 110.0m AOD in the centre of the site to circa 105.7m AOD in the south western corner of the site adjacent to the tributary to the River Ribble (refer to Appendix 4 for details).

3.2 Hydrology and Flooding

Current Environment Agency flood data indicates that the site lies wholly in Flood Zone 1 and therefore above any 1 in 1000 year risk (refer to Appendix 3 for details).

EA / DEFRA flood mapping indicates no areas of the site at risk of surface water flooding or reservoir flooding.

The Ribble Valley Borough Council Strategic Flood Risk Assessment Level 1 dated April 2017 confirms that there is no evidence of groundwater flooding in the vicinity of the site.

A review of the Ribble Valley Borough Council Strategic Flood Risk Assessment Level 1 dated April 2017 also indicates no recorded flood incidents at or near the site and confirms that the site does not lie in an Environment Agency Flood Warning Area

3.3 Existing Sewers

The only adopted sewer infrastructure local to the site is a 150mm diameter combined rising main that crosses the site, broadly from north east to south west, emanating from a sewage pumping station at Commons Lane circa 500m north of the site (refer to Appendix 6 for details).

Following liaison with United Utilities through their formal pre-application wastewater enquiry process, it has been confirmed that the rising main has a 6m easement (3m either side of the centreline of the main) – refer to Appendix 7 for details.

4.0 PROPOSED DEVELOPMENT

4.1 Development Proposals

This Flood Risk Assessment and Drainage Strategy is prepared to accompany the outline planning application with all matters reserved except for access for an employment / industrial development at the site (refer to Appendix 5 for details)

4.2 Surface Water Drainage

The issue of surface water drainage to the proposed development has been considered with reference to the hierarchy of surface water disposal as noted in the Building Regulations H3:

i) Sustainable Urban Drainage Systems (SUDS)
ii) Discharge of surface water off site direct to watercourse
iii) Discharge to adopted sewer

SUDS are made up of one or more structures built to manage surface water runoff. They are used in conjunction with good management of the site to prevent flooding and pollution. There are four general methods of control:

- Filter strips and swales
- Filter drains and permeable surfaces
- Infiltration devices
- Basins and Ponds

In relation to the soakaway potential of the ground, the Integra Consulting Phase 1 desk study (refer to Appendix 8 for details) states that the shallow Devensian Till (predominantly boulder clay) drift deposits indicated to be present demonstrate that the site is not suitable for the adoption of post-development soakaway drainage techniques. Local BGS boreholes indicate that the depth of this clay based till extends to at least 4m minimum below ground level at the north western site boundary. The presence of 2 No on-site ponds is further compelling evidence that the shallow ground conditions are not suitable for post-development soakaway drainage.

A tributary to the River Ribble extends along the south western site boundary and flows from north east to south west. This tributary is designated as 'ordinary watercourse' and hence comes under the jurisdiction of Lancashire County Council Lead Local Flood Authority. On this basis, it is evidently viable to discharge post-development site surface water directly to the on-site tributary to the River Ribble adjacent to the southern point of the site boundary.

Using the hierarchy of surface water drainage design, it is therefore proposed that post-development surface water from the site discharges to the tributary to the River Ribble that flows from north east to south west along the south western site boundary. This surface water drainage solution will naturally require consultation and agreement with Lead Local Flood Authority officer.

With regard to the post-development surface water associated with the proposed areas of new build / hard surfaced external works, we will naturally ensure that 1 in 100 year + 35% climate change water is maintained on the site with no off-site impacts.

A greenfield run off rate of 34 litres per second has been calculated for the site (refer to Appendix 9 for details) based on the anticipated ground conditions with storage volumes provided accordingly.

Appendix 10 contains surface water storage volumetric details for the site based on the calculated greenfield run off rate of 34 litres per second. This results in on site storage of circa 540m3 in a 1 in 30 year event and circa 1210m3 in a 1 in 100 year plus 35% climate change event which will be provided, pragmatically given the nature of the proposed site development, in the form of oversized pipe storage / underground crate storage.

The post-development surface water drainage system will be designed to ensure that:

- There is no surcharge in the 1 in 1 year event:
- Surface water flows remain on site up to a 1 in 100 year + 35% climate change storm event.
- Sufficient surface water storage will be available to ensure there is no risk to property

4.3 National Planning Policy Framework and Technical Guidance

The development proposals at the site are classed as 'less vulnerable' in Table 2 of the Flood Risk and Coastal Change guidance.

'Less vulnerable' developments in Flood Zone 1 are classed as appropriate according to Table 3 of the Flood Risk and Coastal Change guidance.

Proposed post development levels will be engineered in order to protect the development and not provide any increased flood risk elsewhere.

Types of flooding that could affect the site are:
River- the site lies in Flood Zone 1
Sea – there is no risk of flooding from the sea
Land – there are no undrained land slopes towards the site

Groundwater – there are no springs or weep areas on the site
Sewers – there have been no local reports of sewer surcharge

There are no groundwater protection zones in the vicinity of the site and there is negligible residual fluvial risk. The site is not noted to lie within a flood warning area.

4.4 Strategic Flood Risk Assessment & EA Mapping Review

From our review of the Ribble Valley Borough Council Strategic Flood Risk Assessment Level 1 dated April 2017, the site is not understood to lie in a Critical Drainage Area.

There are no groundwater protection zones in the vicinity of the site and there is negligible residual fluvial risk. The site is not noted to lie within a flood warning area.

4.5 Safe Access and Egress

Safe access / egress from the site in extreme conditions will be via the entrance on Longsight Road.

4.6 Surface Water Exceedance Routes

With regard to surface water exceedance routes, whilst the final levels for the site will be subject to change to suit the detailed design process, these routes will be developed to demonstrate how exceedance routes can be suitably managed on site. Raising building levels above the site access road will ensure that excess rainwater is directed away from the buildings and into the site access road.

4.7 Foul Water Drainage

Based on United Utilities requirements, we would propose to discharge foul drainage from the post-development site to the existing adopted 150mm diameter foul gravity drainage system on Abbot Brow located to the north east of the proposed site (refer to Appendix 7 for details).

The foul drainage network will naturally comply with Building Regulations 2010 – Approved Document H1 and the calculations for post-dev elopement foul water discharge will be based on Sewers for Adoption 8th edition.

5.0 SuDS DESIGN STATEMENT

5.1 SuDS Requirements

SuDS measures are required on the proposed development to comply with the National Planning Policy Framework (NPPF), DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems and the SuDS guidance in section 7 of the Ribble Valley Borough Council Strategic Flood Risk Assessment Level 1 dated April 2017.

The key conceptual SUDS design criteria for the development are covered in Non-Statutory Technical Standards for Sustainable Drainage under sections S1 to S9.

Peak Flow Control

S2 of the DEFRA Technical Standards notes that for greenfield developments, the peak runoff from the development for the 1 in 1 year and 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Volume Control

Requirement S4 is deemed applicable to the site - this stipulates that the runoff volume in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event (refer to Appendix 8 for details).

Flood Risk within the Development

S7 notes that the drainage system shall be designed such that no flooding shall occur on any part of the site during a 1 in 30 year storm event.

S8 requirement stipulates that during a 1 in 100 year enhanced rainfall event, no flooding of any building shall occur.

S9 also stipulates that site levels shall be designed such that flows which are as a result of rainfall events exceeding the 1 in 100 year enhanced rainfall event, are managed in exceedance routes that minimise the risks to people and property.

In complying with the above standard for water quantity improvement measures, the design for a 1 in 100 year event will make due allowance for 35% climate change.

Water Quality

In addition to the above measures contained within the DEFRA guidance addressing water quantity issues, designing for water quality is also a requirement of the on-site SUDS measures. Reference is made to CIRIA Report 'C753 – The SUDS Manual', specifically Chapters 4 and 26.

5.2 Proposed SUDS Methodology & Drainage Design Principles

As detailed in section 4.2, discharge of surface water direct to the ground in the form of infiltration measures is not considered feasible based on the relatively impermeable drift deposits likely to be present at shallow depth beneath the site. Accordingly, discharge (attenuated to the calculated greenfield runoff rate) to the on-site tributary to the River Ribble is the proposed method of post-development surface water disposal.

Peak Flow Control

Flow from the site associated with new development shall be limited to a greenfield runoff rate of 34 litres per second. This limiting surface water flow rate is derived from the www.uksuds.com spreadsheet routine, as contained within Appendix 9.

Volume Control

The proposed 34 litres per second discharge flow rate will apply for all flood events from the 1 in 1 year to the 1 in 100 year (enhanced) event.

Flood Risk within the Development

To cater for excess surface water runoff, attenuated surface water will discharge into the on-site tributary to the River Ribble (refer to section 4.2 for details).

The site is to discharge post-development surface water into a below ground attenuation system which in turn will discharge through a flow control chamber to limit surface water discharge to greenfield run off rates prior to discharging to a tributary to the River Ribble which extends along the south western site boundary and flows from north east to south west. This tributary is designated as 'ordinary watercourse' and hence comes under the jurisdiction of Lancashire County Council Lead Local Flood Authority. This will initially require agreement in principle to be reached with Lancashire CC LLFA followed by any necessary permitting through the LLFA in due course.

Appendix 10 contains calculations of in principle surface water storage volumes of circa 1210m3 for the development. It is proposed to accommodate this 1 in 100 year (enhanced) event storage volume within the on-site below ground attenuation system. Accordingly, this will ensure that criteria S7 and S8 are met.

Water Quality

In assessing the level of treatment required to ensure sufficient water quality improvement prior to discharge to watercourse, reference is made to Chapter 26 of CIRIA C753 – The SuDS Manual and specifically, Table 26.2 which details the pollution hazard indices for different site uses:

Based on the proposed development (the closest suitable development definition in Table 26.2 is 'industrial sites'), the pollution hazard level is noted as 'high', with pollution hazard indices being:

Total Suspended Solids 0.8
Metals 0.8
Hydrocarbons 0.9

This is considered to be a conservative assessment of the pollution hazard levels at the post-development site.

In line with the requirements stipulated in Table 26.2 and Table 26.3 of the SuDS Manual, it is proposed to utilise 2 No proprietary water treatment systems at the development site in the form of the Hydro International Up-Flo Filter Vault system in combination with the Hydro International twin walled HDPE chamber 'Downstream Defender' (refer to Appendix 11 for details).

It is proposed that the 'Up-Flo Filter' unit is located immediately downstream of the below ground surface water attenuation storage. The filter unit itself will be specified in order that it has sufficient capacity to accommodate the design flows directly downstream of the below ground attenuation storage and hydrobrake system.

The 'Downstream Defender' unit will be located immediately downstream of the 'Up-Flo Filter' unit and will also have sufficient capacity to accommodate the design flows directly downstream of the below ground attenuation storage and hydro brake system.

The simple index approach in line with the requirements of The SuDS Manual has been followed in order to verify that the SuDS treatment train provided by the combination of the 'Up-Flo Filter' and the 'Downstream Defender' provides a suitable level of water treatment for the proposed industrial development at the subject site.

Step 1 – Define Pollution Hazard Indices

With reference to Table 26.2 of the SuDS Manual, the land use category relevant to the subject site (when adopting a conservative approach) is '*Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured: industrial sites; trunk roads and motorways'.*

Accordingly, the designated pollution hazard level for the development site is 'high' with the following pollution hazard indices applying:

Total Suspended Solids (TSS): 0.8

Metals: 0.8

Hydrocarbons: 0.9

Step 2 – Determine SuDS pollution mitigation indices

Up-Flo Filter:

In terms of the relevant SuDS mitigation indices, the attached data sheet information (refer to Appendix 11) shows that the Up-Flo Filter delivers high removal of a variety of pollutants including:

Sediment or Total Suspended Solids (TSS):
SuDS Pollution Mitigation Index = 0.8

Sediment Bound Heavy Metals and Nutrients:
SuDS Pollution Mitigation Index = 0.69

Liquid Hydrocarbons:
SuDS Pollution Mitigation Index = 0.4

Downstream Defender:

In terms of the relevant SuDS mitigation indices, the attached data sheet information (refer to Appendix 11) shows that the Downstream Defender delivers high removal of a variety of pollutants including:

Sediment or Total Suspended Solids (TSS):
SuDS Pollution Mitigation Index = 0.5

Sediment Bound Heavy Metals and Nutrients:
SuDS Pollution Mitigation Index = 0.4

Liquid Hydrocarbons:
SuDS Pollution Mitigation Index = 0.8

Utilising the Simple Index Approach in line with Chapter 26 of CIRIA C753 The SuDS Manual, the aggregated Surface Water Mitigation Index is as set out below:

Sediment or Total Suspended Solids (TSS):
SuDS Pollution Mitigation Index = 0.8 + (0.5 x 0.5) = 1.05

Sediment Bound Heavy Metals and Nutrients:
SuDS Pollution Mitigation Index = 0.69 + (0.5 x 0.4) = 0.89

Liquid Hydrocarbons:
SuDS Pollution Mitigation Index = 0.4 + (0.5 x 0.8) = 0.8

In combination, the above SuDS Mitigation Indices for the Up-Flo Filter and the Downstream Defender demonstrate that this proposed SuDS treatment system exceeds the relevant pollution hazard indices in relation to the proposed land use for both total suspended solids and heavy metals. The aggregated mitigation index for hydrocarbons is 0.8 relative to the pollution hazard index value of 0.9. Although the pollution hazard indices utilised are considered appropriate given the alternative land use categories, they are also considered to be conservative given the nature of the proposed development.

Accordingly, the proposed use of the Hydro International Up-Flo Filter Vault system together with the twin walled HDPE chamber 'Downstream Defender' is deemed to provide a sufficient SuDS treatment train without the need for any further measures to be employed on the post-development site.

5.3 Management and Maintenance of SuDS Drainage System

The management and maintenance of the above noted SuDS measures to serve the proposed development will be undertaken by a maintenance management company to be appointed for the project. The appointment of the maintenance management company is to be confirmed at the completion of the build phase. All parts of the drainage network are to be accessible and are to be constructed from materials that are suitable and robust for the lifetime of the development.

The maintenance activities required for the drainage network are as follows:

5.3.1 Cellular Storage Structure

The maintenance for the cellular storage structure is as follows:

Operation	**Frequency**
Inspect and identify any areas that are not operating correctly and if required take remedial actions	Monthly for three months then six monthly intervals
Debris caused from catchment surface (where it may cause risk to performance)	Monthly
Where rainfall infiltration into cellular storage from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required but at least twice a year
Remove sediment from upstream surface water network by jetting	Annually or as required
Repair / check all inlets, outlets, overflows and vents	As required
Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after severe storms

5.3.2 Flow Control

The maintenance for the flow control is as follows:

Operation	**Frequency**
Inspect and identify any areas that are not operating correctly, if required take remedial actions	Monthly for three months then at six monthly intervals
Debris removal from catchment surface (where it may cause risk to performance)	Monthly
Check control chamber for blockage or silt, algae or other matter by jetting	As required, but at least four times a year
Remove sediment from upstream drainage network and sediment from within manhole by jetting	As required, but at least twice a year
Repair / check all inlets and control mechanics	As required
Inspect / check all inlets and control mechanics to ensure that they are operating as designed	Twice a year as a minimum and after severe storm events

5.3.3 Flow Control Chamber Design Criteria

In addition to the above maintenance methods, the flow control chamber will be designed so it works effectively throughout the lifespan of the development and will have precautionary features to ensure maintenance work can be carried out promptly and efficiently to ensure no control failure which may otherwise subsequently lead to flooding.

Details of the flow control chamber are as follows:

- High Water Level Alarm: Alarm installed and directed to site maintenance team
- Spares: Control spares to be kept on site for efficient maintenance

5.3.4 Up-Flo-Filter

The maintenance for the Hydro International Up-Flo Filter is as follows (refer to Appendix 11 for Operation and Maintenance manual details):

Operation	**Frequency**
Inspection	Regularly during first year of installation to determine the site-specific rate of pollutant accumulation. After the initial year then every six months.
Oil and floatables removal	Twice a year or as needed or following a spill in the drainage area.
Sediment removal	Every six to twelve months and also following a spill in the drainage area.
Media Pack Replacement	Once per year or as needed in the event of continuous base conditions.
Drain Down Filter Replacement	Once per year with Media Pack replacement or as needed in the event of continuous base conditions.

5.3.5 Downstream Defender

The maintenance for the Hydro International Downstream Defender is as follows – it is noted that, for most cleanouts, it is not necessary to remove the entire volume of liquid in the vessel as only removing the first few centimetres of oils/floatables and the sediment storage volume is required (refer to Appendix 11 for Operation and Maintenance manual details):

Operation	**Frequency**
Inspection	Regularly during first year of installation to determine the site-specific rate of pollutant accumulation. After the initial year then every six months.
Oil and floatables removal	Annually along with sediment removal or following a spill in the drainage area
Sediment removal	Annually or as needed. Also following a spill in the drainage area.

5.3.6 Flood Routes

A visual monthly inspection of flood routes should be made in order to check that routes are not blocked by new fences, walls, soil or other rubbish with removal undertaken as necessary.

5.3.7 Spillage – Emergency Action

Most spillages on development sites are of compounds that do not pose a serious risk to the environment as they enter the drainage system in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommend by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.

In the event of a serous spillage, either by volume or of unknown or toxic compounds, then the spillage should be isolated using soil, turf or fabric and outlet pipes from chambers downstream of the spillage blocked with bungs. Bungs for blocking pipes may be made by wrapping soil or turf in a plastic sheet or close woven fabric. The Environment Agency should be contacted immediately.

5.3.8 Linked and Further Maintenance

The maintenance of the drainage network and SuDS features is to be linked with the landscape maintenance plan for the proposed development.

5.3.9 Maintenance Activities

A log of all maintenance activities is to be kept and made available to the Local Planning Authority (LPA) and / or the Lead Local Flood Authority (LLFA) on request.

6.0 CONCLUSIONS

6.1 Flooding

Following review of the Environment Agency flood maps and data, it has been confirmed that the whole site lies within Flood Zone 1.

There are to be no off-site surface water flood routes generated by the development during an enhanced 1 in 100 year storm. All post-development surface water run-off will be designed to remain on site in the 1 in 100 year + 35% climate change event.

6.2 Site Surface Water Drainage

Following the hierarchy of surface water discharge, it is proposed that post-development attenuated surface water from the development discharges to the on-site tributary to the River Ribble.

It is proposed to discharge all post-development surface water from the proposed areas of new build / hard surfaced external works at greenfield run off rates.

6.3 Foul Water Drainage

Based on United Utilities requirements, it is proposed to discharge foul drainage from the post-development site to the existing adopted 150mm diameter foul gravity drainage system on Abbot Brow located to the north east of the proposed site (refer to Appendix 7 for details).

6.4 Flood Risk Management Measures

There will be a site management Health and Safety document prepared in respect of the site.

6.5 Off Site Impacts

The design of the site surface water system will ensure that no off-site flood flows are generated by the proposed development in the 1% plus climate change event.

6.6 Residual Risk

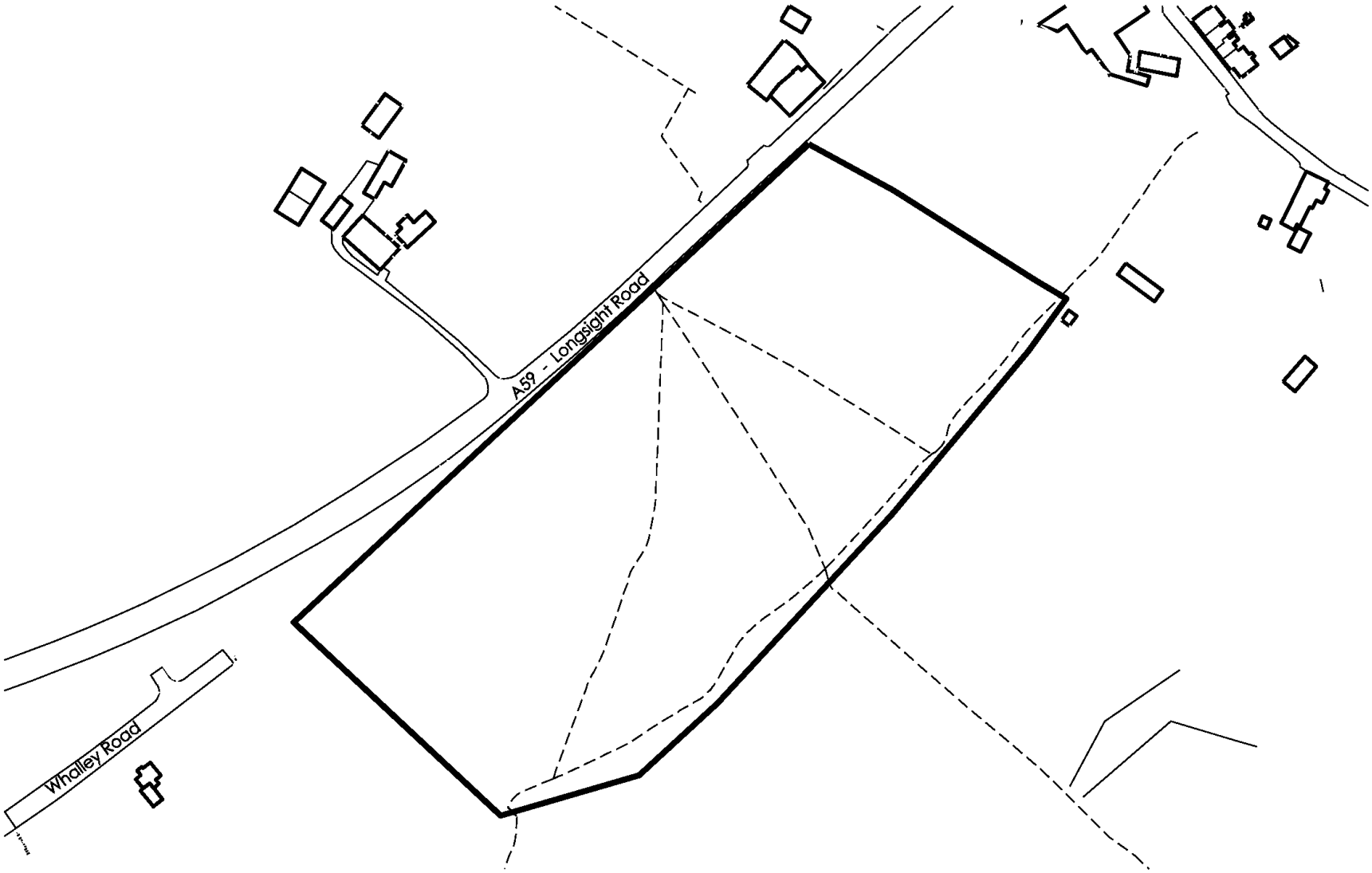
With careful design of the drainage elements as described above, there will be no residual flood related risks remaining after the development has been completed.

A post-development safe emergency access can be maintained at all times during a flood event. Emergency access will be from Longsight Road.

APPENDIX

APPENDIX 1

SITE LOCATION PLAN



ISSUE				
Rev	Description	By	Chk	Date

0M 20M 40M 60M 80M 100M 200M

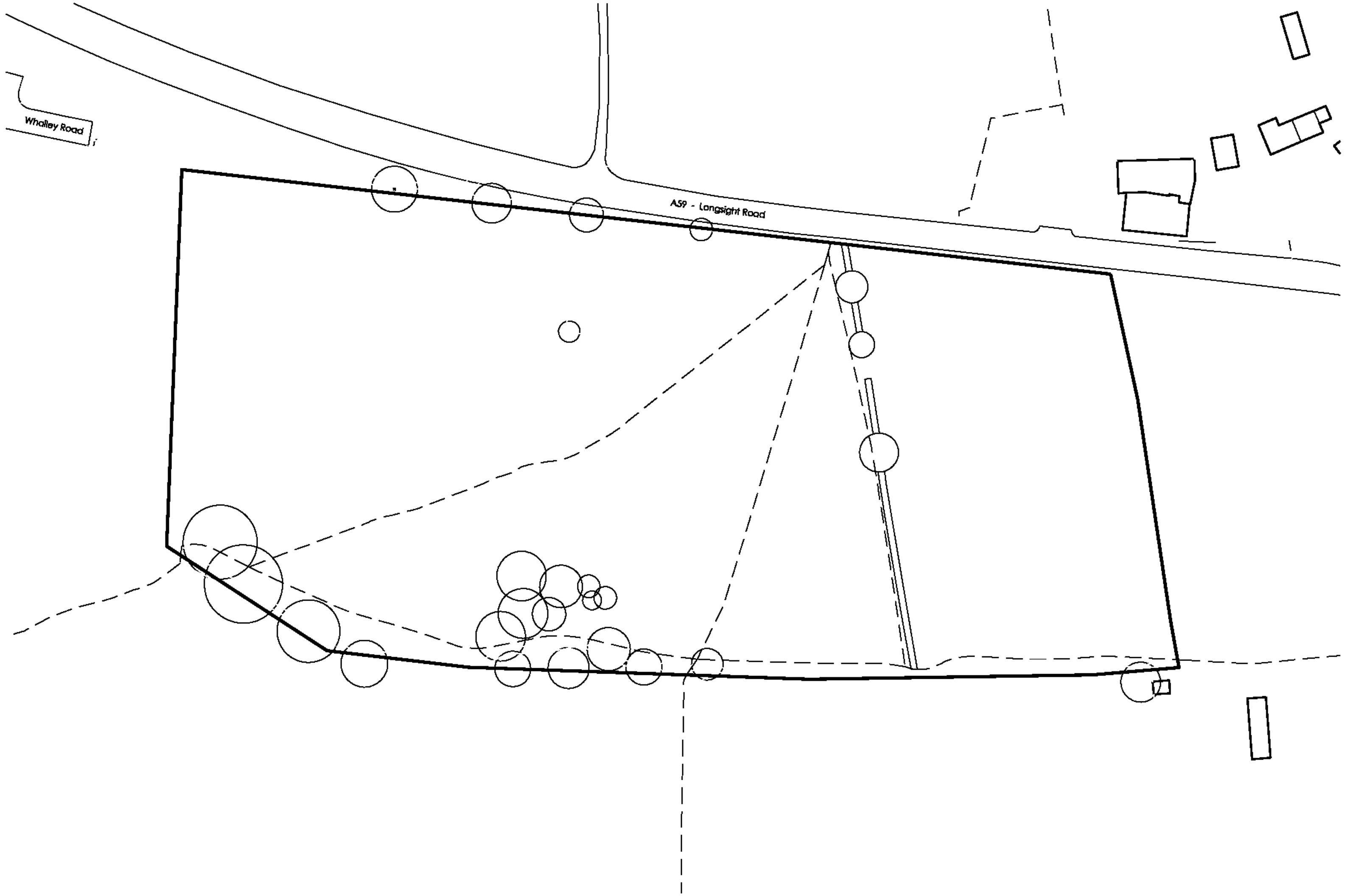
Project	Land at Causeway Farm	Project No.	20-03
		Dwg. No.	L(-1)000
Title	Site Location Plan	Date	AUG 2022
		Scale	1/2500 @ A4

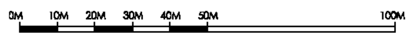
Rev.	00
By	RM
Chk.	MJG
App.	00

mail@gastudio.co.uk
www.gastudio.co.uk
tel. 0161 835 3538
STUDIO
Architects / Masterplanning / Urban Design

APPENDIX 2

EXISTING SITE PLAN





Issue				
Rev	Description	By	Chk	Date

Project	Land at Causeway Farm	Project No.	22-03	Rev.	00
		Dwg. No.	L(-1)001	By	RM
Title	Site Plan as Existing	Date	AUG 2022	Chk.	MJG
		Scale	1/1000 @ A2	App.	00

STUDIO

Architects / Masterplanning / Urban Design

APPENDIX 3

ENVIRONMENT AGENCY FLOOD MAPPING DATA

Flood map for planning

Your reference	Location (easting/northing)	Created
Causeway Farm	**364595/431451**	**9 Oct 2022 17:23**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- in **an area with critical drainage problems as notified by the Environment Agency**
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
Causeway Farm

Location (easting/northing)
364595/431451

Scale
1:2500

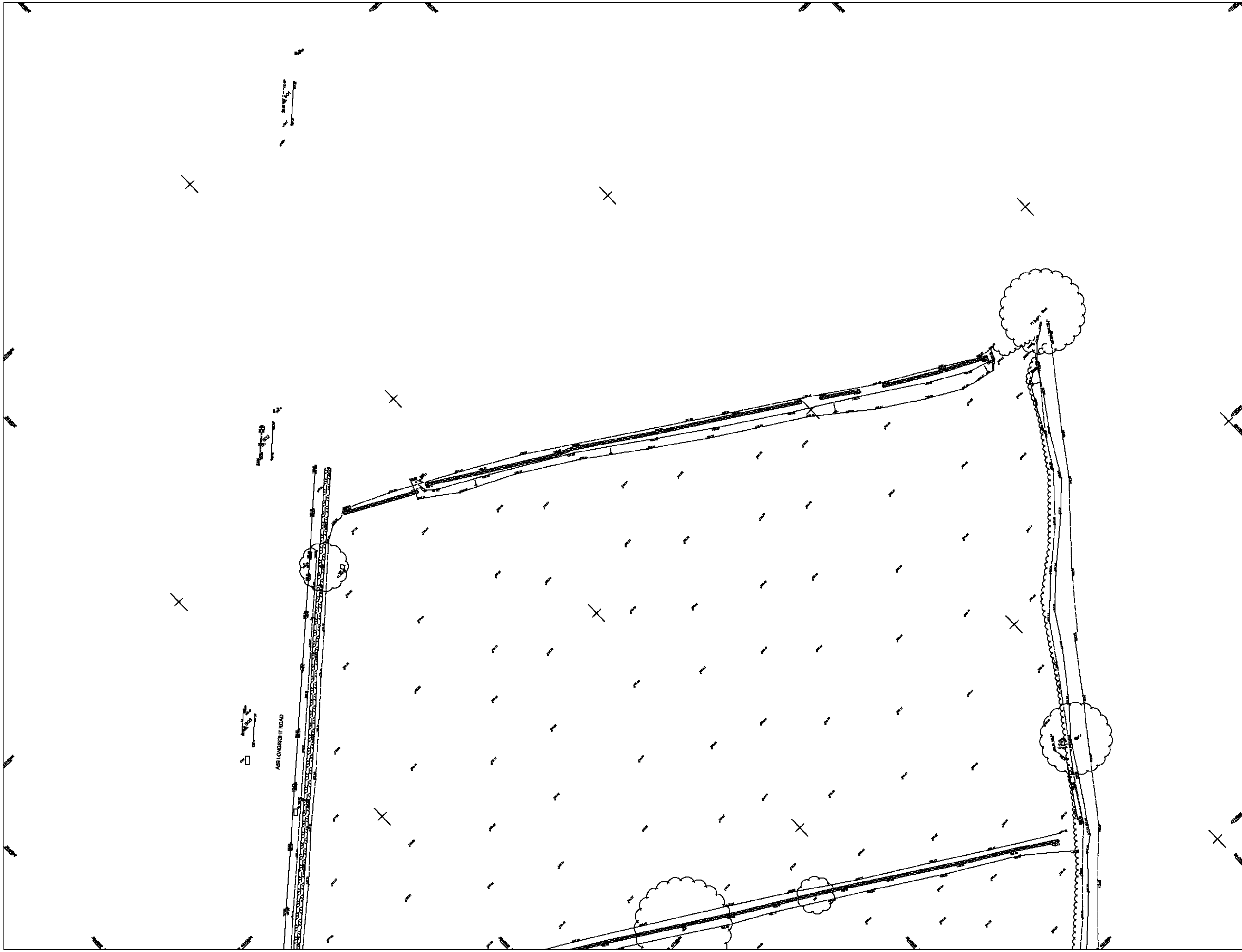
Created
9 Oct 2022 17:23

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

APPENDIX 4

TOPOGRAPHICAL SURVEY



Note:
The survey is plotted on a plane local Grid. Orientation to National Grid.
All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

SURVEY STATIONS			
Name	Easting	Northing	Height
S01	[illegible]	[illegible]	[illegible]
S02	[illegible]	[illegible]	[illegible]
S03	[illegible]	[illegible]	[illegible]
S04	[illegible]	[illegible]	[illegible]
S05	[illegible]	[illegible]	[illegible]
S06	[illegible]	[illegible]	[illegible]
S07	[illegible]	[illegible]	[illegible]
S08	[illegible]	[illegible]	[illegible]

STANDARD REFERENCE & ABBREVIATIONS

SurveY OPERATIONS

Smith Street, Skelmersdale, Lancs
Tel: 01695 725062 Fax: 01695 51816

Client
GA Studio

Drawing Title
Topographical Survey of Land at:
A59 Longsight Road,
Blackburn.
Sheet 1 of 8.

Scale(s)	1:200	Surveyor	MP
Date	Oct 22	Drawn	AW
Job Number	22H208	Checked	SO

Sheet Size & Drg Number & Revision
A0 22H208/001

Note:
The survey is plotted on a plane Local Grid. Orientation to National Grid.
All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

SURVEY STATIONS

Name	Easting	Northing	Height
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

STANDARD REFERENCE & ABBREVIATIONS

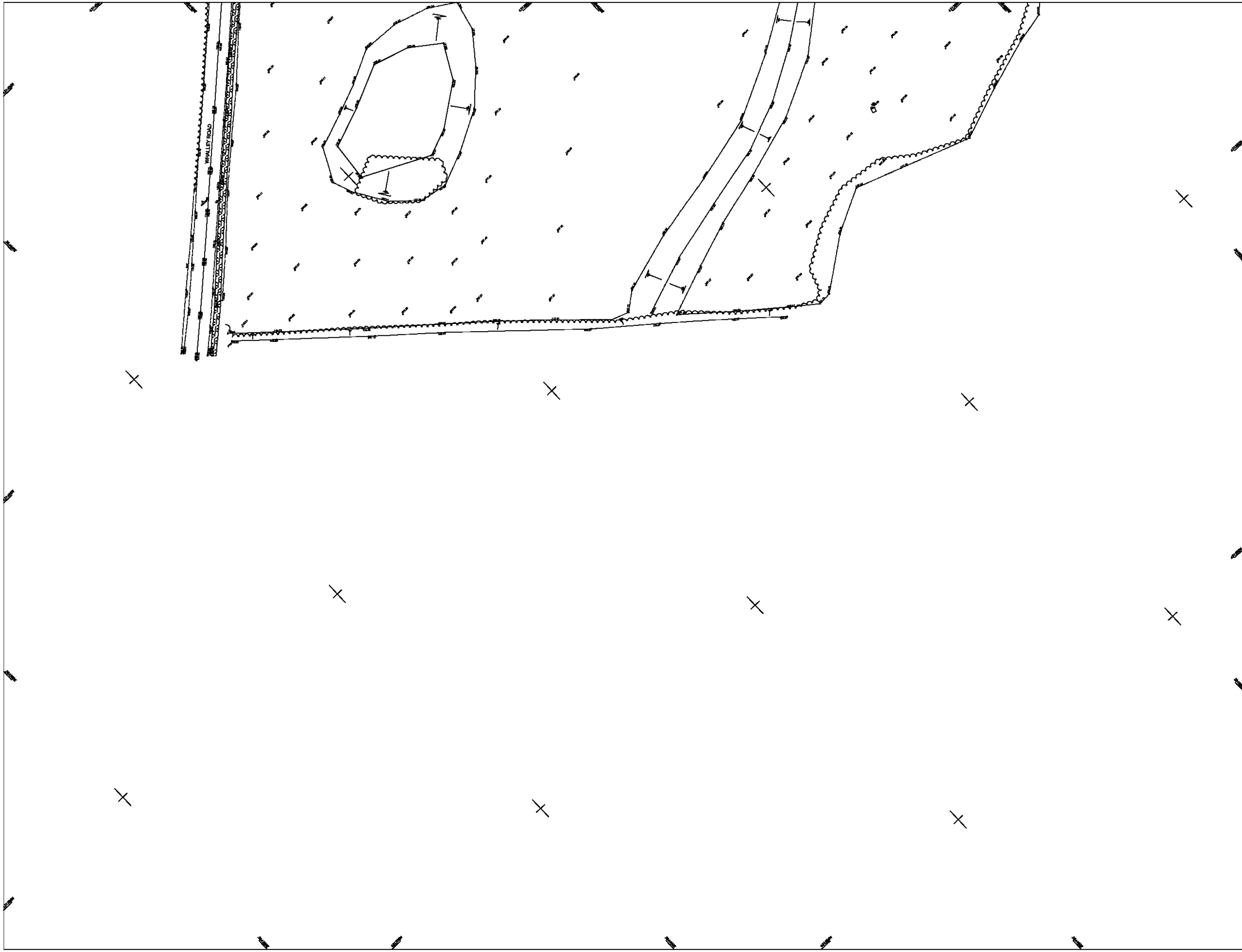
Survey Operations
Smith Street, ... Tel: 01695 725062 Fax: 01695 ...

Client
SA Studio

Drawing Title
Topographical Survey of Land at:
A59 Longsight Road,
Blackburn.
Sheet 2 of 3.

Scale(s)	1:200	Surveyor	MP
Date	Oct 22	Drawn	AW
Job Number	22H208	Checked	SO

Sheet Size & Drg Number & Revision
A0 22H208/002



Note:
The survey is plotted on a plane local Grid. Orientation to National Grid.
All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

SURVEY STATIONS			
Name	Easting	Northing	Height
[illegible]	[illegible]	[illegible]	[illegible]

STANDARD REFERENCE & ABBREVIATIONS

Survey Operations
Smith Street, Skelmersdale, Lancs, WN8 8LN
Tel: 01695 725062 Fax: 01695 51316
Email: mail@surveyops.co.uk — www.surveyops.co.uk

Client
GA Studio

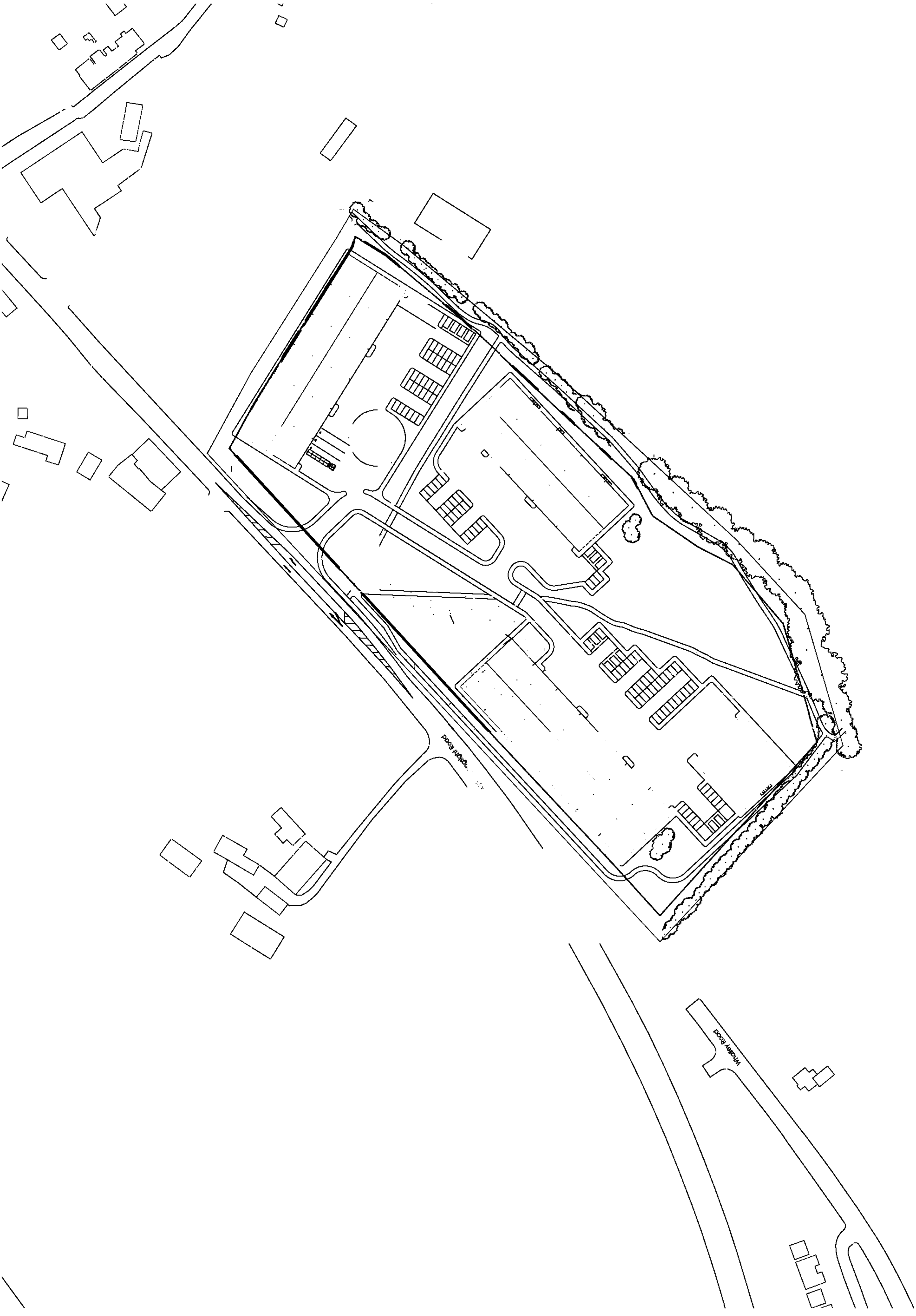
Drawing Title
Topographical Survey of Land at:
A56 Longsight Road,
Blackburn.
Sheet 3 of 3.

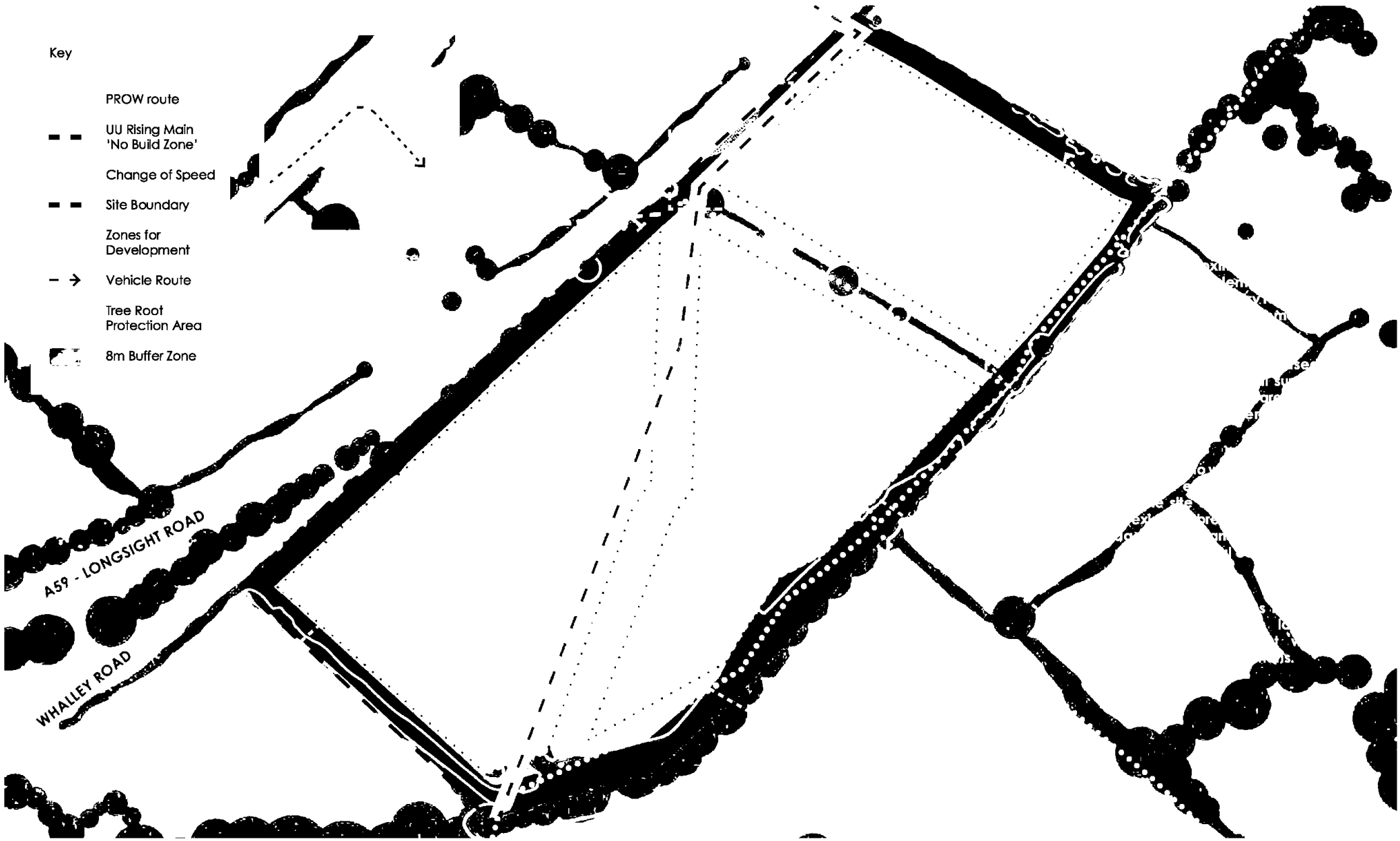
Scale(s)	1:200	Surveyor	MP
Date	Oct 22	Drawn	AW
Job Number	22H208	Checked	SO

Sheet Size & Drg Number & Revision
A0 22H208/003

APPENDIX 5

PROPOSED SITE PLAN


Whalley Road



Rev	Description	By	Chk	Date
		FEASIBILITY		ISSUE
00	Issued for Client	RM	MJG	02.12.22

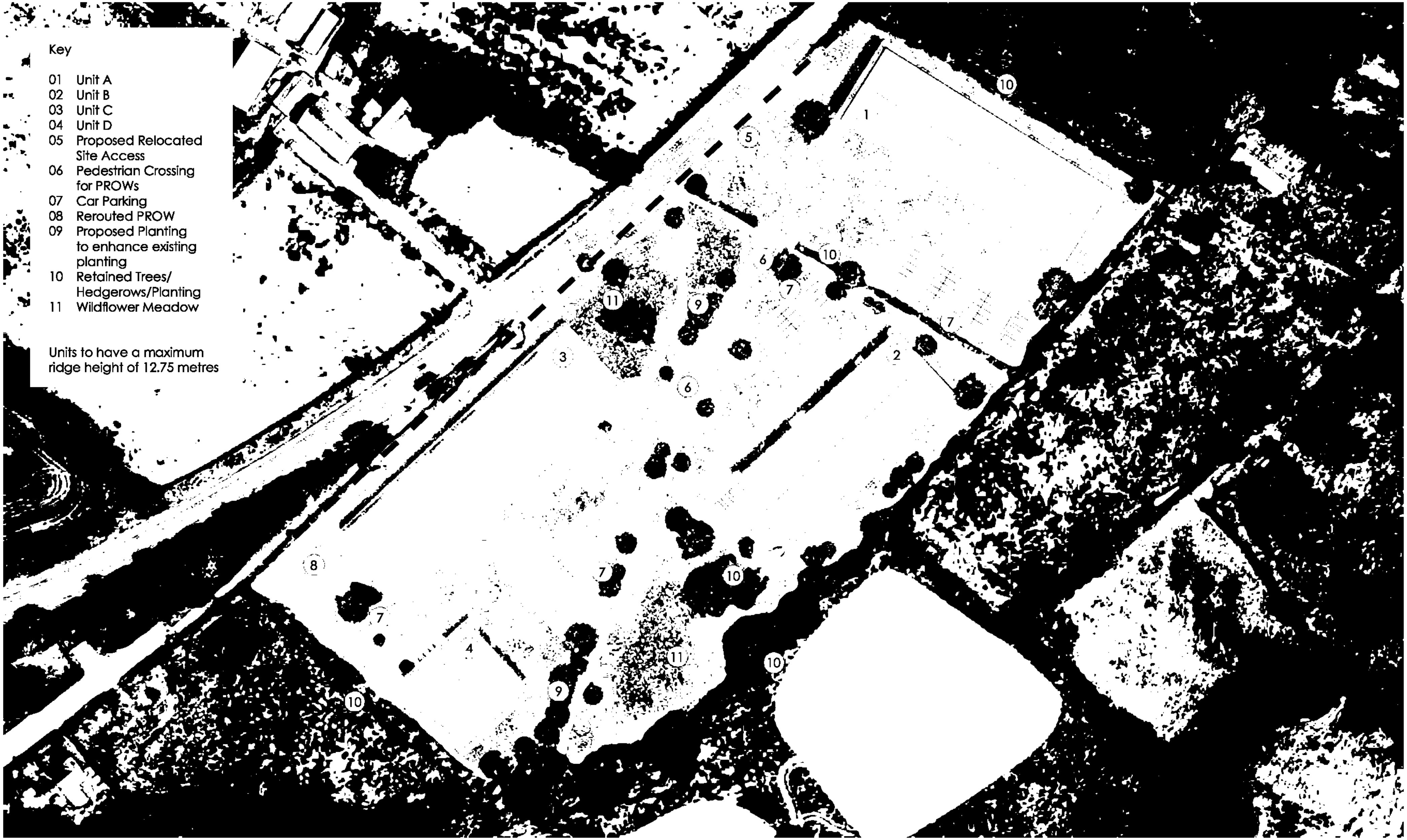
0M 10M 20M 30M 40M 50M 100M

N

Project	Land at Causeway Farm	Project No.	22.03
		Dwg. No.	L(-1)002
Title	Parameters Plan	Date	DEC 2022
		Scale	1:1250 @ A3

Rev.	00
By	RM
Chk.	MJG
App.	00

mail@gastudio.co.uk
www.gastudio.co.uk
tel. 0161 835 3538
GA STUDIO
Architects / Masterplanning / Urban Design



		FEASIBILITY		ISSUE
Rev	Description	By	Chk	Date
01	Revised layout to increase overall development scale	RM	MJG	02.12.22
02	Updated Maximum Ridge Height	RM	MJG	06.02.23

0M 10M 20M 30M 40M 50M 100M

N

Project	Land at Causeway Farm	Project No.	22.03	Rev.	02
		Dwg. No.	L(-1)005	By	RM
Title	Illustrative Masterplan	Date	DEC 2022	Chk.	MJG
		Scale	1:1250 @ A3	App.	00

GA STUDIO
mail@gastudio.co.uk
www.gastudio.co.uk
tel. 0161 835 3538
Architects / Masterplanning / Urban Design

APPENDIX 6

UNITED UTILITIES SEWER PLANS

United Utilities

Water for the North West

How to contact us:

United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

Integra Consulting

14-32
Hewitt Street,
Manchester,
M15 4GB

FAO:

Your Ref: Preston
Our Ref: UUPS-ORD-434658
Date: 01/10/2022

Dear Sirs

Location: Preston

I acknowledge with thanks your request dated 25/09/2022 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. http://www.unitedutilities.com/work-near-asset.aspx .

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please contact us .

Yours Faithfully,

[redacted]

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

United Utilities

Water for the North West

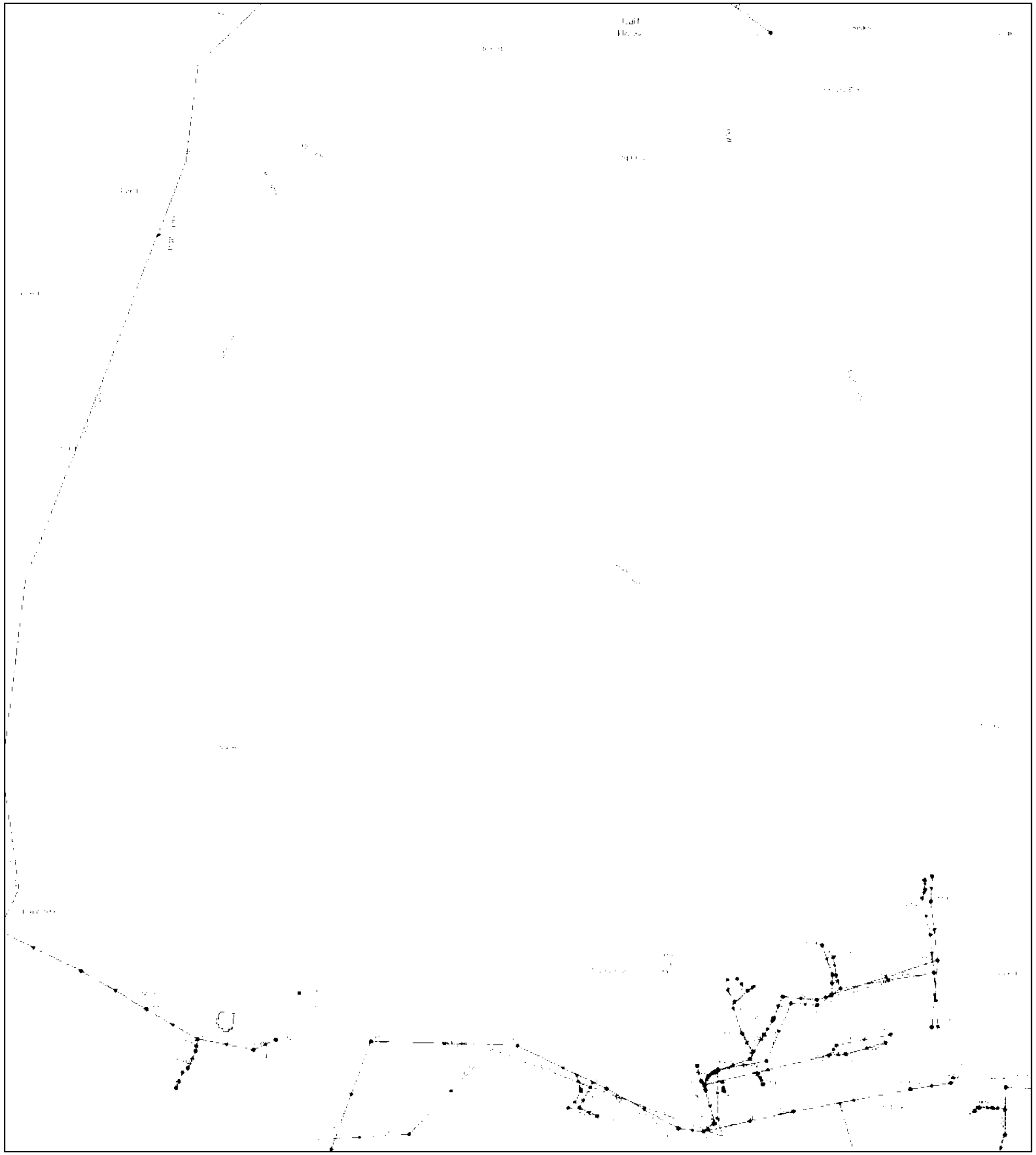
TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
7901	161.45	CO	160.[illegible]7	150			VC	54.[illegible]272	1 in 12
8001		CO		150			VC	42.1864	
9005	172.18	FO	[illegible]	225			VC	37.07746	
9012		FO	0	225			VC	18.07274	
9010		SW	0	225			VC	21.13679	
8011		SW	0	225			VC	147.4616	
8900	163.13	CO	161.[illegible]	150			VC	46.843	1 in 30
8907	164.[illegible]	SW	163.[illegible]7	225			VC	20.[illegible]117	
8910		FO		150			VC	12.42675	
8000	167.5	FO	166.19	225			VC	12.60464	
0910		CO		100			VC	7.264621	
8902	164.1	CO	162.06	225			VC	2.[illegible]	1 in 6
8912		FO	0	300			VC	7.268609	
6901	143.02	CO	141.[illegible]	150			VC	94.[illegible]	1 in 13
6900	146.83	CO	144.[illegible]	150			VC	[illegible]57428	1 in 20
5900	134.91	CO	133.48	150			VC	32.67118	
9000	171.51	FO	170.[illegible]1	150			VC	14.15265	1 in 71
9006	171.52	SW	170.79	150			VC	5.078945	1 in 20
9090	172.08	SW	170.87	225			VC	29.[illegible]	1 in 39
9014	167.[illegible]	SW	0	225			VC	14.41475	
9009	169.[illegible]	SW	166.[illegible]	225			VC	15.[illegible]674	1 in 10
9002	171.57	FO	[illegible]1	225			VC	62.51102	1 in 20
9091	171.59	SW	[illegible]6	225			VC	52.[illegible]777	1 in 29
9011		SW	0	225			VC	7.7[illegible]	
8903		CO	0	225			VC	23.00105	
8906	164.71	CO	160.8	225			VC	3.[illegible]005	1 in 129
8908	166.24	FO	164.[illegible]	225			VC	21.01075	1 in 10
8004		FO		150			VC	28.21167	
0915		CO	171.[illegible]	225			VC	18.1[illegible]	
8901	165.96	SW	164.66	225			VC	27.36566	1 in 28
9092	171.8	SW	170.6	225			VC	21.112[illegible]	
9007	171.59	SW	170.59	225			VC	5.1[illegible]	
8501	116.88	FO	114.10	150			VC	79.29777	1 in 21
8501	116.88	FO	114.10	150			VC	79.29777	1 in 21
9013		FO	0	225			VC	11.1172	
9008	169.8	SW	167.43	225			VC	10.[illegible]	
9004	169.53	FO	167.4	225			VC	17.10247	
8001		FO	0	225			VC	4.969261	
9001	170.74	CO	169.27	150			VC	69.[illegible]	1 in 14
9906		CO	0	225			VC	0.[illegible]749	
8906		SW	0	225			VC	30.70765	
8901	163.83	CO	162.21	150			VC	13.[illegible]41	1 in 26
8916		CO		100			PVC	2.814535	
8904	164.[illegible]	CO	163.07	225			VC	3.01[illegible]5	1 in 151
9015	167.41	SW	166.51	225			VC	34.[illegible]	1 in 54
8903		SW	0	225			PVC	57.81575	
0900	172.8	CO	171.84	225			VC	29.1846	
7900	157.06	CO	[illegible]	150			VC	81.73406	1 in 8
9904		CO	0	225			VC	70.[illegible]215	
8901		CO		100			UN	8.[illegible]	
6904		CO		100			VC	31.[illegible]	
5000	128.31	CO	124.81	150			VC	58.77161	1 in 7
6000	128.31	CO	124.81	150			VC	58.77161	1 in 7
9003	169.96	FO	166.76	225			VC	8.760025	
9001	171.8	FO	170.6	225			VC	33.[illegible]4	
9907		SW	0	225			VC	8.[illegible]	
9900	166.27	CO	164.6	150			VC	50.7[illegible]	1 in 22
8905	164.04	CO	159.76	225			VC	5.447566	1 in 91
8903	164.7	CO	160.[illegible]	225			VC	19.[illegible]	1 in 40
9902	171.[illegible]	CO	170.07	150			VC	22.26054	1 in 29

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Address or Site Reference:

Preston,

OS sheet Number: SD6431SE

Scale: 1:1250 **Date:** 01/10/2022

Nodes: 60

Sheet: 1 of 4

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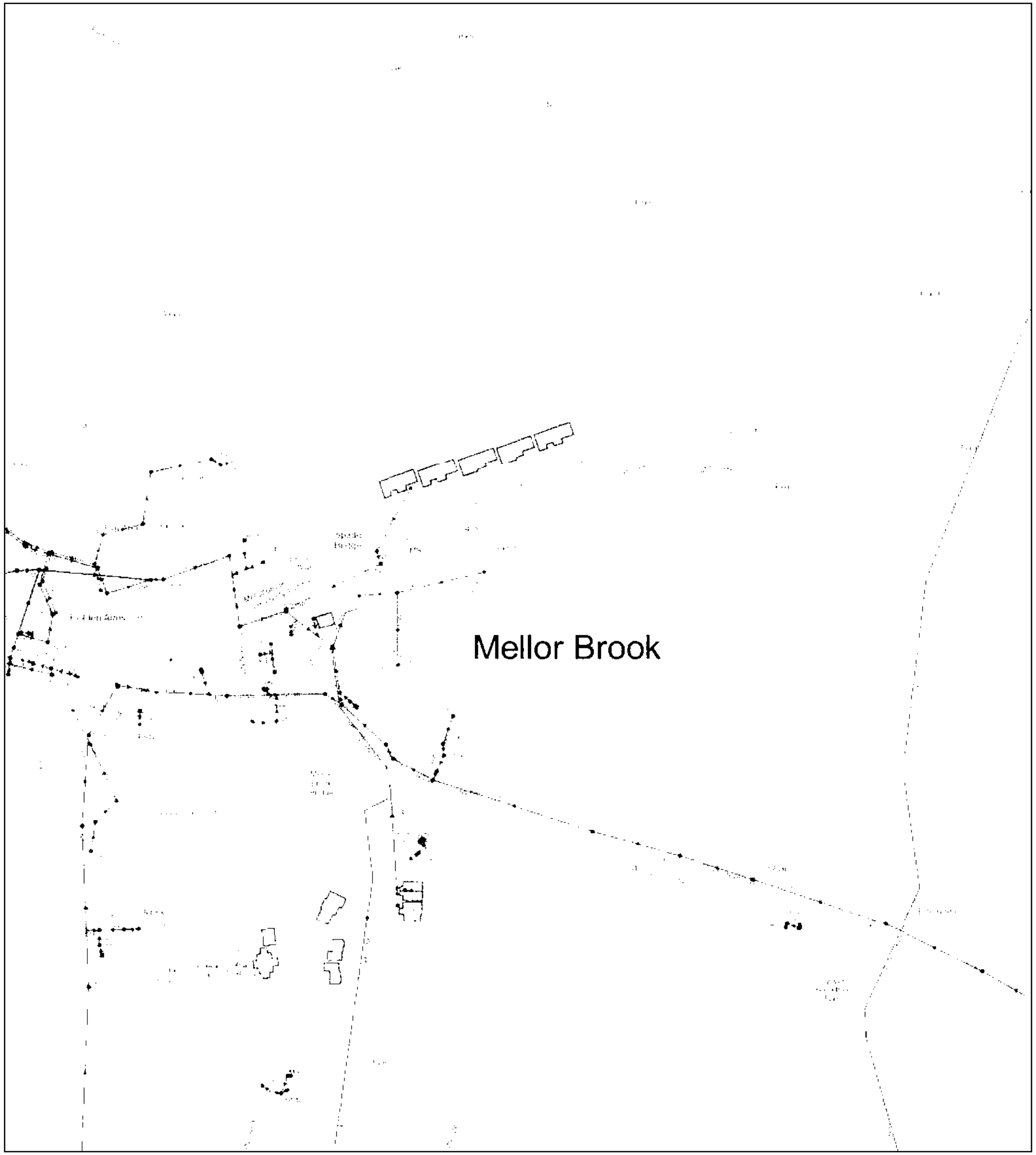
SEWER RECORDS

United Utilities



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
9100	92.88	FO	91.68	150			VC	5.582189	1 in 40
9101		CO	0	150			VC	23.88888	
9204	92.89	CO	91.3	150			VC	13.75419	
9208	92.85	SW		300			VC	5.888812	
9207	93.05	SW	91.75	300			VC	10.39446	1 in 81
9220	92.78	FO	90.35	150			VC	17.88912	1 in 223
0204	91.89	FO	88.01	150			VC	14.84708	1 in 212
0103	94.48	CO	83.01	300			CO	13.08862	
0206	92.21	FO	89.84	150			VC	28.08746	1 in 145
0209	91.89	SW	89.46	225			VC	23.51316	1 in 25
0303	83.98	SW	88.64	225			VC	8.548348	1 in 18
2100	93.02	CO	91.12	150			VC	25.04474	1 in 8
0101	97.58	SW	96.96	150			VC	16.50446	
0102	96.39	CO	0	225			VC	32.30884	
2102		CO		150			VC	18.48811	
9225	92.5	FO	90.55	150			VC	18.84588	1 in 141
0202	92.38	CO	0	150			VC	38.48141	
0210	91.8	SW	88.81	225			VC	28.88887	1 in 14
0302	88.81	SW	88.08	225			VC	6.143781	1 in 28
0200	89.88	CO	88.36	150			VC	39.37214	1 in 108
1202	89.88	SW	88.11	225			VC	38.84113	1 in 17
1104	89.48	FO	88.31	300			VC	8.081761	1 in 127
0000	101.2	CO	88.55	225			VC	88.52884	1 in 22
0108	95.52	SW		300			VC	42.83821	
8002		CO		100			VC	2.559448	
4000	118.18	CO	118.8	150			VC	77.78887	1 in 13
0008		CO		150			VC	13.87871	
9218	91.73	FO	90.2	150			VC	38.18821	1 in 87
9215	91.81	FO	90.26	150			VC	13.50174	1 in 225
9217	91.81	SW	89.96	225			VC	15.59088	1 in 173
0207	92.19	SW	90.06	225			VC	14.88808	1 in 30
0301	90.38	SW	88.41	225			VC	34.13871	1 in 10
1204		CO		100			VC	6.788208	
1200	91.84	CO	87.34	150			VC	32.84768	
1110	89.82	CO	88.06	300			VC	25.81727	
1203	91.24	SW	0	450			CO	21.81402	
1103	90.32	CO	88.07	150			VC	8.731352	
1102		CO	0	150			VC	38.11878	
1101	89.82	CO	87.22	300			VC	6.788888	
1100	89.81	CO	88.9	300			VC	10.88709	1 in 7
0001	98.04	SW	97.22	150			VC	18.2947	1 in 88
0107	97.41	SW	0	150			VC	34.37988	
0104	94.34	CO	82.11	300			VC	38.77788	1 in 128
5000	128.31	CO	124.91	150			VC	58.77181	1 in 7
8000	128.31	CO	124.91	150			VC	58.77181	1 in 7
4008		CO		100			VC	8.871498	
3001	111.78	CO	110.38	150			VC	42.12821	1 in 14
3000	108.88	CO	107.21	150			VC	30.88844	1 in 10
2104		CO		150			VC	9.591362	
2103		CO		150			VC	8.218788	
5001		CO		150			VC	42.1564	
0003		CO		150			VC	7.085283	
9221	92.59	SW	90.89	150			VC	18.88011	1 in 18
0205	91.98	SW	88.85	225			VC	18.93887	1 in 141
9219	91.88	SW	89.89	225			VC	24.88808	1 in 80
9222	93.87	FO	90.37	150			VC	17.88884	1 in 200
9223	93.7	SW	92.31	150			VC	18.88738	1 in 14
9224	93.87	FO	90.48	150			VC	15.46218	1 in 259
0208	92.38	FO	89.66	150			VC	6.88791	1 in 83
0201	92.58	CO	87.87	150			VC	28.85257	1 in 53
1112		CO		150			VC	15.78888	
1109	89.82	FO	88.27	300			VC	7.450862	1 in 7
0106	94.21	CO	91.71	300			VC	84.38712	1 in 20
1116		CO		100			VC	4.208288	
0100	97.53	CO	95.66	225			VC	50.21388	
2101	103.88	CO	101.92	150			VC	92.71888	1 in 9
2105		CO		150			VC	5.168818	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Address or Site Reference:

Preston,

OS sheet Number: SD6431SW

Scale: 1:1250 **Date:** 01/10/2022

Nodes: 67

Sheet: 2 of 4

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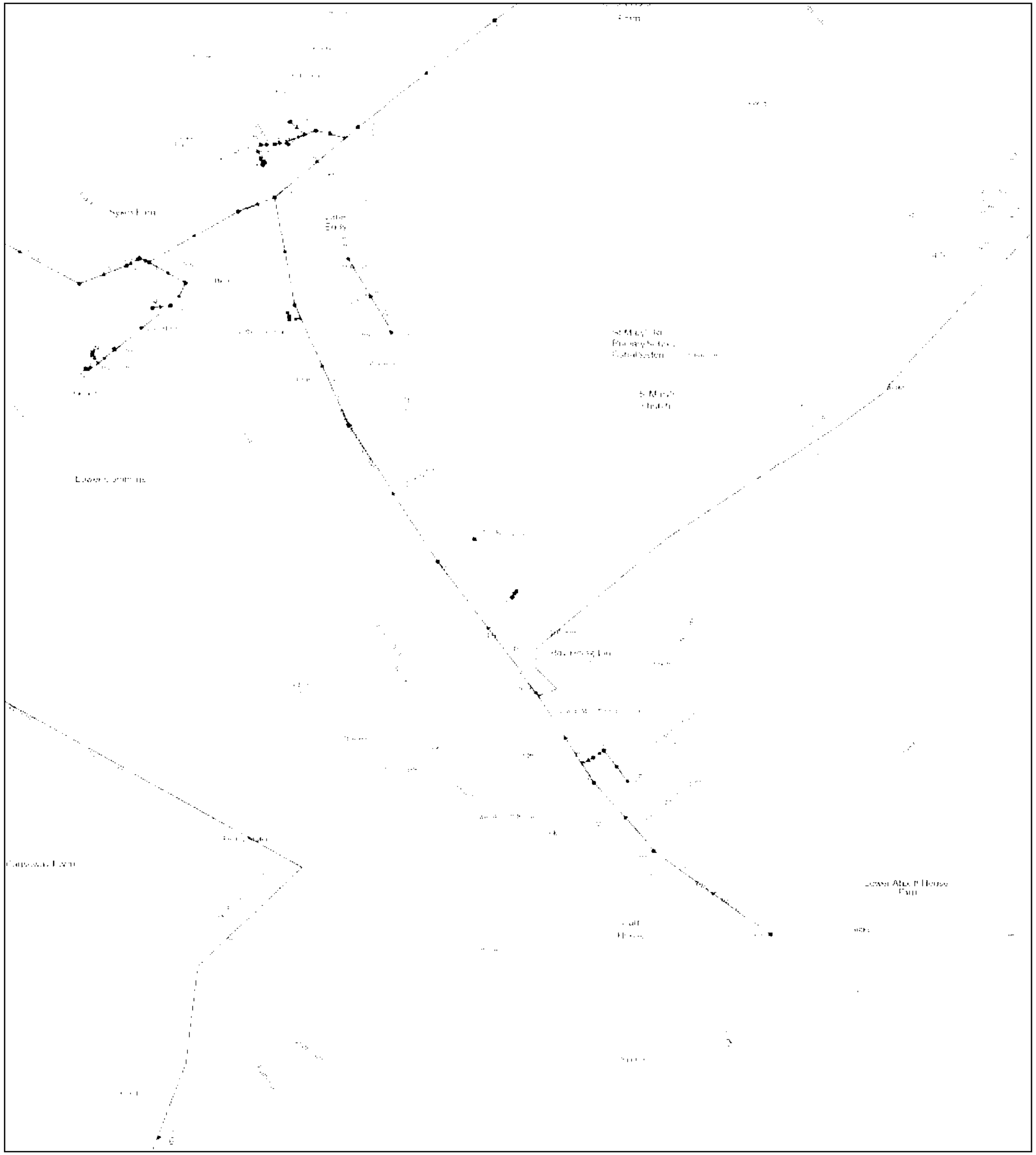
SEWER RECORDS

United Utilities

Water for the North West



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Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
6906		FO		100			VC	18.82983	
8001	99.07	FO	97.48	150			VC	80.28514	1 in 181
6907		FO		150			VC	16.22069	
7602	110.43	FO	109.02	150			VC	59.32489	1 in 48
7601	109.15	FO	107.71	150			VC	80.83402	1 in 29
7701	106.06	FO	104.14	150			VC	80.89604	1 in 28
6607		OO		150			VC	47.36519	
6905	99.37	FO	[illegible]	150			VC	68.84315	1 in 78
6902	96.98	FO	[illegible]	150			VC	27.66567	1 in 82
6902	96.98	FO	[illegible]	150			VC	27.66567	1 in 82
6905	97.18	FO	95.61	150			CI	4.467673	1 in 149
6904	97.48	FO	95.84	150			VC	6.422924	1 in 45
6902	101.18	FO	99.26	150			VC	61.07764	1 in 69
6601	115.58	FO	114.18	150			VC	78.26777	1 in 21
6601	115.58	FO	114.18	150			VC	78.26777	1 in 21
6601	111.65	FO	110.32	150			VC	60.51509	1 in 38
7606		FO		100			VC	7.296679	
6901	100.09	FO	97.08	150			VC	21.66669	1 in 69
6801	98.48	FO	[illegible]	150			VC	76.06242	
6801	98.48	FO	[illegible]	150			VC	76.06242	
6601	102.25	FO	100.66	150			VC	72.68243	1 in 57.[illegible]
7001	101.21	FO	[illegible]	150			VC	66.10204	1 in 141
6909		FO		150			VC	28.14797	
7606		FO		100			VC	7.081401	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

MANHOLE FUNCTION

Address or Site Reference:

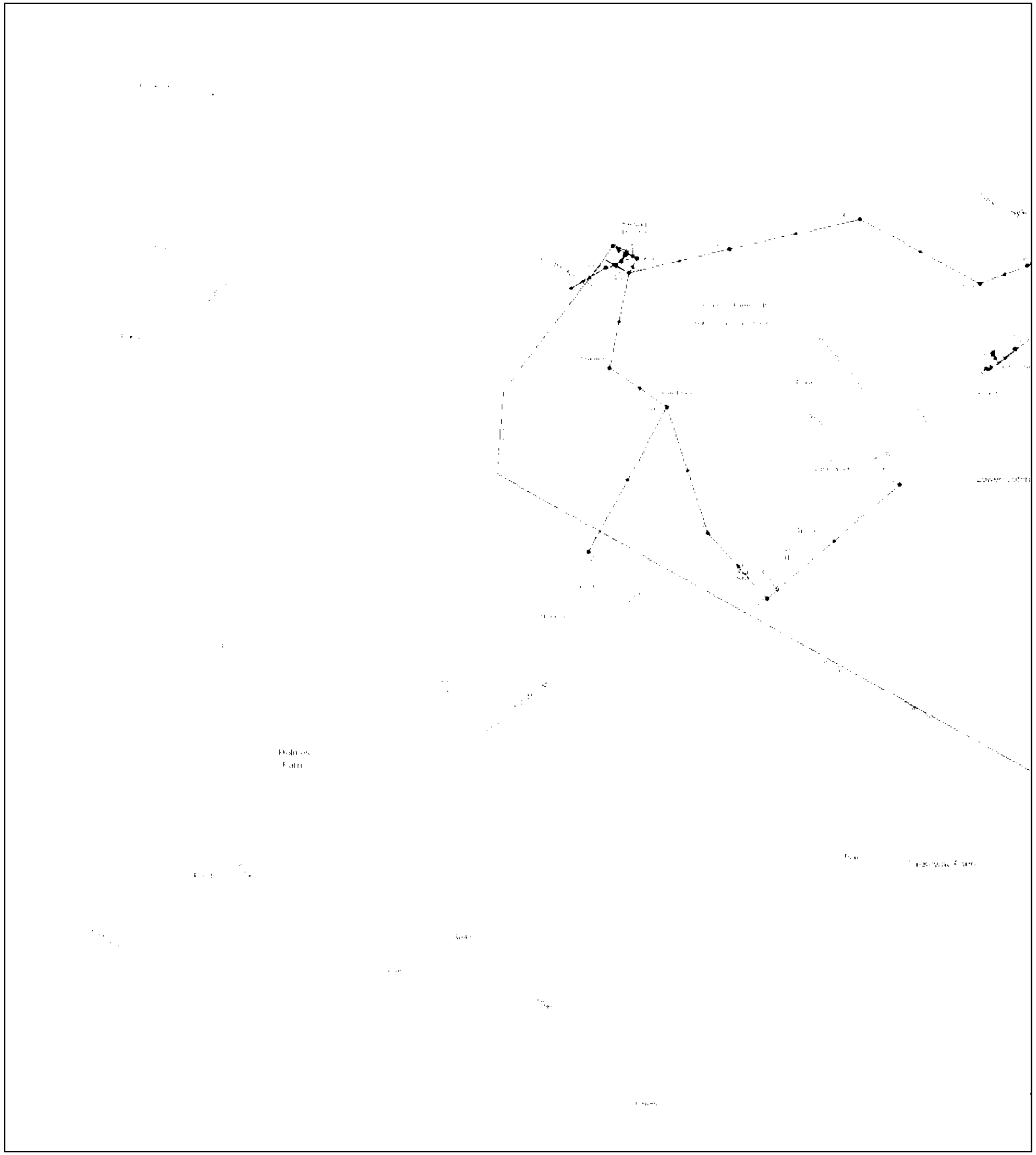
Preston,

OS sheet Number: SD6431NE
Scale: 1:1250 **Date:** 01/10/2022
Nodes: 24
Sheet: 3 of 4

Printed by: Property Searches

SEWER RECORDS

United Utilities



The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
2902	92.97	CV	92.25	225			CO	22.12344	
2901	93.61	CO	92	225			CO	9.178798	1 in 102
4801		FO	0	150			VC	74.22828	
3701		FO	0	150			VC	73.81799	
3906	93.6	CV	92.3	225			CO	9.375714	1 in 768
5901	95.45	FO	95.36	150			VC	75.96942	
5801	95.45	FO	95.36	150			VC	75.96942	
2801	94.48	FO	92.88	150			VC	[illegible]	1 in 67
3801	95.95	FO	94.38	150			VC	38.83738	1 in 28
3904	93.61	CO	91.9	250			CO	6.641967	1 in 11
3902	95.75	FO	93.64	150			VC	57.42787	1 in 36
3702	95.75	FO	93.92	150			VC	43.65632	
5902	95.98	FO	95.74	150			VC	27.56667	1 in 62
5802	95.98	FO	95.74	150			VC	27.56667	1 in 62
4801		FO	0	150			VC	[illegible]	
2701	96.25	FO	94.82	150			VC	91.71288	1 in 229

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad

LEGEND

Address or Site Reference:

Preston,

OS sheet Number: SD6431NW
Scale: 1:1250 **Date:** 01/10/2022
Nodes: 16
Sheet: 4 of 4

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SEWER RECORDS

United Utilities

APPENDIX 7

UNITED UTILITIES PRE-DEV WASTWATER ENQUIRY RESPONSE

[redacted]

From: [redacted]
Sent: 01 February 2023 21:41
To: [redacted]
Subject: RE: Re: Our reference - 02885214

Hi [redacted]

After assessing the site, it appears the 150mm diameter foul sewer on Abbot Brow is the nearest point of connection for the foul to connect to.

Therefore you have the right to connect to this sewer - if you wish to discuss further just let me know.

Kind Regards,

[redacted]
Developer Engineer
Developer Services & Metering
Customer Services
[redacted]
unitedutilities.com

United Utilities
Water for the North West

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

---------- Original Message ----------
[redacted]
Sent: 28/10/2022 09:36
[redacted]
Subject: RE: Re: Our reference - 02885214

[redacted]

With regard to post-development foul water discharge, would it be acceptable to connect to the 150mm foul water sewer on Abbott Brow to the north east of the site?

Kind regards,

[redacted]

[redacted]

[redacted]

[redacted]

A: Suite 4, 14-32 Hewitt Street, Manchester, M15 4GB

integra consulting 20 YEARS IN BUSINESS

[redacted]

Sent: 27 October 2022 12:01

[redacted]

Subject: FW: Re: Our reference - 02885214

Hi[redacted]

Please see email response below sent on 12/10/22

Thanks[redacted]

---------- Forwarded Message ----------

[redacted]

Sent: 12/10/2022 17:10

To:[redacted]

Subject: Re: Our reference - 02885214

Good afternoon[redacted]

Pre Development Enquiry for: Long Sight road, Blackburn, Lancashire, BB2 7HZ UU Reference Number : 02885214

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below:

https://www.unitedutilities.com/builders-developers/working-near-our-assets/

Foul Water

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system.

Our preferred point of discharge would be to the 150mm diameter public combined sewer within Whalley Road located to the south west of your proposed development at an unrestricted rate. This assume there will be no trade effluent waste for this commercial development.

If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.

In accordance with our infrastructure plans we may ask you to change your point of connection. Therefore please contact us when you are ready to formalise your drainage proposals, we would suggest before you submit for Full Planning.

Surface Water

All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80, (Reference ID: 7-080-20150323), of the National Planning Practice Guidance. We also recommend you prioritise the use of multi-functional sustainable drainage systems for the management of surface water in accordance with national planning policy.

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.
This is outlined as follows, in order of priority:

1. **into the ground (infiltration);**
2. **to a surface waterbody;**
3. **to a surface water sewer or highway drain;**
4. **to a combined sewer.**

For guidance, The **North West SuDS Pro-Forma** provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted.

The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area).

The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities.

Infiltration

Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible.

A detailed evidence based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal.

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:

https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs

If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below:

https://www.gov.uk/government/publications/groundwater-protection-position-statements

Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site.

Waterbody

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you contact the Lead Local Flood Authority and/or Environment Agency to discuss a point of discharge to the watercourse located on the southern site boundary.

We would encourage you to identify and engage with any third party landowner and riparian owner to agree access and discharge rights to the water body if this is not in your ownership.

Highway Drainage

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you investigate the possibility of draining surface water to the highway drain where this ultimately discharges to a watercourse, by contacting the relevant Highway Authority.

Public Sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, both discharge to ground via infiltration and discharge to a waterbody should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

As there are no public sewer in the vicinity of the site but there is a watercourse, it is not proposed that any surface water will discharge to the public sewers.

As a Water Company, we have no obligation to accept highway drainage into our public sewer network. However, should your proposals include runoff from highways, we would request that consideration is given to SuDS components that deliver source control are incorporated within the design of the scheme to reduce the volume and frequency of discharges of these flows to the public sewer.

Levels

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the pubic sewerage network under any circumstances

Existing Wastewater Assets Crossing the Site

According to our public sewer records there are public sewers located within your site boundary. We will require unrestricted access to the raising main for maintenance purposes, we would ask that you maintain a minimum clearance of 6m which is measured 3m from the centre line of the pipe unless there happens to be a formal easement agreement in place, in which case the specified easement width would apply. If you cannot achieve this then you may wish to consider diverting and or abandoning the public sewer. We note from the indicative site layout units A & C in the south and middle of the site are in close proximity to the sewer, we would request that the site layout is amended or the rising main is diverted if the buildings are encroaching on the easement.

Please be aware that any proposed diversion may require modelling. This process may take up to 6 months in order to reach an acceptable design.

Please refer to the link below to obtain full details of the processes involved with sewer diversions:

https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-diversions/

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address: DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:

https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/

Connection Application

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

Kind regards,

[redacted]

[redacted]
Developer Services & Metering
Customer Services
[redacted]
unitedutilities.com

---------- Original Message ----------
[redacted]
Sent: 03/10/2022 13:58
[redacted]
Subject: Re: Our reference - 02885214

EXTERNAL EMAIL This email originated outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Many thanks [redacted]

Kind regards,

[redacted]

Sent from Outlook for iOS

[redacted]
Sent: Monday, October 3, 2022 1:54:27 PM
To: [redacted]
Subject: Our reference - 02885214

Dear [redacted]

PRE DEVELOPMENT APPLICATION AT: Longsight Road, BB2 7HZ – UU Ref 02885214

Please accept this email as receipt of your application received on 01/01/22 for the above development. This has now been logged on our system and the job reference is 02885214 we would ask that you quote this reference in all future correspondence.

I have reviewed your application (and attachments) and can confirm this is suitable to be passed to an engineer for technical assessment. You will receive their response within 8 working days.

Kind regards,

[redacted]

[redacted]

[redacted]
Developer Services & Metering
Customer Services
T: 03450726067
unitedutilities.com

If you have received a great service today why not tell us?

https://www.unitedutilities.com/builders-developers/
WastewaterDeveloperServices@uuplc.co.uk

APPENDIX 8

INTEGRA CONSULTING PHASE 1 GEO-ENVIRONMENTAL DESK STUDY REPORT

integra
consulting

Land at Longsight Road,

Balderstone BB2 7HZ

Proposed Employment / Industrial Development

Phase 1 Site Investigation Report

For: Specialist Diesels Ltd.

TABLE OF CONTENTS

1.0 INTRODUCTION

Integra Consulting is providing consultancy services to ***Specialist Diesels Ltd*** (the *Client*) in connection with the outline planning application with all matters reserved except access, for an employment use (Class B2/B8), parking and associated works at land fronting onto Longsight Road (A59), Balderstone, Blackburn, BB2 7HZ.

It is understood that the site is to be developed for commercial use by the construction of a series of steel framed commercial units. External works will include a new access road off the A59 Longsight Road, extensive paved areas for commercial parking at each unit, car parking bays at each unit, and some areas of communal landscaping.

The existing and proposed layout are as illustrated on ***GA Studio*** architectural drawings contained herein.

The proposed development falls within the administrative jurisdiction of ***Ribble Valley Borough Council.***

A Phase I Desk Study was required as a planning stage deliverable prior to a later intrusive phase of investigation and this Phase I report was devised to generally comply with the relevant principles and requirements of a wide range of guidance including BS5930:1999 as amended 2007: "*Code of Practice for Site Investigations*", BS10175: 2011 "*Investigation of Potentially Contaminated Sites - Code of Practice*", and the DEFRA/Environment Agency Report CLR11 "*Model Procedures for the Management of Land Contamination*".

This report should be read in conjunction with the Notes on Limitations, given in Appendix 2.

2.0 PURPOSE & AIMS OF THE STUDY

The primary aim of the Phase I Desk Study was to assess whether the site is likely to be affected by contamination to an extent that it may pose a risk to human health and/or the built environment and/or the wider natural environment or is affected by any other natural or man-made features which may impact on the proposed redevelopment.

Specific tasks undertaken to achieve these objectives were as follows:

- Undertaking of a review of available historical mapping, environmental databases, and Environment Agency data
- Undertaking of a site walkover inspection
- Development of Preliminary Conceptual Model
- Development of a Phase 2 intrusive investigation strategy

3.0 SITE DATA

3.1 Site Location

The site comprises a rectangular shaped parcel of land located immediately to the southeast of Longsight Road (A59), Blackburn, Clayton Le Dale, BB2 7HZ, as shown on the drawings contained in Appendix 1 of this report.

The ***Ordnance Survey*** coordinates for the approximate site centre are 364574 431455. It stands at an approximate elevation of c. 104mAOD.

3.2 Site Description & Walkover Observations

The site was visited during October 2022 on completion of a review of all relevant historical and environmental mapping data (provided in Appendix 4).

The site is located within a mixed agricultural / commercial context and comprises a rectangular shaped parcel of agricultural land located immediately to the southeast of Longsight Road (A59). It extends to the approximate dimensions of c. 300m x 140m; its long axis being on a southwest – northeast alignment.

It is bound to the northwest by public pavements extending along Longsight Road, beyond which lies a motor vehicle refuelling station, and to the southeast by an un-named westerly flowing narrow brook, beyond which lies an extensive parcel of agricultural land. Its northeastern and southwestern boundaries are adjoined by parcels of agricultural land.

The surface topography across the site was seen to be reasonably flat with surface cover comprising species poor grasslands with localised pockets of mixed perennial herbs.

There was no visual evidence of the presence of native and/or non-native plant species within, or adjoining, the site boundary.

Vehicle and pedestrian access can be made via Longsight Road to the north.

The information obtained from the visit is summarised in Table 1 hereunder.

Table 1: Summary of Walkover Observations

FEATURE		OBSERVATION
Current Use of Land		Vacant parcel of agricultural land with associated hedgerows and ponds
Context		Agricultural context
Topography / Surfaces		The surface topography across the site was seen to be sensibly flat with surface cover comprising species poor grasslands with localised pockets of mixed perennial herbs.
Dimensions		c. 300m x 140m; its long axis being on a southwest – northeast alignment.
Access		Vehicle and pedestrian access can be made via Longsight Road to the north.
Buildings Adjacent to the Site		None
Services		None observed
Boundary	NW	Public pavements extending along Longsight Road
	West	Agricultural land
	South	Agricultural land
	East	Agricultural land
Material storage		None observed
Waste disposal		None observed
Other potential contamination		None observed
Ecology*		None observed

**These comments on the ecology are for initial preliminary assessment only and are based on observations undertaken by a person who is a trained ecologist but who has not undertaken a comprehensive Phase I Habitat Survey or similar.*

4.0 SITE HISTORY

The history of the site and its immediate surrounds was investigated by consultation with a range of archive resources. Geographical information, historical mapping and environmental data were primarily based on a GroundSure Environmental Report presented in Appendix 4.

A summary of the historical mapping data is given hereunder:

Table 2: Historical Map Review

YEAR	SCALE	ON SITE	ADJACENT TO SITE	<250M
		Undeveloped / vacant land		Much of the land surrounding the site is undeveloped / vacant land
1844	1:10,560	Pond located in SW portion of the site	NW: Road [later recognised as "Longsight Road"	c.80m N: Property later recognised as "Higher Commons"
1892	1:2,500			c.85m NW: Properties later recognised as "Causeway Farm"
1892	1:10,560			
1910	1:10,560.	Another pond is located at approximate site centre	SE: Footpath, adjacent Brook [flowing NE>SW]	c.90m E: Properties associated with "Calf House"
1911	1:2,500			c.120m NW: Pond
		3nr paths cross the site		c.130m NE: "Bay Horse Inn"
				c.150m SE: Spring
				c.180m N: Pond
1929-32	1:10,560			
1932	1:2,500	No significant change	No significant change	c.95m SW: Property associated with "Glengarth"
1951	1:10,560			
1969	1:10,560			
1969	1:10,000			
1976	1:10,000			
1988	1:2,500			
1992	1:2,500			
1992	1:2,500	No significant change	No significant change	c.100m NE: Garage recognised
2001	1:10,000			
2003	1:1,250			
2003	1:1,250			
2010	1:10,000			
2022	1:10,000			

5.0 ENVIRONMENTAL SETTING

5.1 Documented Geology

The geology of the site was researched by reference to the 1:50,6000 scale ***British Geological Survey*** (BGS) Sheet 075 Preston (2012) 1: 50,000 Scale Solid and Drift Editions and Price. D. *et.al* (1963) '*Geology of the country around Preston* (One-inch geological sheet 75 New Series)' Her Majesty's Stationery Office, London.

The ***BGS*** 1:10, 000 Scale Drift Geological map indicate that the overall site is underlain with natural drift deposits comprising impermeable diamicton (*boulder clay*) comprising gravel sand silt and clay deposits of glacial origin (*Pleistocene Epoch - Late Quaternary - Devensian Sub Age*).

The solid geology is documented to comprise the Copster Green Sandstone of the Pendle Grit Member comprising thickly-bedded, pebbly, coarse-grained feldspathic sandstone with subordinate siltstone beds of the Lower Carboniferous Period (*Namurian Stage - Pendleian Sub-Age*).

The nearest documented geological line of weakness, fault, extending on a north – south alignment lies c. 46m west of the study site.

The '*Indicative Atlas of Radon in England and Wales*' (Miles. J.C.H *et.al*, 2007) Map 13 '*Northern Welsh Marches and Liverpool',* shows the site to be situated within an area where it is believed that less than 1% of the properties within the area are affected by Radon and therefore no Radon Protection Measures will be required for new structures in contact with the ground.

Geological Information obtained from the GroundSure Environmental Report is presented in Appendix 4, and summarised hereunder:

Table 3: Summary of Geological Data from GroundSure Report

GEOLOGY

Data	Distance	Comments
Artificial Ground	N/A	If present, artificial ground and/or reworked ground deposits associated with the development of the site & its immediate surroundings
Superficial Deposits / Drift Geology	On Site	Diamicton of glacial origin
Permeability of Diamicton	Maximum Permeability	Diamicton = High
	Minimum Permeability	Diamicton = Low
Bedrock and Solid Geology	On Site	Copster Green Sandstone
Permeability of Bedrock: On Site	Minimum Permeability	Moderate
	Maximum Permeability	High
Geological Lines of Weakness	On Site	No records
	<250m	46m W. Fault
Radon Affected Area	On Site	The site is not in a Radon Affected Area, as less than 1% of properties are above the Action Level
Radon Protection	On Site	No radon protective measures are necessary

MINING, GROUNDWORKINGS AND NATURAL CAVITIES

Data	Distance	Comments
Natural cavities	<500m	No records
BritPits	<500m	247m E: Abbot Quarry [Sandstone] – Ceased 273m E: Abbott House [Sandstone] - Ceased
Surface ground workings	<250m	On Site: Unspecified Ground Workings On Site: Unspecified Pit 95-6m E: Unspecified Heap 98m E: Unspecified Heap 103m E: Unspecified Heap 128m E: Unspecified Quarry 136m E: Unspecified Quarry 142m E: Sandstone Quarries 144m E: Unspecified Quarry 147m E: Unspecified Heap 160m E: Unspecified Quarry 167m E: Unspecified Pit 195m NE: Unspecified Pit 220m E: Pond 226m E: Unspecified Quarry
Underground workings	<1000m	No records
Historical Mineral Planning Areas	<500m	No records
Non-coal mining	<1000m	On Site: Vein Mineral. Class: A 263m E: Vein Mineral. Class: A
Mining cavities	<1000m	No records
Coal mining	On Site	No records
Brine areas	On Site	No records
Gypsum areas	On Site	No records
Tin mining	On Site	No records
Clay mining	On Site	No records

HAZARDS

Data	Distance	Comments
Maximum shrink swell clays	On site	Very Low
Maximum running sands	On site	Very Low
Maximum compressible deposits	On site	Negligible
Maximum collapsible deposits	On site	Very Low

Maximum landslides	On site	Very Low
Maximum ground dissolution of soluble rocks	On site	Negligible

5.2 Historical Coal Mining

The appended environmental data, ***BGS*** mapping data and ***COAL AUTHORITY*** Gazetteer confirm that the site is not located within an area which is believed to be underlain by productive coal measures which may have been worked in the past and therefore a ***COAL AUTHORITY*** mining report was not procured.

5.3 Hydrology and Hydrogeology

Information on hydrology and hydrogeology obtained from a GroundSure Environmental Report is presented in Appendix 4, and summarised hereunder:

Table 5: Summary of Hydrology and Hydrogeological Data from GroundSure Environmental Report

HYDROGEOLOGY AND HYDROLOGY		
Aquifer within Superficial Drift Deposits (Boulder Clay)	On site	**Diamicton: Secondary Undifferentiated:** Assigned where it is not possible to attribute either category A or B to a soil type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the soil type
Aquifer within Bedrock Deposits	On site	**Copster Green Sandstone- Secondary A:** Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
Groundwater Abstraction Licenses	<500m	No records
Surface Water Abstraction Licenses	<500m	No records
Potable Water Abstraction Licences	<500m	No records
Source Protection Zones	<500m	No records
Source Protection Zones (confined aquifer)	<500m	No records
Water Network (OS Mastermap)	<200m	On Site: Inland river not influenced by normal tidal action 13m NE: Inland river not influenced by normal tidal action 31m SW: Inland river not influenced by normal tidal action 77m NE: Inland river not influenced by normal tidal action 85m NE: Inland river not influenced by normal tidal action 105m NW: Inland river not influenced by normal tidal action 108m NE: Inland river not influenced by normal tidal action 151m SW: Inland river not influenced by normal tidal action 194m NE: Inland river not influenced by normal tidal action 197m E: Inland river not influenced by normal tidal action
Surface water features	<250m	8nr records
WFD Surface water body catchments	On Site	On Site: River. Water body catchment: Ribble - conf Calder to tidal. Operational catchment: Big Ribble
WFD Surface water bodies	<250m	No records
WFD Groundwater bodies	<250m	On Site: Ribble Carboniferous Aquifers. Overall rating: Poor [2019]
FLOODING		
Risk of Flooding from Rivers and Sea (RoFRaS)	<50m	No records
Historical Flood Events	<250m	No records
Flood Defences	<250m	No records
Areas Benefitting from Flood Defences	<100m	No records
Flood Storage Areas	<250m	No records
Flood Zone II	<50m	No records
Flood Zone III	<50m	No records
Surface water flooding: Highest risk	On Site	1 in 30 year, 0.1m – 1.3m
	<50m	1 in 30 year, 0.3m – 1.0m
Groundwater flooding: Highest risk	On Site	Low
	<50m	Low

For simplified interpretation, the geological succession underlying the site may be regarded as a series of discrete units in terms of their hydrogeological significance, as illustrated hereunder:

Table 6: Hydrogeological Interpretation

UNIT	PROPERTIES	HYDROGEOLOGICAL DESIGNATION
Made / Reworked Ground	If present, likely to be generally granular and permeable and will permit vertical and lateral transmission of groundwater.	Unproductive Aquifer
Diamicton	Assigned where it is not possible to attribute either category A or B to a soil type. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the soil type	Secondary Undifferentiated
Copster Green Sandstone	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers	Secondary A Aquifer

5.4 Potential for Soakaway Drainage

The documented geology strongly indicates that soakaway drainage will not function effectively on this site

6.0 FURTHER ENVIRONMENTAL DATA

Environmental data was researched using several sources including Environment Agency Maps and GroundSure Envirosight Report presented in Appendix 4 and is summarised hereunder in Table 6. This environmental data has been used to carry out a Preliminary Qualitative Risk Assessment (Tier 1) and formulate the preliminary conceptual model as discussed in Section 8.0 of this report.

Table 7: Summary of Environmental Data

POTENTIALLY CONTAMINATIVE USES IDENTIFIED FROM 1:10,000 SCALE MAPPING		
Data	**Distance**	**Comments**
Historical industrial land uses	<250m	On Site: Unspecified Pit [1892-1969] On Site: Unspecified Ground Workings [1910-32] 77m NW: Coopers [1846] 86m NE: Pipe [1846] 92m NE: Garage [1969] 95-96m E: Unspecified Heap [1892-1932] 103m NE: Pipe [1846] 103m E: Unspecified Heap [1951-69] 128m NE: Unspecified Tank [1910-32] 128m E: Unspecified Quarry [1932] 134m NE: Unspecified Tank [1951] 136m E: Unspecified Quarry [1951-69] 142m E: Sandstone Quarries [1846] 144m E: Unspecified Quarry [1910] 147m E: Unspecified Heap [1910] 160m E: Unspecified Quarry [1892] 167m E: Pipe [1846] 187m NE: Unspecified Pit [1910-32] 195m NE: Unspecified Pit [1951] 197m SW: Sewing Works [1951] 206m E: Railway Sidings [1932] 217m E: Unspecified Tank [1910] 226m E: Unspecified Quarry [1892] 247m S: Pump House [1976]
Historical tanks	<250m	No records
Historical energy features	<250m	249m S: Electric Sub-Station [1988-99]
Historical petrol stations	<250m	No records
Historical garages	<250m	79m NE: Garage [1988-99] 83m NE: Garage [1967]
Historical military land	<250m	No records
Records of Current Industrial Land Use		
Data	**Distance**	**Comments**
Recent industrial land uses	<250m	33m N: Esso [Petrol and Fuel Stations] 36m N: Pennine Service Station [Vehicle Cleaning Services]
Current or recent petrol stations	<250m	52m NE: Esso [Open] 136m NE: Obsolete
Electricity cables	<250m	No records
Gas pipelines	<250m	No records
Sites determined as Contaminated Land	<250m	No records
Control of Major Accident Hazards (COMAH)	<250m	No records
Regulated explosive sites	<250m	No records
Hazardous substance storage/usage	<250m	No records
Historical licensed industrial activities (IPC)	<250m	No records
Licenced industrial activities (Part A(1))	<250m	No records
Licensed pollutant release (Part A(2)/B)	<250m	22m N: Pennine Service Station. Process: Unloading of Petrol into Storage at Service Stations. Current Permit – Part B
Radioactive Substance Authorisations	<250m	No records
Licensed Discharges to controlled waters	<250m	No records
Pollutant release to surface waters (Red list)	<250m	No records
Pollutant release to public sewer	<250m	No records
List 1 Dangerous Substances	<250m	No records
List 2 Dangerous Substances	<250m	No records
Pollution Incidents (EA/NRW)	<250m	No records
Pollution inventory substances	<250m	No records
Pollution inventory waste transfers	<250m	No records
Pollution inventory radioactive waste	<250m	No records
WASTE AND LANDFILL		
Data	**Distance**	**Comments**

Active or recent landfill	<250m	No records
Historical landfill (BGS records)	<250m	No records
Historical landfill (LA/mapping records)	<250m	No records
Historical landfill (EA/NRW records)	<250m	135m E: Abbot Brow. Waste Type: Industrial, Commercial, Household 465m W: Land adjacent to A59. Waste Type: Inert
Historical waste sites	<250m	No records
Licensed waste sites	<250m	No records
Waste exemptions	<250m	115m NW: Causeway Farm [Using waste exemption] 125m NE: Lower Abbott House Farm [Using / Treating / Disposing of waste exemption] 342m S: Higher Brundhurst Farm [Using / Treating / Disposing of waste exemption] 393m NE: Grange Farm [Using / Disposing of waste exemption] 398m NW: N/A [Storing waste exemption] 440m E: Lower Abbott House Farm [Using / Treating / Disposing of waste exemption] 499m SE: Lower Westalot Farm [Storing waste exemption]

ENVIRONMENTAL DESIGNATIONS

Data	Distance	Comments
Sites of Special Scientific Interest (SSSI)	<500m	None
Conserved wetland sites (Ramsar sites)	<500m	None
Special Areas of Conservation (SAC)	<500m	None
Special Protection Areas (SPA)	<500m	None
National Nature Reserves (NNR)	<500m	None
Local Nature Reserves (LNR)	<500m	None
Designated Ancient Woodland	<500m	354m W: Mammon Wood [Ancient and Semi-Natural Woodland]
Biosphere Reserves	<500m	None
Forest Parks	<500m	None
Marine Conservation Zones	<500m	None
Green Belt	<500m	255m S: Merseyside and Greater Manchester [Ribble Valley]
Proposed Ramsar sites	<500m	None
Possible Special Areas of Conservation (PSAC)	<500m	None
Potential Special Protection Areas (pSPA)	<500m	None
Nitrate Sensitive Areas	<500m	None
Nitrate Vulnerable Zones	<500m	None

7.0 PREVIOUS SITE INVESTIGATIONS / REPORTS

Searches and consultations have established that no previous ground investigation works have been undertaken on this site.

8.0 PRELIMINARY QUALITATIVE RISK ASSESSMENT (TIER 1)

8.1 Introduction

Based on the foregoing study, there is a `*Low - Moderate*` potential for the presence of contamination associated with the historic land uses on the site and/or immediately adjoining the study site of the site, and previous land uses and hence a preliminary risk assessment was undertaken.

The risk assessment methodologies adopted by ***Integra Consulting*** are based on current available guidance from several sources and are included in Appendix 4.

The Tier 1 Risk Assessment and Preliminary Conceptual Model (PCM) were formulated using the information discussed above and based on the following assumptions:

- It is understood that the site is to be developed for commercial use by a series of steel framed commercial units. External works will include a new access road off the A59 Longsight Road, extensive paved areas for commercial parking at each unit, car parking bays at each unit, and some areas of communal landscaping.

  The existing and proposed layout are as illustrated on ***GA Studio*** architectural drawings contained herein.

- Drinking water will be from a mains supply.

In constructing the Preliminary Conceptual Model (PCM), ***Integra Consulting*** applied the guidance contained in CIRIA C552: 2001. This recommends use of a Risk Matrix which classifies risk based on the product of Probability of a source being present, and the Consequence of receptors being exposed to the source. Guidance tables setting out the classifications of probability and consequence together with a risk matrix are given in Tables 8 - 9 hereunder. In using this approach ***Integra Consulting*** recommends actual intrusive investigation of any Risk Classification of "*Moderate*" or over.

Table 8: Matrix of consequences against probability to gain a risk classification [CIRIA C552, 2001]

		CONSEQUENCE			
		SEVERE	MEDIUM	MILD	MINOR
Probability	High Likelihood	[redacted]	High Risk	Moderate Risk	Moderate / Low Risk
	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate / Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table 9: Classification Definitions (C552 CIRIA, 2001)

CLASSIFICATION	DEFINITION
[redacted]	There is a high probability that severe harm could arise to a designated receptor from an identified hazard. Or, there is evidence that server harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that such harm would be server, or if any harm were to occur it is more likely that harm would be relatively mild. Investigation (if not undertaken already) is normally required to clarify the risk and to determine to potential liability. Some remedial works may be required in the longer term.
Moderate / Low	
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be server.

8.2 Preliminary Conceptual Model

By application of the risk assessment methodology outlined above, the following PCM was constructed.

Table 10: Preliminary Conceptual Model (PCM)

POLLUTANT LINKAGE	SOURCE	PATHWAY	RECEPTOR	PROBABILITY	CONSEQUENCE	RISK RATING
1	Broad spectrum of heavy metals, aggressive pH, hydrocarbons, PAH`s in Made Ground associated with the in-filling of on-site unspecified pits etc	Soil and / or soil dust ingestion	Construction workers Future worker Offsite receptors	Likely	Medium	**Moderate**
2	Asbestos containing materials (ACM) in made ground soils associated with the in-filling of on-site unspecified pits etc	Fibre Inhalation	Construction workers Future worker Offsite receptors	Likely	Severe (ACM)	[redacted]
3	Inhalation of vapours associated with potential on-site made ground deposits, associated with the in-filling of on-site unspecified pits and on-site ponds	Inhalation	Future residents	Unlikely	Medium	**Moderate**
4	Inhalation of ground gases from onsite or offsite sources i.e. made ground deposits with the in-filling of on-site unspecified pits and on-site ponds etc.	Inhalation	Future residents	Unlikely	Medium	**Moderate**
5	pH & Sulphate attack on concrete	Future building	Future building	Likely	Mild	**Moderate / Low**
6	Organic contamination	Direct contact with water mains	Potable water supply	Unlikely	Medium	**Moderate**

The contaminants of concern associated with those risks which require intrusive investigation were researched by reference to published industry profiles, and are summarised hereunder:

Table 11: Summary of Contaminants of Concern based on PCM

LINKAGE NO.	METALS	NON-METALS	ORGANICS	GASES	OTHERS
PL1, PL2 PL5, PL6	Cd, Cr (total & hexavalent), Ni, Cu, Zn, Pb, Hg, Se, Mo, Sb	As, sulphates, sulphides, boron, free cyanide	TPHCWG, PAH's, BTEX, Volatiles (by PID), VOC's & SVOC's, SOM	-	pH Asbestos
PL3 & PL4	-	-	-	CH_4, CO_2, CO,	-

				H_2S	
PL1, PL6	-	-	TPHCWG, PAH's, BTEX, Volatiles (by PID)	-	-
PL1-PL6	Cd, Cr (total), Ni, Cu, Zn, Pb, Hg, Se, Mo, Sb	As, sulphates, sulphides, boron, free cyanide	TPHCWG, BTEX PAH's, Volatiles (by PID), SOM	CH_4, CO_2, CO, H_2S	pH Asbestos

8.3 Summary of Risks

The foregoing analysis has identified a significant number of potential risks, and if present, these could adversely impact on human or environmental receptors, and since no previous site investigation has been undertaken, an intrusive phase of investigation is recommended to determine whether the postulated pollutant linkages are present on site.

9.0 AIMS AND PROPOSED SCOPE OF PHASE II INTRUSIVE INVESTIGATION

Based on the findings above, it is recommended that an intrusive investigation be undertaken. The Phase II Intrusive Investigation should include for exploratory holes to be sunk through made ground into the underlying natural strata.

The primary objectives of a ground investigations are to obtain enough data to reliably ascertain ground conditions on site, and to aid confirmation of the potential pollution linkages identified within the Preliminary Conceptual Model above. Sufficient soil and groundwater/soil leachate contamination data should be obtained to reliably allow the Preliminary Conceptual Model to be tested and refined by the performance of a quantitative risk assessment.

Using the guidance contained in BS10175: 2011 and R&D Technical Report P5-0066/TR: 2000 and given the nature of the and loads imposed, it is proposed that 12nr boreholes be sunk using light dynamic sampling methods to a notional depth of c.5mbgl, or to refusal in rock head, whichever is the lesser.

Given the potential for the presence of underlying made ground deposits of an unknown thickness - composition, and given the nature of the development, it is recommended that 5nr light dynamic sampling boreholes be utilised for the installation of standpipes, thus enabling a programme of ground gas monitoring to be undertaken. To comply with CIRIA C665 for a *"Moderate"* risk site, it is proposed that gas monitoring is undertaken as a minimum on 4nr occasions, distributed over a period of 1-month.

It is further proposed that a series of mechanically excavated trial pits (c.10nr) be undertaken to a notional depth of c. 2.5mbgl within the site to assess the shallow ground conditions.

The prime objective of any intrusive ground investigation is to provide reliable soil / groundwater, or soil leachate, contamination data and to assess the potential risk to human health and sensitive environmental receptors.

The proposed scope of works is summarised in Table 12 hereunder:

Table 12: Proposed Scope of Works

RISK	METHOD OF ASSESSMENT
Is the superficial ground impacted by contamination to the extent it may present a risk to human health?	Using the guidance contained in BS10175: 2011 and R&D Technical Report P5-0066/TR: 2000 and given the nature of the and loads imposed, it is proposed that 12nr boreholes be sunk using light dynamic sampling methods to a notional depth of c.5mbgl, or to refusal in rock head, whichever is the lesser. It is further proposed that a series of mechanically excavated trial pits be undertaken to a notional depth of c. 2.5mbgl within the site to assess the shallow ground conditions.
What are the geotechnical properties of the ground?	Broad spectrum contamination analyses will be performed on selective subsamples of recovered made ground (11nr analyses) to suite in Table 11 Standard Penetration Test's (SPT's) to be carried out at regular depth increments throughout the boreholes, with HSV tests to be carried out in cohesive strata on recovered soils. A programme of soil engineering laboratory testing will be carried out. The *in-situ* tests and soil engineering test data will be used in formulating suitable foundation solutions.
Is the site affected by migrating gas from made ground deposits?	The evidence of the desk study is that there is a low – moderate risk of the site being contaminated by ground gases and therefore 3nr boreholes will be utilised for the installation of gas / groundwater monitoring standpipes. CIRIA C665 recommends monitoring on 4nr occasions distributed over a period of 1-month.
Does the site pose a risk to the underlying aquifer	Soil water samples will be recovered from the standpipes and will be analysed to the suite proposed in Table 11. In the event that water does not accumulate in the standpipes, soil leachate analyses will be undertaken to the suite in Table 7.

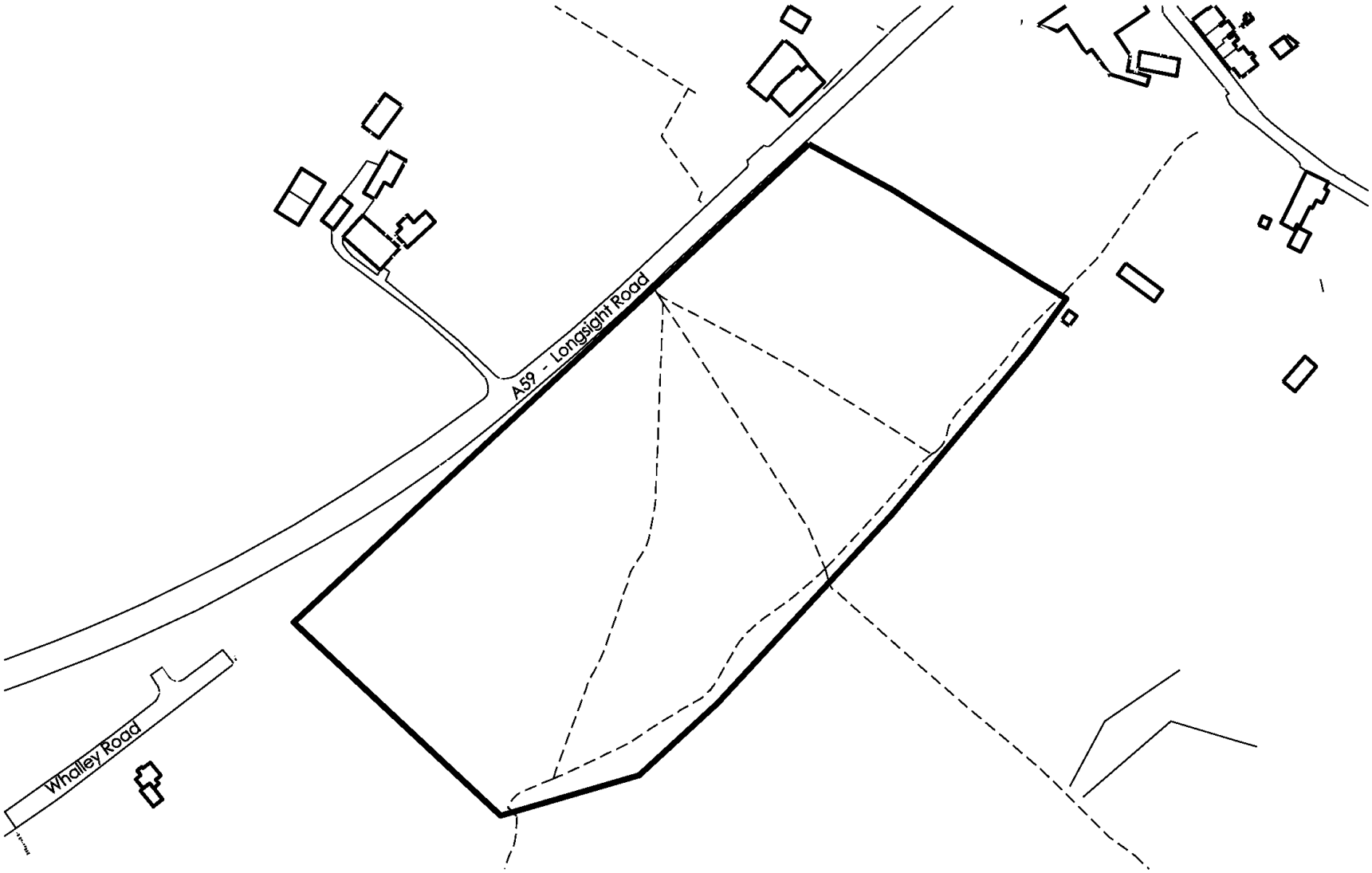
The results will be assessed against Drinking Water Standards and Environmental Quality Standards.

The layout of the proposed intrusive investigation is as annotated on ***GA Studio*** Drawing No. 22-03-L(-1) 002 *'Illustrative Masterplan'* contained herein.

Given that the site is to be redeveloped for commercial land use with associated soft landscaping, contamination data obtained as part of the above recommended Phase II intrusive investigation will be based on criteria contained in publication LQM/CIEH S4UL`s for Human Health Risk Assessment (2015) (***CCG*** Licence No. S4UL3233), applicable to the "*Commercial*" land use scenario. Given this document does not provide criteria for Lead contaminants, it is proposed that Lead results are compared to the C4SL published by DEFRA SP1010 Development of Category 4 Screening Levels for '*Commercial Land*' use.

APPENDIX 1: DRAWINGS:

SITE LOCATION PLAN
AERIAL PLATE
ARCHITECTURAL DRAWINGS



ISSUE				
Rev	Description	By	Chk	Date

0M 20M 40M 60M 80M 100M 200M

Project	Land at Causeway Farm	Project No.	20-03
		Dwg. No.	L(-1)000
Title	Site Location Plan	Date	AUG 2022
		Scale	1/2500 @ A4

Rev.	00
By	RM
Chk.	MJG
App.	00

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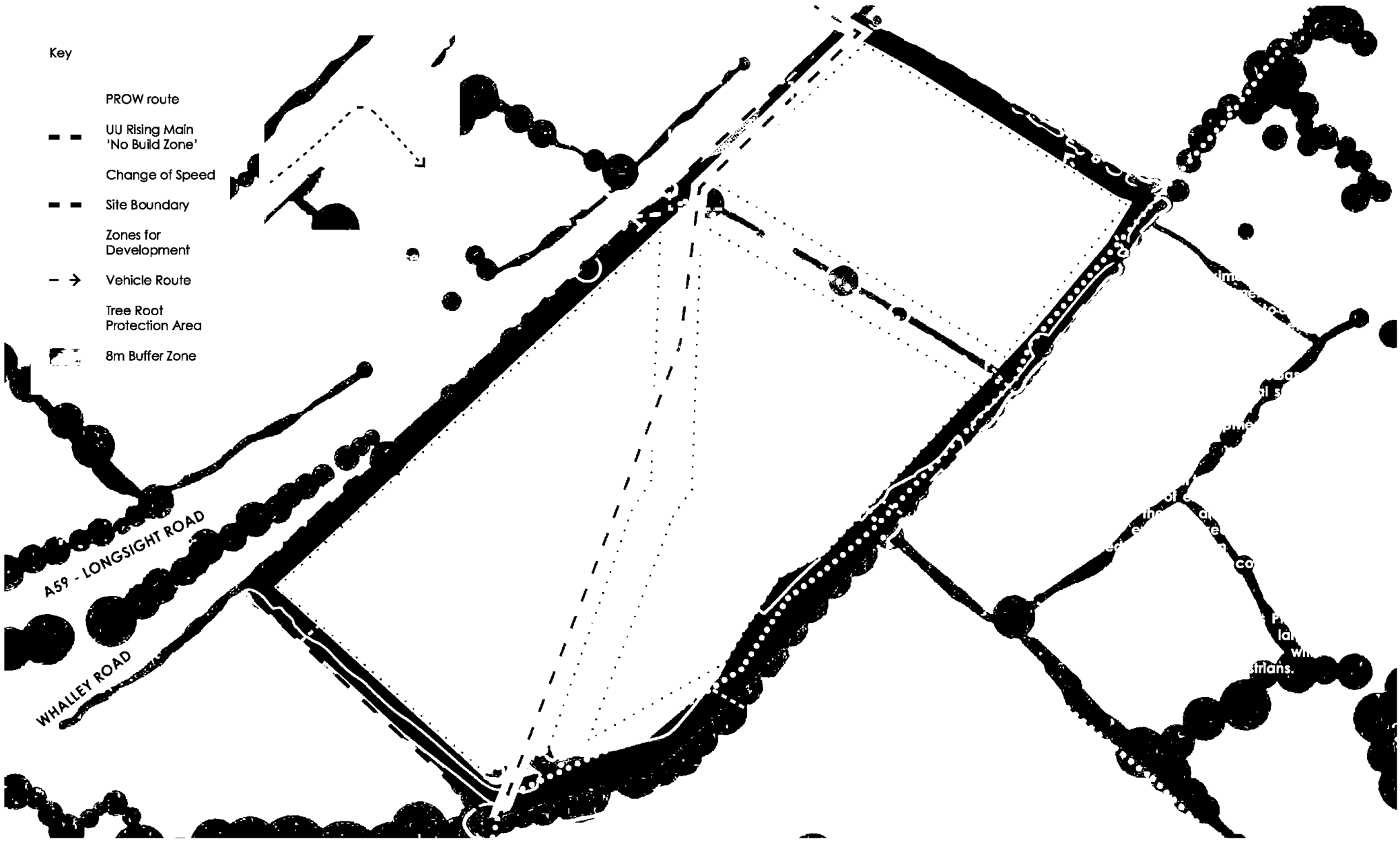

Rev	Description	By	Chk	Date
			FEASIBILITY	ISSUE
00	Issued for Client	RM	MJC	02.12.22

0M 10M 20M 30M 40M 50M 100M

N

Project	Land at Causeway Farm	Project No.	22.03	Rev.	00
		Dwg. No.	L(-1)002	By	RM
Title	Parameters Plan	Date	DEC 2022	Chk.	MJC
		Scale	1:1250 @ A3	App.	00

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Rev	Description	By	Chk	Date
		FEASIBILITY		ISSUE
01	Revised layout to increase overall development scale	RM	MJG	02.12.22
02	Updated Maximum Ridge Height	RM	MJG	06.02.23

Project	Land at Causeway Farm	Project No.	22.03
		Dwg. No.	L(-1)005
Title	Illustrative Masterplan	Date	DEC 2022
		Scale	1:1250 @ A3

Rev.	02
By	RM
Chk.	MJG
App.	00

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tel. 0161 835 3535
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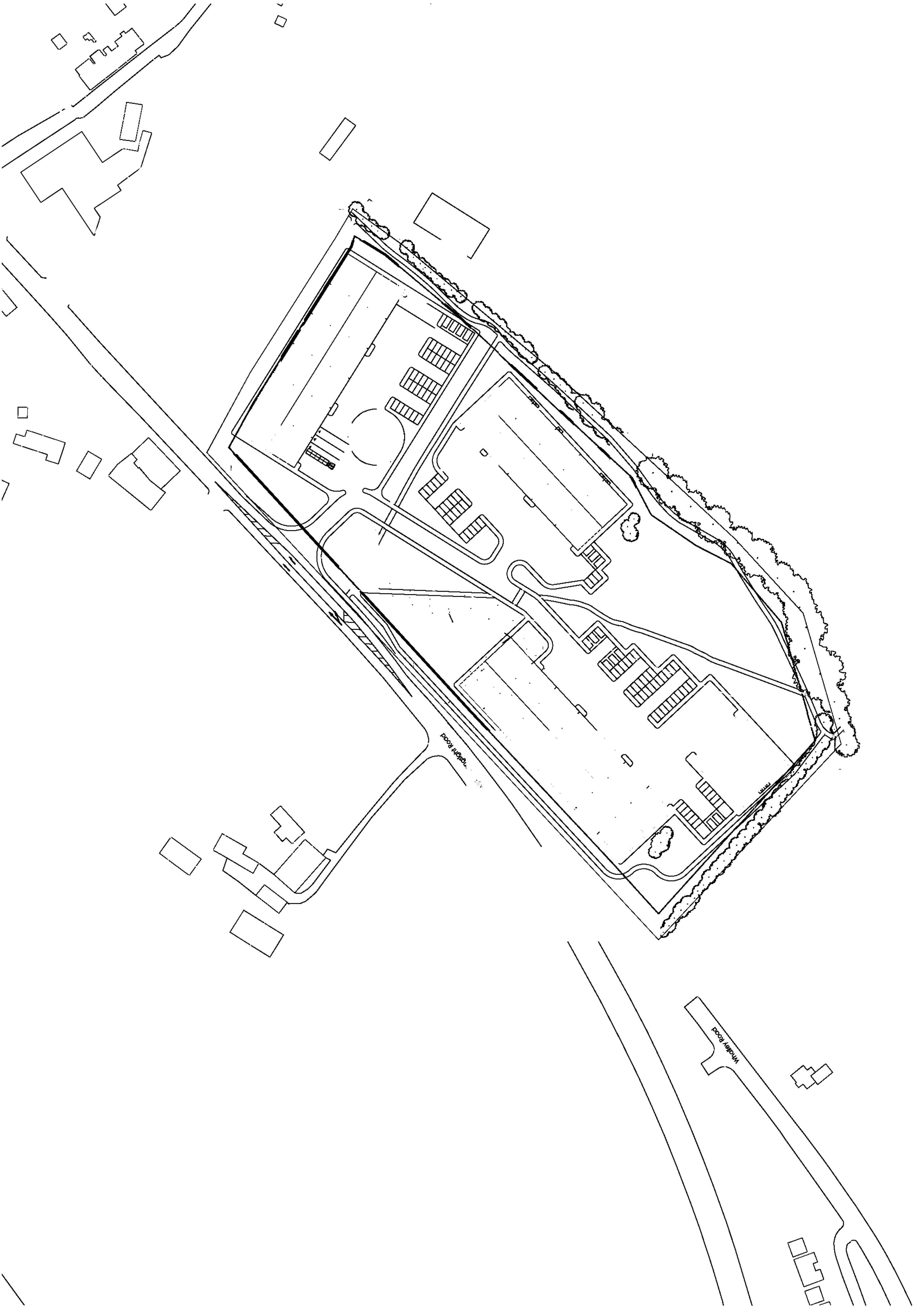
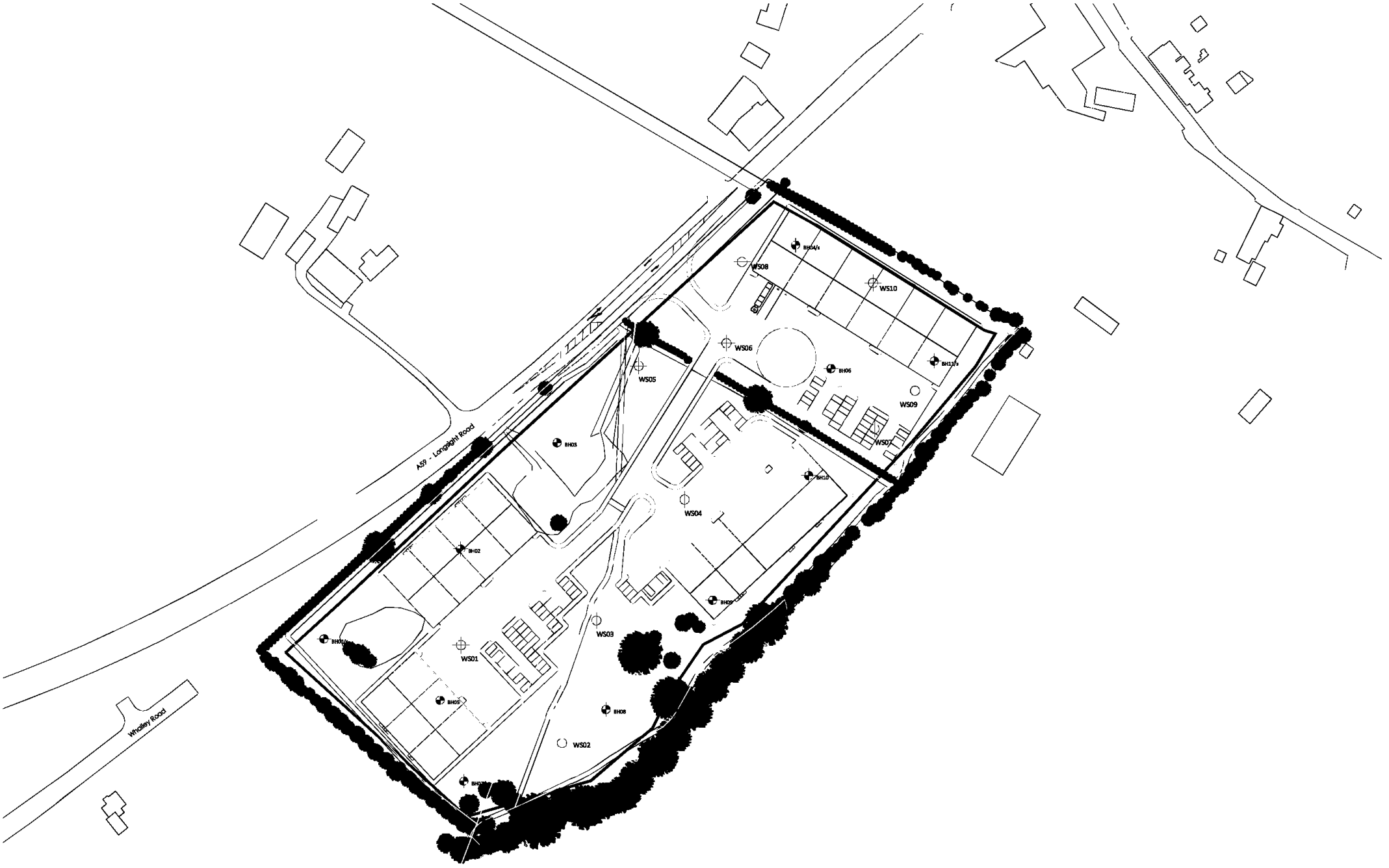


Whalley Road


A59 - Longsight Road
Whalley Road
BH01
BH02
BH03
BH04
BH05
BH06
BH07
BH08
BH09
BH10
BH11
BH12
WS01
WS02
WS03
WS04
WS05
WS06
WS07
WS08
WS09
WS10

APPENDIX 2: NOTES ON LIMITATIONS

Standard Terms and Conditions of Engagement
Notes on Limitations
For: Geoenvironmental and Geotechnical Consultancy Services

General
INTEGRA CONSULTING has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from ***INTEGRA CONSULTING*** and a charge may be levied against such approval.

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- The consequences of this document being used for any purpose or project other than for which it was commissioned and/or

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Phase I Environmental Audits / Desk Studies

The work undertaken to provide the basis of a Phase 1 Desk Study report comprises a study of available documented information from a variety of sources (including the client), together with (where appropriate) a walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in a Desk Study report have been dictated by finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in the report, ***INTEGRA CONSULTING*** reserves the right to review such information and to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental Audits

The investigation of the site has been carried out with the intention of providing enough information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated to potential human targets, building materials, the environment (including adjacent land), and surface and groundwater.

The amount of exploratory work and chemical testing undertaken may have been restricted by the timescale available, and the locations of the exploratory holes may have been restricted to areas unoccupied by the building(s) on the site, and further restricted by the existence of buried services. A more comprehensive investigation may be required if the site is to be redeveloped as, in addition to risk assessment, several important engineering and environmental issues may need to be resolved.

For those reasons, if costs have been included in relation to site remediation these must be considered as tentative only and must, in any event, be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken, investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of site conditions. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised "hotspots" of contamination where concentrations may be significantly higher than those encountered.

Geoenvironmental Ground Investigations

The investigation of the site has been carried out to provide sufficient information within the agreed scope of the investigation, under the general headings of type and degree of contamination, geotechnical characteristics, and ground and groundwater conditions, to provide a reasonable assessment of the environmental risks together with engineering and development implications.

If costs have been included in relation to the site remediation, these must be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken, investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of the site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site of each of the exploratory holes. There may be ground conditions present on the sites which have not been disclosed by this investigation, and which have therefore not been considered in this report.

The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that groundwater levels will vary owing to seasonal, tidal, weather, or other effects.
The risk assessment and opinions provided, inter alia, take into consideration currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

APPENDIX 3: CURRENT CONTAMINATED LAND GUIDANCE / LEGISLATION & RISK ASSESSMENT METHODOLOGIES

LEGISLATION OVERVIEW

This report includes hazard identification and risk assessment in line with the risk-based methods referred to in relevant UK legislation and guidance. Government environmental policy is based upon a "suitable for use approach". When considering the current use of land, Part IIA of the Environment Protection Act 1990 (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995, which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment given the current use and circumstances of the land.

Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

"any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

Significant harm is being caused or there is a significant possibility of such harm being caused;
or
Pollution of controlled waters is being, or is likely to be, caused."

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

"the entry into controlled waters of **any** poisonous, noxious or polluting matter or **any** solid waste matter".

In order to assist in establishing if there is a "significant possibility of significant harm" there must be a "significant pollutant linkage" for potential harm to exist. That means there must be a source(s) of contamination, sensitive receptors present and a connection or pathway between the two. This combination of source-pathway-receptor is termed a "pollutant linkage or SPR linkage."

Part IIA of The Environmental Protection Act 1990 is supported by a substantial quantity of guidance and other Regulations, especially DEFRA Circular 01/2006 Contaminated Land (this replaces DETR Circular 02/2000). Part IIA defines the duties of Local Authorities in dealing with it. Except for situations of very high pollution risk, Part IIA places contaminated land responsibility on thee planning and redevelopment process. In situations where there is very high pollution risk direct action from the Local Authority is usually necessary. Planning Policy Statement 23 (PPS23) provides guidance on the planning process and requires that sites which have been developed shall not be capable of being determined "contaminated land" under Part IIA.

The criteria for assessing levels of pollutants and hence determining whether a site represents a hazard are based on a range of techniques, models and guidance. Within this context it is relevant to note that Government objectives are:

(a) to identify and remove unacceptable risks to human health and the environment;
(b) to seek to bring damaged land back into beneficial use;
(c) to seek to ensure that the cost burdens faced by individuals, companies and society are proportionate, manageable and economically sustainable.

These three objectives underlie the "suitable for use" approach to remediation of contaminated land. The "suitable for use" approach focuses on the risks caused by land contamination. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Risks therefore should be assessed on a site-by-site basis.

The "suitable for use" approach then consists of three elements:

(a) ensuring that land is suitable for its current use - in other words, identifying any land where contamination is causing unacceptable risks to human health and the environment, assessed on the basis of the current use and circumstances of the land, and returning such land to a condition where such risks no longer arise; the contaminated land regime provides the regulatory mechanisms to achieve this;

(b) ensuring that land is made suitable for any new use, as planning permission is given for that new use - in other words, assessing the potential risks from contamination, on the basis of the proposed future use and circumstances, before official permission is given for the development and, where necessary to avoid unacceptable risks to human health and the environment, remediating the land before the new use commences; this is the role of the town and country planning and building control regimes; and

(c) limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought - in other words, recognising that the risks from contaminated land can be satisfactory assessed only in the context of specific uses of the land (whether current or proposed), and that any attempt to guess what might be needed at some time in the future for other uses is likely to result either in premature work (thereby running the risk of distorting social, economic and environmental priorities) or in unnecessary work (thereby wasting resources).

The mere presence of pollutants does not therefore necessarily warrant action, and consideration must be given to the scale of risk

involved for the current and proposed end use of the site.

RISK ASSESSMENT METHODOLOGY

Current practice recommends that the determination of potential liabilities that could arise from land contamination be carried out using the process of risk assessment, whereby "risk" is defined as:

"(a) The probability, or frequency, or occurrence of a defined hazard; and
(b) The magnitude (including the seriousness) of the consequences."

The UK's approach to the assessment of environmental risk is set out in by the Department of the Environment (2000) publication "A Guide to Risk Assessment and Risk Management for Environmental Protection." This established an iterative, systematic staged process which comprises:

(a) Hazard identification
(b) Hazard assessment
(c) Risk estimation
(d) Risk evaluation
(e) Risk Assessment

At each stage during the investigation process the above steps are repeated as more detailed information becomes available for the site.

CLR11- 'Model Procedures for the Management of Land Contamination', a document published by the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) outlines a tiered approach to the assessment of risks posed by contaminated land, as summarised hereunder:

Tier 1: Preliminary Risk Assessment

A Preliminary Risk Assessment is usually undertaken as part of a desk study, outlines potential risks posed by potential contamination to all receptors by defining plausible "pollution linkages" and developing a preliminary conceptual model (PCM). The purpose of this model is to define all possible complete pollution linkages, where the requisite source – pathway – target elements are present, and these elements being defined as:

- a contaminant (source) is a hazardous substance or agent, present at levels that have the potential to cause harm or damage a receptor
- a pathway is the means by or through which a contaminant meets, or otherwise affects, the receptor
- a receptor (target) is an entity (human being, aquatic environment, flora and fauna etc) that is vulnerable to the adverse effects of the contaminant

This relationship is termed a "pollution linkage". It should be recognised that for a health or environmental risk to exist, all three elements of the relationship or linkage must be present, i.e.

- if there is no contaminant, or contaminant present at levels below those considered to be harmful or damaging to a receptor, then there can be no adverse effect on a receptor
- if there is no receptor present that can be adversely affected by a contaminant, no harm or damage can arise
- even where both a contaminant and a receptor are present, no harm or damage will occur if there is no pathway by or through which a linkage between the two can be established

The absence of one or more of each component (source, pathway, receptor) would prevent a pollutant linkage being established and there would be no significant environmental risk.

The PCM is subject to continual refinement as additional data becomes available. As part of a Phase I Investigation (Desk Study and site walk over) a PCM is formed. Based on the PCM, potential pollutant linkages can be assessed. If the PCM and hazard assessment indicate that a pollution linkage is not of significance, then no further assessment or action is required due to this linkage. For each significant and possible linkage, a risk assessment is carried out. The linkages which potentially pose significant risks may require a variety of responses ranging from immediate remedial action or risk management or, more commonly, further investigation and risk assessment. This next stage is usually termed a Phase II Main Site Investigation and should provide additional data to allow refinement of the PCM and assess the level of risk from each pollutant linkage. Risk assessment will usually include Tier 2 Generic Quantitative Risk Assessment and / or, if necessary, a Tier 3 Detailed Quantitative Risk Assessment.

Tier 2: Generic Quantitative Risk Assessment (GQRA)

GQRA requires an intrusive investigation in order to characterise the site assisting in the re-assessment of the source-pathway receptor linkage. The conceptual model should be refined accordingly.

Upon completion of an intrusive investigation it must be decided whether Generic Assessment Criteria (GAC) are suitable for assessing the risk posed by potential contamination at the site. If GAC are deemed unacceptable for risk assessment purposes or cannot be developed a Tier 3 Detailed Quantitative Risk Assessment (DQRA) is required.

If GQRA reveals that unacceptable risks are not present, then no further action is required. If GQRA identifies a possibility of risk, a decision must be made whether further work is required or necessary for the purposes of risk assessment. If further risk assessment is deemed not suitable not required, an Options Appraisal should be undertaken. If further risk assessment is required, the scope nature of further risk assessment must be decided – it is possible that a Tier 3 DQRA will be undertaken in this scenario.

Tier 3: Detailed Quantitative Risk Assessment (DQRA)
DQRA is used when pollutant linkages require further assessment. DQRA is often undertaken for pollutant linkages where GAC are unavailable or inappropriate for or more conservative than the actual circumstances of the site. Site specific data is used to create Site Specific Assessment Criteria (SSAC) and enable a more accurate assessment of the risks. Further investigation may or may not be required to formulate SSAC depending on the site-specific conditions and information already obtained.

If DQRA reveals that unacceptable risks are not present, then no further action is required. If DQRA identifies a possibility of risk, a decision must be made whether further work is required or necessary for the purposes of risk assessment. If further risk assessment is deemed not suitable not required, an Options Appraisal should be undertaken. If further risk assessment is required, the scope and nature of further risk assessment must be decided at this point.

NOTE: A Tier 1 Preliminary Risk Assessment is undertaken as part of a Desk Study Report and a Preliminary Conceptual Model is developed for all pollutant linkages. However, the methodologies for assessing the risks to human health, risks to controlled waters and risk posed by ground gas using quantitative techniques vary considerably, therefore GQRA and DQRA for human health, controlled waters and ground gas must be undertaken separately. The risk assessment methodologies where quantitative assessment is used for risks to human health, risks to controlled waters and risks posed by ground gas, if relevant, are described hereunder.

BACKGROUND INFORMATION, CURRENT GUIDANCE AND RISK ASSESSMENT METHODOLOGY FOR RISKS POSED TO HUMAN HEALTH

Background
In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the EA published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. These reports (CLR7-10) together with associated "SGV" documents have since been withdrawn (August 2008) and the following documents have been published as revised guidance to the CLEA assessment:

Environment Agency : 2008: Updated Technical Background to the CLEA model Science Report SC050021/SR3
Environment Agency : 2008: Human Health Toxicological Assessment of Contaminants in Soil SC050021/SR2

Additional guidance on statistical assessment replacing CLR 7 is provided in:

CL:AIRE :2008 Guidance on Comparing Data with a Critical Concentration

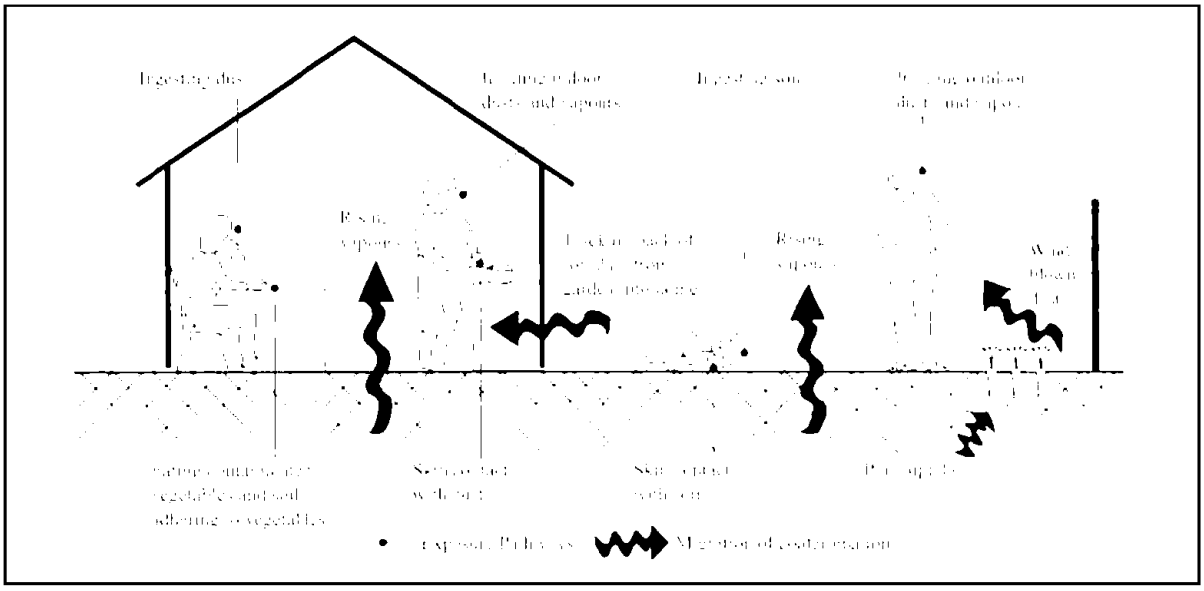
Other guidance/software used in spatial / statistical assessment is provided in:

USEPA 2006: Data Quality Assessment: Statistical Methods for Practitioners
Spatial Analysis and Decision Assistance (SADA) – The University of Tennessee

A different approach to the statistical appraisal of data is required depending on whether the assessment of risk is to assess whether land is Contaminated Land in accordance with regulations, or whether the assessment is to determine whether the site is suitable for new development in according with Planning guidance. This is discussed further in CL:AIRE :2008 "Guidance on Comparing Data with a Critical Concentration".

A program for the derivation of GAC`s based on the above guidance is provided by the Environment Agency and is entitled "CLEA Software Version 1.04".

The CLEA model has been developed to calculate an estimated tolerable daily soil intake (TDSI) for site users given a set 'default' exposure pathway. Ten human exposure pathways are covered in the CLEA model as presented below:



Ingestion
ingestion of outdoor soil
ingestion of indoor dust
ingestion of home grown produce
ingestion of soil attached to home grown produce

Dermal Contact
dermal contact with outdoor soil
dermal contact with indoor dust

Inhalation
inhalation of outdoor dust
inhalation of indoor dust
inhalation of outdoor soil vapour
inhalation of indoor soil vapour

It should be noted that there are other potential exposure pathways on some sites not included in the CLEA model e.g. certain organic compounds can pass through plastic water pipes into drinking water supply.

Where contaminated water is present at a depth less than 2.00mbgl and there is a potential risk of inhalation of vapours (only when volatile compounds are present) the risk from inhalation of vapours from soil water will be assessed using a UK compliant version of BP Risc v4.02.

The presence and/or significance of each of the above exposure pathways are dependent on the type of land use being considered and the nature of the contaminant under scrutiny. Accordingly, the CLEA model considers for principal 'default' land use types and makes a series of 'default' assumptions about human exposure frequency, duration and critical human target groups for each land use considered:

residential
allotments
commercial / industrial land use

The above land use categories defined in the CLEA are detailed below:

Residential: This generic scenario assumes a typical residential property consisting of a two-storey house built on a ground-bearing slab with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden area.

Allotments: This generic scenario assumes a plot of open space (about 250 m2), commonly made available by the local authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than a hectare. The tenants are assumed to be parents or grandparents and that young children make occasional

accompanied visits to the plot.

Commercial/Industrial: There are many kinds of workplace and work-related activities. This generic scenario assumes a typical commercial or light industrial property consisting of a three-storey building at which employees spend most time indoors and are involved in office based or relatively light physical work.

Human Health Risk Assessment Methodology
Assessment of risk for the protection of human health is undertaken using the methodology as outlined previously, and summarised hereunder:

Tier 1 Preliminary Risk Assessment
Tier 2 Generic Quantitative Risk Assessment
Tier 3 Detailed Quantitative Risk Assessment

The Tier 1 Preliminary Risk Assessment is undertaken as part of the desk study report and includes the development of a Preliminary Conceptual Model. Tier 2 and Tier 3 Quantitative Risk Assessments are undertaken in order to develop and refine the Preliminary Conceptual Model aiding a more detailed assessment of the risk posed by contaminants revealed by site investigation and soil / soil water chemical analyses.

The methods used by INTEGRA CONSULTING to derive assessment criteria, to statistically analyse chemical data and to compare chemical data to the derived assessment criteria are discussed hereunder.

Derivation of Generic Assessment Criteria (GAC) and Site-Specific Assessment Criteria (SSAC)
GAC`s are derived based on the proposed land use and the associated applicable exposure pathways. It should be noted that there are difficulties in establishing soil concentrations of contaminants beyond which risks from exposure to these contaminants would be 'unacceptable' and the GAC value does not necessarily equate to the level for "significant possibility of significant harm" as defined in Part IIA of The Environmental Protection Act (1990) to determine whether land is "contaminated." This ultimately requires detailed 'toxicological' information of the health effects of individual contaminants and a scientific judgement on what constitutes an 'unacceptable' risk. The primary purpose of the CLEA derived GAC's are as 'minimal risk thresholds' for the assessment of human health risks in relation to land use.

Minimal risk thresholds calculated using generic input parameters for each of the above land uses are termed Generic Assessment Criteria (GAC) and are used for Generic Quantitative Risk Assessment (GQRA). However, further assessment may be required taking into consideration site specific factors such as the way the land is used, the soil type, the building characteristics and the exact nature of the receptor, to determine whether there is a significant possibility of risk to human health to site users. Such an assessment is known as a Detailed Quantitative Risk Assessment (DQRA) and the resultant threshold concentrations are known as Site Specific Assessment Criteria (SSAC). Such assessments should be conducted with the agreement of the local authority (or the Environment Agency) since it is the authority that determines whether land is Contaminated Land or whether Planning Permission for a new development may be granted.

For the purposes of this report, assessment criteria have been derived in accordance with current guidance based on the conceptual model for the proposed land use using the CLEA v1.04 software. These criteria are not intended to indicate whether the site may be contaminated land, nor do they replace any published soil guideline values. However, the values are intended to provide guidance for the local authority on whether the site may be considered uncontaminated. If, based on the site's proposed future use, the site would be considered by the local authority to be uncontaminated and therefore, on the basis of soil concentrations, fit for purpose, then no further risk assessment based on soil concentrations and the risk to human health would be necessary. However, should these criteria be exceeded, or the conceptual site model vary from the model used in the risk assessment to derive these values then the risk assessment should be updated accordingly.

For contaminants routinely analysed where inhalation is a significant pathway (naphthalene, phenanthrene, Aromatic EC5-EC7, Aromatic EC7-EC8, Aromatic EC8-EC10, Aromatic EC10-EC12, Aromatic EC12-EC16, Aliphatic EC5-EC6, Aliphatic EC8_EC10, Aliphatic EC10-EC12, Aliphatic EC12-EC16), plots of the GAC as a function of Soil Organic Matter (SOM) are used to determine if they pose a potential risk to human health, which are presented hereunder. Where there is an exceedance further assessment may be undertaken.

Statistical Assessment of Soil Contamination Data & Comparison of Contamination Data to Threshold Values
In any site investigation only a small fraction of the soil on the site is analysed. Therefore, the mean derived from the contamination data for a contaminant may not be the same as the true mean for the contaminant distribution on the site. To improve the reliability of any assessment a statistical analysis is undertaken in line with the CL:AIRE document "Guidance on Comparing Soil Contamination Data with a Critical Concentration".

Statistical assessment of soil data is undertaken using programs based on the guidance in the CL:AIRE document or the USEPA software ProUCL v4.0.

Where the number of results in a dataset is less than four, a statistical assessment is not undertaken, and the assessment is performed by comparison of the maximum value(s) with a Health Criteria Value (HCV), such as Generic Assessment Criteria value(s).

For the Planning situation, the regulator needs to check whether the concentration of contaminants is low compared to the HCV. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is lower than the HCV.

For the Part IIA scenario the regulator needs to determine whether the concentration of contaminants is greater than the HCV. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is higher than the HCV. However, the regulator may proceed with determination if there is just a 51% probability, "on the balance of probabilities".

The Outlier Test used in the statistical assessment may not be able identify separate populations if numerous populations are present. In order to ensure that this is not the case a spatial assessment of the data will be undertaken using SADA.

If the screening levels are exceeded, then more sophisticated quantitative risk assessment or remedial action may be undertaken. The benefits of undertaking a quantitative risk assessment must be weighed against the likelihood that it will bring about cost savings in the proposed remediation.

BACKGROUND INFORMATION, CURRENT GUIDANCE AND RISK ASSESSMENT METHODOLOGY FOR RISKS POSED TO CONTROLLED WATER

Definition of Controlled Waters
The term 'controlled waters' is defined in Section 104 of the Water Resources Act 1991 as:

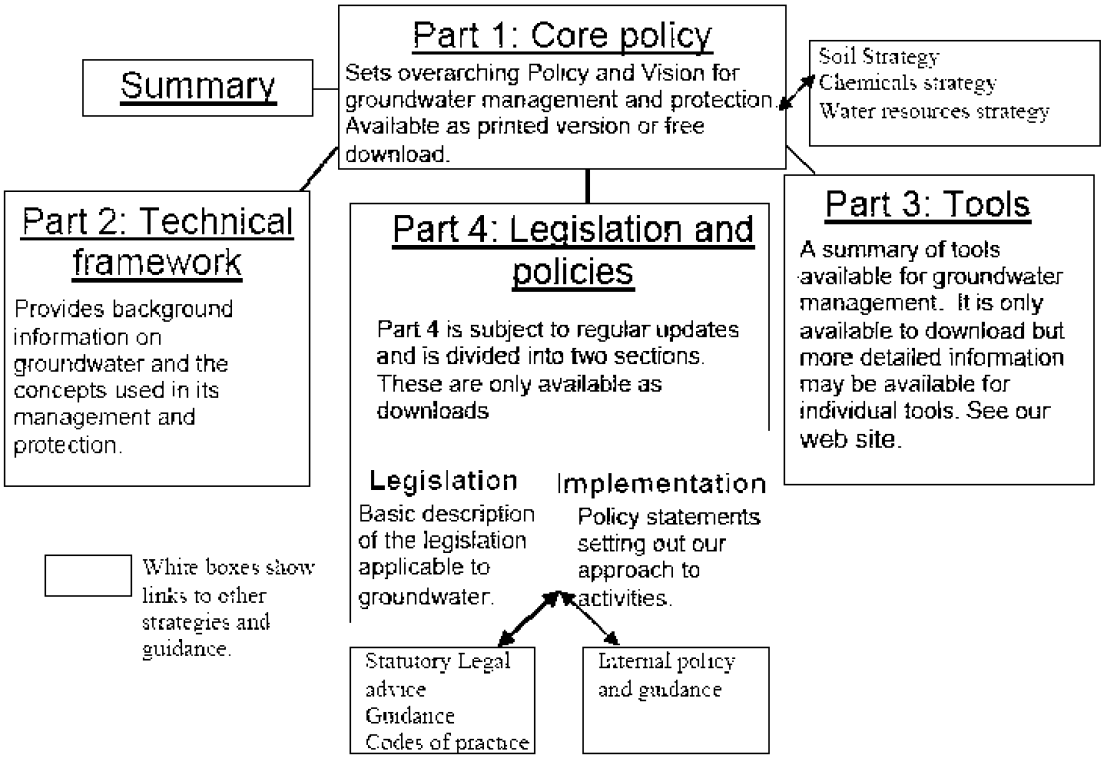
"Territorial Waters...which extend seawards for three miles..., coastal waters..., inland freshwaters, waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and ground waters, that is to say, any waters contained in underground strata."

Note that the definition of groundwater under the Water Resources Act 1991 includes all water within underground strata (including soil / pore water in the unsaturated zone). The definition of groundwater under the Groundwater Directive however is limited to water in the saturated zone. For the purposes of Part IIA of the Environmental Protection Act 1990, the Environment Agency recommends that the groundwater within the saturated zone only is considered as the receptor (rather than soil / pore water).

Environment Agency Guidance
Legislation and guidance surrounding the protection of controlled waters in the UK is abundant and can be complex. The Environment Agency's overall position on groundwater is "To protect and manage groundwater resources for present and future generation in ways that are appropriate for the risks that we identify" (Groundwater Protection : Policy and Practice GP3, 2006). In brief, the core objectives of the existing legislation serve to enforce this position.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document was influential as it provided a focus for key developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was then revised in 1998, since which there have been substantial changes in legislation, driven by Europe. Key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991. Further to legislative changes, gaps identified in the 1998 PPPG required addressing. These changes are reflected in the forthcoming Environment Agency Policy document entitled Groundwater Protection : Policy and Practice (GP3), a draft version of which was available for public consultation (Parts 1 to 3) ending July 2006 with Part 4 issued in March 2008. Part 4 includes a section on key groundwater legislation and the Environment Agency's interpretation of it.

The following gives a breakdown of the structure of the document (taken from the Environment Agency GP3 draft consultation document, 2006)



Controlled Water Risk Assessment Methodology

The risk posed to controlled water is assessed by INTEGRA CONSULTING in accordance with current guidance as outlined hereunder.

In order for a developer of a potentially contaminated site to fulfil their obligations under the legislation, a site assessment would be required to be undertaken in order to identify any potential risks to controlled waters and to derive suitable clean-up criteria if necessary to ensure the protection of controlled waters. The general approach for Groundwater Protection is detailed further in Part 3 of GP3.

When assessing groundwater impact the Environment Agency advocate the application of their framework methodology "Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination" Environment Agency (2006). The methodology has four levels of assessment as described below:

Level 1 considers whether contaminant concentrations in "pore water" in contaminated soil are enough to impact on the receptor, ignoring dilution, dispersion and attenuation along the pathway. The "pore water" concentration is determined from:
measured "pore water" concentrations or perched water quality
ii) soil leaching tests
iii) theoretical calculations based on soil/water partitioning equations

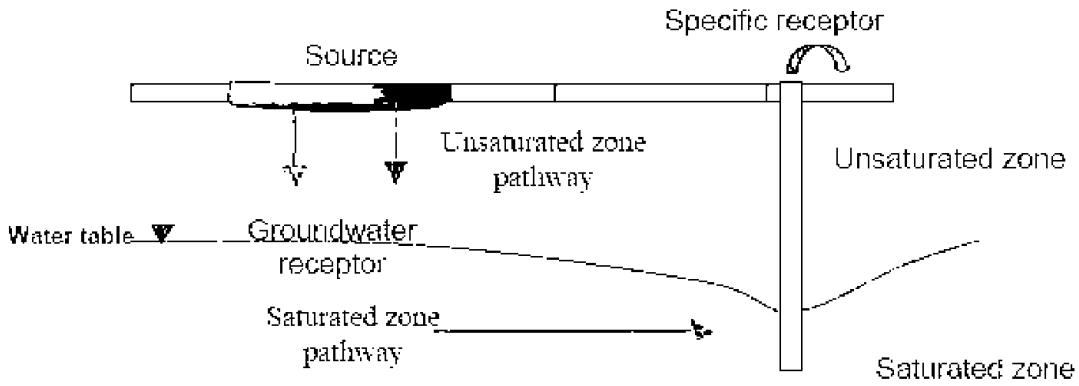
Level 2 considers dilution by the receiving groundwater or surface water body and whether this is enough to reduce contaminant concentrations to acceptable levels. The remedial target is defined as the target concentration multiplied by a dilution factor (DF).

Levels 3 and 4 consider whether natural attenuation (including dispersion, retardation and degradation) of the contaminant as it moves through the unsaturated and saturated zones to the receptor are enough to reduce contaminant concentrations to acceptable levels. The remedial target is defined as target concentration multiplied by a dilution factor (DF) and attenuation factor (AF). In Level 3 simple analytical models are used to calculate the significance of attenuation. The Environment Agency has released a "Remedial targets worksheet v3.1" to carry out basic calculations using a conservative approach up to Level 3 using basic principles assuming a simple migration of contaminants from the source zone into the aquifer receptor. Level 4 assessment uses more sophisticated numerical models and allows for the introduction of additional geological horizons and is used mainly to determine whether soil contaminants will reach their target within a specified timeframe. Use of such software should only be used once agreement has been obtained from the Environment Agency.

Three main stages apply to any risk assessment of controlled waters, these are:

1. Risk Screening (Tier 1 Preliminary Risk Assessment): The understanding of the Conceptual Site Model (CSM) is the key to assessing any site. Using a robust CSM, potential pathways or receptors may be screened out from any further assessment at an

early stage. For example, if the pathway through the unsaturated zone is blocked by the presence of a significant thickness of low permeability clay. A greater understanding of the CSM is achieved with each tier of risk assessment. An example of a basic CSM is given below (taken from the Environment Agency GP3 draft consultation document, 2006):



2. Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Level 1): When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with screening criteria. Published values of screening criteria with which chemical test results can be compared are published in the following guidance:

Water Supply (Water Quality) Regulations 2000
The Private Water Supplies Regulations 1991
Environmental Quality Standards for surface waters based on The EC Dangerous Substances Directive (76/464/EEC and Daughter Directives)
The Surface Waters(Abstraction for Drinking Water Classification) Regulations 1996
World Health Organisation Drinking Water Standards 2004

Should the Level 1 assessment indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

To devise suitable remedial solutions
To carry out more investigation, sampling and analysis
To conduct a site specific Detailed Quantitative Risk Assessment (DQRA) to determine if the materials are suitable for their proposed use, or devise site specific clean-up level

3. Detailed Quantitative Risk Assessment (EA Remedial Targets Methodology Levels 2 to 4): The decision to carry out a DQRA will be dependant on the extent and implications of the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the previous levels of assessment. The conceptual model will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment, the remainder having been screened out.

Additional site-specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria, if derived, will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or compliance point. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

BACKGROUND INFORMATION, CURRENT GUIDANCE AND RISK ASSESSMENT METHODOLOGY FOR RISKS POSED BY GROUND GAS

Origin of Ground and Landfill Gases
When carrying out a ground gas risk assessment, the origin or source of the gases is important as potential risks will vary depending on the source. This Appendix relates to the risk of the two main ground gases of concern; methane and carbon dioxide and does not apply to other ground gases (e.g. radon or vapours from hydrocarbon spills). Methane and carbon dioxide are major constituents of landfill gas but can also occur from a variety of anthropogenic and natural sources, as summarised in Table 5 below:

Gas	Source	Comments
Landfill Gas	Anaerobic decomposition of degradable waste within landfill sites. Typically,	Composition varies over time, particularly in early stages

Gas	Source	Comments
	60% methane and 40% carbon dioxide during methanogenic phase.	Contains a range of minor constituents (particularl carbon monoxide and hydrogen sulphide).
Landfill Associated Gases	- Anaerobic degradation of leachate external to the site; - Degassing of dissolved gases in groundwater; - Evolution of gases following interaction between leachate and groundwater	Can result in secondary (external) production of methan or carbon dioxide.
Made Ground	Anaerobic degradation of organic components	Very variable depending on source
Sewer Gas, Cess Pits	Anaerobic degradation of organic components of sewage producing methane and carbon dioxide.	Often characterised by hydrogen sulphide odour.
Mains Gas	Leakage from underground pipework or storage tanks. Mainly methane but often contains higher alkanes.	An odourise is added to permit detection of leaks Typically, 90% CH4, but 1 to 27% C2-C4 alkanes, May als contain other trace gases e.g. CO, helium and CO2 (fron degradation of CH4 in the ground).
Other Anthropogenic Sources	- Degradation of leaked or spilled hydrocarbons or other industrial chemicals; - Anaerobic degradation of organic contaminants in groundwaters (e.g. silage liquor); - Reactions between monitoring well construction components and environment; - Burial grounds/cemeteries.	Hydrocarbon spillages often have an 'oily' odour. Fue spillages common – Petrol or Diesel and can contain wide range of VOC's. Can degrade to produce methane carbon dioxide.
Alluvium / Marsh / Peat Gas	Anaerobic microbial degradation of organic material (usually waterlogged vegetation / peat). Often associated with the presence of alluvial deposits or dredging's.	
Geogenic Gas	Natural seepages of carbon dioxide and hydrocarbon gases derived from geologic sources such as coal seams and deep oil / gas source formations. Can be present in solution in groundwaters.	Methane most common but can contain carbon dioxid and higher alkanes.
Mine Gases	Various types. Most common is "fire damp" with high methane, produced by the desorption of gas trapped in coal. "Black damp" (Scythe gas) with high carbon dioxide and denser than air. "White damp" is high in carbon monoxide.	Methane most common. Can contain higher alkanes carbon dioxide and carbon monoxide. Often low i oxygen.
Natural Shallow Ground Gas	Various types - high carbon dioxide formed by subsurface aerobic activity leading to depleted oxygen and elevated carbon dioxide; - chemical degradation of rocks (e.g. carbonates) producing carbon dioxide; - carbon dioxide production in root zone of soils by plants.	Gases can be emitted from ground under fallin barometric pressure conditions.

Table 5. Potential Sources of Ground Gases

This Appendix does not provide guidance for the assessment of risk when other gases are present due to 'Other Sources' from the above table (particularly organic compounds such as BTEX and VOC's or for the risk from radon or hydrogen sulphide).

To determine the origin of the gas a range of factors must be considered together, including;

1. Proximity of likely sources
2. Ground conditions (geology, hydrogeology, anthropogenic pathways etc)
3. Properties of gases present including:
    - Chemical composition
    - Physical properties
    - Ratios of components e.g. methane : carbon dioxide
4. Timeframe of activities such as infilling periods, capping works, installation of gas control systems etc

Identification of the originating source may be problematic given that there may be more than one source present and trace gas analysis may be required. Identification of the sources of the gases encountered during monitoring is usually carried out through a process of eliminating the most unlikely potential sources (given the site setting) and selecting those which are most likely.

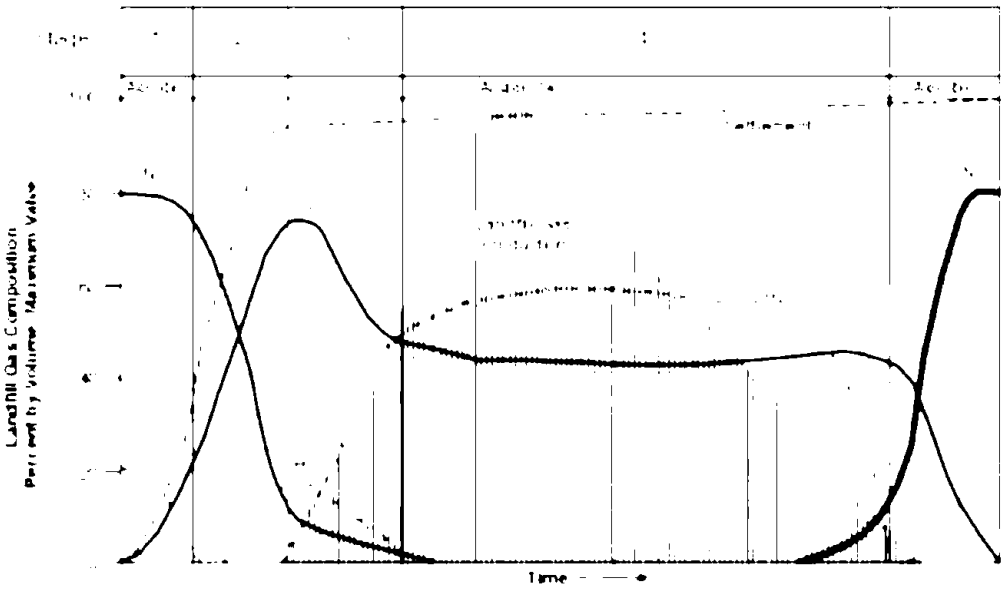
Hazards Associated with Presence of Methane

Methane gas is combustible and potentially explosive. When the concentration of methane in air is between the limits of 5.0%v/v and 15.0%v/v an explosive mixture is formed. The Lower Explosive Limit (LEL) of methane is 5.0%v/v, which is equivalent to 100% LEL. The 15.0%v/v limit is known as the Upper Explosive Limit (UEL), but concentrations above this level cannot be assumed to represent safe concentrations. Further, the LEL and UEL will vary (up and down) depending upon the proportion of other gases (including oxygen). However, the fact that methane is a colourless, odourless gas means that there is no simple indicator of the presence of the gas until such a time as explosive limits are reached, and an incident occurs. Methane is lighter than air and has a low toxicity. However, at high concentrations it can result in asphyxiation due to oxygen displacement.

Hazards Associated with Presence of Carbon Dioxide

Carbon dioxide is a colourless, odourless gas, which, although non-flammable, is both toxic and an asphyxiant. As carbon dioxide is denser than air, it will collect in low points and depressions. The UK Health & Safety Executive (HSE) has published information relating to concentrations of carbon dioxide that humans may be exposed to, which uses concentrations contained in the Control of Substances Hazardous to Health Regulations 2002 (as amended). These are the Long-Term Occupational Exposure Limit (LTOEL, 8-hour period) and the Short-Term Occupational Exposure Limit (STOEL, 15-minute period), which are 0.5% and 1.5% carbon dioxide, respectively.

Parameters Influencing the Rate of Ground Gas Production
The figure below is taken from EA guidance document LFTGN 03 illustrates typical ground gas generation curves from biodegradable materials:



The production of methane and carbon dioxide at a landfill site may be expected to be considerable and ongoing. Concentrations of methane will eventually decrease, followed by concentrations of carbon dioxide, but the duration and rate of gas production can vary markedly between sites. Five distinct phases of gas production occur during the process which are, in order of event as marked above, as follows:

1. An aerobic phase involving oxygen depletion and temperature increase through aerobic respiration;
2. The establishment of anaerobic conditions and the evolution of carbon dioxide and hydrogen through acidogenic activity;
3. Commencement of methanogenic activity; the establishment of populations of methanogenic bacteria;
4. A phase of stable methanogenic activity, which may go on for many tens of years;
5. A phase of decreasing methanogenic activity, representing depletion of the organic material and a return to aerobic conditions.

The time scale for the return to the normal ground gas concentrations will be highly variable, depending upon the types and quantities of materials present. In addition, the optimum parameters influencing the rate of decomposition and ground gas production within the ground at a site are as follows:

High water content with adequate rainfall and water infiltration to provide moisture content between approximately 20 to 26%;
Conditions that either are or are very close to anaerobic;
High proportion of biodegradable materials;
A pH between 6.5 and 8.5, ideally verging slightly on the acidic between pH 6 to 7;
Temperature between 25°C and 55°C;
The ratio of the biochemical and chemical oxygen demands (BOD:COD);
High permeability;
Small particle size, as finer subsurface materials possess a greater surface area to provide a growing 'face' for the micro-organisms, but high fines levels reduces permeability and reduces decomposition rate.

For this reason, it is vital that sources of methane and carbon dioxide are identified prior to the commencement of any work on a construction site, and that the ground gas regime is characterised at the worst temporal conditions a site may experience. From this, a risk assessment is carried out to identify the risk at the site from ground gases so that suitable protection measures can be designed and incorporated into a development to prevent a dangerous build-up of gas occurring.

Factors Influencing the Migration and Behaviour of Ground Gases
There are many factors that influence the migration of ground gases which can affect the risk from a gassing source:

driving force – pressure differential along a pathway, diffusion and dissolved in solution;
meteorological conditions – short term and seasonal conditions including atmospheric pressure changes (e.g. rapidly falling pressure causes gas to expand increasing emission rates), rainfall, frozen ground and thawing, temperature;
geological and groundwater conditions – these can have the over riding influence on the direction/pathways and quantity of migrating gas;
anthropogenic influences – man-made pathways include mine shafts, service runs/drains, foundation piles, underground voids/pits/basements, foundation/building design/construction

Current Guidance
Previous versions of Building Regulations Approved Document C provided statutory guidance stating that consideration should be given to appropriate action and / or specific solutions in situations where methane concentration exceeded 1%v/v or carbon dioxide concentrations exceeded 5%v/v. The latest Building Regulations Approved Document C (DoE 2004) no longer endorses this approach and recommends the use of a risk-based approach to interpreting a gas monitoring survey. This is in line with current EA guidance for landfill gas (LFTGN 03, 2004) which recommends the use of a structured risk-based approach like that outlined in CLR 11. On this basis, recent guidance has been produced in 2006 and 2007 with the aim of providing up to date advice in relation to residential and commercial development. The guidance does not address issues associated with gas derived from landfills, for this refer to "Guidance on the Management of Landfill Gas" (Environment Agency 2004) for an overview.

Recent guidance relevant to gas assessments for residential and commercial development includes;

Wilson et al. (CIRIA C665, December 2007) "Assessing Risks Posed by Hazardous Ground Gases for Buildings."
This document provides up to date advice on all aspects of ground gas risk assessment such as investigation, monitoring programmes, data collection and interpretation. The guidance presents separate methodologies for the characterisation of:
All development types except low rise housing with gardens (Situation A)
Low rise housing with gardens (Situation B)

Boyle and Witherington (NHBC / RSK Group, Report 10627-R01(04) January 2007) "Guidance on the Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present."
This document presents the "Traffic Lights System" detailed below and is relevant only for low rise properties (e.g. bungalows and town houses) that have a ventilated sub-floor void (i.e. Situation B as described in CIRIA C665).

British Standard (BS 8485, December 2007) "Code of Practice for the Characterization and Remediation from Ground Gas in Affected Developments"
This document provides an overview of gas characterisation and assessment. The Standard is intended to be used by designers of gas protection measures and regulators involved in the assessment of design solutions.

Further guidance, Wilson and Card (CIEH) "Ground Gas Handbook for Designers and Regulators" providing practical guidance on ground gas assessments and the design and evaluation of protection measures, is expected to be published in March 2009.

Each of these documents continues to highlight the importance of, and give further guidance towards, carrying out a tiered risk-based decision-making process in accord with government policy on dealing with contamination from historic or natural sources and highlight the importance of the Conceptual Model in site characterisation.

Ground Gas Risk Assessment Methodology
Assessment of risk posed by ground gas is undertaken using the methodology as outlined previously, and summarised hereunder:

Tier 1 Preliminary Risk Assessment
Tier 2 Generic Quantitative Risk Assessment
Tier 3 Detailed Quantitative Risk Assessment

The methodology used in each of the above assessments with concern to ground gas is discussed hereunder.

Tier 1 Preliminary Risk Assessment
All potential sources of methane and carbon dioxide are identified in the Preliminary Conceptual Model and the generation potential determined. The background information discussed earlier is referred to in order to determine the potential for a source to generate ground gas.

CIRIA C665 provides idealised monitoring frequency / period dependant upon generation potential of gas source and sensitivity of the proposed land use as below:

Idealised Frequency and Period of Monitoring (after Table 5.5a and 5.5b, CIRIA C665)

		Generation Potential of Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity	Low (Commercial)	4/1	6/2	6/3	12/6	12/12

	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with Gardens)	6/3	9/6	12/6	24/12	24/24

Notes
1. First number is the number of readings and the second is the minimum period in months (e.g. 6/2 – six sets of readings over two months).
2. At least two sets of readings must be at low (preferably under 1,000 mb) and falling pressure.

The monitoring programme is decided using the above table prior to the intrusive site investigation. However, if the intrusive investigation reveals that the potential source is better or worse than anticipated the monitoring programme should be modified accordingly. For example, if the made ground contains no evidence of organic material and comprises entirely granular brick fill, the potential for that made ground to generate ground gas is reduced considerably.

Tier 2 Generic Quantitative Risk Assessment
Generic Quantitative Risk Assessment is undertaken upon completion of the required gas monitoring period.

All three current guidance documents propose that both ground gas concentrations and flow rates are used to calculate the limiting gas well gas volume flow rates for methane and carbon dioxide, based on the ground gas conditions monitored for during the worse-case temporal conditions. This limiting gas well volume flow rate is termed the Gas Screening Value (GSV, note that this was termed borehole gas volume flow), and is calculated as follows:

GSV (l/hr) = [gas well gas concentration (%v/v)] x [gas well flow rate (l/hr)]
100

GSV's are compared to typical max concentrations and limiting gas screening values derived for either Situation A - All development except low rise housing with gardens, or Situation B low rise housing with gardens (NHBC Traffic Light System). Table 8.5 from CIRIA C665 is used for comparison of gas screening values for "Situation A Developments" and is presented hereunder:

Characteristic Situation (CIRIA R149)	Comparable Partners in Technology gas Regime (see Box 8.2)	Risk Classification	Gas Screening Value (CH4 or CO2) (l/hr)1	Additional Factors	Typical Source of Generation
1	A	Very low risk	<0.07	Typically, methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking susceptible to flooding, completed landfill (WMP 26B criteria)
5	E	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	F	Very high risk	>70		Recent landfill site

Table 8.5 from CIRIA C665 Modified Wilson and Card Classification

Table 8.7 is used for comparison of gas screening values for "Situation B Developments" and is presented hereunder:

Traffic Light	Methane1		Carbon Dioxide2	
	Typical max concentration3 (% by volume)	Gas screening value2,4 (litres/hour)	Typical max concentration3 (% by volume)	Gas screening value2,4 (litres/hour)
Amber 1	1	0.13	5	0.78
	5	0.63	10	1.60

Amber 2				
[redacted]	20	1.60	30	3.10

Notes:
1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter will be the decoder as to what Traffic Light is allocated;
2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the gas being considered;
3. The Typical Maximum Concentration can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment considering site-specific conditions.

Table 8.7 from CIRIA C665 - NHBC Traffic light system for 150 mm void

Dependant on the outcome of the assessment of risk posed by ground gas it is determined whether gas protection measures are required for the proposed development, and or whether a detailed quantitative risk assessment is required for the site.

Selection & Design of Protective Measures
Table 8.6 and Box 8.4 of CIRIA C665 contain information on the detailed design of protection measures and were initially intended for the purposes of determining then level of protection measures a development requires. These tables and related text include some useful information on the design of gas protection measures, however BS84845:2007, which supersedes the guidance included within CIRIA C665, is used for selection of gas protection measures.

BS8485: 2007 uses a scoring system dependant on the Characteristic Situation / NHBC Traffic Light and proposed end use of the site. The scoring system is summarised in BS8485:2007 Table 2 as presented hereunder:

Characteristic gas situation, CS	NHBC traffic light	Required gas protection			
		Non-managed property e.g. private housing	Public building (a)	Commercial buildings	Industrial buildings (b)
1	Green	0	0	0	0
2	Amber 1	3	3	2	1 (c)
3	Amber 2	4	3	2	2
4	Red	6 (d)	5(d)	4	3
5			6(e)	5	4
6				7	6
NOTE Traffic light indications are taken from NHBC Report no.:10627-RO1 (04) and are mainly applicable to low-rise residential housing1. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.					
a) Public buildings include, for example, managed apartments, schools and hospitals. b) Industrial buildings are generally open and well ventilated. However, areas such as office pods might require a separate assessment and may be classified as commercial buildings and require a different scope of gas protection to the main building. c) Maximum methane concentration 20% otherwise consider and increase to CS3. d) Residential building on higher traffic light/CS sites is not recommended unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations. e) Consideration of issues such as ease of evacuation and how false alarms will be handled are needed when completing the design specification of any gas protection scheme					
1 The NHBC guidance and CIRIA C665 guidance refers to low rise housing (which is up to three storeys without lifts) that is constructed with a 150mm ventilated sub-floor void.					

BS8485:2007 Table 2 Required gas protection by characteristic gas situation and type of building

Once a score is assigned, a combination of protection systems / elements is chosen from BS8485:2007 Table 3 shown below:

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
a) Venting/dilution (See Annex A BS8485)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)A	Very good performance	2.5	Ventilation performance in accordance with Annex A (BS8485)
	Good performance	1	If passive ventilation is poor this is generally unacceptable, and some form of active system will be required.
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)A		2.5	There must be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance.
Ventilated car park (basement or under croft)		4	Mechanically assisted systems come in two forms:

			extraction and positive pressurization.
b) Barriers			
Floor slabs Block and beam floor slab Reinforced concrete ground bearing slab Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab Reinforced concrete cast in situ suspended floor slab with minimal service penetrations and water bars around all slab penetrations and at joints Fully tanked basement		 0 0.5 1.5 1.5 2	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs such as joints must be effectively sealed against gas ingress in order to maintain these performances.
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation B,C Proprietary gas resistant membrane to reasonable levels of workmanship /in line with good practice under independent inspection (CQA)B,C Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		0.5 1 2	The performance of membranes is heavily dependent on the quality of design of the installation, resistance to damage after installation, and the integrity of joints.
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using handheld equipment Permanent monitoring and alarm system A	 Installed in the underfloor venting/dilution system Installed in the building	0.5 2 1	Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.
e) Pathway Intervention			
Pathway intervention		-	This can consist of site protection measures for off-site or on-site sources (see Annex A, BS8485)
NOTE In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection			
It is possible to test ventilation systems by installing monitoring probes for post installation validation. If a 1 200g DPM material is to function as a gas barrier it should be installed according to BRE 212 /BRE 414 being taped and sealed to all penetrations Polymeric Materials> 1200 g (proportional to thickness) but their physical properties mean that they are more robust and resistant to damage.			

BS8485:2007 Table 3 Solution Scores

Where the gas situation is 4 or more (and for NHBC Red situations) the site requires a comprehensive risk assessment to confirm the scope of protection measures. These are higher risk sites and reliance on Table 2 and 3 alone is not enough.

For a site which is impacted by migratory gases from an off-site source, the development may be protected by imposing pathway intervention methods, which if successfully validated, could also remove the need for further analysis. It is essential that the gas regime in these circumstances has been fully characterised and that the only source impacting the site is located off site and that the pathway is clearly defined and its interception equally proven before construction commences. Pathway intervention methods may include vertical membrane installations, venting trenches, rows of stone columns, activated trenches and various proprietary systems. These systems are particularly relevant to domestic housing where there is limited scope for foundation type solutions.

CURRENT GUIDANCE ON REMEDIATION

When risk assessment of the site has been completed and it indicates that remedial works are required, the main guidance in managing this process is set out in the DEFRA/EA publication CLR11 (2004) "Model Procedures for the Management of Land Contamination." The stages of managing remediation are as follows:

(a) Options Appraisal and develop Remediation Strategy;
(b) Develop Implementation Plan and Verification Plan;
(c) Remediation, Verification and Monitoring.

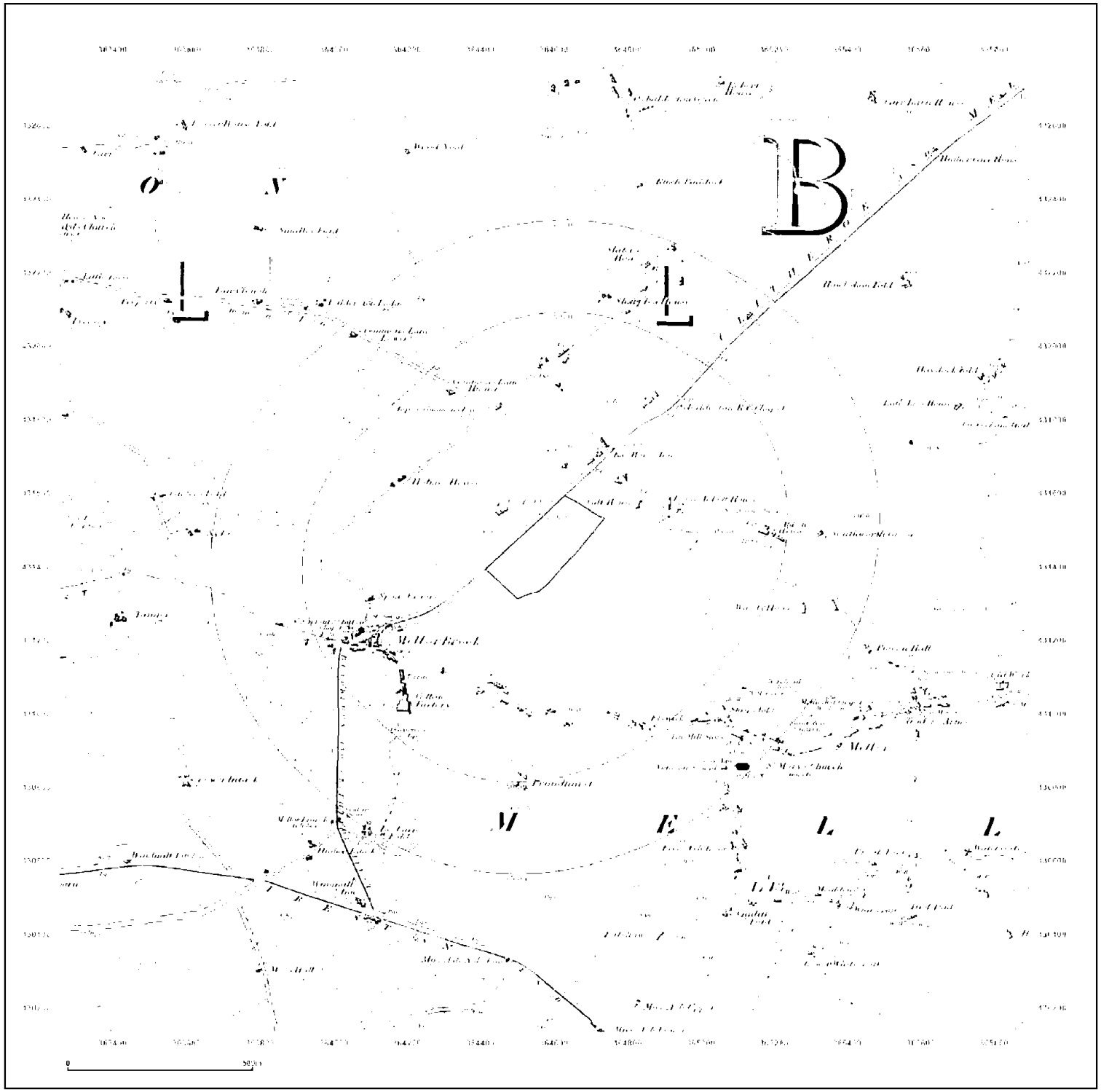
The Remediation Strategy sets out the remediation targets, identifies technically feasible remedial solutions and presents an evaluation of the options so that these can be assessed enabling that the most suitable solution is adopted. An outline of the proposed remedial method should be presented. Agreement should be sought of the appropriate statutory bodies for the Remediation Strategy before proceeding to the next stage.

The Implementation Plan is a detailed method statement setting out how the remediation is to be carried out including stating how the site will be managed, welfare procedures, health and safety considerations together with practical measures such as details of temporary works, programme of works, waste management licences and regulatory consents required. Agreement should again be sought of the appropriate statutory bodies for this Plan.

The Verification Plan sets out the requirements for gathering data to demonstrate that the remediation has met the required remediation objectives and criteria. The Verification Plan presents the requirements for a wide range of issues including the level of supervision, sampling and testing regimes for treated materials, waste and imported materials, required monitoring works during and post remediation, how compliance with all licenses and consents will be checked etc. Agreement should again be sought of the

appropriate statutory bodies for the Verification Plan. On completion of the remediation a Verification Report should be produced to provide a complete record of all remediation activities on site and the data collected as required in the Verification Plan. The Verification Report should demonstrate that the remediation has met the remedial targets to show that the site is suitable for the proposed use.

APPENDIX 4: COMMERCIAL ENVIRONMENTAL DATA



Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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Report Ref: CMAPS-AAG-1065247-4165-061022HIS
Grid Ref: 364575, 431455

Map Name: County Series
Map date: 1844
Scale: 1:10,560
Printed at: 1:10,560

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Surveyed 1844
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

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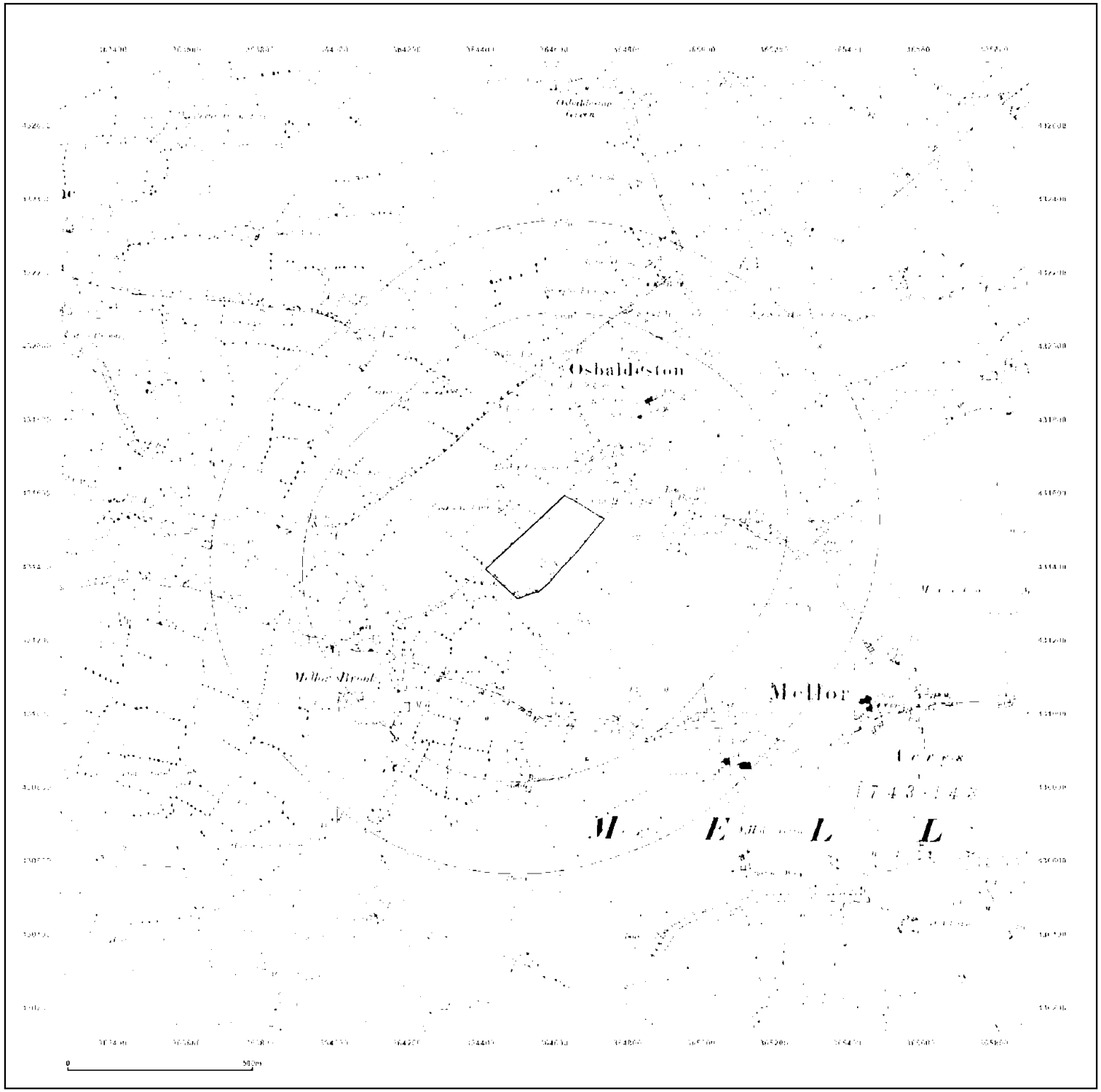

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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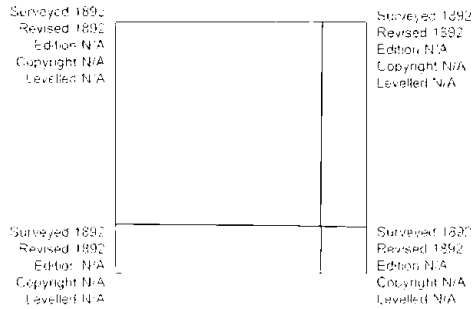

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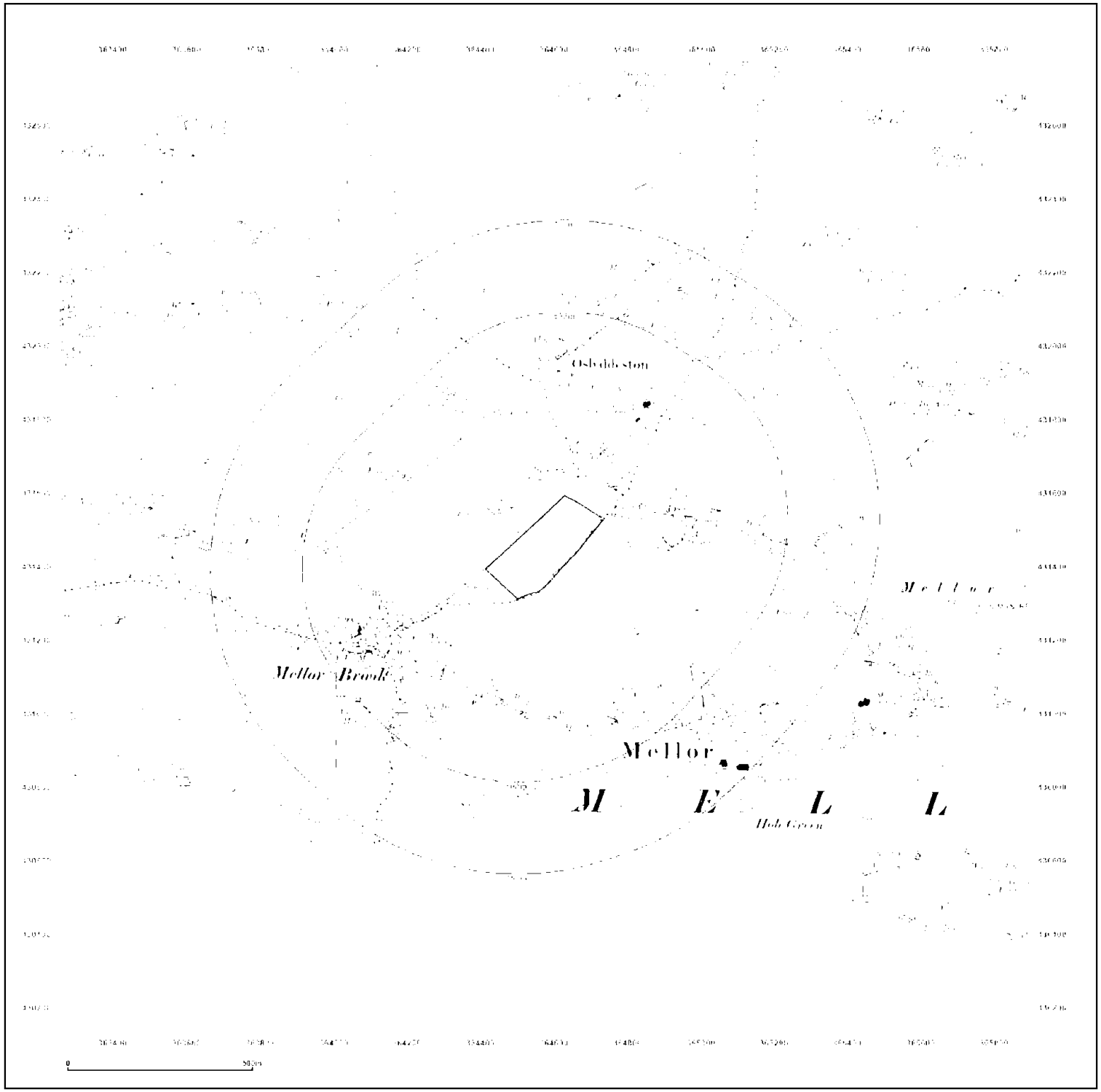

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

Client Ref: CMAPS-AAG-1065247-4165-061022
Report Ref: CMAPS-AAG-1065247-4165-061022HIS
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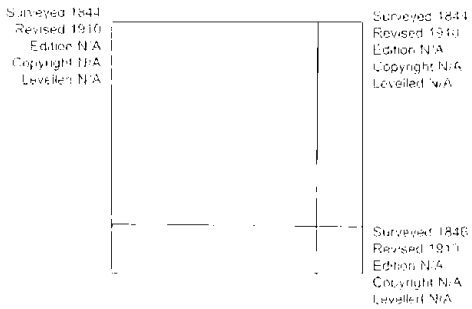

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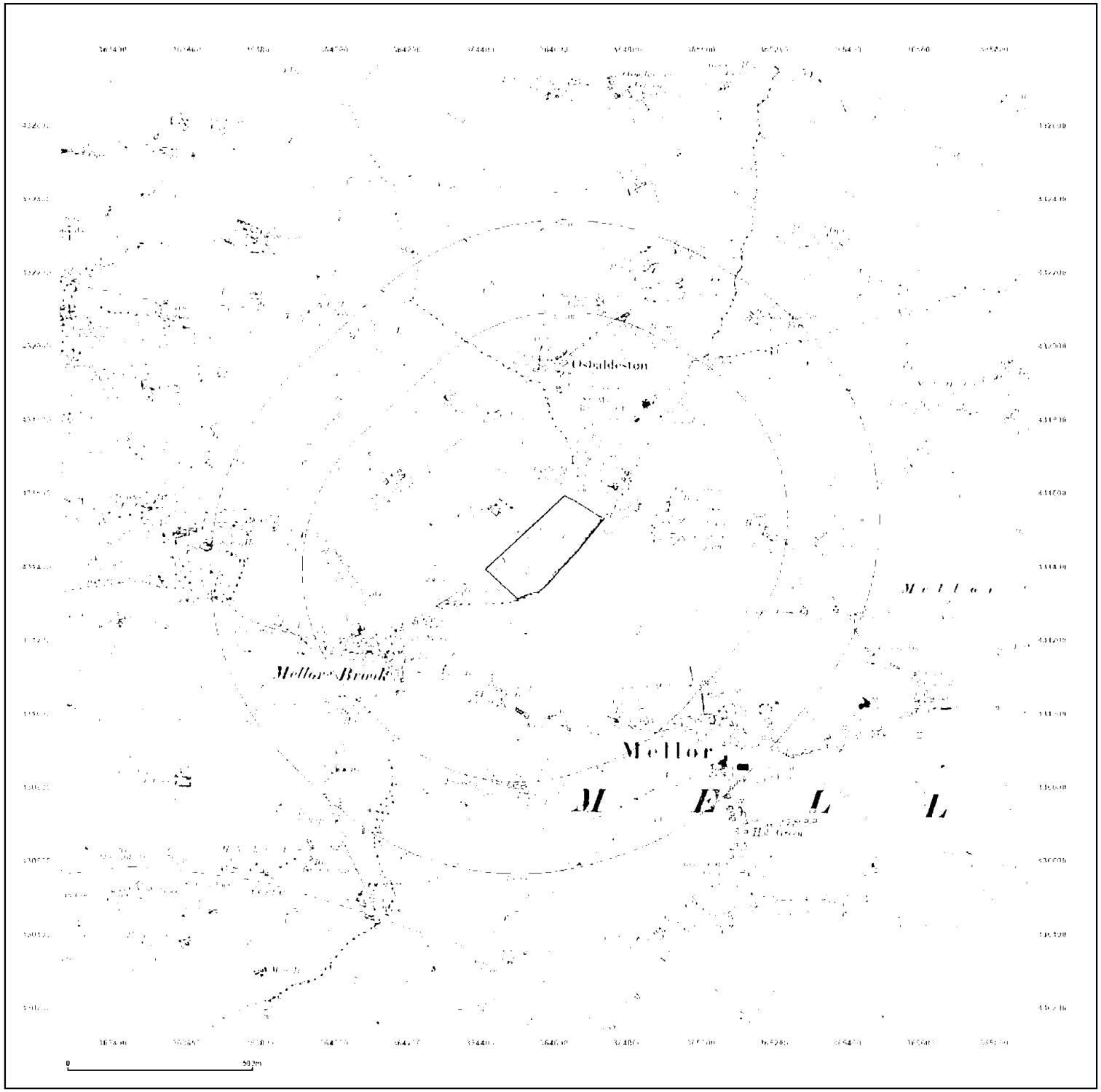

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

Client Ref: CMAPS-AAG-1065247-4165-061022
Report Ref: CMAPS-AAG-1065247-4165-061022HIS
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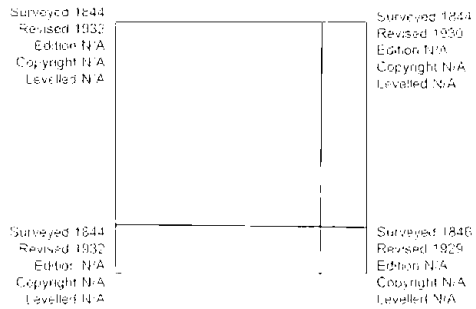

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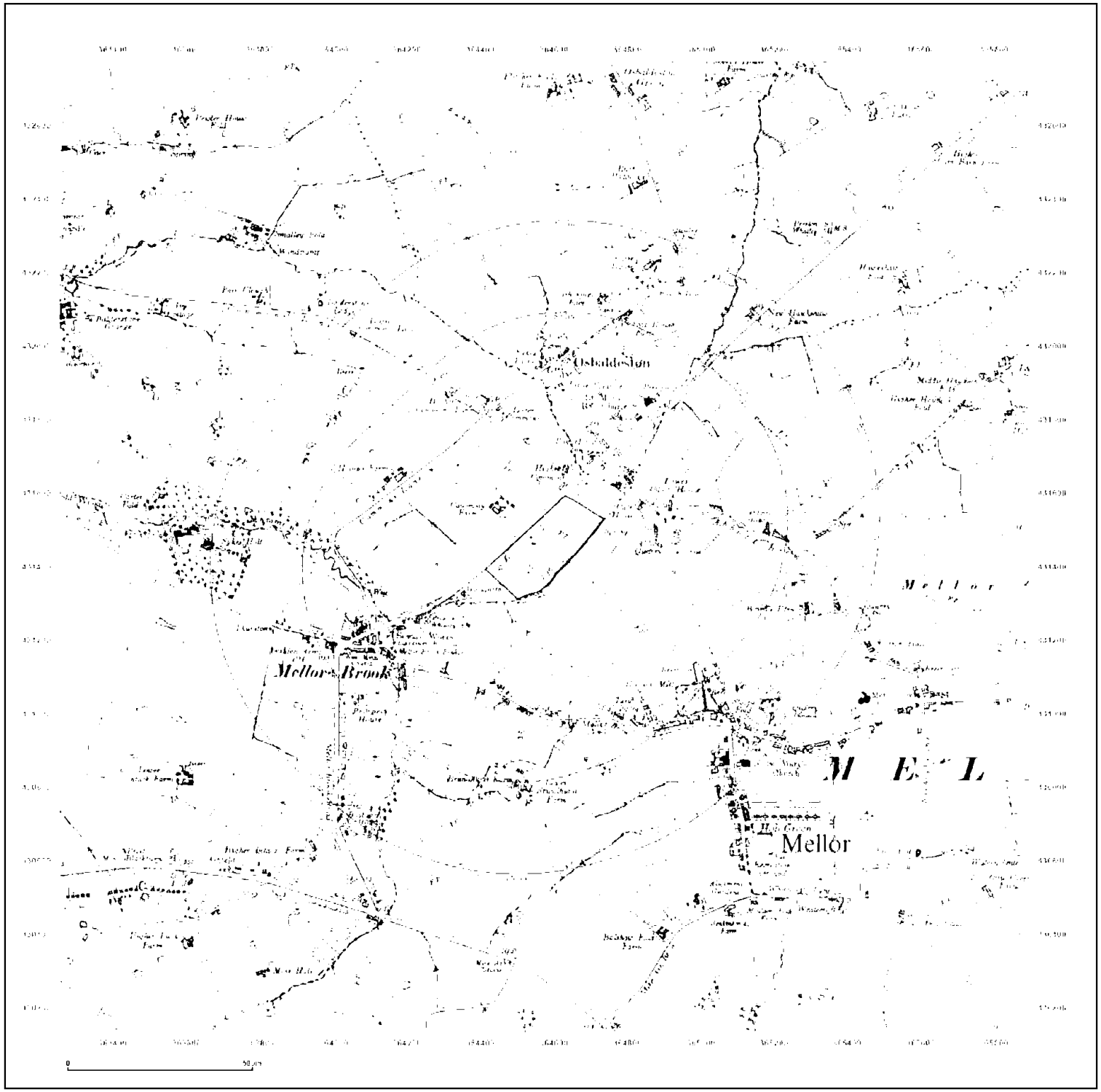

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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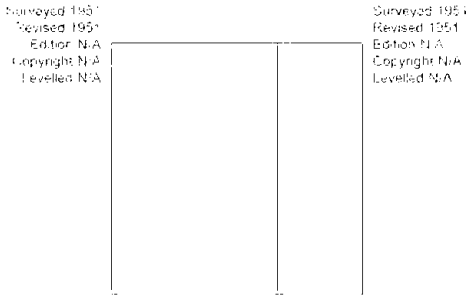

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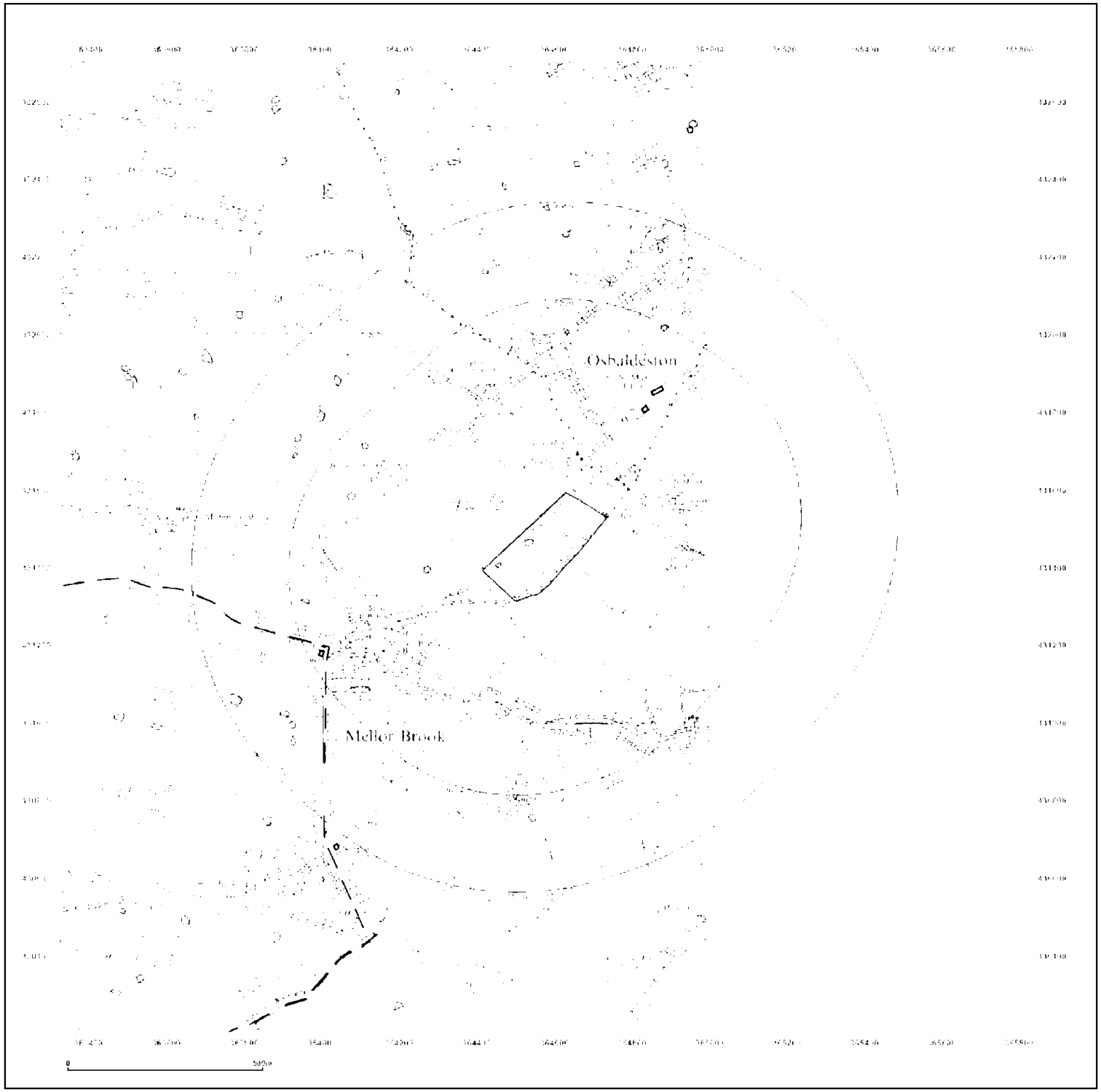

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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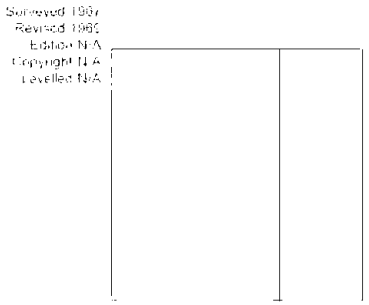

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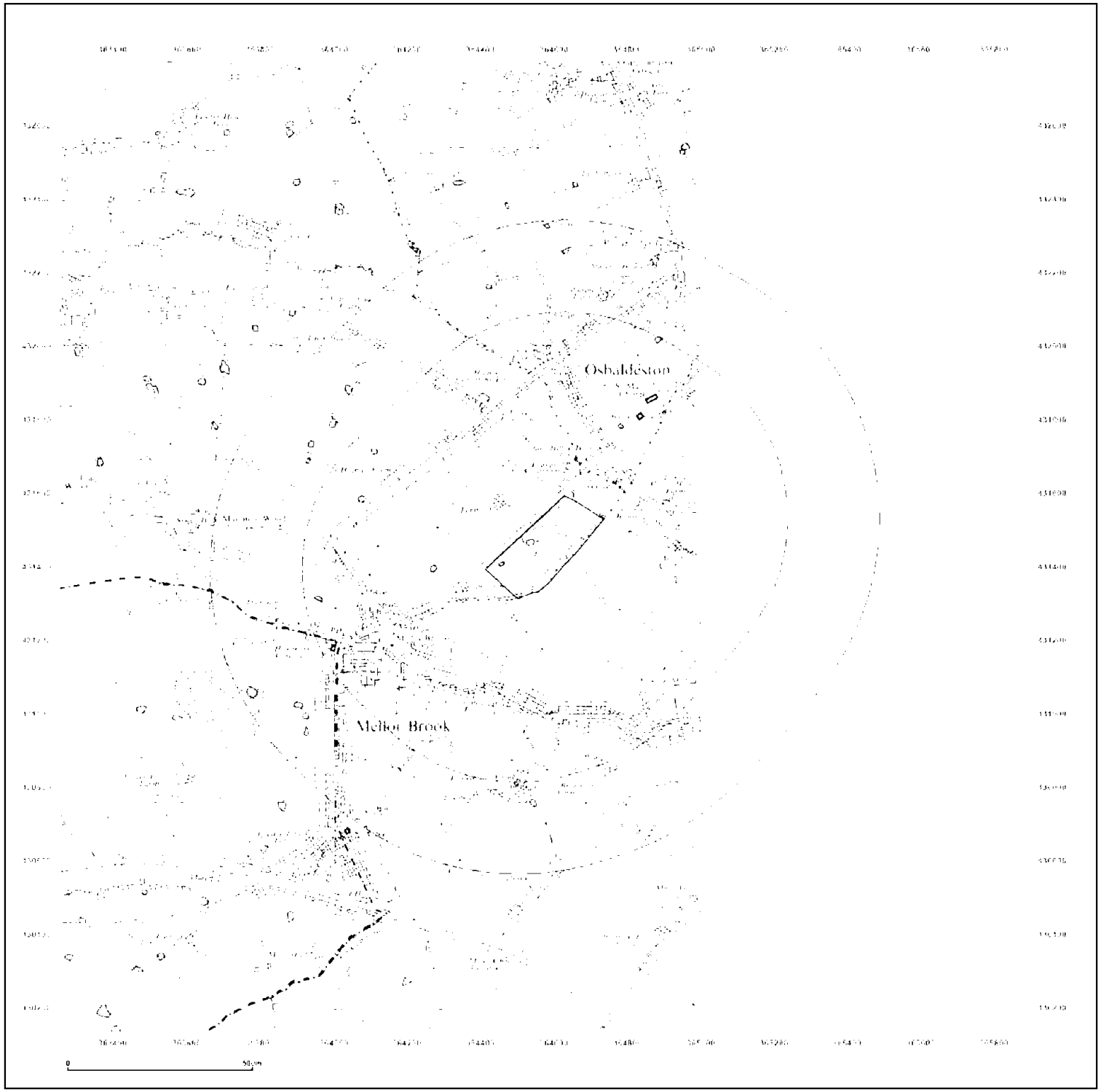

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Causeway Farm Longsight Road,
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7HZ

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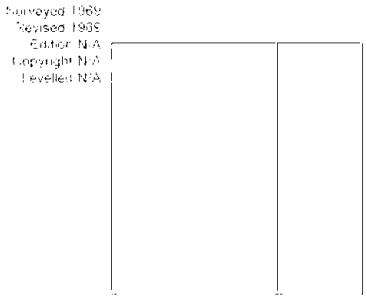

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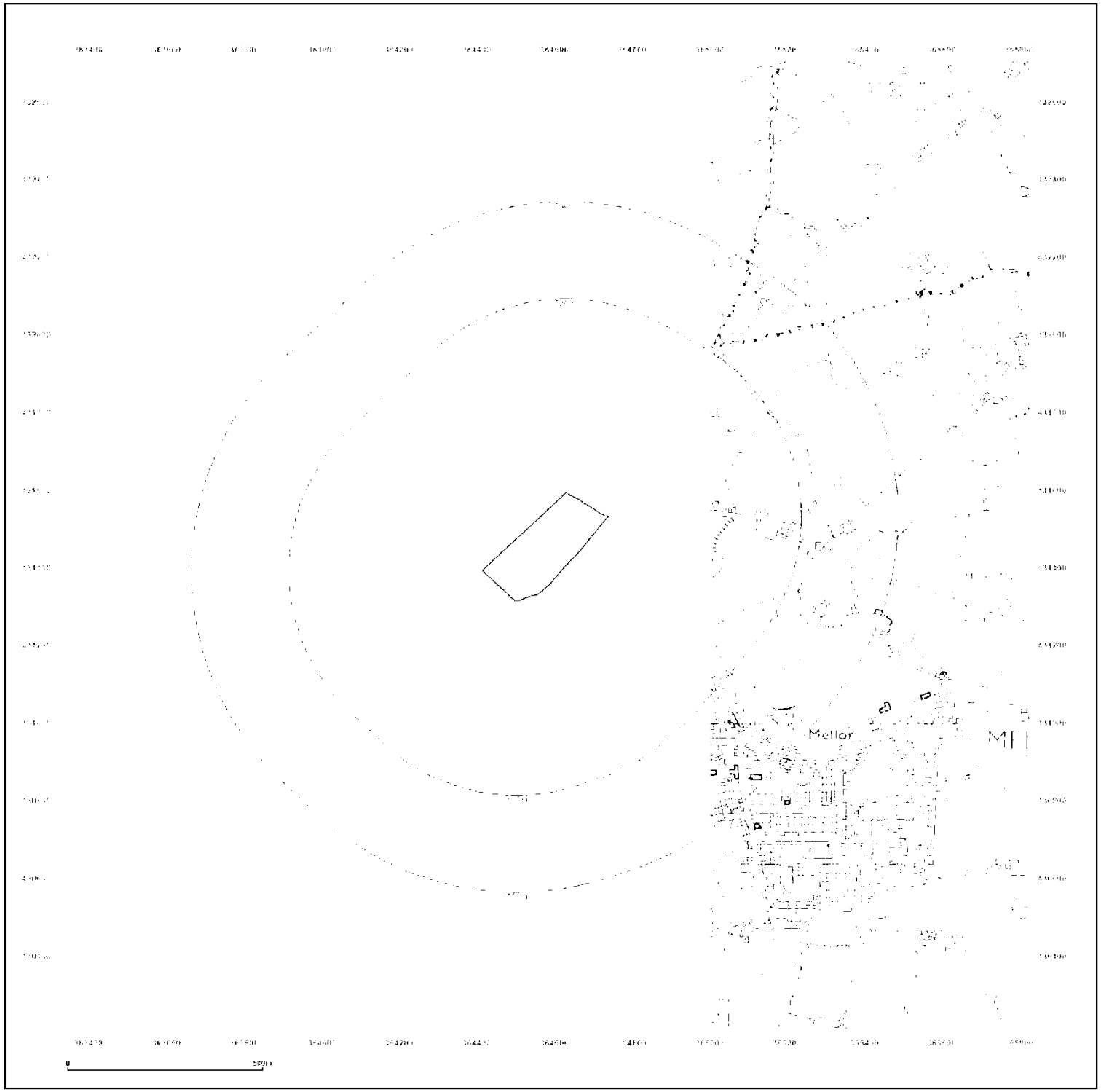

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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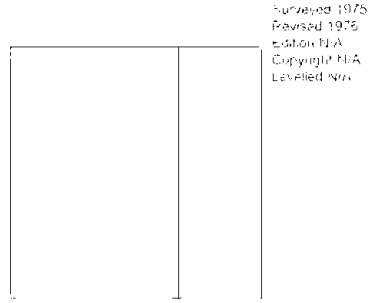

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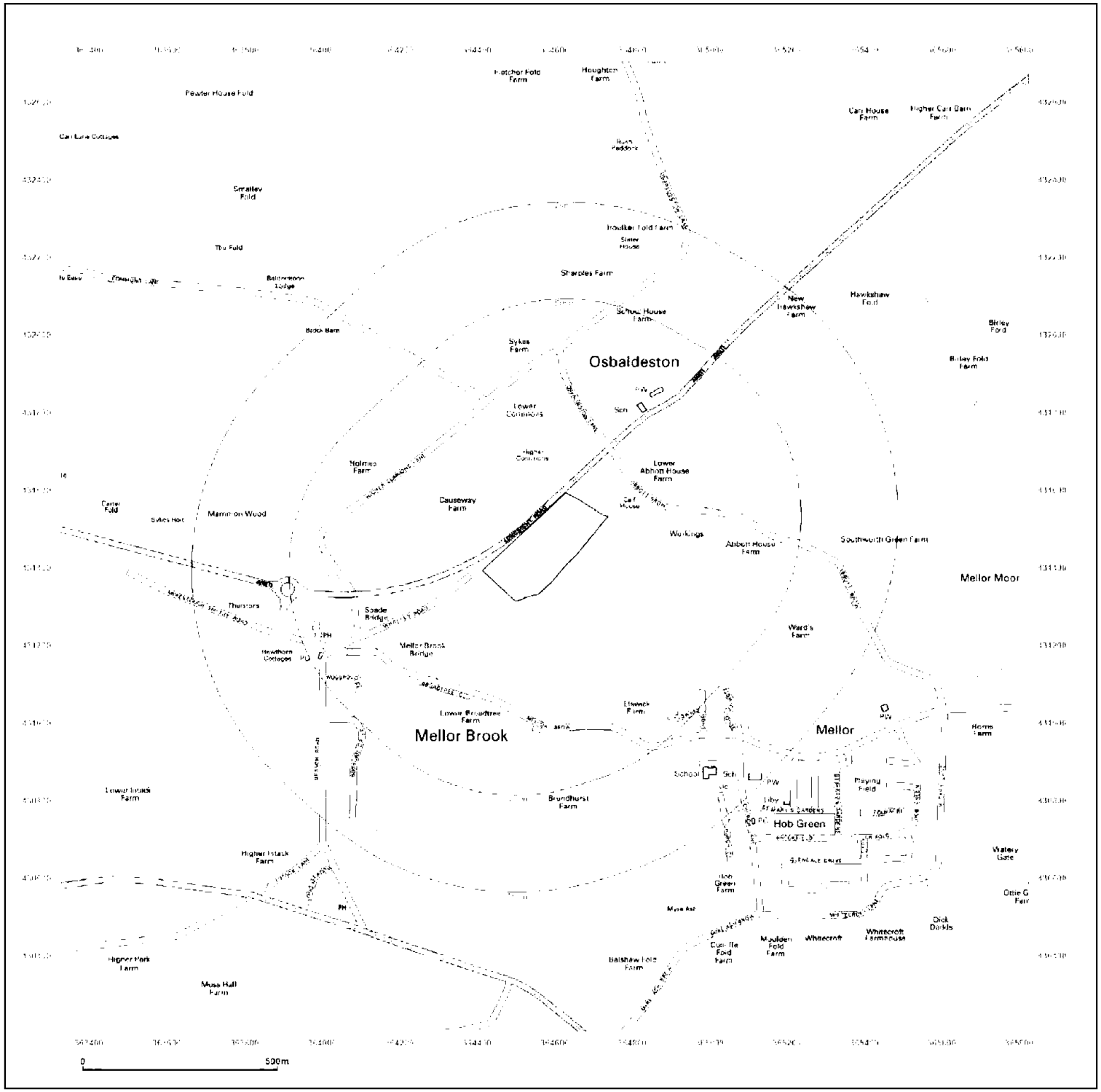

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Site Details:

Causeway Farm Longsight Road, Blackburn, Clayton Le Dale, BB2 7HZ

Client Ref: CMAPS-AAG-1065247-4165-061022
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Grid Ref: 364575, 431455

Map Name: National Grid
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Scale: 1:10,000
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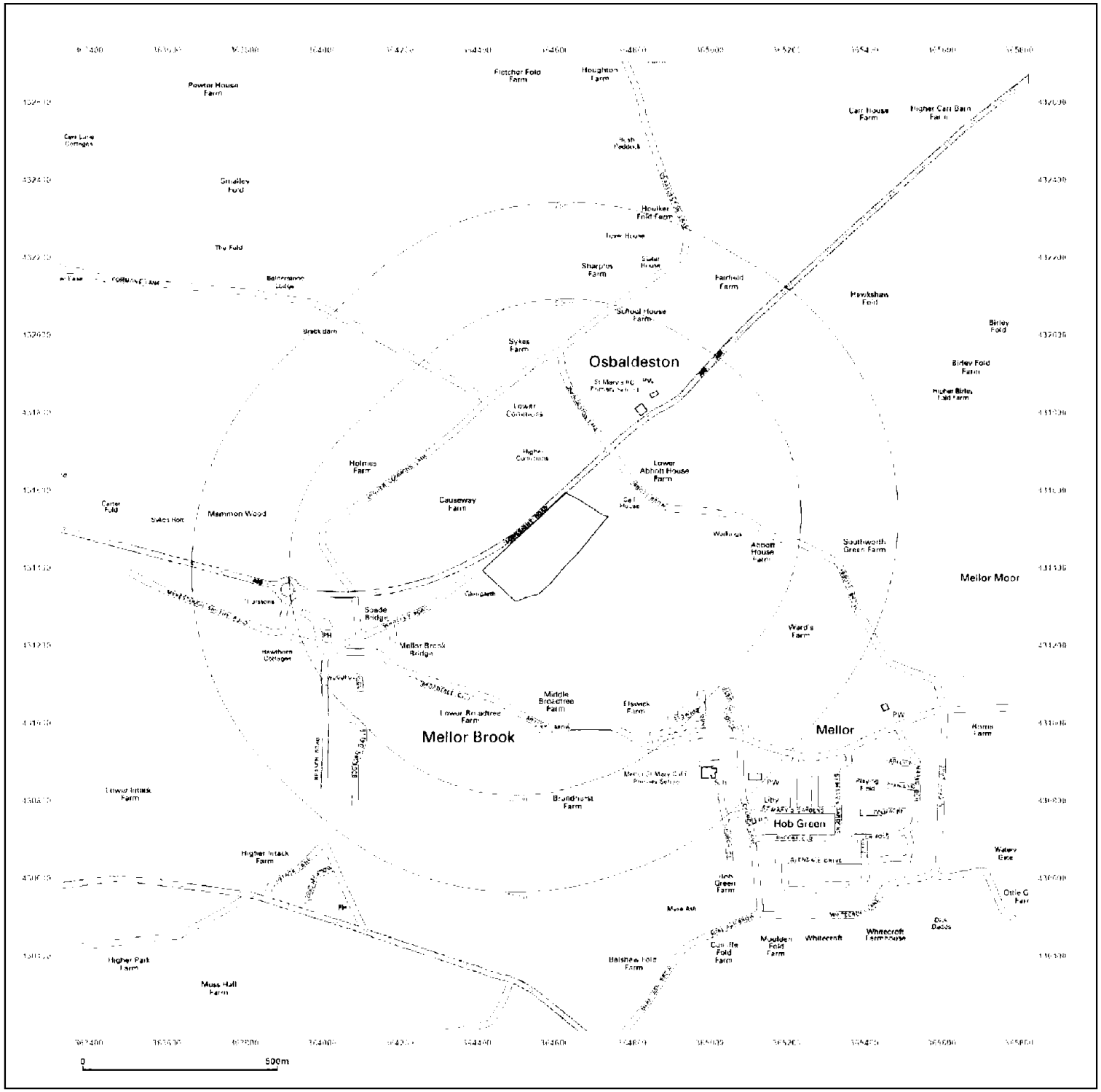

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Site Details:

Causeway Farm Longsight Road, Blackburn, Clayton Le Dale, BB2 7HZ

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Grid Ref: 364575, 431455

Map Name: National Grid
Map date: 2010
Scale: 1:10,000
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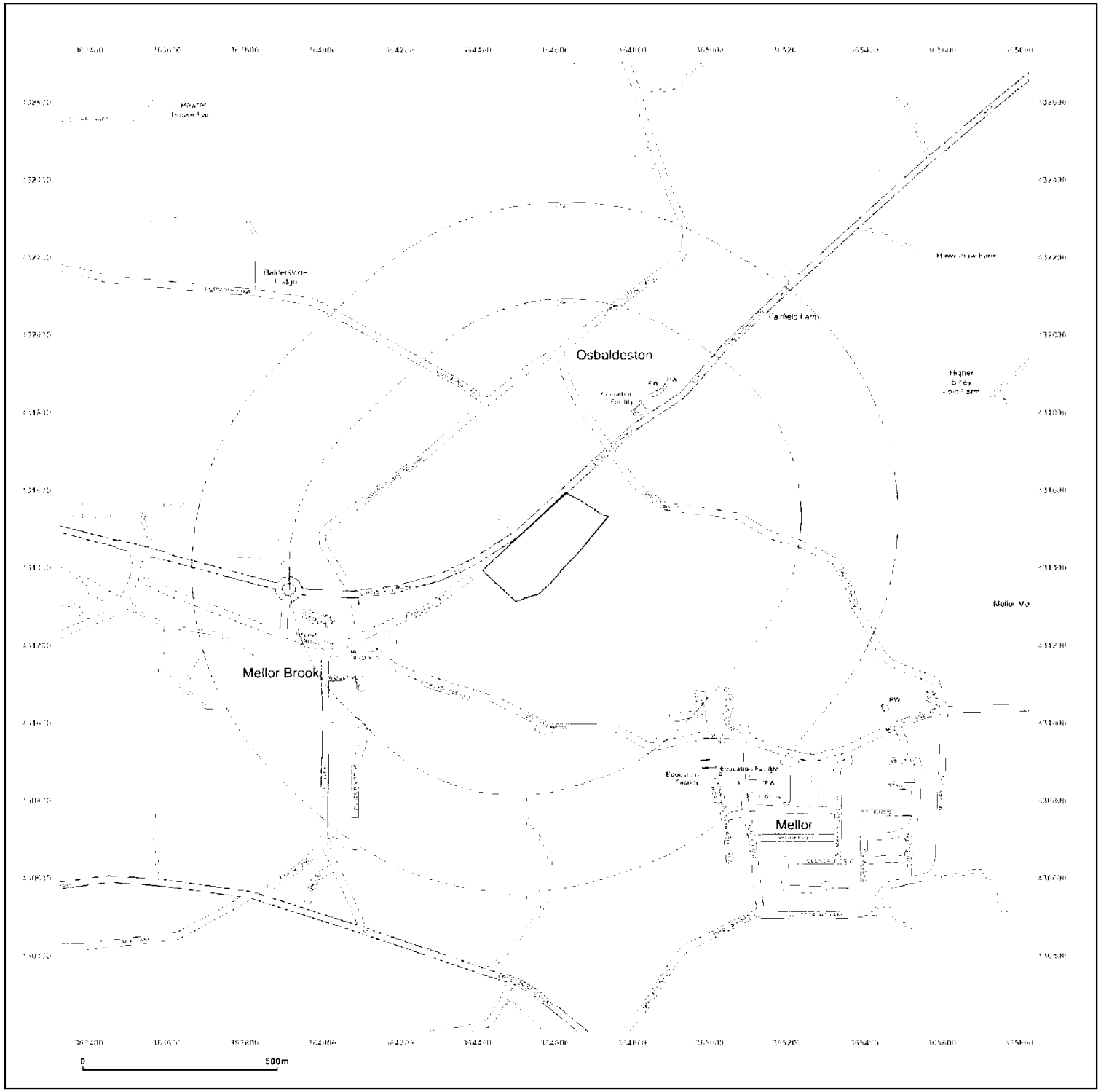

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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Grid Ref: 364575, 431455

Map Name: National Grid
Map date: 2022
Scale: 1:10,000
Printed at: 1:10,000

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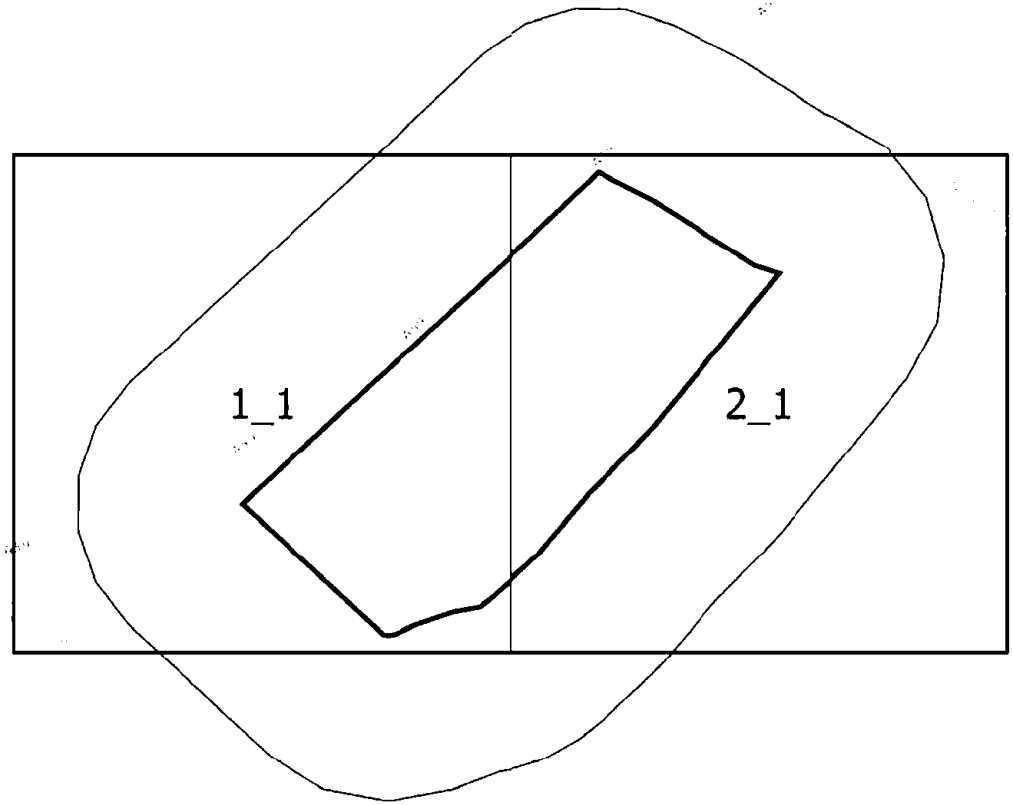

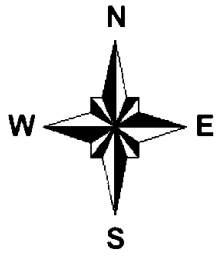

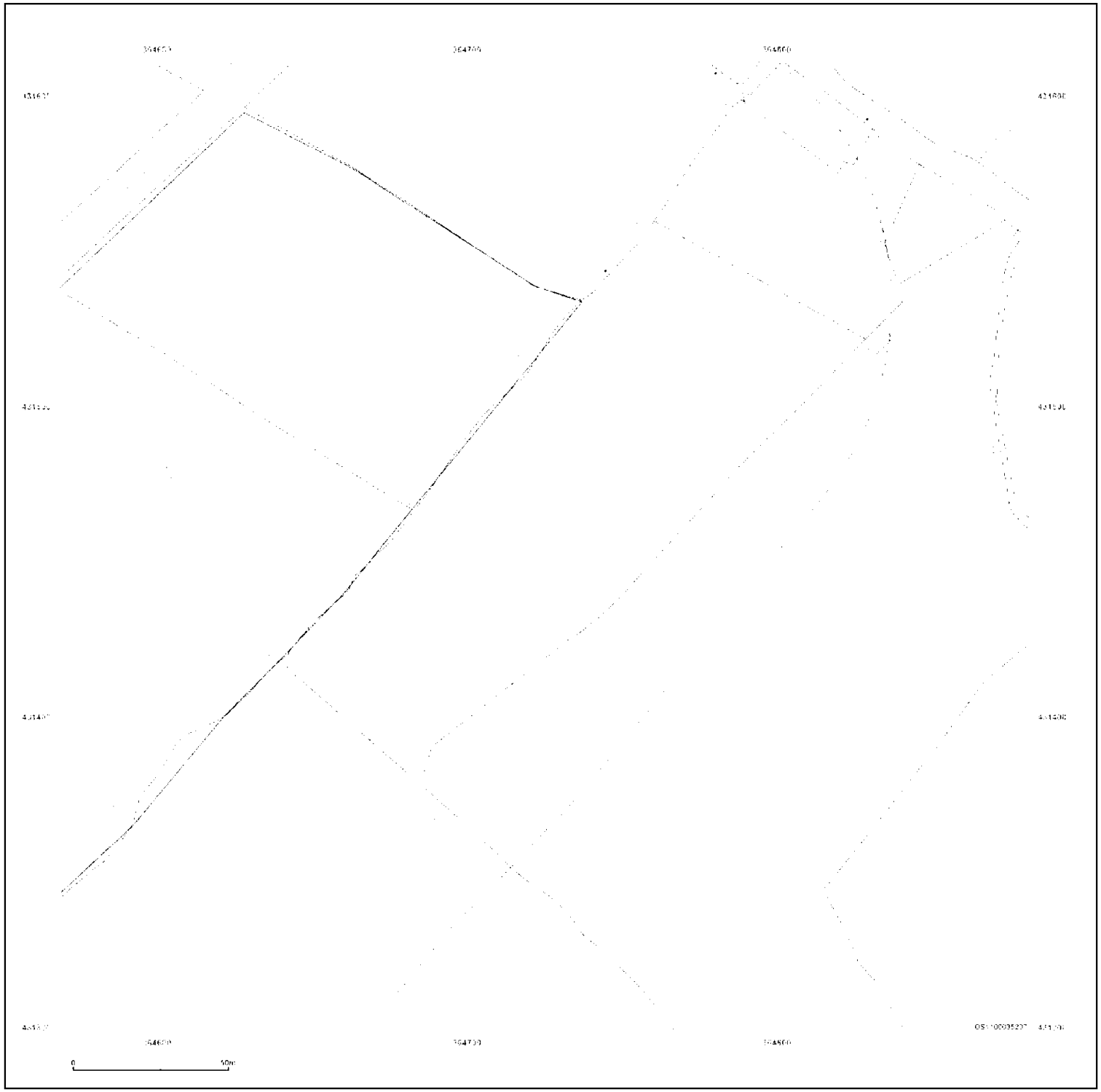

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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Grid Ref: 364725, 431455

Map Name: LandLine
Map date: 2003
Scale: 1:1,250
Printed at: 1:1,250

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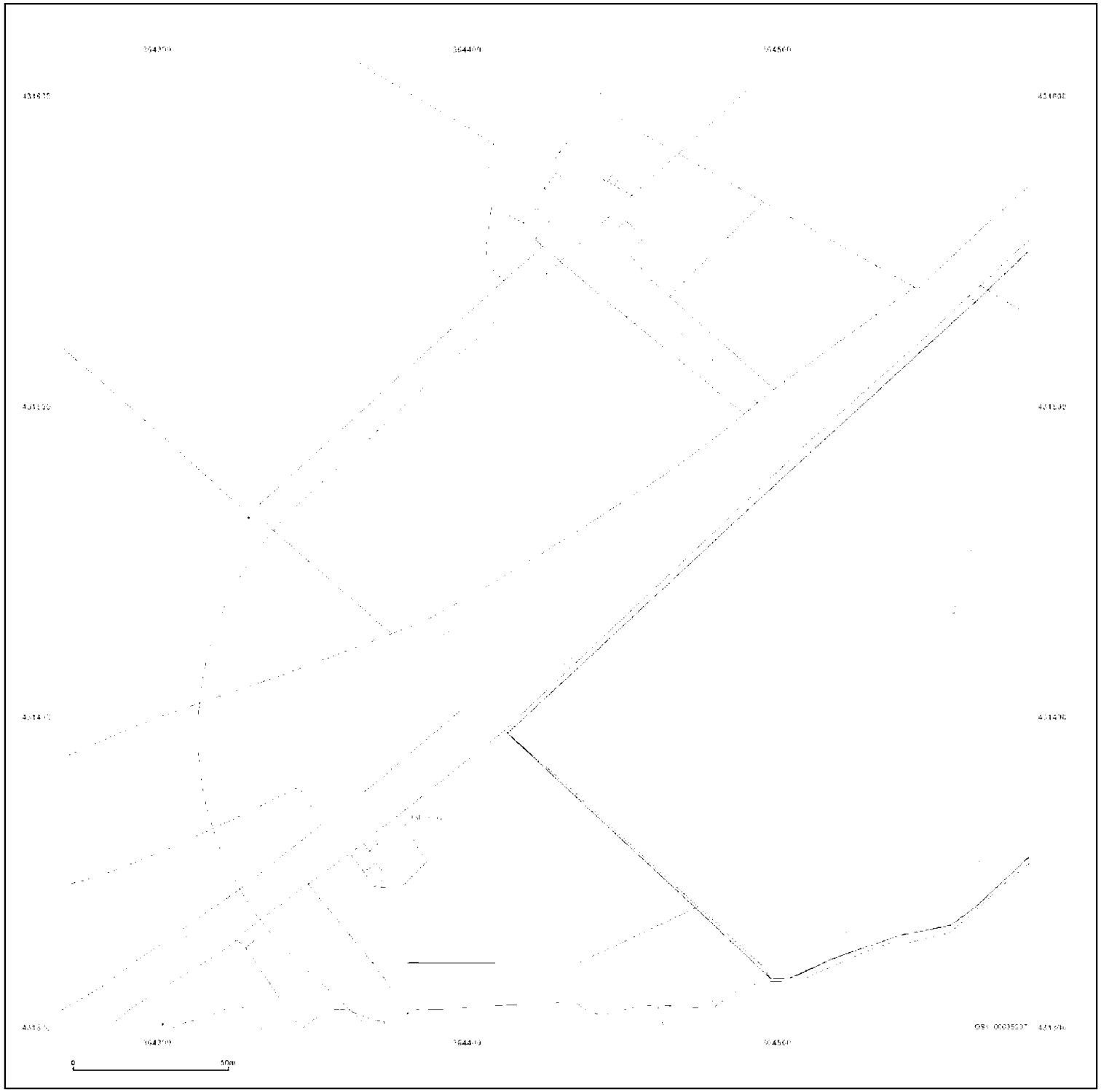

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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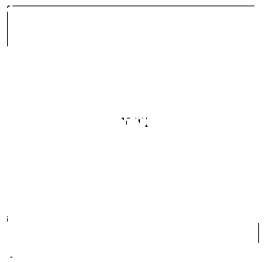

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Production date: 06 October 2022

Map legend available at:
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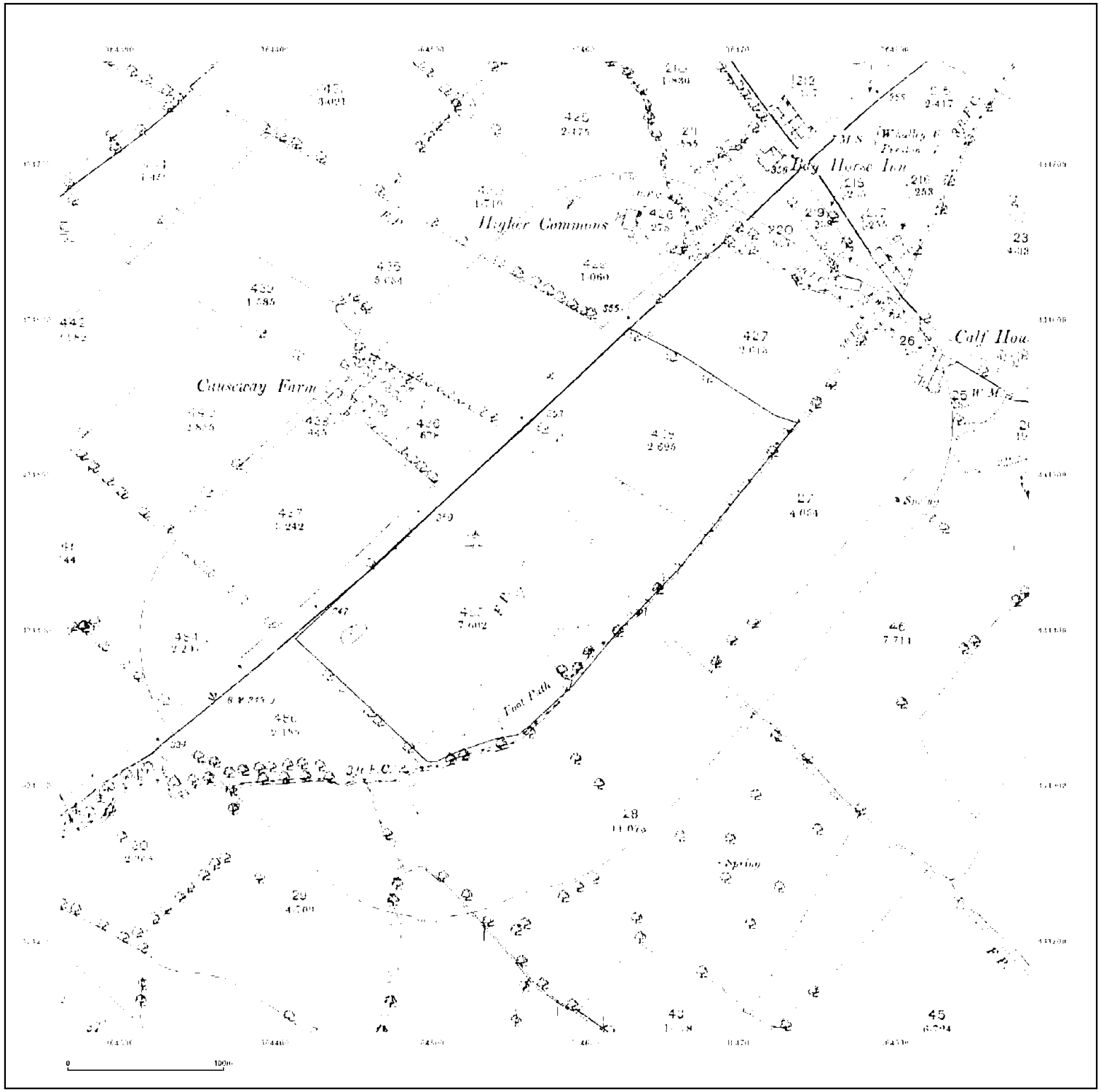

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Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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Grid Ref:	364574, 431454

Map Name:	County Series
Map date:	1892
Scale:	1:2,500
Printed at:	1:2,500

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Surveyed 1892
Revised 1892
Editor N/A
Copyright N/A
Levelled N/A

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Map legend available at:
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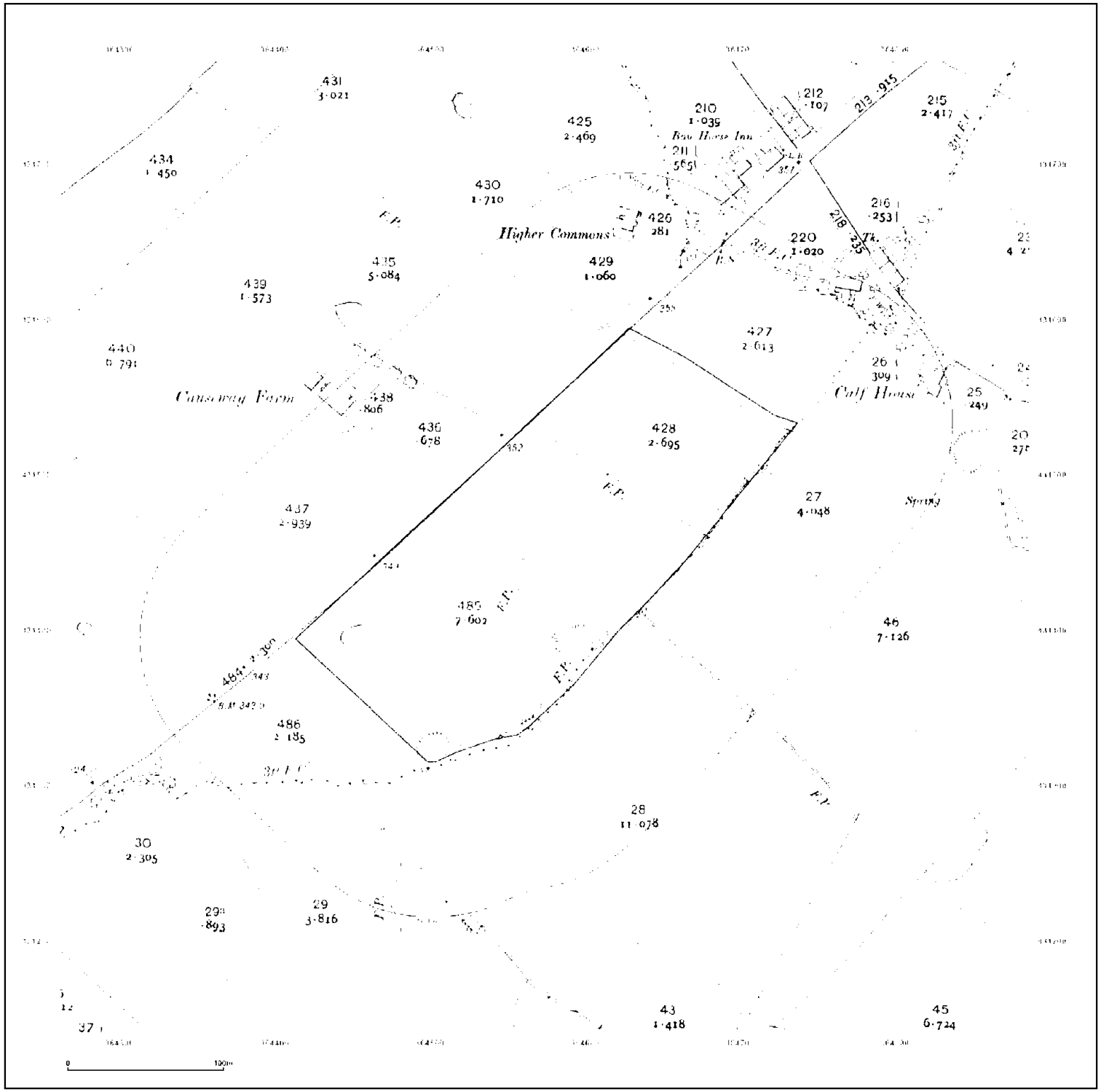

Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

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Map Name: County Series
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Scale: 1:2,500
Printed at: 1:2,500

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Surveyed 1911
Revised 1911
Edition N/A
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Levelled N/A

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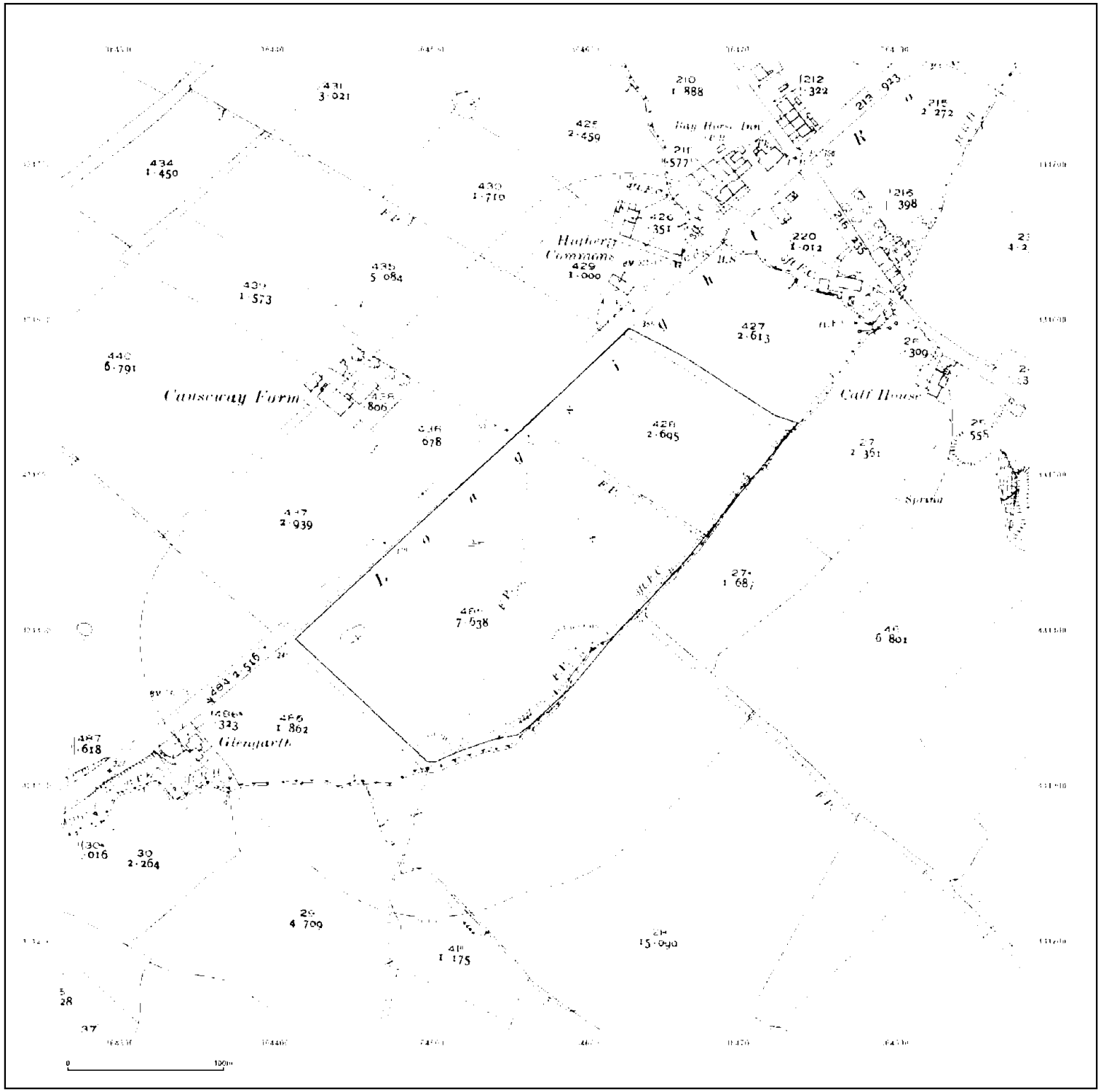

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Site Details:

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Blackburn, Clayton Le Dale, BB2
7HZ

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Surveyed 1932
Revised 1932
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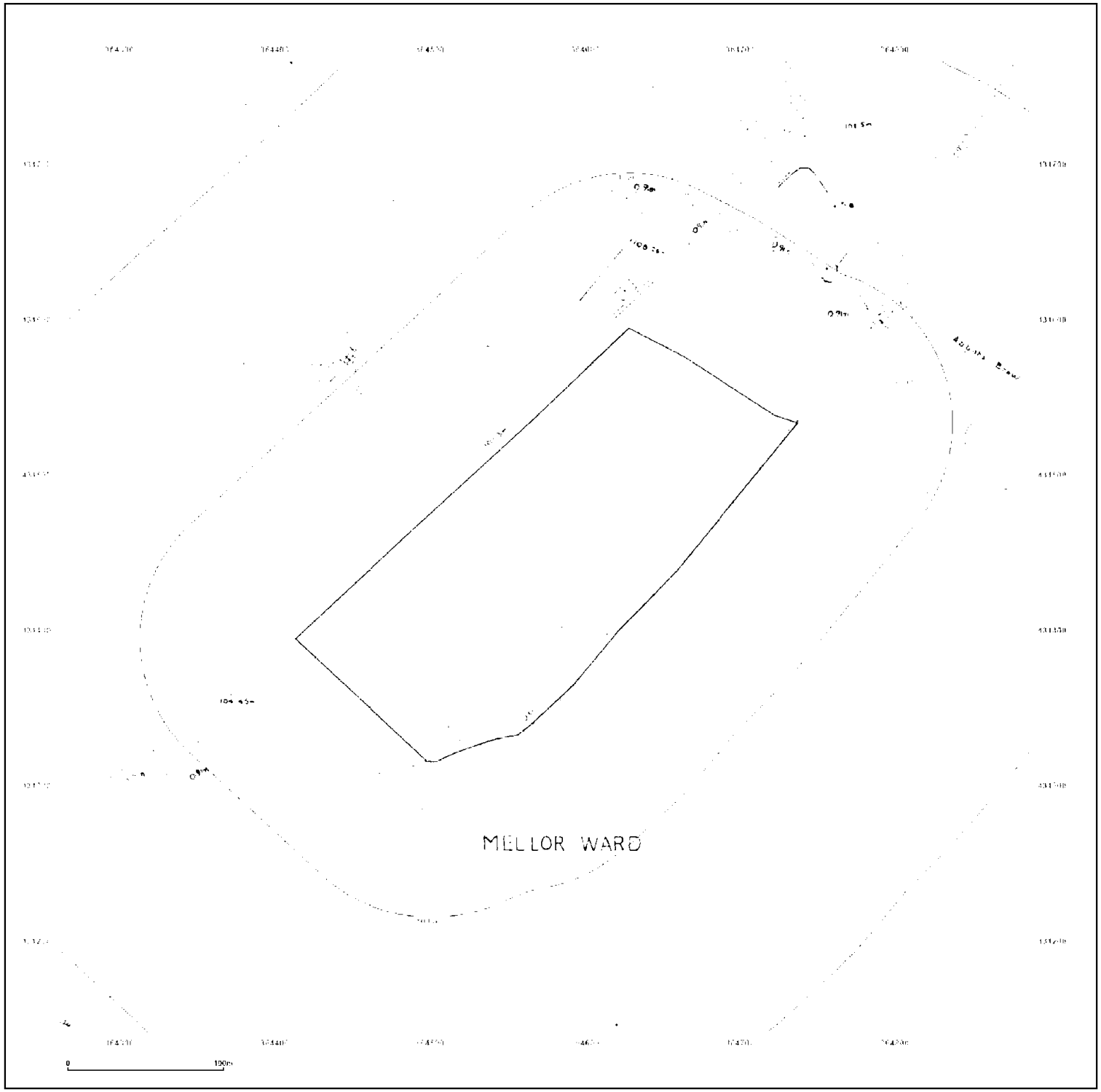

CCG

Site Details:

Causeway Farm Longsight Road,
Blackburn, Clayton Le Dale, BB2
7HZ

Client Ref: CMAPS-AAG-1065247-4165-061022
Report Ref: CMAPS-AAG-1065247-4165-061022HIS_2500
Grid Ref: 364574, 431454

Map Name: National Grid
Map date: 1988
Scale: 1:2,500
Printed at: 1:2,500

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Surveyed N/A
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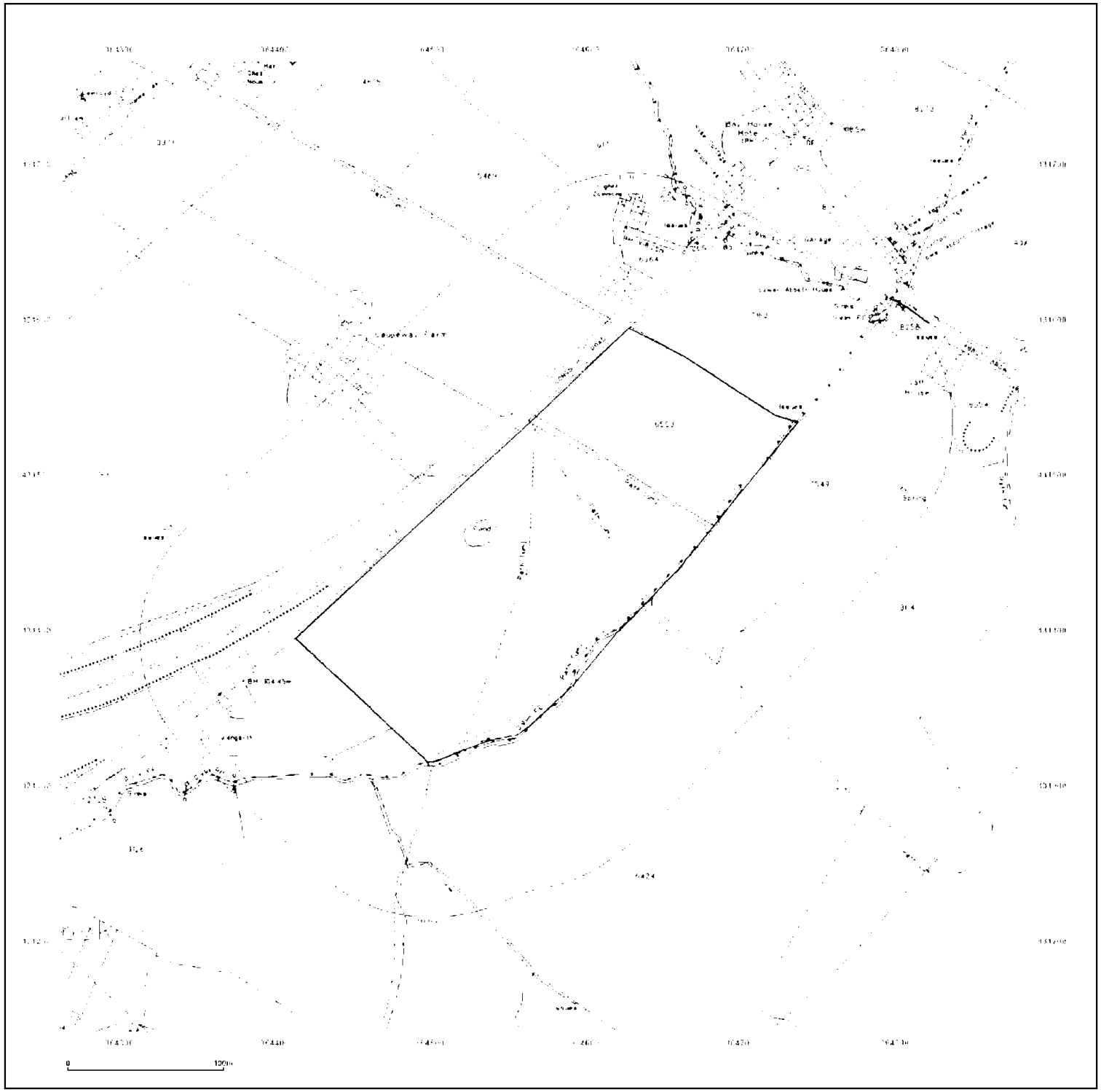

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Groundsure Enviro+Geo Insight

Causeway Farm Longsight Road, Blackburn, Clayton Le Dale, BB2 7HZ

Order Details

Date: 06/10/2022

Your ref: CMAPS-AAG-1065247-4165-061022

Our Ref: CMAPS-AAG-1065247-4165-061022EDRGEO

Site Details

Location: 364574 431455

Area: 4.11 ha

Authority: Ribble Valley Borough Council

Contact us with any questions at:
info@groundsure.com
08444 159 000

Summary of findings

Page	Section	Past land use	On site	0-50m	50-250m	250-500m	500-2000m
12	1.1	Historical industrial land uses	5		23	36	
15	1.3	Historical energy features			1	2	
16	1.5	Historical garages			2		
Page	Section	Past land use - un-grouped	On site	0-50m	50-250m	250-500m	500-2000m
17	2.1	Historical industrial land uses	8		28	43	
21	2.3	Historical energy features			3	2	
21	2.5	Historical garages			4		
Page	Section	Waste and landfill	On site	0-50m	50-250m	250-500m	500-2000m
24	3.4	Historical landfill (EA/NRW records)			1	1	
25	3.7	Waste exemptions			11	19	
Page	Section	Current industrial land use	On site	0-50m	50-250m	250-500m	500-2000m
29	4.1	Recent industrial land uses		2			
30	4.2	Current or recent petrol stations			2		

31	**4.11**	**Licensed pollutant release (Part A(2)/B)**		1			
32	**4.13**	**Licensed Discharges to controlled waters**				6	
34	**4.18**	**Pollution Incidents (EA/NRW)**				4	

Page	Section	Hydrogeology	On site	0-50m	50-250m	250-500m	500-2000m
36	**5.1**	**Superficial aquifer**	Identified (within 500m)				
38	**5.2**	**Bedrock aquifer**	Identified (within 500m)				
40	**5.3**	**Groundwater vulnerability**	Identified (within 50m)				
42	**5.6**	**Groundwater abstractions**					4

Page	Section	Hydrology	On site	0-50m	50-250m	250-500m	500-2000m
45	**6.1**	**Water Network (OS MasterMap)**	1	3	9		

47	**6.2**	**Surface water features**	1	1	6		
47	**6.3**	**WFD Surface water body catchments**	1				
47	**6.4**	**WFD Surface water bodies**					
48	**6.5**	**WFD Groundwater bodies**	1				
Page	Section	River and coastal flooding	On site	0-50m	50-250m	250-500m	500-2000m

Page	Section	Surface water flooding	
52	**8.1**	**Surface water flooding**	1 in 30 year, 0.3m - 1.0m (within 50m)
Page	Section	Groundwater flooding	
54	**9.1**	**Groundwater flooding**	Low (within 50m)

Page	Section	Environmental designations	On site	0-50m	50-250m	250-500m	500-2000m
57	**10.7**	**Designated Ancient Woodland**				1	9
58	**10.11**	**Green Belt**				1	2

61	**10.17**	**SSSI Impact Risk Zones**	1				

Page	Section	Visual and cultural designations	On site	0-50m	50-250m	250-500m	500-2000m
64	**11.4**	**Listed Buildings**			1		

Page	Section	Agricultural designations	On site	0-50m	50-250m	250-500m	500-2000m
66	**12.1**	**Agricultural Land Classification**	Grade 4 (within 250m)				

Page	Section	Habitat designations	On site	0-50m	50-250m	250-500m	500-2000m

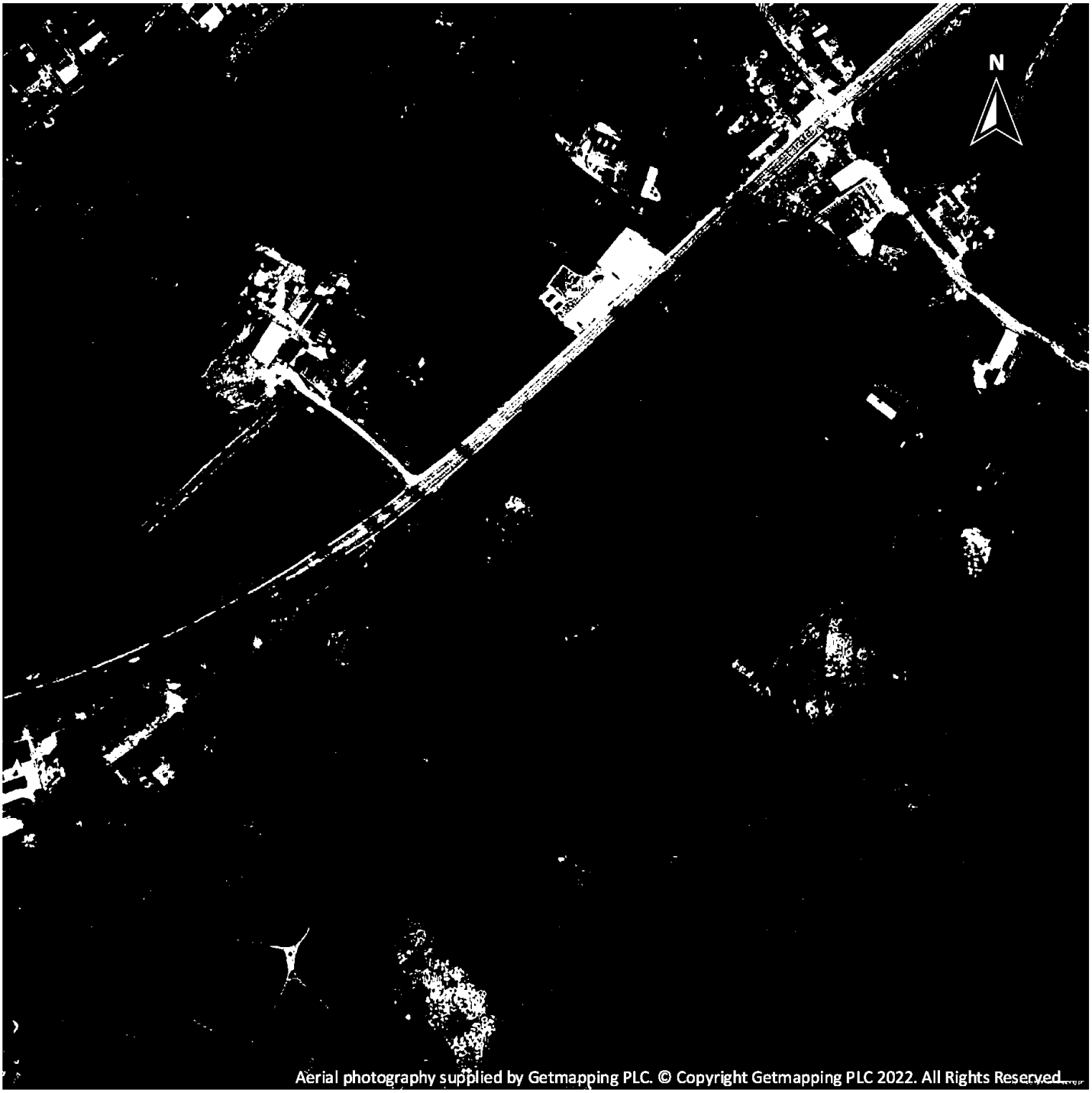
Page	Section	Geology 1:10,000 scale	On site	0-50m	50-250m	250-500m	500-2000m
70	**14.1**	**10k Availability**	Identified (within 500m)				
71	**14.2**	**Artificial and made ground (10k)**			1	2	
72	**14.3**	**Superficial geology (10k)**	1			1	

95	**18.6**	**Non-coal mining**	1			1	

Page	Section	Radon					
98	**19.1**	**Radon**	Less than 1% (within 0m)				
Page	Section	Soil chemistry	On site	0-50m	50-250m	250-500m	500-2000m
99	**20.1**	**BGS Estimated Background Soil Chemistry**	7	5			

Page	Section	Railway infrastructure and projects	On site	0-50m	50-250m	250-500m	500-2000m
102	**21.4**	**Historical railway and tunnel features**			1		

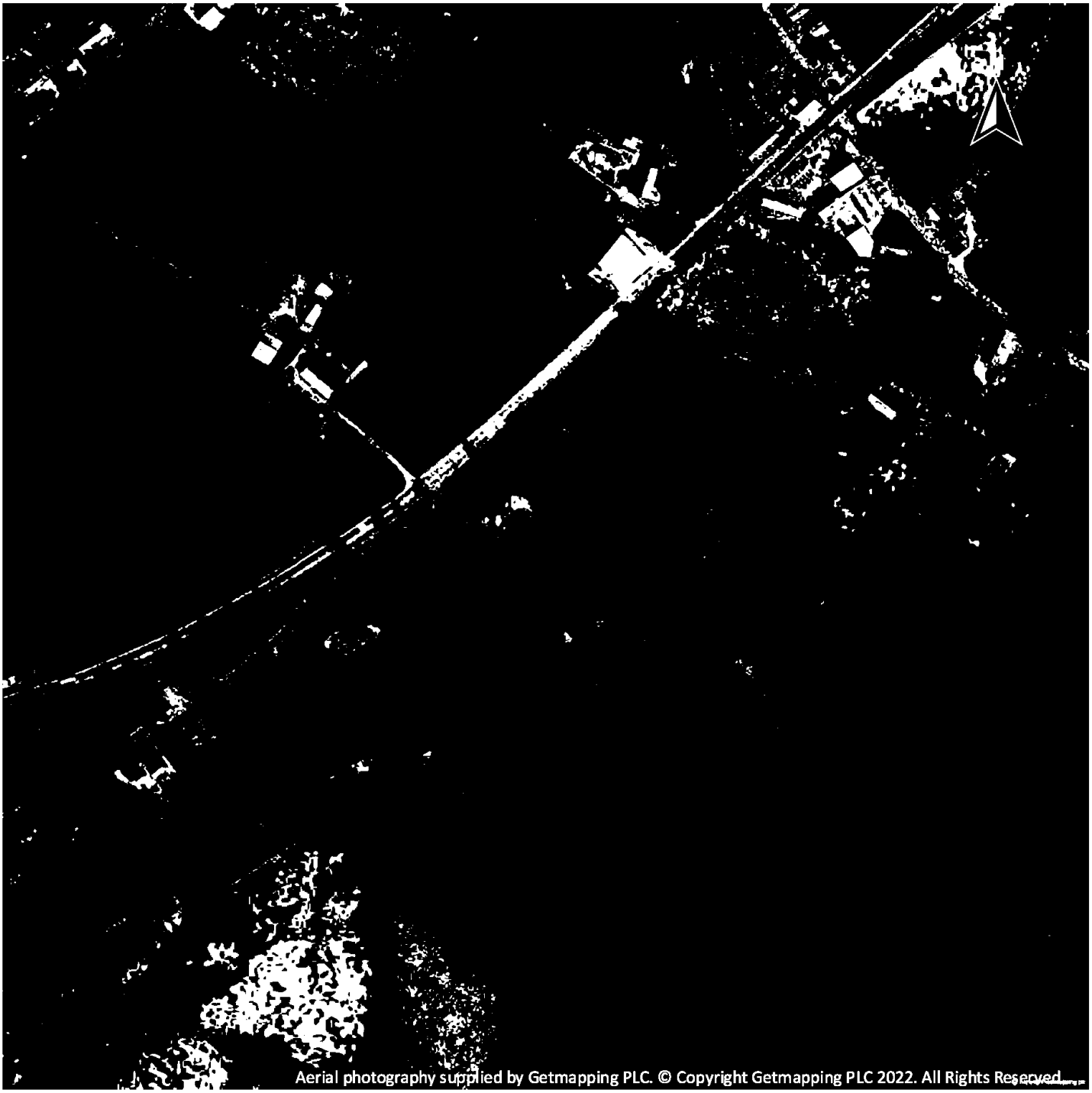
Recent aerial photograph



Capture Date: 16/04/2020

Site Area: 4.11ha

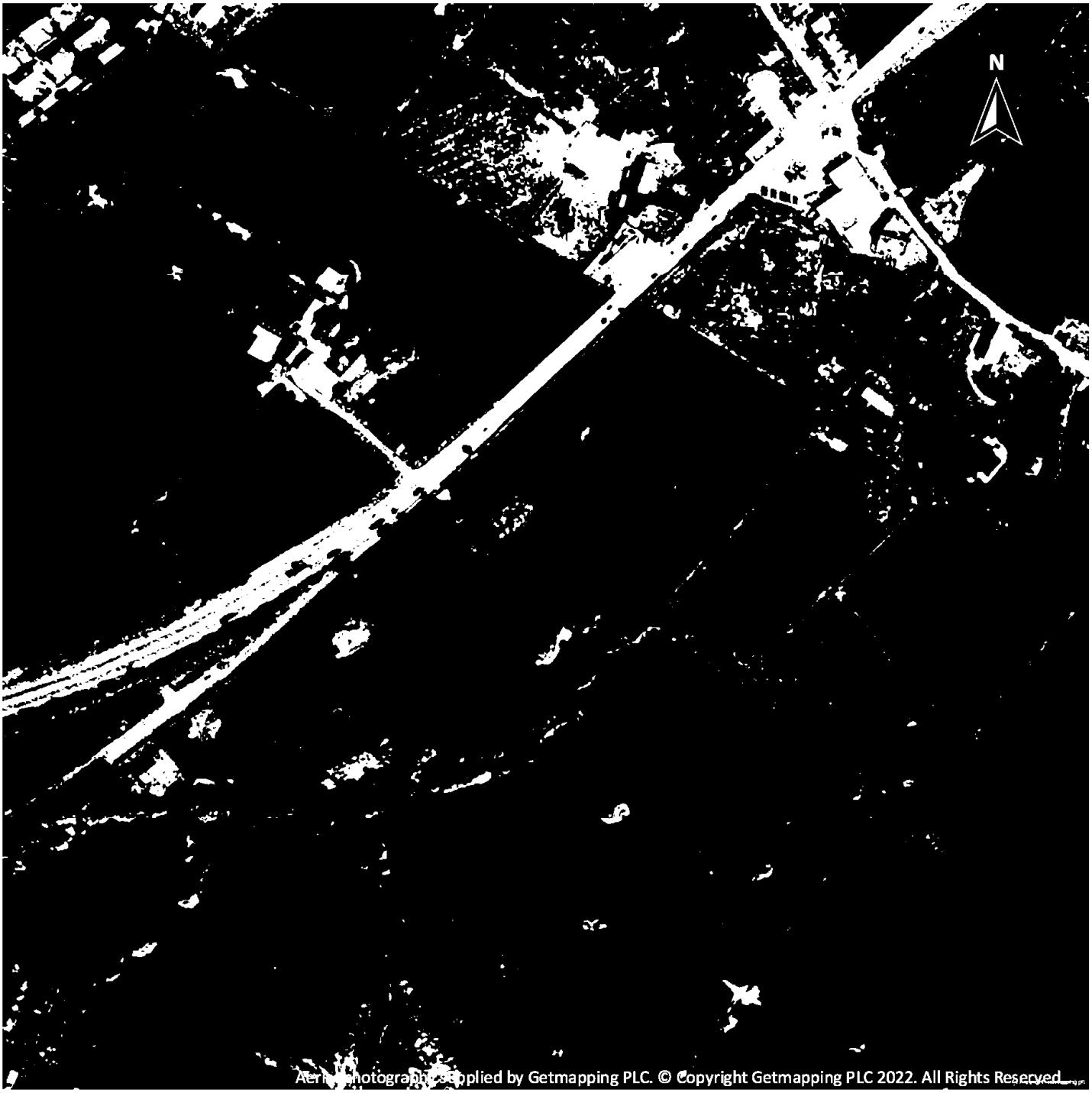
Recent site history - 2012 aerial photograph



Capture Date: 26/03/2012

Site Area: 4.11ha

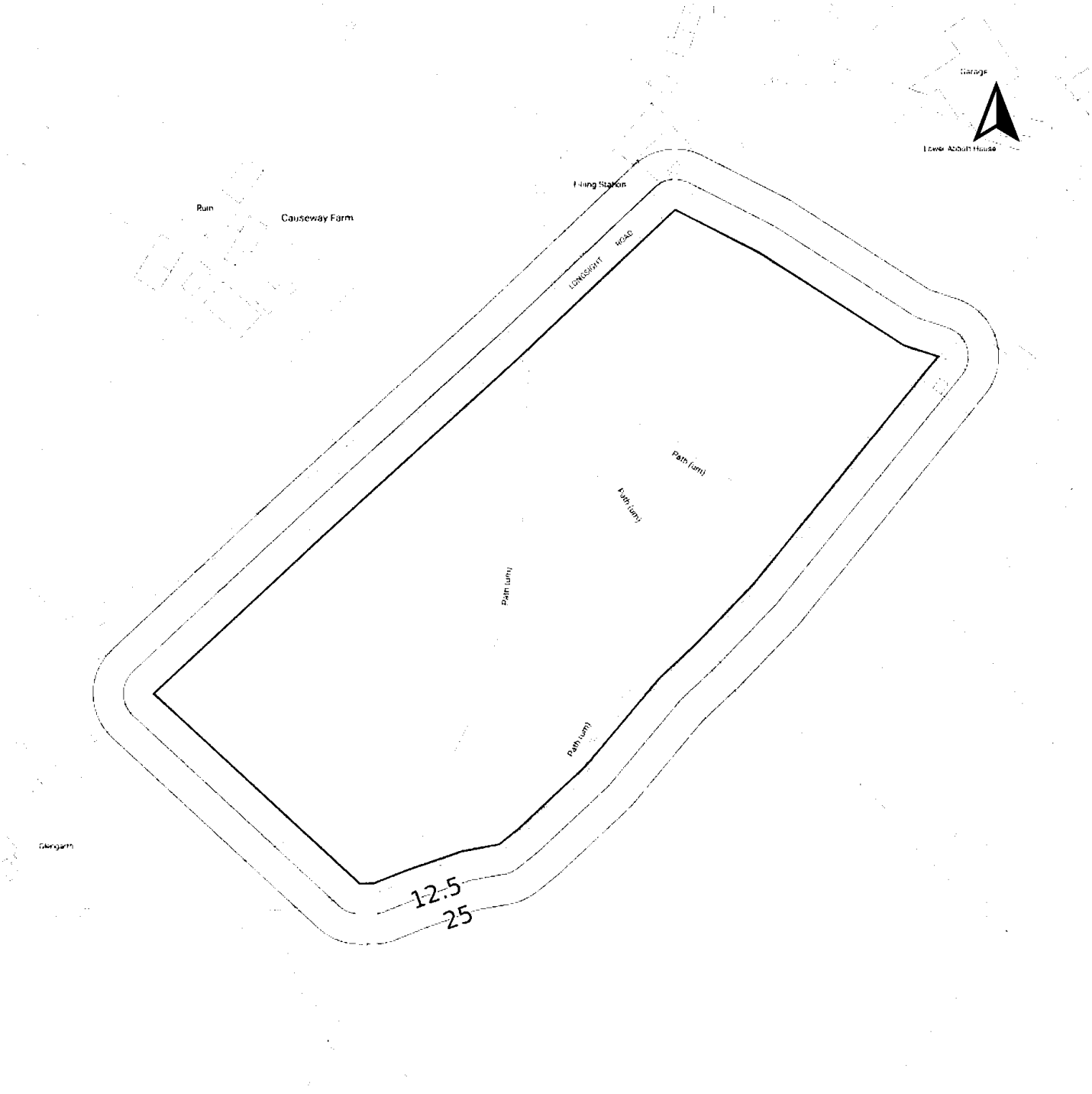
Recent site history - 2001 aerial photograph



Capture Date: 12/05/2001

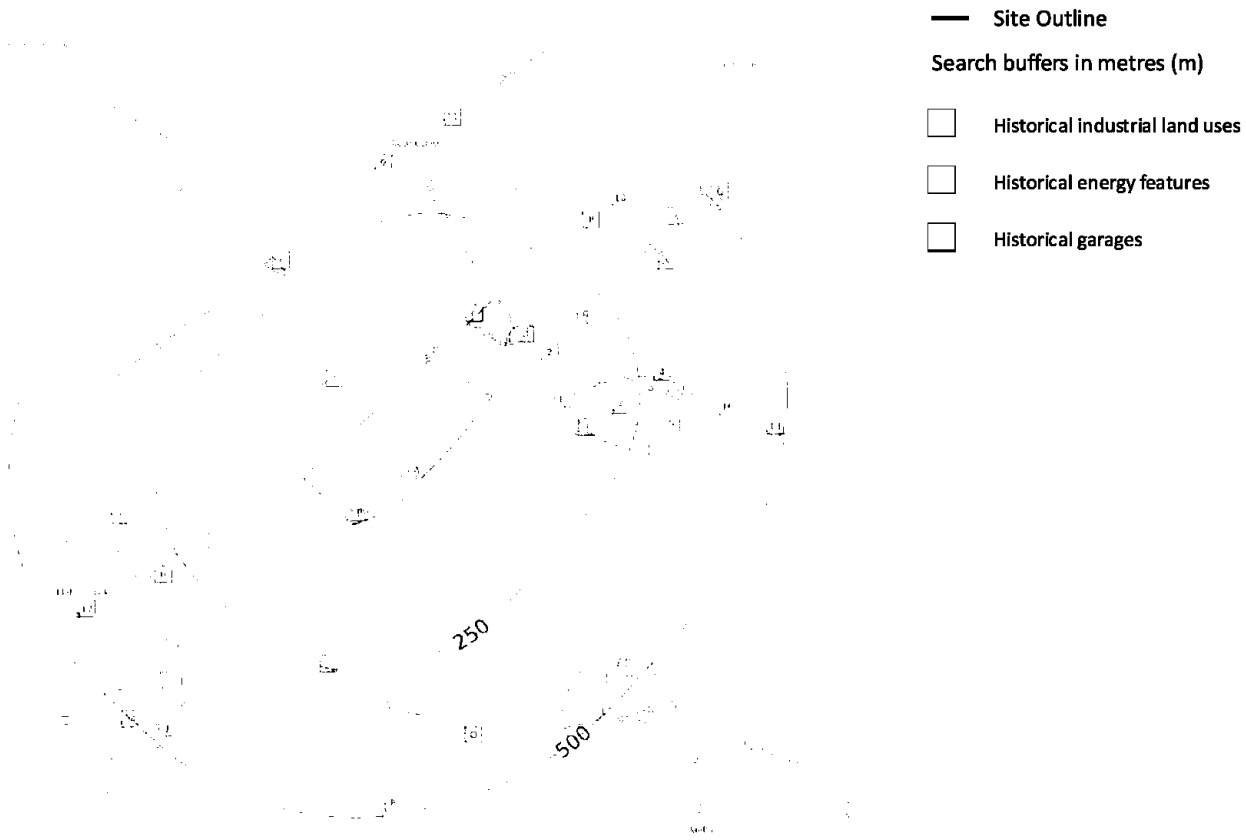
Site Area: 4.11ha

OS MasterMap site plan



Site Area: 4.11ha

1 Past land use



1.1 Historical industrial land uses

Records within 500m **64**

Potentially contaminative land use features digitised from historical Ordnance Survey mapping at 1:10,000 and 1:10,560 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use map on **page 12**

ID	Location	Land use	Dates present	Group ID
A	**On site**	**Unspecified Pit**	**1951**	**688335**

ID	Location	Land use	Dates present	Group ID
A	**On site**	**Unspecified Ground Workings**	**1910 - 1932**	**718837**
B	**On site**	**Unspecified Pit**	**1910 - 1932**	**723853**
B	**On site**	**Unspecified Pit**	**1951 - 1969**	**747365**
B	**On site**	**Unspecified Pit**	**1892**	**774458**

ID	Location	Land use	Dates present	Group ID

ID	Location	Land use	Dates present	Group ID

1.2 Historical tanks

Records within 500m **0**

Tank features digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

1.3 Historical energy features

Records within 500m **3**

Energy features digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use map on **page 12**

ID	Location	Land use	Dates present	Group ID

1.4 Historical petrol stations

Records within 500m **0**

Petrol stations digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

1.5 Historical garages

Records within 500m **2**

Garages digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale, intelligently grouped into contiguous features. To prevent misrepresentation of the size of historical features at any given time, features are only grouped if they have similar geometries within immediately preceding or succeeding map editions. See section 2 for a breakdown of grouping if required. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use map on **page 12**

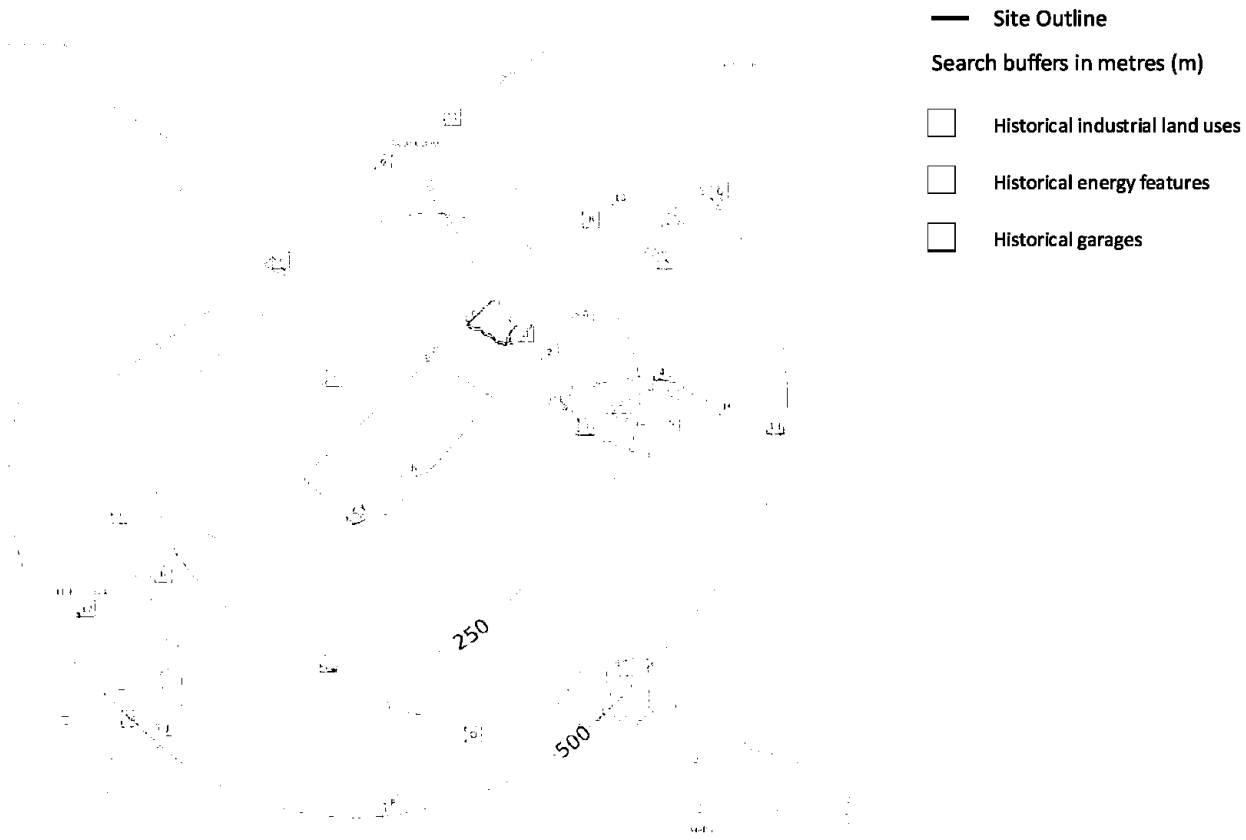
ID	Location	Land use	Dates present	Group ID

1.6 Historical military land

Records within 500m **0**

Areas of military land digitised from multiple sources including the National Archives, local records, MOD records and verified other sources, intelligently grouped into contiguous features.

2 Past land use - un-grouped



2.1 Historical industrial land uses

Records within 500m **79**

Potentially contaminative land use features digitised from historical Ordnance Survey mapping at 1:10,000 and 10,560 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on **page 17**

ID	Location	Land Use	Date	Group ID
A	**On site**	**Unspecified Pit**	**1892**	**774458**
A	**On site**	**Unspecified Pit**	**1910**	**723853**
A	**On site**	**Unspecified Pit**	**1932**	**723853**

ID	Location	Land Use	Date	Group ID
A	**On site**	**Unspecified Pit**	**1951**	**747365**
A	**On site**	**Unspecified Pit**	**1969**	**747365**
B	**On site**	**Unspecified Ground Workings**	**1910**	**718837**
B	**On site**	**Unspecified Ground Workings**	**1932**	**718837**
B	**On site**	**Unspecified Pit**	**1951**	**688335**

ID	Location	Land Use	Date	Group ID

ID	Location	Land Use	Date	Group ID

2.2 Historical tanks

Records within 500m **0**

Tank features digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

2.3 Historical energy features

Records within 500m **5**

Energy features digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on **page 17**

ID	Location	Land Use	Date	Group ID

2.4 Historical petrol stations

Records within 500m **0**

Petrol stations digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

2.5 Historical garages

Records within 500m **4**

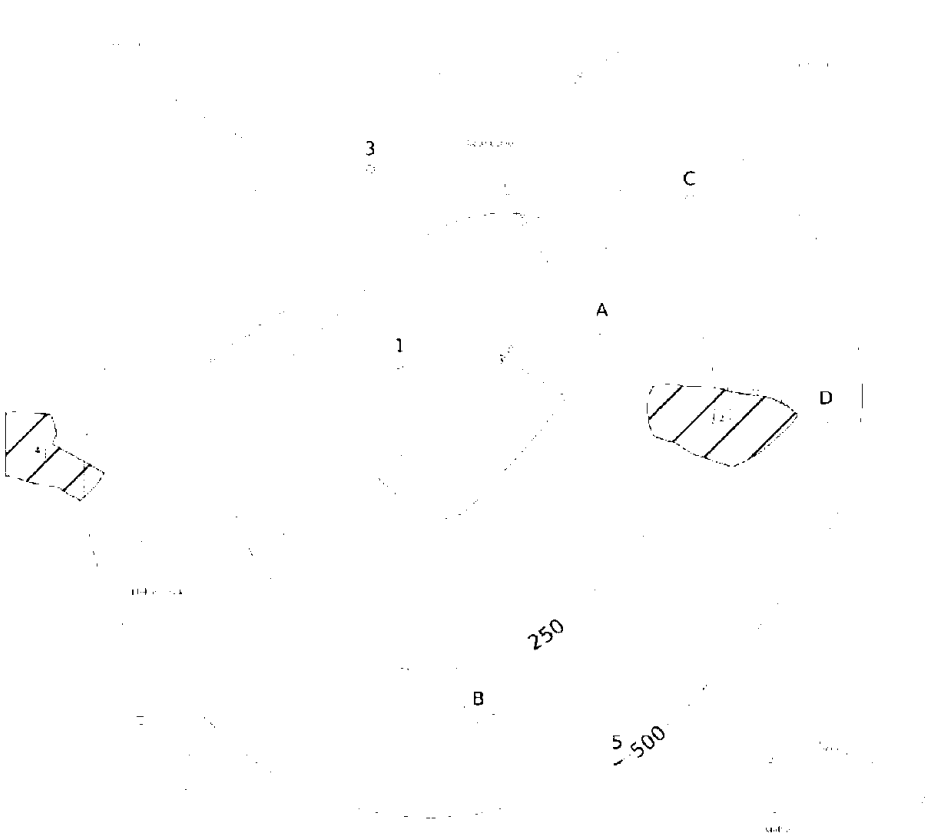
Garages digitised from historical Ordnance Survey mapping at high-detail 1:1,250 and 1:2,500 scale. Any records shown are available intelligently grouped in section 1. Grouped and the original un-grouped features can be cross-referenced across sections 1 and 2 using the 'Group ID'.

Features are displayed on the Past land use - un-grouped map on **page 17**

ID	Location	Land Use	Date	Group ID

ID	Location	Land Use	Date	Group ID

3 Waste and landfill



3.1 Active or recent landfill

Records within 500m	0

Active or recently closed landfill sites under Environment Agency/Natural Resources Wales regulation.

3.2 Historical landfill (BGS records)

Records within 500m	0

Landfill sites identified on a survey carried out on behalf of the DoE in 1973. These sites may have been closed or operational at this time.

3.3 Historical landfill (LA/mapping records)

Records within 500m **0**

Landfill sites identified from Local Authority records and high detail historical mapping.

3.4 Historical landfill (EA/NRW records)

Records within 500m **2**

Known historical (closed) landfill sites (e.g. sites where there is no PPC permit or waste management licence currently in force). This includes sites that existed before the waste licensing regime and sites that have been licensed in the past but where a licence has been revoked, ceased to exist or surrendered and a certificate of completion has been issued.

Features are displayed on the Waste and landfill map on **page 23**

ID	Location	Details

3.5 Historical waste sites

Records within 500m **0**

Waste site records derived from Local Authority planning records and high detail historical mapping.

3.6 Licensed waste sites

Records within 500m **0**

Active or recently closed waste sites under Environment Agency/Natural Resources Wales regulation.

3.7 Waste exemptions

Records within 500m **30**

Activities involving the storage, treatment, use or disposal of waste that are exempt from needing a permit. Exemptions have specific limits and conditions that must be adhered to.

Features are displayed on the Waste and landfill map on **page 23**

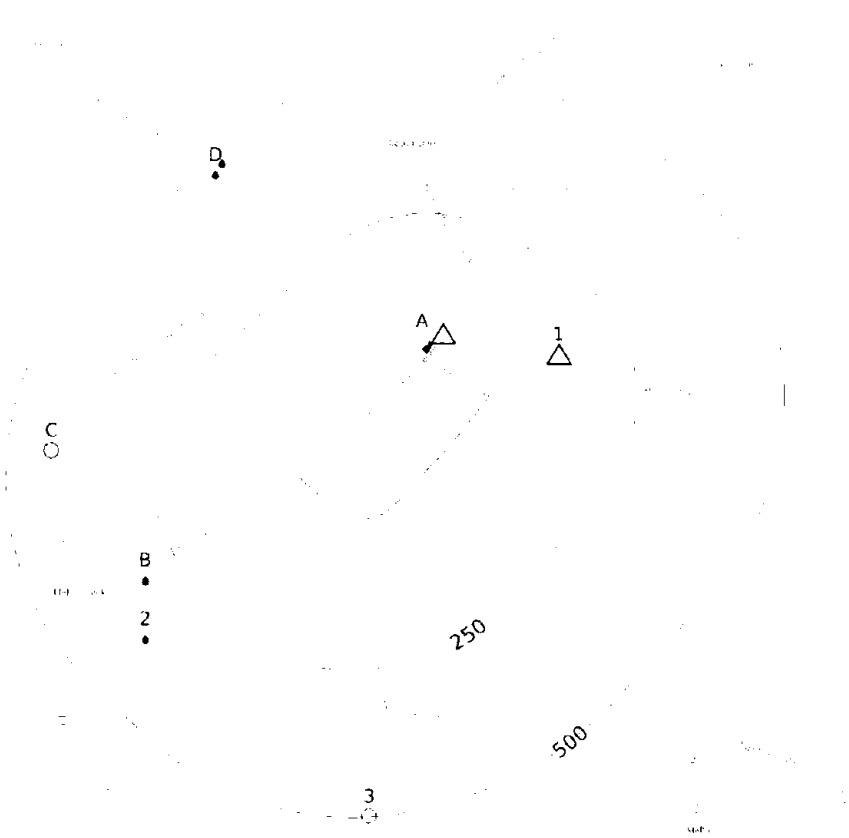
ID	Location	Site	Reference	Category	Sub-Category	Description

ID	Location	Site	Reference	Category	Sub-Category	Description

ID	Location	Site	Reference	Category	Sub-Category	Description

ID	Location	Site	Reference	Category	Sub-Category	Description

4 Current industrial land use



Site Outline

Search buffers in metres (m)

Recent industrial land uses

Current or recent petrol stations

Licensed pollutant release (Part A(2)/B)

Licensed Discharges to controlled waters

Pollution Incidents (EA/NRW)

4.1 Recent industrial land uses

Records within 250m **2**

Current potentially contaminative industrial sites.

Features are displayed on the Current industrial land use map on **page 29**

ID	Location	Company	Address	Activity	Category

4.2 Current or recent petrol stations

Records within 500m **2**

Open, closed, under development and obsolete petrol stations.

Features are displayed on the Current industrial land use map on **page 29**

ID	Location	Company	Address	LPG	Status

4.3 Electricity cables

Records within 500m **0**

High voltage underground electricity transmission cables.

4.4 Gas pipelines

Records within 500m **0**

High pressure underground gas transmission pipelines.

4.5 Sites determined as Contaminated Land

Records within 500m **0**

Contaminated Land Register of sites designated under Part 2a of the Environmental Protection Act 1990.

4.6 Control of Major Accident Hazards (COMAH)

Records within 500m **0**

Control of Major Accident Hazards (COMAH) sites. This data includes upper and lower tier sites, and includes a historical archive of COMAH sites and Notification of Installations Handling Hazardous Substances (NIHHS) records.

4.7 Regulated explosive sites

Records within 500m **0**

Sites registered and licensed by the Health and Safety Executive under the Manufacture and Storage of Explosives Regulations 2005 (MSER). The last update to this data was in April 2011.

4.8 Hazardous substance storage/usage

Records within 500m **0**

Consents granted for a site to hold certain quantities of hazardous substances at or above defined limits in accordance with the Planning (Hazardous Substances) Regulations 2015.

4.9 Historical licensed industrial activities (IPC)

Records within 500m **0**

Integrated Pollution Control (IPC) records of substance releases to air, land and water. This data represents a historical archive as the IPC regime has been superseded.

4.10 Licensed industrial activities (Part A(1))

Records within 500m **0**

Records of Part A(1) installations regulated under the Environmental Permitting (England and Wales) Regulations 2016 for the release of substances to the environment.

4.11 Licensed pollutant release (Part A(2)/B)

Records within 500m **1**

Records of Part A(2) and Part B installations regulated under the Environmental Permitting (England and Wales) Regulations 2016 for the release of substances to the environment.

Features are displayed on the Current industrial land use map on **page 29**

ID	Location	Address	Details

4.12 Radioactive Substance Authorisations

Records within 500m **0**

Records of the storage, use, accumulation and disposal of radioactive substances regulated under the Radioactive Substances Act 1993.

4.13 Licensed Discharges to controlled waters

Records within 500m **6**

Discharges of treated or untreated effluent to controlled waters under the Water Resources Act 1991.

Features are displayed on the Current industrial land use map on **page 29**

ID	Location	Address	Details

ID	Location	Address	Details

4.14 Pollutant release to surface waters (Red List)

Records within 500m **0**

Discharges of specified substances under the Environmental Protection (Prescribed Processes and Substances) Regulations 1991.

4.15 Pollutant release to public sewer

Records within 500m **0**

Discharges of Special Category Effluents to the public sewer.

4.16 List 1 Dangerous Substances

Records within 500m **0**

Discharges of substances identified on List I of European Directive E 2006/11/EC, and regulated under the Environmental Damage (Prevention and Remediation) Regulations 2015.

4.17 List 2 Dangerous Substances

Records within 500m **0**

Discharges of substances identified on List II of European Directive E 2006/11/EC, and regulated under the Environmental Damage (Prevention and Remediation) Regulations 2015.

4.18 Pollution Incidents (EA/NRW)

Records within 500m **4**

Records of substantiated pollution incidents. Since 2006 this data has only included category 1 (major) and 2 (significant) pollution incidents.

Features are displayed on the Current industrial land use map on **page 29**

ID	Location	Details

4.19 Pollution inventory substances

Records within 500m **0**

The pollution inventory (substances) includes reporting on annual emissions of certain regulated substances to air, controlled waters and land. A reporting threshold for each substance is also included. Where emissions fall below the reporting threshold, no value will be given. The data is given for the most recent complete year available.

4.20 Pollution inventory waste transfers

Records within 500m	**0**

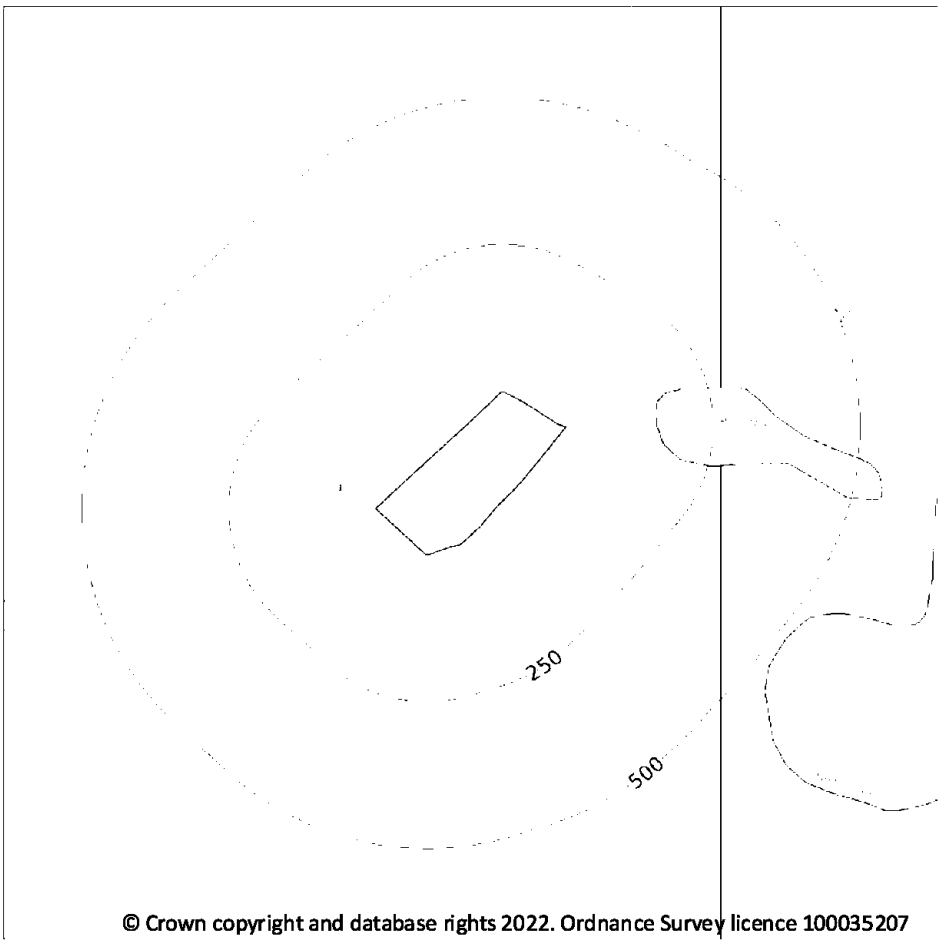
The pollution inventory (waste transfers) includes reporting on annual transfers and recovery/disposal of controlled wastes from a site. A reporting threshold for each waste type is also included. Where releases fall below the reporting threshold, no value will be given. The data is given for the most recent complete year available.

4.21 Pollution inventory radioactive waste

Records within 500m	**0**

The pollution inventory (radioactive wastes) includes reporting on annual releases of radioactive substances from a site, including the means of release. Where releases fall below the reporting threshold, no value will be given. The data is given for the most recent complete year available.

5 Hydrogeology - Superficial aquifer



Site Outline

Search buffers in metres (m)

- Principal
- Secondary A
- Secondary B
- Secondary Undifferentiated
- Unproductive
- Unknown

5.1 Superficial aquifer

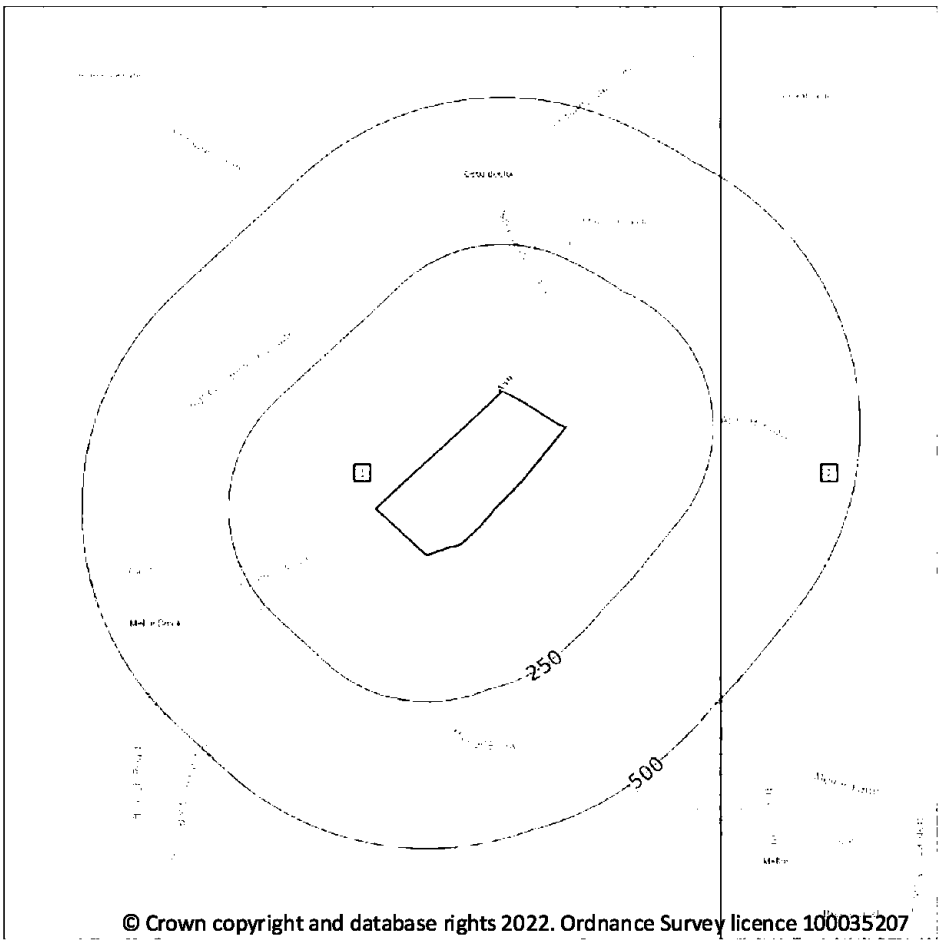
Records within 500m **2**

Aquifer status of groundwater held within superficial geology.

Features are displayed on the Hydrogeology map on **page 36**

ID	Location	Designation	Description
1	**On site**	**Secondary Undifferentiated**	**Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type**

Bedrock aquifer



Site Outline

Search buffers in metres (m)

- ☐ Principal
- ☐ Secondary A
- ☐ Secondary B
- ☐ Secondary Undifferentiated
- ☐ Unproductive

5.2 Bedrock aquifer

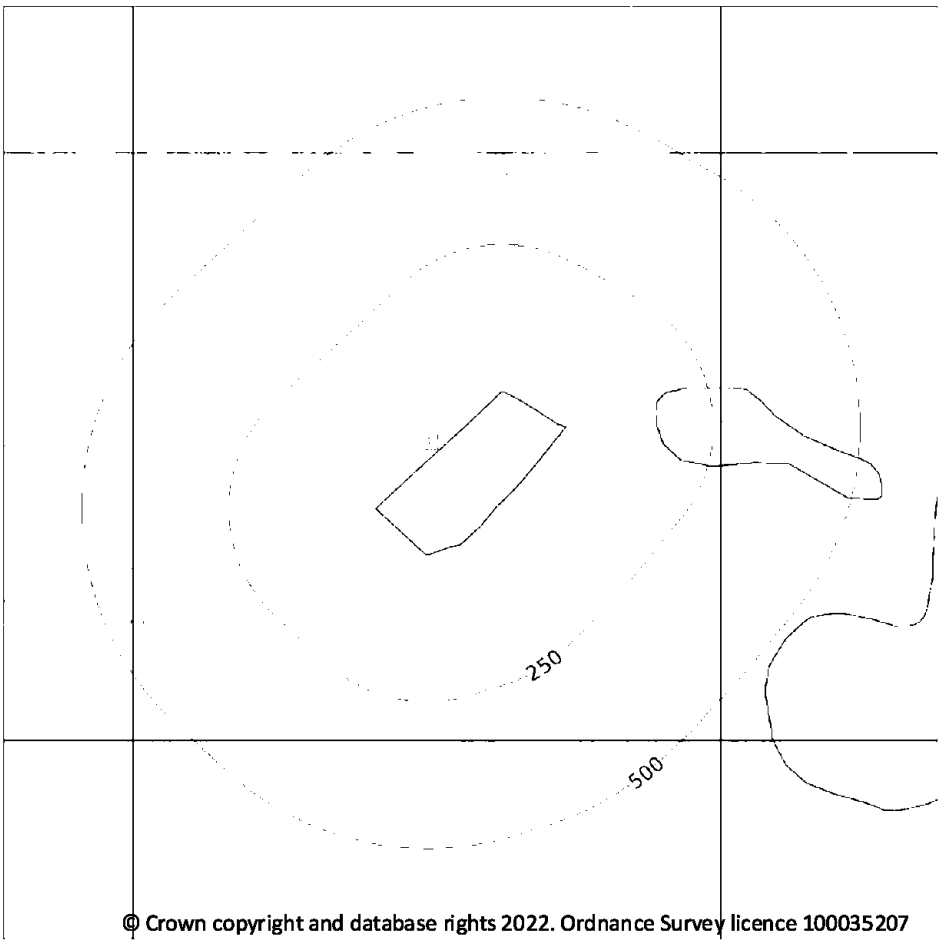
Records within 500m **2**

Aquifer status of groundwater held within bedrock geology.

Features are displayed on the Bedrock aquifer map on **page 38**

ID	Location	Designation	Description
1	**On site**	**Secondary A**	**Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers**

Groundwater vulnerability



Site Outline

Search buffers in metres (m)

Superficial vulnerability

- Principal superficial aquifer, high vulnerability
- Secondary superficial aquifer, high vulnerability
- Principal superficial aquifer, medium vulnerability
- Secondary superficial aquifer, medium vulnerability
- Principal superficial aquifer, low vulnerability
- Secondary superficial aquifer, low vulnerability

Bedrock vulnerability

- Principal bedrock aquifer, high vulnerability
- Secondary bedrock aquifer, high vulnerability
- Principal bedrock aquifer, medium vulnerability
- Secondary bedrock aquifer, medium vulnerability
- Principal bedrock aquifer, low vulnerability
- Secondary bedrock aquifer, low vulnerability

Other information

- Unproductive aquifer
- Soluble rock risk
- Local information

5.3 Groundwater vulnerability

Records within 50m **1**

An assessment of the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a one kilometre square grid. Groundwater vulnerability is described as High, Medium or Low as follows:

High - Areas able to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits.
Medium - Intermediate between high and low vulnerability.
Low - Areas that provide the greatest protection from pollution. They are likely to be characterised by low leaching soils and/or the presence of superficial deposits characterised by a low permeability.

Features are displayed on the Groundwater vulnerability map on **page 40**

ID	Location	Summary	Soil / surface	Superficial geology	Bedrock geology
1	On site	**Summary Classification: Secondary superficial aquifer - Low Vulnerability Combined classification: Productive Bedrock Aquifer, Productive Superficial Aquifer**	**Leaching class: Low Infiltration value: <40% Dilution value: >550mm/year**	**Vulnerability: Low Aquifer type: Secondary Thickness: >10m Patchiness value: >90% Recharge potential: High**	**Vulnerability: Low Aquifer type: Secondary Flow mechanism: Well connected fractures**

5.4 Groundwater vulnerability- soluble rock risk

Records on site **0**

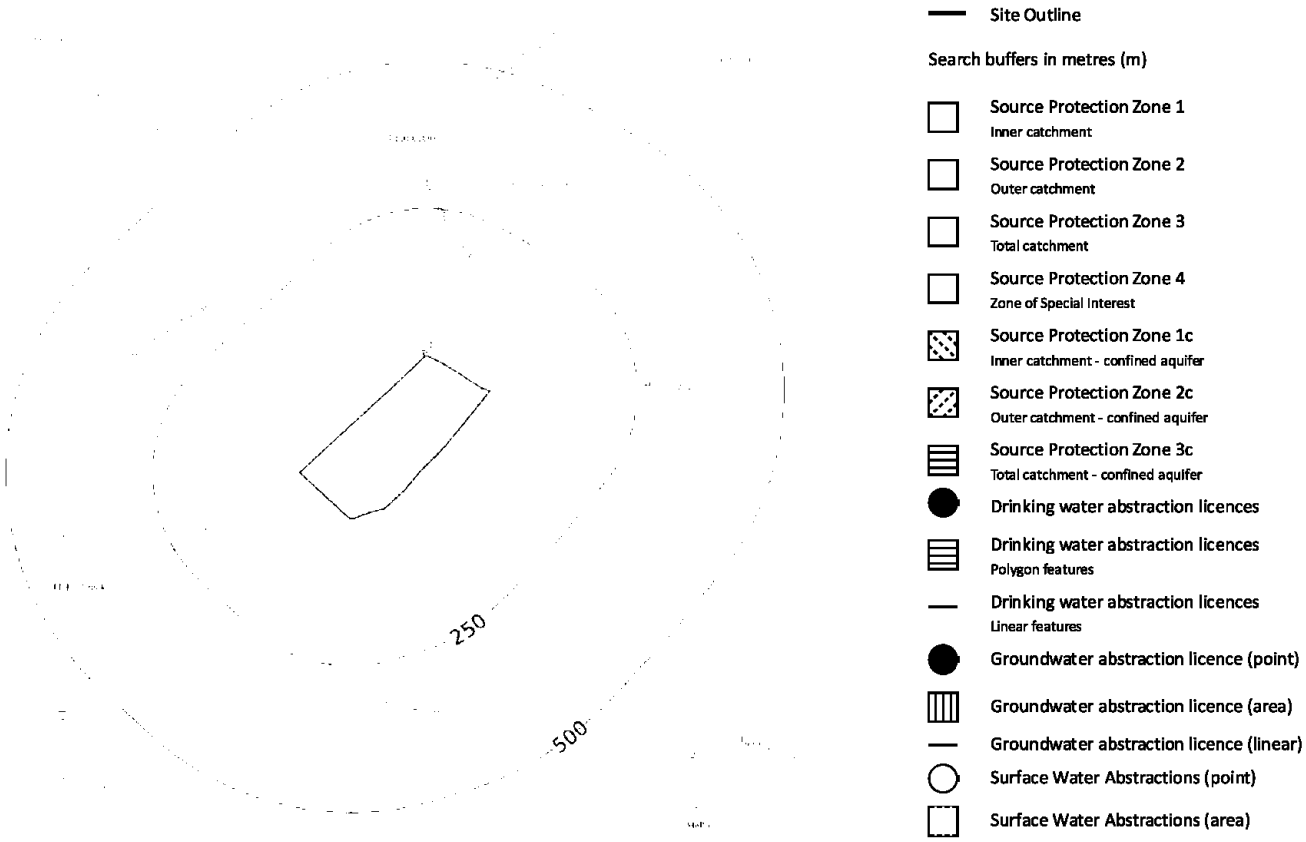
This dataset identifies areas where solution features that enable rapid movement of a pollutant may be present within a 1km grid square.

5.5 Groundwater vulnerability- local information

Records on site **0**

This dataset identifies areas where additional local information affecting vulnerability is held by the Environment Agency. Further information can be obtained by contacting the Environment Agency local Area groundwater team through the Environment Agency National Customer Call Centre on 03798 506 506 or by email on enquiries@environment-agency.gov.uk.

Abstractions and Source Protection Zones



5.6 Groundwater abstractions

Records within 2000m **4**

Licensed groundwater abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, between two points (line data) or a larger area.

Features are displayed on the Abstractions and Source Protection Zones map on **page 42**

ID	Location	Details

5.7 Surface water abstractions

Records within 2000m	**0**

Licensed surface water abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, a stretch of watercourse or a larger area.

5.8 Potable abstractions

Records within 2000m	**0**

Licensed potable water abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, a stretch of watercourse or a larger area.

5.9 Source Protection Zones

Records within 500m	**0**

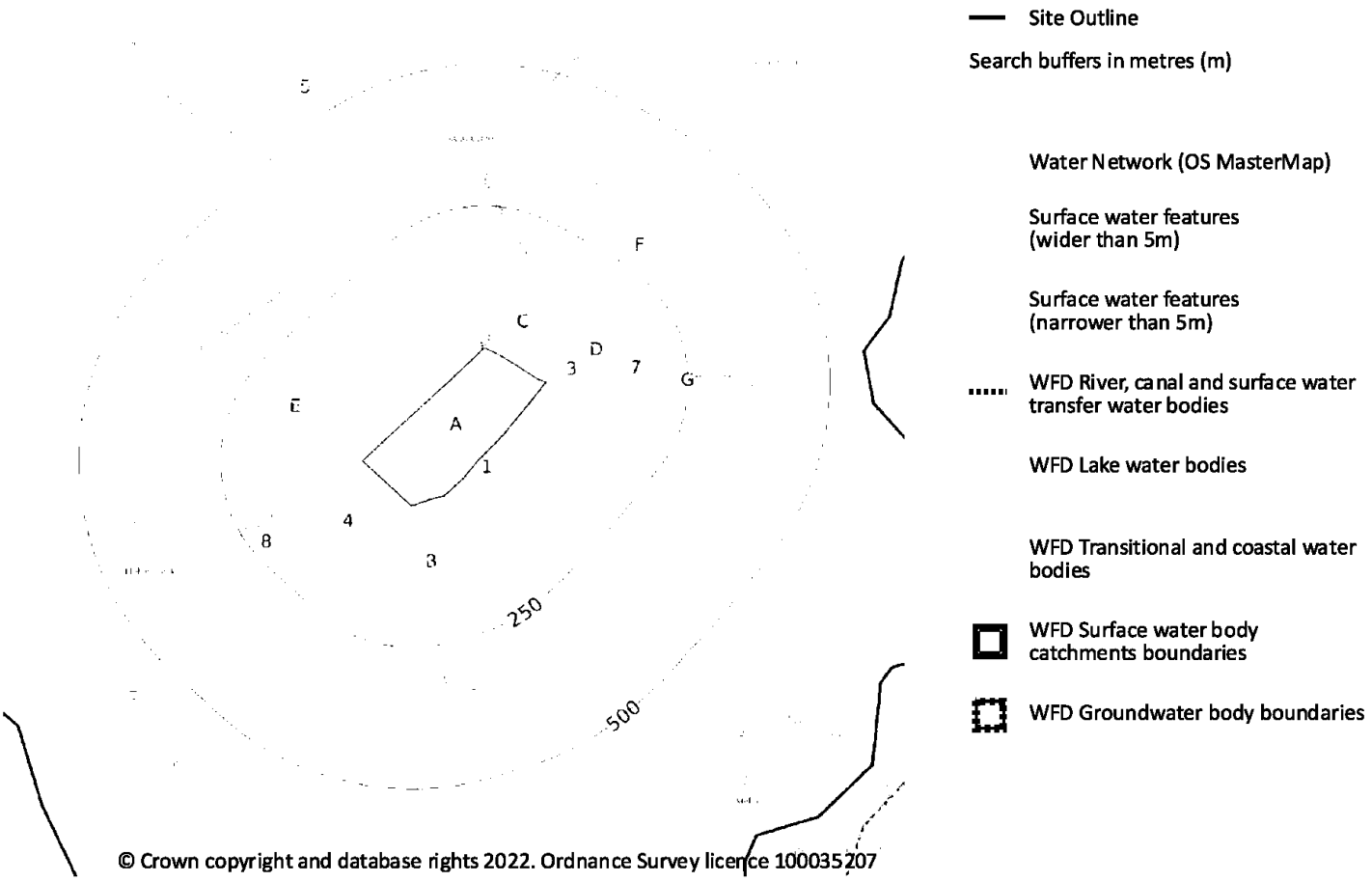
Source Protection Zones define the sensitivity of an area around a potable abstraction site to contamination.

5.10 Source Protection Zones (confined aquifer)

Records within 500m	**0**

Source Protection Zones in the confined aquifer define the sensitivity around a deep groundwater abstraction to contamination. A confined aquifer would normally be protected from contamination by overlying geology and is only considered a sensitive resource if deep excavation/drilling is taking place.

6 Hydrology



6.1 Water Network (OS MasterMap)

Records within 250m **13**

Detailed water network of Great Britain showing the flow and precise central course of every river, stream, lake and canal.

Features are displayed on the Hydrology map on **page 45**

ID	Location	Type of water feature	Ground level	Permanence	Name
1	**On site**	**Inland river not influenced by normal tidal action.**	**On ground surface**	**Watercourse contains water year round (in normal circumstances)**	-

ID	Location	Type of water feature	Ground level	Permanence	Name

6.2 Surface water features

Records within 250m **8**

Covering rivers, streams and lakes (some overlap with OS MasterMap Water Network data in previous section) but additionally covers smaller features such as ponds. Rivers and streams narrower than 5m are represented as a single line. Lakes, ponds and rivers or streams wider than 5m are represented as polygons.

Features are displayed on the Hydrology map on **page 45**

6.3 WFD Surface water body catchments

Records on site **1**

The Water Framework Directive is an EU-led framework for the protection of inland surface waters, estuaries, coastal waters and groundwater through river basin-level management planning. In terms of surface water, these basins are broken down into smaller units known as management, operational and water body catchments.

Features are displayed on the Hydrology map on **page 45**

ID	Location	Type	Water body catchment	Water body ID	Operational catchment	Management catchment
A	**On site**	**River**	**Ribble - conf Calder to tidal**	**GB112071065500**	**Big Ribble**	**Ribble**

6.4 WFD Surface water bodies

Records identified **1**

Surface water bodies under the Directive may be rivers, lakes, estuary or coastal. To achieve the purpose of the Directive, environmental objectives have been set and are reported on for each water body. The progress towards delivery of the objectives is then reported on by the relevant competent authorities at the end of each six-year cycle. The river water body directly associated with the catchment listed in the previous section is detailed below, along with any lake, canal, coastal or artificial water body within 250m of the site. Click on the water body ID in the table to visit the EA Catchment Explorer to find out more about each water body listed.

Features are displayed on the Hydrology map on **page 45**

ID	Location	Type	Name	Water body ID	Overall rating	Chemical rating	Ecological rating	Year

6.5 WFD Groundwater bodies

Records on site **1**

Groundwater bodies are also covered by the Directive and the same regime of objectives and reporting detailed in the previous section is in place. Click on the water body ID in the table to visit the EA Catchment Explorer to find out more about each groundwater body listed.

Features are displayed on the Hydrology map on **page 45**

ID	Location	Name	Water body ID	Overall rating	Chemical rating	Quantitative	Year
A	**On site**	**Ribble Carboniferous Aquifers**	**GB41202G103000**	**Poor**	**Poor**	**Good**	**2019**

7 River and coastal flooding

7.1 Risk of flooding from rivers and the sea

Records within 50m **0**

The chance of flooding from rivers and/or the sea in any given year, based on cells of 50m within the Risk of Flooding from Rivers and Sea (RoFRaS)/Flood Risk Assessment Wales (FRAW) models. Each cell is allocated one of four flood risk categories, taking into account flood defences and their condition. The risk categories for RoFRaS for rivers and the sea and FRAW for rivers are; Very low (less than 1 in 1000 chance in any given year), Low (less than 1 in 100 but greater than or equal to 1 in 1000 chance), Medium (less than 1 in 30 but greater than or equal to 1 in 100 chance) or High (greater than or equal to 1 in 30 chance). The risk categories for FRAW for the sea are; Very low (less than 1 in 1000 chance in any given year), Low (less than 1 in 200 but greater than or equal to 1 in 1000 chance), Medium (less than 1 in 30 but greater than or equal to 1 in 200 chance) or High (greater than or equal to 1 in 30 chance).

7.2 Historical Flood Events

Records within 250m **0**

Records of historic flooding from rivers, the sea, groundwater and surface water. Records began in 1946 when predecessor bodies started collecting detailed information about flooding incidents, although limited details may be included on flooding incidents prior to this date. Takes into account the presence of defences, structures, and other infrastructure where they existed at the time of flooding, and includes flood extents that may have been affected by overtopping, breaches or blockages.

7.3 Flood Defences

Records within 250m **0**

Records of flood defences owned, managed or inspected by the Environment Agency and Natural Resources Wales. Flood defences can be structures, buildings or parts of buildings. Typically these are earth banks, stone and concrete walls, or sheet-piling that is used to prevent or control the extent of flooding.

7.4 Areas Benefiting from Flood Defences

Records within 250m	**0**

Areas that would benefit from the presence of flood defences in a 1 in 100 (1%) chance of flooding each year from rivers or 1 in 200 (0.5%) chance of flooding each year from the sea.

7.5 Flood Storage Areas

Records within 250m	**0**

Areas that act as a balancing reservoir, storage basin or balancing pond to attenuate an incoming flood peak to a flow level that can be accepted by the downstream channel or to delay the timing of a flood peak so that its volume is discharged over a longer period.

River and coastal flooding - Flood Zones

7.6 Flood Zone 2

Records within 50m **0**

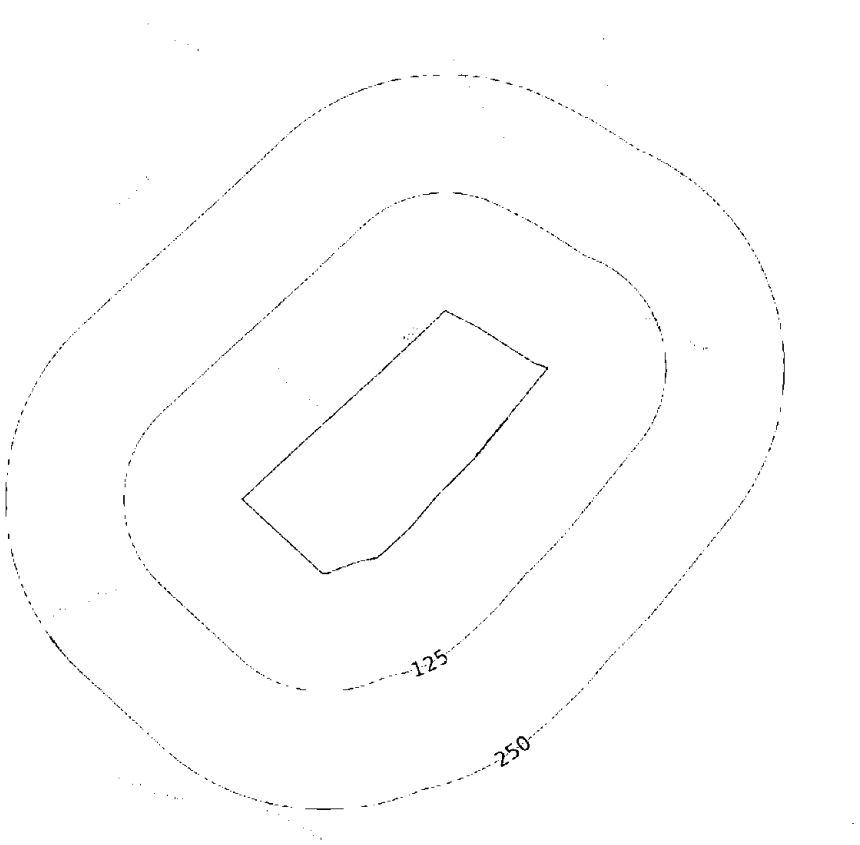
Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land between Flood Zone 3 (see next section) and the extent of the flooding from rivers or the sea with a 1 in 1000 (0.1%) chance of flooding each year.

7.7 Flood Zone 3

Records within 50m **0**

Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land with a 1 in 100 (1%) or greater chance of flooding each year from rivers or a 1 in 200 (0.5%) or greater chance of flooding each year from the sea.

8 Surface water flooding



Site Outline
Search buffers in metres (m)

1 in 1000 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 250 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 100 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 30 return period
- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

8.1 Surface water flooding

Highest risk on site	**1 in 30 year, 0.1m - 0.3m**
Highest risk within 50m	**1 in 30 year, 0.3m - 1.0m**

Ambiental Risk Analytics surface water (pluvial) FloodMap identifies areas likely to flood as a result of extreme rainfall events, i.e. land naturally vulnerable to surface water ponding or flooding. This data set was produced by simulating 1 in 30 year, 1 in 100 year, 1 in 250 year and 1 in 1,000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though some older ones may flood in a 1 in 5 year rainfall event.

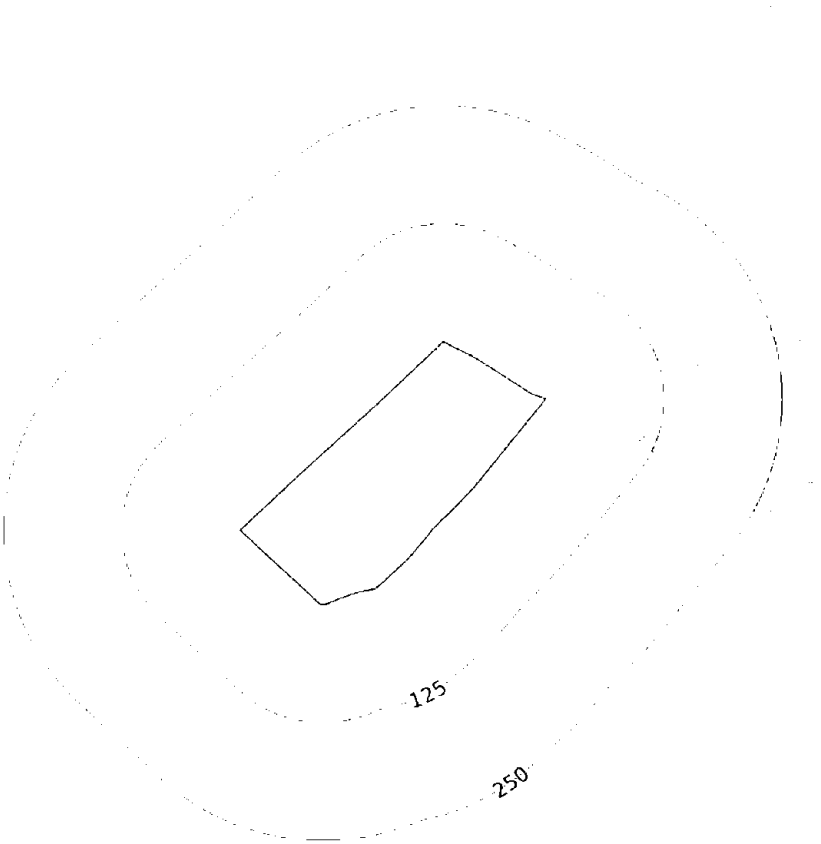
Features are displayed on the Surface water flooding map on **page 52**

The data shown on the map and in the table above shows the highest likelihood of flood events happening at the site. Lower likelihood events may have greater flood depths and hence a greater potential impact on a site.

The table below shows the maximum flood depths for a range of return periods for the site.

Return period	Maximum modelled depth

9 Groundwater flooding



Site Outline

Search buffers in metres (m)

- ☐ High
- ☐ Moderate - High
- ☐ Moderate
- ☐ Low
- ☐ Negligible

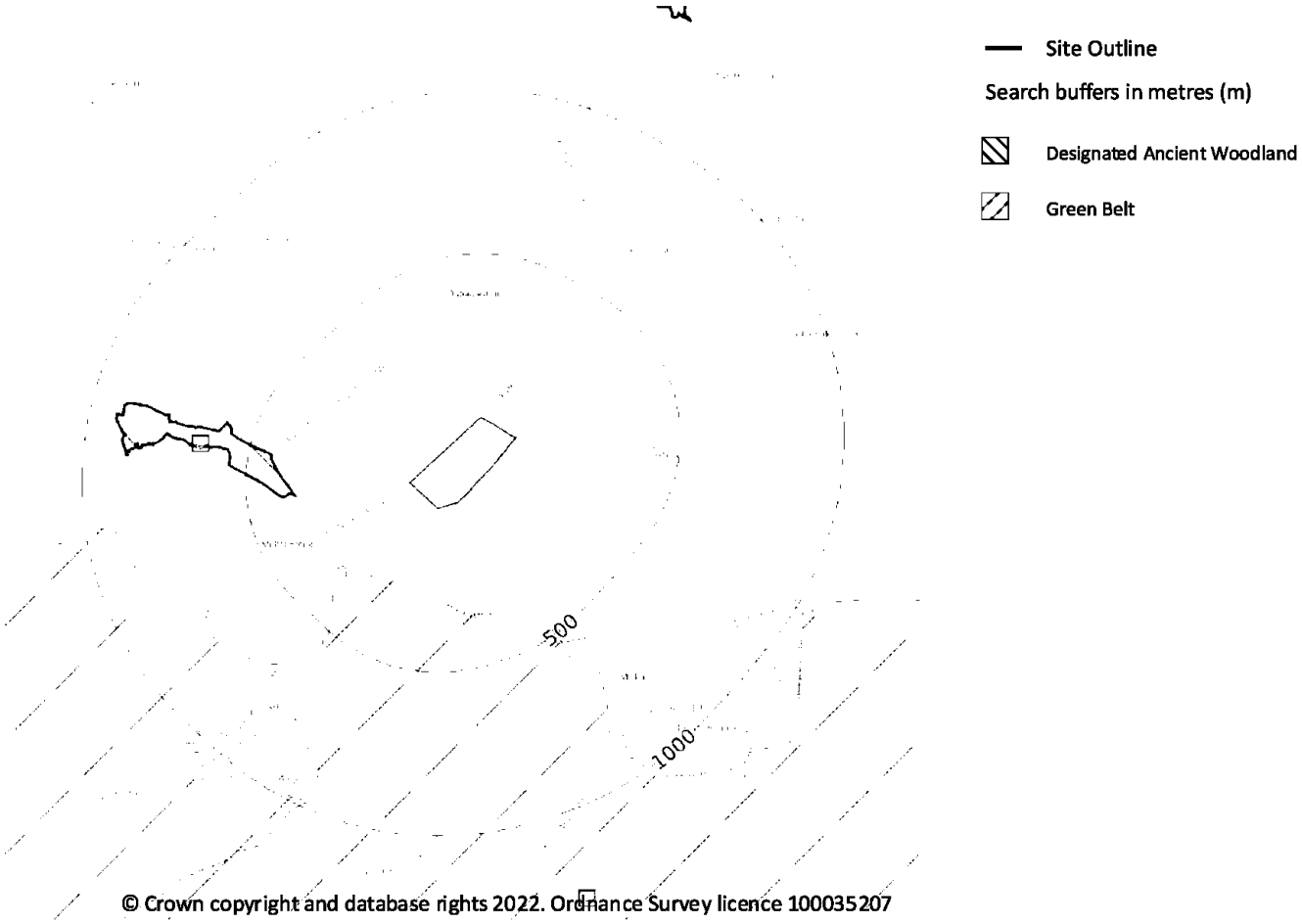
9.1 Groundwater flooding

Highest risk on site	**Low**
Highest risk within 50m	**Low**

Groundwater flooding is caused by unusually high groundwater levels. It occurs when the water table rises above the ground surface or within underground structures such as basements or cellars. Groundwater flooding tends to exhibit a longer duration than surface water flooding, possibly lasting for weeks or months, and as a result it can cause significant damage to property. This risk assessment is based on a 1 in 100 year return period and a 5m Digital Terrain Model (DTM).

Features are displayed on the Groundwater flooding map on **page 54**

10 Environmental designations



10.1 Sites of Special Scientific Interest (SSSI)

Records within 2000m **0**

Sites providing statutory protection for the best examples of UK flora, fauna, or geological or physiographical features. Originally notified under the National Parks and Access to the Countryside Act 1949, SSSIs were re-notified under the Wildlife and Countryside Act 1981. Improved provisions for the protection and management of SSSIs were introduced by the Countryside and Rights of Way Act 2000 (in England and Wales) and (in Scotland) by the Nature Conservation (Scotland) Act 2004 and the Wildlife and Natural Environment (Scotland) Act 2010.

10.2 Conserved wetland sites (Ramsar sites)

Records within 2000m	0

Ramsar sites are designated under the Convention on Wetlands of International Importance, agreed in Ramsar, Iran, in 1971. They cover all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities. These sites cover a broad definition of wetland; marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, and even some marine areas.

10.3 Special Areas of Conservation (SAC)

Records within 2000m	0

Areas which have been identified as best representing the range and variety within the European Union of habitats and (non-bird) species listed on Annexes I and II to the Directive. SACs are designated under the EC Habitats Directive.

10.4 Special Protection Areas (SPA)

Records within 2000m	0

Sites classified by the UK Government under the EC Birds Directive, SPAs are areas of the most important habitat for rare (listed on Annex I to the Directive) and migratory birds within the European Union.

10.5 National Nature Reserves (NNR)

Records within 2000m	0

Sites containing examples of some of the most important natural and semi-natural terrestrial and coastal ecosystems in Great Britain. They are managed to conserve their habitats, provide special opportunities for scientific study or to provide public recreation compatible with natural heritage interests.

10.6 Local Nature Reserves (LNR)

Records within 2000m **0**

Sites managed for nature conservation, and to provide opportunities for research and education, or simply enjoying and having contact with nature. They are declared by local authorities under the National Parks and Access to the Countryside Act 1949 after consultation with the relevant statutory nature conservation agency.

10.7 Designated Ancient Woodland

Records within 2000m **10**

Ancient woodlands are classified as areas which have been wooded continuously since at least 1600 AD. This includes semi-natural woodland and plantations on ancient woodland sites. 'Wooded continuously' does not mean there is or has previously been continuous tree cover across the whole site, and not all trees within the woodland have to be old.

Features are displayed on the Environmental designations map on **page 55**

ID	Location	Name	Woodland Type

10.8 Biosphere Reserves

Records within 2000m **0**

Biosphere Reserves are internationally recognised by UNESCO as sites of excellence to balance conservation and socioeconomic development between nature and people. They are recognised under the Man and the Biosphere (MAB) Programme with the aim of promoting sustainable development founded on the work of the local community.

10.9 Forest Parks

Records within 2000m **0**

These are areas managed by the Forestry Commission designated on the basis of recreational, conservation or scenic interest.

10.10 Marine Conservation Zones

Records within 2000m **0**

A type of marine nature reserve in UK waters established under the Marine and Coastal Access Act (2009). They are designated with the aim to protect nationally important, rare or threatened habitats and species.

10.11 Green Belt

Records within 2000m **3**

Areas designated to prevent urban sprawl by keeping land permanently open.

Features are displayed on the Environmental designations map on **page 55**

ID	Location	Name	Local Authority name

10.12 Proposed Ramsar sites

Records within 2000m **0**

Ramsar sites are areas listed as a Wetland of International Importance under the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) 1971. The sites here supplied have a status of 'Proposed' having been identified for potential adoption under the framework.

10.13 Possible Special Areas of Conservation (pSAC)

Records within 2000m **0**

Special Areas of Conservation are areas which have been identified as best representing the range and variety within the European Union of habitats and (non-bird) species listed on Annexes I and II to the Directive. SACs are designated under the EC Habitats Directive. Those sites supplied here are those with a status of 'Possible' having been identified for potential adoption under the framework.

10.14 Potential Special Protection Areas (pSPA)

Records within 2000m **0**

Special Protection Areas (SPAs) are areas designated (or 'classified') under the European Union Wild Birds Directive for the protection of nationally and internationally important populations of wild birds. Those sites supplied here are those with a status of 'Potential' having been identified for potential adoption under the framework.

10.15 Nitrate Sensitive Areas

Records within 2000m **0**

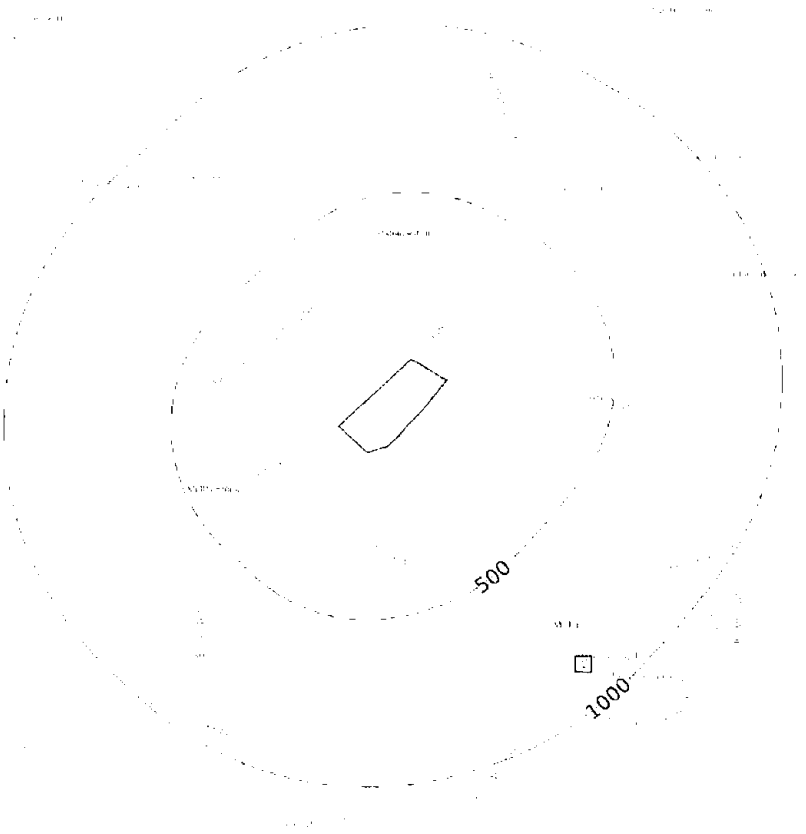
Areas where nitrate concentrations in drinking water sources exceeded or was at risk of exceeding the limit of 50 mg/l set by the 1980 EC Drinking Water Directive. Voluntary agricultural measures as a means of reducing the levels of nitrate were introduced by DEFRA as MAFF, with payments being made to farmers who complied. The scheme was started as a pilot in 1990 in ten areas, later implemented within 32 areas. The scheme was closed to further new entrants in 1998, although existing agreements continued for their full term. All Nitrate Sensitive Areas fell within the areas designated as Nitrate Vulnerable Zones (NVZs) in 1996 under the EC Nitrate Directive (91/676/EEC).

10.16 Nitrate Vulnerable Zones

Records within 2000m	**0**

Areas at risk from agricultural nitrate pollution designated under the EC Nitrate Directive (91/676/EEC). These are areas of land that drain into waters polluted by nitrates. Farmers operating within these areas have to follow mandatory rules to tackle nitrate loss from agriculture.

SSSI Impact Zones and Units



Site Outline

Search buffers in metres (m)

SSSI Impact Risk Zones

SSSI Units

Not recorded

Favourable

Unfavourable - Recovering

Unfavourable - No change

Unfavourable - Declining

Partially destroyed

Destroyed

10.17 SSSI Impact Risk Zones

Records on site **1**

Developed to allow rapid initial assessment of the potential risks to SSSIs posed by development proposals. They define zones around each SSSI which reflect the particular sensitivities of the features for which it is notified and indicate the types of development proposal which could potentially have adverse impacts.

Features are displayed on the SSSI Impact Zones and Units map on **page 61**

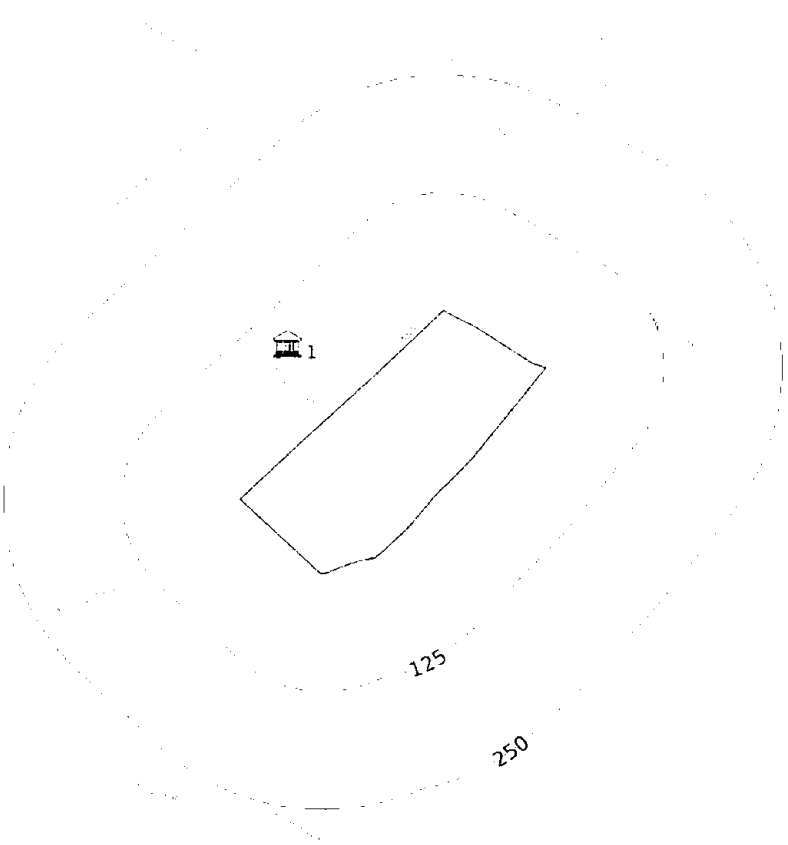
ID	Location	Type of developments requiring consultation
1	**On site**	**Infrastructure - Airports, helipads and other aviation proposals.**

10.18 SSSI Units

Records within 2000m	**0**

Divisions of SSSIs used to record management and condition details. Units are the smallest areas for which Natural England gives a condition assessment, however, the size of units varies greatly depending on the types of management and the conservation interest.

11 Visual and cultural designations



Site Outline

Search buffers in metres (m)

Listed buildings

Conservation areas

Conservation areas - no data

National Parks

Areas of Outstanding Natural Beauty

Registered parks and gardens

Scheduled Monuments

World Heritage Sites

11.1 World Heritage Sites

Records within 250m **0**

Sites designated for their globally important cultural or natural interest requiring appropriate management and protection measures. World Heritage Sites are designated to meet the UK's commitments under the World Heritage Convention.

11.2 Area of Outstanding Natural Beauty

Records within 250m **0**

Areas of Outstanding Natural Beauty (AONB) are conservation areas, chosen because they represent 18% of the finest countryside. Each AONB has been designated for special attention because of the quality of their flora, fauna, historical and cultural associations, and/or scenic views. The National Parks and Access to the Countryside Act of 1949 created AONBs and the Countryside and Rights of Way Act, 2000 added further regulation and protection. There are likely to be restrictions to some developments within these areas.

11.3 National Parks

Records within 250m **0**

In England and Wales, the purpose of National Parks is to conserve and enhance landscapes within the countryside whilst promoting public enjoyment of them and having regard for the social and economic well-being of those living within them. In Scotland National Parks have the additional purpose of promoting the sustainable use of the natural resources of the area and the sustainable social and economic development of its communities. The National Parks and Access to the Countryside Act 1949 established the National Park designation in England and Wales, and The National Parks (Scotland) Act 2000 in Scotland.

11.4 Listed Buildings

Records within 250m **1**

Buildings listed for their special architectural or historical interest. Building control in the form of 'listed building consent' is required in order to make any changes to that building which might affect its special interest. Listed buildings are graded to indicate their relative importance, however building controls apply to all buildings equally, irrespective of their grade, and apply to the interior and exterior of the building in its entirety, together with any curtilage structures.

Features are displayed on the Visual and cultural designations map on **page 63**

ID	Location	Name	Grade	Reference Number	Listed date

11.5 Conservation Areas

Records within 250m **0**

Local planning authorities are obliged to designate as conservation areas any parts of their own area that are of special architectural or historic interest, the character and appearance of which it is desirable to preserve or enhance. Designation of a conservation area gives broader protection than the listing of individual buildings. All the features within the area, listed or otherwise, are recognised as part of its character. Conservation area designation is the means of recognising the importance of all factors and of ensuring that planning decisions address the quality of the landscape in its broadest sense.

11.6 Scheduled Ancient Monuments

Records within 250m **0**

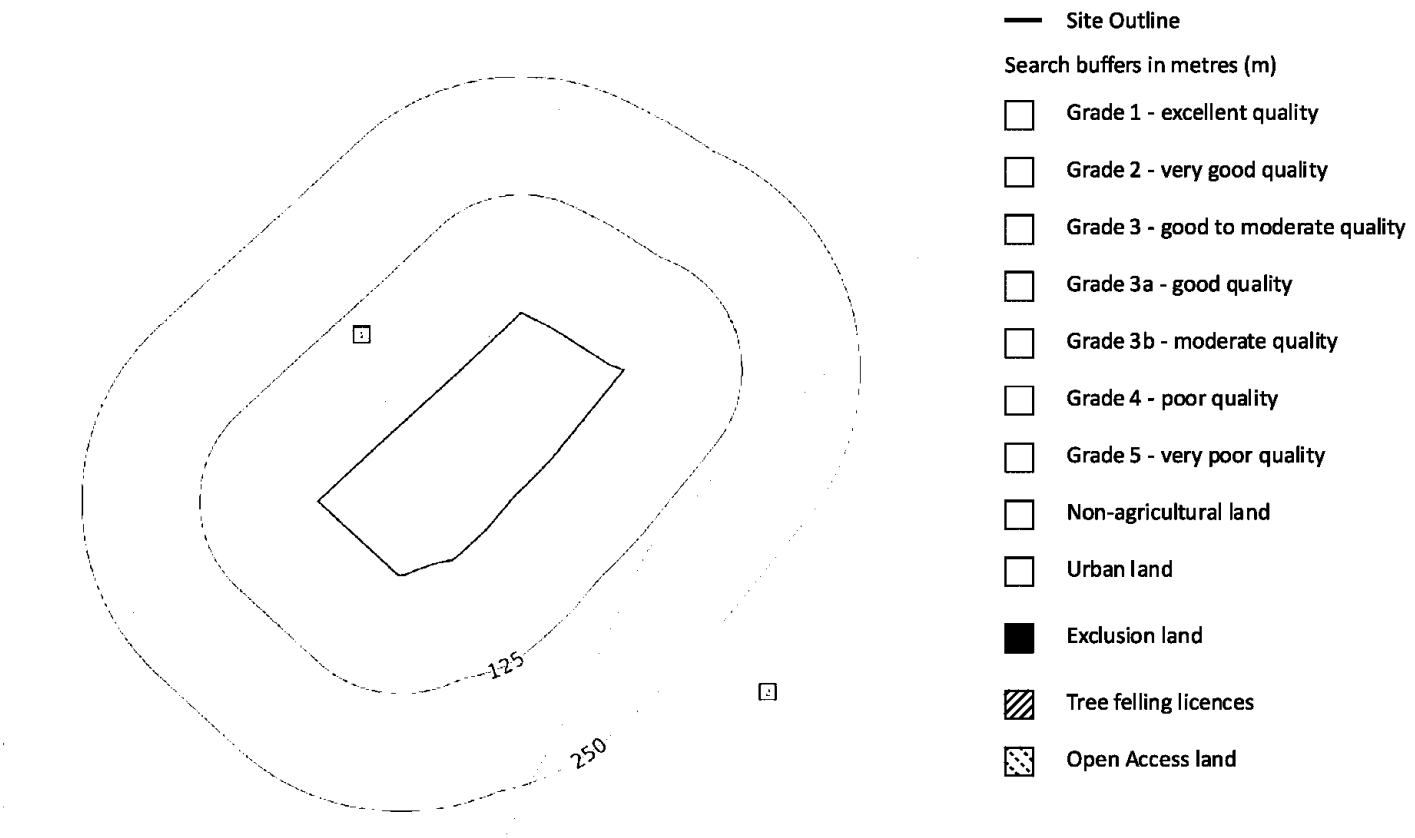
A scheduled monument is an historic building or site that is included in the Schedule of Monuments kept by the Secretary of State for Digital, Culture, Media and Sport. The regime is set out in the Ancient Monuments and Archaeological Areas Act 1979. The Schedule of Monuments has c.20,000 entries and includes sites such as Roman remains, burial mounds, castles, bridges, earthworks, the remains of deserted villages and industrial sites. Monuments are not graded, but all are, by definition, considered to be of national importance.

11.7 Registered Parks and Gardens

Records within 250m **0**

Parks and gardens assessed to be of particular interest and of special historic interest. The emphasis being on 'designed' landscapes, rather than on planting or botanical importance. Registration is a 'material consideration' in the planning process, meaning that planning authorities must consider the impact of any proposed development on the special character of the landscape.

12 Agricultural designations



12.1 Agricultural Land Classification

Records within 250m **2**

Classification of the quality of agricultural land taking into consideration multiple factors including climate, physical geography and soil properties. It should be noted that the categories for the grading of agricultural land are not consistent across England, Wales and Scotland.

Features are displayed on the Agricultural designations map on **page 66**

ID	Location	Classification	Description
1	**On site**	**Grade 3**	**Good to moderate quality agricultural land. Land with moderate limitations which affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where more demanding crops are grown yields are generally lower or more variable than on land in Grades 1 and 2.**

ID	Location	Classification	Description

12.2 Open Access Land

Records within 250m **0**

The Countryside and Rights of Way Act 2000 (CROW Act) gives a public right of access to land without having to use paths. Access land includes mountains, moors, heaths and downs that are privately owned. It also includes common land registered with the local council and some land around the England Coast Path. Generally permitted activities on access land are walking, running, watching wildlife and climbing.

12.3 Tree Felling Licences

Records within 250m **0**

Felling Licence Application (FLA) areas approved by Forestry Commission England. Anyone wishing to fell trees must ensure that a licence or permission under a grant scheme has been issued by the Forestry Commission before any felling is carried out or that one of the exceptions apply.

12.4 Environmental Stewardship Schemes

Records within 250m **0**

Environmental Stewardship covers a range of schemes that provide financial incentives to farmers, foresters and land managers to look after and improve the environment. The schemes identified may be historical schemes that have now expired, or may still be active.

12.5 Countryside Stewardship Schemes

Records within 250m	**0**

Countryside Stewardship covers a range of schemes that provide financial incentives to farmers, foresters and land managers to look after and improve the environment. Main objectives are to improve the farmed environment for wildlife and to reduce diffuse water pollution.

13 Habitat designations

13.1 Priority Habitat Inventory

Records within 250m	**0**

Habitats of principal importance as named under Natural Environment and Rural Communities Act (2006) Section 41.

13.2 Habitat Networks

Records within 250m	**0**

Habitat networks for 18 priority habitat networks (based primarily, but not exclusively, on the priority habitat inventory) and areas suitable for the expansion of networks through restoration and habitat creation.

13.3 Open Mosaic Habitat

Records within 250m	**0**

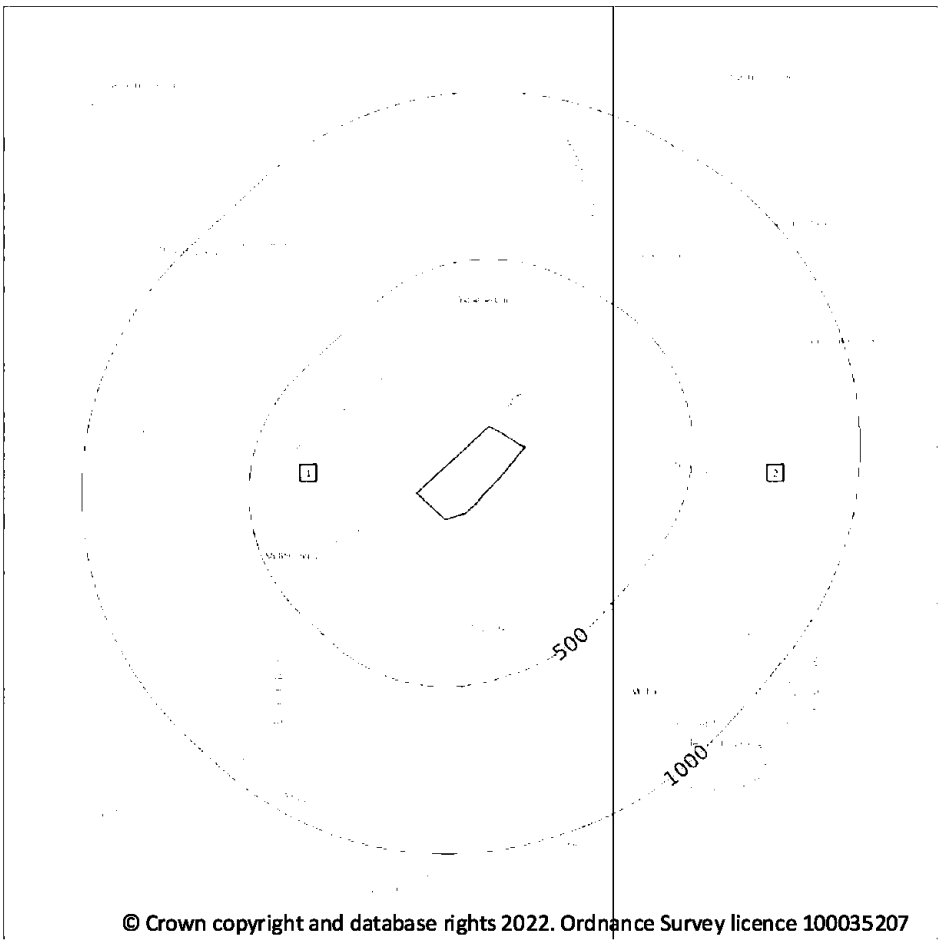
Sites verified as Open Mosaic Habitat. Mosaic habitats are brownfield sites that are identified under the UK Biodiversity Action Plan as a priority habitat due to the habitat variation within a single site, supporting an array of invertebrates.

13.4 Limestone Pavement Orders

Records within 250m	**0**

Limestone pavements are outcrops of limestone where the surface has been worn away by natural means over millennia. These rocks have the appearance of paving blocks, hence their name. Not only do they have geological interest, they also provide valuable habitats for wildlife. These habitats are threatened due to their removal for use in gardens and water features. Many limestone pavements have been designated as SSSIs which affords them some protection. In addition, Section 34 of the Wildlife and Countryside Act 1981 gave them additional protection via the creation of Limestone Pavement Orders, which made it a criminal offence to remove any part of the outcrop. The associated Limestone Pavement Priority Habitat is part of the UK Biodiversity Action Plan priority habitat in England.

14 Geology 1:10,000 scale - Availability



14.1 10k Availability

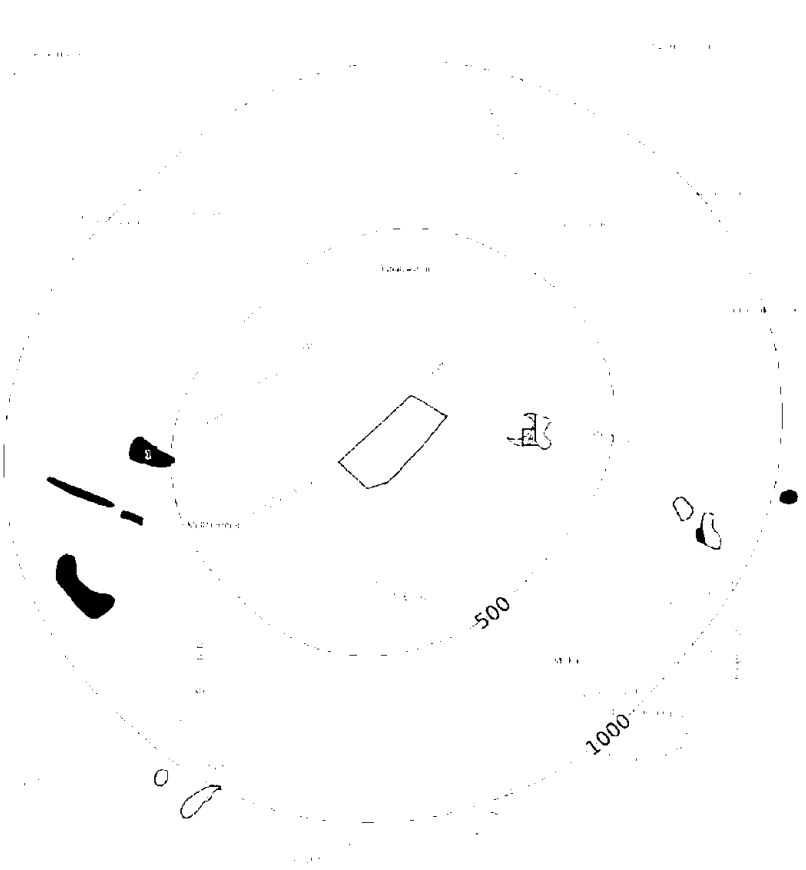
Records within 500m **2**

An indication on the coverage of 1:10,000 scale geology data for the site, the most detailed dataset provided by the British Geological Survey. Either 'Full', 'Partial' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:10,000 scale - Availability map on **page 70**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**Full**	**Full**	**Full**	**Full**	**SD63SW**

Geology 1:10,000 scale - Artificial and made ground



Site Outline

Search buffers in metres (m)

- Reclaimed ground
- Made ground
- Worked ground
- Infilled ground
- Disturbed ground
- Landscaped ground

14.2 Artificial and made ground (10k)

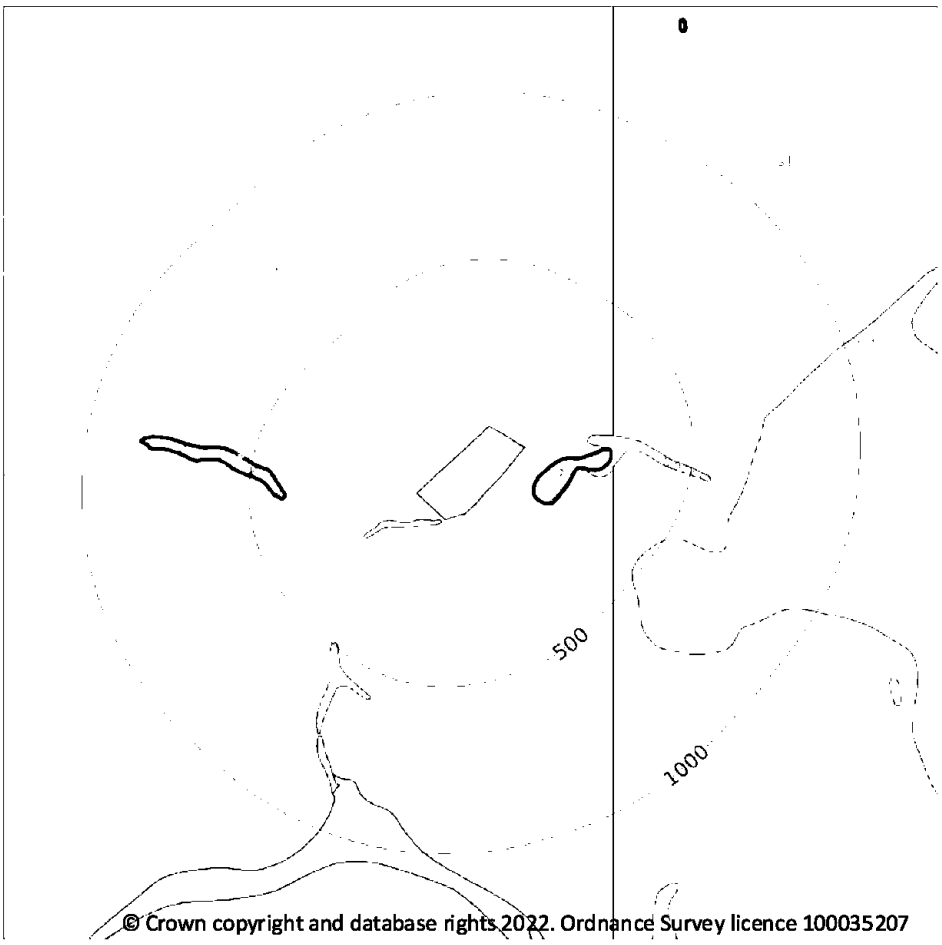
Records within 500m **3**

Details of made, worked, infilled, disturbed and landscaped ground at 1:10,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

Features are displayed on the Geology 1:10,000 scale - Artificial and made ground map on **page 71**

ID	Location	LEX Code	Description	Rock description

Geology 1:10,000 scale - Superficial



Site Outline

Search buffers in metres (m)

Landslip (10k)

Superficial geology (10k)
Please see table for more details.

14.3 Superficial geology (10k)

Records within 500m **2**

Superficial geological deposits at 1:10,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:10,000 scale - Superficial map on **page 72**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**TILLD-CSVZ**	**Till, Devensian - Clay, Sandy, Gravelly, Silty (unlithified Deposits Coding Scheme)**	**Clay, Sandy, Gravelly, Silty**

14.4 Landslip (10k)

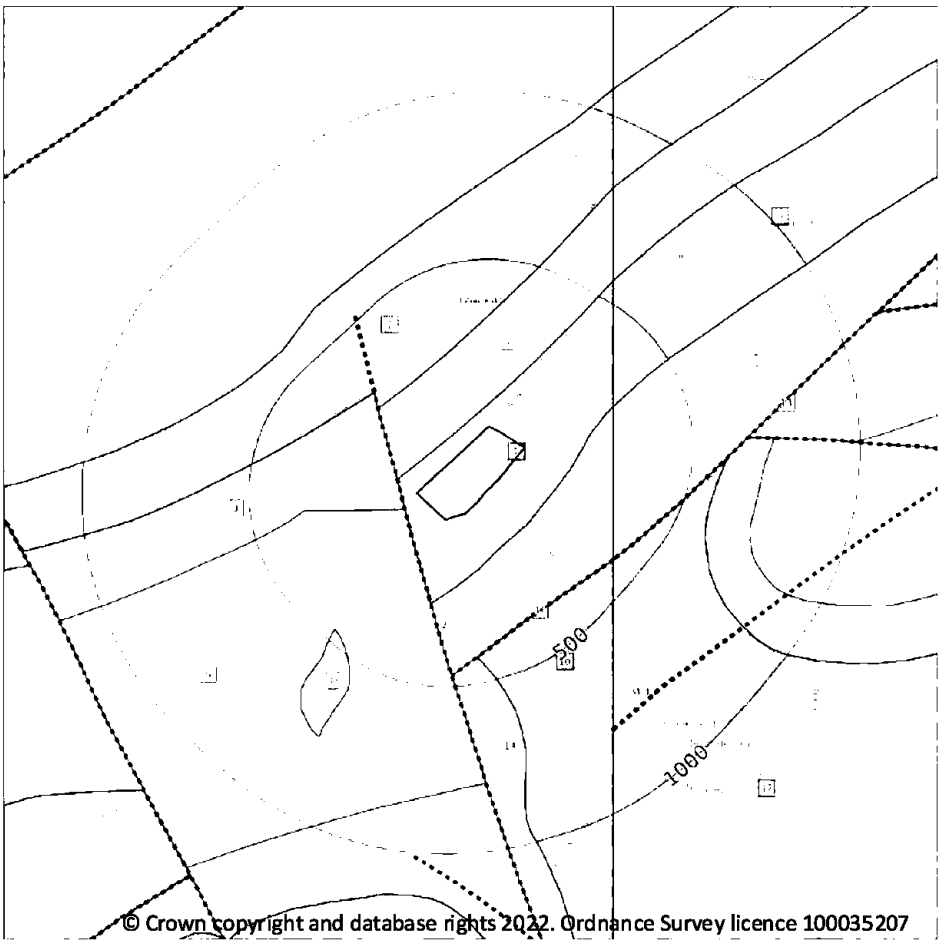
Records within 500m **2**

Mass movement deposits on BGS geological maps at 1:10,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

Features are displayed on the Geology 1:10,000 scale - Superficial map on **page 72**

ID	Location	LEX Code	Description	Rock description

Geology 1:10,000 scale - Bedrock



Site Outline

Search buffers in metres (m)

Bedrock faults and other linear features (10k)

Bedrock geology (10k)
Please see table for more details.

14.5 Bedrock geology (10k)

Records within 500m **12**

Bedrock geology at 1:10,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:10,000 scale - Bedrock map on **page 74**

ID	Location	LEX Code	Description	Rock age
1	**On site**	**CPGS-SDST**	**Copster Green Sandstone - Sandstone**	**Pendleian Sub-age**

ID	Location	LEX Code	Description	Rock age

14.6 Bedrock faults and other linear features (10k)

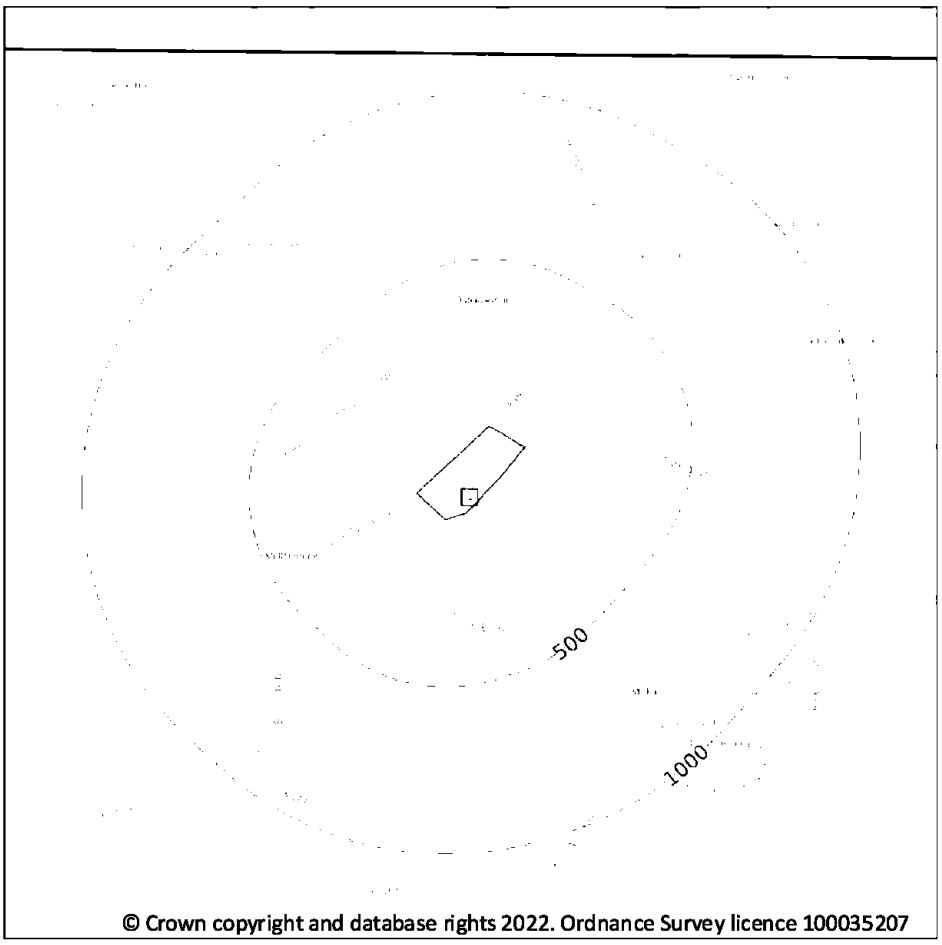
Records within 500m **3**

Linear features at the ground or bedrock surface at 1:10,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

Features are displayed on the Geology 1:10,000 scale - Bedrock map on **page 74**

ID	Location	Category	Description

15 Geology 1:50,000 scale - Availability



Site Outline

Search buffers in metres (m)

Geological map tile

15.1 50k Availability

Records within 500m **1**

An indication on the coverage of 1:50,000 scale geology data for the site. Either 'Full' or 'No coverage' for each geological theme.

Features are displayed on the Geology 1:50,000 scale - Availability map on **page 76**

ID	Location	Artificial	Superficial	Bedrock	Mass movement	Sheet No.
1	**On site**	**No coverage**	**Full**	**Full**	**Full**	**EW075_preston_v4**

Geology 1:50,000 scale - Artificial and made ground

15.2 Artificial and made ground (50k)

Records within 500m **0**

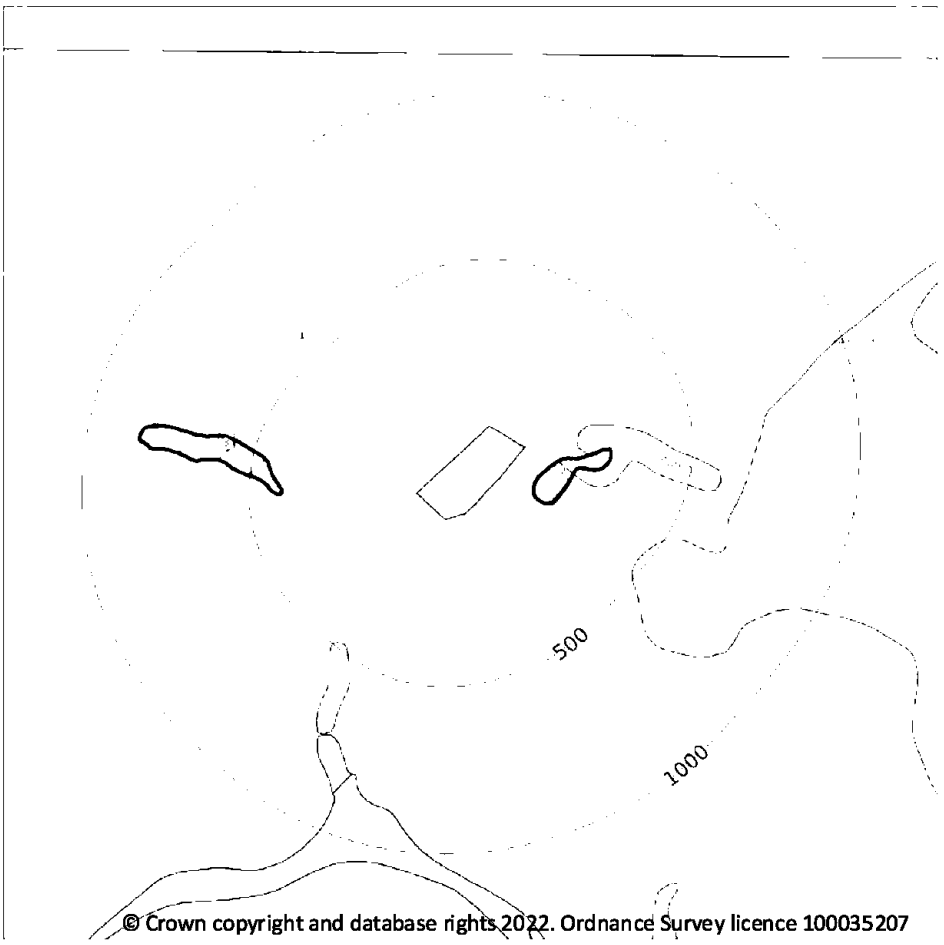
Details of made, worked, infilled, disturbed and landscaped ground at 1:50,000 scale. Artificial ground can be associated with potentially contaminated material, unpredictable engineering conditions and instability.

15.3 Artificial ground permeability (50k)

Records within 50m **0**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any artificial deposits (the zone between the land surface and the water table).

Geology 1:50,000 scale - Superficial



Site Outline

Search buffers in metres (m)

Landslip (50k)

Superficial geology (50k)
Please see table for more details.

15.4 Superficial geology (50k)

Records within 500m **1**

Superficial geological deposits at 1:50,000 scale. Also known as 'drift', these are the youngest geological deposits, formed during the Quaternary. They rest on older deposits or rocks referred to as bedrock.

Features are displayed on the Geology 1:50,000 scale - Superficial map on **page 78**

ID	Location	LEX Code	Description	Rock description
1	**On site**	**TILLD-DMTN**	**TILL, DEVENSIAN**	**DIAMICTON**

15.5 Superficial permeability (50k)

Records within 50m **1**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any superficial deposits (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Mixed**	**High**	**Low**

15.6 Landslip (50k)

Records within 500m **2**

Mass movement deposits on BGS geological maps at 1:50,000 scale. Primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground.

Features are displayed on the Geology 1:50,000 scale - Superficial map on **page 78**

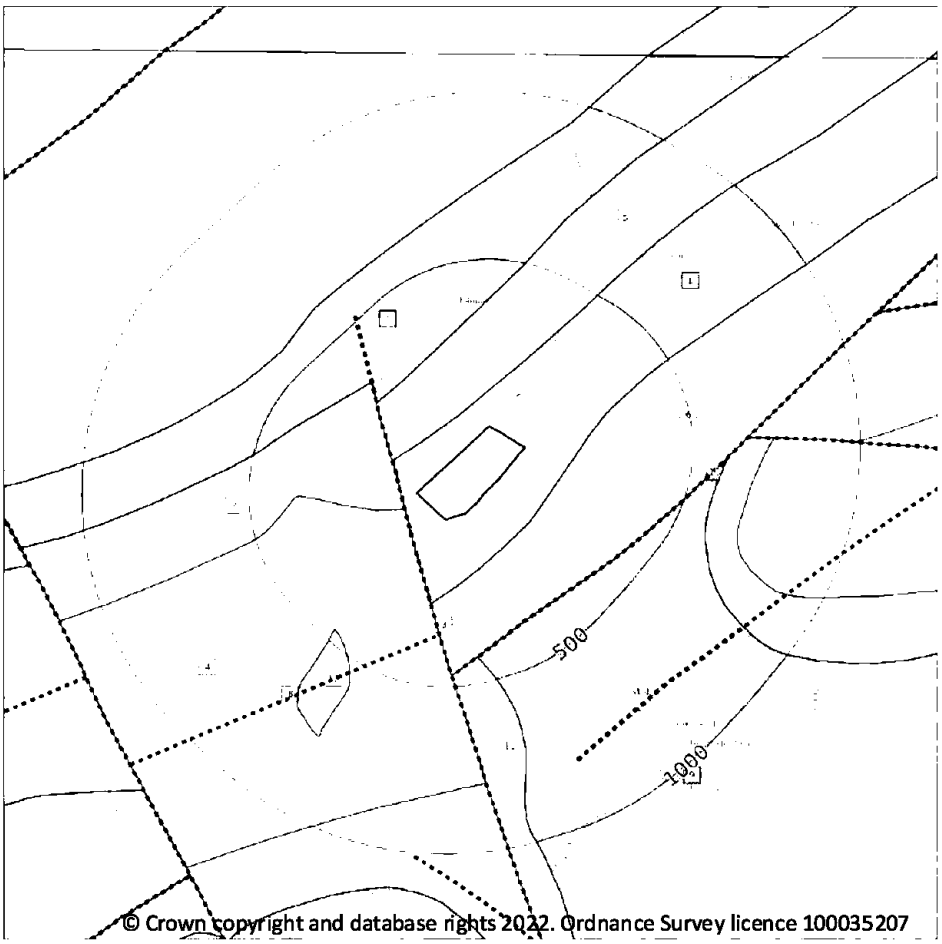
ID	Location	LEX Code	Description	Rock description

15.7 Landslip permeability (50k)

Records within 50m **0**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of any landslip deposits (the zone between the land surface and the water table).

Geology 1:50,000 scale - Bedrock



Site Outline

Search buffers in metres (m)

Bedrock faults and other linear features (50k)

Bedrock geology (50k)
Please see table for more details.

15.8 Bedrock geology (50k)

Records within 500m **9**

Bedrock geology at 1:50,000 scale. The main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Features are displayed on the Geology 1:50,000 scale - Bedrock map on **page 80**

ID	Location	LEX Code	Description	Rock age
1	**On site**	**CPGS-SDST**	**COPSTER GREEN SANDSTONE - SANDSTONE**	**NAMURIAN**

ID	Location	LEX Code	Description	Rock age

15.9 Bedrock permeability (50k)

Records within 50m **2**

A qualitative classification of estimated rates of vertical movement of water from the ground surface through the unsaturated zone of bedrock (the zone between the land surface and the water table).

Location	Flow type	Maximum permeability	Minimum permeability
On site	**Fracture**	**High**	**Moderate**

15.10 Bedrock faults and other linear features (50k)

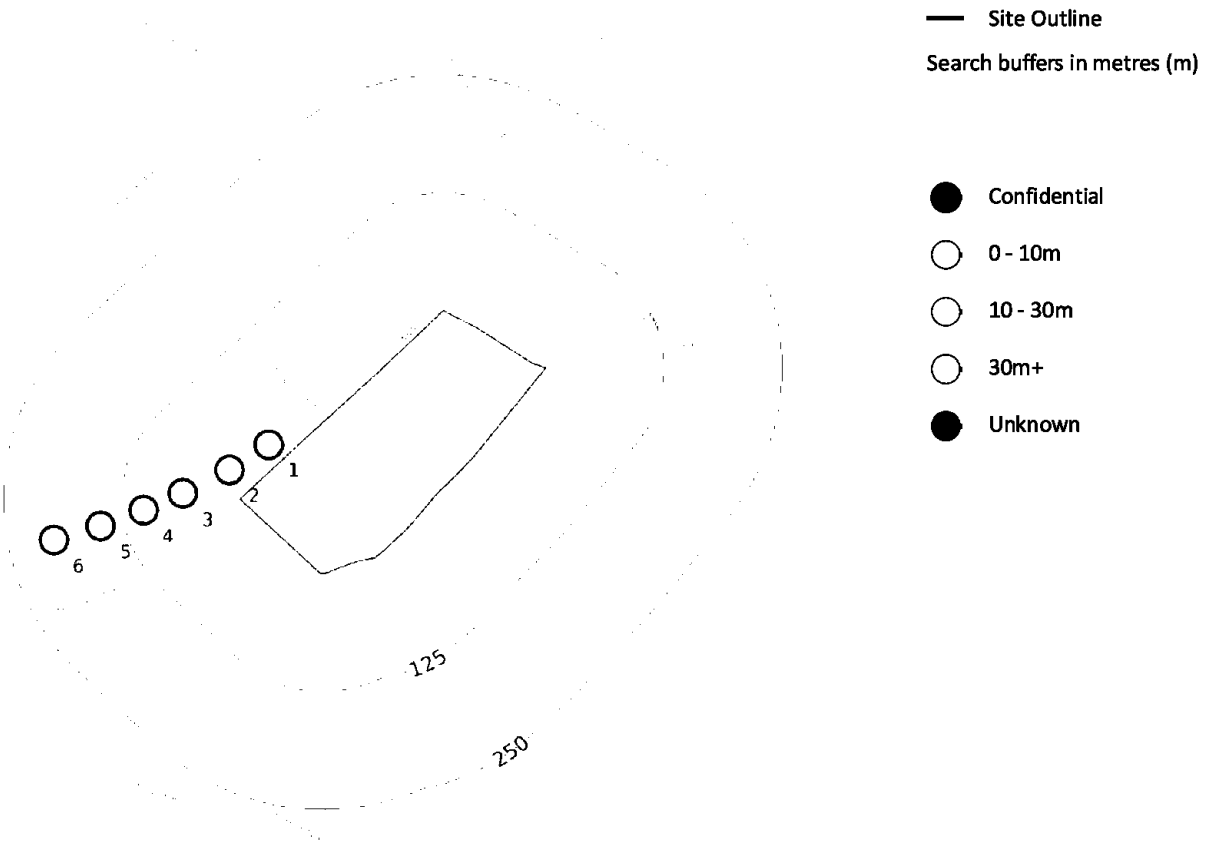
Records within 500m **3**

Linear features at the ground or bedrock surface at 1:50,000 scale of six main types; rock, fault, fold axis, mineral vein, alteration area or landform. Features are either observed or inferred, and relate primarily to bedrock.

Features are displayed on the Geology 1:50,000 scale - Bedrock map on **page 80**

ID	Location	Category	Description

16 Boreholes



16.1 BGS Boreholes

Records within 250m **6**

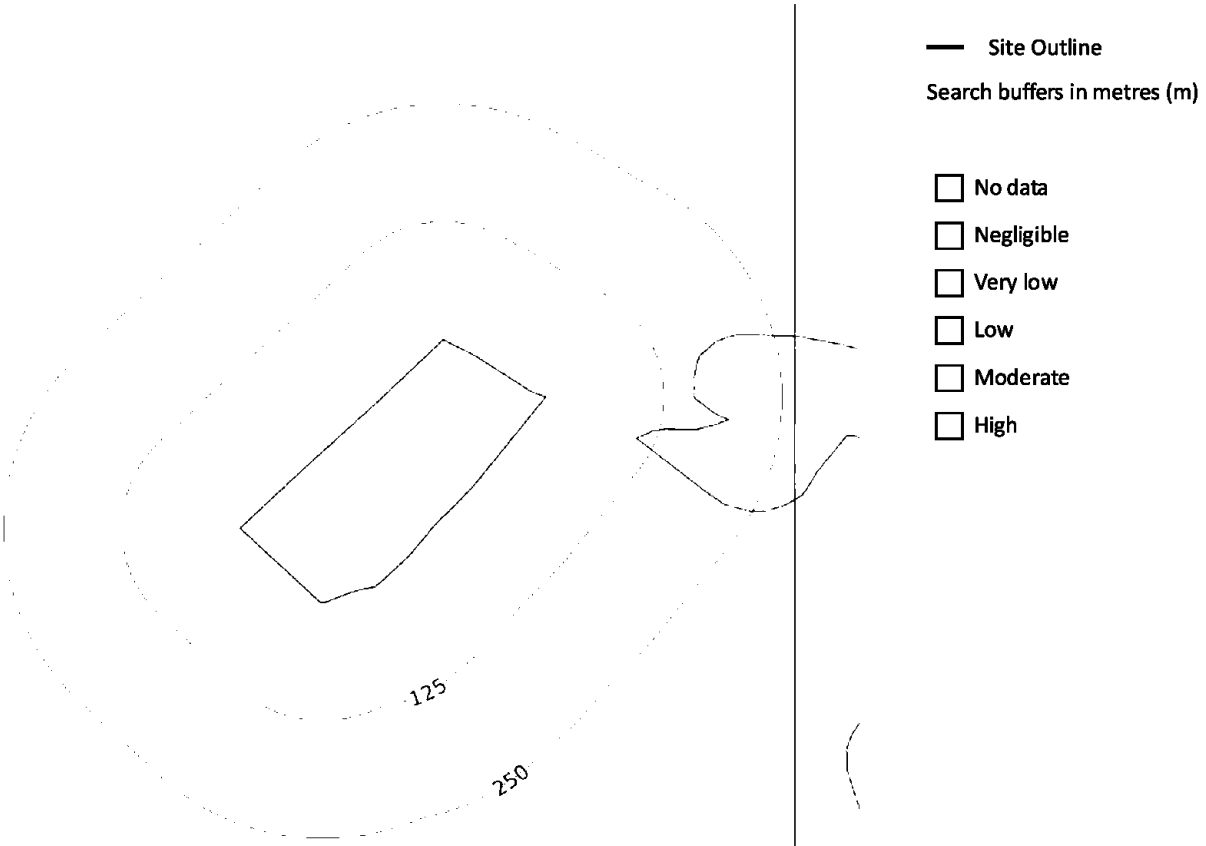
The Single Onshore Boreholes Index (SOBI); an index of over one million records of boreholes, shafts and wells from all forms of drilling and site investigation work held by the British Geological Survey. Covering onshore and nearshore boreholes dating back to at least 1790 and ranging from one to several thousand metres deep.

Features are displayed on the Boreholes map on **page 83**

ID	Location	Grid reference	Name	Length	Confidential	Web link
						17896
						17895
						17894

ID	Location	Grid reference	Name	Length	Confidential	Web link
						17893
						17892
						17891

17 Natural ground subsidence - Shrink swell clays



17.1 Shrink swell clays

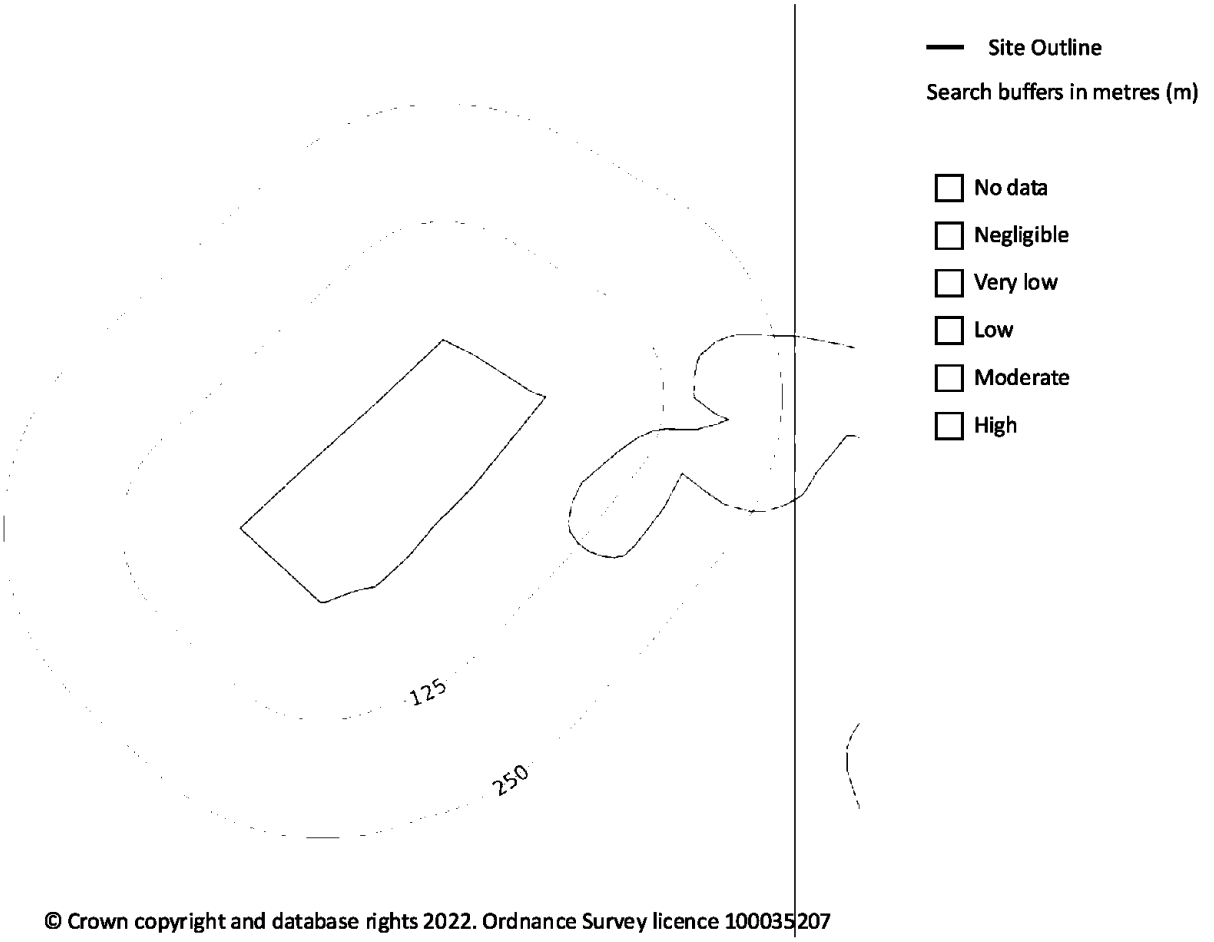
Records within 50m **1**

The potential hazard presented by soils that absorb water when wet (making them swell), and lose water as they dry (making them shrink). This shrink-swell behaviour is controlled by the type and amount of clay in the soil, and by seasonal changes in the soil moisture content (related to rainfall and local drainage).

Features are displayed on the Natural ground subsidence - Shrink swell clays map on **page 85**

Location	Hazard rating	Details
On site	**Very low**	**Ground conditions predominantly low plasticity.**

Natural ground subsidence - Running sands



17.2 Running sands

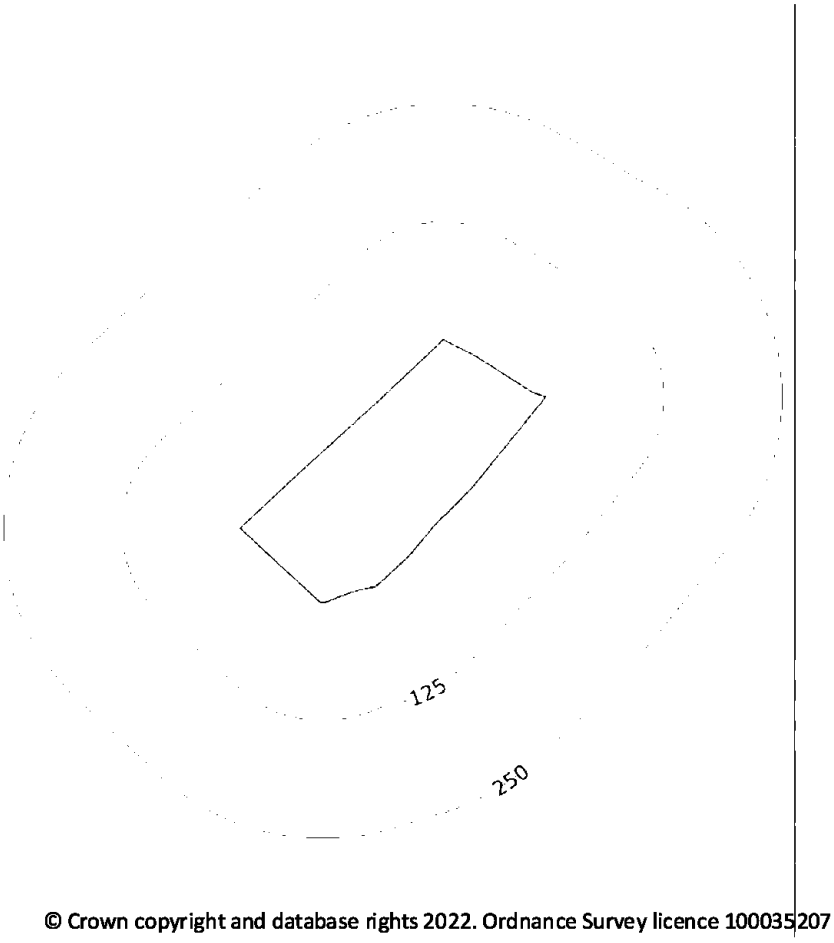
Records within 50m **1**

The potential hazard presented by rocks that can contain loosely-packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', removing support from overlying buildings and causing potential damage.

Features are displayed on the Natural ground subsidence - Running sands map on **page 86**

Location	Hazard rating	Details
On site	**Very low**	**Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.**

Natural ground subsidence - Compressible deposits



Site Outline

Search buffers in metres (m)

- ☐ No data
- ☐ Negligible
- ☐ Very low
- ☐ Low
- ☐ Moderate
- ☐ High

17.3 Compressible deposits

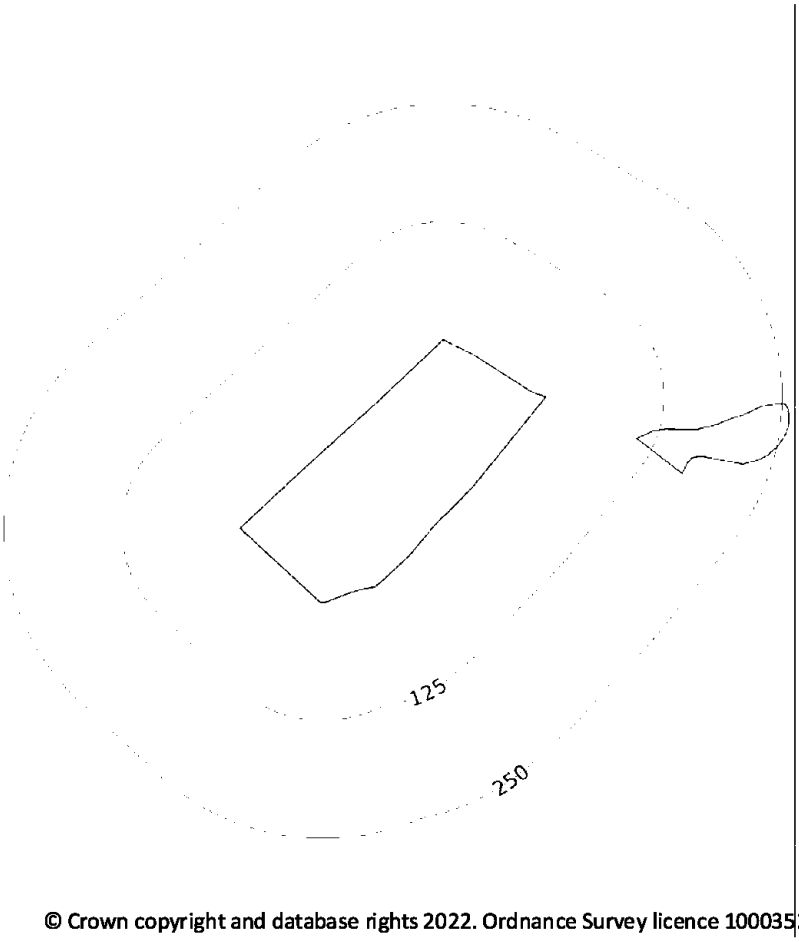
Records within 50m **1**

The potential hazard presented by types of ground that may contain layers of very soft materials like clay or peat and may compress if loaded by overlying structures, or if the groundwater level changes, potentially resulting in depression of the ground and disturbance of foundations.

Features are displayed on the Natural ground subsidence - Compressible deposits map on **page 87**

Location	Hazard rating	Details
On site	**Negligible**	**Compressible strata are not thought to occur.**

Natural ground subsidence - Collapsible deposits



Site Outline

Search buffers in metres (m)

- ☐ No data
- ☐ Negligible
- ☐ Very low
- ☐ Low
- ☐ Moderate
- ☐ High

17.4 Collapsible deposits

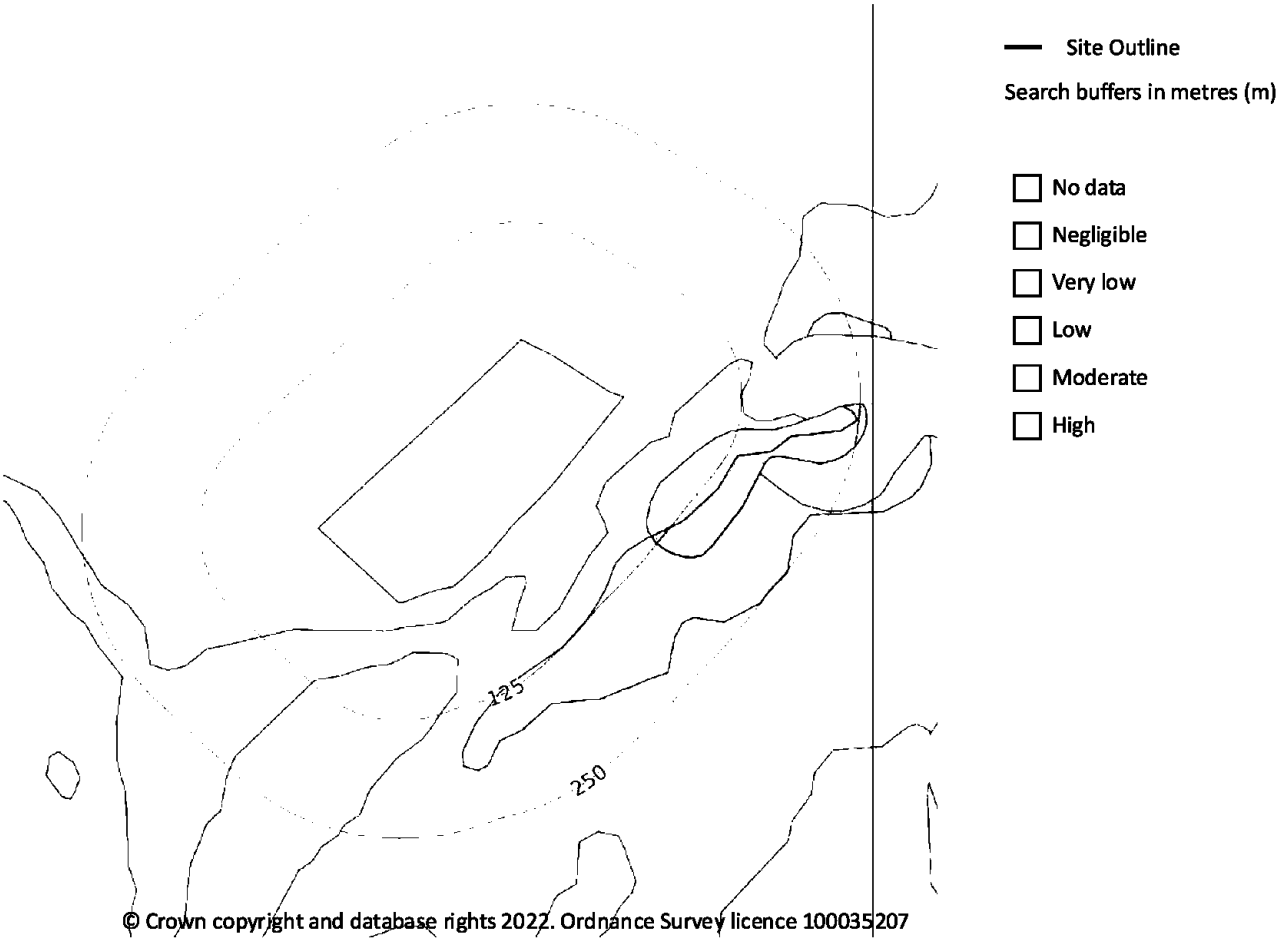
Records within 50m **1**

The potential hazard presented by natural deposits that could collapse when a load (such as a building) is placed on them or they become saturated with water.

Features are displayed on the Natural ground subsidence - Collapsible deposits map on **page 88**

Location	Hazard rating	Details
On site	**Very low**	**Deposits with potential to collapse when loaded and saturated are unlikely to be present.**

Natural ground subsidence - Landslides



17.5 Landslides

Records within 50m **2**

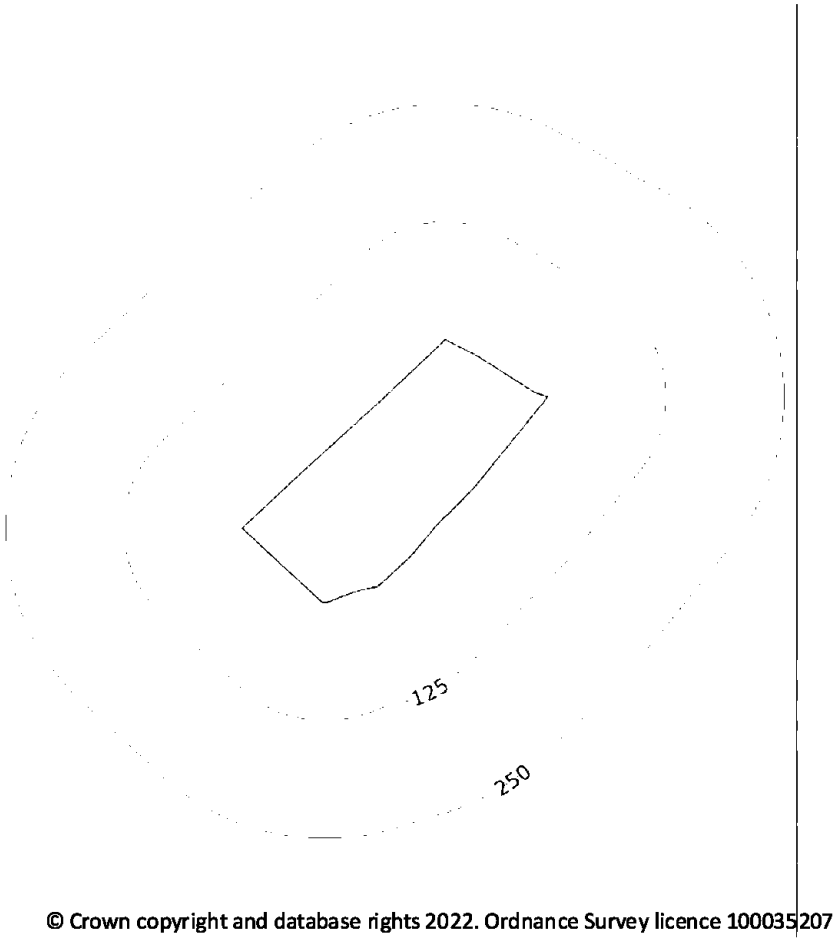
The potential for landsliding (slope instability) to be a hazard assessed using 1:50,000 scale digital maps of superficial and bedrock deposits, combined with information from the BGS National Landslide Database and scientific and engineering reports.

Features are displayed on the Natural ground subsidence - Landslides map on **page 89**

Location	Hazard rating	Details
On site	**Very low**	**Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.**

Location	Hazard rating	Details

Natural ground subsidence - Ground dissolution of soluble rocks



Site Outline

Search buffers in metres (m)

- ☐ No data
- ☐ Negligible
- ☐ Very low
- ☐ Low
- ☐ Moderate
- ☐ High

17.6 Ground dissolution of soluble rocks

Records within 50m **1**

The potential hazard presented by ground dissolution, which occurs when water passing through soluble rocks produces underground cavities and cave systems. These cavities reduce support to the ground above and can cause localised collapse of the overlying rocks and deposits.

Features are displayed on the Natural ground subsidence - Ground dissolution of soluble rocks map on **page 91**

Location	Hazard rating	Details
On site	**Negligible**	**Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.**

18 Mining, ground workings and natural cavities

Site Outline

Search buffers in metres (m)

Natural cavities (Area)

Natural cavities (Point)

BritPits

Surface ground workings

Underground workings

Historical Mineral Planning Areas

Mining Cavities

Non Coal Mining

Sporadic underground mining of restricted extent possible

Localised small scale underground mining possible

Small scale mining possible

Underground mining known or likely within or in close proximity

Underground mining known within or in very close proximity

18.1 Natural cavities

Records within 500m **0**

Industry recognised national database of natural cavities. Sinkholes and caves are formed by the dissolution of soluble rock, such as chalk and limestone, gulls and fissures by cambering. Ground instability can result from movement of loose material contained within these cavities, often triggered by water.

18.2 BritPits

Records within 500m **2**

BritPits (an abbreviation of British Pits) is a database maintained by the British Geological Survey of currently active and closed surface and underground mineral workings. Details of major mineral handling sites, such as wharfs and rail depots are also held in the database.

Features are displayed on the Mining, ground workings and natural cavities map on **page 92**

ID	Location	Details	Description

18.3 Surface ground workings

Records within 250m **25**

Historical land uses identified from Ordnance Survey mapping that involved ground excavation at the surface. These features may or may not have been subsequently backfilled.

Features are displayed on the Mining, ground workings and natural cavities map on **page 92**

ID	Location	Land Use	Year of mapping	Mapping scale
A	**On site**	**Unspecified Ground Workings**	**1910**	**1:10560**
A	**On site**	**Unspecified Ground Workings**	**1932**	**1:10560**
A	**On site**	**Unspecified Pit**	**1951**	**1:10560**
B	**On site**	**Unspecified Pit**	**1892**	**1:10560**
B	**On site**	**Unspecified Pit**	**1910**	**1:10560**
B	**On site**	**Unspecified Pit**	**1932**	**1:10560**

ID	Location	Land Use	Year of mapping	Mapping scale
B	**On site**	**Unspecified Pit**	**1951**	**1:10560**
B	**On site**	**Unspecified Pit**	**1969**	**1:10560**

18.4 Underground workings

Records within 1000m **0**

Historical land uses identified from Ordnance Survey mapping that indicate the presence of underground workings e.g. mine shafts.

18.5 Historical Mineral Planning Areas

Records within 500m **0**

Boundaries of mineral planning permissions for England and Wales. This data was collated between the 1940s (and retrospectively to the 1930s) and the mid 1980s. The data includes permitted, withdrawn and refused permissions.

18.6 Non-coal mining

Records within 1000m **2**

The potential for historical non-coal mining to have affected an area. The assessment is drawn from expert knowledge and literature in addition to the digital geological map of Britain. Mineral commodities may be divided into seven general categories - vein minerals, chalk, oil shale, building stone, bedded ores, evaporites and 'other' commodities (including ball clay, jet, black marble, graphite and chert).

Features are displayed on the Mining, ground workings and natural cavities map on **page 92**

ID	Location	Name	Commodity	Class	Likelihood
1	**On site**	**Not available**	**Vein Mineral**	**A**	**Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered**

18.7 Mining cavities

Records within 1000m **0**

Industry recognised national database of mining cavities. Degraded mines may result in hazardous subsidence (crown holes). Climatic conditions and water escape can also trigger subsidence over mine entrances and workings.

18.8 JPB mining areas

Records on site **0**

Areas which could be affected by former coal and other mining. This data includes some mine plans unavailable to the Coal Authority.

18.9 Coal mining

Records on site **0**

Areas which could be affected by past, current or future coal mining.

18.10 Brine areas

Records on site **0**

The Cheshire Brine Compensation District indicates areas that may be affected by salt and brine extraction in Cheshire and where compensation would be available where damage from this mining has occurred. Damage from salt and brine mining can still occur outside this district, but no compensation will be available.

18.11 Gypsum areas

Records on site **0**

Generalised areas that may be affected by gypsum extraction.

18.12 Tin mining

Records on site **0**

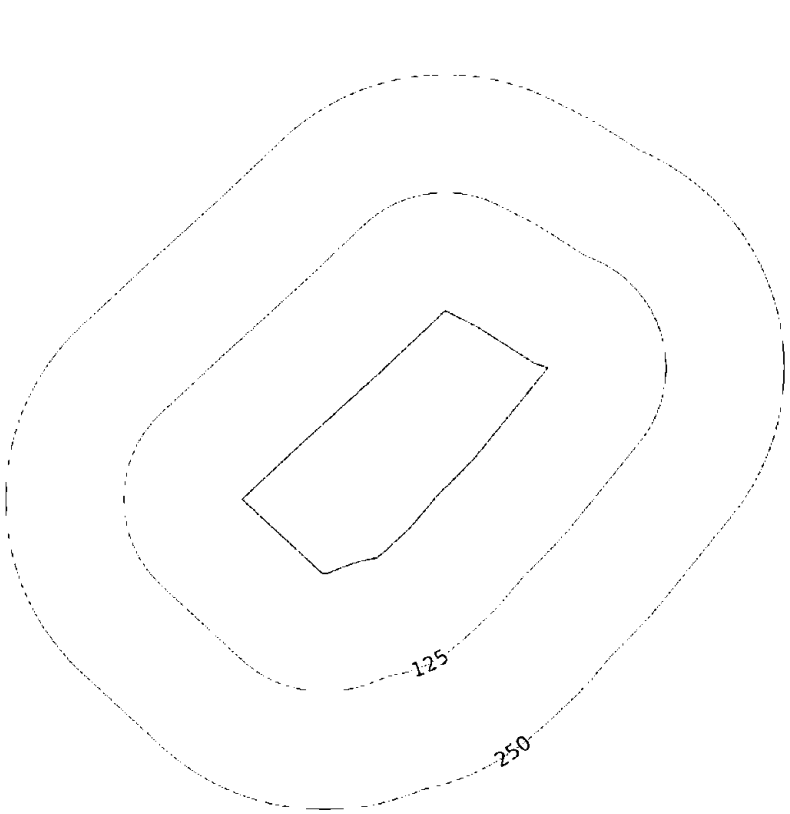
Generalised areas that may be affected by historical tin mining.

18.13 Clay mining

Records on site	0

Generalised areas that may be affected by kaolin and ball clay extraction.

19 Radon



Site Outline

Search buffers in metres (m)

- ☐ Greater than 30%
- ☐ Between 10% and 30%
- ☐ Between 5% and 10%
- ☐ Between 3% and 5%
- ☐ Between 1% and 3%
- ☐ Less than 1%

19.1 Radon

Records on site **1**

Estimated percentage of dwellings exceeding the Radon Action Level. This data is the highest resolution radon dataset available for the UK and is produced to a 75m level of accuracy to allow for geological data accuracy and a 'residential property' buffer. The findings of this section should supersede any estimations derived from the Indicative Atlas of Radon in Great Britain. The data was derived from both geological assessments and long term measurements of radon in more than 479,000 households.

Features are displayed on the Radon map on **page 98**

Location	Estimated properties affected	Radon Protection Measures required
On site	**Less than 1%**	**None****

20 Soil chemistry

20.1 BGS Estimated Background Soil Chemistry

Records within 50m **12**

The estimated values provide the likely background concentration of the potentially harmful elements Arsenic, Cadmium, Chromium, Lead and Nickel in topsoil. The values are estimated primarily from rural topsoil data collected at a sample density of approximately 1 per 2 km^2. In areas where rural soil samples are not available, estimation is based on stream sediment data collected from small streams at a sampling density of 1 per 2.5 km^2; this is the case for most of Scotland, Wales and southern England. The stream sediment data are converted to soil-equivalent concentrations prior to the estimation.

Location	Arsenic	Bioaccessible Arsenic	Lead	Bioaccessible Lead	Cadmium	Chromium	Nickel
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**
On site	**15 mg/kg**	**No data**	**100 mg/kg**	**60 mg/kg**	**1.8 mg/kg**	**60 - 90 mg/kg**	**15 - 30 mg/kg**

20.2 BGS Estimated Urban Soil Chemistry

Records within 50m **0**

Estimated topsoil chemistry of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc and bioaccessible Arsenic and Lead in 23 urban centres across Great Britain. These estimates are derived from interpolation of the measured urban topsoil data referred to above and provide information across each city

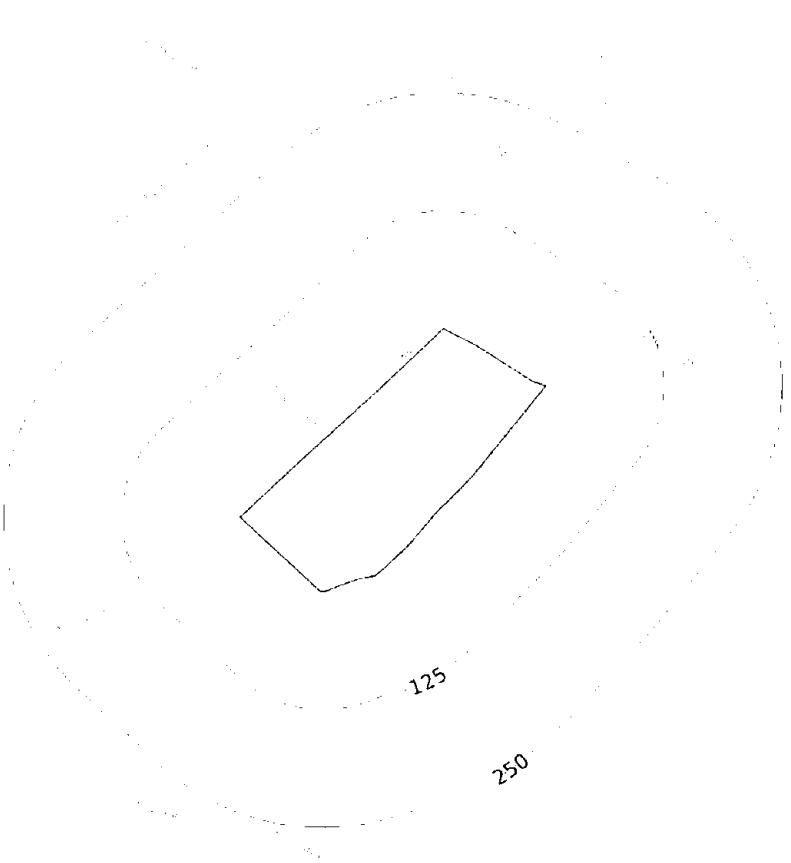
between the measured sample locations (4 per km^2).

20.3 BGS Measured Urban Soil Chemistry

Records within 50m **0**

The locations and measured total concentrations (mg/kg) of Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Tin and Zinc in urban topsoil samples from 23 urban centres across Great Britain. These are collected at a sample density of 4 per km^2.

21 Railway infrastructure and projects



Site Outline
Search buffers in metres (m)
Crossrail 1 Stations
Crossrail 1 Route
Crossrail 2 Stations
Crossrail 2 Route
Crossrail 2 Worksites
Crossrail 2 Safeguarding
Crossrail 2 Headhouses
Railway stations
Active railways
Active tunnels
Abandoned railways
Historic railways
Historic tunnels
Underground stations
Underground Lines
Royal Mail tunnels
HS2 optimised route
HS2 Stations
HS2 Depots
HS2 Surface Safeguarding
HS2 Subsurface Safeguarding

21.1 Underground railways (London)

Records within 250m **0**

Details of all active London Underground lines, including approximate tunnel roof depth and operational hours.

21.2 Underground railways (Non-London)

Records within 250m **0**

Details of the Merseyrail system, the Tyne and Wear Metro and the Glasgow Subway. Not all parts of all systems are located underground. The data contains location information only and does not include a depth assessment.

21.3 Railway tunnels

Records within 250m **0**

Railway tunnels taken from contemporary Ordnance Survey mapping.

21.4 Historical railway and tunnel features

Records within 250m **1**

Railways and tunnels digitised from historical Ordnance Survey mapping as scales of 1:1,250, 1:2,500, 1:10,000 and 1:10,560.

Features are displayed on the Railway infrastructure and projects map on **page 101**

Location	Land Use	Year of mapping	Mapping scale

21.5 Royal Mail tunnels

Records within 250m **0**

The Post Office Railway, otherwise known as the Mail Rail, is an underground railway running through Central London from Paddington Head District Sorting Office to Whitechapel Eastern Head Sorting Office. The line is 10.5km long. The data includes details of the full extent of the tunnels, the depth of the tunnel, and the depth to track level.

21.6 Historical railways

Records within 250m **0**

Former railway lines, including dismantled lines, abandoned lines, disused lines, historic railways and razed lines.

21.7 Railways

Records within 250m **0**

Currently existing railway lines, including standard railways, narrow gauge, funicular, trams and light railways.

21.8 Crossrail 1

Records within 500m **0**

The Crossrail railway project links 41 stations over 100 kilometres from Reading and Heathrow in the west, through underground sections in central London, to Shenfield and Abbey Wood in the east.

21.9 Crossrail 2

Records within 500m **0**

Crossrail 2 is a proposed railway linking the national rail networks in Surrey and Hertfordshire via an underground tunnel through London.

21.10 HS2

Records within 500m **0**

HS2 is a proposed high speed rail network running from London to Manchester and Leeds via Birmingham. Main civils construction on Phase 1 (London to Birmingham) of the project began in 2019, and it is currently anticipated that this phase will be fully operational by 2026. Construction on Phase 2a (Birmingham to Crewe) is anticipated to commence in 2021, with the service fully operational by 2027. Construction on Phase 2b (Crewe to Manchester and Birmingham to Leeds) is scheduled to begin in 2023 and be operational by 2033.

Data providers

Groundsure works with respected data providers to bring you the most relevant and accurate information. To find out who they are and their areas of expertise see https://www.groundsure.com/sources-reference.

Terms and conditions

Groundsure's Terms and Conditions can be accessed at this link: https://www.groundsure.com/terms-and-conditions-jan-2020/.

APPENDIX 5: SITE PHOTOGRAPHS

1. Public pavement extending along the northern site boundary, westerly aspect
2. As above, easterly aspect.

3. An opening in the hedge forming the northern site boundary on Longsight Road
4. Northeastern section of the site

5. As Figure 4 above
6. Northeastern section of the site

7. Species poor henge extending through the eastern section of the site
8. Northeastern section of the site

9. Drainage ditch extending along species poor henge located within eastern section of the site
10. Eastern site boundary

11. Study site as seen from near its eastern boundary, westerly aspect
12. Eastern site boundary, northerly aspect

13. Northeastern site boundary, westerly aspect
14. As above

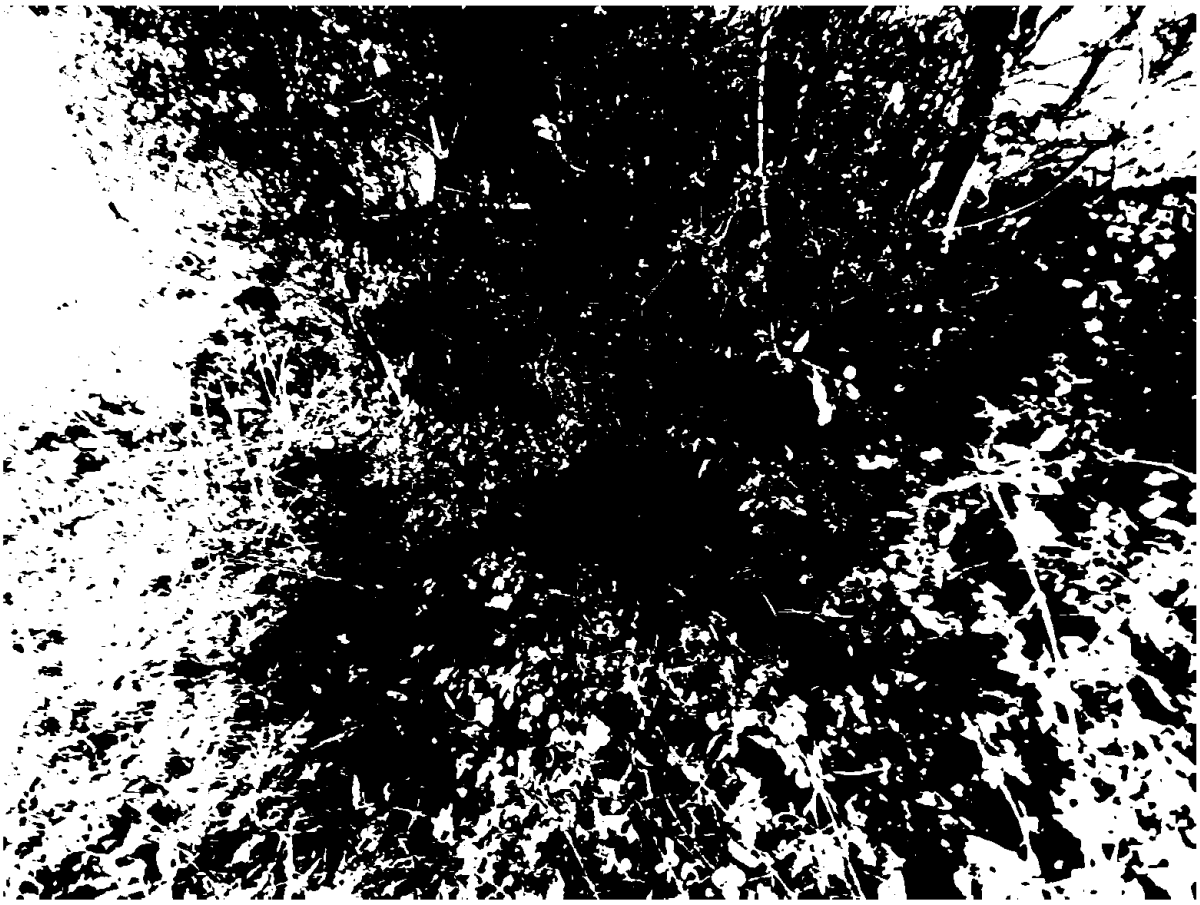
15. Gateway leading into the western section of the site
16. As above

17. Small pond area located within central section of the site
18. As above

19. As Figures 17 & 18 above
20. Northwestern site section of the site

21. Area of tall ruderal species located around pond area
22. Western section of the site as seen from the approx. site centre.

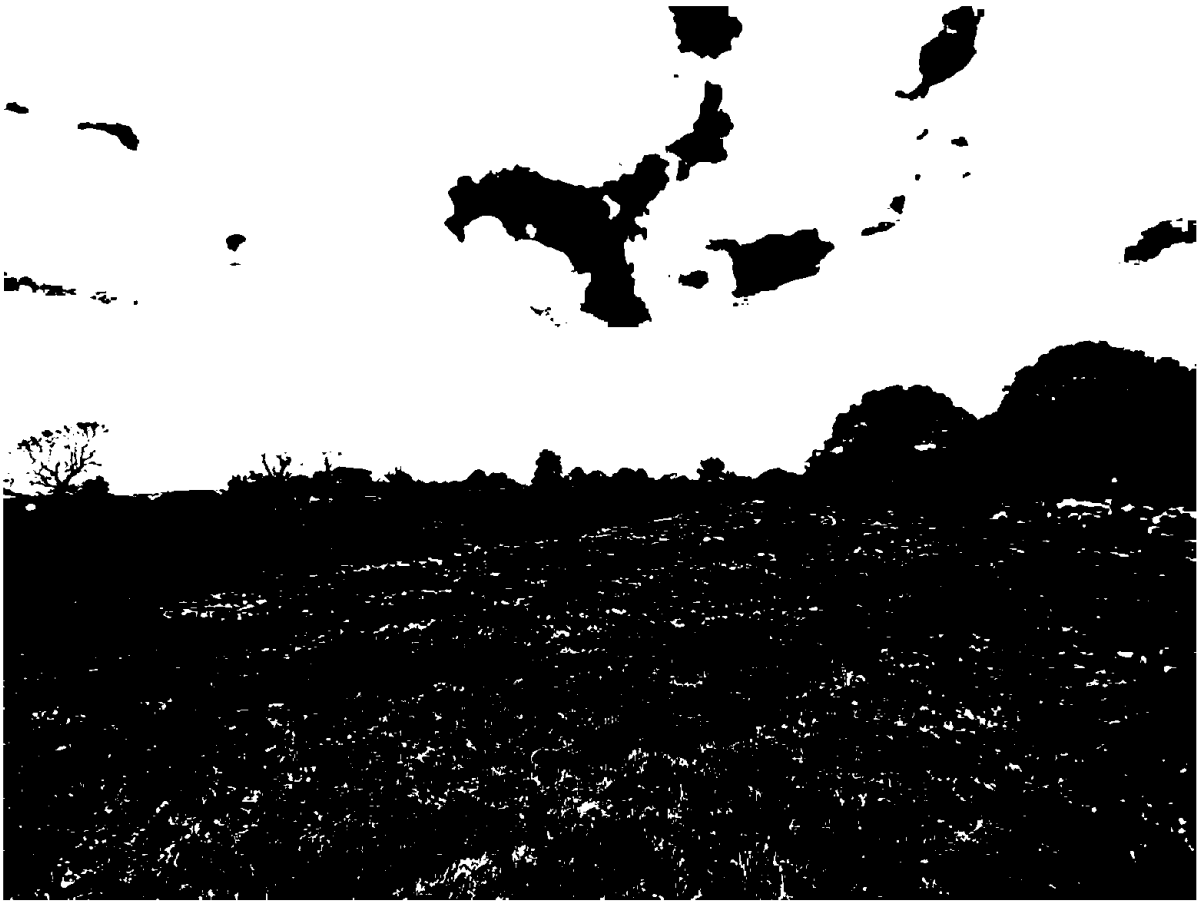
23. As Figure 22 above
24. Western site boundary and associated drainage ditch .

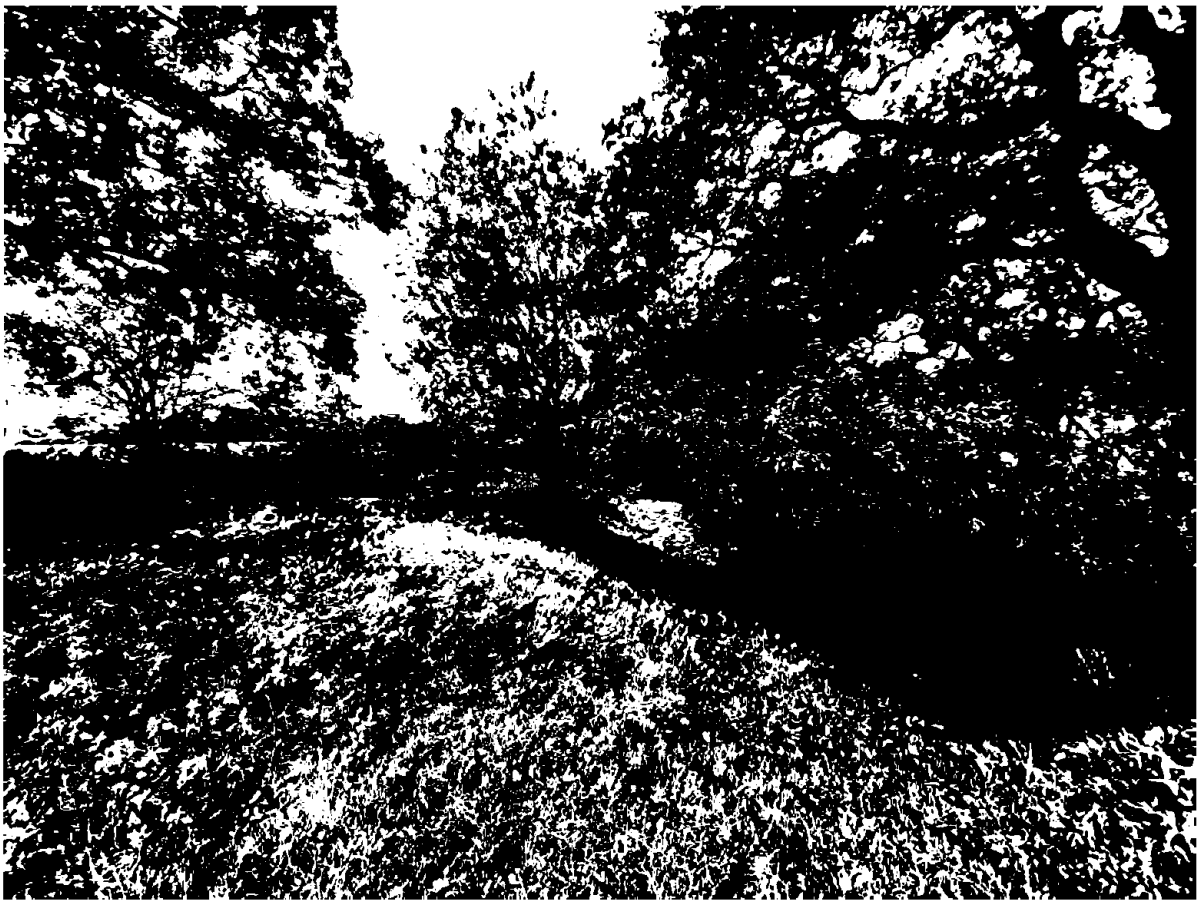


25. As Figure 24 above
26. Western site boundary

27. Gateway leading into to the southwestern section of the site
28. An area of unkempt land located within the southwestern section of the site

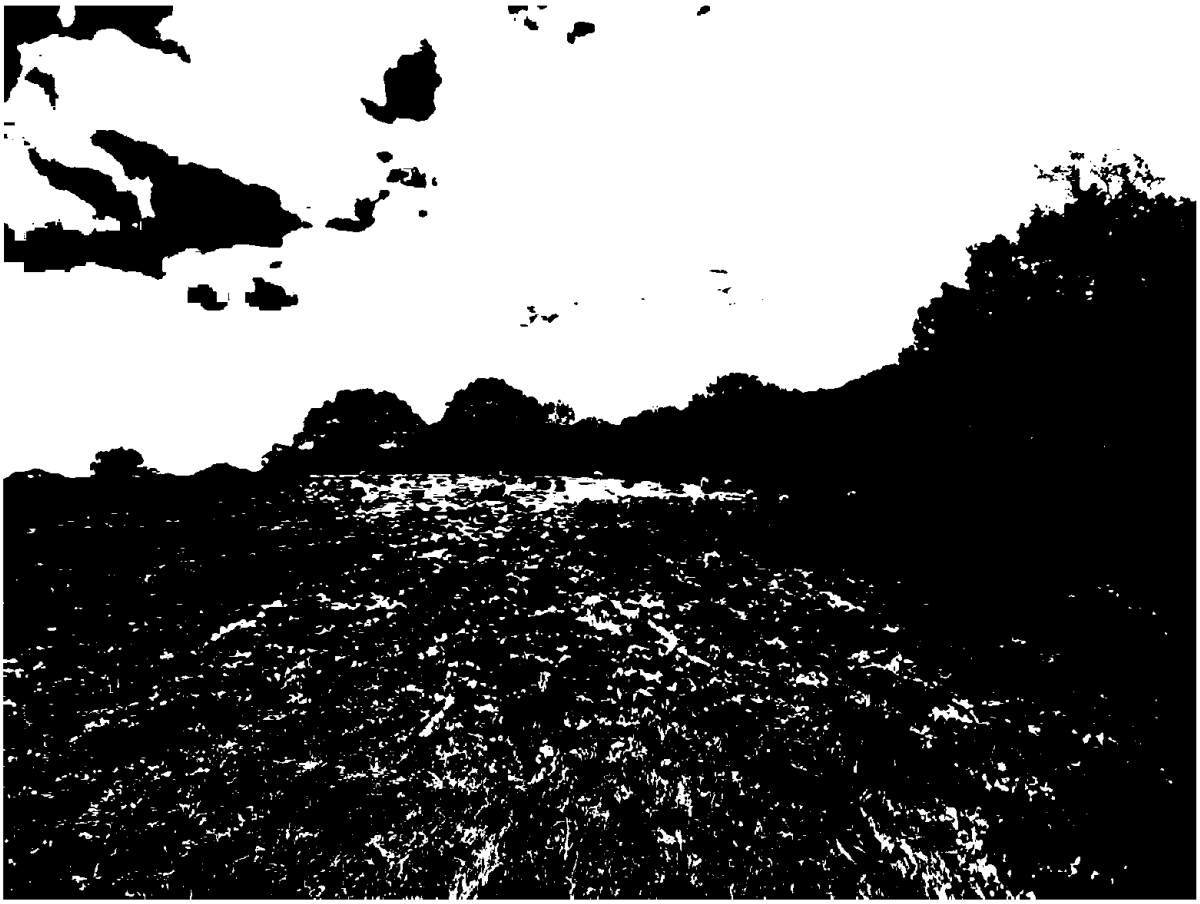
29. Southwestern section of the site
30. As above





31. Small wooded area located along the southeastern site boundary
32. As above

33. Southeastern site boundary
34. Undulating ground within southeastern section of the site



35. Eastern section of the site
36. Section of unkempt grassland within eastern section of the site

37. Small ponded area located within northwestern section of the site
38. As above

APPENDIX 9

GREENFIELD RUNOFF RATE CALCULATION

Print Close Report

HR Wallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Jan Skibniewski

Site name: Causeway Fm, Balderstone

Site location: BB2 7HZ

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.77801° N
Longitude:	2.54018° W
Reference:	2368542759
Date:	Oct 25 2022 23:48

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 4.175

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	1094	1094
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	33.99	33.99
1 in 1 year (l/s):	29.57	29.57
1 in 30 years (l/s):	57.78	57.78
1 in 100 year (l/s):	70.69	70.69
1 in 200 years (l/s):	80.55	80.55

APPENDIX 10

SURFACE WATER ATTENUATION CALCULATIONS

Integra Consulting	Job No 3356	Date 07.12.22
Calculations	Sheet 01	By JS

Job Title Causeway Fm, Balderstone - BB2 7HZ

Storm Water Flood Model

M5-60 = 19.00 **r =** 0.30 **Return, T =** 30 **Area (m²) =** 21220

CC Factor = 0.00 **Limit (l/s) =** 34.0

Totals 539 539

D (mins)	M5-D (mm)	MT-D (mm)	Rate (mm/hr)	Flow (l/s)	CC Flow (l/s)	Storage (m³)	CC Storage (m³)
10.00	8.97	13.23	79.35	464.75	464.75	258.45	258.45
15.00	10.92	16.40	65.59	384.14	384.14	315.13	315.13
20.00	12.40	18.70	56.10	328.58	328.58	353.50	353.50
25.00	13.62	20.64	49.55	290.19	290.19	384.28	384.28
30.00	14.65	22.31	44.61	261.27	261.27	409.09	409.09
35.00	15.56	23.76	40.73	238.56	238.56	429.58	429.58
40.00	16.37	25.06	37.59	220.16	220.16	446.79	446.79
45.00	17.11	26.24	34.98	204.89	204.89	461.41	461.41
50.00	17.79	27.32	32.78	191.98	191.98	473.94	473.94
55.00	18.41	28.31	30.89	180.89	180.89	484.73	484.73
60.00	19.00	29.24	29.24	171.24	171.24	494.05	494.05
65.00	19.55	30.10	27.79	162.75	162.75	502.11	502.11
70.00	20.07	30.92	26.50	155.21	155.21	509.07	509.07
75.00	20.56	31.69	25.35	148.46	148.46	515.07	515.07
80.00	21.03	32.41	24.31	142.38	142.38	520.22	520.22
85.00	21.47	33.11	23.37	136.86	136.86	524.60	524.60
90.00	21.90	33.76	22.51	131.83	131.83	528.30	528.30
95.00	22.31	34.39	21.72	127.22	127.22	531.38	531.38
100.00	22.71	35.00	21.00	122.98	122.98	533.89	533.89
105.00	23.09	35.58	20.33	119.06	119.06	535.88	535.88
110.00	23.45	36.13	19.71	115.42	115.42	537.40	537.40
115.00	23.81	36.67	19.13	112.04	112.04	538.47	538.47
120.00	24.15	37.18	18.59	108.88	108.88	539.14	539.14
125.00	24.49	37.68	18.09	105.92	105.92	539.43	539.43
130.00	24.81	38.16	17.61	103.15	103.15	539.37	539.37
135.00	25.13	38.63	17.17	100.54	100.54	538.98	538.98
140.00	25.44	39.08	16.75	98.08	98.08	538.28	538.28
145.00	25.74	39.51	16.35	95.76	95.76	537.28	537.28
150.00	26.03	39.94	15.97	93.56	93.56	536.02	536.02
155.00	26.31	40.35	15.62	91.47	91.47	534.49	534.49
160.00	26.59	40.75	15.28	89.49	89.49	532.72	532.72
165.00	26.86	41.14	14.96	87.61	87.61	530.72	530.72
170.00	27.13	41.51	14.65	85.81	85.81	528.50	528.50
175.00	27.39	41.88	14.36	84.10	84.10	526.07	526.07
180.00	27.65	42.24	14.08	82.47	82.47	523.44	523.44
185.00	27.90	42.59	13.81	80.90	80.90	520.62	520.62
190.00	28.14	42.93	13.56	79.41	79.41	517.62	517.62
195.00	28.39	43.27	13.31	77.97	77.97	514.45	514.45
200.00	28.62	43.59	13.08	76.59	76.59	511.11	511.11

205.00	28.86	43.91	12.85	75.27	75.27	507.61	507.61
210.00	29.08	44.22	12.63	74.00	74.00	503.96	503.96
215.00	29.31	44.52	12.43	72.77	72.77	500.17	500.17
220.00	29.53	44.82	12.22	71.59	71.59	496.24	496.24
225.00	29.75	45.11	12.03	70.46	70.46	492.17	492.17
230.00	29.96	45.40	11.84	69.36	69.36	487.97	487.97
235.00	30.17	45.68	11.66	68.30	68.30	483.64	483.64
240.00	30.38	45.95	11.49	67.28	67.28	479.20	479.20
245.00	30.59	46.22	11.32	66.29	66.29	474.64	474.64
250.00	30.79	46.48	11.15	65.33	65.33	469.96	469.96
255.00	30.99	46.74	11.00	64.40	64.40	465.18	465.18
260.00	31.18	47.10	10.87	63.66	63.66	462.71	462.71
265.00	31.38	47.37	10.73	62.81	62.81	458.15	458.15
270.00	31.57	47.63	10.59	62.00	62.00	453.52	453.52
275.00	31.76	47.89	10.45	61.20	61.20	448.81	448.81
280.00	31.94	48.15	10.32	60.43	60.43	444.02	444.02
285.00	32.13	48.40	10.19	59.68	59.68	439.16	439.16
290.00	32.31	48.65	10.07	58.96	58.96	434.23	434.23
295.00	32.49	48.90	9.95	58.25	58.25	429.23	429.23
300.00	32.67	49.14	9.83	57.56	57.56	424.17	424.17
305.00	32.84	49.38	9.72	56.90	56.90	419.04	419.04
310.00	33.02	49.62	9.60	56.25	56.25	413.84	413.84
315.00	33.19	49.86	9.50	55.62	55.62	408.59	408.59
320.00	33.36	50.09	9.39	55.00	55.00	403.28	403.28
325.00	33.52	50.32	9.29	54.41	54.41	397.91	397.91
330.00	33.69	50.54	9.19	53.82	53.82	392.48	392.48
335.00	33.85	50.77	9.09	53.25	53.25	387.00	387.00
340.00	34.02	50.99	9.00	52.70	52.70	381.46	381.46
345.00	34.18	51.21	8.91	52.16	52.16	375.88	375.88
350.00	34.34	51.42	8.82	51.63	51.63	370.24	370.24
355.00	34.49	51.64	8.73	51.12	51.12	364.56	364.56
360.00	34.65	51.85	8.64	50.61	50.61	358.82	358.82
365.00	34.80	52.06	8.56	50.12	50.12	353.04	353.04
370.00	34.96	52.27	8.48	49.64	49.64	347.22	347.22
375.00	35.11	52.47	8.40	49.17	49.17	341.35	341.35
380.00	35.26	52.68	8.32	48.71	48.71	335.43	335.43
385.00	35.41	52.88	8.24	48.26	48.26	329.48	329.48
390.00	35.55	53.08	8.17	47.82	47.82	323.48	323.48
395.00	35.70	53.27	8.09	47.39	47.39	317.44	317.44
400.00	35.85	53.47	8.02	46.97	46.97	311.36	311.36
405.00	35.99	53.66	7.95	46.56	46.56	305.24	305.24
410.00	36.13	53.85	7.88	46.16	46.16	299.09	299.09
415.00	36.27	54.05	7.81	45.76	45.76	292.90	292.90
420.00	36.41	54.23	7.75	45.38	45.38	286.67	286.67
425.00	36.55	54.42	7.68	45.00	45.00	280.40	280.40
430.00	36.69	54.61	7.62	44.62	44.62	274.10	274.10
435.00	36.82	54.79	7.56	44.26	44.26	267.77	267.77
440.00	36.96	54.97	7.50	43.90	43.90	261.40	261.40
445.00	37.09	55.15	7.44	43.55	43.55	255.00	255.00
450.00	37.23	55.33	7.38	43.21	43.21	248.57	248.57

455.00	37.36	55.51	7.32	42.87	42.87	242.10	242.10
460.00	37.49	55.68	7.26	42.54	42.54	235.61	235.61
465.00	37.62	55.86	7.21	42.21	42.21	229.08	229.08
470.00	37.75	56.03	7.15	41.89	41.89	222.53	222.53
475.00	37.88	56.20	7.10	41.58	41.58	215.94	215.94
480.00	38.01	56.37	7.05	41.27	41.27	209.33	209.33
485.00	38.13	56.54	6.99	40.97	40.97	202.69	202.69
490.00	38.26	56.71	6.94	40.67	40.67	196.02	196.02
495.00	38.38	56.87	6.89	40.37	40.37	189.32	189.32
500.00	38.51	57.04	6.84	40.09	40.09	182.60	182.60
505.00	38.63	57.20	6.80	39.80	39.80	175.85	175.85
510.00	38.75	57.36	6.75	39.53	39.53	169.07	169.07
515.00	38.87	57.53	6.70	39.25	39.25	162.27	162.27
520.00	38.99	57.69	6.66	38.98	38.98	155.45	155.45
525.00	39.11	57.84	6.61	38.72	38.72	148.60	148.60
530.00	39.23	58.00	6.57	38.46	38.46	141.72	141.72
535.00	39.35	58.16	6.52	38.20	38.20	134.82	134.82
540.00	39.47	58.31	6.48	37.95	37.95	127.90	127.90
545.00	39.58	58.47	6.44	37.70	37.70	120.96	120.96
550.00	39.70	58.62	6.40	37.45	37.45	113.99	113.99
555.00	39.81	58.77	6.35	37.21	37.21	107.00	107.00
560.00	39.93	58.93	6.31	36.98	36.98	99.99	99.99
565.00	40.04	59.08	6.27	36.74	36.74	92.96	92.96
570.00	40.16	59.22	6.23	36.51	36.51	85.91	85.91
575.00	40.27	59.37	6.20	36.28	36.28	78.83	78.83
580.00	40.38	59.52	6.16	36.06	36.06	71.74	71.74
585.00	40.49	59.67	6.12	35.84	35.84	64.62	64.62
590.00	40.60	59.81	6.08	35.62	35.62	57.48	57.48
595.00	40.71	59.96	6.05	35.41	35.41	50.33	50.33
600.00	40.82	60.10	6.01	35.20	35.20	43.15	43.15
605.00	40.93	60.24	5.97	34.99	34.99	35.96	35.96
610.00	41.04	60.38	5.94	34.79	34.79	28.75	28.75
615.00	41.14	60.52	5.90	34.58	34.58	21.52	21.52
620.00	41.25	60.66	5.87	34.38	34.38	14.27	14.27
625.00	41.35	60.80	5.84	34.19	34.19	7.00	7.00
630.00	41.46	60.94	5.80	33.99	33.99	-0.28	-0.28
635.00	41.56	61.08	5.77	33.80	33.80	-7.59	-7.59
640.00	41.67	61.22	5.74	33.61	33.61	-14.91	-14.91
645.00	41.77	61.35	5.71	33.43	33.43	-22.24	-22.24
650.00	41.88	61.49	5.68	33.24	33.24	-29.60	-29.60
655.00	41.98	61.62	5.64	33.06	33.06	-36.97	-36.97
660.00	42.08	61.75	5.61	32.88	32.88	-44.35	-44.35
665.00	42.18	61.89	5.58	32.70	32.70	-51.76	-51.76
670.00	42.28	62.02	5.55	32.53	32.53	-59.17	-59.17
675.00	42.38	62.15	5.52	32.36	32.36	-66.61	-66.61
680.00	42.48	62.28	5.50	32.18	32.18	-74.06	-74.06
685.00	42.58	62.41	5.47	32.02	32.02	-81.52	-81.52
690.00	42.68	62.54	5.44	31.85	31.85	-89.00	-89.00
695.00	42.78	62.67	5.41	31.69	31.69	-96.50	-96.50
700.00	42.88	62.80	5.38	31.52	31.52	-104.01	-104.01

705.00	42.97	62.92	5.36	31.36	31.36	-111.53	-111.53
710.00	43.07	63.05	5.33	31.20	31.20	-119.07	-119.07
715.00	43.17	63.17	5.30	31.05	31.05	-126.63	-126.63
720.00	43.26	63.30	5.27	30.89	30.89	-134.19	-134.19
725.00	43.36	63.42	5.25	30.74	30.74	-141.77	-141.77
730.00	43.45	63.55	5.22	30.59	30.59	-149.37	-149.37
735.00	43.55	63.67	5.20	30.44	30.44	-156.98	-156.98
740.00	43.64	63.79	5.17	30.29	30.29	-164.60	-164.60
745.00	43.74	63.91	5.15	30.15	30.15	-172.23	-172.23
750.00	43.83	64.03	5.12	30.00	30.00	-179.88	-179.88
755.00	43.92	64.16	5.10	29.86	29.86	-187.54	-187.54
760.00	44.02	64.27	5.07	29.72	29.72	-195.21	-195.21
765.00	44.11	64.39	5.05	29.58	29.58	-202.90	-202.90
770.00	44.20	64.51	5.03	29.44	29.44	-210.60	-210.60
775.00	44.29	64.63	5.00	29.31	29.31	-218.31	-218.31
780.00	44.38	64.75	4.98	29.17	29.17	-226.03	-226.03
785.00	44.47	64.87	4.96	29.04	29.04	-233.77	-233.77
790.00	44.56	64.98	4.94	28.90	28.90	-241.52	-241.52
795.00	44.65	65.10	4.91	28.77	28.77	-249.28	-249.28
800.00	44.74	65.21	4.89	28.64	28.64	-257.05	-257.05
805.00	44.83	65.33	4.87	28.52	28.52	-264.83	-264.83
810.00	44.92	65.44	4.85	28.39	28.39	-272.62	-272.62
815.00	45.01	65.55	4.83	28.27	28.27	-280.43	-280.43
820.00	45.09	65.67	4.80	28.14	28.14	-288.24	-288.24
825.00	45.18	65.78	4.78	28.02	28.02	-296.07	-296.07
830.00	45.27	65.89	4.76	27.90	27.90	-303.91	-303.91
835.00	45.35	66.00	4.74	27.78	27.78	-311.76	-311.76
840.00	45.44	66.12	4.72	27.66	27.66	-319.61	-319.61
845.00	45.53	66.23	4.70	27.54	27.54	-327.48	-327.48
850.00	45.61	66.34	4.68	27.42	27.42	-335.37	-335.37
855.00	45.70	66.45	4.66	27.31	27.31	-343.26	-343.26
860.00	45.78	66.55	4.64	27.19	27.19	-351.16	-351.16
865.00	45.87	66.66	4.62	27.08	27.08	-359.07	-359.07
870.00	45.95	66.77	4.60	26.97	26.97	-366.99	-366.99
875.00	46.03	66.88	4.59	26.86	26.86	-374.92	-374.92
880.00	46.12	66.99	4.57	26.75	26.75	-382.86	-382.86
885.00	46.20	67.09	4.55	26.64	26.64	-390.81	-390.81
890.00	46.28	67.20	4.53	26.53	26.53	-398.77	-398.77
895.00	46.37	67.30	4.51	26.43	26.43	-406.74	-406.74
900.00	46.45	67.41	4.49	26.32	26.32	-414.72	-414.72
905.00	46.53	67.51	4.48	26.22	26.22	-422.71	-422.71
910.00	46.61	67.62	4.46	26.11	26.11	-430.71	-430.71
915.00	46.69	67.72	4.44	26.01	26.01	-438.72	-438.72
920.00	46.77	67.83	4.42	25.91	25.91	-446.73	-446.73
925.00	46.85	67.93	4.41	25.81	25.81	-454.76	-454.76
930.00	46.93	68.03	4.39	25.71	25.71	-462.79	-462.79
935.00	47.01	68.13	4.37	25.61	25.61	-470.84	-470.84
940.00	47.09	68.24	4.36	25.51	25.51	-478.89	-478.89
945.00	47.17	68.34	4.34	25.41	25.41	-486.95	-486.95
950.00	47.25	68.44	4.32	25.32	25.32	-495.02	-495.02

955.00	47.33	68.54	4.31	25.22	25.22	-503.10	-503.10
960.00	47.41	68.64	4.29	25.13	25.13	-511.18	-511.18
965.00	47.49	68.74	4.27	25.03	25.03	-519.28	-519.28
970.00	47.57	68.84	4.26	24.94	24.94	-527.38	-527.38
975.00	47.64	68.94	4.24	24.85	24.85	-535.49	-535.49
980.00	47.72	69.04	4.23	24.75	24.75	-543.61	-543.61
985.00	47.80	69.14	4.21	24.66	24.66	-551.74	-551.74
990.00	47.88	69.23	4.20	24.57	24.57	-559.87	-559.87
995.00	47.95	69.33	4.18	24.49	24.49	-568.02	-568.02
1000.00	48.03	69.43	4.17	24.40	24.40	-576.17	-576.17
1005.00	48.11	69.52	4.15	24.31	24.31	-584.33	-584.33
1010.00	48.18	69.62	4.14	24.22	24.22	-592.50	-592.50
1015.00	48.26	69.72	4.12	24.14	24.14	-600.67	-600.67
1020.00	48.33	69.81	4.11	24.05	24.05	-608.85	-608.85
1025.00	48.41	69.91	4.09	23.97	23.97	-617.04	-617.04
1030.00	48.48	70.00	4.08	23.88	23.88	-625.24	-625.24
1035.00	48.56	70.10	4.06	23.80	23.80	-633.44	-633.44
1040.00	48.63	70.19	4.05	23.72	23.72	-641.65	-641.65
1045.00	48.71	70.29	4.04	23.64	23.64	-649.87	-649.87
1050.00	48.78	70.38	4.02	23.55	23.55	-658.10	-658.10
1055.00	48.85	70.47	4.01	23.47	23.47	-666.33	-666.33
1060.00	48.93	70.57	3.99	23.39	23.39	-674.57	-674.57
1065.00	49.00	70.66	3.98	23.31	23.31	-682.82	-682.82
1070.00	49.07	70.75	3.97	23.24	23.24	-691.08	-691.08
1075.00	49.15	70.84	3.95	23.16	23.16	-699.34	-699.34
1080.00	49.22	70.93	3.94	23.08	23.08	-707.61	-707.61
1085.00	49.29	71.03	3.93	23.00	23.00	-715.88	-715.88
1090.00	49.36	71.12	3.91	22.93	22.93	-724.16	-724.16
1095.00	49.43	71.21	3.90	22.85	22.85	-732.45	-732.45
1100.00	49.51	71.30	3.89	22.78	22.78	-740.75	-740.75
1105.00	49.58	71.39	3.88	22.70	22.70	-749.05	-749.05
1110.00	49.65	71.48	3.86	22.63	22.63	-757.36	-757.36
1115.00	49.72	71.57	3.85	22.55	22.55	-765.67	-765.67
1120.00	49.79	71.66	3.84	22.48	22.48	-773.99	-773.99
1125.00	49.86	71.74	3.83	22.41	22.41	-782.32	-782.32
1130.00	49.93	71.83	3.81	22.34	22.34	-790.66	-790.66
1135.00	50.00	71.92	3.80	22.27	22.27	-799.00	-799.00
1140.00	50.07	72.01	3.79	22.20	22.20	-807.34	-807.34
1145.00	50.14	72.10	3.78	22.13	22.13	-815.70	-815.70
1150.00	50.21	72.18	3.77	22.06	22.06	-824.06	-824.06
1155.00	50.28	72.27	3.75	21.99	21.99	-832.42	-832.42
1160.00	50.35	72.36	3.74	21.92	21.92	-840.79	-840.79
1165.00	50.42	72.44	3.73	21.85	21.85	-849.17	-849.17
1170.00	50.48	72.53	3.72	21.78	21.78	-857.55	-857.55
1175.00	50.55	72.62	3.71	21.72	21.72	-865.94	-865.94
1180.00	50.62	72.70	3.70	21.65	21.65	-874.34	-874.34
1185.00	50.69	72.79	3.69	21.58	21.58	-882.74	-882.74
1190.00	50.76	72.87	3.67	21.52	21.52	-891.14	-891.14
1195.00	50.82	72.96	3.66	21.45	21.45	-899.56	-899.56
1200.00	50.89	73.04	3.65	21.39	21.39	-907.97	-907.97

1205.00	50.96	73.13	3.64	21.33	21.33	-916.40	-916.40
1210.00	51.02	73.21	3.63	21.26	21.26	-924.83	-924.83
1215.00	51.09	73.29	3.62	21.20	21.20	-933.26	-933.26
1220.00	51.16	73.38	3.61	21.14	21.14	-941.70	-941.70
1225.00	51.22	73.46	3.60	21.07	21.07	-950.15	-950.15
1230.00	51.29	73.54	3.59	21.01	21.01	-958.60	-958.60
1235.00	51.36	73.63	3.58	20.95	20.95	-967.06	-967.06
1240.00	51.42	73.71	3.57	20.89	20.89	-975.52	-975.52
1245.00	51.49	73.79	3.56	20.83	20.83	-983.99	-983.99
1250.00	51.55	73.87	3.55	20.77	20.77	-992.46	-992.46
1255.00	51.62	73.95	3.54	20.71	20.71	-1000.94	-1000.94
1260.00	51.68	74.04	3.53	20.65	20.65	-1009.42	-1009.42
1265.00	51.75	74.12	3.52	20.59	20.59	-1017.91	-1017.91
1270.00	51.81	74.20	3.51	20.53	20.53	-1026.40	-1026.40
1275.00	51.88	74.28	3.50	20.47	20.47	-1034.90	-1034.90
1280.00	51.94	74.36	3.49	20.41	20.41	-1043.41	-1043.41
1285.00	52.01	74.44	3.48	20.36	20.36	-1051.92	-1051.92
1290.00	52.07	74.52	3.47	20.30	20.30	-1060.43	-1060.43
1295.00	52.14	74.60	3.46	20.24	20.24	-1068.95	-1068.95
1300.00	52.20	74.68	3.45	20.19	20.19	-1077.47	-1077.47
1305.00	52.26	74.76	3.44	20.13	20.13	-1086.00	-1086.00
1310.00	52.33	74.84	3.43	20.07	20.07	-1094.54	-1094.54
1315.00	52.39	74.92	3.42	20.02	20.02	-1103.08	-1103.08
1320.00	52.45	74.99	3.41	19.96	19.96	-1111.62	-1111.62
1325.00	52.51	75.07	3.40	19.91	19.91	-1120.17	-1120.17
1330.00	52.58	75.15	3.39	19.86	19.86	-1128.72	-1128.72
1335.00	52.64	75.23	3.38	19.80	19.80	-1137.28	-1137.28
1340.00	52.70	75.31	3.37	19.75	19.75	-1145.84	-1145.84
1345.00	52.76	75.38	3.36	19.70	19.70	-1154.41	-1154.41
1350.00	52.83	75.46	3.35	19.64	19.64	-1162.98	-1162.98
1355.00	52.89	75.54	3.34	19.59	19.59	-1171.56	-1171.56
1360.00	52.95	75.61	3.34	19.54	19.54	-1180.14	-1180.14
1365.00	53.01	75.69	3.33	19.49	19.49	-1188.72	-1188.72
1370.00	53.07	75.77	3.32	19.43	19.43	-1197.31	-1197.31
1375.00	53.14	75.84	3.31	19.38	19.38	-1205.91	-1205.91
1380.00	53.20	75.92	3.30	19.33	19.33	-1214.51	-1214.51
1385.00	53.26	75.99	3.29	19.28	19.28	-1223.11	-1223.11
1390.00	53.32	76.07	3.28	19.23	19.23	-1231.72	-1231.72
1395.00	53.38	76.15	3.28	19.18	19.18	-1240.33	-1240.33
1400.00	53.44	76.22	3.27	19.13	19.13	-1248.95	-1248.95
1405.00	53.50	76.30	3.26	19.08	19.08	-1257.57	-1257.57
1410.00	53.56	76.37	3.25	19.03	19.03	-1266.19	-1266.19
1415.00	53.62	76.44	3.24	18.98	18.98	-1274.82	-1274.82
1420.00	53.68	76.52	3.23	18.94	18.94	-1283.46	-1283.46
1425.00	53.74	76.59	3.22	18.89	18.89	-1292.09	-1292.09
1430.00	53.80	76.67	3.22	18.84	18.84	-1300.74	-1300.74
1435.00	53.86	76.74	3.21	18.79	18.79	-1309.38	-1309.38
1440.00	53.92	76.81	3.20	18.74	18.74	-1318.03	-1318.03
1445.00	53.98	76.89	3.19	18.70	18.70	-1326.69	-1326.69
1450.00	54.04	76.96	3.18	18.65	18.65	-1335.35	-1335.35

1455.00	54.10	77.03	3.18	18.60	18.60	-1344.01	-1344.01
1460.00	54.15	77.11	3.17	18.56	18.56	-1352.68	-1352.68
1465.00	54.21	77.18	3.16	18.51	18.51	-1361.35	-1361.35
1470.00	54.27	77.25	3.15	18.47	18.47	-1370.02	-1370.02
1475.00	54.33	77.32	3.15	18.42	18.42	-1378.70	-1378.70
1480.00	54.39	77.40	3.14	18.38	18.38	-1387.38	-1387.38
1485.00	54.45	77.47	3.13	18.33	18.33	-1396.07	-1396.07
1490.00	54.50	77.54	3.12	18.29	18.29	-1404.76	-1404.76
1495.00	54.56	77.61	3.11	18.24	18.24	-1413.46	-1413.46
1500.00	54.62	77.68	3.11	18.20	18.20	-1422.15	-1422.15
1505.00	54.68	77.75	3.10	18.15	18.15	-1430.86	-1430.86
1510.00	54.74	77.82	3.09	18.11	18.11	-1439.56	-1439.56
1515.00	54.79	77.89	3.08	18.07	18.07	-1448.27	-1448.27
1520.00	54.85	77.96	3.08	18.02	18.02	-1456.99	-1456.99
1525.00	54.91	78.03	3.07	17.98	17.98	-1465.70	-1465.70
1530.00	54.96	78.10	3.06	17.94	17.94	-1474.42	-1474.42
1535.00	55.02	78.17	3.06	17.90	17.90	-1483.15	-1483.15
1540.00	55.08	78.24	3.05	17.85	17.85	-1491.88	-1491.88
1545.00	55.13	78.31	3.04	17.81	17.81	-1500.61	-1500.61
1550.00	55.19	78.38	3.03	17.77	17.77	-1509.34	-1509.34
1555.00	55.25	78.45	3.03	17.73	17.73	-1518.08	-1518.08
1560.00	55.30	78.52	3.02	17.69	17.69	-1526.83	-1526.83
1565.00	55.36	78.59	3.01	17.65	17.65	-1535.57	-1535.57
1570.00	55.41	78.66	3.01	17.61	17.61	-1544.32	-1544.32
1575.00	55.47	78.73	3.00	17.57	17.57	-1553.08	-1553.08
1580.00	55.53	78.80	2.99	17.52	17.52	-1561.83	-1561.83
1585.00	55.58	78.87	2.99	17.48	17.48	-1570.59	-1570.59
1590.00	55.64	78.93	2.98	17.44	17.44	-1579.36	-1579.36
1595.00	55.69	79.00	2.97	17.41	17.41	-1588.13	-1588.13
1600.00	55.75	79.07	2.97	17.37	17.37	-1596.90	-1596.90
1605.00	55.80	79.14	2.96	17.33	17.33	-1605.67	-1605.67
1610.00	55.86	79.20	2.95	17.29	17.29	-1614.45	-1614.45
1615.00	55.91	79.27	2.95	17.25	17.25	-1623.23	-1623.23
1620.00	55.97	79.34	2.94	17.21	17.21	-1632.01	-1632.01
1625.00	56.02	79.41	2.93	17.17	17.17	-1640.80	-1640.80
1630.00	56.08	79.47	2.93	17.13	17.13	-1649.59	-1649.59
1635.00	56.13	79.54	2.92	17.09	17.09	-1658.39	-1658.39
1640.00	56.19	79.61	2.91	17.06	17.06	-1667.18	-1667.18
1645.00	56.24	79.67	2.91	17.02	17.02	-1675.99	-1675.99
1650.00	56.29	79.74	2.90	16.98	16.98	-1684.79	-1684.79
1655.00	56.35	79.80	2.89	16.94	16.94	-1693.60	-1693.60
1660.00	56.40	79.87	2.89	16.91	16.91	-1702.41	-1702.41
1665.00	56.45	79.94	2.88	16.87	16.87	-1711.22	-1711.22
1670.00	56.51	80.00	2.87	16.83	16.83	-1720.04	-1720.04
1675.00	56.56	80.07	2.87	16.80	16.80	-1728.86	-1728.86
1680.00	56.62	80.13	2.86	16.76	16.76	-1737.68	-1737.68
1685.00	56.67	80.20	2.86	16.72	16.72	-1746.51	-1746.51
1690.00	56.72	80.26	2.85	16.69	16.69	-1755.34	-1755.34
1695.00	56.77	80.33	2.84	16.65	16.65	-1764.17	-1764.17
1700.00	56.83	80.39	2.84	16.62	16.62	-1773.01	-1773.01

1705.00	56.88	80.46	2.83	16.58	16.58	-1781.85	-1781.85
1710.00	56.93	80.52	2.83	16.55	16.55	-1790.69	-1790.69
1715.00	56.99	80.58	2.82	16.51	16.51	-1799.54	-1799.54
1720.00	57.04	80.65	2.81	16.48	16.48	-1808.38	-1808.38
1725.00	57.09	80.71	2.81	16.44	16.44	-1817.23	-1817.23
1730.00	57.14	80.78	2.80	16.41	16.41	-1826.09	-1826.09
1735.00	57.20	80.84	2.80	16.37	16.37	-1834.95	-1834.95
1740.00	57.25	80.90	2.79	16.34	16.34	-1843.81	-1843.81
1745.00	57.30	80.97	2.78	16.30	16.30	-1852.67	-1852.67
1750.00	57.35	81.03	2.78	16.27	16.27	-1861.54	-1861.54
1755.00	57.40	81.09	2.77	16.24	16.24	-1870.40	-1870.40
1760.00	57.46	81.16	2.77	16.20	16.20	-1879.28	-1879.28
1765.00	57.51	81.22	2.76	16.17	16.17	-1888.15	-1888.15
1770.00	57.56	81.28	2.76	16.14	16.14	-1897.03	-1897.03
1775.00	57.61	81.34	2.75	16.10	16.10	-1905.91	-1905.91
1780.00	57.66	81.41	2.74	16.07	16.07	-1914.79	-1914.79
1785.00	57.71	81.47	2.74	16.04	16.04	-1923.68	-1923.68
1790.00	57.76	81.53	2.73	16.01	16.01	-1932.57	-1932.57
1795.00	57.81	81.59	2.73	15.97	15.97	-1941.46	-1941.46
1800.00	57.87	81.66	2.72	15.94	15.94	-1950.35	-1950.35
1805.00	57.92	81.72	2.72	15.91	15.91	-1959.25	-1959.25
1810.00	57.97	81.78	2.71	15.88	15.88	-1968.15	-1968.15
1815.00	58.02	81.84	2.71	15.85	15.85	-1977.05	-1977.05
1820.00	58.07	81.90	2.70	15.81	15.81	-1985.96	-1985.96
1825.00	58.12	81.96	2.69	15.78	15.78	-1994.87	-1994.87
1830.00	58.17	82.02	2.69	15.75	15.75	-2003.78	-2003.78
1835.00	58.22	82.09	2.68	15.72	15.72	-2012.69	-2012.69
1840.00	58.27	82.15	2.68	15.69	15.69	-2021.61	-2021.61
1845.00	58.32	82.21	2.67	15.66	15.66	-2030.53	-2030.53
1850.00	58.37	82.27	2.67	15.63	15.63	-2039.45	-2039.45
1855.00	58.42	82.33	2.66	15.60	15.60	-2048.38	-2048.38
1860.00	58.47	82.39	2.66	15.57	15.57	-2057.30	-2057.30
1865.00	58.52	82.45	2.65	15.54	15.54	-2066.23	-2066.23
1870.00	58.57	82.51	2.65	15.50	15.50	-2075.16	-2075.16
1875.00	58.62	82.57	2.64	15.47	15.47	-2084.10	-2084.10
1880.00	58.67	82.63	2.64	15.44	15.44	-2093.04	-2093.04
1885.00	58.72	82.69	2.63	15.41	15.41	-2101.98	-2101.98
1890.00	58.77	82.75	2.63	15.39	15.39	-2110.92	-2110.92
1895.00	58.81	82.81	2.62	15.36	15.36	-2119.87	-2119.87
1900.00	58.86	82.87	2.62	15.33	15.33	-2128.81	-2128.81
1905.00	58.91	82.93	2.61	15.30	15.30	-2137.76	-2137.76
1910.00	58.96	82.99	2.61	15.27	15.27	-2146.72	-2146.72
1915.00	59.01	83.04	2.60	15.24	15.24	-2155.67	-2155.67
1920.00	59.06	83.10	2.60	15.21	15.21	-2164.63	-2164.63
1925.00	59.11	83.16	2.59	15.18	15.18	-2173.59	-2173.59
1930.00	59.16	83.22	2.59	15.15	15.15	-2182.55	-2182.55
1935.00	59.20	83.28	2.58	15.12	15.12	-2191.52	-2191.52
1940.00	59.25	83.34	2.58	15.10	15.10	-2200.49	-2200.49
1945.00	59.30	83.40	2.57	15.07	15.07	-2209.46	-2209.46
1950.00	59.35	83.45	2.57	15.04	15.04	-2218.43	-2218.43

1955.00	59.40	83.51	2.56	15.01	15.01	-2227.40	-2227.40
1960.00	59.45	83.57	2.56	14.98	14.98	-2236.38	-2236.38
1965.00	59.49	83.63	2.55	14.96	14.96	-2245.36	-2245.36
1970.00	59.54	83.69	2.55	14.93	14.93	-2254.34	-2254.34
1975.00	59.59	83.74	2.54	14.90	14.90	-2263.33	-2263.33
1980.00	59.64	83.80	2.54	14.87	14.87	-2272.31	-2272.31
1985.00	59.68	83.86	2.53	14.85	14.85	-2281.30	-2281.30
1990.00	59.73	83.92	2.53	14.82	14.82	-2290.30	-2290.30
1995.00	59.78	83.97	2.53	14.79	14.79	-2299.29	-2299.29
2000.00	59.83	84.03	2.52	14.76	14.76	-2308.29	-2308.29
2005.00	59.87	84.09	2.52	14.74	14.74	-2317.28	-2317.28
2010.00	59.92	84.14	2.51	14.71	14.71	-2326.28	-2326.28
2015.00	59.97	84.20	2.51	14.68	14.68	-2335.29	-2335.29
2020.00	60.01	84.26	2.50	14.66	14.66	-2344.29	-2344.29
2025.00	60.06	84.31	2.50	14.63	14.63	-2353.30	-2353.30
2030.00	60.11	84.37	2.49	14.60	14.60	-2362.31	-2362.31
2035.00	60.16	84.43	2.49	14.58	14.58	-2371.32	-2371.32
2040.00	60.20	84.48	2.48	14.55	14.55	-2380.34	-2380.34
2045.00	60.25	84.54	2.48	14.53	14.53	-2389.35	-2389.35
2050.00	60.30	84.60	2.48	14.50	14.50	-2398.37	-2398.37
2055.00	60.34	84.65	2.47	14.48	14.48	-2407.40	-2407.40
2060.00	60.39	84.71	2.47	14.45	14.45	-2416.42	-2416.42
2065.00	60.43	84.76	2.46	14.42	14.42	-2425.44	-2425.44
2070.00	60.48	84.82	2.46	14.40	14.40	-2434.47	-2434.47
2075.00	60.53	84.87	2.45	14.37	14.37	-2443.50	-2443.50
2080.00	60.57	84.93	2.45	14.35	14.35	-2452.53	-2452.53
2085.00	60.62	84.98	2.45	14.32	14.32	-2461.57	-2461.57
2090.00	60.66	85.04	2.44	14.30	14.30	-2470.60	-2470.60
2095.00	60.71	85.09	2.44	14.27	14.27	-2479.64	-2479.64
2100.00	60.76	85.15	2.43	14.25	14.25	-2488.68	-2488.68
2105.00	60.80	85.20	2.43	14.22	14.22	-2497.73	-2497.73
2110.00	60.85	85.26	2.42	14.20	14.20	-2506.77	-2506.77
2115.00	60.89	85.31	2.42	14.17	14.17	-2515.82	-2515.82
2120.00	60.94	85.37	2.42	14.15	14.15	-2524.87	-2524.87
2125.00	60.98	85.42	2.41	14.13	14.13	-2533.92	-2533.92
2130.00	61.03	85.48	2.41	14.10	14.10	-2542.97	-2542.97
2135.00	61.07	85.53	2.40	14.08	14.08	-2552.03	-2552.03
2140.00	61.12	85.59	2.40	14.05	14.05	-2561.09	-2561.09
2145.00	61.16	85.64	2.40	14.03	14.03	-2570.14	-2570.14
2150.00	61.21	85.69	2.39	14.01	14.01	-2579.21	-2579.21
2155.00	61.25	85.75	2.39	13.98	13.98	-2588.27	-2588.27
2160.00	61.30	85.80	2.38	13.96	13.96	-2597.34	-2597.34
2165.00	61.34	85.86	2.38	13.94	13.94	-2606.40	-2606.40
2170.00	61.39	85.91	2.38	13.91	13.91	-2615.47	-2615.47
2175.00	61.43	85.96	2.37	13.89	13.89	-2624.54	-2624.54
2180.00	61.48	86.02	2.37	13.87	13.87	-2633.62	-2633.62
2185.00	61.52	86.07	2.36	13.84	13.84	-2642.69	-2642.69
2190.00	61.57	86.12	2.36	13.82	13.82	-2651.77	-2651.77
2195.00	61.61	86.18	2.36	13.80	13.80	-2660.85	-2660.85
2200.00	61.66	86.23	2.35	13.77	13.77	-2669.93	-2669.93

2205.00	61.70	86.28	2.35	13.75	13.75	-2679.02	-2679.02
2210.00	61.74	86.33	2.34	13.73	13.73	-2688.10	-2688.10
2215.00	61.79	86.39	2.34	13.71	13.71	-2697.19	-2697.19
2220.00	61.83	86.44	2.34	13.68	13.68	-2706.28	-2706.28
2225.00	61.88	86.49	2.33	13.66	13.66	-2715.37	-2715.37
2230.00	61.92	86.55	2.33	13.64	13.64	-2724.46	-2724.46
2235.00	61.96	86.60	2.32	13.62	13.62	-2733.56	-2733.56
2240.00	62.01	86.65	2.32	13.59	13.59	-2742.65	-2742.65
2245.00	62.05	86.70	2.32	13.57	13.57	-2751.75	-2751.75
2250.00	62.10	86.75	2.31	13.55	13.55	-2760.85	-2760.85
2255.00	62.14	86.81	2.31	13.53	13.53	-2769.96	-2769.96
2260.00	62.18	86.86	2.31	13.51	13.51	-2779.06	-2779.06
2265.00	62.23	86.91	2.30	13.48	13.48	-2788.17	-2788.17
2270.00	62.27	86.96	2.30	13.46	13.46	-2797.28	-2797.28
2275.00	62.31	87.01	2.29	13.44	13.44	-2806.39	-2806.39
2280.00	62.36	87.07	2.29	13.42	13.42	-2815.50	-2815.50
2285.00	62.40	87.12	2.29	13.40	13.40	-2824.61	-2824.61
2290.00	62.44	87.17	2.28	13.38	13.38	-2833.73	-2833.73
2295.00	62.49	87.22	2.28	13.35	13.35	-2842.84	-2842.84
2300.00	62.53	87.27	2.28	13.33	13.33	-2851.96	-2851.96
2305.00	62.57	87.32	2.27	13.31	13.31	-2861.08	-2861.08
2310.00	62.61	87.37	2.27	13.29	13.29	-2870.21	-2870.21
2315.00	62.66	87.42	2.27	13.27	13.27	-2879.33	-2879.33
2320.00	62.70	87.48	2.26	13.25	13.25	-2888.46	-2888.46
2325.00	62.74	87.53	2.26	13.23	13.23	-2897.59	-2897.59
2330.00	62.79	87.58	2.26	13.21	13.21	-2906.72	-2906.72
2335.00	62.83	87.63	2.25	13.19	13.19	-2915.85	-2915.85
2340.00	62.87	87.68	2.25	13.17	13.17	-2924.98	-2924.98
2345.00	62.91	87.73	2.24	13.15	13.15	-2934.12	-2934.12
2350.00	62.96	87.78	2.24	13.13	13.13	-2943.25	-2943.25
2355.00	63.00	87.83	2.24	13.11	13.11	-2952.39	-2952.39
2360.00	63.04	87.88	2.23	13.09	13.09	-2961.53	-2961.53
2365.00	63.08	87.93	2.23	13.07	13.07	-2970.67	-2970.67
2370.00	63.12	87.98	2.23	13.04	13.04	-2979.82	-2979.82
2375.00	63.17	88.03	2.22	13.02	13.02	-2988.96	-2988.96
2380.00	63.21	88.08	2.22	13.00	13.00	-2998.11	-2998.11
2385.00	63.25	88.13	2.22	12.98	12.98	-3007.26	-3007.26
2390.00	63.29	88.18	2.21	12.97	12.97	-3016.41	-3016.41
2395.00	63.33	88.23	2.21	12.95	12.95	-3025.56	-3025.56
2400.00	63.38	88.28	2.21	12.93	12.93	-3034.72	-3034.72
2405.00	63.42	88.33	2.20	12.91	12.91	-3043.87	-3043.87
2410.00	63.46	88.38	2.20	12.89	12.89	-3053.03	-3053.03
2415.00	63.50	88.43	2.20	12.87	12.87	-3062.19	-3062.19
2420.00	63.54	88.48	2.19	12.85	12.85	-3071.35	-3071.35
2425.00	63.58	88.53	2.19	12.83	12.83	-3080.51	-3080.51
2430.00	63.62	88.57	2.19	12.81	12.81	-3089.68	-3089.68
2435.00	63.67	88.62	2.18	12.79	12.79	-3098.84	-3098.84
2440.00	63.71	88.67	2.18	12.77	12.77	-3108.01	-3108.01
2445.00	63.75	88.72	2.18	12.75	12.75	-3117.18	-3117.18
2450.00	63.79	88.77	2.17	12.73	12.73	-3126.35	-3126.35

2455.00	63.83	88.82	2.17	12.71	12.71	-3135.52	-3135.52
2460.00	63.87	88.87	2.17	12.69	12.69	-3144.70	-3144.70
2465.00	63.91	88.92	2.16	12.68	12.68	-3153.87	-3153.87
2470.00	63.95	88.96	2.16	12.66	12.66	-3163.05	-3163.05
2475.00	63.99	89.01	2.16	12.64	12.64	-3172.23	-3172.23
2480.00	64.04	89.06	2.15	12.62	12.62	-3181.41	-3181.41
2485.00	64.08	89.11	2.15	12.60	12.60	-3190.59	-3190.59
2490.00	64.12	89.16	2.15	12.58	12.58	-3199.77	-3199.77
2495.00	64.16	89.21	2.15	12.56	12.56	-3208.96	-3208.96
2500.00	64.20	89.25	2.14	12.55	12.55	-3218.14	-3218.14
2505.00	64.24	89.30	2.14	12.53	12.53	-3227.33	-3227.33
2510.00	64.28	89.35	2.14	12.51	12.51	-3236.52	-3236.52
2515.00	64.32	89.40	2.13	12.49	12.49	-3245.71	-3245.71
2520.00	64.36	89.45	2.13	12.47	12.47	-3254.91	-3254.91
2525.00	64.40	89.49	2.13	12.45	12.45	-3264.10	-3264.10
2530.00	64.44	89.54	2.12	12.44	12.44	-3273.30	-3273.30
2535.00	64.48	89.59	2.12	12.42	12.42	-3282.49	-3282.49
2540.00	64.52	89.64	2.12	12.40	12.40	-3291.69	-3291.69
2545.00	64.56	89.68	2.11	12.38	12.38	-3300.89	-3300.89
2550.00	64.60	89.73	2.11	12.37	12.37	-3310.10	-3310.10
2555.00	64.64	89.78	2.11	12.35	12.35	-3319.30	-3319.30
2560.00	64.68	89.83	2.11	12.33	12.33	-3328.50	-3328.50
2565.00	64.72	89.87	2.10	12.31	12.31	-3337.71	-3337.71
2570.00	64.76	89.92	2.10	12.29	12.29	-3346.92	-3346.92
2575.00	64.80	89.97	2.10	12.28	12.28	-3356.13	-3356.13
2580.00	64.84	90.01	2.09	12.26	12.26	-3365.34	-3365.34
2585.00	64.88	90.06	2.09	12.24	12.24	-3374.55	-3374.55
2590.00	64.92	90.11	2.09	12.23	12.23	-3383.76	-3383.76
2595.00	64.96	90.15	2.08	12.21	12.21	-3392.98	-3392.98
2600.00	65.00	90.20	2.08	12.19	12.19	-3402.20	-3402.20
2605.00	65.04	90.25	2.08	12.17	12.17	-3411.42	-3411.42
2610.00	65.08	90.29	2.08	12.16	12.16	-3420.63	-3420.63
2615.00	65.12	90.34	2.07	12.14	12.14	-3429.86	-3429.86
2620.00	65.16	90.39	2.07	12.12	12.12	-3439.08	-3439.08
2625.00	65.20	90.43	2.07	12.11	12.11	-3448.30	-3448.30
2630.00	65.24	90.48	2.06	12.09	12.09	-3457.53	-3457.53
2635.00	65.27	90.52	2.06	12.07	12.07	-3466.75	-3466.75
2640.00	65.31	90.57	2.06	12.06	12.06	-3475.98	-3475.98
2645.00	65.35	90.62	2.06	12.04	12.04	-3485.21	-3485.21
2650.00	65.39	90.66	2.05	12.02	12.02	-3494.44	-3494.44
2655.00	65.43	90.71	2.05	12.01	12.01	-3503.68	-3503.68
2660.00	65.47	90.75	2.05	11.99	11.99	-3512.91	-3512.91
2665.00	65.51	90.80	2.04	11.97	11.97	-3522.15	-3522.15
2670.00	65.55	90.85	2.04	11.96	11.96	-3531.38	-3531.38
2675.00	65.59	90.89	2.04	11.94	11.94	-3540.62	-3540.62
2680.00	65.62	90.94	2.04	11.92	11.92	-3549.86	-3549.86
2685.00	65.66	90.98	2.03	11.91	11.91	-3559.10	-3559.10
2690.00	65.70	91.03	2.03	11.89	11.89	-3568.34	-3568.34
2695.00	65.74	91.07	2.03	11.88	11.88	-3577.59	-3577.59
2700.00	65.78	91.12	2.02	11.86	11.86	-3586.83	-3586.83

2705.00	65.82	91.16	2.02	11.84	11.84	-3596.08	-3596.08
2710.00	65.86	91.21	2.02	11.83	11.83	-3605.33	-3605.33
2715.00	65.89	91.25	2.02	11.81	11.81	-3614.58	-3614.58
2720.00	65.93	91.30	2.01	11.80	11.80	-3623.83	-3623.83
2725.00	65.97	91.34	2.01	11.78	11.78	-3633.08	-3633.08
2730.00	66.01	91.39	2.01	11.76	11.76	-3642.33	-3642.33
2735.00	66.05	91.43	2.01	11.75	11.75	-3651.59	-3651.59
2740.00	66.08	91.48	2.00	11.73	11.73	-3660.84	-3660.84
2745.00	66.12	91.52	2.00	11.72	11.72	-3670.10	-3670.10
2750.00	66.16	91.57	2.00	11.70	11.70	-3679.36	-3679.36
2755.00	66.20	91.61	2.00	11.69	11.69	-3688.62	-3688.62
2760.00	66.24	91.66	1.99	11.67	11.67	-3697.88	-3697.88
2765.00	66.27	91.70	1.99	11.65	11.65	-3707.14	-3707.14
2770.00	66.31	91.75	1.99	11.64	11.64	-3716.40	-3716.40
2775.00	66.35	91.79	1.98	11.62	11.62	-3725.67	-3725.67
2780.00	66.39	91.83	1.98	11.61	11.61	-3734.94	-3734.94
2785.00	66.43	91.88	1.98	11.59	11.59	-3744.20	-3744.20
2790.00	66.46	91.92	1.98	11.58	11.58	-3753.47	-3753.47
2795.00	66.50	91.97	1.97	11.56	11.56	-3762.74	-3762.74
2800.00	66.54	92.01	1.97	11.55	11.55	-3772.01	-3772.01
2805.00	66.58	92.06	1.97	11.53	11.53	-3781.29	-3781.29
2810.00	66.61	92.10	1.97	11.52	11.52	-3790.56	-3790.56
2815.00	66.65	92.14	1.96	11.50	11.50	-3799.84	-3799.84
2820.00	66.69	92.19	1.96	11.49	11.49	-3809.11	-3809.11
2825.00	66.73	92.23	1.96	11.47	11.47	-3818.39	-3818.39
2830.00	66.76	92.27	1.96	11.46	11.46	-3827.67	-3827.67
2835.00	66.80	92.32	1.95	11.44	11.44	-3836.95	-3836.95
2840.00	66.84	92.36	1.95	11.43	11.43	-3846.23	-3846.23
2845.00	66.87	92.41	1.95	11.41	11.41	-3855.51	-3855.51
2850.00	66.91	92.45	1.95	11.40	11.40	-3864.80	-3864.80
2855.00	66.95	92.49	1.94	11.38	11.38	-3874.08	-3874.08
2860.00	66.99	92.54	1.94	11.37	11.37	-3883.37	-3883.37
2865.00	67.02	92.58	1.94	11.36	11.36	-3892.66	-3892.66
2870.00	67.06	92.62	1.94	11.34	11.34	-3901.95	-3901.95
2875.00	67.10	92.66	1.93	11.33	11.33	-3911.24	-3911.24
2880.00	67.13	92.71	1.93	11.31	11.31	-3920.53	-3920.53

Notes to User

Only values shown blue to be edited

Sheet only for england and wales

ln M5-D	J0	J1	J2	Cr	ln (MT-D/M5-D)	MT-D/M5-D
2.19	0.1699	0.0028	0.000114	0.204191	0.388207	1.474335
2.39	0.1699	0.0028	0.000114	0.214046	0.406944	1.50222
2.52	0.1644	0.005831	-0.00013	0.216058	0.410769	1.507977
2.61	0.1644	0.005831	-0.00013	0.218898	0.416168	1.516141
2.68	0.1644	0.005831	-0.00013	0.221006	0.420176	1.522229
2.74	0.1644	0.005831	-0.00013	0.222617	0.423239	1.526899
2.80	0.1644	0.005831	-0.00013	0.22387	0.42562	1.53054
2.84	0.1644	0.005831	-0.00013	0.224853	0.42749	1.533404
2.88	0.1644	0.005831	-0.00013	0.225627	0.428962	1.535663
2.91	0.1644	0.005831	-0.00013	0.226235	0.430117	1.537438
2.94	0.1644	0.005831	-0.00013	0.226707	0.431014	1.538817
2.97	0.1644	0.005831	-0.00013	0.227066	0.431697	1.539869
3.00	0.1644	0.005831	-0.00013	0.227331	0.4322	1.540644
3.02	0.1644	0.005831	-0.00013	0.227515	0.43255	1.541183
3.05	0.1644	0.005831	-0.00013	0.22763	0.432769	1.54152
3.07	0.1644	0.005831	-0.00013	0.227685	0.432874	1.541681
3.09	0.1644	0.005831	-0.00013	0.227687	0.432878	1.541689
3.11	0.1644	0.005831	-0.00013	0.227643	0.432795	1.54156
3.12	0.1644	0.005831	-0.00013	0.227559	0.432634	1.541312
3.14	0.1644	0.005831	-0.00013	0.227437	0.432403	1.540956
3.16	0.1644	0.005831	-0.00013	0.227283	0.43211	1.540505
3.17	0.1644	0.005831	-0.00013	0.227099	0.431761	1.539967
3.18	0.1644	0.005831	-0.00013	0.226889	0.431361	1.539351
3.20	0.1644	0.005831	-0.00013	0.226655	0.430915	1.538665
3.21	0.1644	0.005831	-0.00013	0.226398	0.430428	1.537915
3.22	0.1644	0.005831	-0.00013	0.226122	0.429902	1.537107
3.24	0.1644	0.005831	-0.00013	0.225827	0.429341	1.536245
3.25	0.1644	0.005831	-0.00013	0.225515	0.428748	1.535335
3.26	0.1644	0.005831	-0.00013	0.225188	0.428126	1.534379
3.27	0.1644	0.005831	-0.00013	0.224846	0.427476	1.533383
3.28	0.1644	0.005831	-0.00013	0.224491	0.426801	1.532348
3.29	0.1644	0.005831	-0.00013	0.224123	0.426103	1.531278
3.30	0.1644	0.005831	-0.00013	0.223745	0.425383	1.530176
3.31	0.1644	0.005831	-0.00013	0.223355	0.424642	1.529043
3.32	0.1644	0.005831	-0.00013	0.222956	0.423883	1.527883
3.33	0.1644	0.005831	-0.00013	0.222547	0.423107	1.526697
3.34	0.1644	0.005831	-0.00013	0.22213	0.422314	1.525487
3.35	0.1644	0.005831	-0.00013	0.221705	0.421505	1.524254
3.35	0.1644	0.005831	-0.00013	0.221273	0.420683	1.523001

3.36	0.1644	0.005831	-0.00013	0.220833	0.419847	1.521728
3.37	0.1644	0.005831	-0.00013	0.220386	0.418998	1.520437
3.38	0.1644	0.005831	-0.00013	0.219934	0.418138	1.51913
3.39	0.1644	0.005831	-0.00013	0.219475	0.417266	1.517806
3.39	0.1644	0.005831	-0.00013	0.219011	0.416384	1.516468
3.40	0.1644	0.005831	-0.00013	0.218542	0.415492	1.515116
3.41	0.1644	0.005831	-0.00013	0.218068	0.414591	1.513751
3.41	0.1644	0.005831	-0.00013	0.21759	0.413681	1.512374
3.42	0.1644	0.005831	-0.00013	0.217107	0.412762	1.510986
3.43	0.1644	0.005831	-0.00013	0.216619	0.411836	1.509587
3.43	0.1644	0.005831	-0.00013	0.216128	0.410903	1.508179
3.44	0.2644	-0.00162	3.15E-06	0.216913	0.412395	1.510431
3.45	0.2644	-0.00162	3.15E-06	0.216637	0.41187	1.509639
3.45	0.2644	-0.00162	3.15E-06	0.216365	0.411353	1.508858
3.46	0.2644	-0.00162	3.15E-06	0.216097	0.410843	1.508089
3.46	0.2644	-0.00162	3.15E-06	0.215832	0.41034	1.50733
3.47	0.2644	-0.00162	3.15E-06	0.215571	0.409844	1.506582
3.48	0.2644	-0.00162	3.15E-06	0.215314	0.409354	1.505845
3.48	0.2644	-0.00162	3.15E-06	0.215059	0.40887	1.505117
3.49	0.2644	-0.00162	3.15E-06	0.214808	0.408393	1.504398
3.49	0.2644	-0.00162	3.15E-06	0.21456	0.407921	1.503689
3.50	0.2644	-0.00162	3.15E-06	0.214315	0.407456	1.502989
3.50	0.2644	-0.00162	3.15E-06	0.214073	0.406995	1.502297
3.51	0.2644	-0.00162	3.15E-06	0.213834	0.406541	1.501614
3.51	0.2644	-0.00162	3.15E-06	0.213598	0.406091	1.50094
3.52	0.2644	-0.00162	3.15E-06	0.213364	0.405647	1.500273
3.52	0.2644	-0.00162	3.15E-06	0.213133	0.405208	1.499614
3.53	0.2644	-0.00162	3.15E-06	0.212905	0.404773	1.498963
3.53	0.2644	-0.00162	3.15E-06	0.212679	0.404344	1.498319
3.54	0.2644	-0.00162	3.15E-06	0.212455	0.403919	1.497683
3.54	0.2644	-0.00162	3.15E-06	0.212234	0.403499	1.497053
3.55	0.2644	-0.00162	3.15E-06	0.212015	0.403083	1.496431
3.55	0.2644	-0.00162	3.15E-06	0.211799	0.402671	1.495815
3.55	0.2644	-0.00162	3.15E-06	0.211584	0.402264	1.495205
3.56	0.2644	-0.00162	3.15E-06	0.211372	0.40186	1.494603
3.56	0.2644	-0.00162	3.15E-06	0.211162	0.401461	1.494006
3.57	0.2644	-0.00162	3.15E-06	0.210954	0.401066	1.493415
3.57	0.2644	-0.00162	3.15E-06	0.210748	0.400674	1.492831
3.58	0.2644	-0.00162	3.15E-06	0.210544	0.400286	1.492252
3.58	0.2644	-0.00162	3.15E-06	0.210342	0.399902	1.491679
3.58	0.2644	-0.00162	3.15E-06	0.210142	0.399522	1.491111
3.59	0.2644	-0.00162	3.15E-06	0.209944	0.399145	1.490549
3.59	0.2644	-0.00162	3.15E-06	0.209747	0.398771	1.489993
3.59	0.2644	-0.00162	3.15E-06	0.209553	0.398401	1.489441
3.60	0.2644	-0.00162	3.15E-06	0.20936	0.398034	1.488895
3.60	0.2644	-0.00162	3.15E-06	0.209168	0.39767	1.488353
3.61	0.2644	-0.00162	3.15E-06	0.208979	0.39731	1.487817
3.61	0.2644	-0.00162	3.15E-06	0.208791	0.396952	1.487285
3.61	0.2644	-0.00162	3.15E-06	0.208604	0.396598	1.486758
3.62	0.2644	-0.00162	3.15E-06	0.20842	0.396247	1.486236

3.62	0.2644	-0.00162	3.15E-06	0.208236	0.395898	1.485718
3.62	0.2644	-0.00162	3.15E-06	0.208055	0.395553	1.485205
3.63	0.2644	-0.00162	3.15E-06	0.207874	0.39521	1.484696
3.63	0.2644	-0.00162	3.15E-06	0.207695	0.39487	1.484191
3.63	0.2644	-0.00162	3.15E-06	0.207518	0.394533	1.483691
3.64	0.2644	-0.00162	3.15E-06	0.207342	0.394198	1.483194
3.64	0.2644	-0.00162	3.15E-06	0.207167	0.393866	1.482702
3.64	0.2644	-0.00162	3.15E-06	0.206994	0.393536	1.482213
3.65	0.2644	-0.00162	3.15E-06	0.206822	0.39321	1.481729
3.65	0.2644	-0.00162	3.15E-06	0.206651	0.392885	1.481248
3.65	0.2644	-0.00162	3.15E-06	0.206482	0.392563	1.480771
3.66	0.2644	-0.00162	3.15E-06	0.206314	0.392243	1.480298
3.66	0.2644	-0.00162	3.15E-06	0.206147	0.391926	1.479828
3.66	0.2644	-0.00162	3.15E-06	0.205981	0.391611	1.479362
3.67	0.2644	-0.00162	3.15E-06	0.205817	0.391298	1.4789
3.67	0.2644	-0.00162	3.15E-06	0.205654	0.390988	1.478441
3.67	0.2644	-0.00162	3.15E-06	0.205491	0.39068	1.477985
3.68	0.2644	-0.00162	3.15E-06	0.20533	0.390374	1.477533
3.68	0.2644	-0.00162	3.15E-06	0.205171	0.39007	1.477084
3.68	0.2644	-0.00162	3.15E-06	0.205012	0.389768	1.476638
3.68	0.2644	-0.00162	3.15E-06	0.204854	0.389468	1.476195
3.69	0.2644	-0.00162	3.15E-06	0.204697	0.38917	1.475756
3.69	0.2644	-0.00162	3.15E-06	0.204542	0.388874	1.475319
3.69	0.2644	-0.00162	3.15E-06	0.204387	0.388581	1.474886
3.70	0.2644	-0.00162	3.15E-06	0.204234	0.388289	1.474455
3.70	0.2644	-0.00162	3.15E-06	0.204081	0.387999	1.474028
3.70	0.2644	-0.00162	3.15E-06	0.20393	0.387711	1.473603
3.70	0.2644	-0.00162	3.15E-06	0.203779	0.387424	1.473181
3.71	0.2644	-0.00162	3.15E-06	0.20363	0.38714	1.472763
3.71	0.2644	-0.00162	3.15E-06	0.203481	0.386857	1.472346
3.71	0.2644	-0.00162	3.15E-06	0.203333	0.386576	1.471933
3.71	0.2644	-0.00162	3.15E-06	0.203186	0.386297	1.471522
3.72	0.2644	-0.00162	3.15E-06	0.20304	0.38602	1.471114
3.72	0.2644	-0.00162	3.15E-06	0.202895	0.385744	1.470708
3.72	0.2644	-0.00162	3.15E-06	0.202751	0.38547	1.470306
3.72	0.2644	-0.00162	3.15E-06	0.202608	0.385198	1.469905
3.73	0.2644	-0.00162	3.15E-06	0.202466	0.384927	1.469507
3.73	0.2644	-0.00162	3.15E-06	0.202324	0.384658	1.469112
3.73	0.2644	-0.00162	3.15E-06	0.202183	0.384391	1.468719
3.73	0.2644	-0.00162	3.15E-06	0.202043	0.384125	1.468328
3.74	0.2644	-0.00162	3.15E-06	0.201904	0.38386	1.46794
3.74	0.2644	-0.00162	3.15E-06	0.201766	0.383597	1.467554
3.74	0.2644	-0.00162	3.15E-06	0.201629	0.383336	1.467171
3.74	0.2644	-0.00162	3.15E-06	0.201492	0.383076	1.466789
3.75	0.2644	-0.00162	3.15E-06	0.201356	0.382817	1.46641
3.75	0.2644	-0.00162	3.15E-06	0.201221	0.38256	1.466033
3.75	0.2644	-0.00162	3.15E-06	0.201086	0.382305	1.465659
3.75	0.2644	-0.00162	3.15E-06	0.200953	0.382051	1.465286
3.76	0.2644	-0.00162	3.15E-06	0.20082	0.381798	1.464916
3.76	0.2644	-0.00162	3.15E-06	0.200687	0.381546	1.464548

3.76	0.2644	-0.00162	3.15E-06	0.200556	0.381296	1.464181
3.76	0.2644	-0.00162	3.15E-06	0.200425	0.381048	1.463817
3.77	0.2644	-0.00162	3.15E-06	0.200295	0.3808	1.463455
3.77	0.2644	-0.00162	3.15E-06	0.200165	0.380554	1.463095
3.77	0.2644	-0.00162	3.15E-06	0.200037	0.380309	1.462737
3.77	0.2644	-0.00162	3.15E-06	0.199909	0.380066	1.462381
3.77	0.2644	-0.00162	3.15E-06	0.199781	0.379823	1.462026
3.78	0.2644	-0.00162	3.15E-06	0.199654	0.379582	1.461674
3.78	0.2644	-0.00162	3.15E-06	0.199528	0.379343	1.461324
3.78	0.2644	-0.00162	3.15E-06	0.199403	0.379104	1.460975
3.78	0.2644	-0.00162	3.15E-06	0.199278	0.378867	1.460628
3.78	0.2644	-0.00162	3.15E-06	0.199154	0.378631	1.460283
3.79	0.2644	-0.00162	3.15E-06	0.19903	0.378396	1.45994
3.79	0.2644	-0.00162	3.15E-06	0.198907	0.378162	1.459599
3.79	0.2644	-0.00162	3.15E-06	0.198785	0.377929	1.459259
3.79	0.2644	-0.00162	3.15E-06	0.198663	0.377697	1.458921
3.79	0.2644	-0.00162	3.15E-06	0.198542	0.377467	1.458585
3.80	0.2644	-0.00162	3.15E-06	0.198421	0.377238	1.458251
3.80	0.2644	-0.00162	3.15E-06	0.198301	0.377009	1.457918
3.80	0.2644	-0.00162	3.15E-06	0.198182	0.376782	1.457587
3.80	0.2644	-0.00162	3.15E-06	0.198063	0.376556	1.457258
3.80	0.2644	-0.00162	3.15E-06	0.197944	0.376331	1.45693
3.81	0.2644	-0.00162	3.15E-06	0.197827	0.376107	1.456603
3.81	0.2644	-0.00162	3.15E-06	0.197709	0.375884	1.456279
3.81	0.2644	-0.00162	3.15E-06	0.197593	0.375663	1.455956
3.81	0.2644	-0.00162	3.15E-06	0.197476	0.375442	1.455634
3.81	0.2644	-0.00162	3.15E-06	0.197361	0.375222	1.455314
3.82	0.2644	-0.00162	3.15E-06	0.197246	0.375003	1.454996
3.82	0.2644	-0.00162	3.15E-06	0.197131	0.374785	1.454679
3.82	0.2644	-0.00162	3.15E-06	0.197017	0.374568	1.454363
3.82	0.2644	-0.00162	3.15E-06	0.196903	0.374352	1.454049
3.82	0.2644	-0.00162	3.15E-06	0.19679	0.374137	1.453737
3.83	0.2644	-0.00162	3.15E-06	0.196678	0.373923	1.453426
3.83	0.2644	-0.00162	3.15E-06	0.196566	0.37371	1.453116
3.83	0.2644	-0.00162	3.15E-06	0.196454	0.373498	1.452808
3.83	0.2644	-0.00162	3.15E-06	0.196343	0.373287	1.452501
3.83	0.2644	-0.00162	3.15E-06	0.196232	0.373077	1.452196
3.83	0.2644	-0.00162	3.15E-06	0.196122	0.372867	1.451892
3.84	0.2644	-0.00162	3.15E-06	0.196013	0.372659	1.451589
3.84	0.2644	-0.00162	3.15E-06	0.195903	0.372451	1.451288
3.84	0.2644	-0.00162	3.15E-06	0.195795	0.372244	1.450988
3.84	0.2644	-0.00162	3.15E-06	0.195686	0.372039	1.450689
3.84	0.2644	-0.00162	3.15E-06	0.195579	0.371833	1.450391
3.85	0.2644	-0.00162	3.15E-06	0.195471	0.371629	1.450095
3.85	0.2644	-0.00162	3.15E-06	0.195364	0.371426	1.449801
3.85	0.2644	-0.00162	3.15E-06	0.195258	0.371224	1.449507
3.85	0.2644	-0.00162	3.15E-06	0.195152	0.371022	1.449215
3.85	0.2644	-0.00162	3.15E-06	0.195046	0.370821	1.448924
3.85	0.2644	-0.00162	3.15E-06	0.194941	0.370621	1.448634
3.86	0.2644	-0.00162	3.15E-06	0.194836	0.370422	1.448345

3.86	0.2644	-0.00162	3.15E-06	0.194732	0.370223	1.448058
3.86	0.2644	-0.00162	3.15E-06	0.194628	0.370026	1.447772
3.86	0.2644	-0.00162	3.15E-06	0.194524	0.369829	1.447487
3.86	0.2644	-0.00162	3.15E-06	0.194421	0.369633	1.447203
3.86	0.2644	-0.00162	3.15E-06	0.194318	0.369437	1.44692
3.87	0.2644	-0.00162	3.15E-06	0.194216	0.369243	1.446639
3.87	0.2644	-0.00162	3.15E-06	0.194114	0.369049	1.446359
3.87	0.2644	-0.00162	3.15E-06	0.194013	0.368856	1.44608
3.87	0.2644	-0.00162	3.15E-06	0.193911	0.368664	1.445802
3.87	0.2644	-0.00162	3.15E-06	0.193811	0.368472	1.445525
3.87	0.2644	-0.00162	3.15E-06	0.19371	0.368281	1.445249
3.87	0.2644	-0.00162	3.15E-06	0.19361	0.368091	1.444974
3.88	0.2644	-0.00162	3.15E-06	0.193511	0.367902	1.4447
3.88	0.2644	-0.00162	3.15E-06	0.193411	0.367713	1.444428
3.88	0.2644	-0.00162	3.15E-06	0.193313	0.367525	1.444156
3.88	0.2644	-0.00162	3.15E-06	0.193214	0.367338	1.443886
3.88	0.2644	-0.00162	3.15E-06	0.193116	0.367152	1.443617
3.88	0.2644	-0.00162	3.15E-06	0.193018	0.366966	1.443348
3.89	0.2644	-0.00162	3.15E-06	0.192921	0.36678	1.443081
3.89	0.2644	-0.00162	3.15E-06	0.192824	0.366596	1.442815
3.89	0.2644	-0.00162	3.15E-06	0.192727	0.366412	1.44255
3.89	0.2644	-0.00162	3.15E-06	0.192631	0.366229	1.442285
3.89	0.2644	-0.00162	3.15E-06	0.192535	0.366046	1.442022
3.89	0.2644	-0.00162	3.15E-06	0.192439	0.365865	1.44176
3.89	0.2644	-0.00162	3.15E-06	0.192344	0.365683	1.441499
3.90	0.2644	-0.00162	3.15E-06	0.192249	0.365503	1.441238
3.90	0.2644	-0.00162	3.15E-06	0.192154	0.365323	1.440979
3.90	0.2644	-0.00162	3.15E-06	0.19206	0.365143	1.440721
3.90	0.2644	-0.00162	3.15E-06	0.191966	0.364965	1.440463
3.90	0.2644	-0.00162	3.15E-06	0.191872	0.364787	1.440207
3.90	0.2644	-0.00162	3.15E-06	0.191779	0.364609	1.439951
3.90	0.2644	-0.00162	3.15E-06	0.191686	0.364432	1.439697
3.91	0.2644	-0.00162	3.15E-06	0.191593	0.364256	1.439443
3.91	0.2644	-0.00162	3.15E-06	0.191501	0.364081	1.43919
3.91	0.2644	-0.00162	3.15E-06	0.191409	0.363906	1.438938
3.91	0.2644	-0.00162	3.15E-06	0.191317	0.363731	1.438687
3.91	0.2644	-0.00162	3.15E-06	0.191225	0.363557	1.438437
3.91	0.2644	-0.00162	3.15E-06	0.191134	0.363384	1.438188
3.91	0.2644	-0.00162	3.15E-06	0.191044	0.363212	1.43794
3.92	0.2644	-0.00162	3.15E-06	0.190953	0.363039	1.437693
3.92	0.2644	-0.00162	3.15E-06	0.190863	0.362868	1.437446
3.92	0.2644	-0.00162	3.15E-06	0.190773	0.362697	1.4372
3.92	0.2644	-0.00162	3.15E-06	0.190683	0.362527	1.436956
3.92	0.2644	-0.00162	3.15E-06	0.190594	0.362357	1.436712
3.92	0.2644	-0.00162	3.15E-06	0.190505	0.362188	1.436468
3.92	0.2644	-0.00162	3.15E-06	0.190416	0.362019	1.436226
3.93	0.2644	-0.00162	3.15E-06	0.190328	0.361851	1.435985
3.93	0.2644	-0.00162	3.15E-06	0.19024	0.361683	1.435744
3.93	0.2644	-0.00162	3.15E-06	0.190152	0.361516	1.435504
3.93	0.2644	-0.00162	3.15E-06	0.190064	0.36135	1.435265

3.93	0.2644	-0.00162	3.15E-06	0.189977	0.361184	1.435027
3.93	0.2644	-0.00162	3.15E-06	0.18989	0.361018	1.434789
3.93	0.2644	-0.00162	3.15E-06	0.189803	0.360853	1.434553
3.93	0.2644	-0.00162	3.15E-06	0.189717	0.360689	1.434317
3.94	0.2644	-0.00162	3.15E-06	0.18963	0.360525	1.434082
3.94	0.2644	-0.00162	3.15E-06	0.189544	0.360361	1.433847
3.94	0.2644	-0.00162	3.15E-06	0.189459	0.360198	1.433614
3.94	0.2644	-0.00162	3.15E-06	0.189373	0.360036	1.433381
3.94	0.2644	-0.00162	3.15E-06	0.189288	0.359874	1.433149
3.94	0.2644	-0.00162	3.15E-06	0.189203	0.359713	1.432918
3.94	0.2644	-0.00162	3.15E-06	0.189119	0.359552	1.432687
3.95	0.2644	-0.00162	3.15E-06	0.189034	0.359392	1.432458
3.95	0.2644	-0.00162	3.15E-06	0.18895	0.359232	1.432229
3.95	0.2644	-0.00162	3.15E-06	0.188866	0.359072	1.432
3.95	0.2644	-0.00162	3.15E-06	0.188783	0.358913	1.431773
3.95	0.2644	-0.00162	3.15E-06	0.188699	0.358755	1.431546
3.95	0.2644	-0.00162	3.15E-06	0.188616	0.358597	1.43132
3.95	0.2644	-0.00162	3.15E-06	0.188533	0.358439	1.431094
3.95	0.2644	-0.00162	3.15E-06	0.188451	0.358282	1.43087
3.96	0.2644	-0.00162	3.15E-06	0.188369	0.358126	1.430646
3.96	0.2644	-0.00162	3.15E-06	0.188286	0.35797	1.430422
3.96	0.2644	-0.00162	3.15E-06	0.188205	0.357814	1.4302
3.96	0.2644	-0.00162	3.15E-06	0.188123	0.357659	1.429978
3.96	0.2644	-0.00162	3.15E-06	0.188042	0.357504	1.429756
3.96	0.2644	-0.00162	3.15E-06	0.18796	0.35735	1.429536
3.96	0.2644	-0.00162	3.15E-06	0.187879	0.357196	1.429316
3.96	0.2644	-0.00162	3.15E-06	0.187799	0.357043	1.429097
3.96	0.2644	-0.00162	3.15E-06	0.187718	0.35689	1.428878
3.97	0.2644	-0.00162	3.15E-06	0.187638	0.356737	1.42866
3.97	0.2644	-0.00162	3.15E-06	0.187558	0.356585	1.428443
3.97	0.2644	-0.00162	3.15E-06	0.187478	0.356433	1.428226
3.97	0.2644	-0.00162	3.15E-06	0.187399	0.356282	1.42801
3.97	0.2644	-0.00162	3.15E-06	0.18732	0.356131	1.427795
3.97	0.2644	-0.00162	3.15E-06	0.18724	0.355981	1.42758
3.97	0.2644	-0.00162	3.15E-06	0.187162	0.355831	1.427366
3.97	0.2644	-0.00162	3.15E-06	0.187083	0.355682	1.427153
3.98	0.2644	-0.00162	3.15E-06	0.187005	0.355533	1.42694
3.98	0.2644	-0.00162	3.15E-06	0.186926	0.355384	1.426728
3.98	0.2644	-0.00162	3.15E-06	0.186848	0.355236	1.426517
3.98	0.2644	-0.00162	3.15E-06	0.186771	0.355088	1.426306
3.98	0.2644	-0.00162	3.15E-06	0.186693	0.35494	1.426095
3.98	0.2644	-0.00162	3.15E-06	0.186616	0.354793	1.425886
3.98	0.2644	-0.00162	3.15E-06	0.186539	0.354647	1.425677
3.98	0.2644	-0.00162	3.15E-06	0.186462	0.3545	1.425468
3.98	0.2644	-0.00162	3.15E-06	0.186385	0.354354	1.42526
3.99	0.2644	-0.00162	3.15E-06	0.186308	0.354209	1.425053
3.99	0.2644	-0.00162	3.15E-06	0.186232	0.354064	1.424846
3.99	0.2644	-0.00162	3.15E-06	0.186156	0.353919	1.42464
3.99	0.2644	-0.00162	3.15E-06	0.18608	0.353775	1.424435
3.99	0.2644	-0.00162	3.15E-06	0.186004	0.353631	1.42423

3.99	0.2644	-0.00162	3.15E-06	0.185929	0.353488	1.424025
3.99	0.2644	-0.00162	3.15E-06	0.185854	0.353345	1.423822
3.99	0.2644	-0.00162	3.15E-06	0.185779	0.353202	1.423618
3.99	0.2644	-0.00162	3.15E-06	0.185704	0.353059	1.423416
4.00	0.2644	-0.00162	3.15E-06	0.185629	0.352917	1.423214
4.00	0.2644	-0.00162	3.15E-06	0.185555	0.352776	1.423012
4.00	0.2644	-0.00162	3.15E-06	0.18548	0.352634	1.422811
4.00	0.2644	-0.00162	3.15E-06	0.185406	0.352494	1.422611
4.00	0.2644	-0.00162	3.15E-06	0.185332	0.352353	1.422411
4.00	0.2644	-0.00162	3.15E-06	0.185258	0.352213	1.422211
4.00	0.2644	-0.00162	3.15E-06	0.185185	0.352073	1.422012
4.00	0.2644	-0.00162	3.15E-06	0.185112	0.351934	1.421814
4.00	0.2644	-0.00162	3.15E-06	0.185038	0.351795	1.421616
4.00	0.2644	-0.00162	3.15E-06	0.184965	0.351656	1.421419
4.01	0.2644	-0.00162	3.15E-06	0.184893	0.351517	1.421223
4.01	0.2644	-0.00162	3.15E-06	0.18482	0.351379	1.421026
4.01	0.2644	-0.00162	3.15E-06	0.184748	0.351242	1.420831
4.01	0.2644	-0.00162	3.15E-06	0.184675	0.351104	1.420636
4.01	0.2644	-0.00162	3.15E-06	0.184603	0.350967	1.420441
4.01	0.2644	-0.00162	3.15E-06	0.184532	0.350831	1.420247
4.01	0.2644	-0.00162	3.15E-06	0.18446	0.350695	1.420053
4.01	0.2644	-0.00162	3.15E-06	0.184388	0.350559	1.41986
4.01	0.2644	-0.00162	3.15E-06	0.184317	0.350423	1.419668
4.01	0.2644	-0.00162	3.15E-06	0.184246	0.350288	1.419476
4.02	0.2644	-0.00162	3.15E-06	0.184175	0.350153	1.419284
4.02	0.2644	-0.00162	3.15E-06	0.184104	0.350018	1.419093
4.02	0.2644	-0.00162	3.15E-06	0.184033	0.349884	1.418903
4.02	0.2644	-0.00162	3.15E-06	0.183963	0.34975	1.418713
4.02	0.2644	-0.00162	3.15E-06	0.183893	0.349616	1.418523
4.02	0.2644	-0.00162	3.15E-06	0.183823	0.349483	1.418334
4.02	0.2644	-0.00162	3.15E-06	0.183753	0.34935	1.418145
4.02	0.2644	-0.00162	3.15E-06	0.183683	0.349217	1.417957
4.02	0.2644	-0.00162	3.15E-06	0.183613	0.349085	1.41777
4.02	0.2644	-0.00162	3.15E-06	0.183544	0.348953	1.417582
4.03	0.2644	-0.00162	3.15E-06	0.183474	0.348821	1.417396
4.03	0.2644	-0.00162	3.15E-06	0.183405	0.34869	1.417209
4.03	0.2644	-0.00162	3.15E-06	0.183336	0.348559	1.417024
4.03	0.2644	-0.00162	3.15E-06	0.183268	0.348428	1.416838
4.03	0.2644	-0.00162	3.15E-06	0.183199	0.348297	1.416654
4.03	0.2644	-0.00162	3.15E-06	0.183131	0.348167	1.416469
4.03	0.2644	-0.00162	3.15E-06	0.183062	0.348037	1.416285
4.03	0.2644	-0.00162	3.15E-06	0.182994	0.347908	1.416102
4.03	0.2644	-0.00162	3.15E-06	0.182926	0.347779	1.415919
4.03	0.2644	-0.00162	3.15E-06	0.182858	0.34765	1.415736
4.04	0.2644	-0.00162	3.15E-06	0.182791	0.347521	1.415554
4.04	0.2644	-0.00162	3.15E-06	0.182723	0.347393	1.415372
4.04	0.2644	-0.00162	3.15E-06	0.182656	0.347265	1.415191
4.04	0.2644	-0.00162	3.15E-06	0.182589	0.347137	1.41501
4.04	0.2644	-0.00162	3.15E-06	0.182522	0.347009	1.41483
4.04	0.2644	-0.00162	3.15E-06	0.182455	0.346882	1.41465

4.04	0.2644	-0.00162	3.15E-06	0.182388	0.346755	1.414471
4.04	0.2644	-0.00162	3.15E-06	0.182321	0.346629	1.414292
4.04	0.2644	-0.00162	3.15E-06	0.182255	0.346503	1.414113
4.04	0.2644	-0.00162	3.15E-06	0.182189	0.346377	1.413935
4.04	0.2644	-0.00162	3.15E-06	0.182122	0.346251	1.413757
4.05	0.2644	-0.00162	3.15E-06	0.182057	0.346125	1.41358
4.05	0.2644	-0.00162	3.15E-06	0.181991	0.346	1.413403
4.05	0.2644	-0.00162	3.15E-06	0.181925	0.345875	1.413226
4.05	0.2644	-0.00162	3.15E-06	0.181859	0.345751	1.41305
4.05	0.2644	-0.00162	3.15E-06	0.181794	0.345626	1.412875
4.05	0.2644	-0.00162	3.15E-06	0.181729	0.345502	1.412699
4.05	0.2644	-0.00162	3.15E-06	0.181664	0.345379	1.412525
4.05	0.2644	-0.00162	3.15E-06	0.181599	0.345255	1.41235
4.05	0.2644	-0.00162	3.15E-06	0.181534	0.345132	1.412176
4.05	0.2644	-0.00162	3.15E-06	0.181469	0.345009	1.412002
4.05	0.2644	-0.00162	3.15E-06	0.181405	0.344886	1.411829
4.06	0.2644	-0.00162	3.15E-06	0.18134	0.344764	1.411656
4.06	0.2644	-0.00162	3.15E-06	0.181276	0.344642	1.411484
4.06	0.2644	-0.00162	3.15E-06	0.181212	0.34452	1.411312
4.06	0.2644	-0.00162	3.15E-06	0.181148	0.344398	1.41114
4.06	0.2644	-0.00162	3.15E-06	0.181084	0.344277	1.410969
4.06	0.2644	-0.00162	3.15E-06	0.181021	0.344156	1.410798
4.06	0.2644	-0.00162	3.15E-06	0.180957	0.344035	1.410628
4.06	0.2644	-0.00162	3.15E-06	0.180894	0.343914	1.410458
4.06	0.2644	-0.00162	3.15E-06	0.18083	0.343794	1.410288
4.06	0.2644	-0.00162	3.15E-06	0.180767	0.343674	1.410119
4.06	0.2644	-0.00162	3.15E-06	0.180704	0.343554	1.40995
4.07	0.2644	-0.00162	3.15E-06	0.180641	0.343435	1.409781
4.07	0.2644	-0.00162	3.15E-06	0.180578	0.343315	1.409613
4.07	0.2644	-0.00162	3.15E-06	0.180516	0.343196	1.409445
4.07	0.2644	-0.00162	3.15E-06	0.180453	0.343077	1.409278
4.07	0.2644	-0.00162	3.15E-06	0.180391	0.342959	1.409111
4.07	0.2644	-0.00162	3.15E-06	0.180329	0.342841	1.408944
4.07	0.2644	-0.00162	3.15E-06	0.180267	0.342723	1.408778
4.07	0.2644	-0.00162	3.15E-06	0.180205	0.342605	1.408612
4.07	0.2644	-0.00162	3.15E-06	0.180143	0.342487	1.408446
4.07	0.2644	-0.00162	3.15E-06	0.180081	0.34237	1.408281
4.07	0.2644	-0.00162	3.15E-06	0.18002	0.342253	1.408116
4.07	0.2644	-0.00162	3.15E-06	0.179958	0.342136	1.407952
4.08	0.2644	-0.00162	3.15E-06	0.179897	0.342019	1.407788
4.08	0.2644	-0.00162	3.15E-06	0.179836	0.341903	1.407624
4.08	0.2644	-0.00162	3.15E-06	0.179775	0.341787	1.407461
4.08	0.2644	-0.00162	3.15E-06	0.179714	0.341671	1.407297
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4.08	0.2644	-0.00162	3.15E-06	0.179592	0.34144	1.406972
4.08	0.2644	-0.00162	3.15E-06	0.179532	0.341325	1.40681
4.08	0.2644	-0.00162	3.15E-06	0.179471	0.34121	1.406649
4.08	0.2644	-0.00162	3.15E-06	0.179411	0.341095	1.406487
4.08	0.2644	-0.00162	3.15E-06	0.179351	0.340981	1.406326
4.08	0.2644	-0.00162	3.15E-06	0.179291	0.340867	1.406166

4.08	0.2644	-0.00162	3.15E-06	0.179231	0.340753	1.406005
4.09	0.2644	-0.00162	3.15E-06	0.179171	0.340639	1.405845
4.09	0.2644	-0.00162	3.15E-06	0.179111	0.340525	1.405686
4.09	0.2644	-0.00162	3.15E-06	0.179051	0.340412	1.405527
4.09	0.2644	-0.00162	3.15E-06	0.178992	0.340299	1.405368
4.09	0.2644	-0.00162	3.15E-06	0.178933	0.340186	1.405209
4.09	0.2644	-0.00162	3.15E-06	0.178873	0.340073	1.405051
4.09	0.2644	-0.00162	3.15E-06	0.178814	0.339961	1.404893
4.09	0.2644	-0.00162	3.15E-06	0.178755	0.339849	1.404735
4.09	0.2644	-0.00162	3.15E-06	0.178696	0.339737	1.404578
4.09	0.2644	-0.00162	3.15E-06	0.178637	0.339625	1.404421
4.09	0.2644	-0.00162	3.15E-06	0.178579	0.339513	1.404264
4.09	0.2644	-0.00162	3.15E-06	0.17852	0.339402	1.404108
4.09	0.2644	-0.00162	3.15E-06	0.178462	0.339291	1.403952
4.10	0.2644	-0.00162	3.15E-06	0.178403	0.33918	1.403796
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4.10	0.2644	-0.00162	3.15E-06	0.178287	0.338959	1.403486
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4.10	0.2644	-0.00162	3.15E-06	0.178171	0.338739	1.403177
4.10	0.2644	-0.00162	3.15E-06	0.178113	0.338629	1.403022
4.10	0.2644	-0.00162	3.15E-06	0.178056	0.338519	1.402869
4.10	0.2644	-0.00162	3.15E-06	0.177998	0.33841	1.402715
4.10	0.2644	-0.00162	3.15E-06	0.177941	0.338301	1.402562
4.10	0.2644	-0.00162	3.15E-06	0.177883	0.338192	1.402409
4.10	0.2644	-0.00162	3.15E-06	0.177826	0.338083	1.402257
4.10	0.2644	-0.00162	3.15E-06	0.177769	0.337974	1.402104
4.10	0.2644	-0.00162	3.15E-06	0.177712	0.337866	1.401952
4.11	0.2644	-0.00162	3.15E-06	0.177655	0.337758	1.401801
4.11	0.2644	-0.00162	3.15E-06	0.177598	0.33765	1.401649
4.11	0.2644	-0.00162	3.15E-06	0.177542	0.337542	1.401498
4.11	0.2644	-0.00162	3.15E-06	0.177485	0.337434	1.401347
4.11	0.2644	-0.00162	3.15E-06	0.177429	0.337327	1.401197
4.11	0.2644	-0.00162	3.15E-06	0.177372	0.33722	1.401047
4.11	0.2644	-0.00162	3.15E-06	0.177316	0.337113	1.400897
4.11	0.2644	-0.00162	3.15E-06	0.17726	0.337006	1.400747
4.11	0.2644	-0.00162	3.15E-06	0.177204	0.336899	1.400598
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4.11	0.2644	-0.00162	3.15E-06	0.177036	0.336581	1.400152
4.11	0.2644	-0.00162	3.15E-06	0.176981	0.336475	1.400004
4.12	0.2644	-0.00162	3.15E-06	0.176925	0.336369	1.399856
4.12	0.2644	-0.00162	3.15E-06	0.17687	0.336264	1.399708
4.12	0.2644	-0.00162	3.15E-06	0.176814	0.336159	1.399561
4.12	0.2644	-0.00162	3.15E-06	0.176759	0.336054	1.399414
4.12	0.2644	-0.00162	3.15E-06	0.176704	0.335949	1.399268
4.12	0.2644	-0.00162	3.15E-06	0.176649	0.335844	1.399121
4.12	0.2644	-0.00162	3.15E-06	0.176594	0.33574	1.398975
4.12	0.2644	-0.00162	3.15E-06	0.176539	0.335636	1.398829
4.12	0.2644	-0.00162	3.15E-06	0.176484	0.335531	1.398683
4.12	0.2644	-0.00162	3.15E-06	0.17643	0.335428	1.398538

4.12	0.2644	-0.00162	3.15E-06	0.176375	0.335324	1.398393
4.12	0.2644	-0.00162	3.15E-06	0.176321	0.33522	1.398248
4.12	0.2644	-0.00162	3.15E-06	0.176266	0.335117	1.398104
4.12	0.2644	-0.00162	3.15E-06	0.176212	0.335014	1.39796
4.13	0.2644	-0.00162	3.15E-06	0.176158	0.334911	1.397816
4.13	0.2644	-0.00162	3.15E-06	0.176104	0.334808	1.397672
4.13	0.2644	-0.00162	3.15E-06	0.17605	0.334705	1.397529
4.13	0.2644	-0.00162	3.15E-06	0.175996	0.334603	1.397385
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4.13	0.2644	-0.00162	3.15E-06	0.175781	0.334195	1.396816
4.13	0.2644	-0.00162	3.15E-06	0.175728	0.334093	1.396674
4.13	0.2644	-0.00162	3.15E-06	0.175675	0.333992	1.396532
4.13	0.2644	-0.00162	3.15E-06	0.175621	0.333891	1.396391
4.13	0.2644	-0.00162	3.15E-06	0.175568	0.33379	1.39625
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4.13	0.2644	-0.00162	3.15E-06	0.175462	0.333588	1.395968
4.13	0.2644	-0.00162	3.15E-06	0.175409	0.333488	1.395828
4.14	0.2644	-0.00162	3.15E-06	0.175357	0.333388	1.395688
4.14	0.2644	-0.00162	3.15E-06	0.175304	0.333287	1.395548
4.14	0.2644	-0.00162	3.15E-06	0.175251	0.333187	1.395409
4.14	0.2644	-0.00162	3.15E-06	0.175199	0.333088	1.39527
4.14	0.2644	-0.00162	3.15E-06	0.175146	0.332988	1.395131
4.14	0.2644	-0.00162	3.15E-06	0.175094	0.332889	1.394992
4.14	0.2644	-0.00162	3.15E-06	0.175042	0.332789	1.394853
4.14	0.2644	-0.00162	3.15E-06	0.17499	0.33269	1.394715
4.14	0.2644	-0.00162	3.15E-06	0.174938	0.332591	1.394577
4.14	0.2644	-0.00162	3.15E-06	0.174886	0.332492	1.394439
4.14	0.2644	-0.00162	3.15E-06	0.174834	0.332394	1.394302
4.14	0.2644	-0.00162	3.15E-06	0.174782	0.332295	1.394165
4.14	0.2644	-0.00162	3.15E-06	0.17473	0.332197	1.394027
4.14	0.2644	-0.00162	3.15E-06	0.174679	0.332099	1.393891
4.15	0.2644	-0.00162	3.15E-06	0.174627	0.332001	1.393754
4.15	0.2644	-0.00162	3.15E-06	0.174576	0.331903	1.393618
4.15	0.2644	-0.00162	3.15E-06	0.174524	0.331805	1.393482
4.15	0.2644	-0.00162	3.15E-06	0.174473	0.331708	1.393346
4.15	0.2644	-0.00162	3.15E-06	0.174422	0.331611	1.39321
4.15	0.2644	-0.00162	3.15E-06	0.174371	0.331514	1.393075
4.15	0.2644	-0.00162	3.15E-06	0.17432	0.331417	1.39294
4.15	0.2644	-0.00162	3.15E-06	0.174269	0.33132	1.392805
4.15	0.2644	-0.00162	3.15E-06	0.174218	0.331223	1.39267
4.15	0.2644	-0.00162	3.15E-06	0.174167	0.331126	1.392536
4.15	0.2644	-0.00162	3.15E-06	0.174117	0.33103	1.392402
4.15	0.2644	-0.00162	3.15E-06	0.174066	0.330934	1.392268
4.15	0.2644	-0.00162	3.15E-06	0.174016	0.330838	1.392134
4.15	0.2644	-0.00162	3.15E-06	0.173965	0.330742	1.392001
4.15	0.2644	-0.00162	3.15E-06	0.173915	0.330646	1.391867
4.15	0.2644	-0.00162	3.15E-06	0.173864	0.330551	1.391734
4.16	0.2644	-0.00162	3.15E-06	0.173814	0.330455	1.391601

4.16	0.2644	-0.00162	3.15E-06	0.173764	0.33036	1.391469
4.16	0.2644	-0.00162	3.15E-06	0.173714	0.330265	1.391337
4.16	0.2644	-0.00162	3.15E-06	0.173664	0.33017	1.391204
4.16	0.2644	-0.00162	3.15E-06	0.173614	0.330075	1.391073
4.16	0.2644	-0.00162	3.15E-06	0.173565	0.32998	1.390941
4.16	0.2644	-0.00162	3.15E-06	0.173515	0.329886	1.390809
4.16	0.2644	-0.00162	3.15E-06	0.173465	0.329792	1.390678
4.16	0.2644	-0.00162	3.15E-06	0.173416	0.329697	1.390547
4.16	0.2644	-0.00162	3.15E-06	0.173366	0.329603	1.390416
4.16	0.2644	-0.00162	3.15E-06	0.173317	0.329509	1.390286
4.16	0.2644	-0.00162	3.15E-06	0.173267	0.329416	1.390155
4.16	0.2644	-0.00162	3.15E-06	0.173218	0.329322	1.390025
4.16	0.2644	-0.00162	3.15E-06	0.173169	0.329229	1.389895
4.16	0.2644	-0.00162	3.15E-06	0.17312	0.329135	1.389766
4.17	0.2644	-0.00162	3.15E-06	0.173071	0.329042	1.389636
4.17	0.2644	-0.00162	3.15E-06	0.173022	0.328949	1.389507
4.17	0.2644	-0.00162	3.15E-06	0.172973	0.328856	1.389378
4.17	0.2644	-0.00162	3.15E-06	0.172924	0.328763	1.389249
4.17	0.2644	-0.00162	3.15E-06	0.172876	0.328671	1.38912
4.17	0.2644	-0.00162	3.15E-06	0.172827	0.328578	1.388992
4.17	0.2644	-0.00162	3.15E-06	0.172779	0.328486	1.388864
4.17	0.2644	-0.00162	3.15E-06	0.17273	0.328394	1.388736
4.17	0.2644	-0.00162	3.15E-06	0.172682	0.328302	1.388608
4.17	0.2644	-0.00162	3.15E-06	0.172633	0.32821	1.388481
4.17	0.2644	-0.00162	3.15E-06	0.172585	0.328118	1.388353
4.17	0.2644	-0.00162	3.15E-06	0.172537	0.328027	1.388226
4.17	0.2644	-0.00162	3.15E-06	0.172489	0.327935	1.388099
4.17	0.2644	-0.00162	3.15E-06	0.172441	0.327844	1.387972
4.17	0.2644	-0.00162	3.15E-06	0.172393	0.327753	1.387846
4.17	0.2644	-0.00162	3.15E-06	0.172345	0.327662	1.387719
4.17	0.2644	-0.00162	3.15E-06	0.172297	0.327571	1.387593
4.18	0.2644	-0.00162	3.15E-06	0.172249	0.32748	1.387467
4.18	0.2644	-0.00162	3.15E-06	0.172202	0.327389	1.387342
4.18	0.2644	-0.00162	3.15E-06	0.172154	0.327299	1.387216
4.18	0.2644	-0.00162	3.15E-06	0.172107	0.327209	1.387091
4.18	0.2644	-0.00162	3.15E-06	0.172059	0.327118	1.386966
4.18	0.2644	-0.00162	3.15E-06	0.172012	0.327028	1.386841
4.18	0.2644	-0.00162	3.15E-06	0.171964	0.326938	1.386716
4.18	0.2644	-0.00162	3.15E-06	0.171917	0.326849	1.386592
4.18	0.2644	-0.00162	3.15E-06	0.17187	0.326759	1.386467
4.18	0.2644	-0.00162	3.15E-06	0.171823	0.326669	1.386343
4.18	0.2644	-0.00162	3.15E-06	0.171776	0.32658	1.386219
4.18	0.2644	-0.00162	3.15E-06	0.171729	0.326491	1.386095
4.18	0.2644	-0.00162	3.15E-06	0.171682	0.326402	1.385972
4.18	0.2644	-0.00162	3.15E-06	0.171635	0.326313	1.385849
4.18	0.2644	-0.00162	3.15E-06	0.171589	0.326224	1.385725
4.18	0.2644	-0.00162	3.15E-06	0.171542	0.326135	1.385603
4.19	0.2644	-0.00162	3.15E-06	0.171495	0.326046	1.38548
4.19	0.2644	-0.00162	3.15E-06	0.171449	0.325958	1.385357
4.19	0.2644	-0.00162	3.15E-06	0.171402	0.32587	1.385235

4.19	0.2644	-0.00162	3.15E-06	0.171356	0.325781	1.385113
4.19	0.2644	-0.00162	3.15E-06	0.17131	0.325693	1.384991
4.19	0.2644	-0.00162	3.15E-06	0.171263	0.325605	1.384869
4.19	0.2644	-0.00162	3.15E-06	0.171217	0.325518	1.384747
4.19	0.2644	-0.00162	3.15E-06	0.171171	0.32543	1.384626
4.19	0.2644	-0.00162	3.15E-06	0.171125	0.325342	1.384505
4.19	0.2644	-0.00162	3.15E-06	0.171079	0.325255	1.384384
4.19	0.2644	-0.00162	3.15E-06	0.171033	0.325168	1.384263
4.19	0.2644	-0.00162	3.15E-06	0.170987	0.32508	1.384142
4.19	0.2644	-0.00162	3.15E-06	0.170941	0.324993	1.384021
4.19	0.2644	-0.00162	3.15E-06	0.170896	0.324906	1.383901
4.19	0.2644	-0.00162	3.15E-06	0.17085	0.32482	1.383781
4.19	0.2644	-0.00162	3.15E-06	0.170804	0.324733	1.383661
4.19	0.2644	-0.00162	3.15E-06	0.170759	0.324646	1.383541
4.19	0.2644	-0.00162	3.15E-06	0.170713	0.32456	1.383422
4.20	0.2644	-0.00162	3.15E-06	0.170668	0.324474	1.383302
4.20	0.2644	-0.00162	3.15E-06	0.170623	0.324387	1.383183
4.20	0.2644	-0.00162	3.15E-06	0.170577	0.324301	1.383064
4.20	0.2644	-0.00162	3.15E-06	0.170532	0.324215	1.382945
4.20	0.2644	-0.00162	3.15E-06	0.170487	0.32413	1.382827
4.20	0.2644	-0.00162	3.15E-06	0.170442	0.324044	1.382708
4.20	0.2644	-0.00162	3.15E-06	0.170397	0.323958	1.38259
4.20	0.2644	-0.00162	3.15E-06	0.170352	0.323873	1.382472
4.20	0.2644	-0.00162	3.15E-06	0.170307	0.323788	1.382354
4.20	0.2644	-0.00162	3.15E-06	0.170262	0.323702	1.382236
4.20	0.2644	-0.00162	3.15E-06	0.170218	0.323617	1.382118
4.20	0.2644	-0.00162	3.15E-06	0.170173	0.323532	1.382001
4.20	0.2644	-0.00162	3.15E-06	0.170128	0.323448	1.381884
4.20	0.2644	-0.00162	3.15E-06	0.170084	0.323363	1.381767
4.20	0.2644	-0.00162	3.15E-06	0.170039	0.323278	1.38165
4.20	0.2644	-0.00162	3.15E-06	0.169995	0.323194	1.381533
4.20	0.2644	-0.00162	3.15E-06	0.16995	0.323109	1.381416
4.21	0.2644	-0.00162	3.15E-06	0.169906	0.323025	1.3813
4.21	0.2644	-0.00162	3.15E-06	0.169862	0.322941	1.381184
4.21	0.2644	-0.00162	3.15E-06	0.169818	0.322857	1.381068
4.21	0.2644	-0.00162	3.15E-06	0.169774	0.322773	1.380952

Location Index	
England and Wales	1
Scotland and Ireland	2

From Design and Analysis of Urban Storm Drainage, The Wallingford Procedure, Vol 1

Table 6.1 Values of Constants to calculate Cr

Geographic Location	Range of M5-D	Location Index	J0	J1	J2
England and Wales	0-10	1	0.1699	0.0028	0.000114
	11-30		0.1644	0.005831	-0.00013
	31-75		0.2644	-0.00162	3.15E-06
	76-150		0.2718	-0.00195	6.19E-06
	>150		0.1454	-0.00019	1.14E-07

Integra Consulting	Job No 3356	Date 07.12.22
Calculations	Sheet 01	By JS

Job Title Causeway Fm, Balderstone - BB2 7HZ

Storm Water Flood Model

M5-60 = 19.00 **r = 0.30** **Return, T = 100** **Area (m²) = 21220**

CC Factor = 0.35 **Limit (l/s) = 34.0**

Totals **799** **1213**

D (mins)	M5-D (mm)	MT-D (mm)	Rate (mm/hr)	Flow (l/s)	CC Flow (l/s)	Storage (m³)	CC Storage (m³)
10.00	8.97	16.91	101.47	594.27	802.26	336.16	460.96
15.00	10.92	21.22	84.87	497.06	671.03	416.76	573.33
20.00	12.40	24.26	72.77	426.20	575.37	470.64	649.64
25.00	13.62	26.87	64.49	377.69	509.88	515.53	713.82
30.00	14.65	29.10	58.21	340.92	460.24	552.45	767.23
35.00	15.56	31.06	53.25	311.89	421.05	583.57	812.80
40.00	16.37	32.81	49.22	288.27	389.16	610.24	852.39
45.00	17.11	34.40	45.86	268.60	362.60	633.41	887.23
50.00	17.79	35.84	43.01	251.90	340.07	653.71	918.20
55.00	18.41	37.18	40.56	237.52	320.65	671.62	945.96
60.00	19.00	38.41	38.41	224.98	303.72	687.51	970.98
65.00	19.55	39.57	36.52	213.91	288.78	701.66	993.65
70.00	20.07	40.65	34.84	204.07	275.49	714.29	1014.28
75.00	20.56	41.67	33.34	195.24	263.58	725.59	1033.09
80.00	21.03	42.63	31.98	187.27	252.81	735.70	1050.31
85.00	21.47	43.55	30.74	180.03	243.04	744.74	1066.09
90.00	21.90	44.41	29.61	173.41	234.11	752.82	1080.57
95.00	22.31	45.24	28.57	167.34	225.91	760.04	1093.88
100.00	22.71	46.03	27.62	161.74	218.35	766.46	1106.12
105.00	23.09	46.78	26.73	156.56	211.36	772.15	1117.37
110.00	23.45	47.50	25.91	151.75	204.87	777.17	1127.72
115.00	23.81	48.20	25.15	147.27	198.82	781.57	1137.23
120.00	24.15	48.86	24.43	143.08	193.16	785.40	1145.96
125.00	24.49	49.50	23.76	139.16	187.86	788.69	1153.98
130.00	24.81	50.12	23.13	135.47	182.89	791.48	1161.32
135.00	25.13	50.71	22.54	132.00	178.20	793.80	1168.02
140.00	25.44	51.28	21.98	128.72	173.78	795.69	1174.14
145.00	25.74	51.84	21.45	125.63	169.60	797.16	1179.70
150.00	26.03	52.37	20.95	122.69	165.64	798.25	1184.73
155.00	26.31	52.89	20.47	119.91	161.88	798.96	1189.27
160.00	26.59	53.39	20.02	117.26	158.31	799.33	1193.34
165.00	26.86	53.88	19.59	114.74	154.91	799.37	1196.96
170.00	27.13	54.35	19.18	112.34	151.66	799.10	1200.17
175.00	27.39	54.81	18.79	110.05	148.57	798.53	1202.97
180.00	27.65	55.25	18.42	107.86	145.61	797.68	1205.39
185.00	27.90	55.68	18.06	105.76	142.78	796.55	1207.44
190.00	28.14	56.10	17.72	103.75	140.07	795.17	1209.14
195.00	28.39	56.50	17.39	101.82	137.46	793.55	1210.52
200.00	28.62	56.90	17.07	99.97	134.96	791.68	1211.57

205.00	28.86	57.28	16.77	98.19	132.56	789.59	1212.32
210.00	29.08	57.66	16.47	96.48	130.25	787.29	1212.78
215.00	29.31	58.02	16.19	94.83	128.03	784.77	1212.95
220.00	29.53	58.38	15.92	93.25	125.88	782.06	1212.86
225.00	29.75	58.72	15.66	91.71	123.81	779.15	1212.50
230.00	29.96	59.06	15.41	90.24	121.82	776.06	1211.90
235.00	30.17	59.39	15.16	88.81	119.89	772.79	1211.05
240.00	30.38	59.71	14.93	87.43	118.03	769.34	1209.97
245.00	30.59	60.02	14.70	86.09	116.22	765.73	1208.67
250.00	30.79	60.33	14.48	84.80	114.48	761.97	1207.15
255.00	30.99	60.63	14.26	83.55	112.79	758.04	1205.43
260.00	31.18	61.16	14.11	82.66	111.59	759.08	1210.40
265.00	31.38	61.49	13.92	81.53	110.07	755.78	1209.52
270.00	31.57	61.81	13.74	80.44	108.60	752.38	1208.49
275.00	31.76	62.13	13.55	79.39	107.17	748.88	1207.34
280.00	31.94	62.44	13.38	78.36	105.79	745.28	1206.05
285.00	32.13	62.75	13.21	77.37	104.45	741.59	1204.64
290.00	32.31	63.05	13.05	76.40	103.14	737.81	1203.10
295.00	32.49	63.35	12.89	75.47	101.88	733.94	1201.45
300.00	32.67	63.65	12.73	74.55	100.65	729.99	1199.68
305.00	32.84	63.94	12.58	73.67	99.45	725.95	1197.80
310.00	33.02	64.23	12.43	72.81	98.29	721.83	1195.81
315.00	33.19	64.51	12.29	71.97	97.16	717.64	1193.72
320.00	33.36	64.80	12.15	71.15	96.06	713.37	1191.53
325.00	33.52	65.07	12.01	70.36	94.99	709.03	1189.24
330.00	33.69	65.35	11.88	69.59	93.94	704.61	1186.85
335.00	33.85	65.62	11.75	68.83	92.92	700.13	1184.36
340.00	34.02	65.89	11.63	68.10	91.93	695.58	1181.79
345.00	34.18	66.15	11.50	67.38	90.96	690.96	1179.13
350.00	34.34	66.41	11.39	66.68	90.02	686.28	1176.38
355.00	34.49	66.67	11.27	66.00	89.10	681.54	1173.54
360.00	34.65	66.93	11.15	65.33	88.20	676.73	1170.63
365.00	34.80	67.18	11.04	64.68	87.32	671.87	1167.63
370.00	34.96	67.43	10.93	64.04	86.46	666.94	1164.56
375.00	35.11	67.68	10.83	63.42	85.62	661.97	1161.40
380.00	35.26	67.92	10.72	62.81	84.80	656.93	1158.18
385.00	35.41	68.17	10.62	62.22	83.99	651.84	1154.88
390.00	35.55	68.41	10.52	61.64	83.21	646.70	1151.51
395.00	35.70	68.64	10.43	61.07	82.44	641.51	1148.07
400.00	35.85	68.88	10.33	60.51	81.69	636.27	1144.56
405.00	35.99	69.11	10.24	59.97	80.95	630.98	1140.99
410.00	36.13	69.34	10.15	59.43	80.23	625.64	1137.35
415.00	36.27	69.57	10.06	58.91	79.53	620.25	1133.65
420.00	36.41	69.80	9.97	58.40	78.84	614.82	1129.88
425.00	36.55	70.02	9.89	57.90	78.16	609.34	1126.05
430.00	36.69	70.24	9.80	57.40	77.49	603.81	1122.17
435.00	36.82	70.46	9.72	56.92	76.84	598.25	1118.23
440.00	36.96	70.68	9.64	56.45	76.21	592.64	1114.22
445.00	37.09	70.90	9.56	55.98	75.58	586.99	1110.17
450.00	37.23	71.11	9.48	55.53	74.96	581.30	1106.05

455.00	37.36	71.32	9.41	55.08	74.36	575.57	1101.89
460.00	37.49	71.53	9.33	54.64	73.77	569.80	1097.67
465.00	37.62	71.74	9.26	54.21	73.19	563.99	1093.40
470.00	37.75	71.95	9.18	53.79	72.62	558.15	1089.08
475.00	37.88	72.15	9.11	53.38	72.06	552.26	1084.71
480.00	38.01	72.35	9.04	52.97	71.51	546.34	1080.28
485.00	38.13	72.56	8.98	52.57	70.97	540.39	1075.82
490.00	38.26	72.76	8.91	52.18	70.44	534.40	1071.30
495.00	38.38	72.95	8.84	51.79	69.92	528.38	1066.74
500.00	38.51	73.15	8.78	51.41	69.40	522.32	1062.13
505.00	38.63	73.35	8.71	51.04	68.90	516.23	1057.48
510.00	38.75	73.54	8.65	50.67	68.40	510.11	1052.78
515.00	38.87	73.73	8.59	50.31	67.92	503.95	1048.05
520.00	38.99	73.92	8.53	49.95	67.44	497.77	1043.26
525.00	39.11	74.11	8.47	49.60	66.97	491.55	1038.44
530.00	39.23	74.30	8.41	49.26	66.50	485.30	1033.58
535.00	39.35	74.48	8.35	48.92	66.05	479.02	1028.67
540.00	39.47	74.67	8.30	48.59	65.60	472.72	1023.73
545.00	39.58	74.85	8.24	48.26	65.15	466.38	1018.75
550.00	39.70	75.03	8.19	47.94	64.72	460.02	1013.73
555.00	39.81	75.21	8.13	47.62	64.29	453.63	1008.67
560.00	39.93	75.39	8.08	47.31	63.87	447.21	1003.57
565.00	40.04	75.57	8.03	47.00	63.45	440.76	998.44
570.00	40.16	75.75	7.97	46.70	63.04	434.29	993.27
575.00	40.27	75.92	7.92	46.40	62.64	427.79	988.07
580.00	40.38	76.10	7.87	46.11	62.24	421.27	982.83
585.00	40.49	76.27	7.82	45.82	61.85	414.72	977.56
590.00	40.60	76.44	7.77	45.53	61.46	408.14	972.25
595.00	40.71	76.61	7.73	45.25	61.08	401.54	966.91
600.00	40.82	76.78	7.68	44.97	60.71	394.92	961.54
605.00	40.93	76.95	7.63	44.70	60.34	388.27	956.14
610.00	41.04	77.12	7.59	44.43	59.98	381.60	950.70
615.00	41.14	77.29	7.54	44.16	59.62	374.91	945.24
620.00	41.25	77.45	7.50	43.90	59.26	368.19	939.74
625.00	41.35	77.62	7.45	43.64	58.91	361.45	934.21
630.00	41.46	77.78	7.41	43.38	58.57	354.69	928.65
635.00	41.56	77.94	7.36	43.13	58.23	347.91	923.06
640.00	41.67	78.10	7.32	42.88	57.89	341.10	917.44
645.00	41.77	78.26	7.28	42.64	57.56	334.27	911.80
650.00	41.88	78.42	7.24	42.40	57.23	327.43	906.12
655.00	41.98	78.58	7.20	42.16	56.91	320.56	900.42
660.00	42.08	78.74	7.16	41.92	56.59	313.67	894.69
665.00	42.18	78.89	7.12	41.69	56.28	306.76	888.94
670.00	42.28	79.05	7.08	41.46	55.97	299.83	883.15
675.00	42.38	79.20	7.04	41.23	55.66	292.88	877.34
680.00	42.48	79.35	7.00	41.01	55.36	285.92	871.51
685.00	42.58	79.51	6.96	40.79	55.06	278.93	865.64
690.00	42.68	79.66	6.93	40.57	54.77	271.92	859.76
695.00	42.78	79.81	6.89	40.35	54.48	264.90	853.84
700.00	42.88	79.96	6.85	40.14	54.19	257.86	847.91

705.00	42.97	80.11	6.82	39.93	53.90	250.79	841.94
710.00	43.07	80.26	6.78	39.72	53.62	243.72	835.96
715.00	43.17	80.40	6.75	39.52	53.35	236.62	829.95
720.00	43.26	80.55	6.71	39.31	53.07	229.51	823.91
725.00	43.36	80.69	6.68	39.11	52.80	222.37	817.86
730.00	43.45	80.84	6.64	38.91	52.53	215.23	811.78
735.00	43.55	80.98	6.61	38.72	52.27	208.06	805.67
740.00	43.64	81.13	6.58	38.52	52.01	200.88	799.55
745.00	43.74	81.27	6.55	38.33	51.75	193.68	793.40
750.00	43.83	81.41	6.51	38.14	51.49	186.47	787.23
755.00	43.92	81.55	6.48	37.96	51.24	179.24	781.04
760.00	44.02	81.69	6.45	37.77	50.99	171.99	774.83
765.00	44.11	81.83	6.42	37.59	50.74	164.73	768.60
770.00	44.20	81.97	6.39	37.41	50.50	157.45	762.34
775.00	44.29	82.11	6.36	37.23	50.26	150.16	756.07
780.00	44.38	82.24	6.33	37.05	50.02	142.85	749.77
785.00	44.47	82.38	6.30	36.88	49.78	135.53	743.45
790.00	44.56	82.52	6.27	36.70	49.55	128.19	737.12
795.00	44.65	82.65	6.24	36.53	49.32	120.84	730.76
800.00	44.74	82.79	6.21	36.36	49.09	113.47	724.39
805.00	44.83	82.92	6.18	36.20	48.87	106.09	718.00
810.00	44.92	83.05	6.15	36.03	48.64	98.70	711.58
815.00	45.01	83.19	6.12	35.87	48.42	91.29	705.15
820.00	45.09	83.32	6.10	35.70	48.20	83.87	698.70
825.00	45.18	83.45	6.07	35.54	47.98	76.43	692.23
830.00	45.27	83.58	6.04	35.39	47.77	68.98	685.74
835.00	45.35	83.71	6.01	35.23	47.56	61.52	679.24
840.00	45.44	83.84	5.99	35.07	47.35	54.04	672.71
845.00	45.53	83.97	5.96	34.92	47.14	46.55	666.17
850.00	45.61	84.09	5.94	34.77	46.93	39.05	659.61
855.00	45.70	84.22	5.91	34.61	46.73	31.53	653.04
860.00	45.78	84.35	5.88	34.47	46.53	24.00	646.45
865.00	45.87	84.47	5.86	34.32	46.33	16.46	639.84
870.00	45.95	84.60	5.83	34.17	46.13	8.91	633.21
875.00	46.03	84.72	5.81	34.03	45.93	1.34	626.57
880.00	46.12	84.85	5.79	33.88	45.74	-6.23	619.91
885.00	46.20	84.97	5.76	33.74	45.55	-13.82	613.23
890.00	46.28	85.10	5.74	33.60	45.36	-21.42	606.54
895.00	46.37	85.22	5.71	33.46	45.17	-29.04	599.83
900.00	46.45	85.34	5.69	33.32	44.98	-36.66	593.11
905.00	46.53	85.46	5.67	33.18	44.80	-44.30	586.37
910.00	46.61	85.58	5.64	33.05	44.62	-51.95	579.61
915.00	46.69	85.70	5.62	32.91	44.43	-59.61	572.84
920.00	46.77	85.82	5.60	32.78	44.25	-67.28	566.06
925.00	46.85	85.94	5.57	32.65	44.08	-74.96	559.25
930.00	46.93	86.06	5.55	32.52	43.90	-82.65	552.44
935.00	47.01	86.18	5.53	32.39	43.73	-90.36	545.61
940.00	47.09	86.30	5.51	32.26	43.55	-98.07	538.76
945.00	47.17	86.42	5.49	32.13	43.38	-105.80	531.91
950.00	47.25	86.53	5.47	32.01	43.21	-113.53	525.03

955.00	47.33	86.65	5.44	31.88	43.04	-121.28	518.14
960.00	47.41	86.76	5.42	31.76	42.88	-129.04	511.24
965.00	47.49	86.88	5.40	31.64	42.71	-136.80	504.33
970.00	47.57	87.00	5.38	31.52	42.55	-144.58	497.40
975.00	47.64	87.11	5.36	31.40	42.38	-152.37	490.45
980.00	47.72	87.22	5.34	31.28	42.22	-160.16	483.50
985.00	47.80	87.34	5.32	31.16	42.06	-167.97	476.53
990.00	47.88	87.45	5.30	31.04	41.90	-175.79	469.54
995.00	47.95	87.56	5.28	30.92	41.75	-183.62	462.55
1000.00	48.03	87.67	5.26	30.81	41.59	-191.45	455.54
1005.00	48.11	87.79	5.24	30.69	41.44	-199.30	448.51
1010.00	48.18	87.90	5.22	30.58	41.29	-207.16	441.48
1015.00	48.26	88.01	5.20	30.47	41.13	-215.02	434.43
1020.00	48.33	88.12	5.18	30.36	40.98	-222.90	427.37
1025.00	48.41	88.23	5.16	30.25	40.83	-230.78	420.30
1030.00	48.48	88.34	5.15	30.14	40.69	-238.67	413.21
1035.00	48.56	88.45	5.13	30.03	40.54	-246.58	406.11
1040.00	48.63	88.56	5.11	29.92	40.39	-254.49	399.00
1045.00	48.71	88.66	5.09	29.81	40.25	-262.41	391.88
1050.00	48.78	88.77	5.07	29.71	40.11	-270.34	384.75
1055.00	48.85	88.88	5.05	29.60	39.97	-278.27	377.60
1060.00	48.93	88.99	5.04	29.50	39.82	-286.22	370.44
1065.00	49.00	89.09	5.02	29.40	39.69	-294.18	363.27
1070.00	49.07	89.20	5.00	29.29	39.55	-302.14	356.09
1075.00	49.15	89.30	4.98	29.19	39.41	-310.11	348.90
1080.00	49.22	89.41	4.97	29.09	39.27	-318.09	341.70
1085.00	49.29	89.51	4.95	28.99	39.14	-326.08	334.48
1090.00	49.36	89.62	4.93	28.89	39.00	-334.08	327.25
1095.00	49.43	89.72	4.92	28.79	38.87	-342.08	320.02
1100.00	49.51	89.83	4.90	28.70	38.74	-350.10	312.77
1105.00	49.58	89.93	4.88	28.60	38.61	-358.12	305.51
1110.00	49.65	90.03	4.87	28.50	38.48	-366.15	298.24
1115.00	49.72	90.13	4.85	28.41	38.35	-374.19	290.96
1120.00	49.79	90.24	4.83	28.31	38.22	-382.23	283.67
1125.00	49.86	90.34	4.82	28.22	38.09	-390.29	276.36
1130.00	49.93	90.44	4.80	28.12	37.97	-398.35	269.05
1135.00	50.00	90.54	4.79	28.03	37.84	-406.42	261.73
1140.00	50.07	90.64	4.77	27.94	37.72	-414.49	254.40
1145.00	50.14	90.74	4.76	27.85	37.60	-422.58	247.05
1150.00	50.21	90.84	4.74	27.76	37.47	-430.67	239.70
1155.00	50.28	90.94	4.72	27.67	37.35	-438.77	232.33
1160.00	50.35	91.04	4.71	27.58	37.23	-446.87	224.96
1165.00	50.42	91.14	4.69	27.49	37.11	-454.99	217.58
1170.00	50.48	91.24	4.68	27.40	36.99	-463.11	210.18
1175.00	50.55	91.34	4.66	27.32	36.88	-471.24	202.78
1180.00	50.62	91.43	4.65	27.23	36.76	-479.37	195.37
1185.00	50.69	91.53	4.63	27.14	36.64	-487.52	187.94
1190.00	50.76	91.63	4.62	27.06	36.53	-495.67	180.51
1195.00	50.82	91.73	4.61	26.97	36.41	-503.82	173.07
1200.00	50.89	91.82	4.59	26.89	36.30	-511.99	165.62

1205.00	50.96	91.92	4.58	26.81	36.19	-520.16	158.16
1210.00	51.02	92.02	4.56	26.72	36.08	-528.33	150.69
1215.00	51.09	92.11	4.55	26.64	35.96	-536.52	143.21
1220.00	51.16	92.21	4.53	26.56	35.85	-544.71	135.72
1225.00	51.22	92.30	4.52	26.48	35.74	-552.91	128.22
1230.00	51.29	92.40	4.51	26.40	35.64	-561.11	120.72
1235.00	51.36	92.49	4.49	26.32	35.53	-569.32	113.20
1240.00	51.42	92.58	4.48	26.24	35.42	-577.54	105.68
1245.00	51.49	92.68	4.47	26.16	35.31	-585.77	98.15
1250.00	51.55	92.77	4.45	26.08	35.21	-594.00	90.60
1255.00	51.62	92.86	4.44	26.00	35.10	-602.23	83.05
1260.00	51.68	92.96	4.43	25.92	35.00	-610.48	75.50
1265.00	51.75	93.05	4.41	25.85	34.89	-618.73	67.93
1270.00	51.81	93.14	4.40	25.77	34.79	-626.98	60.35
1275.00	51.88	93.23	4.39	25.70	34.69	-635.25	52.77
1280.00	51.94	93.33	4.37	25.62	34.59	-643.51	45.17
1285.00	52.01	93.42	4.36	25.55	34.49	-651.79	37.57
1290.00	52.07	93.51	4.35	25.47	34.39	-660.07	29.96
1295.00	52.14	93.60	4.34	25.40	34.29	-668.36	22.35
1300.00	52.20	93.69	4.32	25.32	34.19	-676.65	14.72
1305.00	52.26	93.78	4.31	25.25	34.09	-684.95	7.09
1310.00	52.33	93.87	4.30	25.18	33.99	-693.26	-0.55
1315.00	52.39	93.96	4.29	25.11	33.90	-701.57	-8.20
1320.00	52.45	94.05	4.27	25.04	33.80	-709.88	-15.86
1325.00	52.51	94.14	4.26	24.97	33.70	-718.21	-23.53
1330.00	52.58	94.23	4.25	24.90	33.61	-726.53	-31.20
1335.00	52.64	94.31	4.24	24.83	33.51	-734.87	-38.88
1340.00	52.70	94.40	4.23	24.76	33.42	-743.21	-46.57
1345.00	52.76	94.49	4.22	24.69	33.33	-751.55	-54.27
1350.00	52.83	94.58	4.20	24.62	33.23	-759.90	-61.97
1355.00	52.89	94.67	4.19	24.55	33.14	-768.26	-69.68
1360.00	52.95	94.75	4.18	24.48	33.05	-776.62	-77.40
1365.00	53.01	94.84	4.17	24.42	32.96	-784.99	-85.13
1370.00	53.07	94.93	4.16	24.35	32.87	-793.37	-92.86
1375.00	53.14	95.01	4.15	24.28	32.78	-801.74	-100.61
1380.00	53.20	95.10	4.13	24.22	32.69	-810.13	-108.35
1385.00	53.26	95.18	4.12	24.15	32.60	-818.52	-116.11
1390.00	53.32	95.27	4.11	24.08	32.51	-826.91	-123.87
1395.00	53.38	95.36	4.10	24.02	32.43	-835.31	-131.64
1400.00	53.44	95.44	4.09	23.96	32.34	-843.72	-139.42
1405.00	53.50	95.53	4.08	23.89	32.25	-852.13	-147.21
1410.00	53.56	95.61	4.07	23.83	32.17	-860.55	-155.00
1415.00	53.62	95.69	4.06	23.76	32.08	-868.97	-162.80
1420.00	53.68	95.78	4.05	23.70	32.00	-877.39	-170.60
1425.00	53.74	95.86	4.04	23.64	31.91	-885.83	-178.41
1430.00	53.80	95.95	4.03	23.58	31.83	-894.26	-186.23
1435.00	53.86	96.03	4.02	23.52	31.75	-902.70	-194.06
1440.00	53.92	96.11	4.00	23.45	31.66	-911.15	-201.89
1445.00	53.98	96.20	3.99	23.39	31.58	-919.60	-209.73
1450.00	54.04	96.28	3.98	23.33	31.50	-928.06	-217.58

1455.00	54.10	96.36	3.97	23.27	31.42	-936.52	-225.43
1460.00	54.15	96.44	3.96	23.21	31.34	-944.99	-233.29
1465.00	54.21	96.52	3.95	23.15	31.26	-953.46	-241.16
1470.00	54.27	96.61	3.94	23.09	31.18	-961.93	-249.03
1475.00	54.33	96.69	3.93	23.03	31.10	-970.42	-256.91
1480.00	54.39	96.77	3.92	22.98	31.02	-978.90	-264.80
1485.00	54.45	96.85	3.91	22.92	30.94	-987.39	-272.69
1490.00	54.50	96.93	3.90	22.86	30.86	-995.89	-280.59
1495.00	54.56	97.01	3.89	22.80	30.78	-1004.39	-288.49
1500.00	54.62	97.09	3.88	22.75	30.71	-1012.89	-296.40
1505.00	54.68	97.17	3.87	22.69	30.63	-1021.40	-304.32
1510.00	54.74	97.25	3.86	22.63	30.55	-1029.91	-312.25
1515.00	54.79	97.33	3.85	22.58	30.48	-1038.43	-320.18
1520.00	54.85	97.41	3.85	22.52	30.40	-1046.96	-328.11
1525.00	54.91	97.49	3.84	22.46	30.33	-1055.48	-336.05
1530.00	54.96	97.57	3.83	22.41	30.25	-1064.02	-344.00
1535.00	55.02	97.65	3.82	22.35	30.18	-1072.55	-351.96
1540.00	55.08	97.73	3.81	22.30	30.10	-1081.09	-359.92
1545.00	55.13	97.81	3.80	22.25	30.03	-1089.64	-367.88
1550.00	55.19	97.88	3.79	22.19	29.96	-1098.19	-375.85
1555.00	55.25	97.96	3.78	22.14	29.89	-1106.74	-383.83
1560.00	55.30	98.04	3.77	22.08	29.81	-1115.30	-391.82
1565.00	55.36	98.12	3.76	22.03	29.74	-1123.86	-399.81
1570.00	55.41	98.20	3.75	21.98	29.67	-1132.43	-407.80
1575.00	55.47	98.27	3.74	21.93	29.60	-1141.00	-415.80
1580.00	55.53	98.35	3.73	21.87	29.53	-1149.58	-423.81
1585.00	55.58	98.43	3.73	21.82	29.46	-1158.16	-431.82
1590.00	55.64	98.50	3.72	21.77	29.39	-1166.74	-439.84
1595.00	55.69	98.58	3.71	21.72	29.32	-1175.33	-447.87
1600.00	55.75	98.66	3.70	21.67	29.25	-1183.92	-455.90
1605.00	55.80	98.73	3.69	21.62	29.18	-1192.52	-463.93
1610.00	55.86	98.81	3.68	21.57	29.11	-1201.12	-471.97
1615.00	55.91	98.88	3.67	21.52	29.05	-1209.72	-480.02
1620.00	55.97	98.96	3.67	21.47	28.98	-1218.33	-488.07
1625.00	56.02	99.03	3.66	21.42	28.91	-1226.95	-496.13
1630.00	56.08	99.11	3.65	21.37	28.84	-1235.56	-504.19
1635.00	56.13	99.18	3.64	21.32	28.78	-1244.18	-512.26
1640.00	56.19	99.26	3.63	21.27	28.71	-1252.81	-520.33
1645.00	56.24	99.33	3.62	21.22	28.65	-1261.44	-528.41
1650.00	56.29	99.41	3.61	21.17	28.58	-1270.07	-536.49
1655.00	56.35	99.48	3.61	21.12	28.52	-1278.71	-544.58
1660.00	56.40	99.56	3.60	21.07	28.45	-1287.35	-552.68
1665.00	56.45	99.63	3.59	21.03	28.39	-1295.99	-560.78
1670.00	56.51	99.70	3.58	20.98	28.32	-1304.64	-568.88
1675.00	56.56	99.78	3.57	20.93	28.26	-1313.29	-576.99
1680.00	56.62	99.85	3.57	20.89	28.20	-1321.95	-585.11
1685.00	56.67	99.92	3.56	20.84	28.13	-1330.61	-593.23
1690.00	56.72	100.00	3.55	20.79	28.07	-1339.27	-601.35
1695.00	56.77	100.07	3.54	20.75	28.01	-1347.94	-609.48
1700.00	56.83	100.14	3.53	20.70	27.94	-1356.61	-617.62

1705.00	56.88	100.21	3.53	20.65	27.88	-1365.28	-625.76
1710.00	56.93	100.29	3.52	20.61	27.82	-1373.96	-633.91
1715.00	56.99	100.36	3.51	20.56	27.76	-1382.64	-642.06
1720.00	57.04	100.43	3.50	20.52	27.70	-1391.33	-650.21
1725.00	57.09	100.50	3.50	20.47	27.64	-1400.02	-658.37
1730.00	57.14	100.57	3.49	20.43	27.58	-1408.71	-666.54
1735.00	57.20	100.64	3.48	20.38	27.52	-1417.40	-674.71
1740.00	57.25	100.72	3.47	20.34	27.46	-1426.10	-682.88
1745.00	57.30	100.79	3.47	20.30	27.40	-1434.81	-691.06
1750.00	57.35	100.86	3.46	20.25	27.34	-1443.51	-699.25
1755.00	57.40	100.93	3.45	20.21	27.28	-1452.23	-707.43
1760.00	57.46	101.00	3.44	20.17	27.22	-1460.94	-715.63
1765.00	57.51	101.07	3.44	20.12	27.16	-1469.66	-723.83
1770.00	57.56	101.14	3.43	20.08	27.11	-1478.38	-732.03
1775.00	57.61	101.21	3.42	20.04	27.05	-1487.10	-740.24
1780.00	57.66	101.28	3.41	19.99	26.99	-1495.83	-748.45
1785.00	57.71	101.35	3.41	19.95	26.93	-1504.56	-756.67
1790.00	57.76	101.42	3.40	19.91	26.88	-1513.30	-764.89
1795.00	57.81	101.49	3.39	19.87	26.82	-1522.03	-773.11
1800.00	57.87	101.56	3.39	19.83	26.77	-1530.77	-781.35
1805.00	57.92	101.62	3.38	19.78	26.71	-1539.52	-789.58
1810.00	57.97	101.69	3.37	19.74	26.65	-1548.27	-797.82
1815.00	58.02	101.76	3.36	19.70	26.60	-1557.02	-806.06
1820.00	58.07	101.83	3.36	19.66	26.54	-1565.77	-814.31
1825.00	58.12	101.90	3.35	19.62	26.49	-1574.53	-822.57
1830.00	58.17	101.97	3.34	19.58	26.43	-1583.29	-830.82
1835.00	58.22	102.04	3.34	19.54	26.38	-1592.06	-839.09
1840.00	58.27	102.10	3.33	19.50	26.32	-1600.82	-847.35
1845.00	58.32	102.17	3.32	19.46	26.27	-1609.59	-855.62
1850.00	58.37	102.24	3.32	19.42	26.22	-1618.37	-863.90
1855.00	58.42	102.31	3.31	19.38	26.16	-1627.15	-872.18
1860.00	58.47	102.37	3.30	19.34	26.11	-1635.93	-880.46
1865.00	58.52	102.44	3.30	19.30	26.06	-1644.71	-888.75
1870.00	58.57	102.51	3.29	19.26	26.00	-1653.50	-897.04
1875.00	58.62	102.58	3.28	19.22	25.95	-1662.29	-905.34
1880.00	58.67	102.64	3.28	19.19	25.90	-1671.08	-913.64
1885.00	58.72	102.71	3.27	19.15	25.85	-1679.87	-921.94
1890.00	58.77	102.77	3.26	19.11	25.80	-1688.67	-930.25
1895.00	58.81	102.84	3.26	19.07	25.75	-1697.48	-938.56
1900.00	58.86	102.91	3.25	19.03	25.69	-1706.28	-946.88
1905.00	58.91	102.97	3.24	18.99	25.64	-1715.09	-955.20
1910.00	58.96	103.04	3.24	18.96	25.59	-1723.90	-963.52
1915.00	59.01	103.11	3.23	18.92	25.54	-1732.71	-971.85
1920.00	59.06	103.17	3.22	18.88	25.49	-1741.53	-980.19
1925.00	59.11	103.24	3.22	18.85	25.44	-1750.35	-988.52
1930.00	59.16	103.30	3.21	18.81	25.39	-1759.17	-996.86
1935.00	59.20	103.37	3.21	18.77	25.34	-1768.00	-1005.21
1940.00	59.25	103.43	3.20	18.74	25.29	-1776.83	-1013.56
1945.00	59.30	103.50	3.19	18.70	25.24	-1785.66	-1021.91
1950.00	59.35	103.56	3.19	18.66	25.19	-1794.50	-1030.27

1955.00	59.40	103.63	3.18	18.63	25.15	-1803.33	-1038.63
1960.00	59.45	103.69	3.17	18.59	25.10	-1812.17	-1046.99
1965.00	59.49	103.75	3.17	18.55	25.05	-1821.02	-1055.36
1970.00	59.54	103.82	3.16	18.52	25.00	-1829.86	-1063.73
1975.00	59.59	103.88	3.16	18.48	24.95	-1838.71	-1072.11
1980.00	59.64	103.95	3.15	18.45	24.90	-1847.56	-1080.49
1985.00	59.68	104.01	3.14	18.41	24.86	-1856.42	-1088.87
1990.00	59.73	104.07	3.14	18.38	24.81	-1865.28	-1097.26
1995.00	59.78	104.14	3.13	18.34	24.76	-1874.14	-1105.65
2000.00	59.83	104.20	3.13	18.31	24.72	-1883.00	-1114.05
2005.00	59.87	104.26	3.12	18.27	24.67	-1891.87	-1122.45
2010.00	59.92	104.33	3.11	18.24	24.62	-1900.73	-1130.85
2015.00	59.97	104.39	3.11	18.21	24.58	-1909.60	-1139.26
2020.00	60.01	104.45	3.10	18.17	24.53	-1918.48	-1147.67
2025.00	60.06	104.52	3.10	18.14	24.48	-1927.36	-1156.08
2030.00	60.11	104.58	3.09	18.10	24.44	-1936.24	-1164.50
2035.00	60.16	104.64	3.09	18.07	24.39	-1945.12	-1172.92
2040.00	60.20	104.70	3.08	18.04	24.35	-1954.00	-1181.34
2045.00	60.25	104.77	3.07	18.00	24.30	-1962.89	-1189.77
2050.00	60.30	104.83	3.07	17.97	24.26	-1971.78	-1198.20
2055.00	60.34	104.89	3.06	17.94	24.21	-1980.67	-1206.64
2060.00	60.39	104.95	3.06	17.90	24.17	-1989.57	-1215.08
2065.00	60.43	105.01	3.05	17.87	24.12	-1998.47	-1223.52
2070.00	60.48	105.08	3.05	17.84	24.08	-2007.37	-1231.96
2075.00	60.53	105.14	3.04	17.81	24.04	-2016.27	-1240.41
2080.00	60.57	105.20	3.03	17.77	23.99	-2025.18	-1248.87
2085.00	60.62	105.26	3.03	17.74	23.95	-2034.08	-1257.32
2090.00	60.66	105.32	3.02	17.71	23.91	-2043.00	-1265.78
2095.00	60.71	105.38	3.02	17.68	23.86	-2051.91	-1274.25
2100.00	60.76	105.44	3.01	17.64	23.82	-2060.82	-1282.71
2105.00	60.80	105.50	3.01	17.61	23.78	-2069.74	-1291.18
2110.00	60.85	105.56	3.00	17.58	23.73	-2078.66	-1299.66
2115.00	60.89	105.62	3.00	17.55	23.69	-2087.59	-1308.13
2120.00	60.94	105.69	2.99	17.52	23.65	-2096.51	-1316.61
2125.00	60.98	105.75	2.99	17.49	23.61	-2105.44	-1325.10
2130.00	61.03	105.81	2.98	17.46	23.57	-2114.37	-1333.58
2135.00	61.07	105.87	2.98	17.42	23.52	-2123.31	-1342.07
2140.00	61.12	105.93	2.97	17.39	23.48	-2132.24	-1350.57
2145.00	61.16	105.99	2.96	17.36	23.44	-2141.18	-1359.07
2150.00	61.21	106.05	2.96	17.33	23.40	-2150.12	-1367.57
2155.00	61.25	106.10	2.95	17.30	23.36	-2159.07	-1376.07
2160.00	61.30	106.16	2.95	17.27	23.32	-2168.01	-1384.58
2165.00	61.34	106.22	2.94	17.24	23.28	-2176.96	-1393.09
2170.00	61.39	106.28	2.94	17.21	23.24	-2185.91	-1401.60
2175.00	61.43	106.34	2.93	17.18	23.19	-2194.86	-1410.12
2180.00	61.48	106.40	2.93	17.15	23.15	-2203.82	-1418.63
2185.00	61.52	106.46	2.92	17.12	23.11	-2212.78	-1427.16
2190.00	61.57	106.52	2.92	17.09	23.07	-2221.74	-1435.68
2195.00	61.61	106.58	2.91	17.06	23.03	-2230.70	-1444.21
2200.00	61.66	106.64	2.91	17.03	22.99	-2239.66	-1452.74

2205.00	61.70	106.69	2.90	17.00	22.95	-2248.63	-1461.28
2210.00	61.74	106.75	2.90	16.97	22.92	-2257.60	-1469.82
2215.00	61.79	106.81	2.89	16.95	22.88	-2266.57	-1478.36
2220.00	61.83	106.87	2.89	16.92	22.84	-2275.54	-1486.91
2225.00	61.88	106.93	2.88	16.89	22.80	-2284.52	-1495.45
2230.00	61.92	106.99	2.88	16.86	22.76	-2293.50	-1504.00
2235.00	61.96	107.04	2.87	16.83	22.72	-2302.48	-1512.56
2240.00	62.01	107.10	2.87	16.80	22.68	-2311.46	-1521.12
2245.00	62.05	107.16	2.86	16.77	22.64	-2320.45	-1529.68
2250.00	62.10	107.22	2.86	16.74	22.61	-2329.44	-1538.24
2255.00	62.14	107.27	2.85	16.72	22.57	-2338.43	-1546.80
2260.00	62.18	107.33	2.85	16.69	22.53	-2347.42	-1555.37
2265.00	62.23	107.39	2.84	16.66	22.49	-2356.41	-1563.95
2270.00	62.27	107.45	2.84	16.63	22.45	-2365.41	-1572.52
2275.00	62.31	107.50	2.84	16.61	22.42	-2374.41	-1581.10
2280.00	62.36	107.56	2.83	16.58	22.38	-2383.41	-1589.68
2285.00	62.40	107.62	2.83	16.55	22.34	-2392.41	-1598.26
2290.00	62.44	107.67	2.82	16.52	22.31	-2401.42	-1606.85
2295.00	62.49	107.73	2.82	16.50	22.27	-2410.42	-1615.44
2300.00	62.53	107.79	2.81	16.47	22.23	-2419.43	-1624.03
2305.00	62.57	107.84	2.81	16.44	22.20	-2428.44	-1632.63
2310.00	62.61	107.90	2.80	16.41	22.16	-2437.46	-1641.23
2315.00	62.66	107.95	2.80	16.39	22.12	-2446.47	-1649.83
2320.00	62.70	108.01	2.79	16.36	22.09	-2455.49	-1658.43
2325.00	62.74	108.07	2.79	16.33	22.05	-2464.51	-1667.04
2330.00	62.79	108.12	2.78	16.31	22.01	-2473.53	-1675.65
2335.00	62.83	108.18	2.78	16.28	21.98	-2482.56	-1684.26
2340.00	62.87	108.23	2.78	16.25	21.94	-2491.58	-1692.88
2345.00	62.91	108.29	2.77	16.23	21.91	-2500.61	-1701.50
2350.00	62.96	108.34	2.77	16.20	21.87	-2509.64	-1710.12
2355.00	63.00	108.40	2.76	16.17	21.84	-2518.68	-1718.74
2360.00	63.04	108.46	2.76	16.15	21.80	-2527.71	-1727.37
2365.00	63.08	108.51	2.75	16.12	21.77	-2536.75	-1736.00
2370.00	63.12	108.57	2.75	16.10	21.73	-2545.79	-1744.63
2375.00	63.17	108.62	2.74	16.07	21.70	-2554.83	-1753.27
2380.00	63.21	108.68	2.74	16.05	21.66	-2563.87	-1761.90
2385.00	63.25	108.73	2.74	16.02	21.63	-2572.91	-1770.54
2390.00	63.29	108.78	2.73	15.99	21.59	-2581.96	-1779.19
2395.00	63.33	108.84	2.73	15.97	21.56	-2591.01	-1787.83
2400.00	63.38	108.89	2.72	15.94	21.52	-2600.06	-1796.48
2405.00	63.42	108.95	2.72	15.92	21.49	-2609.11	-1805.13
2410.00	63.46	109.00	2.71	15.89	21.46	-2618.17	-1813.79
2415.00	63.50	109.06	2.71	15.87	21.42	-2627.23	-1822.44
2420.00	63.54	109.11	2.71	15.84	21.39	-2636.28	-1831.10
2425.00	63.58	109.16	2.70	15.82	21.36	-2645.34	-1839.77
2430.00	63.62	109.22	2.70	15.79	21.32	-2654.41	-1848.43
2435.00	63.67	109.27	2.69	15.77	21.29	-2663.47	-1857.10
2440.00	63.71	109.33	2.69	15.74	21.26	-2672.54	-1865.77
2445.00	63.75	109.38	2.68	15.72	21.22	-2681.61	-1874.44
2450.00	63.79	109.43	2.68	15.70	21.19	-2690.68	-1883.11

2455.00	63.83	109.49	2.68	15.67	21.16	-2699.75	-1891.79
2460.00	63.87	109.54	2.67	15.65	21.12	-2708.82	-1900.47
2465.00	63.91	109.59	2.67	15.62	21.09	-2717.90	-1909.16
2470.00	63.95	109.65	2.66	15.60	21.06	-2726.98	-1917.84
2475.00	63.99	109.70	2.66	15.58	21.03	-2736.06	-1926.53
2480.00	64.04	109.75	2.66	15.55	20.99	-2745.14	-1935.22
2485.00	64.08	109.81	2.65	15.53	20.96	-2754.22	-1943.91
2490.00	64.12	109.86	2.65	15.50	20.93	-2763.31	-1952.61
2495.00	64.16	109.91	2.64	15.48	20.90	-2772.40	-1961.30
2500.00	64.20	109.96	2.64	15.46	20.87	-2781.49	-1970.01
2505.00	64.24	110.02	2.64	15.43	20.83	-2790.58	-1978.71
2510.00	64.28	110.07	2.63	15.41	20.80	-2799.67	-1987.41
2515.00	64.32	110.12	2.63	15.39	20.77	-2808.76	-1996.12
2520.00	64.36	110.17	2.62	15.36	20.74	-2817.86	-2004.83
2525.00	64.40	110.23	2.62	15.34	20.71	-2826.96	-2013.54
2530.00	64.44	110.28	2.62	15.32	20.68	-2836.06	-2022.26
2535.00	64.48	110.33	2.61	15.29	20.65	-2845.16	-2030.98
2540.00	64.52	110.38	2.61	15.27	20.62	-2854.27	-2039.70
2545.00	64.56	110.43	2.60	15.25	20.59	-2863.37	-2048.42
2550.00	64.60	110.49	2.60	15.23	20.55	-2872.48	-2057.15
2555.00	64.64	110.54	2.60	15.20	20.52	-2881.59	-2065.87
2560.00	64.68	110.59	2.59	15.18	20.49	-2890.70	-2074.60
2565.00	64.72	110.64	2.59	15.16	20.46	-2899.81	-2083.33
2570.00	64.76	110.69	2.58	15.14	20.43	-2908.93	-2092.07
2575.00	64.80	110.74	2.58	15.11	20.40	-2918.04	-2100.81
2580.00	64.84	110.80	2.58	15.09	20.37	-2927.16	-2109.55
2585.00	64.88	110.85	2.57	15.07	20.34	-2936.28	-2118.29
2590.00	64.92	110.90	2.57	15.05	20.31	-2945.40	-2127.03
2595.00	64.96	110.95	2.57	15.02	20.28	-2954.52	-2135.78
2600.00	65.00	111.00	2.56	15.00	20.25	-2963.65	-2144.53
2605.00	65.04	111.05	2.56	14.98	20.22	-2972.78	-2153.28
2610.00	65.08	111.10	2.55	14.96	20.19	-2981.90	-2162.03
2615.00	65.12	111.15	2.55	14.94	20.16	-2991.03	-2170.79
2620.00	65.16	111.20	2.55	14.91	20.14	-3000.17	-2179.54
2625.00	65.20	111.25	2.54	14.89	20.11	-3009.30	-2188.30
2630.00	65.24	111.30	2.54	14.87	20.08	-3018.43	-2197.07
2635.00	65.27	111.35	2.54	14.85	20.05	-3027.57	-2205.83
2640.00	65.31	111.41	2.53	14.83	20.02	-3036.71	-2214.60
2645.00	65.35	111.46	2.53	14.81	19.99	-3045.85	-2223.37
2650.00	65.39	111.51	2.52	14.79	19.96	-3054.99	-2232.14
2655.00	65.43	111.56	2.52	14.77	19.93	-3064.13	-2240.91
2660.00	65.47	111.61	2.52	14.74	19.90	-3073.28	-2249.69
2665.00	65.51	111.66	2.51	14.72	19.88	-3082.43	-2258.47
2670.00	65.55	111.71	2.51	14.70	19.85	-3091.58	-2267.25
2675.00	65.59	111.76	2.51	14.68	19.82	-3100.73	-2276.03
2680.00	65.62	111.81	2.50	14.66	19.79	-3109.88	-2284.81
2685.00	65.66	111.85	2.50	14.64	19.76	-3119.03	-2293.60
2690.00	65.70	111.90	2.50	14.62	19.73	-3128.19	-2302.39
2695.00	65.74	111.95	2.49	14.60	19.71	-3137.34	-2311.18
2700.00	65.78	112.00	2.49	14.58	19.68	-3146.50	-2319.98

2705.00	65.82	112.05	2.49	14.56	19.65	-3155.66	-2328.77
2710.00	65.86	112.10	2.48	14.54	19.62	-3164.82	-2337.57
2715.00	65.89	112.15	2.48	14.52	19.60	-3173.98	-2346.37
2720.00	65.93	112.20	2.48	14.50	19.57	-3183.15	-2355.17
2725.00	65.97	112.25	2.47	14.48	19.54	-3192.32	-2363.98
2730.00	66.01	112.30	2.47	14.45	19.51	-3201.48	-2372.78
2735.00	66.05	112.35	2.46	14.43	19.49	-3210.65	-2381.59
2740.00	66.08	112.40	2.46	14.41	19.46	-3219.82	-2390.40
2745.00	66.12	112.44	2.46	14.39	19.43	-3229.00	-2399.21
2750.00	66.16	112.49	2.45	14.37	19.41	-3238.17	-2408.03
2755.00	66.20	112.54	2.45	14.35	19.38	-3247.35	-2416.85
2760.00	66.24	112.59	2.45	14.34	19.35	-3256.52	-2425.67
2765.00	66.27	112.64	2.44	14.32	19.33	-3265.70	-2434.49
2770.00	66.31	112.69	2.44	14.30	19.30	-3274.88	-2443.31
2775.00	66.35	112.74	2.44	14.28	19.27	-3284.06	-2452.13
2780.00	66.39	112.78	2.43	14.26	19.25	-3293.25	-2460.96
2785.00	66.43	112.83	2.43	14.24	19.22	-3302.43	-2469.79
2790.00	66.46	112.88	2.43	14.22	19.19	-3311.62	-2478.62
2795.00	66.50	112.93	2.42	14.20	19.17	-3320.81	-2487.46
2800.00	66.54	112.98	2.42	14.18	19.14	-3329.99	-2496.29
2805.00	66.58	113.02	2.42	14.16	19.12	-3339.19	-2505.13
2810.00	66.61	113.07	2.41	14.14	19.09	-3348.38	-2513.97
2815.00	66.65	113.12	2.41	14.12	19.06	-3357.57	-2522.81
2820.00	66.69	113.17	2.41	14.10	19.04	-3366.77	-2531.65
2825.00	66.73	113.21	2.40	14.08	19.01	-3375.96	-2540.50
2830.00	66.76	113.26	2.40	14.06	18.99	-3385.16	-2549.35
2835.00	66.80	113.31	2.40	14.04	18.96	-3394.36	-2558.20
2840.00	66.84	113.36	2.39	14.03	18.94	-3403.56	-2567.05
2845.00	66.87	113.40	2.39	14.01	18.91	-3412.77	-2575.90
2850.00	66.91	113.45	2.39	13.99	18.88	-3421.97	-2584.76
2855.00	66.95	113.50	2.39	13.97	18.86	-3431.18	-2593.62
2860.00	66.99	113.55	2.38	13.95	18.83	-3440.38	-2602.48
2865.00	67.02	113.59	2.38	13.93	18.81	-3449.59	-2611.34
2870.00	67.06	113.64	2.38	13.91	18.78	-3458.80	-2620.20
2875.00	67.10	113.69	2.37	13.90	18.76	-3468.01	-2629.07
2880.00	67.13	113.73	2.37	13.88	18.73	-3477.22	-2637.93

Notes to User

Only values shown blue to be edited

Sheet only for england and wales

ln M5-D	J0	J1	J2	Cr	ln (MT-D/M5-D)	MT-D/M5-D
2.19	0.1699	0.0028	0.000114	0.204191	0.634047	1.885225
2.39	0.1699	0.0028	0.000114	0.214046	0.66465	1.943809
2.52	0.1644	0.005831	-0.00013	0.216058	0.670897	1.95599
2.61	0.1644	0.005831	-0.00013	0.218898	0.679715	1.973316
2.68	0.1644	0.005831	-0.00013	0.221006	0.686261	1.986275
2.74	0.1644	0.005831	-0.00013	0.222617	0.691263	1.996236
2.80	0.1644	0.005831	-0.00013	0.22387	0.695153	2.004016
2.84	0.1644	0.005831	-0.00013	0.224853	0.698207	2.010146
2.88	0.1644	0.005831	-0.00013	0.225627	0.700612	2.014985
2.91	0.1644	0.005831	-0.00013	0.226235	0.702498	2.01879
2.94	0.1644	0.005831	-0.00013	0.226707	0.703963	2.021749
2.97	0.1644	0.005831	-0.00013	0.227066	0.705078	2.024005
3.00	0.1644	0.005831	-0.00013	0.227331	0.7059	2.025669
3.02	0.1644	0.005831	-0.00013	0.227515	0.706472	2.026828
3.05	0.1644	0.005831	-0.00013	0.22763	0.706829	2.027552
3.07	0.1644	0.005831	-0.00013	0.227685	0.707	2.027898
3.09	0.1644	0.005831	-0.00013	0.227687	0.707008	2.027914
3.11	0.1644	0.005831	-0.00013	0.227643	0.706872	2.027638
3.12	0.1644	0.005831	-0.00013	0.227559	0.706608	2.027104
3.14	0.1644	0.005831	-0.00013	0.227437	0.706231	2.02634
3.16	0.1644	0.005831	-0.00013	0.227283	0.705753	2.025371
3.17	0.1644	0.005831	-0.00013	0.227099	0.705183	2.024216
3.18	0.1644	0.005831	-0.00013	0.226889	0.70453	2.022895
3.20	0.1644	0.005831	-0.00013	0.226655	0.703802	2.021423
3.21	0.1644	0.005831	-0.00013	0.226398	0.703005	2.019814
3.22	0.1644	0.005831	-0.00013	0.226122	0.702147	2.01808
3.24	0.1644	0.005831	-0.00013	0.225827	0.701231	2.016233
3.25	0.1644	0.005831	-0.00013	0.225515	0.700262	2.014281
3.26	0.1644	0.005831	-0.00013	0.225188	0.699246	2.012234
3.27	0.1644	0.005831	-0.00013	0.224846	0.698184	2.0101
3.28	0.1644	0.005831	-0.00013	0.224491	0.697082	2.007885
3.29	0.1644	0.005831	-0.00013	0.224123	0.695941	2.005596
3.30	0.1644	0.005831	-0.00013	0.223745	0.694765	2.003238
3.31	0.1644	0.005831	-0.00013	0.223355	0.693556	2.000818
3.32	0.1644	0.005831	-0.00013	0.222956	0.692316	1.998338
3.33	0.1644	0.005831	-0.00013	0.222547	0.691048	1.995805
3.34	0.1644	0.005831	-0.00013	0.22213	0.689753	1.993222
3.35	0.1644	0.005831	-0.00013	0.221705	0.688432	1.990593
3.35	0.1644	0.005831	-0.00013	0.221273	0.687089	1.98792

3.36	0.1644	0.005831	-0.00013	0.220833	0.685723	1.985207
3.37	0.1644	0.005831	-0.00013	0.220386	0.684337	1.982458
3.38	0.1644	0.005831	-0.00013	0.219934	0.682932	1.979674
3.39	0.1644	0.005831	-0.00013	0.219475	0.681508	1.976857
3.39	0.1644	0.005831	-0.00013	0.219011	0.680068	1.974012
3.40	0.1644	0.005831	-0.00013	0.218542	0.678611	1.971138
3.41	0.1644	0.005831	-0.00013	0.218068	0.677139	1.968239
3.41	0.1644	0.005831	-0.00013	0.21759	0.675653	1.965315
3.42	0.1644	0.005831	-0.00013	0.217107	0.674153	1.96237
3.43	0.1644	0.005831	-0.00013	0.216619	0.67264	1.959404
3.43	0.1644	0.005831	-0.00013	0.216128	0.671116	1.956419
3.44	0.2644	-0.00162	3.15E-06	0.216913	0.673553	1.961192
3.45	0.2644	-0.00162	3.15E-06	0.216637	0.672696	1.959513
3.45	0.2644	-0.00162	3.15E-06	0.216365	0.671851	1.957858
3.46	0.2644	-0.00162	3.15E-06	0.216097	0.671018	1.956228
3.46	0.2644	-0.00162	3.15E-06	0.215832	0.670197	1.954622
3.47	0.2644	-0.00162	3.15E-06	0.215571	0.669386	1.953038
3.48	0.2644	-0.00162	3.15E-06	0.215314	0.668586	1.951476
3.48	0.2644	-0.00162	3.15E-06	0.215059	0.667796	1.949935
3.49	0.2644	-0.00162	3.15E-06	0.214808	0.667016	1.948415
3.49	0.2644	-0.00162	3.15E-06	0.21456	0.666246	1.946915
3.50	0.2644	-0.00162	3.15E-06	0.214315	0.665485	1.945434
3.50	0.2644	-0.00162	3.15E-06	0.214073	0.664734	1.943973
3.51	0.2644	-0.00162	3.15E-06	0.213834	0.663991	1.94253
3.51	0.2644	-0.00162	3.15E-06	0.213598	0.663257	1.941104
3.52	0.2644	-0.00162	3.15E-06	0.213364	0.662531	1.939696
3.52	0.2644	-0.00162	3.15E-06	0.213133	0.661814	1.938305
3.53	0.2644	-0.00162	3.15E-06	0.212905	0.661105	1.936931
3.53	0.2644	-0.00162	3.15E-06	0.212679	0.660403	1.935573
3.54	0.2644	-0.00162	3.15E-06	0.212455	0.659709	1.93423
3.54	0.2644	-0.00162	3.15E-06	0.212234	0.659023	1.932902
3.55	0.2644	-0.00162	3.15E-06	0.212015	0.658343	1.931589
3.55	0.2644	-0.00162	3.15E-06	0.211799	0.657671	1.930291
3.55	0.2644	-0.00162	3.15E-06	0.211584	0.657005	1.929007
3.56	0.2644	-0.00162	3.15E-06	0.211372	0.656347	1.927737
3.56	0.2644	-0.00162	3.15E-06	0.211162	0.655695	1.92648
3.57	0.2644	-0.00162	3.15E-06	0.210954	0.655049	1.925237
3.57	0.2644	-0.00162	3.15E-06	0.210748	0.654409	1.924006
3.58	0.2644	-0.00162	3.15E-06	0.210544	0.653776	1.922788
3.58	0.2644	-0.00162	3.15E-06	0.210342	0.653149	1.921582
3.58	0.2644	-0.00162	3.15E-06	0.210142	0.652527	1.920388
3.59	0.2644	-0.00162	3.15E-06	0.209944	0.651911	1.919206
3.59	0.2644	-0.00162	3.15E-06	0.209747	0.651301	1.918035
3.59	0.2644	-0.00162	3.15E-06	0.209553	0.650697	1.916876
3.60	0.2644	-0.00162	3.15E-06	0.20936	0.650097	1.915727
3.60	0.2644	-0.00162	3.15E-06	0.209168	0.649503	1.91459
3.61	0.2644	-0.00162	3.15E-06	0.208979	0.648915	1.913463
3.61	0.2644	-0.00162	3.15E-06	0.208791	0.648331	1.912346
3.61	0.2644	-0.00162	3.15E-06	0.208604	0.647752	1.91124
3.62	0.2644	-0.00162	3.15E-06	0.20842	0.647178	1.910143

3.62	0.2644	-0.00162	3.15E-06	0.208236	0.646609	1.909056
3.62	0.2644	-0.00162	3.15E-06	0.208055	0.646045	1.907979
3.63	0.2644	-0.00162	3.15E-06	0.207874	0.645485	1.906911
3.63	0.2644	-0.00162	3.15E-06	0.207695	0.644929	1.905853
3.63	0.2644	-0.00162	3.15E-06	0.207518	0.644379	1.904803
3.64	0.2644	-0.00162	3.15E-06	0.207342	0.643832	1.903762
3.64	0.2644	-0.00162	3.15E-06	0.207167	0.64329	1.90273
3.64	0.2644	-0.00162	3.15E-06	0.206994	0.642752	1.901706
3.65	0.2644	-0.00162	3.15E-06	0.206822	0.642218	1.900691
3.65	0.2644	-0.00162	3.15E-06	0.206651	0.641688	1.899684
3.65	0.2644	-0.00162	3.15E-06	0.206482	0.641162	1.898685
3.66	0.2644	-0.00162	3.15E-06	0.206314	0.64064	1.897694
3.66	0.2644	-0.00162	3.15E-06	0.206147	0.640121	1.896711
3.66	0.2644	-0.00162	3.15E-06	0.205981	0.639607	1.895736
3.67	0.2644	-0.00162	3.15E-06	0.205817	0.639096	1.894768
3.67	0.2644	-0.00162	3.15E-06	0.205654	0.638589	1.893807
3.67	0.2644	-0.00162	3.15E-06	0.205491	0.638086	1.892854
3.68	0.2644	-0.00162	3.15E-06	0.20533	0.637586	1.891908
3.68	0.2644	-0.00162	3.15E-06	0.205171	0.637089	1.890969
3.68	0.2644	-0.00162	3.15E-06	0.205012	0.636596	1.890037
3.68	0.2644	-0.00162	3.15E-06	0.204854	0.636107	1.889111
3.69	0.2644	-0.00162	3.15E-06	0.204697	0.63562	1.888193
3.69	0.2644	-0.00162	3.15E-06	0.204542	0.635137	1.887281
3.69	0.2644	-0.00162	3.15E-06	0.204387	0.634657	1.886375
3.70	0.2644	-0.00162	3.15E-06	0.204234	0.63418	1.885476
3.70	0.2644	-0.00162	3.15E-06	0.204081	0.633707	1.884584
3.70	0.2644	-0.00162	3.15E-06	0.20393	0.633236	1.883697
3.70	0.2644	-0.00162	3.15E-06	0.203779	0.632769	1.882817
3.71	0.2644	-0.00162	3.15E-06	0.20363	0.632304	1.881942
3.71	0.2644	-0.00162	3.15E-06	0.203481	0.631843	1.881074
3.71	0.2644	-0.00162	3.15E-06	0.203333	0.631384	1.880211
3.71	0.2644	-0.00162	3.15E-06	0.203186	0.630928	1.879354
3.72	0.2644	-0.00162	3.15E-06	0.20304	0.630475	1.878503
3.72	0.2644	-0.00162	3.15E-06	0.202895	0.630025	1.877657
3.72	0.2644	-0.00162	3.15E-06	0.202751	0.629577	1.876817
3.72	0.2644	-0.00162	3.15E-06	0.202608	0.629132	1.875982
3.73	0.2644	-0.00162	3.15E-06	0.202466	0.62869	1.875153
3.73	0.2644	-0.00162	3.15E-06	0.202324	0.628251	1.874329
3.73	0.2644	-0.00162	3.15E-06	0.202183	0.627814	1.87351
3.73	0.2644	-0.00162	3.15E-06	0.202043	0.627379	1.872697
3.74	0.2644	-0.00162	3.15E-06	0.201904	0.626947	1.871888
3.74	0.2644	-0.00162	3.15E-06	0.201766	0.626518	1.871084
3.74	0.2644	-0.00162	3.15E-06	0.201629	0.626091	1.870286
3.74	0.2644	-0.00162	3.15E-06	0.201492	0.625667	1.869492
3.75	0.2644	-0.00162	3.15E-06	0.201356	0.625244	1.868703
3.75	0.2644	-0.00162	3.15E-06	0.201221	0.624825	1.867918
3.75	0.2644	-0.00162	3.15E-06	0.201086	0.624407	1.867139
3.75	0.2644	-0.00162	3.15E-06	0.200953	0.623992	1.866364
3.76	0.2644	-0.00162	3.15E-06	0.20082	0.623579	1.865593
3.76	0.2644	-0.00162	3.15E-06	0.200687	0.623169	1.864828

3.76	0.2644	-0.00162	3.15E-06	0.200556	0.62276	1.864066
3.76	0.2644	-0.00162	3.15E-06	0.200425	0.622354	1.863309
3.77	0.2644	-0.00162	3.15E-06	0.200295	0.62195	1.862556
3.77	0.2644	-0.00162	3.15E-06	0.200165	0.621548	1.861808
3.77	0.2644	-0.00162	3.15E-06	0.200037	0.621148	1.861063
3.77	0.2644	-0.00162	3.15E-06	0.199909	0.62075	1.860323
3.77	0.2644	-0.00162	3.15E-06	0.199781	0.620355	1.859587
3.78	0.2644	-0.00162	3.15E-06	0.199654	0.619961	1.858855
3.78	0.2644	-0.00162	3.15E-06	0.199528	0.619569	1.858128
3.78	0.2644	-0.00162	3.15E-06	0.199403	0.61918	1.857404
3.78	0.2644	-0.00162	3.15E-06	0.199278	0.618792	1.856684
3.78	0.2644	-0.00162	3.15E-06	0.199154	0.618406	1.855968
3.79	0.2644	-0.00162	3.15E-06	0.19903	0.618022	1.855255
3.79	0.2644	-0.00162	3.15E-06	0.198907	0.61764	1.854547
3.79	0.2644	-0.00162	3.15E-06	0.198785	0.61726	1.853842
3.79	0.2644	-0.00162	3.15E-06	0.198663	0.616882	1.853141
3.79	0.2644	-0.00162	3.15E-06	0.198542	0.616506	1.852444
3.80	0.2644	-0.00162	3.15E-06	0.198421	0.616131	1.85175
3.80	0.2644	-0.00162	3.15E-06	0.198301	0.615759	1.85106
3.80	0.2644	-0.00162	3.15E-06	0.198182	0.615388	1.850374
3.80	0.2644	-0.00162	3.15E-06	0.198063	0.615018	1.849691
3.80	0.2644	-0.00162	3.15E-06	0.197944	0.614651	1.849011
3.81	0.2644	-0.00162	3.15E-06	0.197827	0.614285	1.848335
3.81	0.2644	-0.00162	3.15E-06	0.197709	0.613921	1.847662
3.81	0.2644	-0.00162	3.15E-06	0.197593	0.613559	1.846993
3.81	0.2644	-0.00162	3.15E-06	0.197476	0.613198	1.846326
3.81	0.2644	-0.00162	3.15E-06	0.197361	0.612839	1.845664
3.82	0.2644	-0.00162	3.15E-06	0.197246	0.612481	1.845004
3.82	0.2644	-0.00162	3.15E-06	0.197131	0.612126	1.844348
3.82	0.2644	-0.00162	3.15E-06	0.197017	0.611771	1.843694
3.82	0.2644	-0.00162	3.15E-06	0.196903	0.611419	1.843044
3.82	0.2644	-0.00162	3.15E-06	0.19679	0.611068	1.842397
3.83	0.2644	-0.00162	3.15E-06	0.196678	0.610718	1.841754
3.83	0.2644	-0.00162	3.15E-06	0.196566	0.61037	1.841113
3.83	0.2644	-0.00162	3.15E-06	0.196454	0.610024	1.840475
3.83	0.2644	-0.00162	3.15E-06	0.196343	0.609679	1.83984
3.83	0.2644	-0.00162	3.15E-06	0.196232	0.609335	1.839208
3.83	0.2644	-0.00162	3.15E-06	0.196122	0.608993	1.838579
3.84	0.2644	-0.00162	3.15E-06	0.196013	0.608653	1.837953
3.84	0.2644	-0.00162	3.15E-06	0.195903	0.608314	1.83733
3.84	0.2644	-0.00162	3.15E-06	0.195795	0.607976	1.83671
3.84	0.2644	-0.00162	3.15E-06	0.195686	0.60764	1.836092
3.84	0.2644	-0.00162	3.15E-06	0.195579	0.607305	1.835478
3.85	0.2644	-0.00162	3.15E-06	0.195471	0.606971	1.834866
3.85	0.2644	-0.00162	3.15E-06	0.195364	0.606639	1.834257
3.85	0.2644	-0.00162	3.15E-06	0.195258	0.606309	1.83365
3.85	0.2644	-0.00162	3.15E-06	0.195152	0.605979	1.833046
3.85	0.2644	-0.00162	3.15E-06	0.195046	0.605651	1.832445
3.85	0.2644	-0.00162	3.15E-06	0.194941	0.605324	1.831846
3.86	0.2644	-0.00162	3.15E-06	0.194836	0.604999	1.83125

3.86	0.2644	-0.00162	3.15E-06	0.194732	0.604675	1.830657
3.86	0.2644	-0.00162	3.15E-06	0.194628	0.604352	1.830066
3.86	0.2644	-0.00162	3.15E-06	0.194524	0.604031	1.829478
3.86	0.2644	-0.00162	3.15E-06	0.194421	0.60371	1.828892
3.86	0.2644	-0.00162	3.15E-06	0.194318	0.603391	1.828309
3.87	0.2644	-0.00162	3.15E-06	0.194216	0.603074	1.827728
3.87	0.2644	-0.00162	3.15E-06	0.194114	0.602757	1.82715
3.87	0.2644	-0.00162	3.15E-06	0.194013	0.602442	1.826574
3.87	0.2644	-0.00162	3.15E-06	0.193911	0.602128	1.826
3.87	0.2644	-0.00162	3.15E-06	0.193811	0.601815	1.825429
3.87	0.2644	-0.00162	3.15E-06	0.19371	0.601503	1.82486
3.87	0.2644	-0.00162	3.15E-06	0.19361	0.601193	1.824294
3.88	0.2644	-0.00162	3.15E-06	0.193511	0.600884	1.82373
3.88	0.2644	-0.00162	3.15E-06	0.193411	0.600575	1.823168
3.88	0.2644	-0.00162	3.15E-06	0.193313	0.600268	1.822608
3.88	0.2644	-0.00162	3.15E-06	0.193214	0.599963	1.822051
3.88	0.2644	-0.00162	3.15E-06	0.193116	0.599658	1.821496
3.88	0.2644	-0.00162	3.15E-06	0.193018	0.599354	1.820943
3.89	0.2644	-0.00162	3.15E-06	0.192921	0.599052	1.820392
3.89	0.2644	-0.00162	3.15E-06	0.192824	0.59875	1.819843
3.89	0.2644	-0.00162	3.15E-06	0.192727	0.59845	1.819297
3.89	0.2644	-0.00162	3.15E-06	0.192631	0.598151	1.818753
3.89	0.2644	-0.00162	3.15E-06	0.192535	0.597853	1.818211
3.89	0.2644	-0.00162	3.15E-06	0.192439	0.597556	1.817671
3.89	0.2644	-0.00162	3.15E-06	0.192344	0.59726	1.817133
3.90	0.2644	-0.00162	3.15E-06	0.192249	0.596965	1.816597
3.90	0.2644	-0.00162	3.15E-06	0.192154	0.596671	1.816063
3.90	0.2644	-0.00162	3.15E-06	0.19206	0.596378	1.815531
3.90	0.2644	-0.00162	3.15E-06	0.191966	0.596086	1.815002
3.90	0.2644	-0.00162	3.15E-06	0.191872	0.595796	1.814474
3.90	0.2644	-0.00162	3.15E-06	0.191779	0.595506	1.813948
3.90	0.2644	-0.00162	3.15E-06	0.191686	0.595217	1.813424
3.91	0.2644	-0.00162	3.15E-06	0.191593	0.594929	1.812902
3.91	0.2644	-0.00162	3.15E-06	0.191501	0.594642	1.812383
3.91	0.2644	-0.00162	3.15E-06	0.191409	0.594356	1.811865
3.91	0.2644	-0.00162	3.15E-06	0.191317	0.594072	1.811349
3.91	0.2644	-0.00162	3.15E-06	0.191225	0.593788	1.810834
3.91	0.2644	-0.00162	3.15E-06	0.191134	0.593505	1.810322
3.91	0.2644	-0.00162	3.15E-06	0.191044	0.593223	1.809812
3.92	0.2644	-0.00162	3.15E-06	0.190953	0.592942	1.809303
3.92	0.2644	-0.00162	3.15E-06	0.190863	0.592662	1.808796
3.92	0.2644	-0.00162	3.15E-06	0.190773	0.592382	1.808291
3.92	0.2644	-0.00162	3.15E-06	0.190683	0.592104	1.807788
3.92	0.2644	-0.00162	3.15E-06	0.190594	0.591827	1.807287
3.92	0.2644	-0.00162	3.15E-06	0.190505	0.59155	1.806787
3.92	0.2644	-0.00162	3.15E-06	0.190416	0.591275	1.80629
3.93	0.2644	-0.00162	3.15E-06	0.190328	0.591	1.805794
3.93	0.2644	-0.00162	3.15E-06	0.19024	0.590726	1.805299
3.93	0.2644	-0.00162	3.15E-06	0.190152	0.590454	1.804807
3.93	0.2644	-0.00162	3.15E-06	0.190064	0.590182	1.804316

3.93	0.2644	-0.00162	3.15E-06	0.189977	0.58991	1.803827
3.93	0.2644	-0.00162	3.15E-06	0.18989	0.58964	1.803339
3.93	0.2644	-0.00162	3.15E-06	0.189803	0.589371	1.802854
3.93	0.2644	-0.00162	3.15E-06	0.189717	0.589102	1.80237
3.94	0.2644	-0.00162	3.15E-06	0.18963	0.588835	1.801887
3.94	0.2644	-0.00162	3.15E-06	0.189544	0.588568	1.801406
3.94	0.2644	-0.00162	3.15E-06	0.189459	0.588302	1.800927
3.94	0.2644	-0.00162	3.15E-06	0.189373	0.588036	1.80045
3.94	0.2644	-0.00162	3.15E-06	0.189288	0.587772	1.799974
3.94	0.2644	-0.00162	3.15E-06	0.189203	0.587508	1.799499
3.94	0.2644	-0.00162	3.15E-06	0.189119	0.587246	1.799027
3.95	0.2644	-0.00162	3.15E-06	0.189034	0.586984	1.798555
3.95	0.2644	-0.00162	3.15E-06	0.18895	0.586723	1.798086
3.95	0.2644	-0.00162	3.15E-06	0.188866	0.586462	1.797618
3.95	0.2644	-0.00162	3.15E-06	0.188783	0.586203	1.797151
3.95	0.2644	-0.00162	3.15E-06	0.188699	0.585944	1.796686
3.95	0.2644	-0.00162	3.15E-06	0.188616	0.585686	1.796222
3.95	0.2644	-0.00162	3.15E-06	0.188533	0.585429	1.79576
3.95	0.2644	-0.00162	3.15E-06	0.188451	0.585172	1.7953
3.96	0.2644	-0.00162	3.15E-06	0.188369	0.584916	1.794841
3.96	0.2644	-0.00162	3.15E-06	0.188286	0.584661	1.794383
3.96	0.2644	-0.00162	3.15E-06	0.188205	0.584407	1.793927
3.96	0.2644	-0.00162	3.15E-06	0.188123	0.584154	1.793473
3.96	0.2644	-0.00162	3.15E-06	0.188042	0.583901	1.793019
3.96	0.2644	-0.00162	3.15E-06	0.18796	0.583649	1.792568
3.96	0.2644	-0.00162	3.15E-06	0.187879	0.583398	1.792117
3.96	0.2644	-0.00162	3.15E-06	0.187799	0.583147	1.791668
3.96	0.2644	-0.00162	3.15E-06	0.187718	0.582897	1.791221
3.97	0.2644	-0.00162	3.15E-06	0.187638	0.582648	1.790775
3.97	0.2644	-0.00162	3.15E-06	0.187558	0.5824	1.79033
3.97	0.2644	-0.00162	3.15E-06	0.187478	0.582152	1.789887
3.97	0.2644	-0.00162	3.15E-06	0.187399	0.581905	1.789445
3.97	0.2644	-0.00162	3.15E-06	0.18732	0.581659	1.789004
3.97	0.2644	-0.00162	3.15E-06	0.18724	0.581413	1.788565
3.97	0.2644	-0.00162	3.15E-06	0.187162	0.581169	1.788127
3.97	0.2644	-0.00162	3.15E-06	0.187083	0.580924	1.78769
3.98	0.2644	-0.00162	3.15E-06	0.187005	0.580681	1.787255
3.98	0.2644	-0.00162	3.15E-06	0.186926	0.580438	1.786821
3.98	0.2644	-0.00162	3.15E-06	0.186848	0.580196	1.786388
3.98	0.2644	-0.00162	3.15E-06	0.186771	0.579954	1.785957
3.98	0.2644	-0.00162	3.15E-06	0.186693	0.579714	1.785527
3.98	0.2644	-0.00162	3.15E-06	0.186616	0.579473	1.785098
3.98	0.2644	-0.00162	3.15E-06	0.186539	0.579234	1.784671
3.98	0.2644	-0.00162	3.15E-06	0.186462	0.578995	1.784244
3.98	0.2644	-0.00162	3.15E-06	0.186385	0.578757	1.783819
3.99	0.2644	-0.00162	3.15E-06	0.186308	0.578519	1.783396
3.99	0.2644	-0.00162	3.15E-06	0.186232	0.578282	1.782973
3.99	0.2644	-0.00162	3.15E-06	0.186156	0.578046	1.782552
3.99	0.2644	-0.00162	3.15E-06	0.18608	0.57781	1.782132
3.99	0.2644	-0.00162	3.15E-06	0.186004	0.577575	1.781713

3.99	0.2644	-0.00162	3.15E-06	0.185929	0.577341	1.781296
3.99	0.2644	-0.00162	3.15E-06	0.185854	0.577107	1.780879
3.99	0.2644	-0.00162	3.15E-06	0.185779	0.576874	1.780464
3.99	0.2644	-0.00162	3.15E-06	0.185704	0.576642	1.78005
4.00	0.2644	-0.00162	3.15E-06	0.185629	0.57641	1.779637
4.00	0.2644	-0.00162	3.15E-06	0.185555	0.576178	1.779226
4.00	0.2644	-0.00162	3.15E-06	0.18548	0.575948	1.778815
4.00	0.2644	-0.00162	3.15E-06	0.185406	0.575718	1.778406
4.00	0.2644	-0.00162	3.15E-06	0.185332	0.575488	1.777998
4.00	0.2644	-0.00162	3.15E-06	0.185258	0.575259	1.777591
4.00	0.2644	-0.00162	3.15E-06	0.185185	0.575031	1.777185
4.00	0.2644	-0.00162	3.15E-06	0.185112	0.574803	1.77678
4.00	0.2644	-0.00162	3.15E-06	0.185038	0.574576	1.776377
4.00	0.2644	-0.00162	3.15E-06	0.184965	0.574349	1.775974
4.01	0.2644	-0.00162	3.15E-06	0.184893	0.574123	1.775573
4.01	0.2644	-0.00162	3.15E-06	0.18482	0.573898	1.775173
4.01	0.2644	-0.00162	3.15E-06	0.184748	0.573673	1.774774
4.01	0.2644	-0.00162	3.15E-06	0.184675	0.573449	1.774376
4.01	0.2644	-0.00162	3.15E-06	0.184603	0.573225	1.773979
4.01	0.2644	-0.00162	3.15E-06	0.184532	0.573002	1.773583
4.01	0.2644	-0.00162	3.15E-06	0.18446	0.572779	1.773188
4.01	0.2644	-0.00162	3.15E-06	0.184388	0.572557	1.772794
4.01	0.2644	-0.00162	3.15E-06	0.184317	0.572336	1.772402
4.01	0.2644	-0.00162	3.15E-06	0.184246	0.572115	1.77201
4.02	0.2644	-0.00162	3.15E-06	0.184175	0.571894	1.77162
4.02	0.2644	-0.00162	3.15E-06	0.184104	0.571674	1.77123
4.02	0.2644	-0.00162	3.15E-06	0.184033	0.571455	1.770842
4.02	0.2644	-0.00162	3.15E-06	0.183963	0.571236	1.770454
4.02	0.2644	-0.00162	3.15E-06	0.183893	0.571018	1.770068
4.02	0.2644	-0.00162	3.15E-06	0.183823	0.5708	1.769683
4.02	0.2644	-0.00162	3.15E-06	0.183753	0.570583	1.769298
4.02	0.2644	-0.00162	3.15E-06	0.183683	0.570366	1.768915
4.02	0.2644	-0.00162	3.15E-06	0.183613	0.57015	1.768533
4.02	0.2644	-0.00162	3.15E-06	0.183544	0.569935	1.768151
4.03	0.2644	-0.00162	3.15E-06	0.183474	0.569719	1.767771
4.03	0.2644	-0.00162	3.15E-06	0.183405	0.569505	1.767392
4.03	0.2644	-0.00162	3.15E-06	0.183336	0.569291	1.767013
4.03	0.2644	-0.00162	3.15E-06	0.183268	0.569077	1.766636
4.03	0.2644	-0.00162	3.15E-06	0.183199	0.568864	1.76626
4.03	0.2644	-0.00162	3.15E-06	0.183131	0.568651	1.765884
4.03	0.2644	-0.00162	3.15E-06	0.183062	0.568439	1.76551
4.03	0.2644	-0.00162	3.15E-06	0.182994	0.568228	1.765136
4.03	0.2644	-0.00162	3.15E-06	0.182926	0.568017	1.764764
4.03	0.2644	-0.00162	3.15E-06	0.182858	0.567806	1.764392
4.04	0.2644	-0.00162	3.15E-06	0.182791	0.567596	1.764021
4.04	0.2644	-0.00162	3.15E-06	0.182723	0.567386	1.763652
4.04	0.2644	-0.00162	3.15E-06	0.182656	0.567177	1.763283
4.04	0.2644	-0.00162	3.15E-06	0.182589	0.566969	1.762915
4.04	0.2644	-0.00162	3.15E-06	0.182522	0.56676	1.762548
4.04	0.2644	-0.00162	3.15E-06	0.182455	0.566553	1.762182

4.04	0.2644	-0.00162	3.15E-06	0.182388	0.566346	1.761817
4.04	0.2644	-0.00162	3.15E-06	0.182321	0.566139	1.761453
4.04	0.2644	-0.00162	3.15E-06	0.182255	0.565932	1.761089
4.04	0.2644	-0.00162	3.15E-06	0.182189	0.565727	1.760727
4.04	0.2644	-0.00162	3.15E-06	0.182122	0.565521	1.760365
4.05	0.2644	-0.00162	3.15E-06	0.182057	0.565316	1.760005
4.05	0.2644	-0.00162	3.15E-06	0.181991	0.565112	1.759645
4.05	0.2644	-0.00162	3.15E-06	0.181925	0.564908	1.759286
4.05	0.2644	-0.00162	3.15E-06	0.181859	0.564705	1.758928
4.05	0.2644	-0.00162	3.15E-06	0.181794	0.564502	1.758571
4.05	0.2644	-0.00162	3.15E-06	0.181729	0.564299	1.758215
4.05	0.2644	-0.00162	3.15E-06	0.181664	0.564097	1.757859
4.05	0.2644	-0.00162	3.15E-06	0.181599	0.563895	1.757505
4.05	0.2644	-0.00162	3.15E-06	0.181534	0.563694	1.757151
4.05	0.2644	-0.00162	3.15E-06	0.181469	0.563493	1.756798
4.05	0.2644	-0.00162	3.15E-06	0.181405	0.563293	1.756446
4.06	0.2644	-0.00162	3.15E-06	0.18134	0.563093	1.756095
4.06	0.2644	-0.00162	3.15E-06	0.181276	0.562893	1.755745
4.06	0.2644	-0.00162	3.15E-06	0.181212	0.562694	1.755395
4.06	0.2644	-0.00162	3.15E-06	0.181148	0.562495	1.755047
4.06	0.2644	-0.00162	3.15E-06	0.181084	0.562297	1.754699
4.06	0.2644	-0.00162	3.15E-06	0.181021	0.562099	1.754352
4.06	0.2644	-0.00162	3.15E-06	0.180957	0.561902	1.754006
4.06	0.2644	-0.00162	3.15E-06	0.180894	0.561705	1.75366
4.06	0.2644	-0.00162	3.15E-06	0.18083	0.561509	1.753316
4.06	0.2644	-0.00162	3.15E-06	0.180767	0.561313	1.752972
4.06	0.2644	-0.00162	3.15E-06	0.180704	0.561117	1.752629
4.07	0.2644	-0.00162	3.15E-06	0.180641	0.560922	1.752287
4.07	0.2644	-0.00162	3.15E-06	0.180578	0.560727	1.751945
4.07	0.2644	-0.00162	3.15E-06	0.180516	0.560532	1.751605
4.07	0.2644	-0.00162	3.15E-06	0.180453	0.560338	1.751265
4.07	0.2644	-0.00162	3.15E-06	0.180391	0.560145	1.750926
4.07	0.2644	-0.00162	3.15E-06	0.180329	0.559952	1.750588
4.07	0.2644	-0.00162	3.15E-06	0.180267	0.559759	1.75025
4.07	0.2644	-0.00162	3.15E-06	0.180205	0.559566	1.749914
4.07	0.2644	-0.00162	3.15E-06	0.180143	0.559374	1.749578
4.07	0.2644	-0.00162	3.15E-06	0.180081	0.559183	1.749242
4.07	0.2644	-0.00162	3.15E-06	0.18002	0.558992	1.748908
4.07	0.2644	-0.00162	3.15E-06	0.179958	0.558801	1.748574
4.08	0.2644	-0.00162	3.15E-06	0.179897	0.55861	1.748241
4.08	0.2644	-0.00162	3.15E-06	0.179836	0.55842	1.747909
4.08	0.2644	-0.00162	3.15E-06	0.179775	0.558231	1.747578
4.08	0.2644	-0.00162	3.15E-06	0.179714	0.558042	1.747247
4.08	0.2644	-0.00162	3.15E-06	0.179653	0.557853	1.746917
4.08	0.2644	-0.00162	3.15E-06	0.179592	0.557664	1.746588
4.08	0.2644	-0.00162	3.15E-06	0.179532	0.557476	1.74626
4.08	0.2644	-0.00162	3.15E-06	0.179471	0.557288	1.745932
4.08	0.2644	-0.00162	3.15E-06	0.179411	0.557101	1.745605
4.08	0.2644	-0.00162	3.15E-06	0.179351	0.556914	1.745278
4.08	0.2644	-0.00162	3.15E-06	0.179291	0.556728	1.744953

4.08	0.2644	-0.00162	3.15E-06	0.179231	0.556541	1.744628
4.09	0.2644	-0.00162	3.15E-06	0.179171	0.556356	1.744304
4.09	0.2644	-0.00162	3.15E-06	0.179111	0.55617	1.74398
4.09	0.2644	-0.00162	3.15E-06	0.179051	0.555985	1.743658
4.09	0.2644	-0.00162	3.15E-06	0.178992	0.5558	1.743336
4.09	0.2644	-0.00162	3.15E-06	0.178933	0.555616	1.743014
4.09	0.2644	-0.00162	3.15E-06	0.178873	0.555432	1.742694
4.09	0.2644	-0.00162	3.15E-06	0.178814	0.555248	1.742374
4.09	0.2644	-0.00162	3.15E-06	0.178755	0.555065	1.742054
4.09	0.2644	-0.00162	3.15E-06	0.178696	0.554882	1.741736
4.09	0.2644	-0.00162	3.15E-06	0.178637	0.5547	1.741418
4.09	0.2644	-0.00162	3.15E-06	0.178579	0.554517	1.7411
4.09	0.2644	-0.00162	3.15E-06	0.17852	0.554336	1.740784
4.09	0.2644	-0.00162	3.15E-06	0.178462	0.554154	1.740468
4.10	0.2644	-0.00162	3.15E-06	0.178403	0.553973	1.740153
4.10	0.2644	-0.00162	3.15E-06	0.178345	0.553792	1.739838
4.10	0.2644	-0.00162	3.15E-06	0.178287	0.553612	1.739524
4.10	0.2644	-0.00162	3.15E-06	0.178229	0.553432	1.739211
4.10	0.2644	-0.00162	3.15E-06	0.178171	0.553252	1.738899
4.10	0.2644	-0.00162	3.15E-06	0.178113	0.553072	1.738587
4.10	0.2644	-0.00162	3.15E-06	0.178056	0.552893	1.738275
4.10	0.2644	-0.00162	3.15E-06	0.177998	0.552715	1.737965
4.10	0.2644	-0.00162	3.15E-06	0.177941	0.552536	1.737655
4.10	0.2644	-0.00162	3.15E-06	0.177883	0.552358	1.737345
4.10	0.2644	-0.00162	3.15E-06	0.177826	0.552181	1.737037
4.10	0.2644	-0.00162	3.15E-06	0.177769	0.552003	1.736729
4.10	0.2644	-0.00162	3.15E-06	0.177712	0.551826	1.736421
4.11	0.2644	-0.00162	3.15E-06	0.177655	0.55165	1.736115
4.11	0.2644	-0.00162	3.15E-06	0.177598	0.551473	1.735808
4.11	0.2644	-0.00162	3.15E-06	0.177542	0.551297	1.735503
4.11	0.2644	-0.00162	3.15E-06	0.177485	0.551121	1.735198
4.11	0.2644	-0.00162	3.15E-06	0.177429	0.550946	1.734894
4.11	0.2644	-0.00162	3.15E-06	0.177372	0.550771	1.73459
4.11	0.2644	-0.00162	3.15E-06	0.177316	0.550596	1.734287
4.11	0.2644	-0.00162	3.15E-06	0.17726	0.550422	1.733985
4.11	0.2644	-0.00162	3.15E-06	0.177204	0.550248	1.733683
4.11	0.2644	-0.00162	3.15E-06	0.177148	0.550074	1.733382
4.11	0.2644	-0.00162	3.15E-06	0.177092	0.549901	1.733081
4.11	0.2644	-0.00162	3.15E-06	0.177036	0.549728	1.732781
4.11	0.2644	-0.00162	3.15E-06	0.176981	0.549555	1.732482
4.12	0.2644	-0.00162	3.15E-06	0.176925	0.549382	1.732183
4.12	0.2644	-0.00162	3.15E-06	0.17687	0.54921	1.731885
4.12	0.2644	-0.00162	3.15E-06	0.176814	0.549038	1.731587
4.12	0.2644	-0.00162	3.15E-06	0.176759	0.548867	1.73129
4.12	0.2644	-0.00162	3.15E-06	0.176704	0.548696	1.730994
4.12	0.2644	-0.00162	3.15E-06	0.176649	0.548525	1.730698
4.12	0.2644	-0.00162	3.15E-06	0.176594	0.548354	1.730402
4.12	0.2644	-0.00162	3.15E-06	0.176539	0.548184	1.730108
4.12	0.2644	-0.00162	3.15E-06	0.176484	0.548014	1.729814
4.12	0.2644	-0.00162	3.15E-06	0.17643	0.547844	1.72952

4.12	0.2644	-0.00162	3.15E-06	0.176375	0.547675	1.729227
4.12	0.2644	-0.00162	3.15E-06	0.176321	0.547506	1.728935
4.12	0.2644	-0.00162	3.15E-06	0.176266	0.547337	1.728643
4.12	0.2644	-0.00162	3.15E-06	0.176212	0.547168	1.728352
4.13	0.2644	-0.00162	3.15E-06	0.176158	0.547	1.728061
4.13	0.2644	-0.00162	3.15E-06	0.176104	0.546832	1.727771
4.13	0.2644	-0.00162	3.15E-06	0.17605	0.546665	1.727481
4.13	0.2644	-0.00162	3.15E-06	0.175996	0.546497	1.727192
4.13	0.2644	-0.00162	3.15E-06	0.175942	0.54633	1.726904
4.13	0.2644	-0.00162	3.15E-06	0.175888	0.546164	1.726616
4.13	0.2644	-0.00162	3.15E-06	0.175835	0.545997	1.726329
4.13	0.2644	-0.00162	3.15E-06	0.175781	0.545831	1.726042
4.13	0.2644	-0.00162	3.15E-06	0.175728	0.545665	1.725756
4.13	0.2644	-0.00162	3.15E-06	0.175675	0.5455	1.72547
4.13	0.2644	-0.00162	3.15E-06	0.175621	0.545334	1.725185
4.13	0.2644	-0.00162	3.15E-06	0.175568	0.545169	1.7249
4.13	0.2644	-0.00162	3.15E-06	0.175515	0.545005	1.724616
4.13	0.2644	-0.00162	3.15E-06	0.175462	0.54484	1.724333
4.13	0.2644	-0.00162	3.15E-06	0.175409	0.544676	1.72405
4.14	0.2644	-0.00162	3.15E-06	0.175357	0.544512	1.723767
4.14	0.2644	-0.00162	3.15E-06	0.175304	0.544349	1.723485
4.14	0.2644	-0.00162	3.15E-06	0.175251	0.544185	1.723204
4.14	0.2644	-0.00162	3.15E-06	0.175199	0.544022	1.722923
4.14	0.2644	-0.00162	3.15E-06	0.175146	0.54386	1.722643
4.14	0.2644	-0.00162	3.15E-06	0.175094	0.543697	1.722363
4.14	0.2644	-0.00162	3.15E-06	0.175042	0.543535	1.722084
4.14	0.2644	-0.00162	3.15E-06	0.17499	0.543373	1.721805
4.14	0.2644	-0.00162	3.15E-06	0.174938	0.543211	1.721527
4.14	0.2644	-0.00162	3.15E-06	0.174886	0.54305	1.721249
4.14	0.2644	-0.00162	3.15E-06	0.174834	0.542889	1.720972
4.14	0.2644	-0.00162	3.15E-06	0.174782	0.542728	1.720695
4.14	0.2644	-0.00162	3.15E-06	0.17473	0.542568	1.720419
4.14	0.2644	-0.00162	3.15E-06	0.174679	0.542407	1.720143
4.15	0.2644	-0.00162	3.15E-06	0.174627	0.542247	1.719868
4.15	0.2644	-0.00162	3.15E-06	0.174576	0.542088	1.719593
4.15	0.2644	-0.00162	3.15E-06	0.174524	0.541928	1.719319
4.15	0.2644	-0.00162	3.15E-06	0.174473	0.541769	1.719045
4.15	0.2644	-0.00162	3.15E-06	0.174422	0.54161	1.718772
4.15	0.2644	-0.00162	3.15E-06	0.174371	0.541451	1.718499
4.15	0.2644	-0.00162	3.15E-06	0.17432	0.541293	1.718227
4.15	0.2644	-0.00162	3.15E-06	0.174269	0.541135	1.717955
4.15	0.2644	-0.00162	3.15E-06	0.174218	0.540977	1.717684
4.15	0.2644	-0.00162	3.15E-06	0.174167	0.540819	1.717413
4.15	0.2644	-0.00162	3.15E-06	0.174117	0.540662	1.717143
4.15	0.2644	-0.00162	3.15E-06	0.174066	0.540505	1.716873
4.15	0.2644	-0.00162	3.15E-06	0.174016	0.540348	1.716604
4.15	0.2644	-0.00162	3.15E-06	0.173965	0.540191	1.716335
4.15	0.2644	-0.00162	3.15E-06	0.173915	0.540035	1.716067
4.15	0.2644	-0.00162	3.15E-06	0.173864	0.539879	1.715799
4.16	0.2644	-0.00162	3.15E-06	0.173814	0.539723	1.715531

4.16	0.2644	-0.00162	3.15E-06	0.173764	0.539567	1.715264
4.16	0.2644	-0.00162	3.15E-06	0.173714	0.539412	1.714998
4.16	0.2644	-0.00162	3.15E-06	0.173664	0.539257	1.714732
4.16	0.2644	-0.00162	3.15E-06	0.173614	0.539102	1.714466
4.16	0.2644	-0.00162	3.15E-06	0.173565	0.538947	1.714201
4.16	0.2644	-0.00162	3.15E-06	0.173515	0.538793	1.713937
4.16	0.2644	-0.00162	3.15E-06	0.173465	0.538639	1.713673
4.16	0.2644	-0.00162	3.15E-06	0.173416	0.538485	1.713409
4.16	0.2644	-0.00162	3.15E-06	0.173366	0.538331	1.713146
4.16	0.2644	-0.00162	3.15E-06	0.173317	0.538178	1.712883
4.16	0.2644	-0.00162	3.15E-06	0.173267	0.538025	1.712621
4.16	0.2644	-0.00162	3.15E-06	0.173218	0.537872	1.712359
4.16	0.2644	-0.00162	3.15E-06	0.173169	0.537719	1.712098
4.16	0.2644	-0.00162	3.15E-06	0.17312	0.537567	1.711837
4.17	0.2644	-0.00162	3.15E-06	0.173071	0.537415	1.711576
4.17	0.2644	-0.00162	3.15E-06	0.173022	0.537263	1.711316
4.17	0.2644	-0.00162	3.15E-06	0.172973	0.537111	1.711057
4.17	0.2644	-0.00162	3.15E-06	0.172924	0.53696	1.710797
4.17	0.2644	-0.00162	3.15E-06	0.172876	0.536808	1.710539
4.17	0.2644	-0.00162	3.15E-06	0.172827	0.536657	1.710281
4.17	0.2644	-0.00162	3.15E-06	0.172779	0.536507	1.710023
4.17	0.2644	-0.00162	3.15E-06	0.17273	0.536356	1.709765
4.17	0.2644	-0.00162	3.15E-06	0.172682	0.536206	1.709508
4.17	0.2644	-0.00162	3.15E-06	0.172633	0.536056	1.709252
4.17	0.2644	-0.00162	3.15E-06	0.172585	0.535906	1.708996
4.17	0.2644	-0.00162	3.15E-06	0.172537	0.535756	1.70874
4.17	0.2644	-0.00162	3.15E-06	0.172489	0.535607	1.708485
4.17	0.2644	-0.00162	3.15E-06	0.172441	0.535458	1.70823
4.17	0.2644	-0.00162	3.15E-06	0.172393	0.535309	1.707976
4.17	0.2644	-0.00162	3.15E-06	0.172345	0.53516	1.707722
4.17	0.2644	-0.00162	3.15E-06	0.172297	0.535012	1.707468
4.18	0.2644	-0.00162	3.15E-06	0.172249	0.534864	1.707215
4.18	0.2644	-0.00162	3.15E-06	0.172202	0.534716	1.706963
4.18	0.2644	-0.00162	3.15E-06	0.172154	0.534568	1.706711
4.18	0.2644	-0.00162	3.15E-06	0.172107	0.53442	1.706459
4.18	0.2644	-0.00162	3.15E-06	0.172059	0.534273	1.706207
4.18	0.2644	-0.00162	3.15E-06	0.172012	0.534126	1.705956
4.18	0.2644	-0.00162	3.15E-06	0.171964	0.533979	1.705706
4.18	0.2644	-0.00162	3.15E-06	0.171917	0.533832	1.705456
4.18	0.2644	-0.00162	3.15E-06	0.17187	0.533686	1.705206
4.18	0.2644	-0.00162	3.15E-06	0.171823	0.53354	1.704957
4.18	0.2644	-0.00162	3.15E-06	0.171776	0.533394	1.704708
4.18	0.2644	-0.00162	3.15E-06	0.171729	0.533248	1.704459
4.18	0.2644	-0.00162	3.15E-06	0.171682	0.533102	1.704211
4.18	0.2644	-0.00162	3.15E-06	0.171635	0.532957	1.703963
4.18	0.2644	-0.00162	3.15E-06	0.171589	0.532812	1.703716
4.18	0.2644	-0.00162	3.15E-06	0.171542	0.532667	1.703469
4.19	0.2644	-0.00162	3.15E-06	0.171495	0.532522	1.703223
4.19	0.2644	-0.00162	3.15E-06	0.171449	0.532378	1.702977
4.19	0.2644	-0.00162	3.15E-06	0.171402	0.532233	1.702731

4.19	0.2644	-0.00162	3.15E-06	0.171356	0.532089	1.702486
4.19	0.2644	-0.00162	3.15E-06	0.17131	0.531945	1.702241
4.19	0.2644	-0.00162	3.15E-06	0.171263	0.531802	1.701996
4.19	0.2644	-0.00162	3.15E-06	0.171217	0.531658	1.701752
4.19	0.2644	-0.00162	3.15E-06	0.171171	0.531515	1.701508
4.19	0.2644	-0.00162	3.15E-06	0.171125	0.531372	1.701265
4.19	0.2644	-0.00162	3.15E-06	0.171079	0.531229	1.701022
4.19	0.2644	-0.00162	3.15E-06	0.171033	0.531087	1.70078
4.19	0.2644	-0.00162	3.15E-06	0.170987	0.530944	1.700537
4.19	0.2644	-0.00162	3.15E-06	0.170941	0.530802	1.700296
4.19	0.2644	-0.00162	3.15E-06	0.170896	0.53066	1.700054
4.19	0.2644	-0.00162	3.15E-06	0.17085	0.530518	1.699813
4.19	0.2644	-0.00162	3.15E-06	0.170804	0.530377	1.699573
4.19	0.2644	-0.00162	3.15E-06	0.170759	0.530236	1.699332
4.19	0.2644	-0.00162	3.15E-06	0.170713	0.530094	1.699093
4.20	0.2644	-0.00162	3.15E-06	0.170668	0.529953	1.698853
4.20	0.2644	-0.00162	3.15E-06	0.170623	0.529813	1.698614
4.20	0.2644	-0.00162	3.15E-06	0.170577	0.529672	1.698375
4.20	0.2644	-0.00162	3.15E-06	0.170532	0.529532	1.698137
4.20	0.2644	-0.00162	3.15E-06	0.170487	0.529392	1.697899
4.20	0.2644	-0.00162	3.15E-06	0.170442	0.529252	1.697661
4.20	0.2644	-0.00162	3.15E-06	0.170397	0.529112	1.697424
4.20	0.2644	-0.00162	3.15E-06	0.170352	0.528972	1.697187
4.20	0.2644	-0.00162	3.15E-06	0.170307	0.528833	1.696951
4.20	0.2644	-0.00162	3.15E-06	0.170262	0.528694	1.696715
4.20	0.2644	-0.00162	3.15E-06	0.170218	0.528555	1.696479
4.20	0.2644	-0.00162	3.15E-06	0.170173	0.528416	1.696243
4.20	0.2644	-0.00162	3.15E-06	0.170128	0.528277	1.696008
4.20	0.2644	-0.00162	3.15E-06	0.170084	0.528139	1.695774
4.20	0.2644	-0.00162	3.15E-06	0.170039	0.528001	1.695539
4.20	0.2644	-0.00162	3.15E-06	0.169995	0.527863	1.695305
4.20	0.2644	-0.00162	3.15E-06	0.16995	0.527725	1.695072
4.21	0.2644	-0.00162	3.15E-06	0.169906	0.527587	1.694839
4.21	0.2644	-0.00162	3.15E-06	0.169862	0.52745	1.694606
4.21	0.2644	-0.00162	3.15E-06	0.169818	0.527313	1.694373
4.21	0.2644	-0.00162	3.15E-06	0.169774	0.527176	1.694141

Location Index	
England and Wales	1
Scotland and Ireland	2

From Design and Analysis of Urban Storm Drainage, The Wallingford Procedure, Vol 1

Table 6.1 Values of Constants to calculate Cr

Geographic Location	Range of M5-D	Location Index	J0	J1	J2
England and Wales	0-10	1	0.1699	0.0028	0.000114
	11-30		0.1644	0.005831	-0.00013
	31-75		0.2644	-0.00162	3.15E-06
	76-150		0.2718	-0.00195	6.19E-06
	>150		0.1454	-0.00019	1.14E-07

APPENDIX 11

SuDS TREATMENT TRAIN - HYDRO INTERNATIONAL UP-FLO FILTER AND DOWNSTREAM DEFENDER DATA

Design Data

Up-Flo™ Filter

Fluidised Bed Up Flow Filtration System

The Up-Flo™ Filter is an innovative surface water filtration technology that delivers a high performance multi-stage treatment train within a single device. The Up-Flo™ Filter combines sedimentation and screening with fluidised bed filtration technology to deliver high levels of performance.

1. Inlet pipe
2. Media pack.
3. Sump.
4. Bypass siphon with floatables baffle
5. Outlet module with integral drain down port.
6. Filter module.
7. Outlet pipe.
8. Angled screen

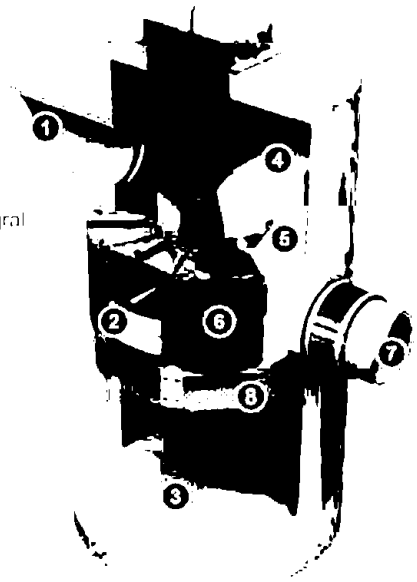


Figure 1 - The Up-Flo™ Fluidised Bed Up Flow Filtration System

Components and Filter Media

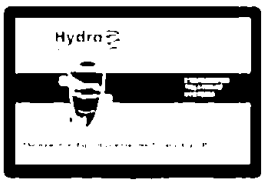
The Up-Flo™ Filter packs a 4-5 stage treatment train into a single device that can be fitted into a standard manhole. Settleable solids are collected in the chamber sump, whilst floatable material gathers in the central chamber.

An angled 4 mm perforated screen prevents coarse material from reaching the filter media. The media itself can be tailored to target specific pollutant groups and, where required, promote reactive filtration. The fluidised bed technology prevents blinding, clogging and compaction of the media surface, whilst ensuring that no wormholes can form to short-circuit the treatment process.

Filter media options include:

Filter Sand:
A good all-round media to target sediment and sediment-bound pollutants.

CPZ™ Mix:
An engineered media to promote reactive filtration for enhanced treatment of metals, nutrients and organics.



Watch a short video showing the Up-Flo™ Filter operation at:

http://www.hydro-int.com/uk/products/flo-filter

Repeatable, Reliable Performance

The Up-Flo™ Filter combines multiple sequential treatment processes to deliver sedimentation, screening and filtration all in one compact unit to remove a wide variety of pollutants including:

Very Fine Particles

Greater than 80% removal of fine sand and silt particles to a mass-median particle size of 22 µm

See Technical Abstract: Performance Verification of Sediment Removal with Sil-Co-Sil 106 for your media of choice.

Gross Pollutants

Inclusion of the angled screen and protected bypass syphon effectively removes gross pollutants, including litter and leaf debris.

Liquid and Sediment Bound Hydrocarbons

Removal of various forms of hydrocarbons, including polycyclic aromatic hydrocarbons (PAHs).

Heavy Metals

Heavy Metals

Greater than 70% removal of metals commonly found in surface water runoff.

See Technical Abstract: Field Evaluation of Metals Removal

Nutrients

Nutrients

Greater then 70% removal of phosphorus and other nutrients.

See Technical Abstract: Field Evaluation of Phosphorus Removal.

StormTrain® Series
Stormwater Hotline: 01275 337937
stormwater@hydro-int.com
hydro-int.com

Design Data
Up-Flo™ Filter
Fluidised Bed Up Flow Filtration System

Sizing

The modular design of the Up-Flo™ Filter ensures that project specific treatment goals are easily met. Intended for intercepting pollutants at or close to source, the modular components are standardised for installation into a standard 1.2 m diameter manhole. For larger catchment areas, custom built vaults can be created to accommodate additional filter modules.

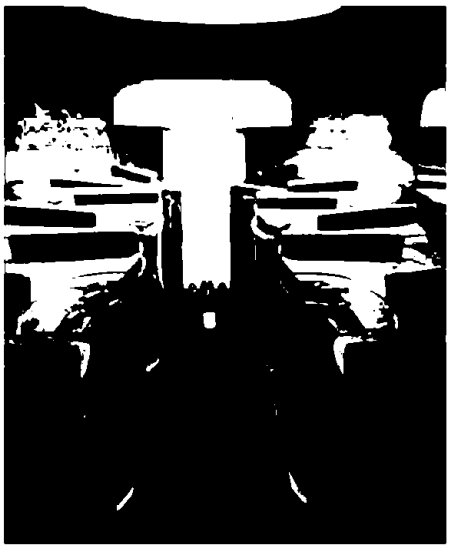
For design purposes, the selected number of modules required should be such that the total Treatment Flow Rate is greater or equal to the site's Water Quality Flow Rate.

The hydraulic capacity of the system should be considered with respect to the peak discharge flow rate from the site or pipe full flow rate.

Model	Chamber Size (m)	Number of Filter Modules	Treatment Flow Rate (l/s) [a]	Hydraulic Capacity (l/s) [b]	Operating Head (mm) [c]	Oil Storage Capacity (l)	Sediment Storage Capacity (m^3)
Manhole	1.2 m diameter	1-6	1.3 - 7.8	170	750	190	0.7
Vault	Site specific	7-19	7.8 - 24.7	170	750	Site specific	Site specific

Notes:
a) Treatment flow rates based on >80% removal of Sil-Co-Sil 106 fine sand and silt (D_{50} = 22 µm).
b) Maximum flow rate that can pass through the chamber without surcharge to the upstream network.
c) Driving head for filter media.

Table 1 - Up-Flo™ Filter design information.



Expert Design Service

Hydro's professional engineers are on hand to provide free support with the correct sizing and application of the Up-Flo™ Filter within in each drainage design.

We can also provide estimated maintenance intervals, whole life cost estimates and predicted pollutant removal performance.

Call the StormTrain® Hotline on: 01275 337955 or email stormtrain@hydro-int.com

StormTrain® Series
Stormwater Hotline: 01275 337937
stormwater@hydro-int.com

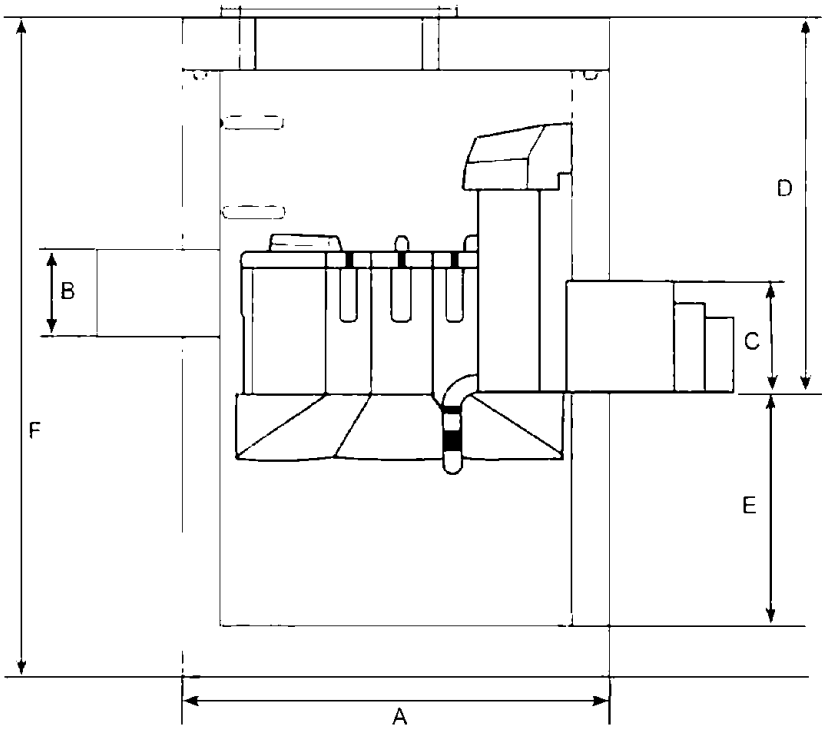
Easy Installation for Trouble-free Construction

The Up-Flo™ Filter is typically delivered to site as a pre-cast concrete manhole, complete with innovative manhole sealing system and internal components already installed. Installation is therefore similar to any other manhole installation on site.

The relative position of the filter modules and the inlet / outlet pipes can be adjusted to suit site conditions.

The outlet adapter allows a variety of different outlet pipe sizes to be easily connected (see Table 2).

Full installation guidelines are available.



Dimensions and Weights

The dimensions in Table 2 are given as a guide for standard manhole configurations. Vault configurations are site specific.

Detailed general arrangement drawings are available for download from http://www.hydro-int.com/uk/products/flo-filter

Unit	External Diameter of Unit (mm) (A)	Inlet Pipe Diameter (mm) [c] (B)	Outlet Pipe Diameter (mm) [c] (C)	Depth (m) Depth to Outlet Invert (m BGL) (D)	Depth (m) Sump Depth (m) (E)	Depth (m) Component Depth [a] (m) (F)	Lift Weight (t)
1.2 m Sealed Manhole System with HD Cover Slab	1460	300	225-375	1.150	1.100	2.560	n/a
HD Cover Slab [b]						0.230	0.60
Base Section						1.145	1.85
Top Section						1.330	1.60

Notes:
a) Base and Top Section component depths are shown as the total height during transportation / before assembly on site. The total depth is the depth of the assembled unit.
b) Cover slabs are heavy duty, suited for highways loading and are supplied with one or two access openings for maintenance.
c) Stub pipes are provided.

Table 2 - Up-Flo™ Filter dimensions and weights.

Simple and Cost-effective Maintenance

The gentle and effective action of the Up-Flo™ Filter ensures the filtration media have a much longer life than comparable media filters, so maintenance is infrequent, cost-effective and simple, with just three easy steps:

1) Floatable debris and litter is skimmed from the water surface.
2) Sediment collected in the sump is removed with a standard vacuum tanker.
3) Filter media packs are exchanged with no specialist lifting or handling equipment required.

Up-Flo™ Filter Technical Guidance

Case Studies

Installation and Maintenance Guidelines

General Arrangement Drawings

The Hydro StormTrain® Series of Surface Water Treatment Devices

The Up-Flo™ Filter is one of the Hydro StormTrain® Series of surface water treatment devices. Each device delivers proven, measureable and repeatable surface water treatment performance. Each can be used independently to meet the specific needs of a site or combined to form a management train. They can be used alongside natural SuDS features to protect, enable or enhance them.

First Defense®
Vortex Separator

Downstream Defender®
Advanced Hydrodynamic Vortex Separator

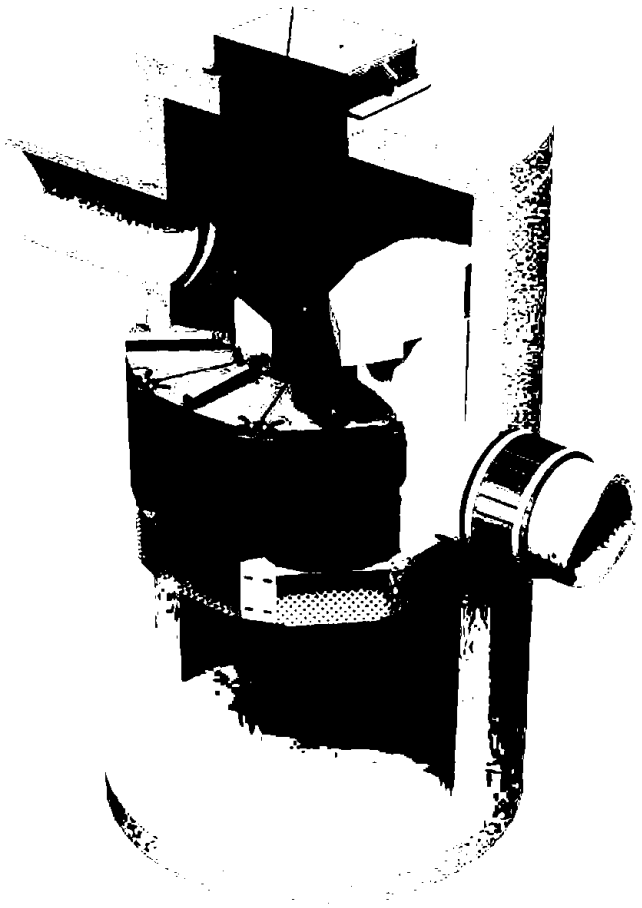
Up-Flo™ Filter
Fluidised Bed Up Flow Filtration System

Hydro Biofilter™
Biofiltration System

Patent: www.hydro-int.com/patents

Tel:+44 (0)1275 337 937 stormwater@hydro-int.com
Hydro International
Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD
hydro-int.com

Hydro International



Up-Flo™ Filter
Operation & Maintenance Manual

Site Name: .....

Location on Site: .....

Hydro International Ref No: .....

DISCLAIMER: Information and data contained in this manual is exclusively for the purpose of assisting in the operation and maintenance of Hydro International's Up-Flo™ Filter. No warranty is given nor can liability be accepted for use of this information for any other purpose. Hydro International have a policy of continuous product development and reserve the right to amend specifications without notice.

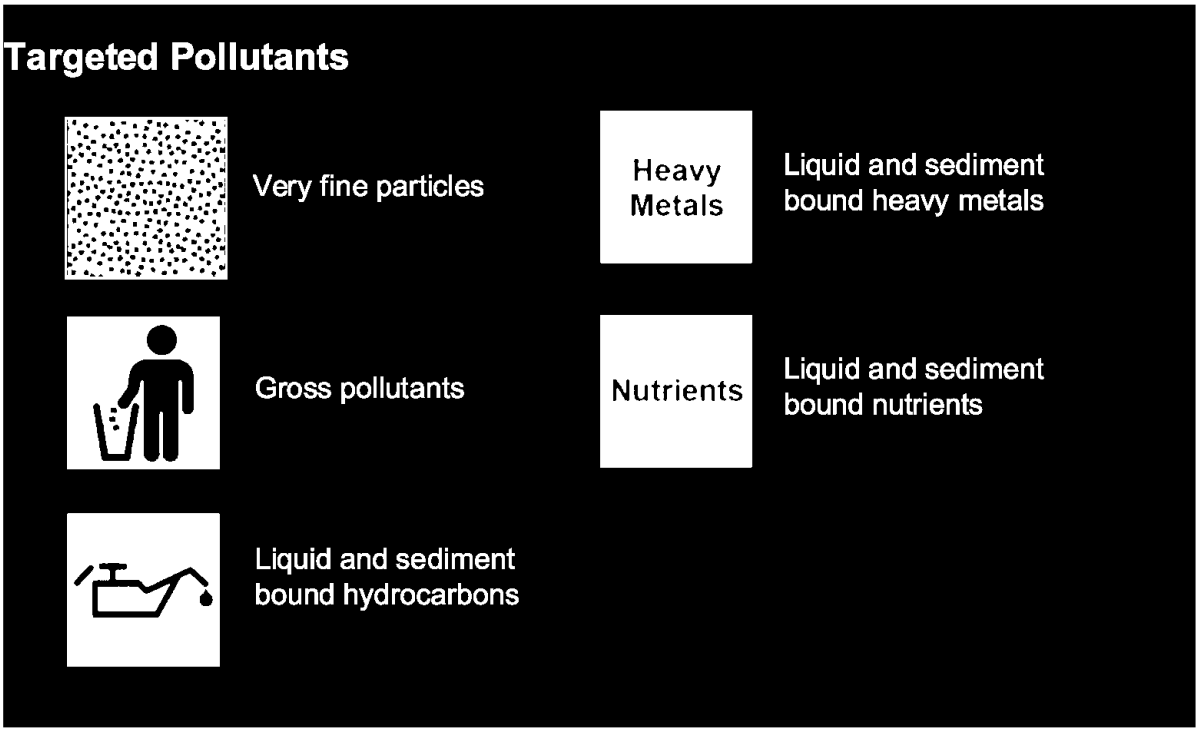
Up-Flo™ Filter Operation & Maintenance Manual

Table of Contents

Your Up-Flo™ Filter

Your Up-Flo™ Filter is an advanced stormwater treatment solution that combines sedimentation and screening with fluidised bed filtration to deliver exceptional surface water pollution removal.

Its innovative design delivers high efficiency across a wide range of flows in a much smaller footprint than conventional or other swirl-type devices and is the perfect choice for your site. Your Up-Flo™ Filter will remove and retain pollutants including:



How it Works

The Up-Flo™ Filter is a modular high-rate Stormwater filtration device. As shown below, it is installed into a 1200 mm diameter catch basin structure. Each Filter Module has a screen and support bracket that is attached to the concrete manhole and each contains a Media Pack that includes flow distribution and filtration media. Modules can attach to each other to form a "ring" of up to six modules. Up to two of the modules are attached to an Outlet Module that has a Bypass Hood and filtered Drain Down. The modular design can be supplied in different configurations depending on the application.

An upward flow path through the Filter Modules allows stormwater to be screened and filtered. In addition to the screening and filtering processes, gross pollutants will also settle into the sump or float to the surface of the water held within the manhole. The standard units are designed with a 900 mm sump to allow for sediment and gross pollutant accumulations between maintenance intervals.

This manual describes the operation of the Up-Flo™ Filter and provides general maintenance requirements that will ensure the filter will continue to operate and perform as intended. In general, a minimum of two inspections are required the first year to monitor sediment and gross pollutant accumulations in the manhole structure and inspect the Filter Media Pack and Drain Down Filter. The frequency of the maintenance interval is site specific as it will depend on the rate of pollutant accumulations. The first year of inspections and monitoring pollutant accumulations will determine future maintenance intervals.

1) Inlet pipe.
2) Media pack.
3) Sump.
4) Bypass siphon with floatables baffle.
5) Outlet module with integral drain down port.
6) Filter module.
7) Outlet pipe.
8) Angled screen.

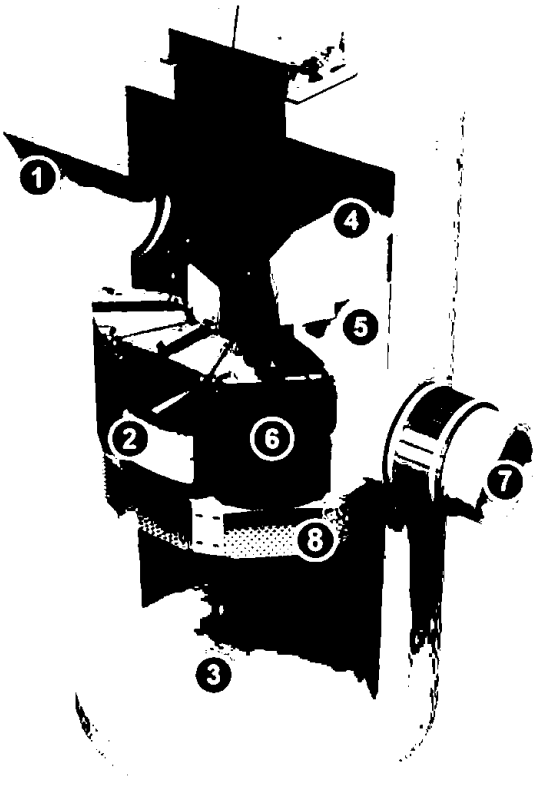


Figure 1 – the Up-Flo™ fluidised bed up flow filtration system – manhole configuration.

Benefits of the Up-Flo™ Filter

Exceptional treatment on any catchment

The Up-Flo™ Filter's modular filtration components allow you to adapt your design to meet the needs of any catchment area, capturing the specific levels of trash, silt and sediment, oils, metals and nutrients required.

Two-stage treatment in a single unit

The Up-Flo™ Filter combines pre-treatment, screening and filtration, delivering highly efficient multi-stage treatment in one device.

Save site space

The Up-Flo™ Filter's higher loading rates result in a smaller treatment footprint, which saves construction time and money, and makes for an easier installation.

Cut maintenance

No moving parts means that there's less opportunity for treatment disruption or breakage, while the system design is suited to long-term maintenance. Longer media life means longer service intervals, and media bags are easily removed and replaced while media cartridge modules stay put during maintenance.

Applications

The Up-Flo™ Filter is especially useful in high-density urban environments, where high pollutant loadings need to be managed in limited space or where it is difficult to control the quality of surface water runoff using conventional or natural SuDS techniques alone.

The Up-Flo™ Filter is perfectly suited to industrial sites, locations contributing runoff to wetlands/protected regions, or any area requiring a high level of treatment.

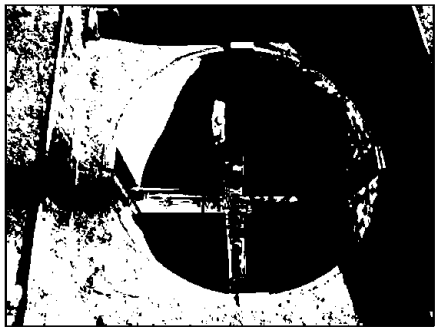
The Up-Flo™ Filter provides an effective solution in both newbuild or retrofit situations for residential, commercial or industrial developments, highways or car parks.

Make it Smart

Get Monitoring Alerts from your Up-Flo™ Filter

Your Up-Flo™ Filter will need regular inspection and maintenance to change the media packs, remove floatable debris, sediment and screenings from the sump.

Save time and money by only visiting your Up-Flo™ Filter when it actually needs emptying - add Smart Monitoring and receive automated alerts for maintenance.



Make it Smart

Add Hydro-Logic® Smart Monitoring and your Up-Flo™ Filter will let you know when it needs maintenance.

Maintenance Services

Hydro International offer service contracts to inspect, replace media packs and empty your Up-Flo™ Filter. Contracts can be tailored to your requirements.

To find out more about Smart Monitoring or our maintenance services, please call us on **+44 (0)1275 878371** or email **sudsservices@hydro-int.com**

Operation

Introduction

The Up-Flo™ Filter operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirements and is fabricated with durable noncorrosive components. Personnel is not required to operate the unit and maintenance is limited to periodic inspections, sediment and floatables removal, Media Pack replacement and Drain Down Filter replacement.

Pollutant Capture

The Up-Flo™ Filter is designed to operate as a "treatment train" by incorporating multiple treatment technologies into a single device. Trash and gross debris are removed by sedimentation and screening before they are introduced to the filtration media, preventing surface blinding of the filter media. The Up-Flo™ Filter is a wet-sump device. Between storm events, oil and floatables are stored on the water surface separate from the sediment storage volume in the sump (see Figure 1). The high-capacity bypass siphon acts as a floatables baffle to prevent washout of captured floatable pollutants during high-intensity events.

Reduced Clogging

The Up-Flo™ Filter has been designed to minimise the occurrence of clogging and blinding. The Up-Flo™ Filter employs a unique Drain Down design that allows the water level in the chamber to drop below the filter media between events. The Drain Down mechanism creates a reverse flow that flushes captured pollutants off the surface of the filter bag, helping to prevent blinding. By allowing the water to drain out, the drain-down mechanism also reduces the weight of the filter bags. This makes the bags easier and safer to remove during maintenance operations.

Overflow Protection

The Angled Screens are designed to prevent ragging and blinding. The Angled Screens are situated below the Filter Modules, sheltering them from the direct path of the influent. Coarse debris settles in the sump before the runoff flows up through the screens, protecting them from blinding. In the unlikely event of a blockage, the high capacity Siphonic Bypass is designed to convey high enough flow that large storm events will not create upstream flooding.

Maintenance

Overview

The Up-Flo™ Filter protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the proper functioning of the Up-Flo™ Filter. The Up-Flo™ Filter design allows for easy and safe inspection, monitoring and clean-out procedures. It has a wide central opening between the Filter Modules for easy and comfortable access to all of the components (See Figure 1).

Completion of all the maintenance activities for a typical manhole Up-Flo™ Filter takes less than one hour. Maintenance activities include inspection, floatables removal, oil removal, sediment removal, Media Pack replacement, and Drain Down Filter replacement.

Maintenance intervals are determined from monitoring the Up-Flo™ Filter during its first year of operation. Depending on the site, some maintenance activities may have to be performed on a more frequent basis than others. In the case of inspection and floatables removal, a Jet Vac truck is not required. Otherwise, a Jet Vac truck is normally required for oil removal, removal of sediment from the sump, and replacement of the Media Packs and Drain Down Filter. In most cases, entry into the Up-Flo™ Filter vessel is required for replacement of the Media Packs and Drain Down Filter, and Confined Space Entry procedures will have to be followed. Media Packs should not be installed in the modules until construction activities are complete and site stabilisation is effective.

We can provide full inspection and maintenance services for your Up-Flo™ Filter providing peace of mind and saving you time and money.

Make it Smart

Add Hydro-Logic® Smart Monitoring and your Up-Flo™ Filter will let you know when it needs maintenance.

You can also make your Up-Flo™ 'Smart' by adding a Smart Monitoring Hydro-Logic® Flexi Logger to provide monitoring and alerts when maintenance is required.

To find out more about Smart Monitoring or our maintenance services, please call us on **+44 (0)1275 878371** or email **sudsservices@hydro-int.com**

Determining Your Maintenance Schedule

Hydro International recommends that inspections be performed at least every six months during the first year of operation. Use the following guidelines for determining maintenance intervals:

- Floatables and Oil Monitoring: The water surface in the Up-Flo™ Filter should be monitored for accumulation of floatables and oil. Floatables should not be allowed to accumulate to the point where they completely cover the surface of the water. Oil should not be allowed to accumulate to the point where it has formed a measurable thickness on the surface of the water. The rate of floatables and oil accumulation can be estimated by dividing the surface area covered by floatables and/or oil by the number of months since the Up-Flo™ Filter was installed.

- Sediment Monitoring: A simple probe, such as the Sludge-Judge®, should be used to determine the depth of sediment in the sump. The maximum allowable sediment depth in a typical 1200 mm diameter manhole equipped with an Up-Flo™ Filter is 400 mm. In any case, sediment must be removed before it blocks the inlet to the Drain Down Filter. The rate of sediment accumulation can be estimated by dividing the measured depth of sediment by the number of months since the Up-Flo™ Filter was installed.

- Media Pack Monitoring: Filter bags should be weighed to determine the amount of particles that have been captured in the bags. Filter bags from one or two modules should be weighed. Spent filter bags weigh approximately 24 kgs wet. The rate of filter bag clogging can be estimated by subtracting the wet weight of a new bag (approximately 17 kg for filter sand and 14 kg for CPZ) from the measured wet weight of the bags being checked and dividing by the number of months since the bags were installed.

- Drain Down Filter Monitoring: The water level in the Up-Flo™ Filter should be monitored to ensure that the Drain Down Filter is operating properly. One to two days after a significant rainfall, the water level inside the vessel should have dropped to a point where it is equal with the base of the Filter Modules. If the water level has not reached that point, then the Drain Down Filter has either become clogged or blinded by trash or debris. If there is no evidence of trash or debris around the Drain Down Filter inlet, then it has likely become clogged with particles. The rate of Drain Down Filter clogging can be estimated by noting the number of months since the Up-Flo™ Filter was installed.

Hydro International recommends a maximum maintenance interval of one year for all maintenance activities but, based on the first-year monitoring, a shorter maintenance interval for some maintenance activities may be appropriate.

Service - Inspection

Inspection is a simple process that requires monitoring pollutant accumulations. Maintenance crews should be familiar with the Up-Flo™ Filter and its components prior to inspection.

Scheduling

- Inspection may be conducted during any season of the year but should occur shortly after a predicted rainfall to ensure components are operating properly.

Recommended Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Scale to measure the weight of the filter bags
- Tools to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge Judge®)
- Hydro International Up-Flo™ Filter Maintenance Log
- Trash bags for removed floatables

Up-Flo™ Filter Capacities

Model	Chamber Size (m)	Number of Filter Modules	Treatment Flow Rate (l/s) a)	Hydraulic Capacity (l/s) b)	Operating Head (mm) c)	Oil Storage Capacity (l)	Sediment Storage Capacity (m^3)
Manhole	1.2m Diameter	1-6	1.3-7.8	170	750	190	0.7

Table 1. Up-Flo Filter Design Information

a) Treatment flow rates based on >80% removal of Sil-Co-Sil 106 fine sand and silt (D_{50} = 22µm)
b) Maximum flow rate that can pass through the chamber without surcharge to the upstream network
c) Driving head for filter media

Inspection Guidance Procedures

1. Set up any necessary safety equipment (such as traffic cones) to provide access to the Up-Flo™ Filter. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole or vault.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Such as water level higher than the filter modules or open filter module lids

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the chamber.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel. Maximum sediment depth is 400 mm.

6. Remove the Filter Module lid by turning the cam latch and remove the Filter Media Pack. Weigh the filter bags from one or two modules. Filter bags should be replaced if the wet weight exceeds 24kgs.

7. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or a high standing water level.

8. Securely replace the grate or lid.

9. Remove safety equipment.

10. Notify us of any irregularities noted during inspection by calling us on +44 (0)1275 878371 or emailing us at sudsservices@hydro-int.com.

Service – Oil, Floatables and Sump Cleanout

A Jet Vac truck is used to remove captured sediment, oil and floatables.

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a Jet Vac truck hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump cleanout may typically be done during any season of the year - before and after rainy season.
- Floatables and sump cleanout should occur as soon as possible following a contaminated spill in the contributing drainage area

Recommended Equipment

- Safety Equipment (traffic cones, etc).
- Tools to remove grate or lid.
- Pole with skimmer or net (if only floatables are being removed).
- Sediment probe (such as a Sludge Judge®).
- Jet Vac truck (flexible hose preferred).
- Pressure nozzle attachment or other screen-cleaning device.
- Hydro International Up-Flo™ Filter Maintenance Log.

Oil, Floatables and Sediment Clean Out Guidance Procedures

1. Set up any necessary safety equipment (such as traffic cones) around the access of the Up-Flo™ Filter. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the grate or lid to the manhole or vault.
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.
4. If the standing water level in the sump is above the base of the Filter Modules tug the Pull Chain(s) to release the Drain Down Plug(s). Allow the excess water to drain out of the chamber.
5. Use the skimmer pole to fit the Drain Down plug back into the open port.
6. Once all floatables have been removed, drop the Jet Vac truck hose to the base of the sump. Vacuum out the sediment and gross debris from the sump floor.
7. Retract the Jet Vac truck hose from the vessel.
8. Inspect the Angled Screens for blockages and ragging. If present, remove the obstruction or ragged materials from the surface using a hose or other screen-cleaning device.
9. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Note any apparent irregularities such as damaged components or blockages.
10. Securely replace the grate or lid.
11. Remove safety equipment.

12. Notify us of any irregularities noted during inspection by calling us on +44 (0) 1275 878371 or e-mailing us at sudsservices@hydro-int.com.

Service – Replacement of Media Packs and Drain Down Filter

Unless the Up-Flo™ Filter has been installed as a very shallow unit, it is necessary to have a competent person enter the vessel to replace Media Packs.

Scheduling

- Call Hydro International to order replacement Media Packs and Drain Down filter prior to scheduling maintenance.
- Because Media Pack replacement requires entry into the Up-Flo™ chamber, maintenance events should be scheduled during dry weather.
- Media Pack replacement should occur immediately after a contaminated spill in the contributing drainage area.

Recommended Equipment

- Safety Equipment (traffic cones, etc).
- Crowbar to remove grate or lid.
- Pole with skimmer or net (if floatables removal is not to be done with Jet Vac truck hose).
- Sediment probe (such as a Sludge Judge®).
- Jet Vac truck (flexible hose preferred).
- Confined Space Entry Equipment.
- Up-Flo™ Filter Replacement Media Packs (available from Hydro International).
- Hydro International Up-Flo™ Filter Maintenance Log.
- Screwdriver (flat head).
- Replacement Drain Down Filter components supplied by Hydro International.

Media Pack and Drain Down Filter Replacement Guidance Procedures

1. Follow Floatables and Sump Cleanout Procedures, 1 – 10.
2. Following Confined Space Entry procedures, enter the Up-Flo™ Filter Chamber.
3. Open the Filter Module by turning the three cam latches on the front and sides of the module. Remove the lid (1) to gain access to the Media Pack.
4. Remove and discard the spent Media Pack. The Media Pack contents include:
   - A top layer of green (2) Flow-Distributing Media.
   - Two Media Bags (3) equipped with nylon handles.
   - A bottom layer of green (2) Flow-Distributing Media.
5. Insert a new Media Pack, supplied by Hydro International.
   - First, insert a bottom layer of green Flow-Distributing Media. Be sure that the media sits snugly and level at the bottom of the Filter Module.
   - Next, insert the first of two replacement Media Bags. Smooth the bag out with your hands to make sure that the bag extends snugly to the walls and corners of the Filter Module.
   - Insert the second Media Bag, following the same procedure.
   - Insert the top layer of green Flow-Distributing Media. Be sure that the piece fits snugly against the walls and corners of the Filter Module.

- Put the lid on and secure the three latches. Check to make sure that the latches are closed properly.

6. Use a screwdriver to unscrew the Drain Down Filter from the face of the Outlet Module. DO NOT DISCARD THIS PIECE.
7. Install new Drain Down Filter supplied by Hydro International.
8. Exit the Up-Flo™ Filter chamber and securely replace the grate or lid.
9. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables, oil and gross debris removed, and the depth of sediment measured. Note the number of Media Packs replaced. Note any irregularities such as damaged components or blockages.
10. Remove safety equipment.
11. Dispose of spent media packs at your local landfill, following local regulations.
12. Return the spent Drain Down Filter to Hydro International.
13. Notify us of any irregularities noted during inspection by calling us on +44 (0) 1275 878371 or e-mailing us at sudsservices@hydro-int.com.

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Twice per year, or as needed - Following a contaminated spill in the drainage area
Sediment Removal	- Twice per year or as needed - Following a contaminated spill in the drainage area
Media Pack Replacement	- Once per year or as needed - Following a contaminated spill in the drainage area
Drain Down Filter Replacement	- Once per year with Media Pack replacement - As needed, in the event of continuous base flow conditions

Up-Flo™ Filter Installation Log

Hydro International Reference Number			
Site Name			
Site Location			
Owner		Contractor	
Contact Name		Contact Name	
Company Name		Company Name	
Address		Address	
Telephone		Telephone	
Fax		Fax	
Installation Date			
Total Number of Up-Flo™ Filter Modules			

Up-Flo™ Filter Installation Location Record

Site Map	
Site Plan (include vehicle restrictions and lift heights)	

Photo 1	
Photo 2	

Up-Flo™ Filter Inspection and Maintenance Log

(Master Performance Control Record)

Date	Initials	Area / Depth of Floatables & Oils	Sediment Depth Measured (mm)	Volume of Sediment Removed (m^3)	Number of Media Packs Replaced	Site Activity and Comments

Up-Flo™ Filter Inspection and Maintenance Log

(Master Performance Control Record)

Date	Initials	Area / Depth of Floatables & Oils	Sediment Depth Measured (mm)	Volume of Sediment Removed (m^3)	Number of Media Packs Replaced	Site Activity and Comments

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(Master Performance Control Record)

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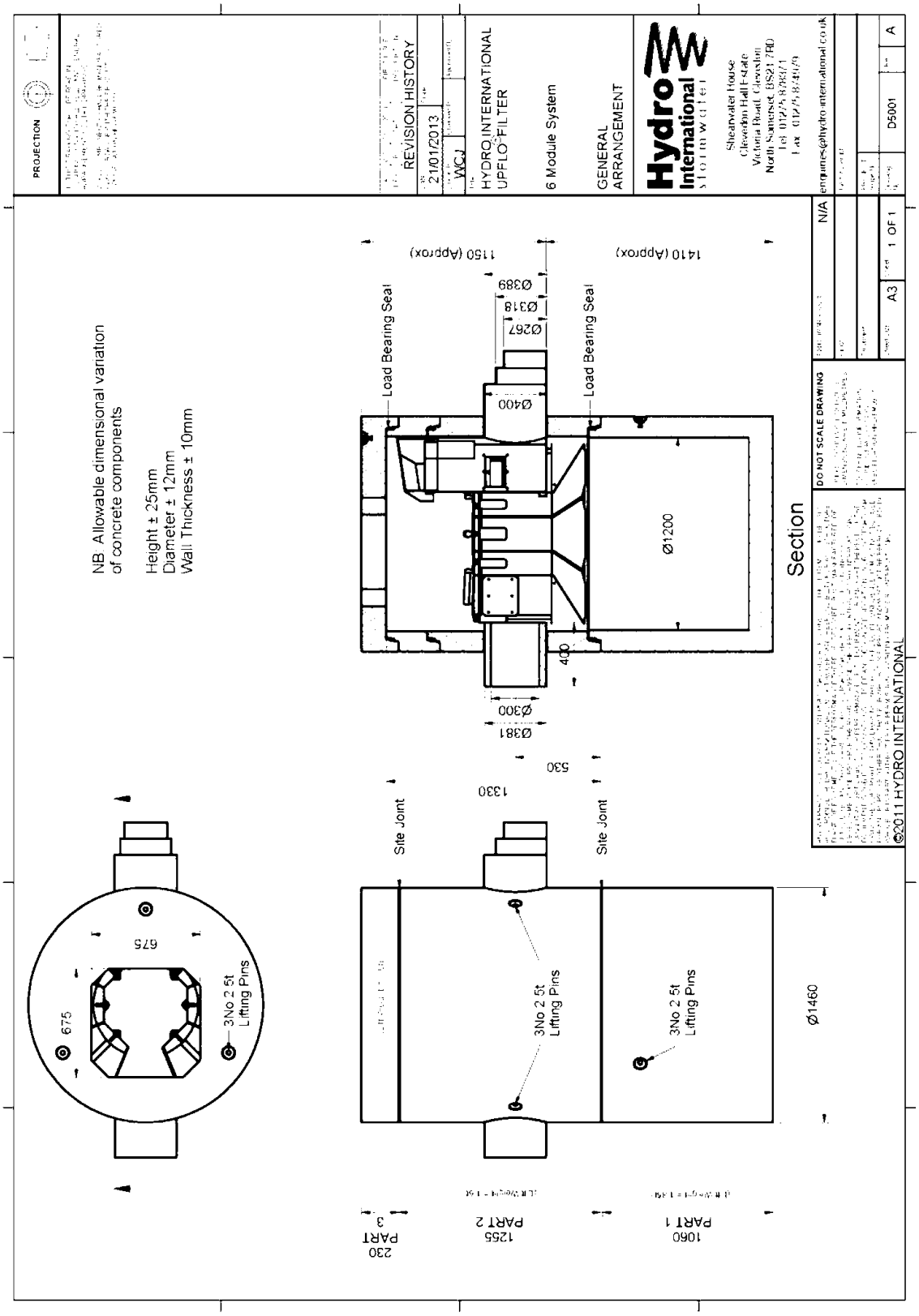
Typical General Arrangement Drawing



Contact

We're committed to excellence in water management, and we want to make sure that you are fully supported throughout your system's lifetime.

If you would like to discuss the operation and maintenance of your Up-Flo™ Filter or would like to learn more about how we can help you to optimise and maintain your sustainable drainage assets to ensure effective, long-term environmental compliance, please contact one of our support specialists:

Tel: +44 (0)1275 878371

E-mail: sudsservices@hydro-int.com

hydro-int.com

B/1020

Design Data

Downstream Defender®

Advanced Hydrodynamic Vortex Separator

The Downstream Defender® is an advanced hydrodynamic vortex separator for the effective and reliable removal of fine particles, oils and other floatable debris from surface water runoff.

Its innovative design delivers high efficiency across a wide range of flows in a much smaller footprint than conventional or other swirl-type devices and it is the perfect choice for any catchment likely to convey high quantities of contamination.

1. Access for removal of floatables and sediments
2. Inlet pipe.
3. Inlet chute.
4. Centre shaft.
5. Dip plate.
6. Centre cone.
7. Benching skirt.
8. Floatables and oil storage
9. Isolated sediment storage zone.
10. Outlet pipe.

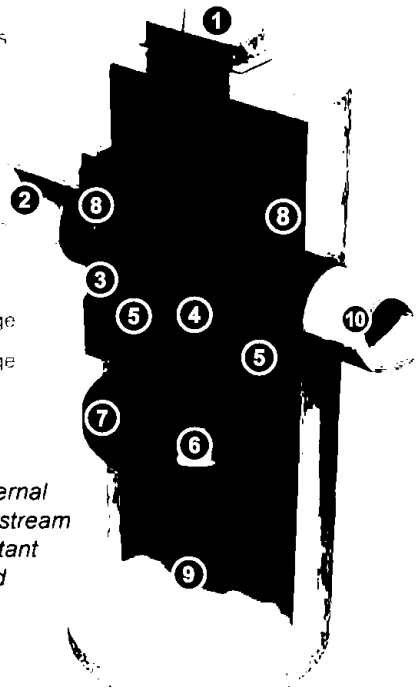


Figure 1 - The unique internal components of the Downstream Defender® enhance pollutant removal performance and prevent wash out.

Unique Flow Modifying Components

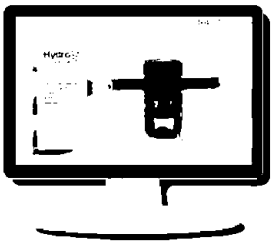
The Downstream Defender® consists of a choice of concrete or HDPE chamber with unique flow modifying internal components. It is these internal components that differentiate the Downstream Defender® from catchpits, sedimentation basins or sedimentation sumps. They facilitate advanced hydrodynamic vortex separation by reducing turbulence, lengthening the flow path to increase chamber residence time and introducing shear planes.

The internal components also ensure that the pollutant storage zones are isolated and protected from high flows that could cause pollutant re-entrainment or wash out.

Compared to devices that have poorly designed internal components, the Downstream Defender® captures and retains more of the annual pollutant load.

Watch a short video showing the Downstream Defender® components and operation at:

http://www.hydro-int.com/en-gb/products/down-stream-defender-0



Repeatable, Reliable Performance

The Downstream Defender® delivers high removal of pollutants through advanced, hydrodynamic separation across a wide range of flows. The device has a proven track record of tackling an assortment of pollutants including:

Sediment (or Total Suspended Solids)

The Downstream Defender® is a highly effective sediment/TSS removal device. It can be sized in a number of ways to suit the application and level of protection required (see Table 1). **SuDS Mitigation Index = 0.5.**

Gross Pollutants

100% removal of floatable debris, such as food wrappers, Styrofoam cups and drinks cartons

Liquid Hydrocarbons

Effective spill containment device that meets the BS EN 858-1:2002 Class I and Class II effluent targets at low flow rates. Note these systems are not considered oil separators according to the BS EN 858-1 and must not be used in applications where full certification is required. **SuDS Mitigation Index = 0.8.**

Sediment Bound Hydrocarbons (including Polycylic Aromatic Hydrocarbons - PAHs)

PAHs have low solubility in water and are readily adsorbed onto sediment particles. Effective removal of sediment particles will also ensure the removal of many PAHs.

Sediment Bound Heavy Metals and Nutrients

Heavy Metals

Nutrients

As an efficient device for removal of fine sediment, the Downstream Defender® is also effective for the removal of sediment bound pollutants. **SuDS Mitigation Index (Metals) = 0.4.**

Tel: +44 (0)1275 337955
stormtrain@hydro-int.com

hydro-int.com/stormtrain

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

No Risk of Pollutant Wash Out

The Downstream Defender® has been specially designed to isolate the pollutant storage zones and is proven to prevent pollutant wash out.

Sizing

The Downstream Defender® can be sized for different treatment goals and objectives.

For design purposes, the selected model's Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.

The hydraulic capacity of the selected model should be considered with respect to the peak discharge flow rate from the site.

Model Diameter (m)	Treatment Flow Rate - Fine (l/s) [a]	Treatment Flow Rate - Coarse (l/s) [b]	Hydraulic Capacity (l/s) [c]	Minimum Oil Storage Capacity (l)	Minimum Sediment Storage Capacity (m^3) [e]	Maximum Headloss at Treatment Flow Rate - Coarse (mm)
1.2	30	38	120	283	0.39	150
1.8	69	85	270	1356	0.73	225
2.55	138	171	542	2535	2.89	300
3.0	190	237	750	4693	3.10	375

Notes:
a) Treatment Flow Rate - Fine is based on an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particle size (D_{50}) of 75 microns and a specific gravity of 2.65.
b) Treatment Flow Rate - Coarse is based on an annualised removal efficiency of >80% of all particles between 50 and 1000 microns with a mass-median particle size (D_{50}) of 146 microns and a specific gravity of 2.65.
c) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm.
d) Alternative sizing based on different sediment grades available on request.
e) Additional sediment storage capacity can be provided to extend maintenance intervals if required.

Table 1 - Downstream Defender® design information.

Expert Design Service

Hydro International's professional engineers are on hand to provide free support with the correct sizing and selection of the Downstream Defender® within each drainage design.

We can also provide estimated maintenance intervals, whole life cost estimates and predicted pollutant removal performance.

Call the StormTrain® Hotline on: 01275 337955 or email stormtrain@hydro-int.com

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

Setting Out

The Downstream Defender® can accommodate a change in pipe direction to suit site specific requirements. Combined with the high rate internal bypass, this helps to avoid the need for additional manholes on site. Head loss across the chamber is kept to a minimum (see Table 1). The inlet and outlet pipes should be sized in accordance with Table 2 (opposite), and a minimum of 90 degrees between inlet and outlet is required.

Inlet and outlet pipe connections are at the same invert level.

Additional manhole sections can be provided to extend the chamber to meet site cover and invert levels or provide additional pollutant storage where required.

Easy to Install

The Downstream Defender® is delivered to site as a near finished manhole with internal components already installed. Installation is therefore similar to any other manhole installation on site. Full installation guidelines are available.

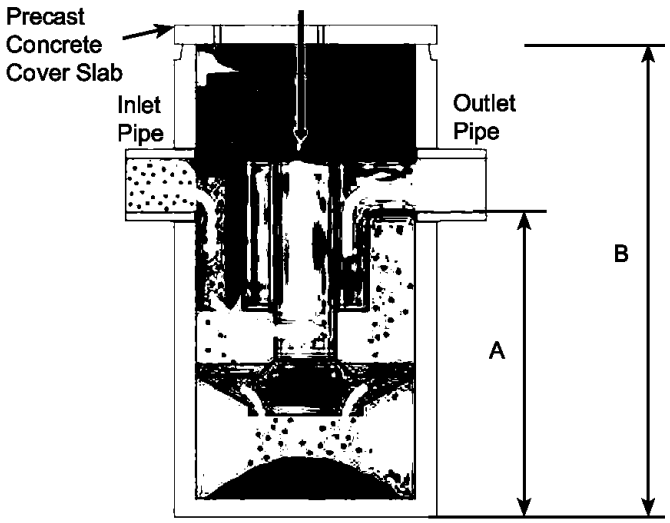
We can provide structural concrete systems for simple plug-and-play installation or choice of lightweight single and twin wall plastic chambers.

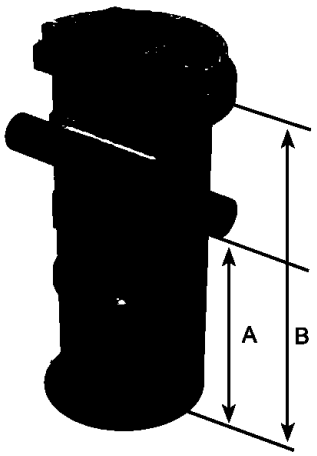
Easy to Maintain

Maintenance of the Downstream Defender® is simple, safe and cost-effective. Maintenance is carried out from the surface, using a standard vacuum tanker and personnel are not required to enter the device.

With a large capacity to store sediments and oils (see Table 1), and with a proven ability to prevent wash out, maintenance intervals can be years rather than months - depending on site conditions. The unit can also be fitted with a Hydro-Logic™ Smart Monitoring system to alert the site operator when maintenance is required and provide peace of mind that the unit is operating normally at other times.

Additional pollutant storage can be built into the chamber to extend maintenance intervals if required.





Tel: +44 (0)1275 337955
stormtrain@hydro-int.com

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

Hydro International

Dimensions and Weights

General arrangement drawings of all units are available for download from:
http://www.hydro-int.com/en-gb/products/downstream-defender-0

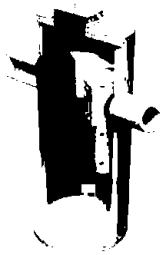
Model	Material	Chamber Diameter - Internal (mm)	Chamber Diameter - External (mm)	Inlet and Outlet ID (mm)	Depth to invert (m) (A) (1)	Chamber Depth (m) (B) (2)	Max Component Lift Weight (kg)
PQL1320.1000	Concrete	1200	1460	300	1.916	2.830	2200
PQL1320.1030	Concrete	1800	2160	450	2.495	4.029	5450
PQL1320.1060	Concrete	2550	2850	600	2.95	4.95	8700
PQL1320.1090	Concrete	3000	3350	750	3.12	5.20	12100
PQL1320.1020	HDPE Single Wall	1188	1200	300	1.55	2.3	140
PQL1320.1051	HDPE Single Wall	1776	1812	500	2.11	3.41	460
PQL1320.1081	HDPE Single Wall	2530	2570	600	2.94	4.8	900
PQL1320.1111	HDPE Single Wall	2974	3000	800	3.13	5.3	1300
PQL1320.1025	HDPE Twin Wall	1200	1300	300	1.56	2.22	400
PQL1320.1055	HDPE Twin Wall	1800	2200	560	2.467	3.75	1100

Notes:
1) Minimum depth to invert shown. Depth to invert can be increased if required.
2) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required.

Table 2 - Downstream Defender® unit types, dimensions and weights.

The Hydro StormTrain® Series of Surface Water Treatment Devices

The Downstream Defender® is one of the Hydro StormTrain® Series of surface water treatment devices. Each device delivers proven, measurable and repeatable surface water treatment performance. Each can be used independently to meet the specific needs of a site or combined to form a management train. They can be used alongside natural SuDS features to protect, enable or enhance them.



First Defense®
Vortex Separator

Downstream Defender®
Advanced Hydrodynamic
Vortex Separator

Up-Flo™ Filter
Fluidised Bed Up Flow
Filtration System

Hydro Biofilter™
Biofiltration System

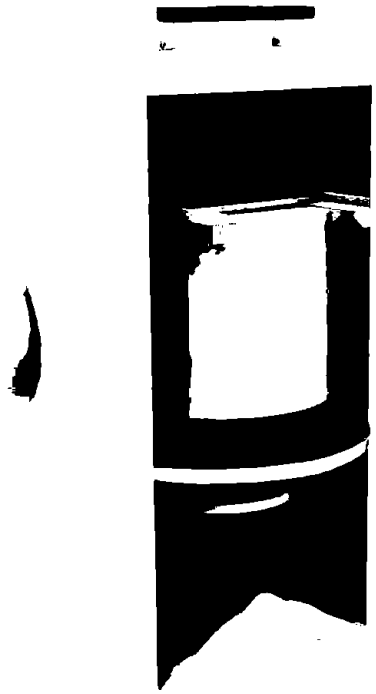
Patent: www.hydro-int.com/patents

Tel: +44 (0)1275 337955 stormtrain@hydro-int.com

Hydro International
Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD

hydro-int.com/stormtrain

Hydro International®



Operation and Maintenance Manual

Downstream Defender®

Vortex Separator for Stormwater Treatment

Turning Water Around ...®

Table of Contents

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® by Hydro International

The Downstream Defender® is an advanced Hydrodynamic Vortex Separator designed to provide high removal efficiencies of settleable solids and their associated pollutants, oil, and floatables over a wide range of flow rates.

The Downstream Defender® has unique, flow-modifying internal components developed from extensive full-scale testing, CFD modeling and over thirty years of hydrodynamic separation experience in wastewater, combined sewer and stormwater applications. These internal components distinguish the Downstream Defender® from simple swirl-type devices and conventional oil/grit separators by minimizing turbulence and headlosses, enhancing separation, and preventing washout of previously stored pollutants.

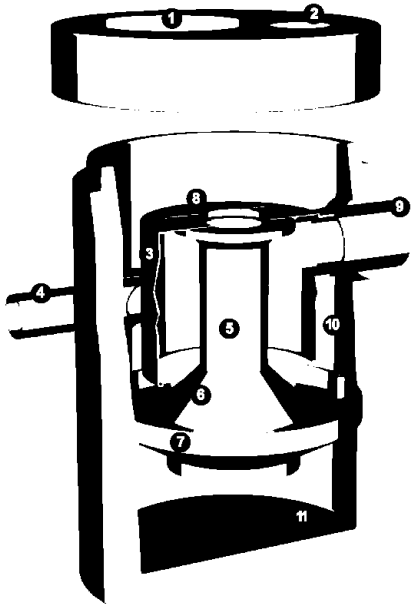
The high removal efficiencies and inherent low headlosses of the Downstream Defender® allow for a small footprint making it a compact and economical solution for the treatment of non-point source pollution.

Benefits of the Downstream Defender®

- Removes sediment, floatables, oil and grease
- No pollutant washouts
- Small footprint
- No loss of treatment capacity between clean-outs
- Low headloss
- Efficient over a wide ranges of flows
- Easy to install
- Low maintenance

Applications

- New developments and retrofits
- Utility yards
- Streets and roadways
- Parking lots
- Pre-treatment for filters, infiltration and storage
- Industrial and commercial facilities
- Wetlands protection



Downstream Defender® Components

1. Central Access Port
2. Floatables Access Port (6-ft., 8-ft. and 10-ft. models only)
3. Dip Plate
4. Tangential Inlet
5. Center Shaft
6. Center Cone
7. Benching Skirt
8. Floatables Lid
9. Outlet Pipe
10. Floatables Storage
11. Isolated Sediment Storage Zone

Hydro Maintenance Services

Hydro International has been engineering stormwater treatment systems for over 30 years. We understand the mechanics of removing pollutants from stormwater and how to keep systems running at an optimal level.

Nobody Knows our Systems Better than we do

Avoid Service Negligence

Sanitation services providers not intimately familiar with stormwater treatment systems are at risk of the following:

- Inadvertently breaking parts or failing to clean/replace system components appropriately.
- Charging you for more frequent maintenance because they lacked the tools to service your system properly in the first place.
- Billing you for replacement parts that might have been covered under your Hydro warranty plan
- Charging for maintenance that may not yet have been required.

Leave the Dirty Work to us

Trash, sediment and polluted water is stored inside treatment systems until they are removed by our team with a vactor truck. Sometimes teams must physically enter the system chambers in order to prepare the system for maintenance and install any replacement parts. Services include but are not limited to:

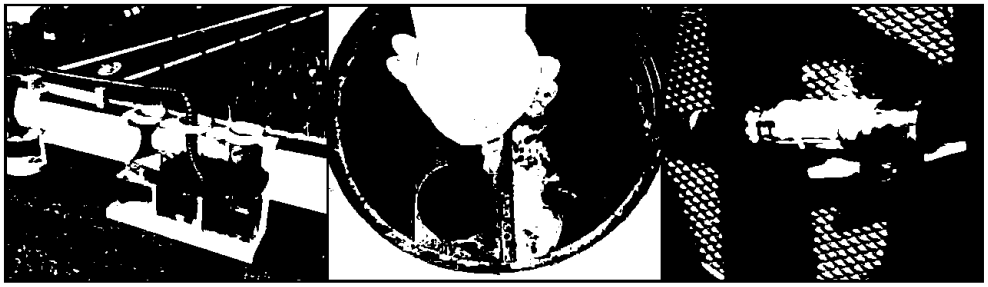
- Solids removal
- Removal of liquid pollutants
- Replacement media installation (when applicable)

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® Operation and Maintenance Manual

Better Tools, Better Results

Not all vactor trucks are created equal. Appropriate tools and suction power are needed to service stormwater systems appropriately. Companies who don't specialize in stormwater treatment won't have the tools to properly clean systems or install new parts.

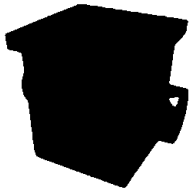


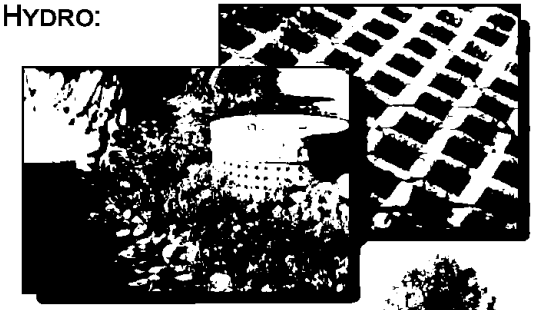
Service Warranty

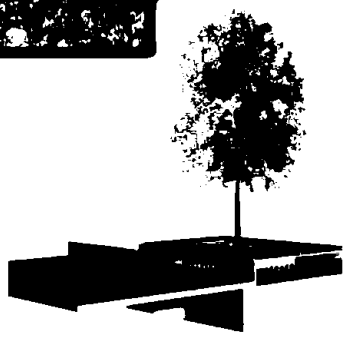
Make sure you're not paying for service that is covered under your warranty plan. Only Hydro International's service teams can identify tune-ups that should be on us, not you.

Treatment Systems Serviced by Hydro:

- Stormwwater filters
- Stormwater separators
- Baffle boxes
- Biofilters/biorention systems
- Storage structures
- Catch basins
- Stormwater ponds
- Permeable pavement







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1 (888) 382-7808

LEARN MORE AT HYDRO-INT.COM/SERVICE

Operation

Introduction

The Downstream Defender® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The Downstream Defender® has been designed to allow for easy and safe access for inspection/monitoring and clean-out procedures. Entry into the unit or removal of the internal components is not necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the Downstream Defender® have been designed to protect the oil, floatables and sediment storage volumes so that separator performance is not reduced as pollutants accumulate between clean-outs. Additionally, the Downstream Defender® is designed and installed into the storm drain system so that the vessel remains wet between storm events. Oil and floatables are stored on the water surface in the outer annulus separate from the sediment storage volume in the sump of the unit providing the option for separate oil disposal, and accessories such as adsorbant pads. Since the oil/floatables and sediment storage volumes are isolated from the active separation region, the potential for re-suspension and washout of stored pollutants between clean-outs is minimized.

Wet Sump

The sump of the Downstream Defender® retains a standing water level between storm events. The water in the sump prevents stored sediment from solidifying in the base of the unit. The clean-out procedure becomes more difficult and labor intensive if the system allows fine sediment to dry-out and consolidate. Dried sediment must be manually removed by maintenance crews. This is a labor intensive operation in a hazardous environment.

Blockage Protection

The Downstream Defender® has large clear openings and no internal restrictions or weirs, minimizing the risk of blockage and hydraulic losses. In addition to increasing the system headloss, orifices and internal weirs can increase the risk of blockage within the unit.

Maintenance

Overview

The Downstream Defender® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the Downstream Defender®. The Downstream Defender® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the Downstream Defender® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

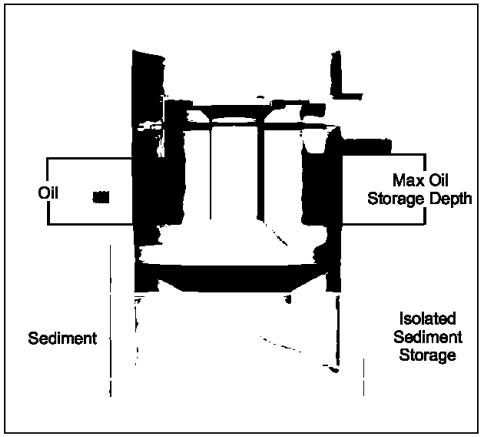

Fig.1 Pollutant storage volumes of the Downswtream Defender®.

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

The Downstream Defender® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole. On the 6-ft, 8-ft and 10-ft units, the floatables access port is above the outlet pipe between the concrete manhole wall and the dip plate. The sediment removal access ports for all Downstream Defender® models are located directly over the hollow center shaft.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the Downstream Defender®, nor do they require the internal components of the Downstream Defender® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Determining Your Maintenance Schedule

The frequency of cleanout is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil/flotables removal, for a 6-ft Downstream Defender® typically takes less than 30 minutes and removes a combined water/oil volume of about 500 gallons.

Inspection Procedures

Inspection is a simple process that does not involve entry into the Downstream Defender®. Maintenance crews should be familiar with the Downstream Defender® and its components prior to inspection.

Scheduling

- It is important to inspect your Downstream Defender® every six months during the first year of operation to determine your site-specific rate of pollutant accumulation
- Typically, inspection may be conducted during any season of the year
- Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1

Recommended Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge Judge®)
- Trash bag for removed floatables
- Downstream Defender® Maintenance Log

Table 1. Downstream Defender® Pollutant Storage Capacities and Max. Cleanout Depths.

Unit Diameter (feet)	Total Oil Storage (gallons)	Oil Clean-out Depth (inches)	Total Sediment Storage (gallons)	Sediment Clean-out Depth (inches)	Max. Liquid Volume Removed (gallons)
4	70	<16	141	<18	384
6	216	<23	424	<24	1,239
8	540	<33	939	<30	2,884
10	1,050	<42	1,757	<36	5,546
12	1,770	<49	2,970	<42	9,460

NOTES

1. Refer to Dowmstream Defender® Clean-out Detail (Fig. 1) for measurement of depths.

2. Oil accumulation is typically less than sediment, however, removal of oil and sediment during the same service is recommended.

3. Remove floatables first, then remove sediment storage volume.

4. Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.

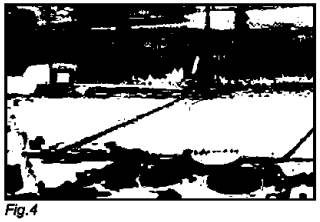
Fig.4


Fig.5

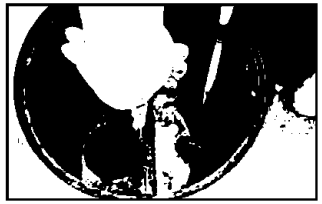
Fig.6

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the lids to the manhole (Fig. 4). NOTE: The 4-ft Downstream Defender® will only have one lid.
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. See Fig.7 and 8 for typical inspection views.
4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the outer annulus of the chamber.
5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel (Fig.5).
6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.
7. Securely replace the grate or lid.
8. Take down safety equipment.
9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Cleanout

Floatables cleanout is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.6).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump cleanout are typically conducted once a year during any season.
- If sediment depths are greater than 75% of maximum clean-out depths stated in Table 1, sediment removal is required.
- Floatables and sump cleanout should occur as soon as possible following a spill in the contributing drainage area.

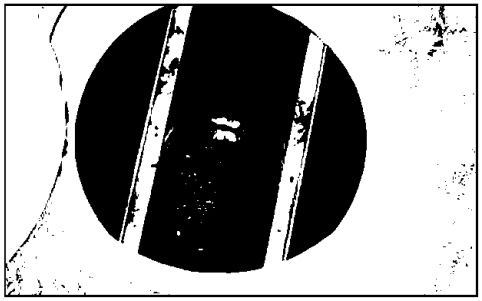
Fig.7 View over center shaft into sediment storage zone.

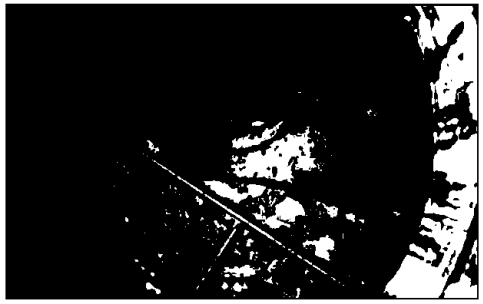
Fig.8 View of outer annulus of floatables and oil collection zone.

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (6-inch flexible hose recommended)
- Downstream Defender® Maintenance Log

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the lids to the manhole (NOTE: The 4-ft Downstream Defender® will only have one lid).
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.
4. Using the Floatables Port for access, remove oil and floatables stored on the surface of the water with the vactor hose or the skimmer net (Fig.9).
5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (Pg.9).
6. Once all floatables have been removed, drop the vactor hose to the base of the sump via the Central Access Port. Vactor out the sediment and gross debris off the sump floor (Fig.6).
7. Retract the vactor hose from the vessel.
8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.
9. Securely replace the grate or lid.

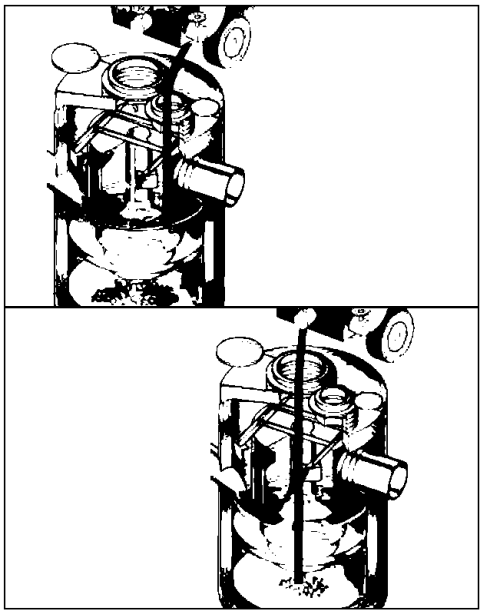
Fig.9 Floatables and sediment are removed with a vactor hose

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area
NOTE: For most cleanouts it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

Hydro International®

Downstream Defender® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL (CIRCLE ONE): **4-FT** **6-FT** **8-FT** **10-FT** **CUSTOM**

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Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Hydro International®

Downstream Defender® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment * Depth Measured	Volume of Sediment Removed	Site Activity and Comments

*Note: Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.

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Notes

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Hydro International

Do it Right the First Time

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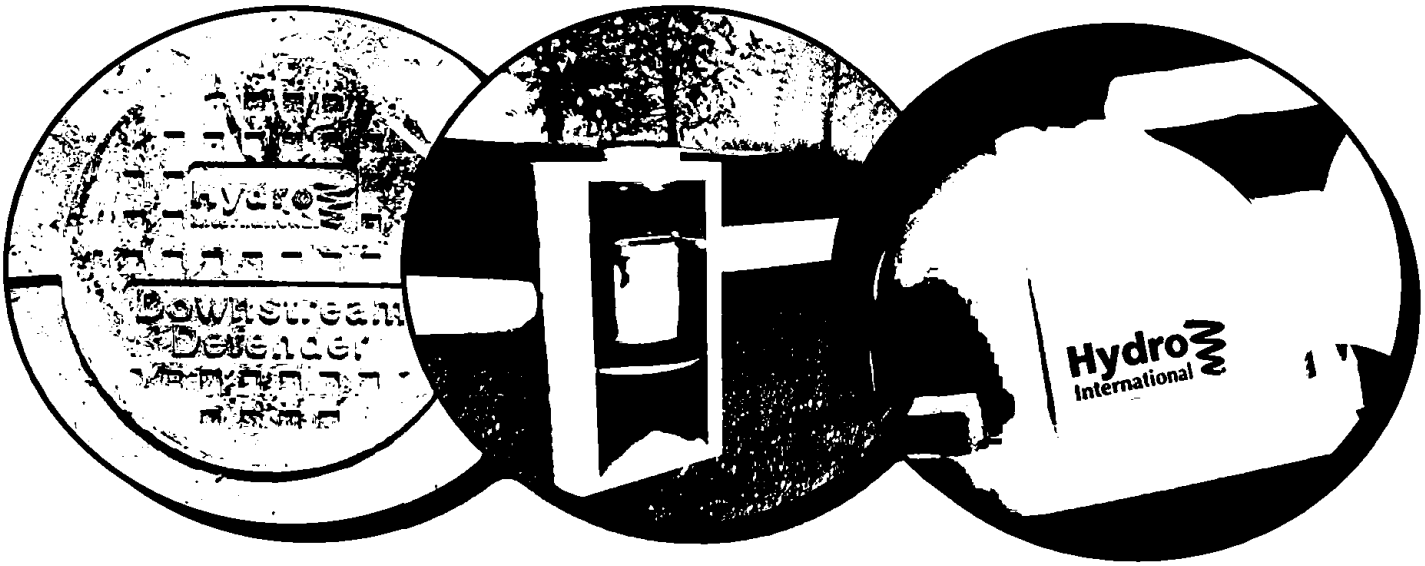


CALL **1 (888) 382-7808** TO SCHEDULE AN INSPECTION

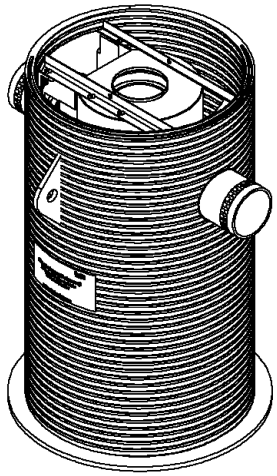
Stormwater Solutions

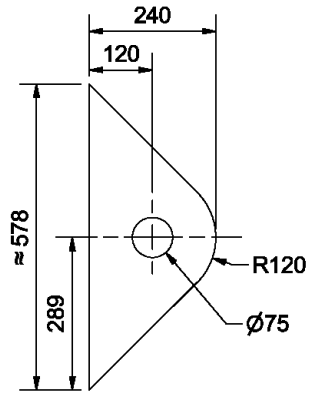
94 Hutchins Drive
Portland, ME 04102

Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

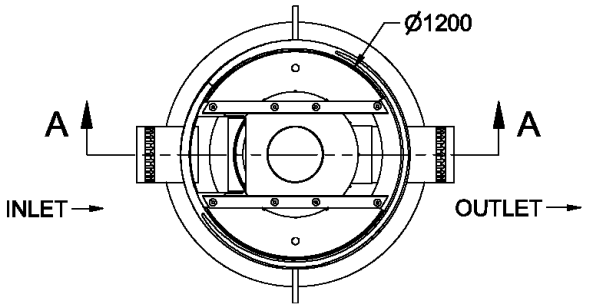
www.hydro-int.com

Turning Water Around...®

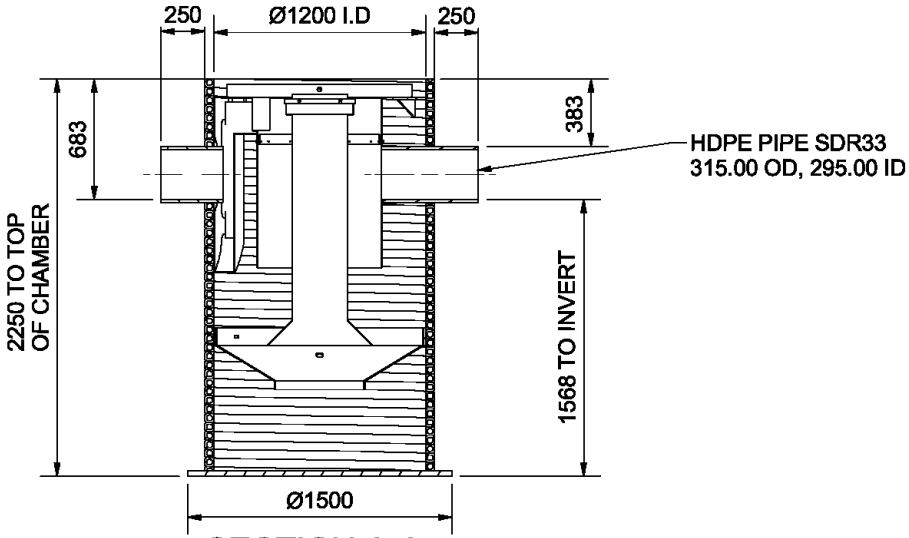




LIFTING LUG DETAIL
30mm THICK
SCALE 1:10



PLAN VIEW



SECTION A-A
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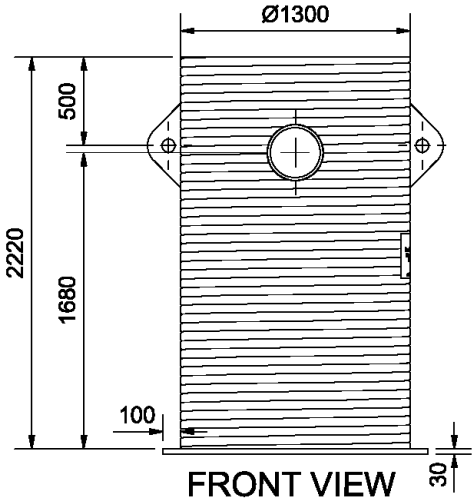

FRONT VIEW

PROJECTION

COMMENTS:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT GENERAL ARRANGEMENT & DETAIL DRAWINGS
2. ALL COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH PRODUCTION SPECIFICATION FM09.15
3. ALL COMPONENTS SHALL BE MANUFACTURED FROM HDPE (BLACK PE80) UNLESS SHOWN OTHERWISE
4. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH DRAWING NUMBER DD122500-2_12DD
5. ALL CHAMBER COMPONENTS SHALL BE LEAK TESTED USING EITHER AN AIR OR WATER TEST PROCEDURE

REVISION HISTORY

REV	BY	DESCRIPTION	DATE
A	CRA	FIRST ISSUE	05 FEB 19

DATE:	SCALE:
15/10/2018	1:30

DRAWN BY:	CHECKED BY:	APPROVED BY
WCJ	DGE	WCJ

Title
HYDRO INTERNATIONAL
DOWNSTREAM
DEFENDER®

1200 TWIN WALLL
4 kN TUBE CHAMBER

GENERAL ARRANGEMENT

Hydro International®
Shearwater House
Victoria Road
Clevedon, UK
BS21 7RD
Tel: +44 (0)1275 878371
Fax: +44 (0)1275 874979
hydro-int.com

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WEIGHT:	MATERIAL:
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NEXT ASSEMBLY:
-PQL 1320,1025

DRAWING NO.:
TW 1320-1025-01001

SHEET SIZE:	SHEET:	Rev:
A3	1 OF 1	A

A Guide to The SuDS Manual (C753) Simple Index Approach

Hydro International

The SuDS Manual (C753) Simple Index Approach

Introduction

In Table 26.1 of The SuDS Manual (C753) four risk based approaches for water quality management are specified:

1. Simple Index Approach
2. Risk Screening (generally used to determine if Simple Index Approach is appropriate)
3. Detailed Risk Assessment
4. Process-Based Treatment Modelling

With the intention that the simpler approaches are applied in lower risk scenarios, with more sophisticated assessments only used when appropriate to the risk.

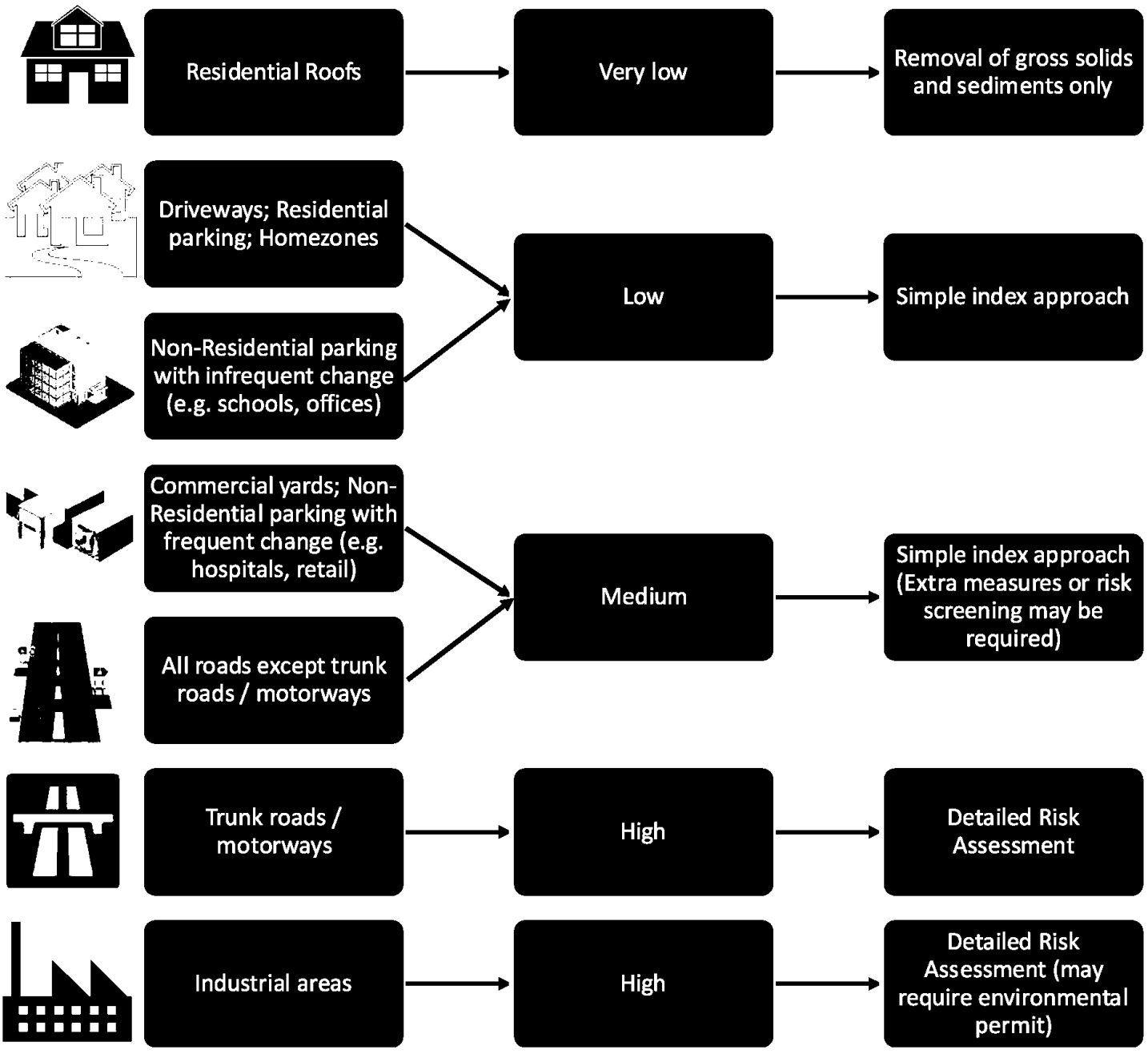

Figure 1: Applying the Risk Based Water Quality Management Approaches (Source: After Table 4.3 of the SuDS Manual)

Applying the Simple Index Approach (SIA)

The Simple Index Approach (SIA) recommended in Section 26.7.1 of The SuDS Manual (C753) was developed from that set out by Middlesex University (as outlined in Annex 5 of Chapter 26 of The SuDS Manual) and follows a three step approach:

Step 1 – Allocate suitable pollution hazard indices for the proposed land use categories

Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index

Step 3 – Where the discharge is to protected[1] surface waters or groundwater, consider the need for a more precautionary approach.

Note:

1 Designated as those protected for the supply of drinking water (see SuDS Manual Table 4.3).

Step 1: Define pollution hazard indices

Pollution hazad indices are presented in Table 26.2 of The SuDS Manual and reproduced here for simplicity. The indices range from 0 (no pollution of this type) to 1 (high pollution hazard for this contaminant type).

Table 1: Pollution hazard indices for different land use classes (Source: Reproduced from The SuDS Manual Table 26.2)

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Liquid Hydrocarbons (free floating oils)
Residential Roofs	Very low	0.2	0.2	0.05
Other Roofs (typically commercial / industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones and general access roads) **and non-residential car parks with infrequent change** (e.g. schools, offices) – i.e. <300 traffic movements / day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential parking with frequent change (e.g. hospitals, retail); **all roads except low traffic roads and trunk roads / motorways[1]**	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites); **sites where chemicals and fuels** (other than domestic fuel oil) **are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]**	High	0.8[2]	0.8[2]	0.9[2]

Notes:

1. Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009)
2. These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (see also The SuDS Manual Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help to determine the most appropriate treatment approach to the development of a design solution. **Also consider spill protection – contact Hydro International to find out more about our specialist treatment and containment options for high pollution hazard sites.**

Where a site land use falls outside of these categories, the indices should be adapted (and agreed with the drainage approving / adopting body) or else a more detailed risk assessment should be carried out.
Equivalent indices should be developed for other contaminants of interest of any given site. **For assistance with development of indices or detailed site analysis, contact Hydro International.**

Step 2: Determine SuDS Pollution Mitigation Indices

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for that contaminant type):

Total SuDS Mitigation Index (for each contaminant) ≥ **Pollution hazard index (for each contaminant)**

If the mitigation index of an individual component is insufficient, two components (or more) in series will be required, with a factor of 0.5 used to account for the reduced performance of secondary or tertiary components, in line with the following equation:

$$\text{Total SuDS Mitigation Index} = \text{Mitigation Index}_1 + 0.5\,(\text{Mitigation Index}_2)$$

Where *Mitigation Index$_n$ = Mitigation Index for Component n.*

If the only runoff destination is to surface water (i.e. there is no infiltration from the SuDS to groundwater), the surface water mitigation indices should be used.

Where the principal destination of the runoff is to groundwater, then the groundwater indices should be used. This will be the case, even for infiltration systems that are designed to discharge to surface waters once the infiltration capacity is exceeded – In this scenario, the overflow will often not need to be treated prior to discharge to surface waters as the risk will be low (highly contaminated flows will have been treated prior to infiltration) and dilution will be high.

In England and Wales, if the principal runoff destination is intended to be to surface water, but some infiltration (even in small amounts) may occur through unlined components, then the groundwater indices should be used for the proportion of runoff that discharges to groundwater and the surface water indices used for the proportion of runoff that discharges to surface waters. In Scotland & Northern Ireland, groundwater risk management is not a requirement for this scenario.

Table 2: SuDS mitigation indices for discharges to surface waters (Source: Extended and reproduced from The SuDS Manual Table 26.3)

Type of SuDS Component	Mitigation Indices[1]		
	TSS	Metals	Liquid Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention System	0.8	0.8	0.8
Permeable Pavement	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond[3,4]	0.7[3]	0.7	0.5
Wetland[4]	0.8[3]	0.8	0.8
First Defense® Vortex Separator	0.5[a]	0.33[c]	0.4[d]
Downstream Defender® Advanced Vortex Separator	0.5[a]	0.4[c]	0.8[a]
Up-Flo™ Filter	0.8[a]	0.69[c, e]	0.4[d]
Hydro-Biofilter™ Bioretention System	0.8[b]	0.8[b]	0.8[d]

Notes:

1) SuDS components only deliver these indices if they are designed and constructed for both hydraulics and treatment in accordance with the relevant technical chapters of the SuDS Manual (C753) and the Guidance on Construction of SuDS (C768). Designers and installers of SuDS components should be able to demonstrate competence in their respective areas.
2) Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
3) Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment (TSS) should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
4) Where a wetland is not specifically designed to provide significantly enhanced treatment performance, it should be considered as having the same mitigation indices as a pond.
5) Performance basis for Hydro StormTrain® Series of Proprietary Treatment Devices:
   a) Derived from 3rd party testing and / or verification programmes. Test reports available on request.
   b) Derived from testing and / or monitoring. Test reports available on request.
   c) Derived from partitioning of sediment bound and dissolved contaminants and associated testing. Evidence available on request.
   d) Based on typical values for components of this type.
   e) Dependant on filter media used.
6) SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA's Regulatory Method 08 (WAT-RM-08) provides further information on the regulation of surface water discharges from built developments in Scotland.

Table 3: SuDS mitigation indices for discharges to groundwater (Source: Extended and reproduced from The SuDS Manual Table 26.4)

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	Mitigation Indices		
	TSS	Metals	Liquid Hydrocarbons
A layer of dense vegetation underlain by soil with good contaminant attenuation potential[2] of at least 300mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment) underlain by soil with good contaminant attenuation potential[2] of at least 300mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment and including a geotextile at the base separating the foundation from the subgrade) underlain by soil with good contaminant attenuation potential[2] of at least 300mm in depth[3]	0.7[4]	0.6	0.7
Bioretention underlain by soil with good contaminant attenuation potential[2] of at least 300mm in depth[3]	0.8[4]	0.8	0.8
Flow through Proprietary Treatment System prior to infiltration SuDS	**TSS**	**Metals**	**Liquid Hydrocarbons**
First Defense® Vortex Separator	0.5[a]	0.33[c]	0.4[d]
Downstream Defender® Advanced Vortex Separator	0.5[a]	0.4[c]	0.8[a]
Up-Flo™ Filter	0.8[a]	0.69[c,e]	0.4[d]
Hydro-Biofilter™ Bioretention System	0.8[b]	0.8[b]	0.8[d]

Notes:

SuDS components only deliver these indices if they are designed and constructed in accordance with the relevant technical chapters of the SuDS Manual (C753) and the Guidance on Construction of SUDS (C768). Designers and installers of SuDS components should be able to demonstrate competence in their respective areas.

1) All designs must include a minimum of 1m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level (as required by infiltration design – see The SuDS Manual Chapter 25).
2) For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance.
3) Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.
4) If significant amounts of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure. It is recommended to remove sediment prior to the infiltration system as far as reasonably practical.
5) Performance basis for the Hydro StormTrain® Series of Proprietary Treatment Devices:
    a) Derived from 3rd party testing and / or verification programmes. Test reports available on request.
    b) Derived from testing and / or monitoring. Test reports available on request.
    c) Derived from partitioning of sediment bound and dissolved contaminants and associated testing. Evidence available on request.
    d) Based on typical values for components of this type.
    e) Dependant on filter media used.
6) SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA's Regulatory Method 08 (WAT-RM-08) provides further information on the regulation of surface water discharges from built developments in Scotland.

IMPORTANT NOTES:

- Where the indices are not considered representative by the designer, a more detailed risk assessment can be undertaken.
- Components should always be designed for treatment, as described in the relevant technical guidance set out in the individual component chapters of The SuDS Manual. **If they are incorrectly designed, constructed or inadequately maintained, their treatment performance could be significanty adversely affected.**
- Where the infiltration component itself does not provide sufficient pollution mitigation, the design should include upstream SuDS components that are lined to prevent infiltration from occurring until sufficient treatment has taken place.

Step 3: Consider the need for a precautionary approach where discharges are to protected waters

Reference should be made to local standards, planning requirements and guidance, particularly with reference to discharges to protected waters where more detailed risk assessments or enhanced treatment may be required.

Case Studies:

Small is Beautiful

A First Defense® provided a much-needed small footprint solution to meeting regulatory requirements on a confined site for a new commercial office development in Perkins Township, Ohio.
TSS was the main pollutant of concern and although the Simple Index Approach was not in use in Ohio at the time of installation, retrospectively considering this approach would give:

TSS Hazard Index (Office Development) = 0.5
First Defense® TSS Mitigation Index = 0.5

Mitigation Index ≥ Hazard Index

Pollution Protection in Whisky Country

Poor drainage, flooding and freezing weather led to a landslip and extreme surface degradation along a section of the narrow A95 near Elgin. Although it pre-dated the new SuDS Manual risk based approach, treatment was vital as the surface water runoff destination was to an area world-renowned for the production of single malt whiskey and an important salmon fishery.
A Downstream Defender® advanced hydrodynamic vortex separator minimises the risk of sediment and hydrocarbon pollution reaching the sensitive watercourse.

Downstream Defender® Mitigation Indices:
TSS = 0.5
Heavy Metals = 0.4
Liquid Hydrocarbons = 0.8

Fine Filtration enables Mixed-Use Development

Environment Agency planning conditions for a new commercial access road to retail and light commercial units as part of a mixed-use development in Faversham, Kent, required treatment prior to infiltration.
A bypass separator provides important spill protection for liquid hydrocarbons, prior to an Up-Flo™ Filter that ensures fine filtration of sediments and associated contaminants, such as Polycyclic Aromatic Hydrocarbons (PAHs). Although the installation pre-dates the Simple Index Approach, retrospective consideration of the approach gives:

Contaminant	TSS	Metals	PAHs
Hazard Indices	0.7	0.6	0.7
Up-Flo™ Filter Mitigation Indices	0.8	0.69	0.72

Stringent Quality Control, Naturally

Hydro Biofilter™ have brought attractive landscaping and stringent surface water quality control to a sensitive location in Barry, South Wales.
3 units were retrofitted to the Business Support Centre car park as part of a wide urban regeneration scheme, effectively removing pollutants prior to discharge into the adjacent, rejuvenated harbourside.

Contaminant	TSS	Metals	Hydro-carbons
Hazard Indices	0.7	0.6	0.7
Hydro Biofilter™ Mitigation Indices	0.8	0.8	0.8

Simple Index Approach (SIA) Tool

A SIA spreadsheet tool has been developed by HR Wallingford on behalf of the Scottish Environment Protection Agency (SEPA) to support the implementation of the Simple Index Approach. The tool is freely available to download at www.susdrain.org/resources/SuDS_Manual.html.
The spreadsheet tool works through the Simple Index Approach Design Steps:

Step 1: Define pollution hazard indices

	Runoff Area Land Use Description	*Hazard Level*	*Pollution Hazard Indices* Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Non-residential car parking with frequent change (eg hospitals, retail)	Medium	0.7	0.6	0.7
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Medium**	**0.7**	**0.6**	**0.7**

Step 2: Determine SuDS Pollution Mitigation Indices

	SuDS Component Description			*Pollution Mitigation Indices* Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list:	Pond or wetland	0		0.7	0.7	0.5
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list:	None	0		0	0	0
If the proposed SuDS components are bespoke proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:	Downstream Defender	SuDS Component 1	SuDS Component 1	0.5	0.4	0.8
		SuDS Component 2				
		SuDS Component 3				
	Aggregated Surface Water Pollution Mitigation Index			**0.85**	**0.75**	**>0.95**

Calculation of Total SuDS Mitigation Indices and Results

	Combined Pollution Mitigation Indices Total Suspended	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	**0.85**	**0.75**	**>0.95**

	Sufficiency of Pollution Mitigation Indices Suspended Solids	Metals	Hydrocarbons
	Sufficient	**Sufficient**	**Sufficient**

The Hydro StormTrain® Series of Surface Water Treatment Devices

Each Hydro StormTrain® device delivers proven, measurable and repeatable surface water treatment performance. Each can be used independently to meet the specific treatment needs of a site; or can combined with one another or in conjunction with other SuDS components to form a mangament train; or can be used to protect and enhance SuDS features less suited to providing the first stage of treatment or more prone to failure due to sedimentation or shock loads associated with spills.

First Defense®
Vortex Separator

Downstream Defender®
Advanced Hydrodyanmic Vortex Separator

Up-Flo™ Filter
Fluidised Bed Up Flow Filtration System

Hydro Biofilter™
Bioretention System

Learn more…

Enquire about our SuDS Treatment Devices and Support Services

Hydro International's design, advisory, inspection & maintenance services can reduce the costs and risks associated with selecting, installing and maintaining SuDS.

Contact the team today:
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Email: sudsservices@hydro-int.com
Visit: www.hydro-int.com/sudsservices

Hydro International is a global leader in sustainable technologies for the control and treatment of stormwater and wastewater. For more than 30 years, Hydro has been at the forefront of water industry innovation and product development. From housing developments and municipal sewage works to paper mills and public highways, thousands of Hydro products are operating in countries all over the world. With strong bases in both the United States and the United Kinbgdom, and a network of partners and agents, Hydro is strategically placed to deliver winning technological solutions to customers wherever they are in the world.

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