

APPENDIX 4

ACCESS ARRANGEMENTS

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Notes

1. This drawing is based on survey information supplied by Survey Solutions, and Motion cannot guarantee the accuracy of the data provided.
2. Preliminary access design subject to confirmation of highway boundary information.

Legend

Highway Boundary

B	Boundaries	EU	EU	AW	15/10/2024
A	Highway Boundary	EU	EU	AW	15/10/2024
-	First Issue	EU	EU	AW	16/09/2024
Rev.	Description	Drm	Chk	App	Date

Drawing Status:

FOR PLANNING
NOT FOR CONSTRUCTION



Client:

Hines Associates

Project:

North Lane, Marks Tey

Title:

Proposed Access Arrangement
Eastern Parcel

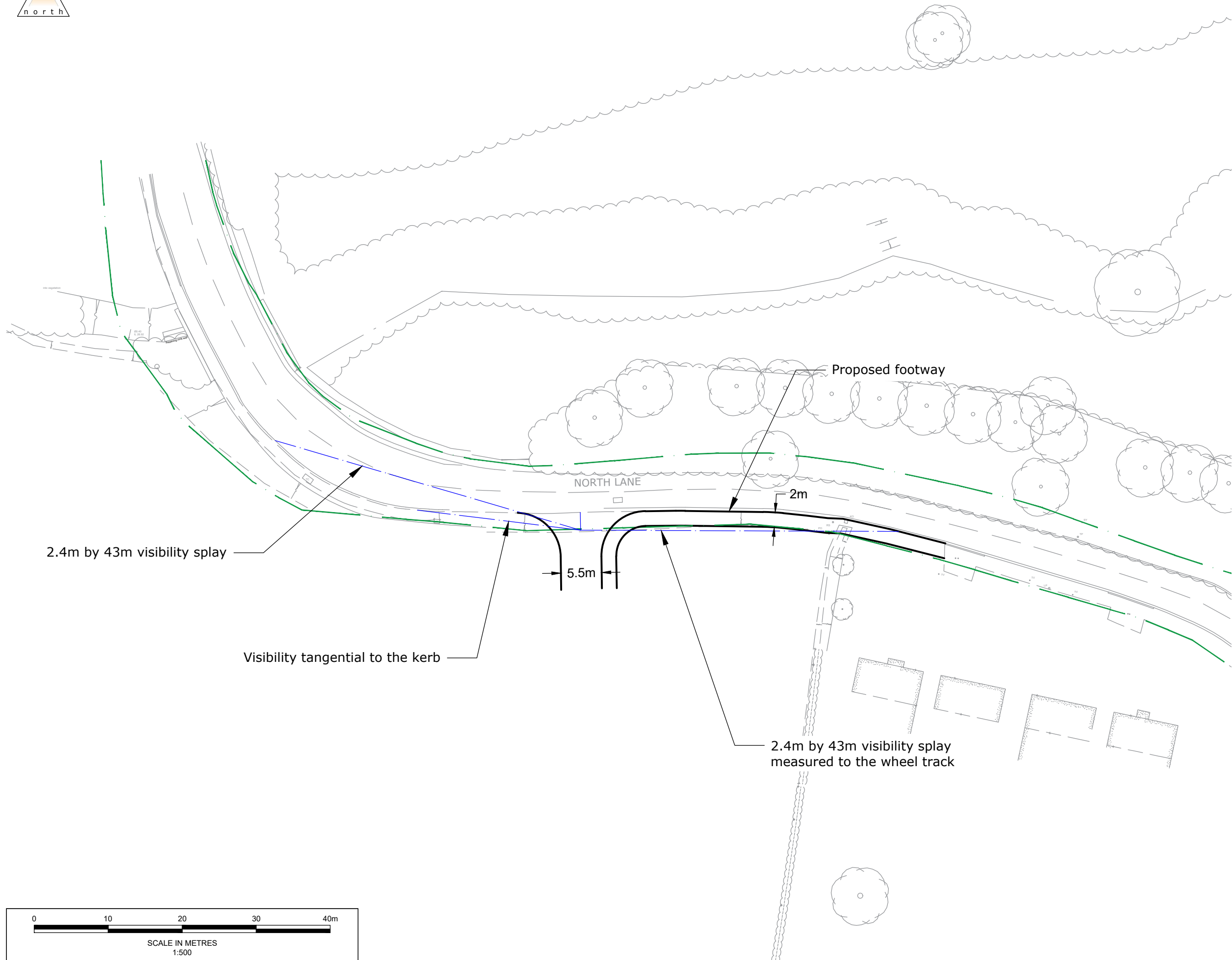
Scale: 1:500 (@ A3)

Drawing:

2407046-02

Revision:

B



Notes

1. This drawing is based on survey information supplied by Survey Solutions, and Motion cannot guarantee the accuracy of the data provided.
4. Highway boundary information obtained from Essex County Council and based on OS mapping, Motion cannot guarantee the accuracy of the data provided.

Legend

— Highway Boundary

B	Boundaries	EU	EU	AW	15/10/2024
A	Highway Boundary	EU	EU	AW	15/10/2024
-	First Issue	EU	EU	AW	16/09/2024
Rev.	Description	Drm	Chk	App	Date

Drawing Status:

FOR PLANNING
NOT FOR CONSTRUCTION



Client:
Hines Associates

Project:
North Lane, Marks Tey

Title:
Proposed Access Arrangement
Western Parcel

Scale: 1:500 (@ A3)

Drawing: 2407046-01 Revision: B

APPENDIX 5

ECOLOGY PRELIMINARY REVIEW

Preliminary Ecological Review: Constraints and Opportunities

Land at North Lane, Marks Tey, Colchester

(ref: ESEC/24071/01)

Introduction and Methodology

Essential Ecology (ESEC) has been commissioned by Richard Hines to provide ecological services in respect of land at North Lane, Marks Tey, Colchester, hereafter referred to as the site (centred at OS grid reference TL91792434).

To inform the appraisal of ecological constraints and opportunities of potential development at the site, a desk study of freely available resources (including the Multi-Agency Geographic Information for the Countryside (MAGIC) database and ancient tree hunt database) and a site walkover and appraisal have been undertaken by Essential Ecology in September and October 2024.

Ecological Designations

Preliminary Assessment

No international statutory designations are present within or adjacent to the site. However, the site lies within the zone of influence of a group of designations collectively known as the Essex Coastal sites.

No statutory ecological designations are present within or adjacent to the site. The nearest statutory ecological designation is Chalkney Wood Site of Special Scientific Interest (SSSI), located c.4.7km north west of the site. A statutory geological designation, Marks Tey Brickpit SSSI, has also been identified immediately west of the site (see drawing ESEC/24071/01-01).

Broad information on the location of non-statutory designations has been obtained from the Colchester City Council interactive policies map. No non-statutory designations have been identified within the site. The nearest identified non-statutory designation is Marks Tey Brickpit Local Wildlife Site (LWS), located beyond the railway line to the west of the site.

Constraints and Opportunities

With regards to the Essex Coastal sites, Colchester Borough Council advise that population growth in Essex is likely to significantly affect these designations through increased recreational disturbance in combination with other Local Plans. Colchester Borough Council, along with other Local Planning

Authorities in Essex, has agreed to the '*Recreational Disturbance Avoidance and Mitigation Strategy (RAMS) for the Essex Coast*'. The RAMS identifies necessary measures to avoid and mitigate likely significant effects from recreational disturbance in-combination with other plans and projects. In order to fund these measures, all residential developments within the zone of influence will pay a 'per dwelling' tariff. As of 2024, this tariff is set at £163.86 per dwelling. A shadow Appropriate Assessment will also be required to inform any future planning application for the site on the basis that the proposals will result in a net increase in excess of 100 units.

A review of the Impact Risk Zones for Sites of Special Scientific Interest (SSSI IRZs) indicates that at the site's location, Natural England would expect to be consulted in respect of proposed residential developments which result in a net increase of 100 units or more, in relation to Chalkney Wood SSSI. It is anticipated that the proposals will result in a net increase in excess of 100 units and therefore early consultation with Natural England is advised. Proposed residential development at the site would be unlikely to have a harmful effect on any other more distant statutory ecological designations within the local area.

The proposed development has potential to result in indirect impacts on Marks Tey Brickpit. In order to ensure this designation is fully safeguarded throughout construction, suitable mitigation measures would be implemented throughout habitat clearance/construction works. Despite the geographic proximity, the site is well separated from the designation by the railway line and not connected by any public rights of way. On this basis, the proposed development is considered unlikely to result in any adverse impacts as a result of increased recreational pressure. No impacts on any other more distant non-statutory designations are anticipated as a result of proposed development at the site.

Specific consideration is not given to the geological designation, Marks Tey Brickpit SSSI, within this report. It is understood that a geological consultant has been brought in to advise on this matter.

Habitats

Preliminary Assessment

The site is dominated by grassland (likely modified grassland or poor condition other neutral grassland) and arable land, along with areas of scrub (Bramble and mixed), trees (including mature specimens), woodland, native hedgerows, tree lines, wet ditches and a watercourse at the field boundaries.

The majority of the site is of limited ecological significance. Habitats of elevated value in the context of the site are generally restricted to the field boundaries and include woodland, semi-mature to mature trees, native hedgerows, tree lines and the watercourse. In particular, hedgerows and tree lines likely qualify as Priority Habitat, whilst consideration will need to be given to whether the areas of woodland and the watercourse are likely to qualify as Priority Habitat as part of further habitat survey work.

Constraints and Opportunities

In order to inform any future planning application for the site, it is recommended that an extended UKHab survey is undertaken in order to accurately classify and assess habitats (including in order to assess qualification as Priority Habitat), whilst it is also recommended that any arboricultural survey undertaken pays particular attention to mature trees at the site to establish/rule out presence of any veteran trees. In order to ensure retained onsite and offsite habitats in the local area are fully safeguarded throughout construction, suitable measures would need to be implemented throughout habitat clearance/construction works.

Given the location of habitats of value at the field boundaries, residential development at the site could be sensitively designed to retain these habitat features as part of any future development. The opportunity also exists to enhance retained habitats at the site through the implementation of ecologically-led management. In particular, it is understood that areas within the north of the site are located within the flood plain and therefore unlikely to be suitable for residential development. The proposals would therefore present an opportunity to provide ecological enhancements within the flood plain which would not be brought forward in the absence of development.

Protected Species

As part of the site walkover, general observations were made of any faunal use of the site, with particular attention paid to the potential presence of protected or notable species. A preliminary assessment of the site's likely value to faunal groups is set out below:

Roosting Bats

Preliminary Assessment

No buildings/built structures are present within the site. A number of established trees are present within the site which may provide opportunities for roosting bats. Indeed, during the site walkover a number of trees were incidentally noted to be suitable for roosting bats.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that a ground-level tree assessment (GLTA) is undertaken of trees within the site to inform any future planning application. In accordance with best practice guidance, any trees to be lost/impacted as a result of any future residential development at the site would be subject to climbed aerial inspection(s) and recategorised accordingly. The requirement for any mitigation and indeed licensing would be informed by the results of the survey and would be in line with best practice guidance.

Any proposals for the site would be sensitively designed to retain trees suitable to support roosting bats, where feasible. The proposals also present an opportunity to provide an enhancement for bats through the creation of new roosting opportunities in the form of bat boxes/roost units on

buildings/retained trees. Placement of such features within areas of woodland and along the watercourse corridor would also maximise likelihood of use.

Foraging and Commuting Bats

Preliminary Assessment

The site provides opportunities for foraging and commuting bats, in the form of woodland, scrub, tree lines, hedgerows and the watercourse. The site also appears well connected to larger areas of offsite woodland and reservoirs/ponds within the local area. As such, the site is likely to be of moderate potential for foraging and commuting bats.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that seasonal nighttime bat walkovers and monthly static activity surveys are undertaken. Survey work should be undertaken in accordance with best practice guidance. The requirement for any mitigation would be informed by the results of the survey and would be in line with best practice guidance. In order to minimise impacts on foraging and commuting bats using the site, a sensitive lighting scheme would also be designed for the site. This would aim to minimise increased impacts of lighting, particularly within retained woodland, tree lines, hedgerows and the watercourse corridor.

The proposals for the site would be sensitively designed to retain features of value to foraging and commuting bats, including woodland, scrub, hedgerows, tree lines and the watercourse, where feasible. The proposals also present an opportunity to enhance the site for bats through implementation of ecologically-led habitat management at the site and creation of additional habitats of value, such as species-rich other neutral grassland.

Badger

Preliminary Assessment

No evidence of Badger was recorded at the site. Opportunities for foraging Badger are present, particularly in the form of woodland, hedgerows, tree lines, scrub and the watercourse, whilst opportunities for sett building are also present.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that a Badger survey is undertaken. Given the lack of evidence recorded as part of the site walkover, the site is unlikely to be of high importance to the local Badger population. Nevertheless, should any Badger setts be identified, consideration will be given to whether these could be sensitively retained as part of any future proposals for the site. The requirement for any mitigation would be informed by the results of the survey and the proposals for the site. Regardless, in order to ensure individual Badgers are fully safeguarded throughout construction, suitable mitigation measures would be implemented throughout habitat clearance/construction works.

The proposals for the site would be sensitively designed to retain features of value to Badger, including woodland, scrub, hedgerows and the watercourse, where feasible. The proposals present an opportunity to enhance the site for Badger (and other mammals) through the implementation of ecologically-led habitat management and the inclusion of fruit and nut bearing species as part of any proposed landscaping.

Dormouse

Preliminary Assessment

The site provides opportunities for Dormouse, in the form of woodland, scrub, tree lines and hedgerows, whilst the site also appears well connected to larger areas of offsite woodland within the local area. Populations of Dormouse are known to be present within the county, albeit Essex is not a stronghold for this species.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that Dormouse survey surveys are undertaken. The requirement for any mitigation and indeed licensing would be informed by the results of the survey and would be in line with best practice guidance.

The proposals would be sensitively designed to retain features of value to Dormouse, including woodland, scrub, hedgerows and tree lines, where feasible. The proposals present an opportunity to enhance the site for Dormouse through the implementation of ecologically-led habitat management (particularly woodland and hedgerows), the inclusion of planting beneficial for Dormouse and the provision of Dormouse boxes within areas of retained woodland.

Water Vole and Otter

Preliminary Assessment

The site provides opportunities for Water Vole in the form of the watercourse and associated corridor and wet ditches. These habitats, as well as areas of woodland and scrub, also provide opportunities for Otter. It is understood that Water Vole are rare within the county and therefore reasonably unlikely to be present. Conversely, it is understood that the number of Otter populations across the county are on the increase.

Constraints and Opportunities

Consideration of Otter (and to a lesser extent Water Vole) surveys will need to be given as part of any future planning application. The requirement for such survey work will be dependent on the proposals and likely impacts to the watercourse itself. Where the watercourse is impacted (e.g., insufficient buffer between development and the watercourse, creation of bridges, creation of outfalls etc.), surveys are more likely to be required. The requirement for any mitigation and indeed licensing would be informed by the results of the survey and would be in line with best practice guidance.

The proposals would be sensitively designed to retain features of value to Water Vole & Otter, including the watercourse and associated corridor, wet ditches, woodland and scrub, where feasible. The proposals present an opportunity to enhance the site for Water Vole and Otter through the implementation of ecologically-led habitat management and incorporation of suitable habitat as part of drainage schemes.

Birds

Preliminary Assessment

Given the nature of the site which includes a variety of habitats, the site has potential to support a variety of bird assemblages. Opportunities for nesting and foraging are afforded by woodland, trees, hedgerows, tree lines, scrub and the watercourse, whilst arable land may also provide opportunities for farmland bird specialists.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that breeding bird surveys are undertaken. The requirement for any mitigation (for example Skylark plots) would be informed by the results of the survey. Regardless, in order to safeguard nesting birds during habitat clearance works, a pre-clearance check of suitable nesting habitat should be undertaken.

The proposals for the site would be sensitively designed to retain features of value to birds, including woodland, scrub, tree lines, trees, hedgerows and the watercourse, where feasible. The proposals present an opportunity to provide an enhancement for birds through the implementation of ecologically-led management of habitats and creation of new nesting opportunities in the form of bird boxes/units on buildings/trees, including those specifically targeting declining urban species. Enhancements for foraging birds could be provided through the inclusion of fruit and nut bearing species within proposed planting.

Reptiles

Preliminary Assessment

The site provides opportunities for reptile species, in the form of outgrown grassland, scrub, woodland and the base of hedgerows, whilst the site is connected to suitable habitat within the wider landscape via the watercourse and the adjacent railway. Furthermore, common reptile species, such as Grass Snake and Slow-worm, are known to be present within the local area.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that reptile surveys are undertaken. The requirement for any mitigation (for example a trapping and translocation exercise and/or the implementation of sensitive habitat clearance) would be informed by the results of the survey.

The proposals for the site would be sensitively designed to retain features of value to reptiles, including woodland, scrub, hedgerows and the watercourse, as well as grassland particular within the flood plain. The proposals also present an opportunity to provide an enhancement for reptiles through the implementation of ecologically-led management of habitats and creation of new hibernacula.

Great Crested Newts

Preliminary Assessment

Two ditches (which held water at the time of survey) are present within the site, whilst two large waterbodies have been identified within 250m of the site. In terms of terrestrial habitat, the site provides opportunities for Great Crested Newts in the form of outgrown grassland, scrub, hedgerow bases and to a lesser extent woodland.

Natural England Great Crested Newt District Licensing is operational within Essex. The site appears to be located with a 'green zone' which indicates that this species is sparsely distributed in this area.

Constraints and Opportunities

In order to inform any future planning application at the site, it is recommended that an appraisal, to include a habitat suitability index (HSI) assessment, is undertaken of the onsite ditches and offsite waterbodies within 250m of the site. Any waterbodies assessed to be suitable could be subject to further survey work in the form of an eDNA survey and/or traditional presence/absence surveys. The requirement for any mitigation and indeed traditional licensing would be informed by the results of the survey. Alternatively, the District Licensing route could be taken which would remove the requirement for provision of onsite mitigation.

The proposals for the site would be sensitively designed to retain features of value to Great Crested Newts, including ditches, scrub, hedgerows and the watercourse, as well as pockets of grassland. The proposals present an opportunity to provide an enhancement for Great Crested Newts (and other amphibians) through the implementation of ecologically-led management of habitats, incorporation of suitable habitat as part of drainage schemes and creation of new hibernacula.

Invertebrates

Preliminary Assessment

Habitats which may be of elevated value in the context of the site, include scrub, other broadleaved woodland, hedgerows, trees, tree lines and the watercourse, as well as areas of deadwood. These habitats however appear to be common in the local area, whilst no evidence to suggest that the site would be of elevated value for invertebrate species was identified.

Constraints and Opportunities

The proposals for the site would be sensitively designed to retain features of value to invertebrates, including woodland, scrub, hedgerows, tree lines, trees and the watercourse, where feasible. The opportunity exists to enhance retained habitats through the implementation of ecologically-led

management which would benefit invertebrate species. The proposals also present the opportunity to enhance the site for invertebrates through the provision of habitat features, such as bee bricks within the fabric of proposed buildings and provision of invertebrate boxes and buried log piles within areas of retained habitats/landscaping.

Consideration of Biodiversity Net Gain

Habitats

It is recommended that habitat condition assessments of the areas of grassland scrub, trees and woodland are undertaken to inform the assessment of Biodiversity Net Gain (BNG).

The western extent of the site is dominated by arable land in the form of cereal crops. Arable land is assigned a 'nil' value within the Statutory Metric and therefore considered suitable for development.

The eastern and central portions of the site are dominated by grassland (likely modified grassland or poor condition other neutral grassland). The value of the grassland within the metric would be determined following the UKHab survey and condition assessment survey. Given the apparent nature of the grassland habitat within the site (i.e., modified or poor condition other neutral), the value within the metric is anticipated to be higher than that of arable but amongst the lower scoring of all the grassland types. Areas of grassland are therefore considered to be suitable for development, albeit compensatory grassland habitats and/or enhancement of retained grassland would likely be required as part of any scheme. Similarly, replacement and/or enhancement of areas of scrub would also likely be required to compensate for any losses. It is understood that the central parcel and the northern extent of the eastern parcel is located within the flood plain and therefore unlikely suitable for development. These areas therefore provide opportunities for bring forward biodiversity benefits which could significantly contribute to the biodiversity net gain score.

Onsite habitats which are of comparatively higher value within the metric include woodland and trees which are more than or equal to 30cm diameter at breast height. A concerted effort would be made to ensure these habitats are retained and where feasible enhanced within areas of greenspace as part of any future proposals. Replacement tree planting would also be provided as part of any proposals.

Given that the scheme would deliver 'significant onsite enhancements', Colchester Borough Council may also require habitat management prescriptions for the site which would be set out within a Habitat Management and Monitoring Plan (HMMP).

Hedge Features

It is recommended that habitat condition assessments of hedgerows and tree lines are undertaken to inform the assessment of Biodiversity Net Gain (BNG).

The majority of hedgerows and tree lines at the site are located at the site boundaries and the site has been sensitively designed to ensure the majority are incorporated in to the landscaping scheme. Hedgerows and tree lines would be retained outside of curtilages wherever feasible to ensure their long-term retention. Enhancements to the hedgerow network could also likely be made through the provision of additional planting to increase species-richness, the addition of standard trees and removal of non-native/naturalised species, as well as creation of additional lengths of native hedgerow.

Watercourse Features

The watercourse at the site would be retained within a buffer of greenspace as part of any proposals. Given the location of the watercourse within the site boundary, a River Condition Assessment (RCA) survey will be required to inform any future planning application. In this instance, the proposals would be required to demonstrate a 10% net gain in watercourse units at the site. It is recommended that at the detailed design stage any works which would directly impact the watercourse, such as creation of outfalls or creation/modification of a bridge, are avoided, where feasible. There is scope to incorporate watercourse enhancements as part of any future scheme, however it is noted that the watercourse is for the most part a semi-natural feature and therefore it is unlikely that any onsite enhancement scheme would be significant enough to uplift the watercourses condition within the metric.

Summary

Early consideration is being given to BNG in the design process in order to ensure any proposals for the site are sensitively designed for the benefit of biodiversity. As set out above, such benefits focus on retention of existing habitats, hedgerow features and watercourse features and provision of enhancements focused within the area of floodplain which is not suitable for development and retained habitats. It is noted that it is not always feasible to demonstrate a net gain in watercourse units within the site even where watercourses are treated sensitively as part of the masterplan design process and there may therefore be a requirement to purchase offsite units in order to achieve the statutory 10% net gain requirement.

Ecology Input into the Planning Submission

In order to inform the planning submission, the following surveys are recommended:

- Desktop study (to include a data search from the Local Records Centre)
- Extended UKHab Survey
- Habitat Condition Assessments
- Ground-level tree Assessment (GLTA) for roosting bats
- Aerial Tree Climbing Inspection for roosting bats (where trees suitable for roosting are lost/impacted)
- Foraging and Commuting Bat Surveys - nighttime bat walkovers

- Foraging and Commuting Bat Surveys - automated detector surveys
- Badger Survey
- Dormouse Surveys
- Water Vole and Otter Surveys
- Breeding Bird Surveys
- Habitat Suitability Index (HSI) Assessments for Great Crested Newts (not necessarily required under the District Licensing route)
- eDNA/Traditional Surveys for Great Crested Newts (not necessarily required under the District Licensing route)
- Reptile Surveys

Natural England will need to be consulted in relation to potential impacts of proposed development at the site on statutory ecological designations.

The following reports, informed by the survey work and consultation with Natural England, would be submitted to inform the planning application:

- Ecological Impact Assessment (EcIA)
- Biodiversity Gain Statement
- Habitat Management and Monitoring Plan (HMMP) (possibly required, confirm with Colchester Borough Council at the appropriate stage)
- Shadow Appropriate Assessment (Shadow AA)

Conclusion

The site comprises a variety of common habitats (including Priority Habitats) and has the potential to support a variety of protected species. A suite of ecological survey and assessment work will therefore be required to inform the site design and ensure habitats of value in their own right and/or for their value to protected species are retained and enhanced, where feasible. Consideration will also need to be given to ecological designations, in consultation with Natural England, to ensure any increases in recreational pressure resulting from the proposed development are suitably mitigated for.

Overall, on the basis of the information currently available and subject to the implementation of the above surveys/recommendations, it is considered that the site is suitable for development, whilst the opportunity exists to bring forward biodiversity benefits which would not be brought forward in the absence of the proposals. Such benefits would be quantified through completion of the statutory metric and where it is not possible to demonstrate a 10% net gain within the site itself, consideration would be given to the purchase of offsite units.



Key:

- Site boundary
- Modified grassland
- Cereal crops
- Mixed scrub
- Bramble scrub
- Woodland
- Tree
- Hedgerow
- Tree line
- Wet ditch
- Watercourse
- Offsite pond
- Offsite Marks Tey Brickpit SSSI

Project:
Land at North Lane, Marks Tey, Colchester

Drawing Title:
Habitats & Ecological Features

Drawing No:
ESEC/24071/01-01

Date:
October 2024



a: 25 Katmandu Road, Bromsgrove, Worcestershire, B60 2SP
t: 07841 042796 | e: info@essentialecology.co.uk
w: www.essentialecology.co.uk

APPENDIX 6

FLOOD RISK ASSESSMENT

Flood Risk and Drainage Appraisal

Site: Land at North Lane, Marks Tey, Colchester
Prepared by: VBH
Approved by: JM
Date: 14th October 2024

motion
84 North Street
Guildford
GU1 4AU
Tel: 01483 531300
www.motion.co.uk

1.0 Introduction

- 1.1 This Flood Risk and Drainage Appraisal has been prepared by Motion on behalf of Bidwells LLP in support of development on Land at North Lane, Marks Tey, Colchester. The nearest grid reference is E 591553 N 224325 and postcode CO6 1EG.
- 1.2 The site is formed of three parcels: known as the western parcel, the eastern parcel and the northern parcel. This is illustrated in Figure 1.1 and a site location plan can be found in **Appendix A**. The Roman River runs along the northern boundary of the Western Parcel and Eastern Parcel and through the centre of the Northern Parcel. The Roman River is a tributary of the River Colne. The Western and Northern parcels are open farmland. The Eastern parcel is also open farmland and the edge abuts the railway lines of the Great Eastern Mainline.

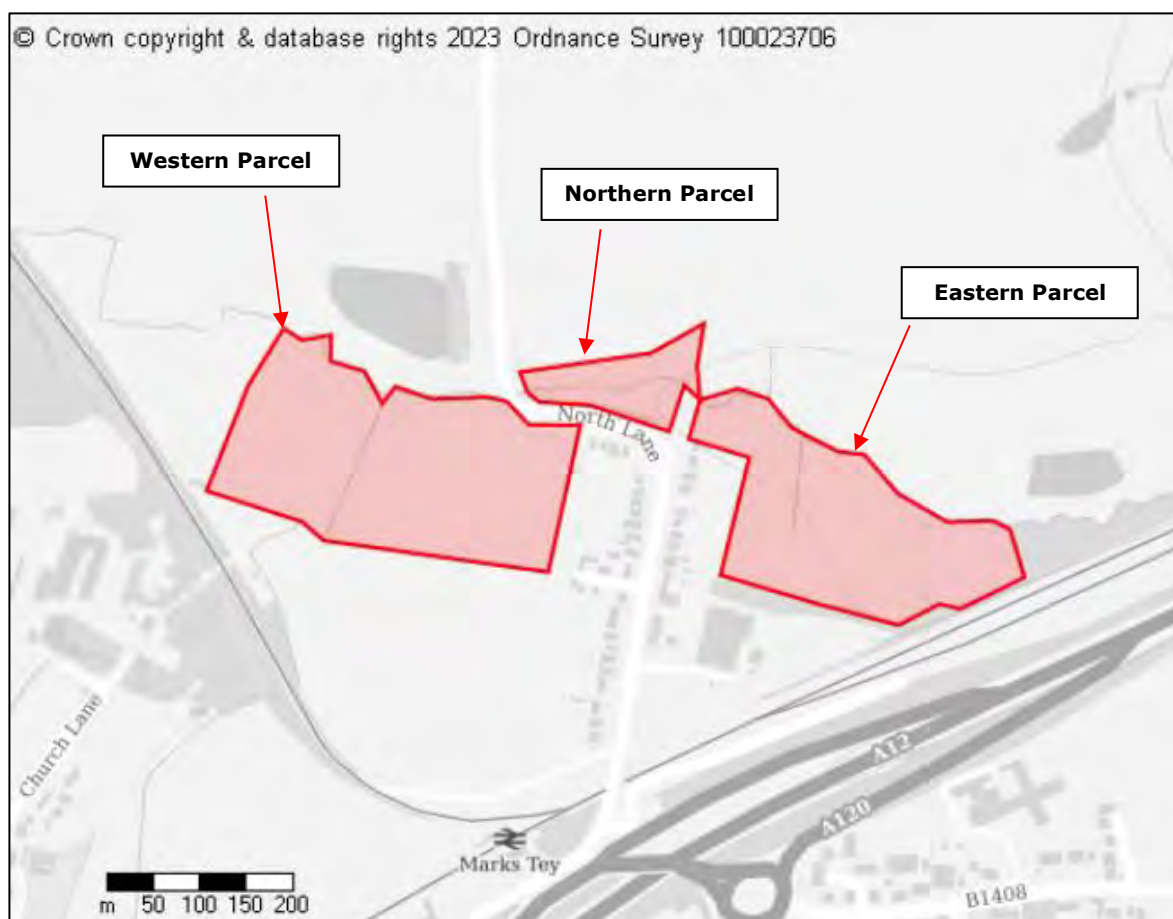


Figure 1.1 Site location plan

- 1.3 This report considers the flood risk and potential drainage matters associated with the potential development of the site, in particular the flood risk associated with rivers, surface water and groundwater.
- 1.4 The site is located within Flood Zone 1 (less than 1 in 1,000 annual probability of flooding from rivers or the sea), Flood Zone 2 (between 1 in 1,000 and 1 in 100 annual probability of flooding from rivers or the sea)

and Flood Zone 3 (more than 1 in 100 annual probability of flooding from rivers or the sea). Therefore, a Flood Risk Assessment (FRA) will be required as part of any future planning application.

2.0 Site Description

- 2.1 The proposed development site comprises of existing open field and farmland. The site can be described as greenfield development. The Western parcel is approximately 7.36 hectare (ha), the Northern parcel is approximately 1.46 ha and the Eastern parcel is 5.15 ha. The nearest main river to the site is the Roman River which runs along the northern boundary of the Western and Eastern parcels and through the centre of the Northern parcel. There are also some small drainage ditches which drain into the Roman River. There is a small drainage ditch which cuts through the centre on the Western parcel and another which cuts through the centre of the Eastern parcel.

Geology

- 2.2 The Department for the Environment, Food and Rural Affairs (Defra's) Magic Map states that soils in the area are 'slightly acid loamy and clayey soils with impeded drainage'.
- 2.3 The British Geological Survey (BGS) online Geoindex Mapping indicates that the site is underlain by London Clay Group which is made up of clay, silt and sand with superficial deposits of interglacial deposits which is also made up of silt and clay. Boreholes local to the site were investigated and the nearest available borehole is located on North Lane, adjacent to the western parcel. This Borehole record supports the findings of the BGS mapping and confirms that the site is likely to be underlain by clay. The Borehole record can be found in **Appendix B**.
- 2.4 Literature values for infiltration in clay soils (BS 7533-13:2009) suggest that infiltration rates are typically in the order of 10^{-8} to 10^{-10} . Table 25.1 of CIRIA C753 supports this by suggesting infiltration rates of less than 3×10^{-8} are likely. Infiltration rates lower than 1.0×10^{-6} m/s are not generally conducive to infiltration and usually only System B (partial infiltration) infiltration features are possible. If infiltration rates are indeed as low as 10^{-8} , then infiltration would not be possible on the site.

Topography

- 2.5 A topographical survey of the existing site is provided in **Appendix C** of this report. The topographic survey shows that each three parcels of land fall towards the Roman River.
- 2.6 The Western parcel falls in a northerly direction towards the Roman River. The survey shows a drainage ditch located towards the centre of the site which flows in a northern direction towards the Roman River and splits the site into two catchments known as Western Parcel Catchment A (3.07 ha) and Western parcel Catchment B (4.29 ha). The ground levels on the Western parcel range from approximately 33.58 metres Above Ordnance Datum (mAOD) to 29.48 mAOD.
- 2.7 The Eastern parcel falls in a north-easterly direction towards the Roman River. The survey shows a drainage ditch located towards the centre of the site which flows in a northern direction towards the Roman River. The ditch splits the site into three catchments known as Eastern Parcel Catchment A (1.99 ha), Eastern Parcel Catchment B (2.44 ha) and Eastern parcel Catchment C (0.74 ha). The ground levels on the Eastern parcel range from approximately 30.96 mAOD to 28.04 mAOD.
- 2.8 The Northern parcel falls towards the centre of the site towards the Roman River which cuts through the sites centre and splits the site into two catchments known as Northern Parcel Catchment A (0.81 ha) and Northern parcel Catchment B (0.65 ha). The ground levels on the northern parcel range from approximately 29.78 metres mAOD to 28.95 mAOD.
- 2.9 The catchment location plan is shown in Figure 2.1

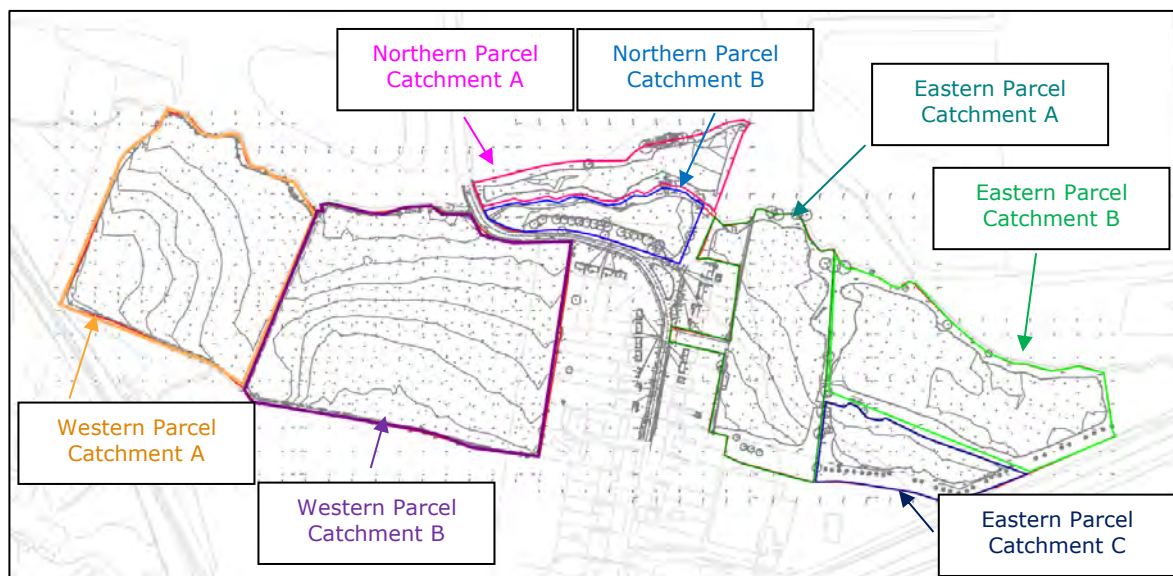


Figure 2.1 Catchment location plan

Existing Drainage Regime

- 2.10 The site can currently be described as a greenfield which is that the site drains to the existing watercourses and/or infiltrate into the ground. Sewer records were requested from Anglian Water to determine the existing surface and foul sewer network in vicinity of the site. Figure 2.2 shows an extract of the Anglian Water sewer records which can be found in full in **Appendix D**. The Asset records indicate that there are no surface water sewers which currently serve the site. There is an existing 150mm foul water sewer which runs along North Lane and connects to a pumping station and pumped across the A12 to the south of the site. The nearest manhole is 7310 which has a cover level of 30.334m AOD and invert level of 27.874m AOD. Due to ground levels on site and that all land parcels have ditches which the foul drainage would need to cross is it understood that for all three parcels the foul drainage would need to be pumped. This would either be to manhole 7310 or to the pumping station south of the A12.



Figure 2.2 Anglian Water Asset Data

3.0 Flood Risk

- 3.1 In this section several potential sources of flooding have been considered and the probability of any likely impacts assessed.

Flooding from Rivers and the Sea

- 3.2 A 'Flood Product 4' data request was submitted to the EA and their response can be found in **Appendix E**. The EA Flood Map shows that the site is located within Flood Zone 1 (less than 1 in 1,000 annual probability of flooding from rivers or the sea), Flood Zone 2 (between 1 in 1,000 and 1 in 100 annual probability of flooding from rivers or the sea) and Flood Zone 3 (more than 1 in 100 annual probability of flooding from rivers or the sea). The EA have confirmed that there is no detailed modelling available of the watercourses in the area so they are unable to provide predicted flood levels and depths. Normally, in these circumstances, an FRA will need to undertake a modelling exercise in order to derive flood levels and extents, both with and without allowances for climate change for the watercourse, in order to inform the design for the site. However, the EA state in their response that they are currently undertaking the National Flood Risk Assessment 2 project which is further improving modelling across the nation and may provide updated modelling for the site. This modelling is expected to be published in early 2025.
- 3.3 The nearest main river to the site is the Roman River which runs along the northern boundary of the western and eastern parcels and through the centre of the northern parcel. There are also some small drainage ditches which drain into the Roman River. There is a small drainage ditch which cuts through the centre on the western parcel and another which cuts through the centre of the eastern parcel.
- 3.4 The EA in their response state that an environmental permit for flood risk activities is required if you want to do work in, under, over or within 8 metres of a fluvial river or any flood defence structure or culvert. Therefore, if the development is within 8m of the Roman River than an environmental permit will be required.
- 3.5 For highly vulnerable, more vulnerable, less vulnerable and water compatible developments in flood zones 2 and 3a, the 'central' climate change allowance is the EA minimum benchmark for flood risk mitigation.

- 3.6 The site lies within the Combined Essex Management Catchment Management. In this catchment, the central climate change allowance for 2020s, 2050s and 2080s are 27%, 37% and 72%, respectively. Therefore, the catchment can expect peak river flow increases of this magnitude and should use these percentage increases in the assessment of future fluvial water flood risk.
- 3.7 Proposals for 'more vulnerable' development should include floor levels set no lower than 300 mm above the level of any flooding that would occur if defences were overtopped in a 1% / 0.5% flood event (including allowances for climate change). Safe refuge should also be provided above the 0.1% undefended/breach flood level (including allowances for climate change).
- 3.8 The historic flood map in the Envirocheck Flood Screening Report and SFRA mapping shows that there are no historic flood events which have affected the proposed site. The Envirocheck Flood Screening report historical flood map can be seen in **Appendix F**.
- 3.9 In accordance with the NPPF, residential units are classed as a 'More Vulnerable' land use and, as such, the proposed residential units should be located within the area of site located in Flood Zone 1.
- 3.10 **It is therefore concluded that the site is at low to high risk of flooding from rivers and the sea. The proposed residential units should be located within the area of site located in Flood Zone 1.**

Groundwater Flooding

- 3.11 Groundwater flooding occurs when water originating in aquifers reaches the surface, typically as a result of high groundwater levels caused by prolonged rainfall.
- 3.12 BGS mapping has identified that the development is underlain by London Clay Group which is made up of clay, silt and sand with superficial deposits of interglacial deposits which is also made up of silt and clay. Boreholes local to the site were investigated and the nearest available borehole is located on North Lane, adjacent to the western parcel. This Borehole record supports the findings of the BGS mapping and confirms that the site is likely to be underlain by clay.
- 3.13 A Flood Screening Report has been obtained from Envirocheck and this can be found in **Appendix F**. According to the BGS Groundwater Flooding Susceptibility maps the GeoSmart Information the site is in an area of negligible risk. According to the BGS Groundwater Flooding Susceptibility maps Where the Roman River crosses the site the site is in an area where there is potential for groundwater flooding to occur at the surface.
- 3.14 **It is therefore concluded that the site is at low risk of flooding from Groundwater.**

Surface Water Flooding

- 3.15 Flooding from overland flow occurs when intense rainfall is unable to infiltrate into the ground or enter drainage systems resulting in localised flooding in low spots that provide no means of outfall.
- 3.16 The Envirocheck Flood Screening Report in **Appendix F** provides detailed information on surface water flood risk on the site. Referring to the JBA Pluvial Flood Risk Mapping (undefended), for the 1 in 75-year pluvial flood event the site is not at risk of surface water flooding except at the location of the Roman River. For the 1 in 200-year pluvial flood event the site is not at risk of surface water flooding except at the location of the Roman River and its tributaries. There are also some isolated areas of flooding on the eastern parcel close to the drainage ditch with water depths ranging from 0.0m to 0.3m. For the 1 in 1,000-year pluvial flood event the site is not at risk of surface water flooding except at the location and surrounding area of the Roman River and its tributaries with water depths ranging from 0.0m to 0.6m.
- 3.17 The Envirocheck Flood Screening Report in **Appendix F** provides detailed information on surface water flood risk on the site. Referring to the EA Pluvial Flood Risk Mapping, for the 1 in 30-year pluvial flood event the site is not at risk of surface water flooding except at the location of the Roman River. For the 1 in 100-year pluvial flood event the site is not at risk of surface water flooding except at the location of the Roman River and its tributaries. There are also some isolated areas of flooding on the eastern parcel close to the drainage ditch with water depths ranging from 0.0m to 0.3m. For the 1 in 1,000-year pluvial flood event the site is not

at risk of surface water flooding except at the location and surrounding area of the Roman River and its tributaries with water depths ranging from 0.0m to 1m.

- 3.18 It is therefore concluded that the site is at low to high risk of flooding from surface water. It is recommended that the proposed residential units are not located within an area of surface water flood risk. Surface water flooding can be adequately mitigated through site level design.**

Flooding from Infrastructure Failure and Artificial Sources

- 3.19 In order to control and convey surface water runoff from impermeable surfaces in urban areas, underground surface water sewers or combined sewers (foul and surface water) are often utilised in urban areas. Pipes, culverts etc. have a finite capacity and therefore pose a risk of flooding due to the risk of siltation, blockage or collapse.
- 3.20 The Envirocheck Flood Screening Report in **Appendix F** provides detailed information on canal failure flood risk on the site. This demonstrates that the site is not at risk of flooding from canal flooding.
- 3.21 The EA provides a map showing the maximum potential flood extent, in the event that all reservoirs with a capacity of greater than 25,000 cubic metres were to fail and release the water they hold. The map shows that the site would not experience flooding in this scenario. There are no other significant artificial waterbodies in proximity of the site.
- 3.22 It is therefore concluded that the site is at low risk of flooding from infrastructure failure and artificial sources. No mitigation measures from infrastructure failure and artificial sources will be required as part of any development on this site.**

Implications to the site

- 3.23 In accordance with the NPPF, residential development is classed as a 'More Vulnerable' land use and, as such, that any residential units be appropriately located within in Flood Zone 1 and within the area classed as very low surface water flood risk.

4.0 Drainage

Surface Water drainage Strategy

- 4.1 The site can be described as a greenfield, and it is understood that the development of the site will result in an increase in impermeable area.
- 4.2 UKSuDS's online calculator was used to determine the QBAR greenfield runoff rate for the site, showing a result of 2.21 l/s/ha. This output can be seen in **Appendix G**.
- 4.3 The site lies within the Combined Essex Management Catchment Management. In this catchment, the upper end climate change allowance for the 3.3% AEP and 1% AEP rainfall events are 35% and 45%, respectively. Therefore, the development can expect peak rainfall increases of this magnitude and should use these percentage increases in the assessment of future surface water flood risk.
- 4.4 Infiltration techniques are not believed to be viable on site, so the proposed surface water drainage strategy is to attenuate surface water and then due to discharge into the existing surface water ditches on the eastern and western parcels or to the Roman River.
- 4.5 MicroDrainage software was used to determine the volume required to attenuate the runoff from storm events up to the 1 in a 100-year storm (+ 45% increase for climate change) for western parcel and eastern parcel catchments which assumed that post development 60% of the catchment will be impermeable. This output can be seen in **Appendix H**. The results are summarised in Table 4.1. The northern parcel is more constrained in terms of flood risk so surface water attenuation has not been calculated at this stage.

Table 4.1 – Attenuation Requirement for each catchment

Catchment	Assumed impermeable Area (ha)	Attenuation storage required (m3)	Outflow restriction (l/s)
Western Parcel Catchment A	1.84	1,432 - 1,903	4.07
Western Parcel Catchment B	2.57	2,003 - 2,661	5.68
Eastern Parcel Catchment A	1.19	931 - 1,236	2.63
Eastern Parcel Catchment B	1.46	1,141 - 1,515	3.23
Eastern Parcel Catchment C	0.44	286 - 385	2 (practical minimum)

- 4.6 It is likely that the (Lead Local Flood Authority) LLFA will want SuDS to deal with the increased volume of surface water runoff. A plan showing the location of SUDS features on site is detailed in **Appendix I**. A combination of attenuation ponds which should be located outside of Flood Zone 3, swales are permeable paving are recommended for this site.

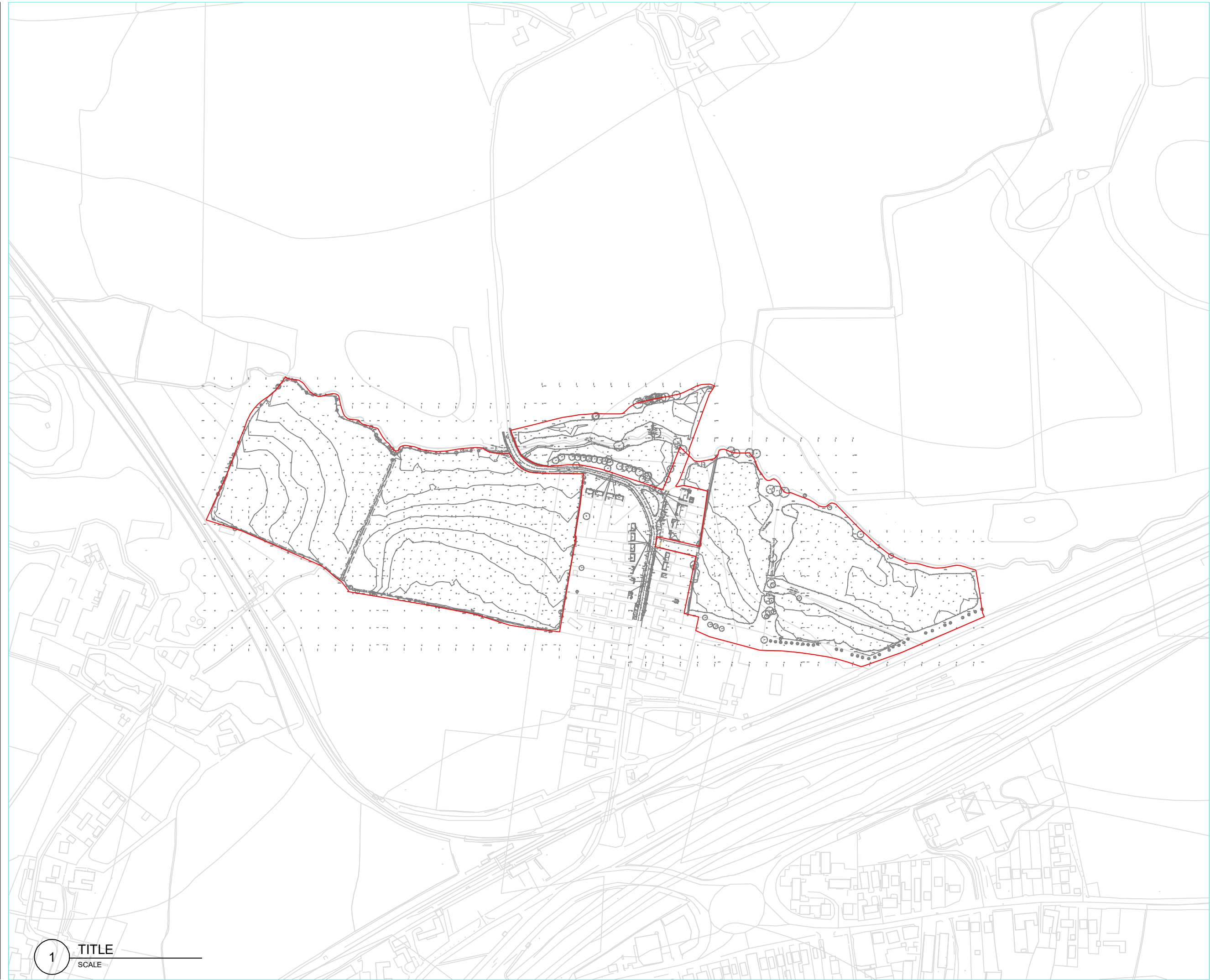
5.0 Conclusions and Recommendations

- 5.1 This Flood Risk and Drainage Appraisal has been prepared by Motion on behalf of Bidwells LLP in support of development on Land at North Lane, Marks Tey, Colchester.
- 5.2 The site is formed of three parcels: known as the western parcel, the eastern parcel and the northern parcel. Due to the watercourses flowing through the site the three parcels are split into seven catchments in total. The catchments are known as Western Parcel Catchment A, Western Parcel Catchment B, Eastern Parcel Catchment A, Eastern Parcel Catchment B, Eastern Parcel Catchment C, Northern Parcel Catchment A and Northern Parcel Catchment B. The catchment location are detailed in Figure 2.1.
- 5.3 The nearest main river to the site is the Roman River which runs along the northern boundary of the western and eastern parcels and through the centre of the northern parcel.
- 5.4 BGS mapping has identified that the development is underlain by London Clay formation which is generally not conducive to infiltration techniques.
- 5.5 The EA Flood Map shows that the site is located within Flood Zone 1 (less than 1 in 1,000 annual probability of flooding from rivers or the sea), Flood Zone 2 (between 1 in 1,000 and 1 in 100 annual probability of flooding from rivers or the sea) and Flood Zone 3 (more than 1 in 100 annual probability of flooding from rivers or the sea). In accordance with the NPPF, residential units are classed as a 'More Vulnerable' land use and, as such, the proposed residential units should be located within the area of site located in Flood Zone 1.
- 5.6 The site is at low to high risk of flooding from surface water. The areas of higher risk of surface water flooding are located near the Roman River and drainage ditches. It is recommended that the proposed residential units are not located within an area of surface water flood risk.
- 5.7 The site is at low risk of ground water flooding and flooding from infrastructure failure and artificial sources.
- 5.8 Asset records were requested from Anglian Water. The Asset records indicate that there are no surface water sewers which currently serve the site. There is an existing 150mm foul water sewer which runs along North Lane and connects to a pumping station and pumped across the A12 to the south of the site. The nearest manhole is 7310 which has a cover level of 30.334m AOD and invert level of 27.874m AOD. Due to ground levels on site is it understood that for all three parcels of land the foul drainage would need to be pumped. This would either be to manhole 7310 or to the pumping station south of the A12.

- 5.9 It is understood that the development of the site will result in an increase in impermeable area and therefore there will be an increase in the total volume of surface water runoff from the site. MicroDrainage software was used to determine the volume required to attenuate the runoff from storm events up to the 1 in a 100-year storm (+ 45% increase for climate change) assuming post development 60% of the catchment was impermeable. The results are summarised in Table 4.1.
- 5.10 It is likely that the (Lead Local Flood Authority) LLFA will want SuDS to deal with the increased volume of surface water runoff. A combination of attenuation ponds which should be located outside of Flood Zone 3, swales and permeable paving are recommended SuDS features for this site.

Appendix A

Proposed Site Location

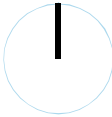


1

TITLE
SCALE

Rev.	Date	Details
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GENERAL
Do not scale from this drawing.
All dimensions to be checked on site.
This plan is to be read with all
accompanying documentation.
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Masterplanning, Landscape
& Assessment
Bidwell House, Trumpington Road,
Cambridge CB2 9LD



Project Phase: - Date: - Drawn By: -

Drawing Number: -

Job Code: -

Checked By: -

Revision: -

OS License Number:
100017734

Appendix B

BGS Borehole records



Norwest Holst Soil Engineering Ltd.						Borehole No. 1	
Contract No. F8344D		BOREHOLE LOG		Sheet 1 of 1			
Location Marks Tey		TL92SW 99		Chainage 9162 2438			
Client Essex County Council				Ground Level..... m.A.O.D.			
Method of Boring.....Cable Percussion				Date..... 21/2/89			
Diameter of Borehole.....150mm							
Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D. %	Daily Progress
TOPSOIL		0.10					
Light brown SAND and GRAVEL		1.00		150mm CASED TO 1.50m	1.00 (60)		
Stiff grey green and brown mottled slightly gravelly CLAY		2.80			2.00 (60)		
Stiff blue grey gravelly CLAY ...gravel comprises chalk					3.00 (55)		
					4.00 (50)		
					5.00 (60)		
					6.50 (60)		
					8.00 (60)		
					9.50 (60)		
Borehole complete at 10.00m		10.00					21/2

Type of Sample	Remarks (Observations of Ground Water etc.)
Is S.P.T. Undisturbed	() U100 blows
Ic. C.P.T. Vane	Groundwater not encountered
O Jar Water	
● Bulk Piezometer	

Water levels are subject to seasonal or tidal variations and should not be taken as constant

Appendix C

Topographic Survey





TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

[illegible]

DRAWING NOTES

Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including: sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Surveyed physical features may not necessarily represent the legal boundary line.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

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This drawing should only be scaled using digital methods.

SURVEY CONTROL CO-ORDINATES				
STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
ST01	591617.646	224393.393	30.808	Hiti Na
ST02	591640.428	224363.777	30.375	Hiti Na
ST03	591729.388	224354.158	30.125	Hiti Na
ST04	591787.736	224335.401	30.255	Hiti Na
ST05	591784.407	224280.662	30.786	Hiti Na
ST06	591875.190	224260.860	29.587	Peg & I

SURVEY GRID AND LEVEL DATUM

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PROJECT TITLE
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COLCHESTER, COB 1FG

DRAWING DETAIL
TOPOGRAPHICAL SURVEY

TOPOGRAPHICAL SURVEY
Sheet 3 of 9

CLIENT	SCALE
RICHARD HINES	1:200

SURVEYOR	SURVEY DATE	CHECKED BY	APPROVED BY	DWG STATUS
WHG/FC	22/08/2024		JLH	FINAL

DRAWING NUMBER 69458IPLS-03	REVISION	ISSUE DATE
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TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

[illegible]

DRAWING NOTES

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Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical

General

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ST01	591617.646	224393.393	30.808	HiH Nail
ST02	591640.428	224363.777	30.375	HiH Nail
ST03	591729.388	224354.158	30.125	HiH Nail
ST04	591787.736	224335.401	30.255	HiH Nail
ST05	591874.407	224280.662	30.786	HiH Nail
ST06	591875.190	224260.860	29.567	Peg & Nail

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PROJECT TITLE

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COLCHESTER, C06 1EG.

DRAWING DETAIL				
TOPOGRAPHICAL SURVEY				
Sheet 4 of 9				
CLIENT RICHARD HINES				SCALE 1:200
SURVEYOR WHG/FC	DATE 22/08/2024	CHECKED BY	APPROVED BY JLH	DWG STATUS FINAL
DRAWING NUMBER 694581PLS-04			REVISION	ISSUE DATE





ABBREVIATIONS & SYMBOLS

[illegible]

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STATIONS	EASTINGS	NORTHINGS
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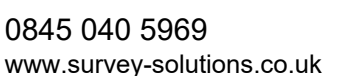
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ST04	591787.736	224335.401	30.255	Hilti Nail
ST05	591784.407	224280.662	30.786	Hilti Nail
ST06	591875.190	224280.860	29.567	Peg & N

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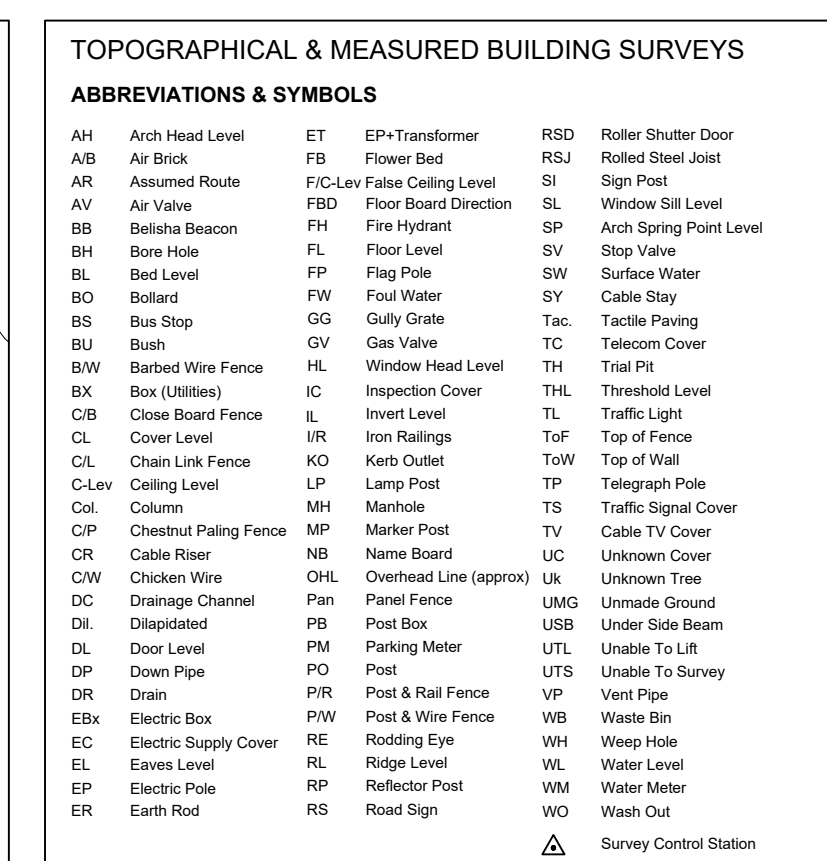
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DRAWING DETAIL
TOPOGRAPHICAL SURVEY
Sheet 5 of 9

CLIENT RICHARD HINES				SCALE 1:200
SURVEYOR WHG/FC	SURVEY DATE 22/08/2024	CHECKED BY	APPROVED BY JLH	DWG STATUS FINAL
DRAWING NUMBER 694581PLS-05			REVISION	ISSUE DATE



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Measured Building Surveys

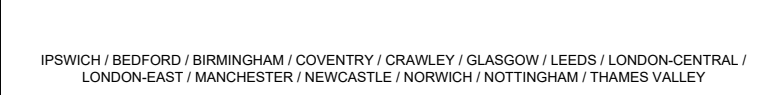
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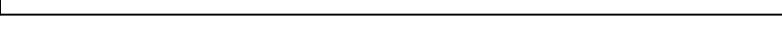
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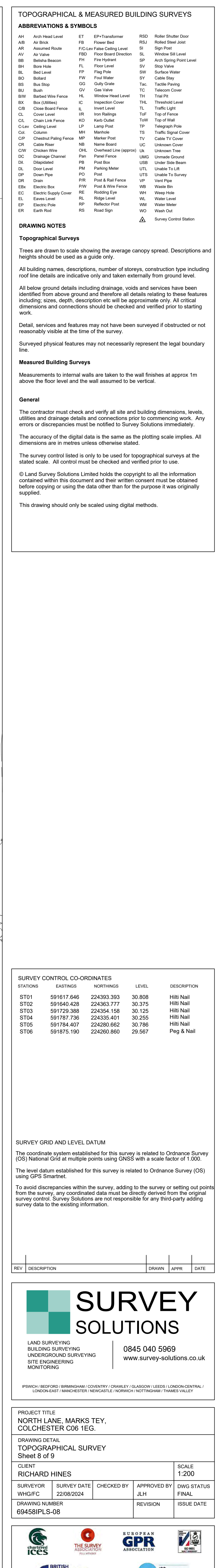
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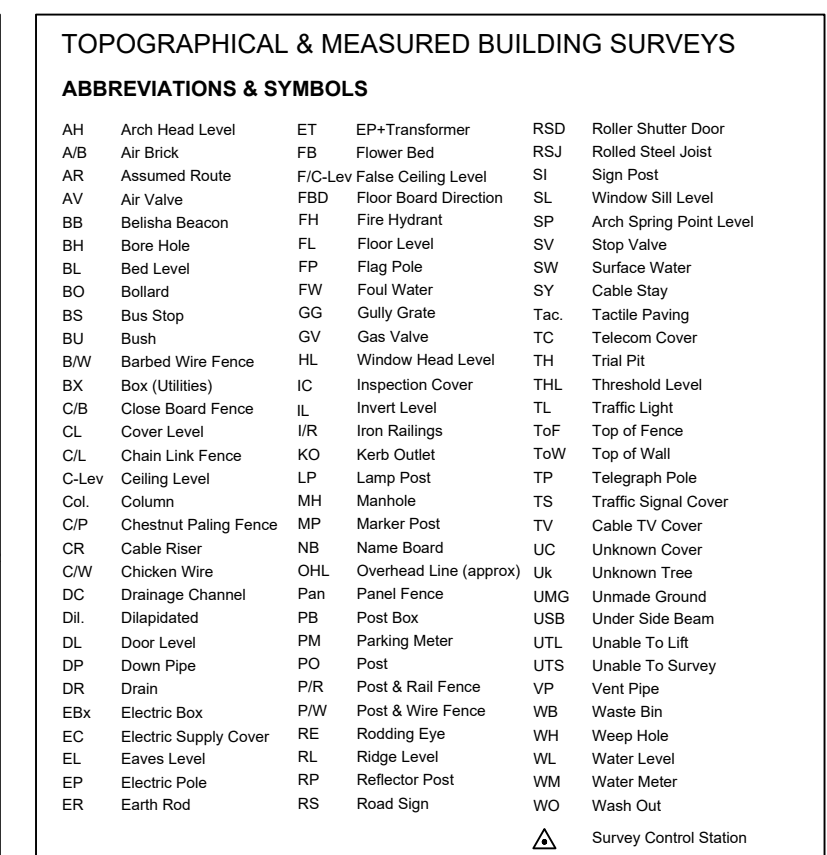


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COLCHESTER C06 1EG

Sheet 7 of 9	
CLIENT RICHARD HINES.	SCALE 1:200







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ST05	591784.407	224280.062	30.786	Hilt Nail
ST06	591875.190	224260.080	29.567	Peg & Nail

REV	DESCRIPTION	DRAWN	APPR	DATE
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Appendix D

Anglian Water Asset Records

Appendix E

Environment Agency Flood Product 4 Data set



Product 4: Supporting Documentation

GUIDANCE INCLUDED:

1. **PRODUCT 4 FACT SHEET.**
2. **FLOOD ZONE 3 FACTSHEET - EAST ANGLIA (EAST)**
3. **FLOOD RISK ASSESSMENT (FRA) CHECKLIST**
4. **NEW TIDAL CLIMATE CHANGE ALLOWANCES FOR ESSEX, NORFOLK AND SUFFOLK**
5. **UPDATED FLUVIAL CLIMATE CHANGE ALLOWANCES FOR ESSEX, NORFOLK AND SUFFOLK**

PARTNERSHIP AND STRATEGIC OVERVIEW TEAM – EAST ANGLIA (EAST) Version 6 Updated May 2023

customer service line
03708 506 506

incident hotline
0800 80 70 60

floodline
03459 88 11 88

Product 4 Fact Sheet

Thank you for your enquiry.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Please refer to the Open Government Licence available here:

<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/> which explains the permitted use of this information.

You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system)
- overflowing or backing up of sewer or drainage systems which have been overwhelmed
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea.

Areas Benefiting from Flood Defences

Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

Flood Risk Assessment Checklist

If you are planning on using this data within a Flood Risk Assessment, we recommend that you take the time to fill in the attached FRA checklist, and to read the attachments which contain information relevant to the area that interests you.

We would like to stress the importance of filling in the Flood Risk Assessment check list and providing up-to-date and correct data. The data will be checked against our records when we review the Flood Risk Assessment in our role as statutory consultee.

It is important that you provide a map in section 2 of the FRA checklist (See Appendix A), including the highest and most representative flood levels for your site. We recommend using a number of nodes that provide a fair representation of the modelled data across your site. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate.

If you have a new enquiry or would like us to review the information we have provided under the Freedom of Information Act 2000 and Environmental Information Regulations 2004 please contact us within two months by email at Enquiries_EastAnglia@environment-agency.gov.uk

East Anglia Area

Ipswich Office, Icen House, Cobham Road, Ipswich, Suffolk, IP3 9JD

General Enquiries: 03708 506506

Email: enquiries@environment-agency.gov.uk

Website: <https://www.gov.uk/government/organisations/environment-agency>

Flood Zone 3 Factsheet

East Anglia (East)

Oct 2017 - v.7

This factsheet provides information to assist with the preparation of a Flood Risk Assessment (FRA) in support of development proposals reviewed by the East Anglia teams, based at Ipswich. It should be read alongside the Environment Agency's general FRA advice ([FRA Guidance note 3](#)). For information relating to proposals managed by East Anglia teams please contact: planning.eastanglia@environment-agency.gov.uk.

This factsheet covers issues relating to FRAs only and does not address other matters we may take into account when considering development proposals (e.g. proximity to a watercourse, contaminated land, Water Framework Directive and biodiversity requirements). For further information on those issues, please contact: planning.eastanglia@environment-agency.gov.uk

Sequential Test and Exception Test

The Local Planning Authority (LPA) will need to be satisfied that the proposed development passes the flood risk Sequential Test, and if applicable, the first part of the Exception Test, in line with requirements of the National Planning Policy Framework (NPPF). We therefore strongly suggest you speak to them prior to commencing work on an FRA. Information regarding the [aim of the Sequential Test](#), [applying the Sequential Test](#) and the [Exception Test](#) can all be found in the Practice Guide supporting the NPPF.

Inappropriate development

[Table 2](#) of the Practice Guide categorizes developments according to their vulnerability and [table 3](#) sets out which vulnerabilities are inappropriate in Flood Zone 3. You should be aware that we are likely to object in principle where it is indicated that a development is not compatible in Flood Zone 3. Please note that Flood Zone 3b is defined by the Local Planning Authority's Strategic Flood Risk Assessment, or by the 5% (1 in 20 year) modelled flood outlines and levels held by the Environment Agency.

More detail on what should be in the FRA (additional to that highlighted in Guidance Note 3):

The FRA should assess all sources of flooding and provide sufficient information on the characteristics of flooding at the site, such as frequency, depth, velocity, speed of onset, and duration. As a minimum the FRA needs to assess the flood risk on site by comparing our modelled flood levels with a GPS verified topographical survey of the site to determine the anticipated flood depths during the 5% (1 in 20), 1% / 0.5% (1 in 100 / 200) (design) and 0.1% (1 in 1000) (extreme) events including allowances for climate change. Climate change allowances can be found on [our website](#). If the area is protected by defences then the FRA should consider both the actual flood risk to the site through overtopping of the defences, and the residual risk posed by the defences being breached.

- **Sequential approach on site**

If the site contains a range of Flood Zones, the sequential approach should be applied within the site to direct development to the areas of lowest flood risk. If it isn't possible to locate all development in Flood Zone 1, then the most vulnerable elements should be located in the lowest risk parts of the site.

- **Finished Floor Levels**

Proposals for 'more vulnerable' development should include floor levels set no lower than 300 mm above the level of any flooding that would occur if defences were overtopped in a 1% / 0.5% flood event (including allowances for climate change). Safe refuge should also be provided above the 0.1% undefended/breach flood level (including allowances for climate change). We are likely to raise an objection where these requirements are not achieved.

We recommend 'less vulnerable' development also meets this requirement to minimize disruption and costs in a flood event. If this is not achievable then it is recommended that a place of refuge is provided above the 0.1% flood level (including allowances for climate change). Where safety is reliant on refuge it is important that the building is structurally resilient to withstand the pressures and forces (hydrostatic & hydrodynamic) associated with flood water. The LPA may need to receive supporting information and calculations to provide certainty that the buildings will be constructed to withstand these water pressures.

- **Safe Access**

During a flood, the journey to safe, dry areas completely outside the extent of a 1% / 0.5% flood event (including allowances for climate change), should not involve crossing areas of potentially fast flowing water. Those venturing out on foot in areas where flooding exceeds 100 millimetres or so would be at risk from a wide range of hazards, including, for example unmarked drops, or access chambers where the cover has been swept away. Safe access and egress routes should be assessed in accordance with the guidance document '[FD2320 \(Flood Risk Assessment Guidance for New Developments\)](#)'.

- **Emergency Flood Plan**

Where safe access cannot be achieved, or if the development would be at actual flood risk or residual risk of flooding in a breach, an emergency flood plan must be provided. The plan should deal with matters of evacuation and refuge, and should demonstrate that people will not be exposed to flood hazards. The emergency flood plan should be submitted as part of the FRA and will need to be agreed with the Local Planning Authority.

- **Flood Resilience / Resistance Measures**

To minimize the disruption and cost implications of a flood event we encourage development to incorporate flood resilience/resistance measures up to the extreme 0.1% climate change flood level.

Information on preparing property for flooding can be found in the documents '[Improving the Flood performance of new buildings](#)' and '[Prepare your property for flooding](#)'.

- **Betterment**

Every effort should be made by the applicant to improve the flood risk to the local area, especially if there are known flooding issues. Opportunities should also be taken to provide environmental enhancements as part of the design, for example naturalizing any rivers on the site with a buffer zone on both sides.

- **Increases in Built Footprint (excluding open coast situations)**

It will need to be shown that any increase in built footprint within the extent of a 1% flood event (including allowances for climate change), can be directly compensated for on a volume-for-volume and level-for-level basis to prevent a loss of floodplain storage. If there are no available areas for compensation above the design flood level and compensation will not be possible, then a calculation of the offsite flood risk impacts will need to be undertaken. If this shows significant offsite impacts then no increases in built footprint will be allowed. Further guidance on the provision of compensatory flood storage is provided in section A3.3.10 of the CIRIA document C624.

Flood Defence Consent

Flood Defence Consents now fall under the Environmental Permitting (England and Wales) Regulations 2010 system (EPR). You may need an environmental permit for flood risk activities if you want to do work in, under, over or within 8 metres of a fluvial river or any flood defence structure or culvert / 16m from a tidal river or any flood defence structure or culvert. New forms and further information can be found at: <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>.

Local policies and recommendations

You will need to demonstrate to the Local Planning Authority that the requirements of any local flood risk planning policies have been met and the recommendations of the relevant Strategic Flood Risk Assessment, Shoreline Management Plans and Catchment Flood Management Plans have been considered.

Further Information:

If you require the flooding information we hold for this site then please email our local Customers and Engagement Team: enquiries_eastanglia@environment-agency.gov.uk. For further details on our flood map products please visit our website at: www.environment-agency.gov.uk/research/planning/93498.aspx.

Flood Risk Assessment (FRA) Checklist

This document should be attached to the front of the Flood Risk Assessment (FRA) issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. This document is not a substitute for a FRA. Please note, under our responsibilities as a statutory consultee we will review any submitted FRA only in respect to fluvial and tidal risk. Your FRA should also consider other sources of flooding such as surface water, drainage, and ground water flooding.

1. Development Proposal

Site name	
National Grid Reference (NGR)	
Flood Risk Assessment	Reference/Title: Date:
Existing site use & vulnerability classification	
Proposed site use & vulnerability classification	

2. Flood Risk

Flood Zone(s) affecting the site/property	
Sources of flooding affecting the site	
Have you considered flood storage compensation?	Yes/No **

3. Please provide a node map and accompanying table in the Flood Risk Assessment similar to the example given (see Appendix A). You should clearly demonstrate the highest and most representative flood levels for your proposed development. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate.

4. Mitigation

Finished floor levels (in mAOD) for each proposed floor.	
Have you considered a freeboard for these Finished Floor Levels?***	
Drawing reference showing Finished Floor Levels for proposed development	
Have you considered suitable internal and external access for safe refuge above the flood level?	Yes/No

5. Proximity to the watercourse/ flood defence/ culvert

Are the proposed developments on, over, under or within 8 metres of a fluvial main river or 16 metres of a tidal main river or flood defence?	Yes/No If yes, please provide a cross section drawing in your planning application showing the distance of the proposed development in relation to the watercourse/flood defence/culvert. If yes, this will require a Flood Risk Activity Permit.
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Map Many of our flood datasets are available online:
 Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#), [Risk of Flooding from Rivers and Sea](#), [Historic Flood Map](#), [Current Flood Warnings](#))

**** Please be aware floodplain compensation may be required for your site. Floodplain compensation is normally required when the proposed site use has an increased built footprint in relation to the existing site use and lies primarily in Flood Zone 3, which is considered the fluvial floodplain. This is normally demarked in the modelled data by the 1 in 100 + Climate Change flood return period.**

***** Please refer to the Local Authority's SFRA for further guidance on freeboard requirements for each type of development**

Environment Agency, Icen House, Cobham Road, Ipswich, IP3 9JD

Customer services line: 03708 506 506

Email: enquiries@environment-agency.gov.uk

www.environment-agency.gov.uk

Planning advice and guidance

The Environment Agency are keen to work with partners to enable development which is resilient to flooding for its lifetime and provides wider benefits to communities. If you have requested this information to help inform a development proposal, then we recommend engaging with us as early as possible by using the pre-application form available from our website:

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Complete the form in the link and email back to planning.eastanglia@environment-agency.gov.uk

We recognise the value of early engagement in development planning decisions. This allows complex issues to be discussed, innovative solutions to be developed that both enables new development and protects existing communities. Such engagement can often avoid delays in the planning process following planning application submission, by reaching agreements up-front. We offer a charged pre-application advice service for applicants who wish to discuss a development proposal.

We can also provide a preliminary opinion for free which will identify environmental constraints related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

Flood Risk Assessments guidance

In preparing your planning application submission, you should refer to the Environment Agency's Flood Risk Standing Advice and the Planning Practice Guidance for information about what flood risk assessment is needed for new development in the different Flood Zones. This information can be accessed via:

<https://www.gov.uk/flood-risk-assessment-standing-advice>

<http://planningguidance.planningportal.gov.uk/>

<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>

<https://www.gov.uk/guidance/flood-risk-and-coastal-change>

You should also consult the Strategic Flood Risk Assessment and flood risk local plan policies produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. You should discuss surface water management with your Lead Local Flood Authority.
3. Where a planning application requires a FRA and this is not submitted or deficient, the Environment Agency may well raise an objection due to insufficient information

Advice to Consultants

The data provided in the checklist and FRA will be checked against our records as we review the FRAs when consulted on by the Local Planning Authority in our remit as statutory consultee for flood risk from tidal and fluvial sources. We require you to get in touch with us to check for the most up to date model information and FRA checklist. Having the latest data is important as not having the data will possibly delay us in reviewing your application at planning stage.

Appendix A: (This is an example only for how to do the node map and accompanying table)



1. Outline your site boundary clearly
2. Clearly mark the node points where you are extracting data from
3. Select node points that cover the site, around the site itself, and along the access route to the site to give a representative sample

	National Grid Reference		Modelled Levels
Node	Easting	Northing	[insert return period]
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Flood risk assessments: Climate change allowances

Application of the allowances and local considerations

East Anglia; Essex, Norfolk, Suffolk, Cambridgeshire and Bedfordshire

1) The climate change allowances

The [National Planning Practice Guidance](#) refers planners, developers and advisors to the Environment Agency guidance on considering climate change in Flood Risk Assessments (FRAs). This guidance was updated in October 2021 and is available on [Gov.uk](#). The guidance can be used for planning applications, local plans, neighbourhood plans and other projects. It provides climate change allowances for peak river flow, peak rainfall, sea level rise, wind speed and wave height. The guidance provides a range of allowances to assess fluvial flooding, rather than a single national allowance. It advises on what allowances to use for assessment based on vulnerability classification, flood zone and development lifetime.

2) Assessment of climate change impacts on fluvial flooding

Where existing EA flood risk datasets and models do not provide the required climate change allowances, it is up to developers to undertake any work needed to appropriately assess the impacts of climate change on flood risk. They can do this by using the approaches in **Table A** below:

Table A below indicates the level of technical assessment of climate change impacts on fluvial flooding appropriate for new developments depending on their scale and location. This should be used as **a guide only**. Ultimately, the agreed approach should be based on expert local knowledge of flood risk conditions, local sensitivities and other influences. **For these reasons, we recommend that applicants and / or their consultants should contact the Environment Agency at the pre-planning application stage to confirm the assessment approach, on a case by case basis.** The email addresses for our Sustainable Places teams at our respective offices can be found in Section 8 below.

Table A defines three possible approaches to account for flood risk impacts due to climate change, in new development proposals:

- **Basic:** Developer can add an allowance to the 'design flood' (i.e. 1% annual probability) peak levels to account for potential climate change impacts. The allowance should be derived and agreed locally by Environment Agency teams.
- **Intermediate:** Developer can use existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance being applied to the 'design flood' flow.
- **Detailed:** Perform detailed hydraulic modelling, either through re-running Environment Agency hydraulic models (if available) or construction of a new model by the developer.

Table A – Indicative guide to assessment approach

VULNERABILITY CLASSIFICATION	FLOOD ZONE	DEVELOPMENT TYPE		
		NON-MAJOR	SMALL-MAJOR	LARGE-MAJOR
ESSENTIAL INFRASTRUCTURE	Zone 2	Detailed		
	Zone 3a	Detailed		
	Zone 3b	Detailed		
HIGHLY VULNERABLE	Zone 2	Intermediate/ Basic	Intermediate/ Basic	Detailed
	Zone 3a	Not appropriate development		
	Zone 3b	Not appropriate development		
MORE VULNERABLE	Zone 2	Basic	Basic	Intermediate/ Basic
	Zone 3a	Intermediate/ Basic	Detailed	Detailed
	Zone 3b	Not appropriate development		
LESS VULNERABLE	Zone 2	Basic	Basic	Intermediate/ Basic
	Zone 3a	Basic	Basic	Detailed
	Zone 3b	Not appropriate development		
WATER COMPATIBLE	Zone 2	None		
	Zone 3a	Intermediate/ Basic		
	Zone 3b	Detailed		

Note: Where the table states 'not appropriate development', this is in line with national planning policy. If in exceptional circumstances such development types are proposed in these locations, we would expect a detailed modelling approach to be used.

NOTES:

- Non-Major: 1-9 dwellings/ less than 0.5 ha | Office / light industrial under 1ha | General industrial under 1 ha | Retail under 1 ha | Gypsy/traveller site between 0 and 9 pitches
- Small-Major: 10 to 30 dwellings | Office / light industrial 1ha to 5ha | General industrial 1ha to 5ha | Retail over 1ha to 5ha | Gypsy/traveller site over 10 to 30 pitches
- Large-Major: 30+ dwellings | Office / light industrial 5ha+ | General industrial 5ha+ | Retail 5ha+ | Gypsy/traveler site over 30+ pitches | any other development that creates a non-residential building or development over 1000 sq m.

The assessment approach should be agreed with the Environment Agency as part of pre-planning application discussions to avoid abortive work.

3) Specific local considerations

Where the Environment Agency and the applicant and / or their consultant has agreed that a 'basic' level of assessment is appropriate, the figures in Table B below can be used as a precautionary allowance for potential climate change impacts on peak 'design' (i.e. 1% annual probability) fluvial flood level rather than undertaking detailed modelling.

Table B – Local precautionary allowances for potential climate change impacts

Essex, Norfolk and Suffolk

Hydraulic Model (Watercourse)	Precautionary allowance (basic approach)
Blackwater & Brain - Blackwater between TL7520925623 and TL7820324314 Brain between TL7373323312 and TL7683821321	500mm
Other main rivers, tributaries and ordinary watercourses	For other main rivers, tributaries and ordinary watercourses that are not stated above, basic allowances have not been calculated. In this instance you can either: • If flow data is available you can request this data from us and can conduct an intermediate assessment yourself • Or alternatively, you can choose to undertake a Detailed Assessment and "perform detailed hydraulic modelling, through either re-running our hydraulic models (if available) or constructing a new model

Cambridgeshire and Bedfordshire

Watercourse / Model	Precautionary allowance (basic approach)
Alconbury Brook	600mm
River Kym	
Lower Ouse (Model Extent)	700mm
Mid Ouse (Cold Brayfield to Bromham – between SP9156852223 and TL0132950919)	700mm
Mid Ouse (East of Bedford to Roxton – between TL0791848903 and TL1618854543)	700mm
River Hiz and River Purwell	400mm
River Ivel	500mm
Pix Brook	450mm
Potton Brook	500mm
River Cam and tributaries (excluding the Cam Lodes and the Slade System)	450mm
Great Barford (ordinary watercourses)	500mm
Bromham (ordinary watercourse)	550mm

NOTES:

Urban areas excluded from the 'basic' approach: St Ives, Holywell, Godmanchester, Swavesey, Over, Bedford, Newport Pagnell, Buckingham and Leighton Buzzard. More detailed assessment of climate change allowances will need to be undertaken in these locations.

Use of these allowances will only be accepted after discussion with the Environment Agency.

4) Fluvial flood risk mitigation

For planning consultations where we are a statutory consultee and our [Flood risk standing advice](#) **does not** apply we use the following benchmarks to inform flood risk mitigation for different [vulnerability classifications](#). **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis.** For planning consultations where we are not a statutory consultee or our [Flood risk Standing advice](#) applies, we recommend that local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as **'essential infrastructure'** our benchmark for flood risk mitigation is for it to be designed to the **'higher central'** climate change allowance for the epoch that most closely represents the lifetime of the development, including decommissioning. Please note that nationally significant infrastructure projects (NSIPs) may also need to assess a **credible maximum climate change scenario** by applying the **'upper end'** allowance for peak river flow as a sensitivity test. This will help to determine how sensitive the development is to changes in the climate and to ensure that it can be adapted to large-scale climate change over its lifetime.
- For **highly vulnerable, more vulnerable, less vulnerable and water compatible** developments in flood zones 2 and 3a, the **'central'** climate change allowance is our minimum benchmark for flood risk mitigation. For large urban settlement extensions or developments that form new communities, the credible maximum climate change scenario must be assessed; in these circumstances, you should use the **'upper end'** allowance.
- For **water compatible** development in flood zone 3b, the **'central'** climate change allowance for the epoch that most closely represents the lifetime of the development is our minimum benchmark for flood risk mitigation.

For peak river flow allowances and a visual representation of the above, please see Tables 1 and 2 below.

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2125)
Upper and Bedford Ouse	Upper end	24%	30%	58%
	Higher central	10%	11%	30%
	Central	5%	4%	19%
Cam and Ely Ouse	Upper End	21%	22%	45%
	Higher Central	7%	5%	19%
	Central	2%	-2%	9%
Old Bedford and Middle Level	Upper End	23%	22%	39%
	Higher central	9%	4%	15%
	Central	3%	-3%	6%
North West Norfolk	Upper End	30%	34%	57%
	Higher central	18%	18%	33%
	Central	13%	11%	23%
North Norfolk Rivers	Upper End	26%	27%	48%
	Higher central	13%	11%	24%
	Central	7%	4%	14%
Broadland Rivers	Upper End	27%	27%	44%
	Higher central	14%	10%	20%
	Central	8%	3%	11%
East Suffolk	Upper End	25%	29%	54%
	Higher central	13%	13%	29%
	Central	8%	7%	19%
Combined Essex	Upper End	27%	37%	72%
	Higher central	13%	16%	38%
	Central	7%	8%	25%

South Essex	Upper End	22%	27%	48%
	Higher central	11%	11%	26%
	Central	6%	5%	17%

If you are not sure which management catchment your site falls within, please use the guidance and link to the peak river flow map, which can be found at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-river-flow-allowances>

Table 2: Using peak river flow allowances for flood risk assessments

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
2	higher central ¹	central ²	central ²	central	central
3a	higher central ¹	X	central ²	central	central
3b	higher central ¹	X	X	X	central

X – Development should not be permitted

If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the higher central allowance.

¹ For NSIPs, the ‘upper end’ allowance should be used to assess a credible maximum climate change scenario.

² For large urban settlement extensions or developments that form new communities, the credible maximum climate change scenario must be assessed. In these circumstances, you should use the ‘upper end’ allowance.

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case we may want to check this data and how you propose to use it.

Assessing off-site impacts and calculating floodplain compensation

The appropriate allowance to assess off-site impacts and calculation floodplain compensation requirements depends on the land uses in affected areas.

The ‘**central**’ allowance should be used in most cases. However, the ‘**higher central**’ allowance should be used when the affected area contains essential infrastructure.

5) Development in tidal flood risk areas

For flood risk assessments and strategic flood risk assessments, assess both the **higher central** and **upper end** allowances for all development vulnerability classes (see table 3 below).

For NSIPs and large urban settlement extensions or developments that form new communities, the **credible maximum climate change scenario** should be assessed (sea level rise and sensitivity test allowances for offshore wind speed and extreme wave height and storm surge uplift). To assess the flood risk from a high impact climate change scenario, you should use the H⁺⁺ allowance of 1.9m for the total sea level rise to 2100.

Table 3: sea level allowances for each epoch in mm for each year (based on a 1981 to 2000 baseline) – the total sea level risk for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20
Anglian	Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

6) Tidal flood risk mitigation

For planning consultations where we are a statutory consultee and our flood risk standing advice does not apply, we use the following benchmarks to inform flood risk mitigation for different [vulnerability classifications](#). **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis. Please note you may be charged for this advice.** For planning consultations where we are not a statutory consultee or our flood risk standing advice applies, we recommend that local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as essential Infrastructure, highly vulnerable development and more vulnerable development, our minimum benchmark for flood risk mitigation is the **‘upper end’** climate change allowance for the development lifetime (including decommissioning where relevant).
- For water compatible or less vulnerable development (e.g. commercial), our minimum benchmark for flood risk mitigation is the **‘higher central’** climate change allowance for the development lifetime. In sensitive locations it may be necessary to use the **‘upper end’** allowance to inform built in resilience.

If you are using our 2018 Coastal Flood Modelling Data outputs:

The **upper end** allowance become progressively higher each year than the climate change flood level outputs used in our current 2018 coastal flood model. So as an approximation we recommend that the following uplift values are added on to the on-site climate change flood levels provided in the Product 4:

- For development lifetimes extending to 2122, add 0.34m
- For development lifetimes extending to 2123, add 0.36m
- For development lifetimes extending to 2124, add 0.38m
- For development lifetimes extending to 2125, add 0.40m

If the proposed development is greater than 30 houses and the flood zone is in an open-coast location, we recommend that a more accurate impact of the increased upper end flood levels on the overtopping on-site flood levels is modelled by rerunning our coastal overtopping model with the new flood levels; you can obtain the model from us with a Product 6 and 7 request. If the site is located within a small or constrained tidal or coastal floodplain then regardless of the size of the development, you may also need to undertake remodelling of the flood levels to obtain an accurate assessment of the impacts of climate change; please contact us for advice (contact details in Section 8 below).

If you are using our Broads 2008 Flood Modelling Data outputs:

For the **upper end** allowance, please add the following uplift values onto the climate change flood levels provided in the Product 4:

- For development lifetimes extending to 2122, add 0.34m
- For development lifetimes extending to 2123, add 0.36m
- For development lifetimes extending to 2124, add 0.38m
- For development lifetimes extending to 2125, add 0.40m

If you are using our 2008 Thames Flood Modelling Data outputs:

Please add the appropriate climate change allowances for the South East River Basin District onto the present day flood levels obtained in the Product 4, starting from a base year of 2005. The allowances should be applied to the year appropriate to the respective development lifetime for residential or commercial developments.

**** note**:** *We anticipate that there will be updated flood modelling outputs available for the Thames Estuary in mid-2022. Developers preparing Flood Risk Assessments for developments in this area should check for availability of new data with the East Anglia (East) PSO team (contact details in Section 8 below).*

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case, we may want to check this data and how you propose to use it.

7) Assessment of climate change impacts for Surface Water Management

Please see the latest advice on the use of Peak Rainfall Intensity climate change allowances, which can be found here: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

The Environment Agency is not a statutory consultee to the land use planning system for the consideration of surface water flood risk and management. We therefore recommend that you contact the relevant Lead Local Flood Authority (contact details listed below) to discuss Flood Risk Assessment requirements to support your development's surface water management proposals.

Cambridgeshire County Council - fr.planning@cambridgeshire.gov.uk
Central Bedfordshire Council - floodrisk@centralbedfordshire.gov.uk
Bedford Borough Council - floodrisk@bedford.gov.uk
Milton Keynes Council - llfa@milton-keynes.gov.uk
Buckinghamshire County Council - floodmanagement@buckscc.gov.uk
Herts County Council - floodandwatermanagement@hertscc.gov.uk
Northamptonshire County Council - floodandwater@northamptonshire.gov.uk
Norfolk County Council - llfa@norfolk.gov.uk
Suffolk County Council - floods@suffolk.gov.uk
Essex County Council - suds@essex.gov.uk
Thurrock Council - TransportDevelopment@thurrock.gov.uk
Southend-on-Sea Council - llfa@southend.gov.uk

8) Our Service

Non-chargeable service

We will give a free opinion on:

- What climate change allowance to apply to a particular development type
- Which technical approach is suitable in the FRA

Chargeable service:

- Review of climate change impacts using intermediate and detailed technical approaches (i.e. modelling review)
- Assessment and review of proposals for managed adaptation.

Contact Details

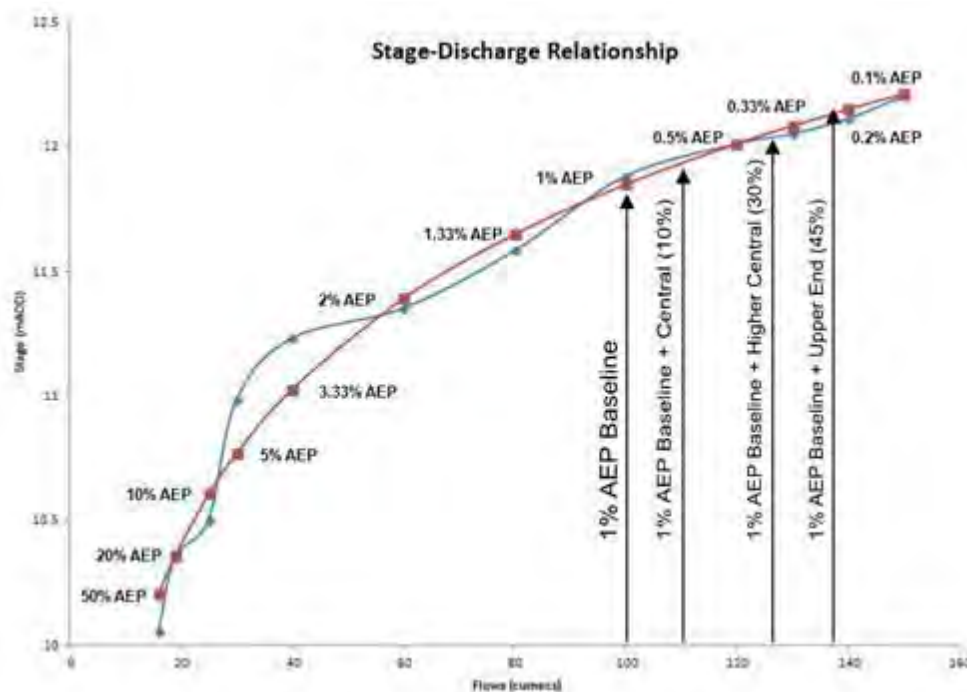
For East Anglia (Great Ouse Catchment): planning.brampton@environment-agency.gov.uk

For East Anglia (East): planning.ipswich@environment-agency.gov.uk

Appendix 1 – Further information on the Intermediate approach.

- 1) The methodology the chart is based on does not produce an accurate stage-discharge rating and is a simplified methodology for producing flood levels that can be applied in low risk small-scale development situations.
- 2) The method should not be applied where there is existing detailed modelled climate change outputs that use the new allowances. In such circumstances, the 'with climate change' modelled scenarios should be applied.

An example stage-discharge relationship is shown below.



Flood risk assessment data

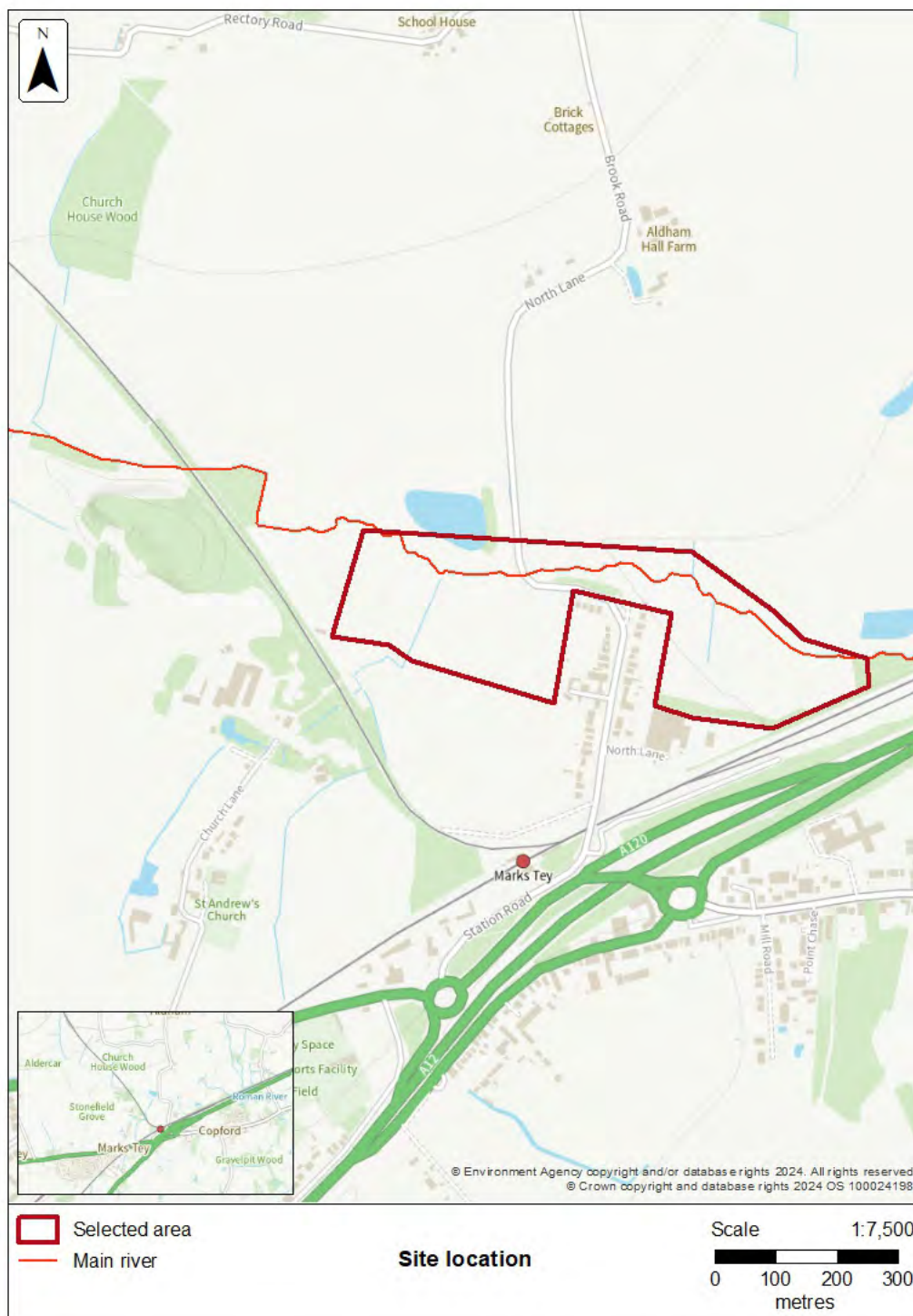
Location of site: 591531 / 224333 (shown as easting and northing coordinates)

Document created on: 15 August 2024

This information was previously known as a product 4.

Customer reference number: 6JC6NWYUJGXN

Map showing the location that flood risk assessment data has been requested for.



How to use this information

You can use this information as part of a flood risk assessment for a planning application. To do this, you should include it in the appendix of your flood risk assessment.

We recommend that you work with a flood risk consultant to get your flood risk assessment.

Included in this document

In this document you'll find:

- how to find information about surface water and other sources of flooding
- definitions for the terminology used throughout
- flood map for planning (rivers and the sea)
- information about strategic flood risk assessments
- information about this data
- information about flood risk activity permits
- help and advice

Information that's unavailable

This document **does not** contain:

- historic flooding
- flood defences and attributes
- modelled data
- climate change modelled data

We do not have historic flooding data for this location.

Please note that:

- flooding may have occurred that we do not have records for
- flooding can come from a range of different sources
- we can only supply flood risk data relating to flooding from rivers or the sea

You can contact your Lead Local Flood Authority or Internal Drainage Board to see if they have other relevant local flood information. Please note that some areas do not have an Internal Drainage Board.

We aren't able to display flood defence locations and attributes as there are no formal flood defences in the area of interest.

There is not any modelled data available for this location. This is because detailed modelling hasn't been carried out in this area.

There is not any modelled climate change data for this location. This is because detailed modelling hasn't been carried out in this area. You will need to consider the [latest flood risk assessment climate change allowances](#) and factor in the new allowances to demonstrate the development will be safe from flooding.

Surface water and other sources of flooding

Use the [long term flood risk service](#) to find out about the risk of flooding from:

- surface water
- ordinary watercourses
- reservoirs

Or you can contact your Lead Local Flood Authority for further information.

Your Lead Local Flood Authority is Colchester.

For information about sewer flooding, contact the relevant water company for the area.

Terminology used

Annual exceedance probability (AEP)

This refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which is calculated to have a 1% chance of occurring in any one year, is described as 1% AEP.

Metres above ordnance datum (mAOD)

All flood levels are given in metres above ordnance datum which is defined as the mean sea level at Newlyn, Cornwall.

Flood map for planning (rivers and the sea)

Your selected location is in flood zone 3.

Flood zone 3 shows the area at risk of flooding for an undefended flood event with a:

- 0.5% or greater probability of occurring in any year for flooding from the sea
- 1% or greater probability of occurring in any year for fluvial (river) flooding

Flood zone 2 shows the area at risk of flooding for an undefended flood event with:

- between a 0.1% and 0.5% probability of occurring in any year for flooding from the sea
- between a 0.1% and 1% probability of occurring in any year for fluvial (river) flooding

It's important to remember that the flood zones on this map:

- refer to the land at risk of flooding and do not refer to individual properties
- refer to the probability of river and sea flooding, ignoring the presence of defences
- do not take into account potential impacts of climate change

The flood zones are not currently being updated. The last update was in November 2023. Some of the flood zones may have changed, however all source data is included in the models below.



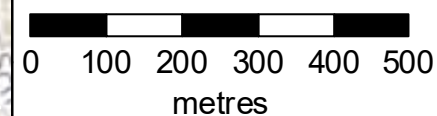
Flood map for planning

Location (easting/northing)
591531/224333

Scale
1:10,000

Created
15 Aug 2024

-  Selected area
-  Main river
-  Flood zone 3
-  Flood zone 2



Strategic flood risk assessments

We recommend that you check the relevant local authority's strategic flood risk assessment (SFRA) as part of your work to prepare a site specific flood risk assessment.

This should give you information about:

- the potential impacts of climate change in this catchment
- areas defined as functional floodplain
- flooding from other sources, such as surface water, ground water and reservoirs

Your Lead Local Flood Authority is Colchester.

About this data

This data has been generated by strategic scale flood models and is not intended for use at the individual property scale. If you're intending to use this data as part of a flood risk assessment, please include an appropriate modelling tolerance as part of your assessment. The Environment Agency regularly updates its modelling. We recommend that you check the data provided is the most recent, before submitting your flood risk assessment.

Flood risk activity permits

Under the Environmental Permitting (England and Wales) Regulations 2016 some developments may require an environmental permit for flood risk activities from the Environment Agency. This includes any permanent or temporary works that are in, over, under, or nearby a designated main river or flood defence structure.

[Find out more about flood risk activity permits](#)

Help and advice

Contact the East Anglia Environment Agency team at enquiries_eastanglia@environment-agency.gov.uk for:

- [more information about getting a product 5, 6, 7 or 8](#)
- general help and advice about the site you're requesting data for

Flood risk assessments: Climate change allowances

Application of the allowances and local considerations

East Anglia; Essex, Norfolk, Suffolk, Cambridgeshire and Bedfordshire

1) The climate change allowances

The [National Planning Practice Guidance](#) refers planners, developers and advisors to the Environment Agency guidance on considering climate change in Flood Risk Assessments (FRAs). This guidance was updated in October 2021 and is available on [Gov.uk](#). The guidance can be used for planning applications, local plans, neighbourhood plans and other projects. It provides climate change allowances for peak river flow, peak rainfall, sea level rise, wind speed and wave height. The guidance provides a range of allowances to assess fluvial flooding, rather than a single national allowance. It advises on what allowances to use for assessment based on vulnerability classification, flood zone and development lifetime.

2) Assessment of climate change impacts on fluvial flooding

Where existing EA flood risk datasets and models do not provide the required climate change allowances, it is up to developers to undertake any work needed to appropriately assess the impacts of climate change on flood risk. They can do this by using the approaches in **Table A** below:

Table A below indicates the level of technical assessment of climate change impacts on fluvial flooding appropriate for new developments depending on their scale and location. This should be used as **a guide only**. Ultimately, the agreed approach should be based on expert local knowledge of flood risk conditions, local sensitivities and other influences. **For these reasons, we recommend that applicants and / or their consultants should contact the Environment Agency at the pre-planning application stage to confirm the assessment approach, on a case by case basis.** The email addresses for our Sustainable Places teams at our respective offices can be found in Section 8 below.

Table A defines three possible approaches to account for flood risk impacts due to climate change, in new development proposals:

- **Basic:** Developer can add an allowance to the 'design flood' (i.e. 1% annual probability) peak levels to account for potential climate change impacts. The allowance should be derived and agreed locally by Environment Agency teams.
- **Intermediate:** Developer can use existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance being applied to the 'design flood' flow.
- **Detailed:** Perform detailed hydraulic modelling, either through re-running Environment Agency hydraulic models (if available) or construction of a new model by the developer.

Table A – Indicative guide to assessment approach

VULNERABILITY CLASSIFICATION	FLOOD ZONE	DEVELOPMENT TYPE		
		NON-MAJOR	SMALL-MAJOR	LARGE-MAJOR
ESSENTIAL INFRASTRUCTURE	Zone 2	Detailed		
	Zone 3a	Detailed		
	Zone 3b	Detailed		
HIGHLY VULNERABLE	Zone 2	Intermediate/ Basic	Intermediate/ Basic	Detailed
	Zone 3a	Not appropriate development		
	Zone 3b	Not appropriate development		
MORE VULNERABLE	Zone 2	Basic	Basic	Intermediate/ Basic
	Zone 3a	Intermediate/ Basic	Detailed	Detailed
	Zone 3b	Not appropriate development		
LESS VULNERABLE	Zone 2	Basic	Basic	Intermediate/ Basic
	Zone 3a	Basic	Basic	Detailed
	Zone 3b	Not appropriate development		
WATER COMPATIBLE	Zone 2	None		
	Zone 3a	Intermediate/ Basic		
	Zone 3b	Detailed		

Note: Where the table states 'not appropriate development', this is in line with national planning policy. If in exceptional circumstances such development types are proposed in these locations, we would expect a detailed modelling approach to be used.

NOTES:

- Non-Major: 1-9 dwellings/ less than 0.5 ha | Office / light industrial under 1ha | General industrial under 1 ha | Retail under 1 ha | Gypsy/traveller site between 0 and 9 pitches
- Small-Major: 10 to 30 dwellings | Office / light industrial 1ha to 5ha | General industrial 1ha to 5ha | Retail over 1ha to 5ha | Gypsy/traveller site over 10 to 30 pitches
- Large-Major: 30+ dwellings | Office / light industrial 5ha+ | General industrial 5ha+ | Retail 5ha+ | Gypsy/traveler site over 30+ pitches | any other development that creates a non-residential building or development over 1000 sq m.

The assessment approach should be agreed with the Environment Agency as part of pre-planning application discussions to avoid abortive work.

3) Specific local considerations

Where the Environment Agency and the applicant and / or their consultant has agreed that a 'basic' level of assessment is appropriate, the figures in Table B below can be used as a precautionary allowance for potential climate change impacts on peak 'design' (i.e. 1% annual probability) fluvial flood level rather than undertaking detailed modelling.

Table B – Local precautionary allowances for potential climate change impacts

Essex, Norfolk and Suffolk

Hydraulic Model (Watercourse)	Precautionary allowance (basic approach)
Blackwater & Brain - Blackwater between TL7520925623 and TL7820324314 Brain between TL7373323312 and TL7683821321	500mm
Other main rivers, tributaries and ordinary watercourses	For other main rivers, tributaries and ordinary watercourses that are not stated above, basic allowances have not been calculated. In this instance you can either: • If flow data is available you can request this data from us and can conduct an intermediate assessment yourself • Or alternatively, you can choose to undertake a Detailed Assessment and "perform detailed hydraulic modelling, through either re-running our hydraulic models (if available) or constructing a new model

Cambridgeshire and Bedfordshire

Watercourse / Model	Precautionary allowance (basic approach)
Alconbury Brook	600mm
River Kym	
Lower Ouse (Model Extent)	700mm
Mid Ouse (Cold Brayfield to Bromham – between SP9156852223 and TL0132950919)	700mm
Mid Ouse (East of Bedford to Roxton – between TL0791848903 and TL1618854543)	700mm
River Hiz and River Purwell	400mm
River Ivel	500mm
Pix Brook	450mm
Potton Brook	500mm
River Cam and tributaries (excluding the Cam Lodes and the Slade System)	450mm
Great Barford (ordinary watercourses)	500mm
Bromham (ordinary watercourse)	550mm

NOTES:

Urban areas excluded from the 'basic' approach: St Ives, Holywell, Godmanchester, Swavesey, Over, Bedford, Newport Pagnell, Buckingham and Leighton Buzzard. More detailed assessment of climate change allowances will need to be undertaken in these locations.

Use of these allowances will only be accepted after discussion with the Environment Agency.

4) Fluvial flood risk mitigation

For planning consultations where we are a statutory consultee and our [Flood risk standing advice](#) **does not** apply we use the following benchmarks to inform flood risk mitigation for different [vulnerability classifications](#). **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis.** For planning consultations where we are not a statutory consultee or our [Flood risk Standing advice](#) applies, we recommend that local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as **'essential infrastructure'** our benchmark for flood risk mitigation is for it to be designed to the **'higher central'** climate change allowance for the epoch that most closely represents the lifetime of the development, including decommissioning. Please note that nationally significant infrastructure projects (NSIPs) may also need to assess a **credible maximum climate change scenario** by applying the **'upper end'** allowance for peak river flow as a sensitivity test. This will help to determine how sensitive the development is to changes in the climate and to ensure that it can be adapted to large-scale climate change over its lifetime.
- For **highly vulnerable, more vulnerable, less vulnerable and water compatible** developments in flood zones 2 and 3a, the **'central'** climate change allowance is our minimum benchmark for flood risk mitigation. For large urban settlement extensions or developments that form new communities, the credible maximum climate change scenario must be assessed; in these circumstances, you should use the **'upper end'** allowance.
- For **water compatible** development in flood zone 3b, the **'central'** climate change allowance for the epoch that most closely represents the lifetime of the development is our minimum benchmark for flood risk mitigation.

For peak river flow allowances and a visual representation of the above, please see Tables 1 and 2 below.

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2125)
Upper and Bedford Ouse	Upper end	24%	30%	58%
	Higher central	10%	11%	30%
	Central	5%	4%	19%
Cam and Ely Ouse	Upper End	21%	22%	45%
	Higher Central	7%	5%	19%
	Central	2%	-2%	9%
Old Bedford and Middle Level	Upper End	23%	22%	39%
	Higher central	9%	4%	15%
	Central	3%	-3%	6%
North West Norfolk	Upper End	30%	34%	57%
	Higher central	18%	18%	33%
	Central	13%	11%	23%
North Norfolk Rivers	Upper End	26%	27%	48%
	Higher central	13%	11%	24%
	Central	7%	4%	14%
Broadland Rivers	Upper End	27%	27%	44%
	Higher central	14%	10%	20%
	Central	8%	3%	11%
East Suffolk	Upper End	25%	29%	54%
	Higher central	13%	13%	29%
	Central	8%	7%	19%
Combined Essex	Upper End	27%	37%	72%
	Higher central	13%	16%	38%
	Central	7%	8%	25%

South Essex	Upper End	22%	27%	48%
	Higher central	11%	11%	26%
	Central	6%	5%	17%

If you are not sure which management catchment your site falls within, please use the guidance and link to the peak river flow map, which can be found at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-river-flow-allowances>

Table 2: Using peak river flow allowances for flood risk assessments

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
2	higher central ¹	central ²	central ²	central	central
3a	higher central ¹	X	central ²	central	central
3b	higher central ¹	X	X	X	central

X – Development should not be permitted

If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the higher central allowance.

¹ For NSIPs, the ‘upper end’ allowance should be used to assess a credible maximum climate change scenario.

² For large urban settlement extensions or developments that form new communities, the credible maximum climate change scenario must be assessed. In these circumstances, you should use the ‘upper end’ allowance.

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case we may want to check this data and how you propose to use it.

Assessing off-site impacts and calculating floodplain compensation

The appropriate allowance to assess off-site impacts and calculation floodplain compensation requirements depends on the land uses in affected areas.

The ‘**central**’ allowance should be used in most cases. However, the ‘**higher central**’ allowance should be used when the affected area contains essential infrastructure.

5) Development in tidal flood risk areas

For flood risk assessments and strategic flood risk assessments, assess both the **higher central** and **upper end** allowances for all development vulnerability classes (see table 3 below).

For NSIPs and large urban settlement extensions or developments that form new communities, the **credible maximum climate change scenario** should be assessed (sea level rise and sensitivity test allowances for offshore wind speed and extreme wave height and storm surge uplift). To assess the flood risk from a high impact climate change scenario, you should use the H⁺⁺ allowance of 1.9m for the total sea level rise to 2100.

Table 3: sea level allowances for each epoch in mm for each year (based on a 1981 to 2000 baseline) – the total sea level risk for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20
Anglian	Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

6) Tidal flood risk mitigation

For planning consultations where we are a statutory consultee and our flood risk standing advice does not apply, we use the following benchmarks to inform flood risk mitigation for different [vulnerability classifications](#). **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis. Please note you may be charged for this advice.** For planning consultations where we are not a statutory consultee or our flood risk standing advice applies, we recommend that local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as essential Infrastructure, highly vulnerable development and more vulnerable development, our minimum benchmark for flood risk mitigation is the **‘upper end’** climate change allowance for the development lifetime (including decommissioning where relevant).
- For water compatible or less vulnerable development (e.g. commercial), our minimum benchmark for flood risk mitigation is the **‘higher central’** climate change allowance for the development lifetime. In sensitive locations it may be necessary to use the **‘upper end’** allowance to inform built in resilience.

If you are using our 2018 Coastal Flood Modelling Data outputs:

The **upper end** allowance become progressively higher each year than the climate change flood level outputs used in our current 2018 coastal flood model. So as an approximation we recommend that the following uplift values are added on to the on-site climate change flood levels provided in the Product 4:

- For development lifetimes extending to 2122, add 0.34m
- For development lifetimes extending to 2123, add 0.36m
- For development lifetimes extending to 2124, add 0.38m
- For development lifetimes extending to 2125, add 0.40m

If the proposed development is greater than 30 houses and the flood zone is in an open-coast location, we recommend that a more accurate impact of the increased upper end flood levels on the overtopping on-site flood levels is modelled by rerunning our coastal overtopping model with the new flood levels; you can obtain the model from us with a Product 6 and 7 request. If the site is located within a small or constrained tidal or coastal floodplain then regardless of the size of the development, you may also need to undertake remodelling of the flood levels to obtain an accurate assessment of the impacts of climate change; please contact us for advice (contact details in Section 8 below).

If you are using our Broads 2008 Flood Modelling Data outputs:

For the **upper end** allowance, please add the following uplift values onto the climate change flood levels provided in the Product 4:

- For development lifetimes extending to 2122, add 0.34m
- For development lifetimes extending to 2123, add 0.36m
- For development lifetimes extending to 2124, add 0.38m
- For development lifetimes extending to 2125, add 0.40m

If you are using our 2008 Thames Flood Modelling Data outputs:

Please add the appropriate climate change allowances for the South East River Basin District onto the present day flood levels obtained in the Product 4, starting from a base year of 2005. The allowances should be applied to the year appropriate to the respective development lifetime for residential or commercial developments.

**** note**:** *We anticipate that there will be updated flood modelling outputs available for the Thames Estuary in mid-2022. Developers preparing Flood Risk Assessments for developments in this area should check for availability of new data with the East Anglia (East) PSO team (contact details in Section 8 below).*

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case, we may want to check this data and how you propose to use it.

7) Assessment of climate change impacts for Surface Water Management

Please see the latest advice on the use of Peak Rainfall Intensity climate change allowances, which can be found here: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

The Environment Agency is not a statutory consultee to the land use planning system for the consideration of surface water flood risk and management. We therefore recommend that you contact the relevant Lead Local Flood Authority (contact details listed below) to discuss Flood Risk Assessment requirements to support your development's surface water management proposals.

Cambridgeshire County Council - fr.planning@cambridgeshire.gov.uk
Central Bedfordshire Council - floodrisk@centralbedfordshire.gov.uk
Bedford Borough Council - floodrisk@bedford.gov.uk
Milton Keynes Council - llfa@milton-keynes.gov.uk
Buckinghamshire County Council - floodmanagement@buckscc.gov.uk
Herts County Council - floodandwatermanagement@hertscc.gov.uk
Northamptonshire County Council - floodandwater@northamptonshire.gov.uk
Norfolk County Council - llfa@norfolk.gov.uk
Suffolk County Council - floods@suffolk.gov.uk
Essex County Council - suds@essex.gov.uk
Thurrock Council - TransportDevelopment@thurrock.gov.uk
Southend-on-Sea Council - llfa@southend.gov.uk

8) Our Service

Non-chargeable service

We will give a free opinion on:

- What climate change allowance to apply to a particular development type
- Which technical approach is suitable in the FRA

Chargeable service:

- Review of climate change impacts using intermediate and detailed technical approaches (i.e. modelling review)
- Assessment and review of proposals for managed adaptation.

Contact Details

For East Anglia (Great Ouse Catchment): planning.brampton@environment-agency.gov.uk

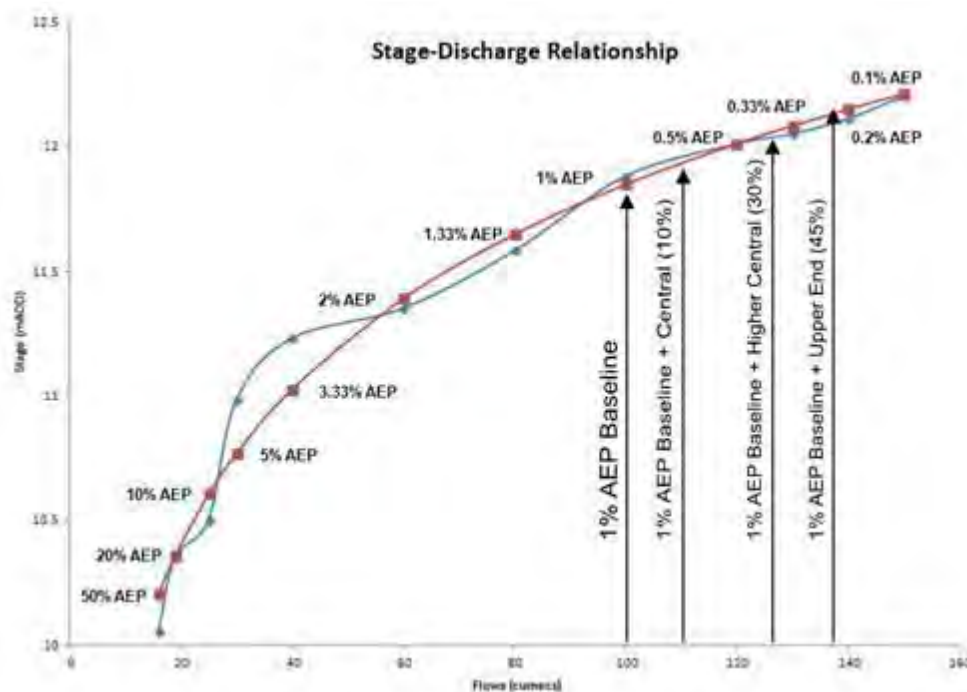
For East Anglia (East): planning.ipswich@environment-agency.gov.uk

Appendix 1 – Further information on the Intermediate approach.

1) The methodology the chart is based on does not produce an accurate stage-discharge rating and is a simplified methodology for producing flood levels that can be applied in low risk small-scale development situations.

2) The method should not be applied where there is existing detailed modelled climate change outputs that use the new allowances. In such circumstances, the 'with climate change' modelled scenarios should be applied.

An example stage-discharge relationship is shown below.





Product 4: Supporting Documentation

GUIDANCE INCLUDED:

1. PRODUCT 4 FACT SHEET.
2. FLOOD ZONE 3 FACTSHEET - EAST ANGLIA (EAST)
3. FLOOD RISK ASSESSMENT (FRA) CHECKLIST
4. NEW TIDAL CLIMATE CHANGE ALLOWANCES FOR ESSEX, NORFOLK AND SUFFOLK
5. UPDATED FLUVIAL CLIMATE CHANGE ALLOWANCES FOR ESSEX, NORFOLK AND SUFFOLK

PARTNERSHIP AND STRATEGIC OVERVIEW TEAM – EAST ANGLIA (EAST) Version 6 Updated May 2023

customer service line
03708 506 506

incident hotline
0800 80 70 60

floodline
03459 88 11 88

Product 4 Fact Sheet

Thank you for your enquiry.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Please refer to the Open Government Licence available here:

<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/> which explains the permitted use of this information.

You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system)
- overflowing or backing up of sewer or drainage systems which have been overwhelmed
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea.

Areas Benefiting from Flood Defences

Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

Flood Risk Assessment Checklist

If you are planning on using this data within a Flood Risk Assessment, we recommend that you take the time to fill in the attached FRA checklist, and to read the attachments which contain information relevant to the area that interests you.

We would like to stress the importance of filling in the Flood Risk Assessment check list and providing up-to-date and correct data. The data will be checked against our records when we review the Flood Risk Assessment in our role as statutory consultee.

It is important that you provide a map in section 2 of the FRA checklist (See Appendix A), including the highest and most representative flood levels for your site. We recommend using a number of nodes that provide a fair representation of the modelled data across your site. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate.

If you have a new enquiry or would like us to review the information we have provided under the Freedom of Information Act 2000 and Environmental Information Regulations 2004 please contact us within two months by email at Enquiries_EastAnglia@environment-agency.gov.uk

East Anglia Area

Ipswich Office, Icen House, Cobham Road, Ipswich, Suffolk, IP3 9JD

General Enquiries: 03708 506506

Email: enquiries@environment-agency.gov.uk

Website: <https://www.gov.uk/government/organisations/environment-agency>

Flood Zone 3 Factsheet

East Anglia (East)

Oct 2017 - v.7

This factsheet provides information to assist with the preparation of a Flood Risk Assessment (FRA) in support of development proposals reviewed by the East Anglia teams, based at Ipswich. It should be read alongside the Environment Agency's general FRA advice ([FRA Guidance note 3](#)). For information relating to proposals managed by East Anglia teams please contact: planning.eastanglia@environment-agency.gov.uk.

This factsheet covers issues relating to FRAs only and does not address other matters we may take into account when considering development proposals (e.g. proximity to a watercourse, contaminated land, Water Framework Directive and biodiversity requirements). For further information on those issues, please contact: planning.eastanglia@environment-agency.gov.uk

Sequential Test and Exception Test

The Local Planning Authority (LPA) will need to be satisfied that the proposed development passes the flood risk Sequential Test, and if applicable, the first part of the Exception Test, in line with requirements of the National Planning Policy Framework (NPPF). We therefore strongly suggest you speak to them prior to commencing work on an FRA. Information regarding the [aim of the Sequential Test](#), [applying the Sequential Test](#) and the [Exception Test](#) can all be found in the Practice Guide supporting the NPPF.

Inappropriate development

[Table 2](#) of the Practice Guide categorizes developments according to their vulnerability and [table 3](#) sets out which vulnerabilities are inappropriate in Flood Zone 3. You should be aware that we are likely to object in principle where it is indicated that a development is not compatible in Flood Zone 3. Please note that Flood Zone 3b is defined by the Local Planning Authority's Strategic Flood Risk Assessment, or by the 5% (1 in 20 year) modelled flood outlines and levels held by the Environment Agency.

More detail on what should be in the FRA (additional to that highlighted in Guidance Note 3):

The FRA should assess all sources of flooding and provide sufficient information on the characteristics of flooding at the site, such as frequency, depth, velocity, speed of onset, and duration. As a minimum the FRA needs to assess the flood risk on site by comparing our modelled flood levels with a GPS verified topographical survey of the site to determine the anticipated flood depths during the 5% (1 in 20), 1% / 0.5% (1 in 100 / 200) (design) and 0.1% (1 in 1000) (extreme) events including allowances for climate change. Climate change allowances can be found on [our website](#). If the area is protected by defences then the FRA should consider both the actual flood risk to the site through overtopping of the defences, and the residual risk posed by the defences being breached.

- **Sequential approach on site**

If the site contains a range of Flood Zones, the sequential approach should be applied within the site to direct development to the areas of lowest flood risk. If it isn't possible to locate all development in Flood Zone 1, then the most vulnerable elements should be located in the lowest risk parts of the site.

- **Finished Floor Levels**

Proposals for 'more vulnerable' development should include floor levels set no lower than 300 mm above the level of any flooding that would occur if defences were overtopped in a 1% / 0.5% flood event (including allowances for climate change). Safe refuge should also be provided above the 0.1% undefended/breach flood level (including allowances for climate change). We are likely to raise an objection where these requirements are not achieved.

We recommend 'less vulnerable' development also meets this requirement to minimize disruption and costs in a flood event. If this is not achievable then it is recommended that a place of refuge is provided above the 0.1% flood level (including allowances for climate change). Where safety is reliant on refuge it is important that the building is structurally resilient to withstand the pressures and forces (hydrostatic & hydrodynamic) associated with flood water. The LPA may need to receive supporting information and calculations to provide certainty that the buildings will be constructed to withstand these water pressures.

- **Safe Access**

During a flood, the journey to safe, dry areas completely outside the extent of a 1% / 0.5% flood event (including allowances for climate change), should not involve crossing areas of potentially fast flowing water. Those venturing out on foot in areas where flooding exceeds 100 millimetres or so would be at risk from a wide range of hazards, including, for example unmarked drops, or access chambers where the cover has been swept away. Safe access and egress routes should be assessed in accordance with the guidance document '[FD2320 \(Flood Risk Assessment Guidance for New Developments\)](#)'.

- **Emergency Flood Plan**

Where safe access cannot be achieved, or if the development would be at actual flood risk or residual risk of flooding in a breach, an emergency flood plan must be provided. The plan should deal with matters of evacuation and refuge, and should demonstrate that people will not be exposed to flood hazards. The emergency flood plan should be submitted as part of the FRA and will need to be agreed with the Local Planning Authority.

- **Flood Resilience / Resistance Measures**

To minimize the disruption and cost implications of a flood event we encourage development to incorporate flood resilience/resistance measures up to the extreme 0.1% climate change flood level.

Information on preparing property for flooding can be found in the documents '[Improving the Flood performance of new buildings](#)' and '[Prepare your property for flooding](#)'.

- **Betterment**

Every effort should be made by the applicant to improve the flood risk to the local area, especially if there are known flooding issues. Opportunities should also be taken to provide environmental enhancements as part of the design, for example naturalizing any rivers on the site with a buffer zone on both sides.

- **Increases in Built Footprint (excluding open coast situations)**

It will need to be shown that any increase in built footprint within the extent of a 1% flood event (including allowances for climate change), can be directly compensated for on a volume-for-volume and level-for-level basis to prevent a loss of floodplain storage. If there are no available areas for compensation above the design flood level and compensation will not be possible, then a calculation of the offsite flood risk impacts will need to be undertaken. If this shows significant offsite impacts then no increases in built footprint will be allowed. Further guidance on the provision of compensatory flood storage is provided in section A3.3.10 of the CIRIA document C624.

Flood Defence Consent

Flood Defence Consents now fall under the Environmental Permitting (England and Wales) Regulations 2010 system (EPR). You may need an environmental permit for flood risk activities if you want to do work in, under, over or within 8 metres of a fluvial river or any flood defence structure or culvert / 16m from a tidal river or any flood defence structure or culvert. New forms and further information can be found at: <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>.

Local policies and recommendations

You will need to demonstrate to the Local Planning Authority that the requirements of any local flood risk planning policies have been met and the recommendations of the relevant Strategic Flood Risk Assessment, Shoreline Management Plans and Catchment Flood Management Plans have been considered.

Further Information:

If you require the flooding information we hold for this site then please email our local Customers and Engagement Team: enquiries_eastanglia@environment-agency.gov.uk. For further details on our flood map products please visit our website at: www.environment-agency.gov.uk/research/planning/93498.aspx.

Flood Risk Assessment (FRA) Checklist

This document should be attached to the front of the Flood Risk Assessment (FRA) issued to Local Planning Authorities (LPA) in support of a development proposal which may be at risk of flooding. This document is not a substitute for a FRA. Please note, under our responsibilities as a statutory consultee we will review any submitted FRA only in respect to fluvial and tidal risk. Your FRA should also consider other sources of flooding such as surface water, drainage, and ground water flooding.

1. Development Proposal

Site name	
National Grid Reference (NGR)	
Flood Risk Assessment	Reference/Title: Date:
Existing site use & vulnerability classification	
Proposed site use & vulnerability classification	

2. Flood Risk

Flood Zone(s) affecting the site/property	
Sources of flooding affecting the site	
Have you considered flood storage compensation?	Yes/No **

3. Please provide a node map and accompanying table in the Flood Risk Assessment similar to the example given (see Appendix A). You should clearly demonstrate the highest and most representative flood levels for your proposed development. For example, if it is a small extension (< 250 square metres) then approximately 5-10 nodes would be sufficient. For larger sites, approximately 10 to 20 nodes would be appropriate.

4. Mitigation

Finished floor levels (in mAOD) for each proposed floor.	
Have you considered a freeboard for these Finished Floor Levels?***	
Drawing reference showing Finished Floor Levels for proposed development	
Have you considered suitable internal and external access for safe refuge above the flood level?	Yes/No

5. Proximity to the watercourse/ flood defence/ culvert

Are the proposed developments on, over, under or within 8 metres of a fluvial main river or 16 metres of a tidal main river or flood defence?	Yes/No If yes, please provide a cross section drawing in your planning application showing the distance of the proposed development in relation to the watercourse/flood defence/culvert. If yes, this will require a Flood Risk Activity Permit.
---	---

Map Many of our flood datasets are available online:
 Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#), [Risk of Flooding from Rivers and Sea](#), [Historic Flood Map](#), [Current Flood Warnings](#))

**** Please be aware floodplain compensation may be required for your site. Floodplain compensation is normally required when the proposed site use has an increased built footprint in relation to the existing site use and lies primarily in Flood Zone 3, which is considered the fluvial floodplain. This is normally demarked in the modelled data by the 1 in 100 + Climate Change flood return period.**

***** Please refer to the Local Authority's SFRA for further guidance on freeboard requirements for each type of development**

Environment Agency, Icen House, Cobham Road, Ipswich, IP3 9JD

Customer services line: 03708 506 506

Email: enquiries@environment-agency.gov.uk

www.environment-agency.gov.uk

Planning advice and guidance

The Environment Agency are keen to work with partners to enable development which is resilient to flooding for its lifetime and provides wider benefits to communities. If you have requested this information to help inform a development proposal, then we recommend engaging with us as early as possible by using the pre-application form available from our website:

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Complete the form in the link and email back to planning.eastanglia@environment-agency.gov.uk

We recognise the value of early engagement in development planning decisions. This allows complex issues to be discussed, innovative solutions to be developed that both enables new development and protects existing communities. Such engagement can often avoid delays in the planning process following planning application submission, by reaching agreements up-front. We offer a charged pre-application advice service for applicants who wish to discuss a development proposal.

We can also provide a preliminary opinion for free which will identify environmental constraints related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

Flood Risk Assessments guidance

In preparing your planning application submission, you should refer to the Environment Agency's Flood Risk Standing Advice and the Planning Practice Guidance for information about what flood risk assessment is needed for new development in the different Flood Zones. This information can be accessed via:

<https://www.gov.uk/flood-risk-assessment-standing-advice>

<http://planningguidance.planningportal.gov.uk/>

<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>

<https://www.gov.uk/guidance/flood-risk-and-coastal-change>

You should also consult the Strategic Flood Risk Assessment and flood risk local plan policies produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. You should discuss surface water management with your Lead Local Flood Authority.
3. Where a planning application requires a FRA and this is not submitted or deficient, the Environment Agency may well raise an objection due to insufficient information

Advice to Consultants

The data provided in the checklist and FRA will be checked against our records as we review the FRAs when consulted on by the Local Planning Authority in our remit as statutory consultee for flood risk from tidal and fluvial sources. We require you to get in touch with us to check for the most up to date model information and FRA checklist. Having the latest data is important as not having the data will possibly delay us in reviewing your application at planning stage.

Appendix A: (This is an example only for how to do the node map and accompanying table)



1. Outline your site boundary clearly
2. Clearly mark the node points where you are extracting data from
3. Select node points that cover the site, around the site itself, and along the access route to the site to give a representative sample

	National Grid Reference		Modelled Levels
Node	Easting	Northing	[insert return period]
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Flood risk assessments: Climate change allowances

Application of the allowances and local considerations

East Anglia; Essex, Norfolk, Suffolk, Cambridgeshire and Bedfordshire

1) The climate change allowances

The [National Planning Practice Guidance](#) refers planners, developers and advisors to the Environment Agency guidance on considering climate change in Flood Risk Assessments (FRAs). This guidance was updated in October 2021 and is available on [Gov.uk](#). The guidance can be used for planning applications, local plans, neighbourhood plans and other projects. It provides climate change allowances for peak river flow, peak rainfall, sea level rise, wind speed and wave height. The guidance provides a range of allowances to assess fluvial flooding, rather than a single national allowance. It advises on what allowances to use for assessment based on vulnerability classification, flood zone and development lifetime.

2) Assessment of climate change impacts on fluvial flooding

Where existing EA flood risk datasets and models do not provide the required climate change allowances, it is up to developers to undertake any work needed to appropriately assess the impacts of climate change on flood risk. They can do this by using the approaches in **Table A** below:

Table A below indicates the level of technical assessment of climate change impacts on fluvial flooding appropriate for new developments depending on their scale and location. This should be used as **a guide only**. Ultimately, the agreed approach should be based on expert local knowledge of flood risk conditions, local sensitivities and other influences. **For these reasons, we recommend that applicants and / or their consultants should contact the Environment Agency at the pre-planning application stage to confirm the assessment approach, on a case by case basis.** The email addresses for our Sustainable Places teams at our respective offices can be found in Section 8 below.

Table A defines three possible approaches to account for flood risk impacts due to climate change, in new development proposals:

- **Basic:** Developer can add an allowance to the 'design flood' (i.e. 1% annual probability) peak levels to account for potential climate change impacts. The allowance should be derived and agreed locally by Environment Agency teams.
- **Intermediate:** Developer can use existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance being applied to the 'design flood' flow.
- **Detailed:** Perform detailed hydraulic modelling, either through re-running Environment Agency hydraulic models (if available) or construction of a new model by the developer.

Table A – Indicative guide to assessment approach

VULNERABILITY CLASSIFICATION	FLOOD ZONE	DEVELOPMENT TYPE		
		NON-MAJOR	SMALL-MAJOR	LARGE-MAJOR
ESSENTIAL INFRASTRUCTURE	Zone 2	Detailed		
	Zone 3a	Detailed		
	Zone 3b	Detailed		
HIGHLY VULNERABLE	Zone 2	Intermediate/ Basic	Intermediate/ Basic	Detailed
	Zone 3a	Not appropriate development		
	Zone 3b	Not appropriate development		
MORE VULNERABLE	Zone 2	Basic	Basic	Intermediate/ Basic
	Zone 3a	Intermediate/ Basic	Detailed	Detailed
	Zone 3b	Not appropriate development		
LESS VULNERABLE	Zone 2	Basic	Basic	Intermediate/ Basic
	Zone 3a	Basic	Basic	Detailed
	Zone 3b	Not appropriate development		
WATER COMPATIBLE	Zone 2	None		
	Zone 3a	Intermediate/ Basic		
	Zone 3b	Detailed		

Note: Where the table states 'not appropriate development', this is in line with national planning policy. If in exceptional circumstances such development types are proposed in these locations, we would expect a detailed modelling approach to be used.

NOTES:

- Non-Major: 1-9 dwellings/ less than 0.5 ha | Office / light industrial under 1ha | General industrial under 1 ha | Retail under 1 ha | Gypsy/traveller site between 0 and 9 pitches
- Small-Major: 10 to 30 dwellings | Office / light industrial 1ha to 5ha | General industrial 1ha to 5ha | Retail over 1ha to 5ha | Gypsy/traveller site over 10 to 30 pitches
- Large-Major: 30+ dwellings | Office / light industrial 5ha+ | General industrial 5ha+ | Retail 5ha+ | Gypsy/traveler site over 30+ pitches | any other development that creates a non-residential building or development over 1000 sq m.

The assessment approach should be agreed with the Environment Agency as part of pre-planning application discussions to avoid abortive work.

3) Specific local considerations

Where the Environment Agency and the applicant and / or their consultant has agreed that a 'basic' level of assessment is appropriate, the figures in Table B below can be used as a precautionary allowance for potential climate change impacts on peak 'design' (i.e. 1% annual probability) fluvial flood level rather than undertaking detailed modelling.

Table B – Local precautionary allowances for potential climate change impacts

Essex, Norfolk and Suffolk

Hydraulic Model (Watercourse)	Precautionary allowance (basic approach)
Blackwater & Brain - Blackwater between TL7520925623 and TL7820324314 Brain between TL7373323312 and TL7683821321	500mm
Other main rivers, tributaries and ordinary watercourses	For other main rivers, tributaries and ordinary watercourses that are not stated above, basic allowances have not been calculated. In this instance you can either: • If flow data is available you can request this data from us and can conduct an intermediate assessment yourself • Or alternatively, you can choose to undertake a Detailed Assessment and "perform detailed hydraulic modelling, through either re-running our hydraulic models (if available) or constructing a new model

Cambridgeshire and Bedfordshire

Watercourse / Model	Precautionary allowance (basic approach)
Alconbury Brook	600mm
River Kym	
Lower Ouse (Model Extent)	700mm
Mid Ouse (Cold Brayfield to Bromham – between SP9156852223 and TL0132950919)	700mm
Mid Ouse (East of Bedford to Roxton – between TL0791848903 and TL1618854543)	700mm
River Hiz and River Purwell	400mm
River Ivel	500mm
Pix Brook	450mm
Potton Brook	500mm
River Cam and tributaries (excluding the Cam Lodes and the Slade System)	450mm
Great Barford (ordinary watercourses)	500mm
Bromham (ordinary watercourse)	550mm

NOTES:

Urban areas excluded from the 'basic' approach: St Ives, Holywell, Godmanchester, Swavesey, Over, Bedford, Newport Pagnell, Buckingham and Leighton Buzzard. More detailed assessment of climate change allowances will need to be undertaken in these locations.

Use of these allowances will only be accepted after discussion with the Environment Agency.

4) Fluvial flood risk mitigation

For planning consultations where we are a statutory consultee and our [Flood risk standing advice](#) **does not** apply we use the following benchmarks to inform flood risk mitigation for different [vulnerability classifications](#). **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis.** For planning consultations where we are not a statutory consultee or our [Flood risk Standing advice](#) applies, we recommend that local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as **'essential infrastructure'** our benchmark for flood risk mitigation is for it to be designed to the **'higher central'** climate change allowance for the epoch that most closely represents the lifetime of the development, including decommissioning. Please note that nationally significant infrastructure projects (NSIPs) may also need to assess a **credible maximum climate change scenario** by applying the **'upper end'** allowance for peak river flow as a sensitivity test. This will help to determine how sensitive the development is to changes in the climate and to ensure that it can be adapted to large-scale climate change over its lifetime.
- For **highly vulnerable, more vulnerable, less vulnerable and water compatible** developments in flood zones 2 and 3a, the **'central'** climate change allowance is our minimum benchmark for flood risk mitigation. For large urban settlement extensions or developments that form new communities, the credible maximum climate change scenario must be assessed; in these circumstances, you should use the **'upper end'** allowance.
- For **water compatible** development in flood zone 3b, the **'central'** climate change allowance for the epoch that most closely represents the lifetime of the development is our minimum benchmark for flood risk mitigation.

For peak river flow allowances and a visual representation of the above, please see Tables 1 and 2 below.

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2125)
Upper and Bedford Ouse	Upper end	24%	30%	58%
	Higher central	10%	11%	30%
	Central	5%	4%	19%
Cam and Ely Ouse	Upper End	21%	22%	45%
	Higher Central	7%	5%	19%
	Central	2%	-2%	9%
Old Bedford and Middle Level	Upper End	23%	22%	39%
	Higher central	9%	4%	15%
	Central	3%	-3%	6%
North West Norfolk	Upper End	30%	34%	57%
	Higher central	18%	18%	33%
	Central	13%	11%	23%
North Norfolk Rivers	Upper End	26%	27%	48%
	Higher central	13%	11%	24%
	Central	7%	4%	14%
Broadland Rivers	Upper End	27%	27%	44%
	Higher central	14%	10%	20%
	Central	8%	3%	11%
East Suffolk	Upper End	25%	29%	54%
	Higher central	13%	13%	29%
	Central	8%	7%	19%
Combined Essex	Upper End	27%	37%	72%
	Higher central	13%	16%	38%
	Central	7%	8%	25%

South Essex	Upper End	22%	27%	48%
	Higher central	11%	11%	26%
	Central	6%	5%	17%

If you are not sure which management catchment your site falls within, please use the guidance and link to the peak river flow map, which can be found at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-river-flow-allowances>

Table 2: Using peak river flow allowances for flood risk assessments

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
2	higher central ¹	central ²	central ²	central	central
3a	higher central ¹	X	central ²	central	central
3b	higher central ¹	X	X	X	central

X – Development should not be permitted

If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the higher central allowance.

¹ For NSIPs, the ‘upper end’ allowance should be used to assess a credible maximum climate change scenario.

² For large urban settlement extensions or developments that form new communities, the credible maximum climate change scenario must be assessed. In these circumstances, you should use the ‘upper end’ allowance.

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case we may want to check this data and how you propose to use it.

Assessing off-site impacts and calculating floodplain compensation

The appropriate allowance to assess off-site impacts and calculation floodplain compensation requirements depends on the land uses in affected areas.

The ‘**central**’ allowance should be used in most cases. However, the ‘**higher central**’ allowance should be used when the affected area contains essential infrastructure.

5) Development in tidal flood risk areas

For flood risk assessments and strategic flood risk assessments, assess both the **higher central** and **upper end** allowances for all development vulnerability classes (see table 3 below).

For NSIPs and large urban settlement extensions or developments that form new communities, the **credible maximum climate change scenario** should be assessed (sea level rise and sensitivity test allowances for offshore wind speed and extreme wave height and storm surge uplift). To assess the flood risk from a high impact climate change scenario, you should use the H⁺⁺ allowance of 1.9m for the total sea level rise to 2100.

Table 3: sea level allowances for each epoch in mm for each year (based on a 1981 to 2000 baseline) – the total sea level risk for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20
Anglian	Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

6) Tidal flood risk mitigation

For planning consultations where we are a statutory consultee and our flood risk standing advice does not apply, we use the following benchmarks to inform flood risk mitigation for different [vulnerability classifications](#). **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis. Please note you may be charged for this advice.** For planning consultations where we are not a statutory consultee or our flood risk standing advice applies, we recommend that local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as essential Infrastructure, highly vulnerable development and more vulnerable development, our minimum benchmark for flood risk mitigation is the **‘upper end’** climate change allowance for the development lifetime (including decommissioning where relevant).
- For water compatible or less vulnerable development (e.g. commercial), our minimum benchmark for flood risk mitigation is the **‘higher central’** climate change allowance for the development lifetime. In sensitive locations it may be necessary to use the **‘upper end’** allowance to inform built in resilience.

If you are using our 2018 Coastal Flood Modelling Data outputs:

The **upper end** allowance become progressively higher each year than the climate change flood level outputs used in our current 2018 coastal flood model. So as an approximation we recommend that the following uplift values are added on to the on-site climate change flood levels provided in the Product 4:

- For development lifetimes extending to 2122, add 0.34m
- For development lifetimes extending to 2123, add 0.36m
- For development lifetimes extending to 2124, add 0.38m
- For development lifetimes extending to 2125, add 0.40m

If the proposed development is greater than 30 houses and the flood zone is in an open-coast location, we recommend that a more accurate impact of the increased upper end flood levels on the overtopping on-site flood levels is modelled by rerunning our coastal overtopping model with the new flood levels; you can obtain the model from us with a Product 6 and 7 request. If the site is located within a small or constrained tidal or coastal floodplain then regardless of the size of the development, you may also need to undertake remodelling of the flood levels to obtain an accurate assessment of the impacts of climate change; please contact us for advice (contact details in Section 8 below).

If you are using our Broads 2008 Flood Modelling Data outputs:

For the **upper end** allowance, please add the following uplift values onto the climate change flood levels provided in the Product 4:

- For development lifetimes extending to 2122, add 0.34m
- For development lifetimes extending to 2123, add 0.36m
- For development lifetimes extending to 2124, add 0.38m
- For development lifetimes extending to 2125, add 0.40m

If you are using our 2008 Thames Flood Modelling Data outputs:

Please add the appropriate climate change allowances for the South East River Basin District onto the present day flood levels obtained in the Product 4, starting from a base year of 2005. The allowances should be applied to the year appropriate to the respective development lifetime for residential or commercial developments.

**** note**:** *We anticipate that there will be updated flood modelling outputs available for the Thames Estuary in mid-2022. Developers preparing Flood Risk Assessments for developments in this area should check for availability of new data with the East Anglia (East) PSO team (contact details in Section 8 below).*

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case, we may want to check this data and how you propose to use it.

7) Assessment of climate change impacts for Surface Water Management

Please see the latest advice on the use of Peak Rainfall Intensity climate change allowances, which can be found here: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

The Environment Agency is not a statutory consultee to the land use planning system for the consideration of surface water flood risk and management. We therefore recommend that you contact the relevant Lead Local Flood Authority (contact details listed below) to discuss Flood Risk Assessment requirements to support your development's surface water management proposals.

Cambridgeshire County Council - fr.planning@cambridgeshire.gov.uk
Central Bedfordshire Council - floodrisk@centralbedfordshire.gov.uk
Bedford Borough Council - floodrisk@bedford.gov.uk
Milton Keynes Council - llfa@milton-keynes.gov.uk
Buckinghamshire County Council - floodmanagement@buckscc.gov.uk
Herts County Council - floodandwatermanagement@hertscc.gov.uk
Northamptonshire County Council - floodandwater@northamptonshire.gov.uk
Norfolk County Council - llfa@norfolk.gov.uk
Suffolk County Council - floods@suffolk.gov.uk
Essex County Council - suds@essex.gov.uk
Thurrock Council - TransportDevelopment@thurrock.gov.uk
Southend-on-Sea Council - llfa@southend.gov.uk

8) Our Service

Non-chargeable service

We will give a free opinion on:

- What climate change allowance to apply to a particular development type
- Which technical approach is suitable in the FRA

Chargeable service:

- Review of climate change impacts using intermediate and detailed technical approaches (i.e. modelling review)
- Assessment and review of proposals for managed adaptation.

Contact Details

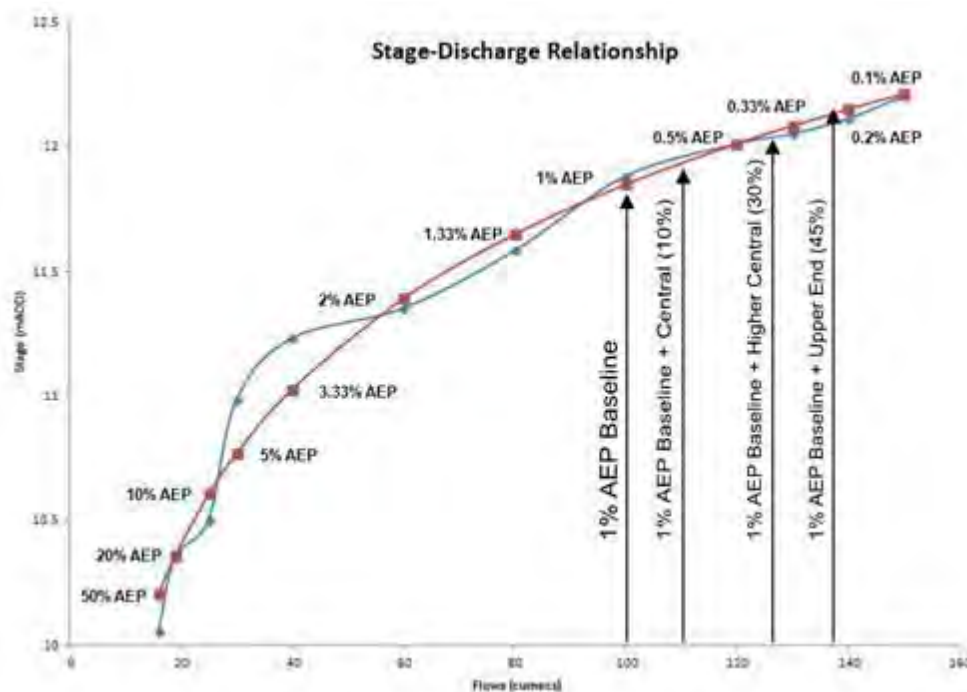
For East Anglia (Great Ouse Catchment): planning.brampton@environment-agency.gov.uk

For East Anglia (East): planning.ipswich@environment-agency.gov.uk

Appendix 1 – Further information on the Intermediate approach.

- 1) The methodology the chart is based on does not produce an accurate stage-discharge rating and is a simplified methodology for producing flood levels that can be applied in low risk small-scale development situations.
- 2) The method should not be applied where there is existing detailed modelled climate change outputs that use the new allowances. In such circumstances, the 'with climate change' modelled scenarios should be applied.

An example stage-discharge relationship is shown below.



Appendix F

Envirocheck Flood Screening report



motion

EANRW Flood Data Map (1:10,000)

General

-  Specified Site
-  Specified Buffer(s)
-  Bearing Reference Point

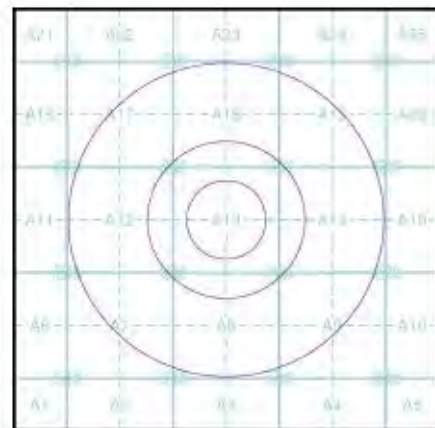
Flood Data

-  Extreme Flooding from Rivers or Sea without Defences (Zone 2)
-  Flooding from Rivers or Sea without Defences (Zone 3)
-  Area Benefiting from Flood Defence
-  Flood Water Storage Areas
-  Flood Defence

Contours (height in metres)

- Standard Contour  105
- Master Contour  100
- Spot Height  1167.1
-  MLW Mean Low Water
-  MHW Mean High Water

EANRW Flood Data Map - Slice A



Order Details

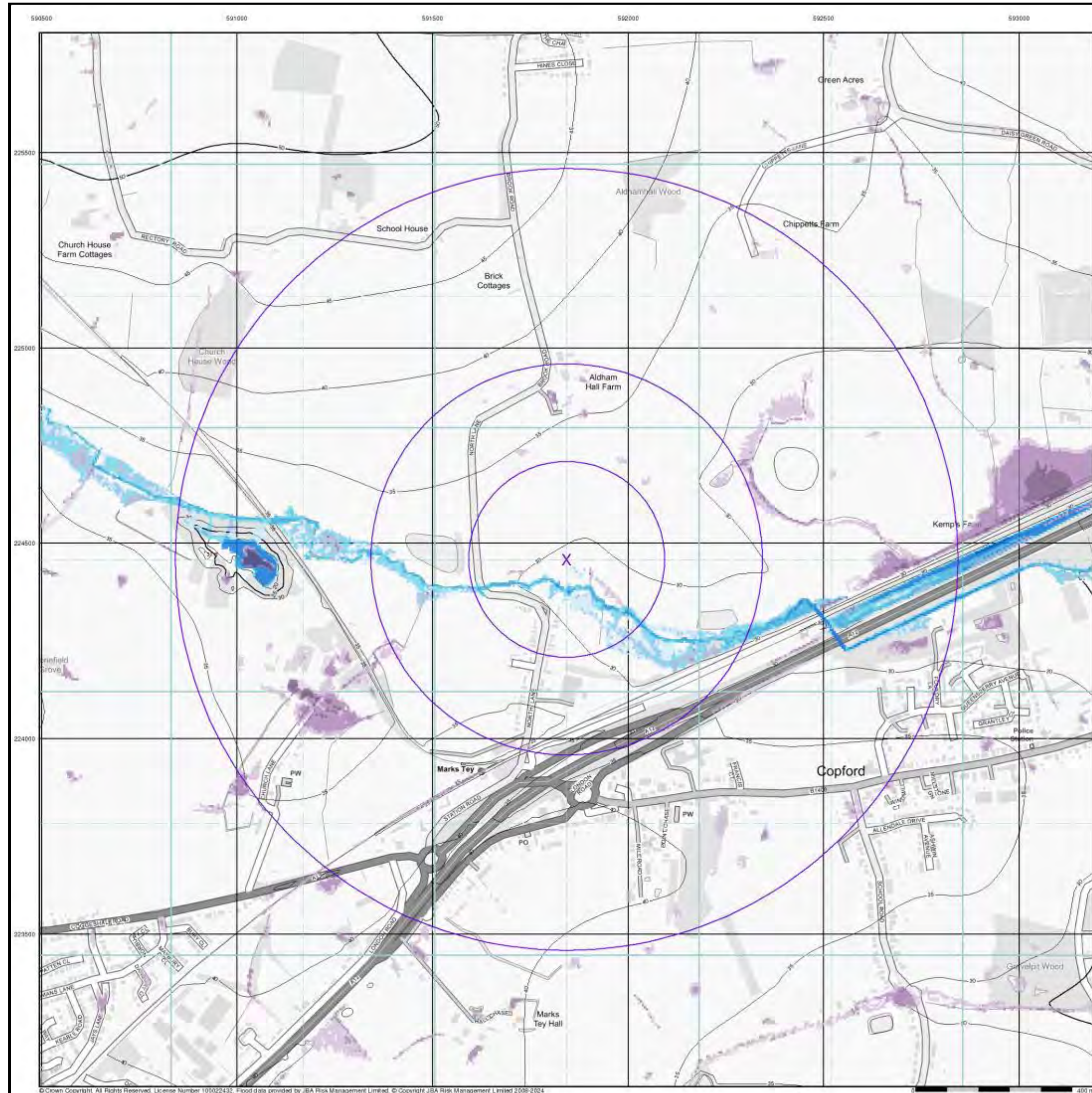
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

Landmark
INFORMATION GROUP

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



JBA 75 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

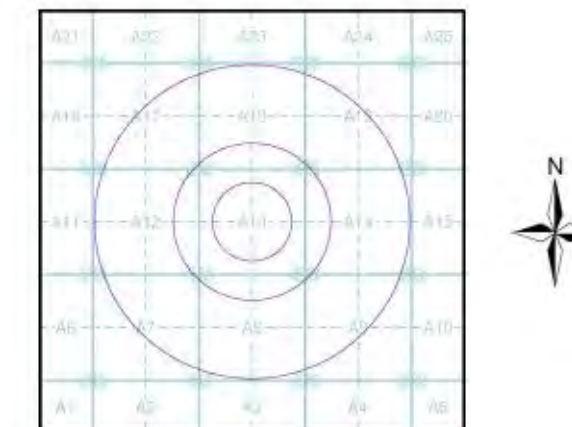
Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height
- MLW Mean Low Water
- MHW Mean High Water

JBA 75 Year Return Flood Map (Undefended) - Slice A



Order Details

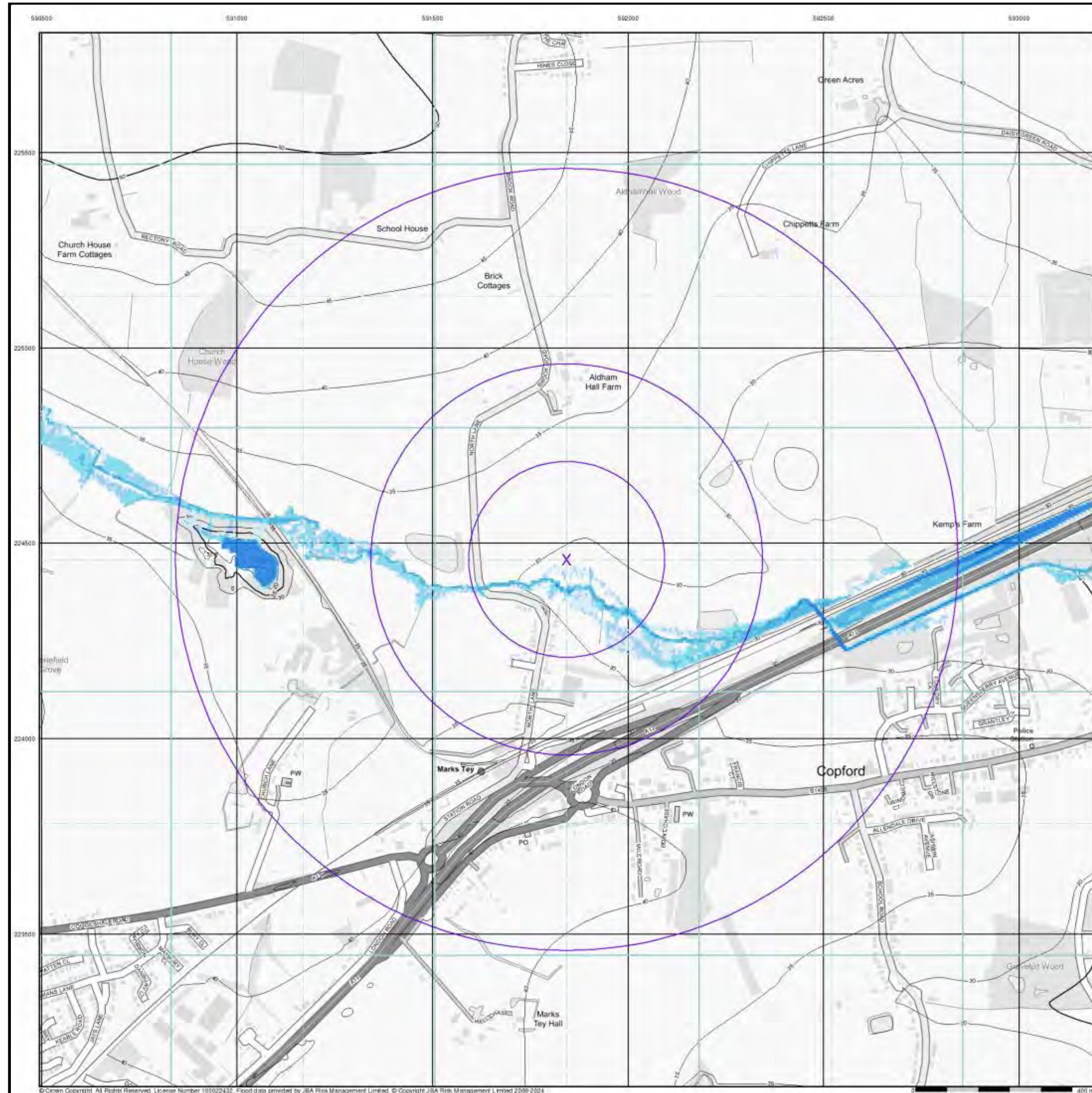
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

Landmark
INFORMATION GROUP

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JBA 100 Year Return Flood Map (Undefended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Modelled Flood Depth

Fluvial Depth

0.01m - 0.05m
0.05m - 0.1m
0.1m - 0.3m
0.3m - 1m
>1m

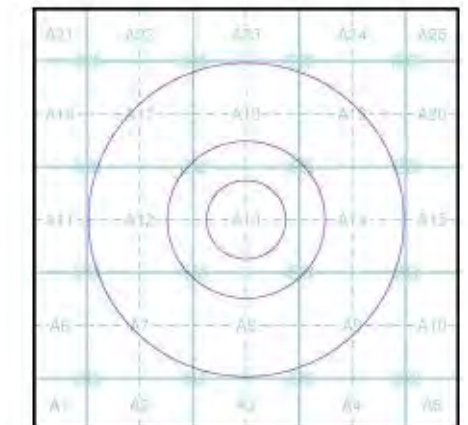
Coastal Depth

0.01m - 0.05m
0.05m - 0.1m
0.1m - 0.3m
0.3m - 1m
>1m

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height
- MLW Mean Low Water
- MHW Mean High Water

JBA 100 Year Return Flood Map (Undefended) - Slice A



Order Details

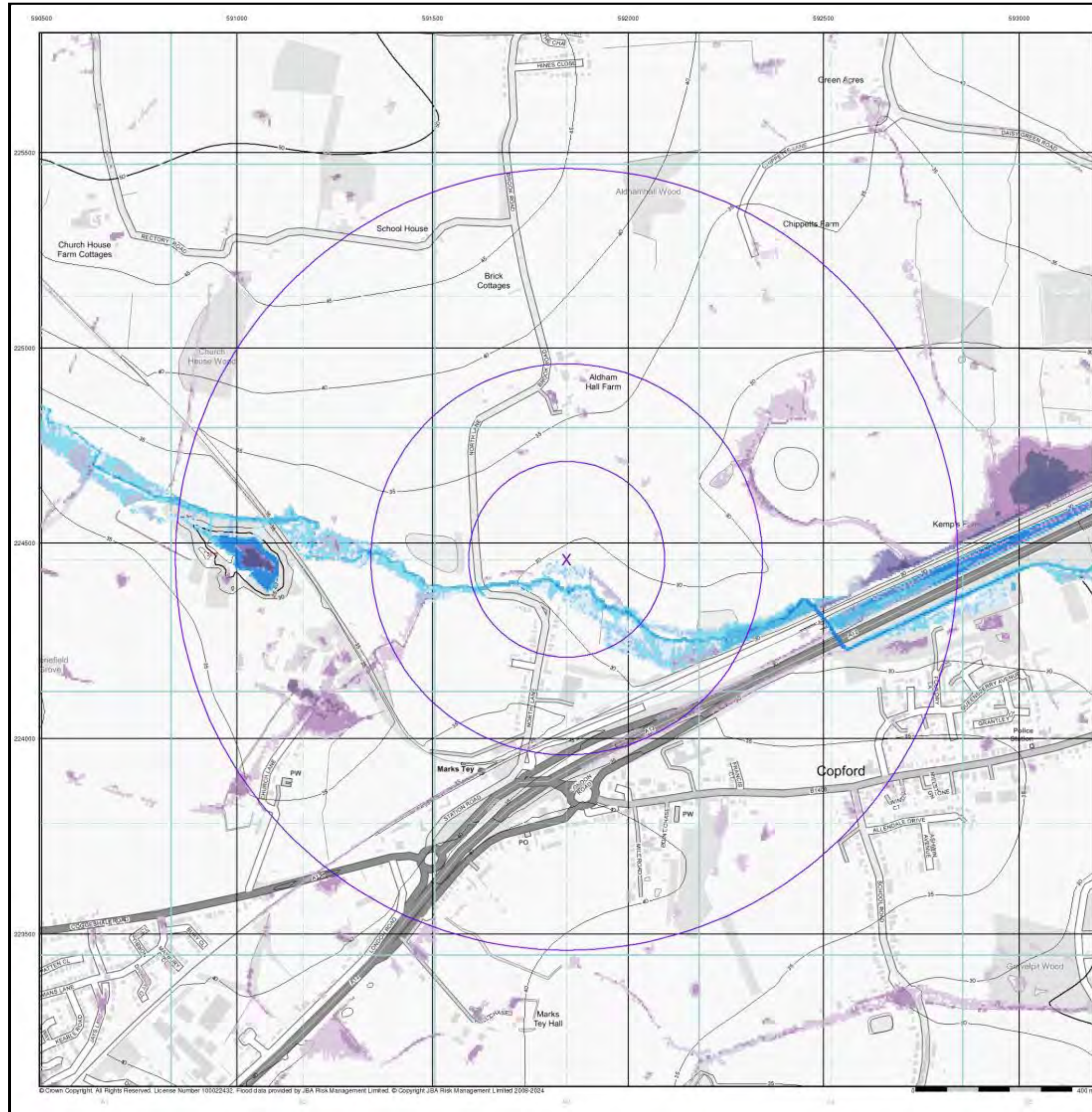
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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Web: www.envirocheck.co.uk



JBA 200 Year Return Flood Map (Un defended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

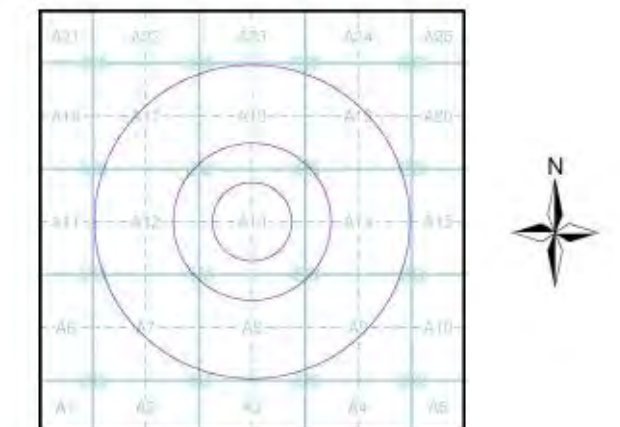
Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height
- MLW Mean Low Water
- MHW Mean High Water

JBA 200 Year Return Flood Map (Un defended) - Slice A



Order Details

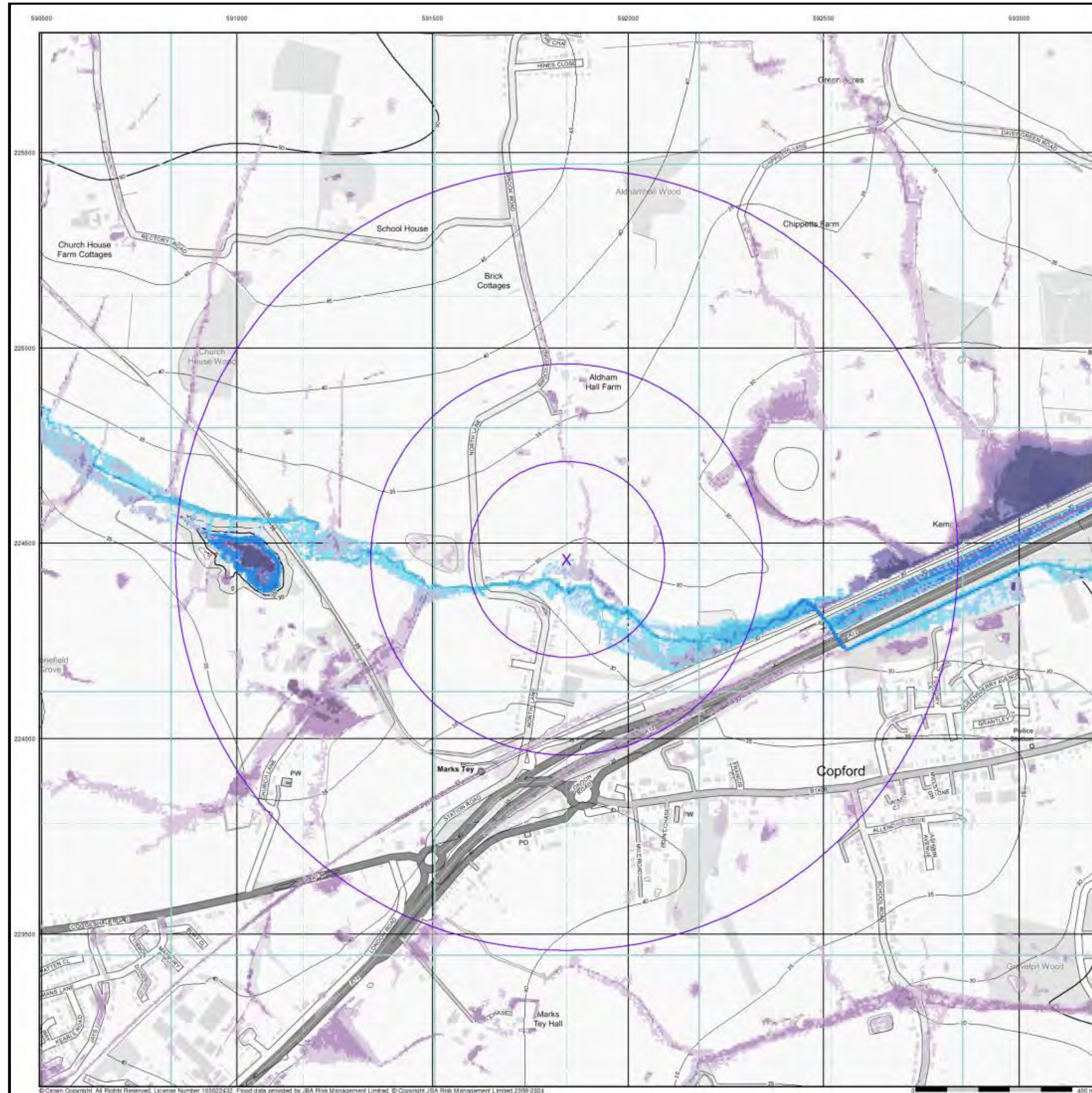
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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INFORMATION GROUP

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JBA 1000 Year Return Flood Map (Un defended) (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

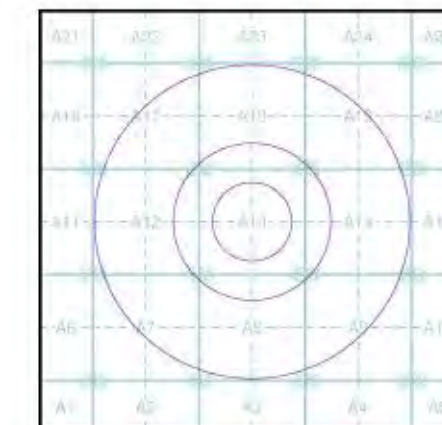
Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height
- MLW Mean Low Water
- MHW Mean High Water

JBA 1000 Year Return Flood Map (Un defended) - Slice A



Order Details

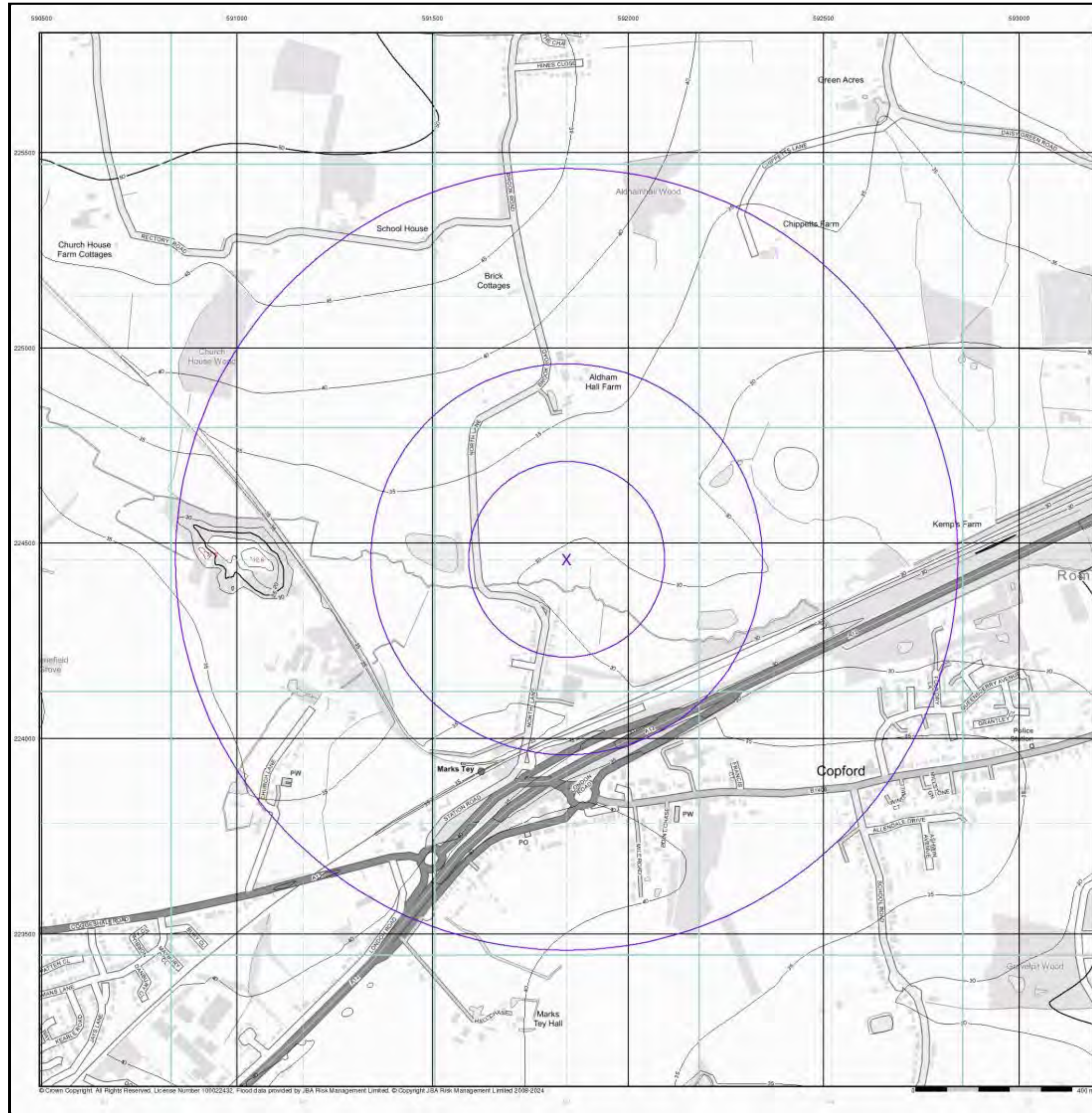
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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JBA Canal Failure Map (1:10,000)

General

-  Specified Site
-  Specified Buffer(s)
-  Bearing Reference Point

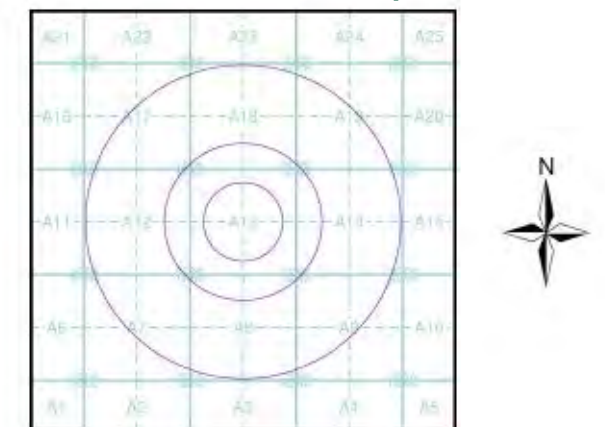
Flood Data

-  Canal Failure
-  Coverage

Contours (height in metres)

- Standard Contour  105  100  95
- Master Contour  105  100  95
- Spot Height  107.8
-  MLW Mean Low Water
-  MHW Mean High Water

JBA Canal Failure Flood Map - Slice A



Order Details

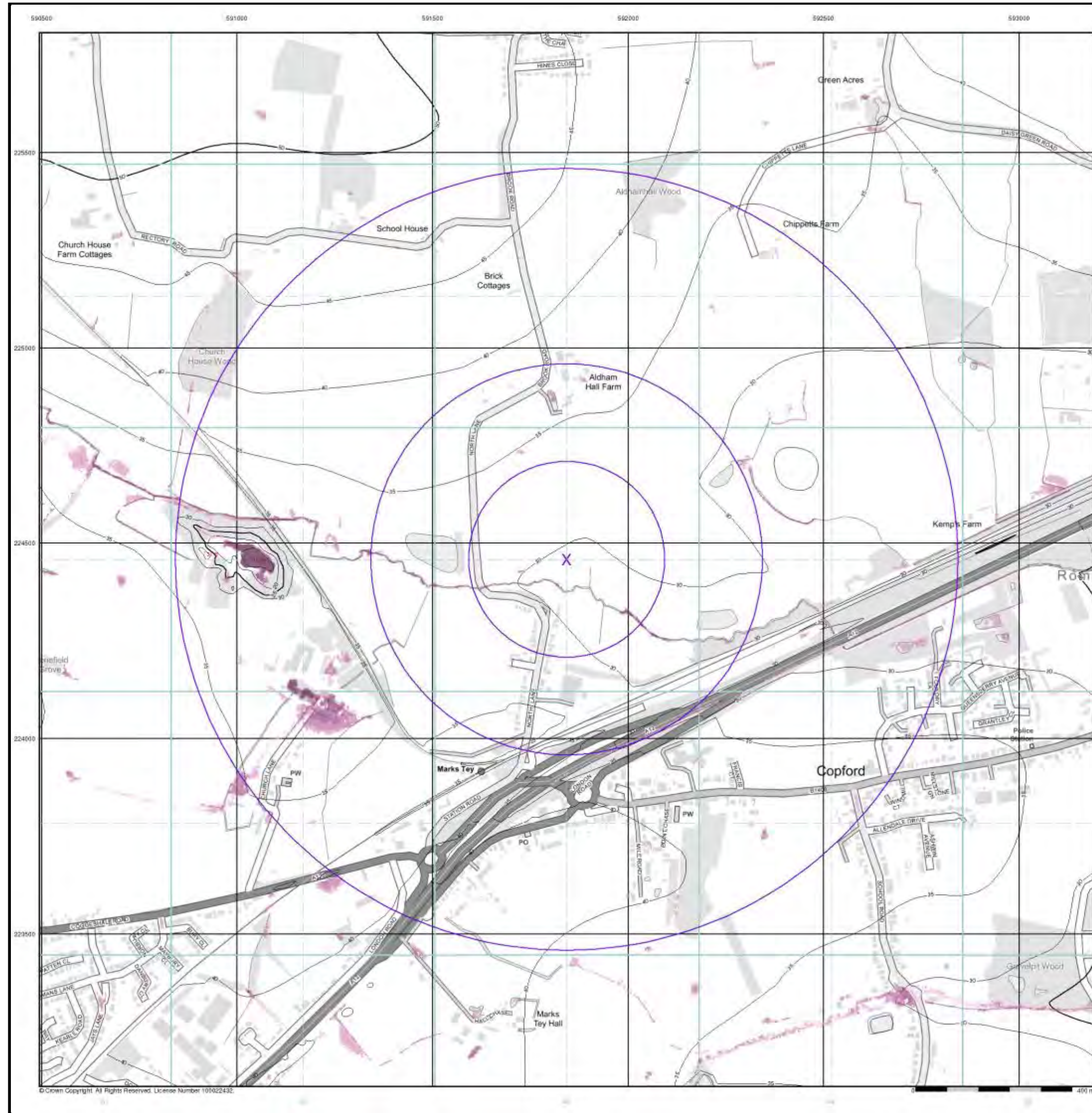
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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EA/NRW Surface Water 30 Year Return Depth Map (1:10,000)

General

 Specified Site  Specified Buffer(s)  Bearing Reference Point

Surface Water Depth

0 - 0.15m
0.15 - 0.30m
0.30 - 0.60m
0.60 - 0.90m
0.90 - 1.20m
> 1.20m

Contours (height in metres)

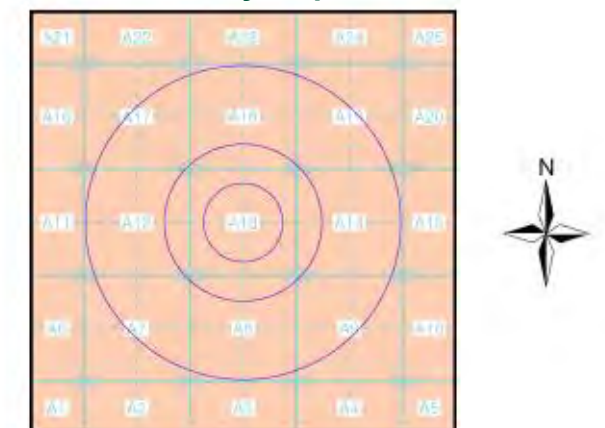
Standard Contour  25  100  95  MLW Mean Low Water
Master Contour  100  95  MHW Mean High Water
Spot Height  157.4

Suitability

See the suitability map below

 National to county  Street to parcels of land
 County to town  Property
 Town to street

EA/NRW Suitability Map - Slice A



Order Details

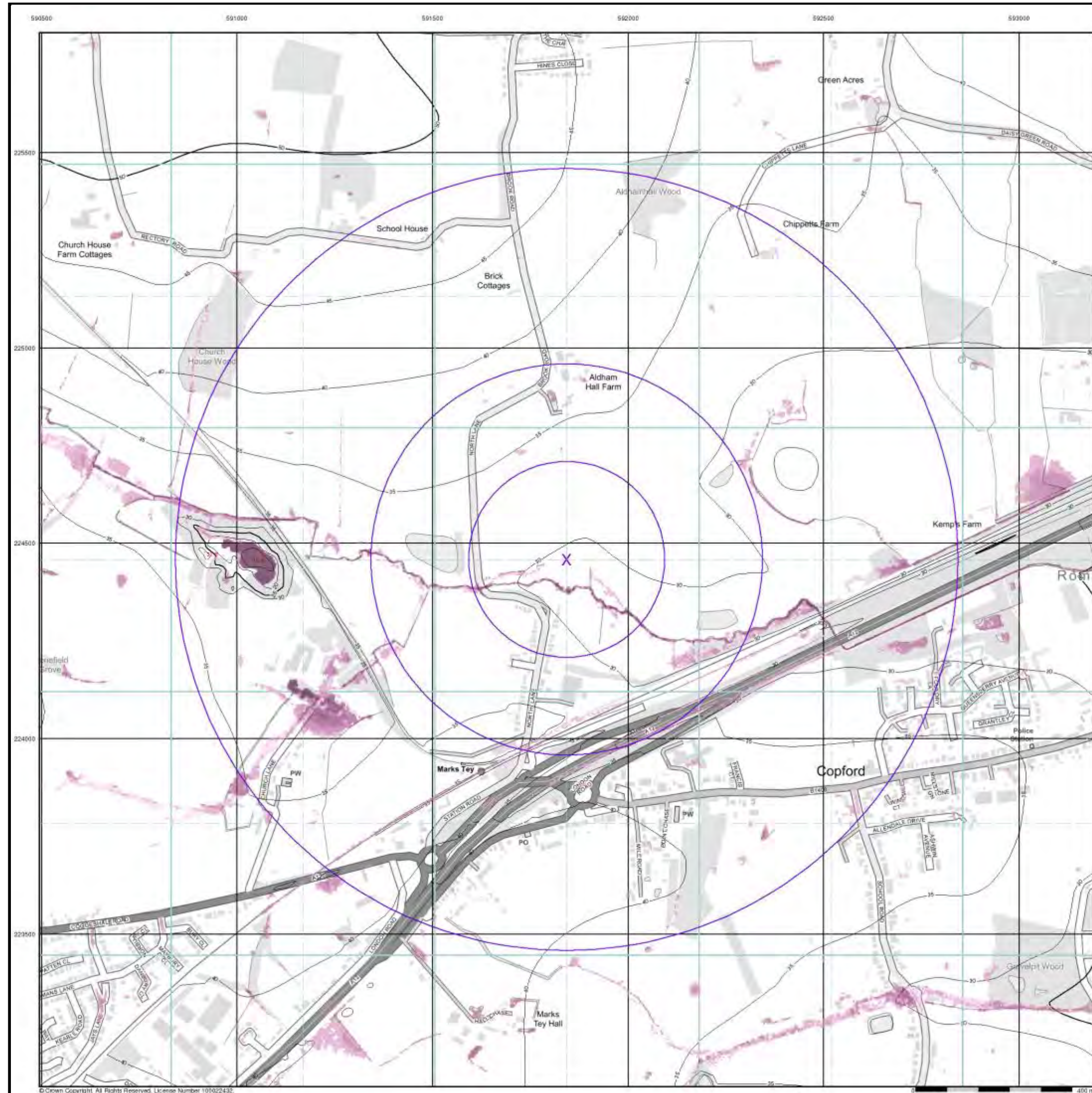
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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INFORMATION GROUP

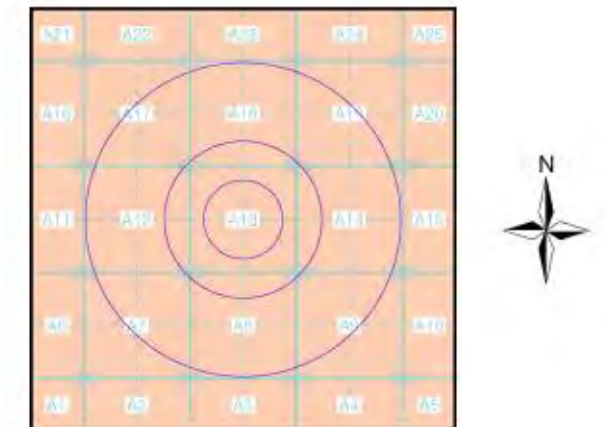
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



EA/NRW Surface Water 100 Year Return Depth Map



EA/NRW Suitability Map - Slice A



Order Details

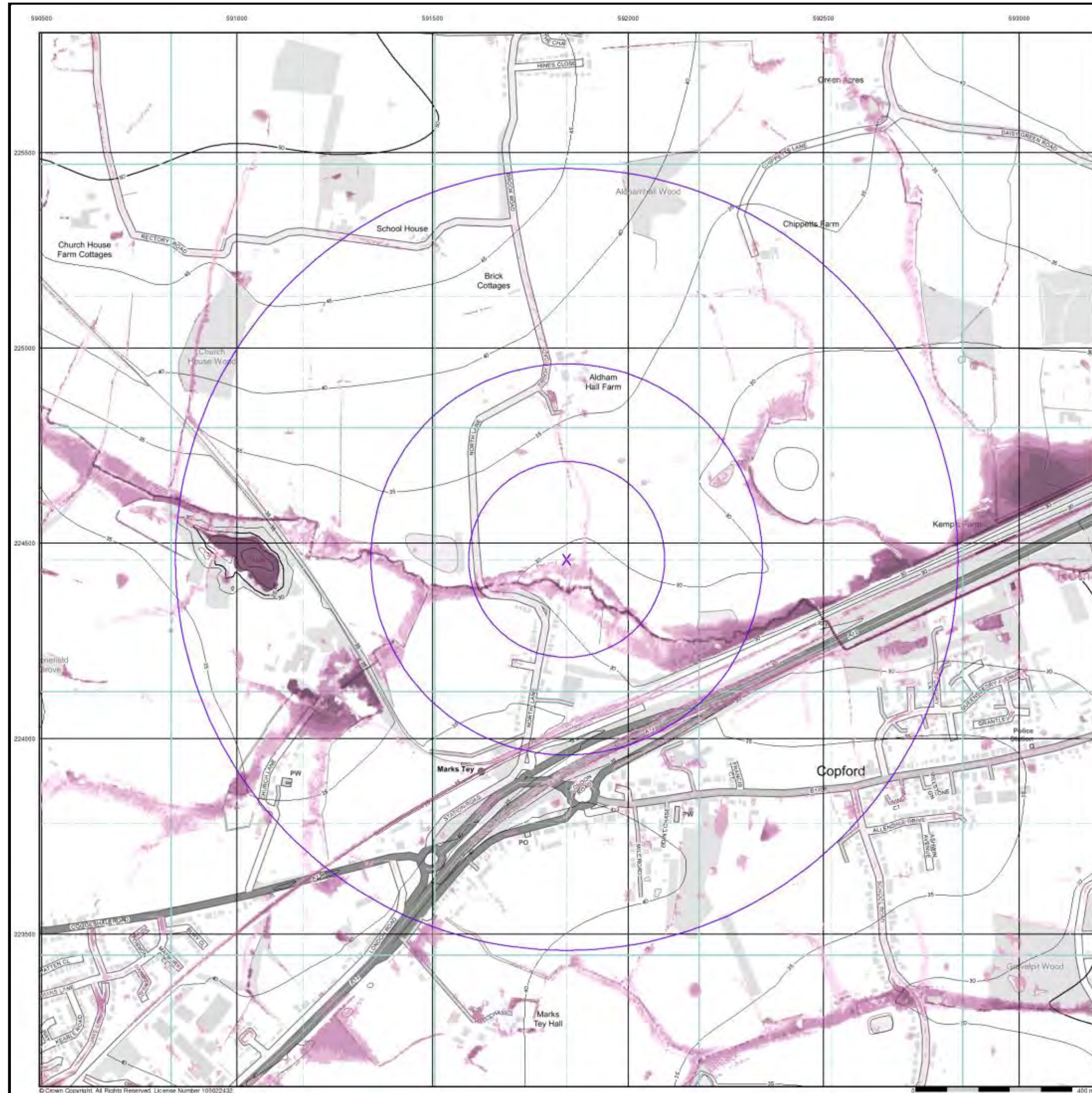
Order Number: 355379732_1_1
 Customer Ref: 1bwcol 2408044
 National Grid Reference: 591840, 224460
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

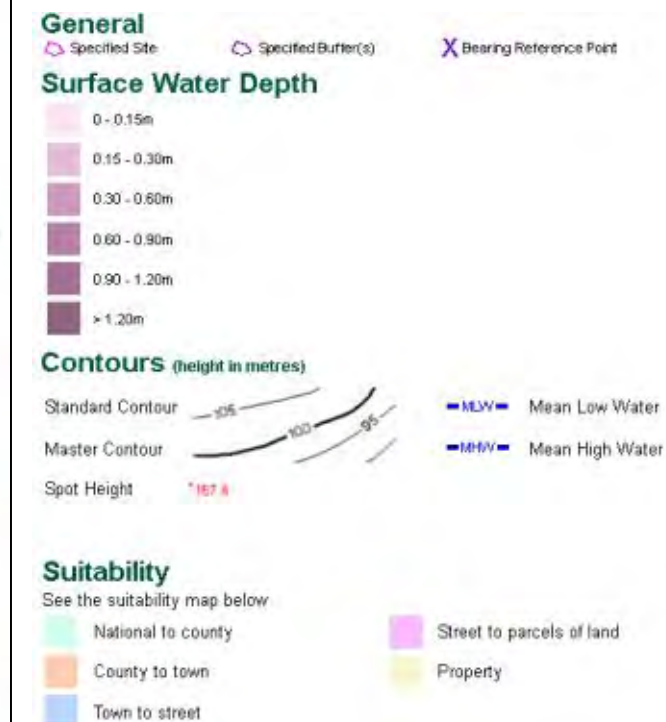
Landmark
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Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

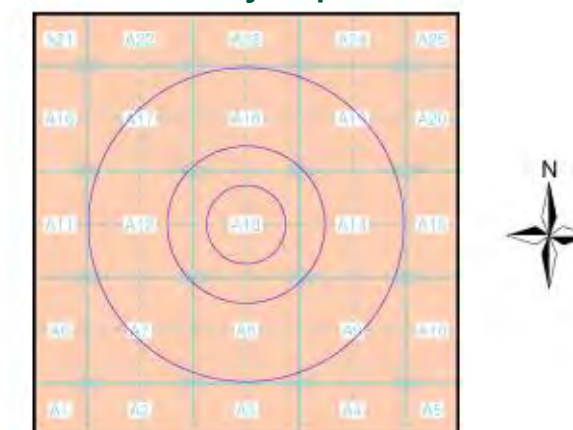


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EA/NRW Surface Water 1000 Year Return Depth Map (1:10,000)



EA/NRW Suitability Map - Slice A



Order Details

Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

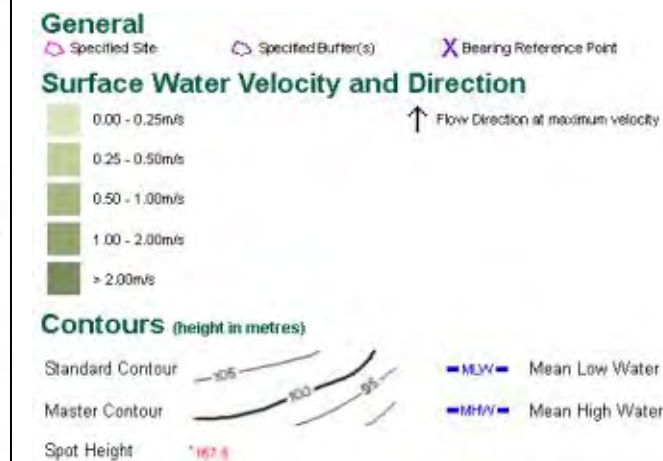
Landmark
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Fax: 0844 844 9951
Web: www.envirocheck.co.uk

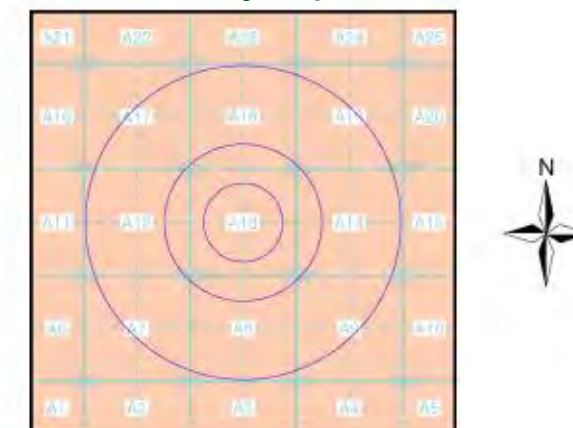


motion

EA/NRW Surface Water 30 Year Return Velocity and Flow Direction Map (1:10,000)



EA/NRW Suitability Map - Slice A



Order Details

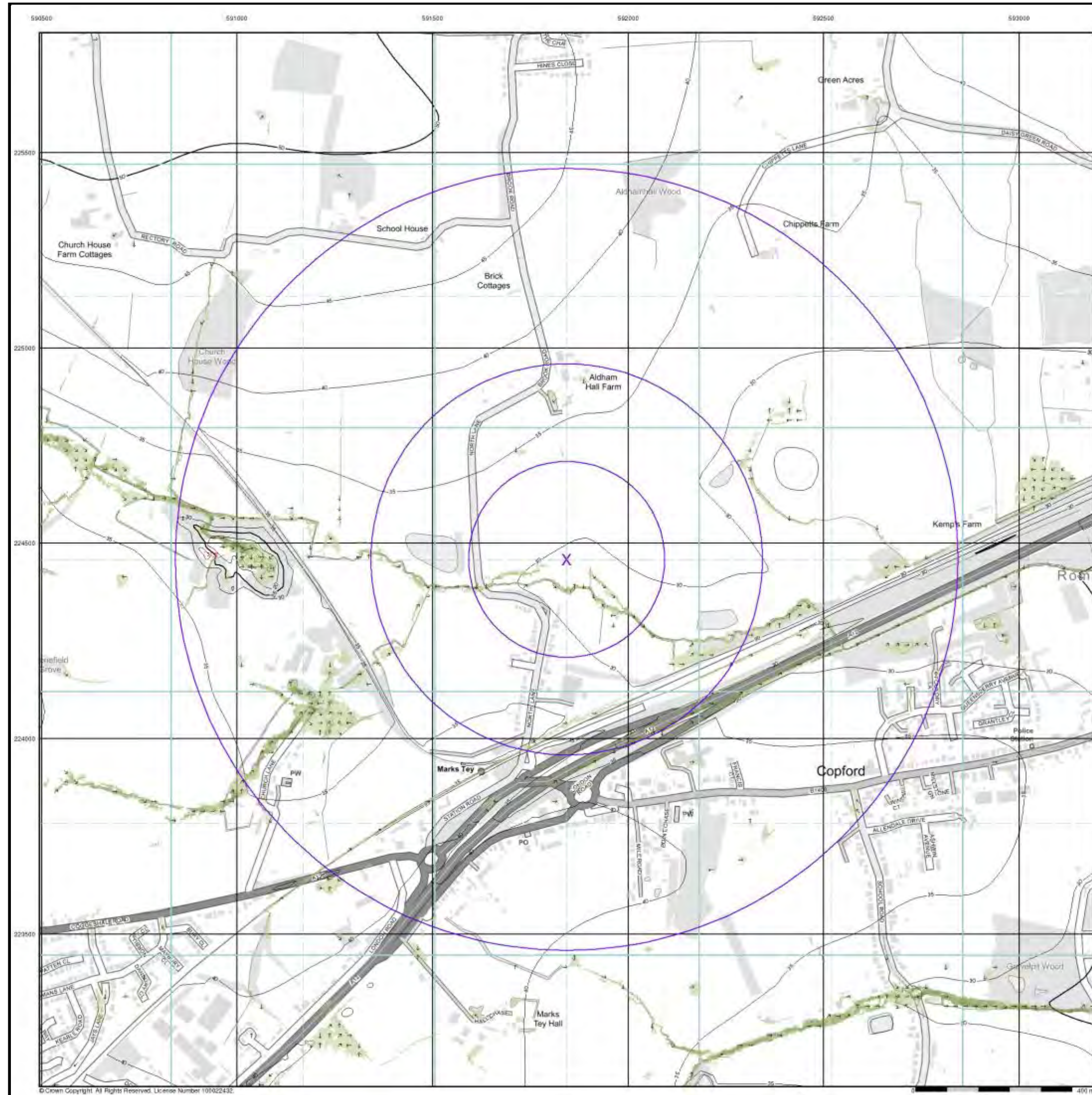
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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Web: www.envirocheck.co.uk



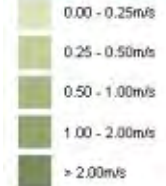
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EA/NRW Surface Water 100 Year Return Velocity and Flow Direction Map (1:10,000)

General

 Specified Site  Specified Buffer(s)  Bearing Reference Point

Surface Water Velocity and Direction

 0.00 - 0.25m/s
0.25 - 0.50m/s
0.50 - 1.00m/s
1.00 - 2.00m/s
> 2.00m/s

 Flow Direction at maximum velocity

Contours (height in metres)

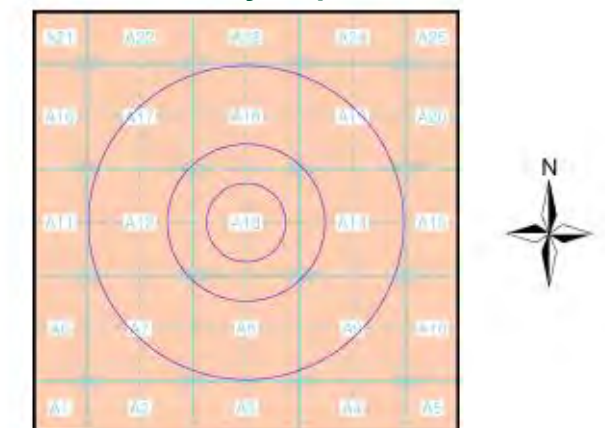
Standard Contour  105  Mean Low Water
Master Contour  100  Mean High Water
Spot Height  167.4

Suitability

See the suitability map below

 National to county  Street to parcels of land
 County to town  Property
 Town to street

EA/NRW Suitability Map - Slice A



Order Details

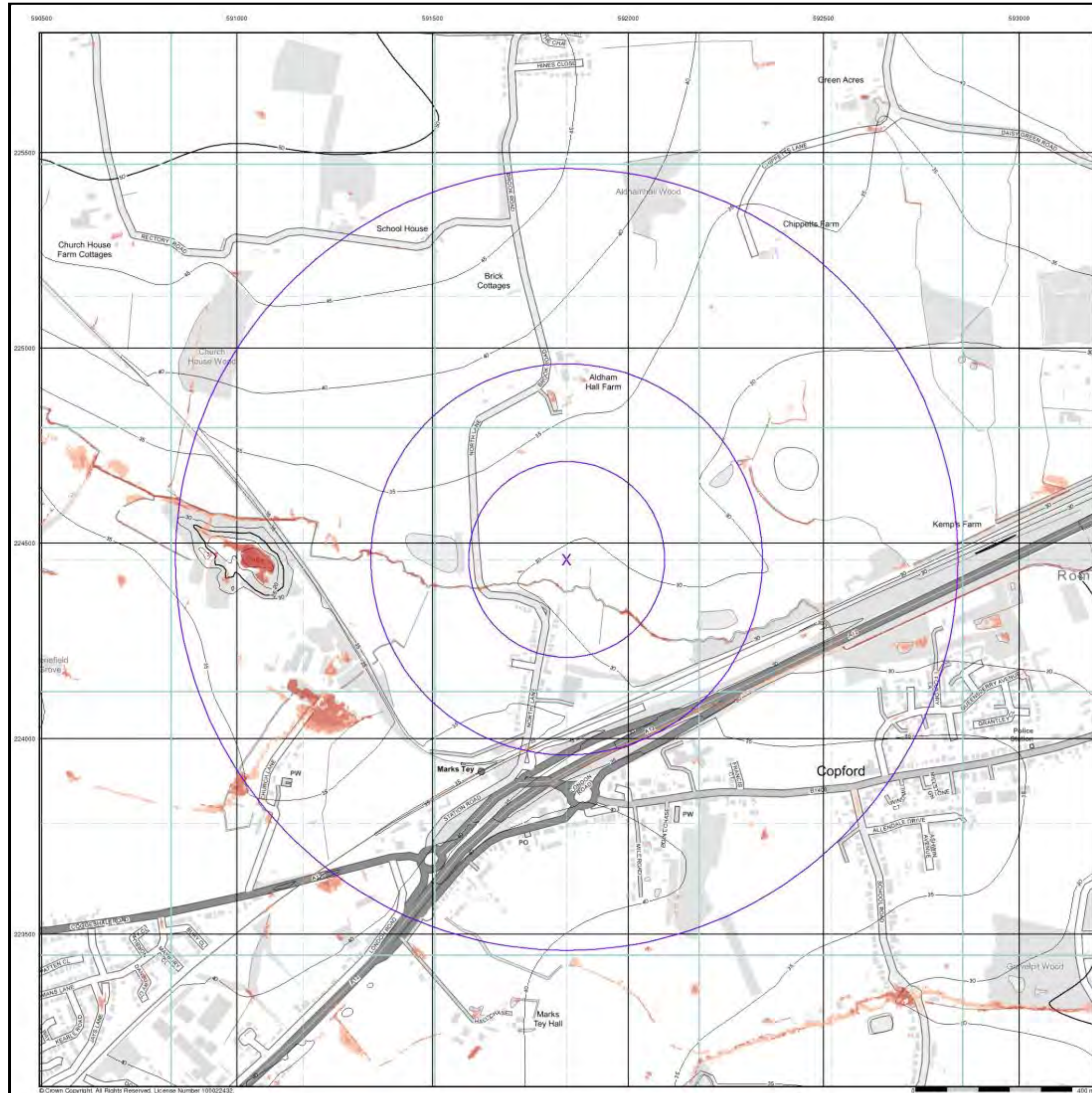
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

Landmark
INFORMATION GROUP

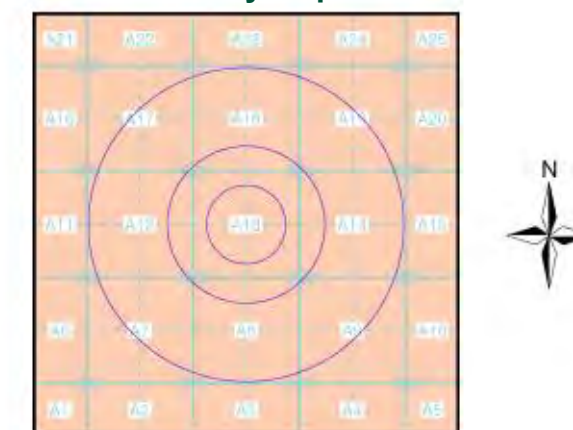
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



EA/NRW Surface Water 30 Year Return Hazard Rating Map (1:10,000)

- General**
- Specified Site
 - Specified Buffer(s)
 - Bearing Reference Point
- Surface Water Hazard Rating**
- Low (0.5 – 0.75)
 - Moderate (0.75 – 1.25)
 - Significant (1.25 – 2.0)
 - Extreme (>2.0)
- Contours (height in metres)**
- Standard Contour
 - Master Contour
 - Spot Height
 - MLW Mean Low Water
 - MHW Mean High Water
- Suitability**
- See the suitability map below
- National to county
 - County to town
 - Town to street
 - Street to parcels of land
 - Property

EA/NRW Suitability Map - Slice A



Order Details

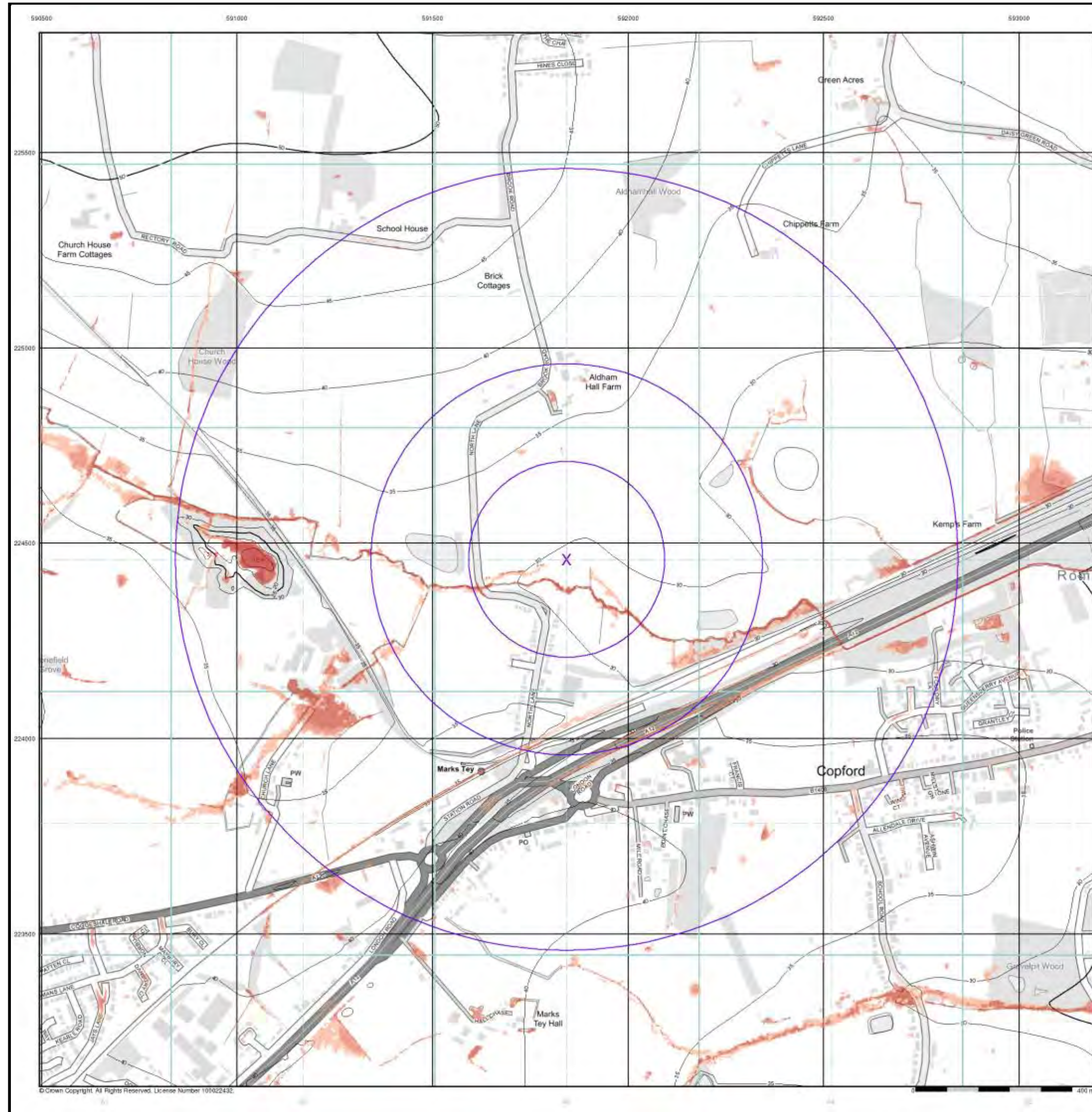
Order Number: 355379732_1_1
 Customer Ref: 1bwcol 2408044
 National Grid Reference: 591840, 224460
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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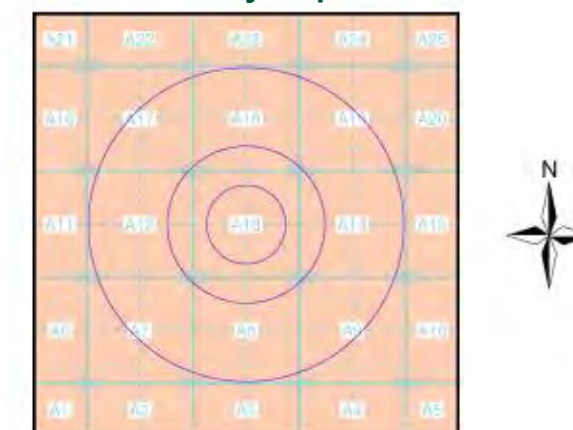


motion

EA/NRW Surface Water 100 Year Return Hazard Rating Map (1:10,000)

- General**
- Specified Site
 - Specified Buffer(s)
 - Bearing Reference Point
- Surface Water Hazard Rating**
- Low (0.5 – 0.75)
 - Moderate (0.75 – 1.25)
 - Significant (1.25 – 2.0)
 - Extreme (>2.0)
- Contours (height in metres)**
- Standard Contour
 - Master Contour
 - Spot Height
- Suitability**
- See the suitability map below
- National to county
 - County to town
 - Town to street
 - Street to parcels of land
 - Property
- Contours (height in metres)**
- Mean Low Water
 - Mean High Water

EA/NRW Suitability Map - Slice A



Order Details

Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

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Web: www.envirocheck.co.uk

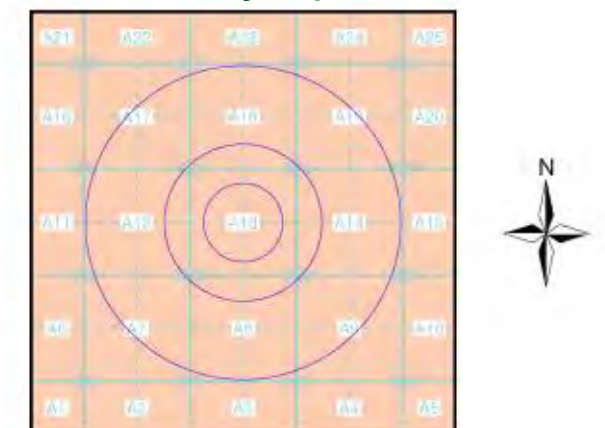


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EA/NRW Surface Water 1000 Year Return Hazard Rating Map (1:10,000)



EA/NRW Suitability Map - Slice A



Order Details

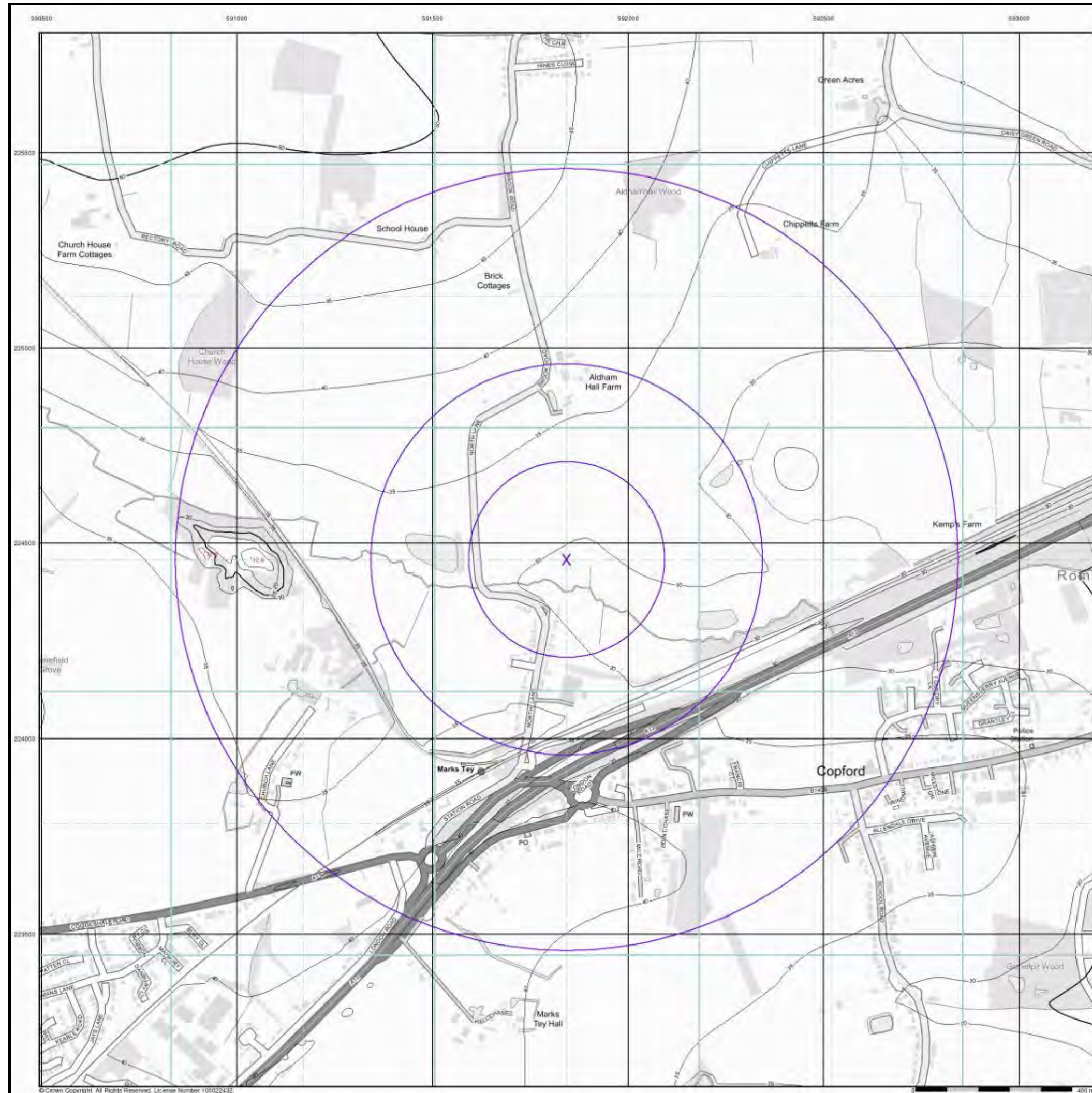
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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EANRW Historic Flood Map (1:10,000)

General

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

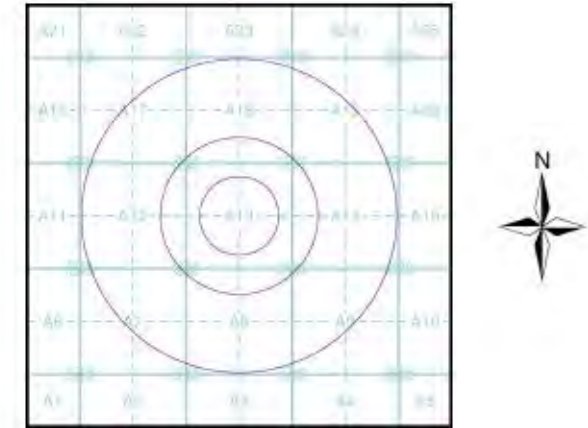
Historic Flood Events Data

- | | |
|--|--|
|  Channel Capacity Exceeded (no raised defences) |  Obstruction/Blockage - Culvert |
|  Channel Capacity Exceeded /Surface Water |  Obstruction/Blockage - Debris Screen |
|  Groundwater/High Water Table |  Operational Failure/ Breach of Defence |
|  Local Drainage/Surface Water |  Other |
|  Mechanical Failure |  Overtopping of Defences |
|  Obstruction/Blockage - Bridge |  Surface Water |
|  Obstruction/Blockage - Channel |  Unknown |
|  Historical Flood Liabilities | |

Contours (height in metres)

- Standard Contour  105  Mean Low Water
- Master Contour  100  Mean High Water
- Spot Height  107.5

EANRW Historic Flood Map - Slice A



Order Details

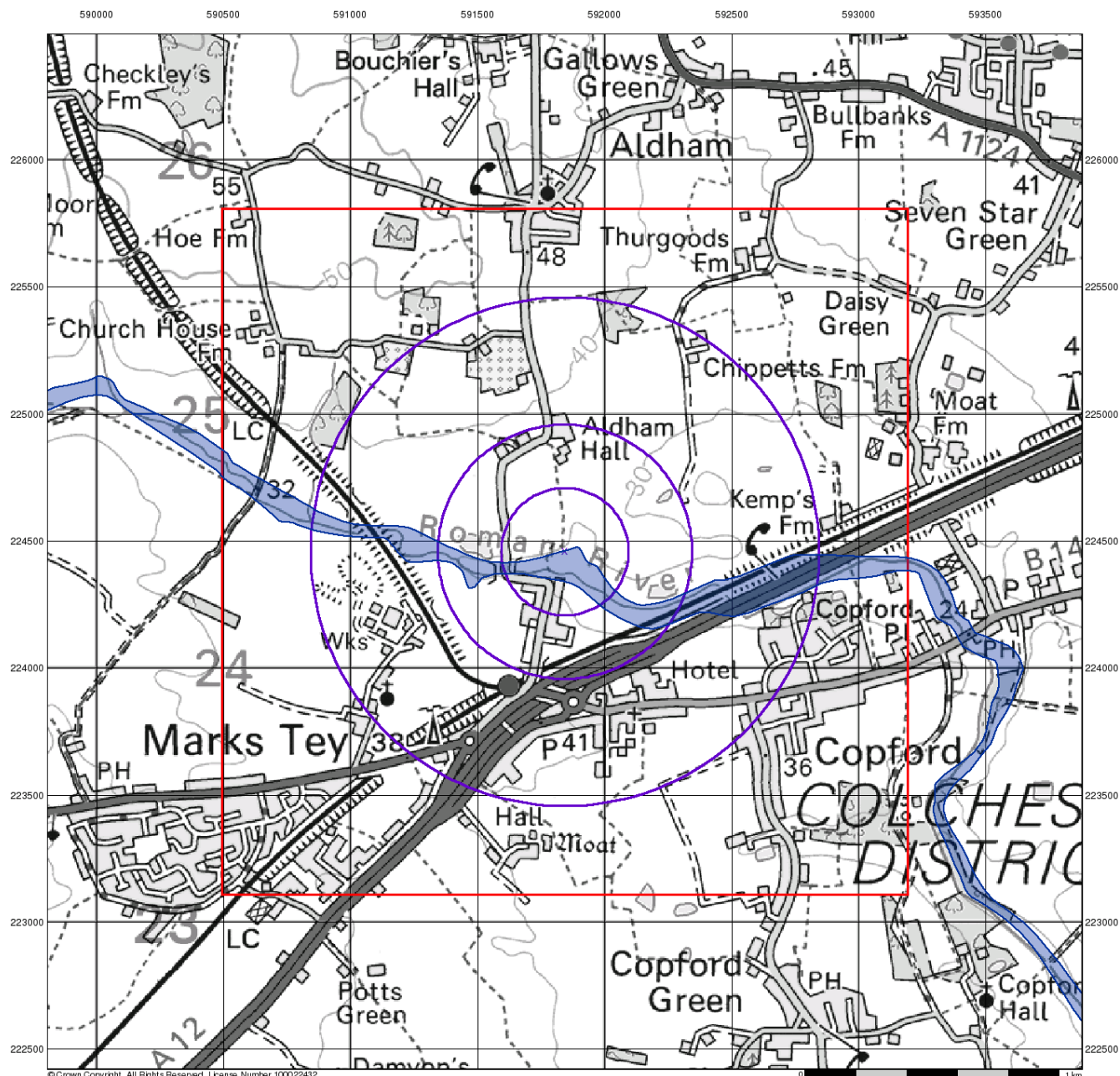
Order Number: 355379732_1_1
Customer Ref: 1bwcol 2408044
National Grid Reference: 591840, 224460
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

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motion BGS Flood Data (1:50,000)

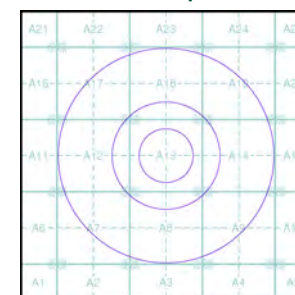
General

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

BGS Geological Indicators of Flooding

-  Coastal
-  Inland
-  Bodies of Water

BGS Flood Data Map - Slice A



Order Details

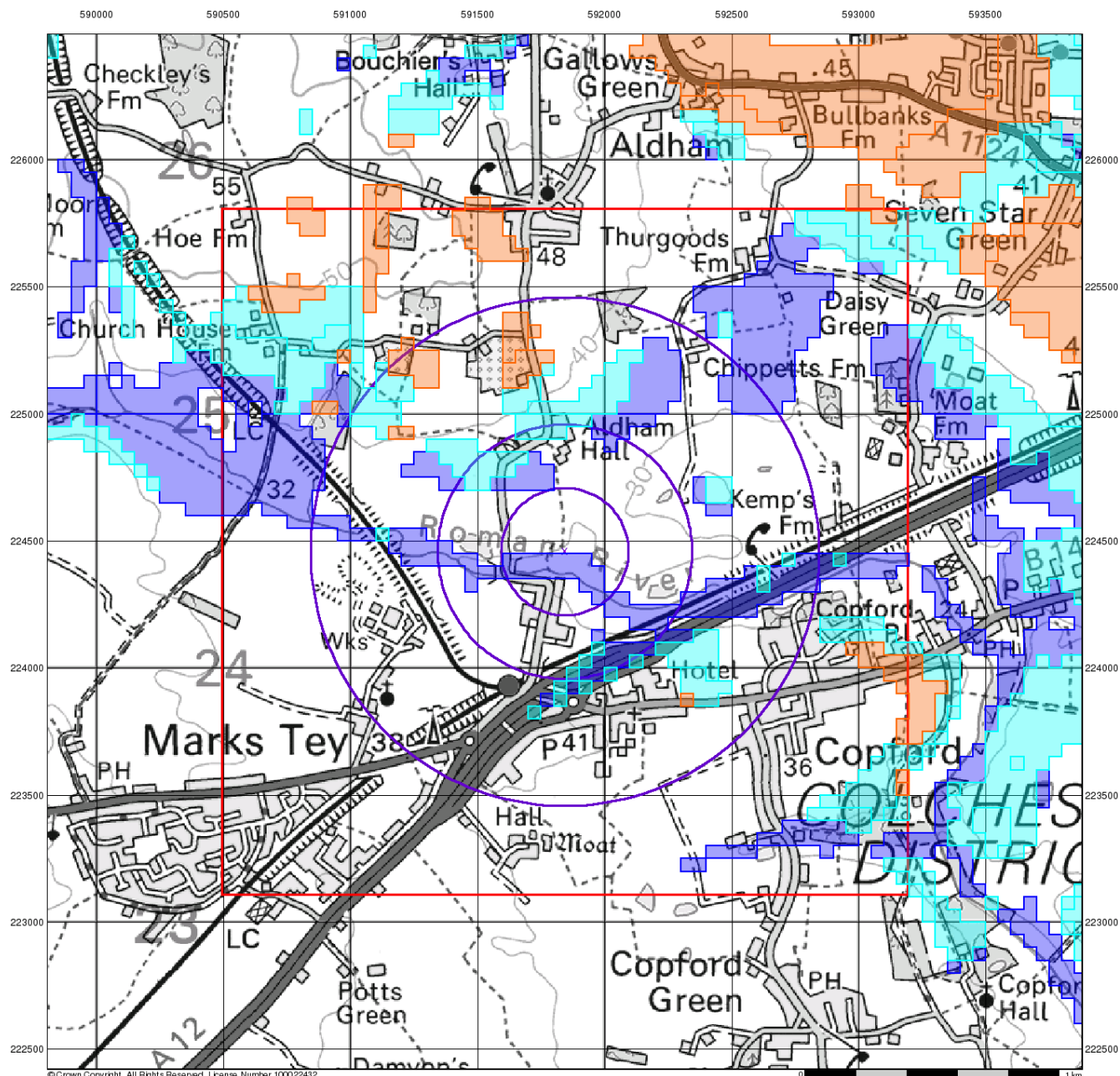
Order Number: 355379732_1_1
 Customer Ref: 1bwcol 2408044
 National Grid Reference: 591840, 224460
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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motion **BGS Flood Data (1:50,000)**

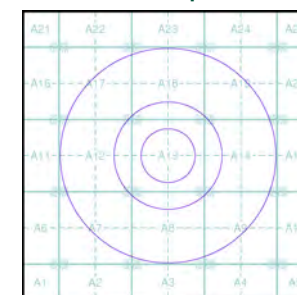
General

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

BGS Groundwater Flooding Susceptibility

- Potential for Groundwater Flooding to Occur at Surface
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Limited Potential for Groundwater Flooding to Occur

BGS Flood Data Map - Slice A



Order Details

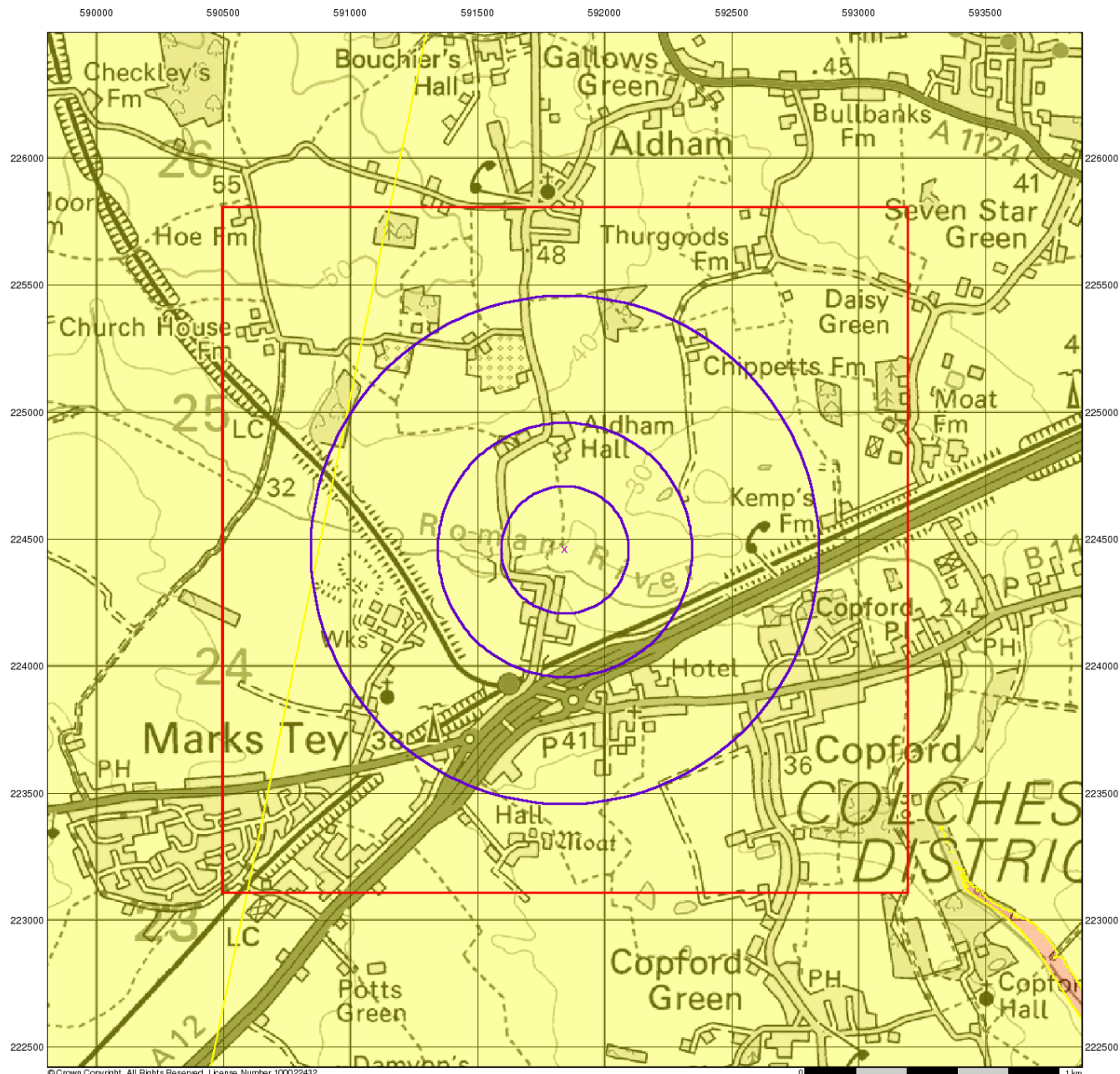
Order Number: 355379732_1_1
 Customer Ref: 1bwcol 2408044
 National Grid Reference: 591840, 224460
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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 Web: www.envirocheck.co.uk



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0 1 km



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

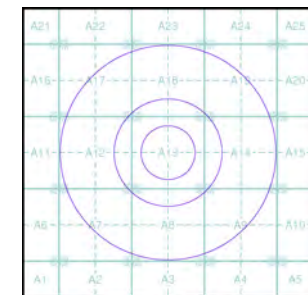
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice

GeoSmart Information Groundwater Flooding Risk

- High Risk
- Moderate Risk
- Low Risk
- Negligible Risk

GeoSmart Information Groundwater Flood Map - Slice A



Order Details

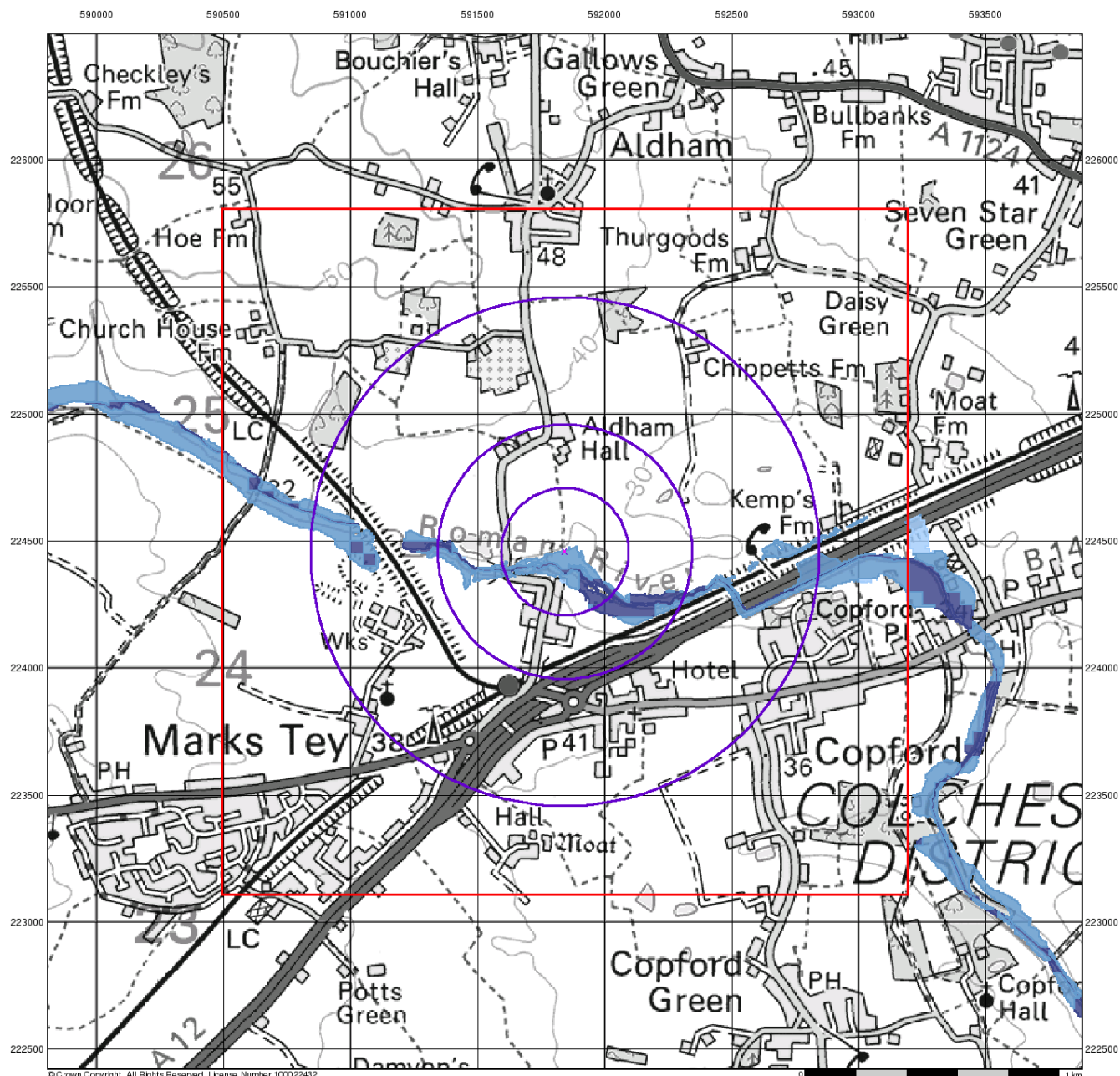
Order Number: 355379732_1_1
 Customer Ref: 1bwcol 2408044
 National Grid Reference: 591840, 224460
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

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motion **EA/NRW RoFRS Data (1:50,000)**

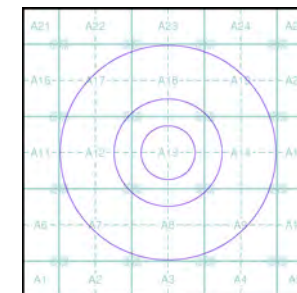
General

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

Risk of Flooding from Rivers and Sea (RoFRS)

- High Risk
- Medium Risk
- Low Risk
- Very Low Risk

EA/NRW RoFRS Data Map - Slice A



Order Details

Order Number: 355379732_1_1
 Customer Ref: 1bwcol 2408044
 National Grid Reference: 591840, 224460
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

21, North Lane, Marks Tey, COLCHESTER, CO6 1EG

Landmark
 INFORMATION GROUP

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

Appendix G

UKSuDS Greenfield Runoff Calculations

Calculated by:	Vicki holdo
Site name:	
Site location:	

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:	51.88568° N
Longitude:	0.78458° E
Reference:	750248943
Date:	Aug 12 2024 15:10

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	1
-----------------------	---

Methodology

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

Notes

(1) Is $Q_{\text{BAR}} < 2.0 \text{ l/s/ha}$?

When Q_{BAR} is $< 2.0 \text{ l/s/ha}$ then limiting discharge rates are set at 2.0 l/s/ha .

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

(2) Are flow rates $< 5.0 \text{ l/s}$?

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.

Hydrological
characteristics

	Default	Edited
SAAR (mm):	560	560
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

(3) Is $\text{SPR/SPRHOST} \leq 0.3$?

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):	2.21	2.21
1 in 1 year (l/s):	1.88	1.88
1 in 30 years (l/s):	5.09	5.09
1 in 100 year (l/s):	7.06	7.06
1 in 200 years (l/s):	8.28	8.28

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix H

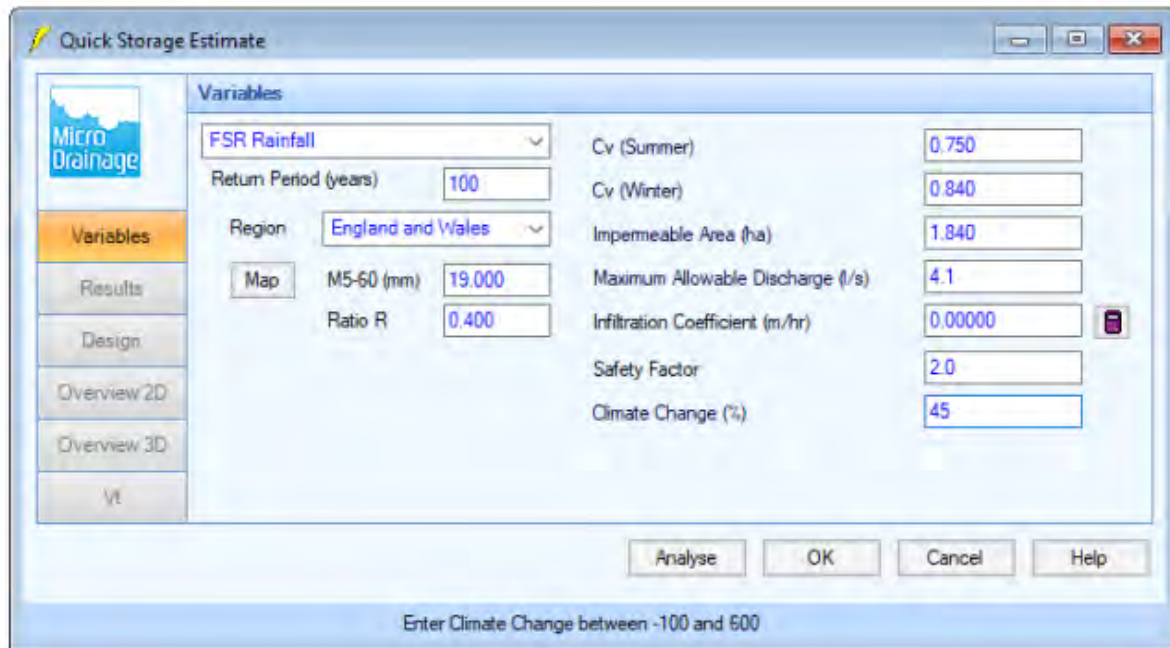
MicroDrainage Calculations

Mark Teys

Western Parcel Catchment A

Impermeable area assumed to be 1.84ha (60% impermeable)

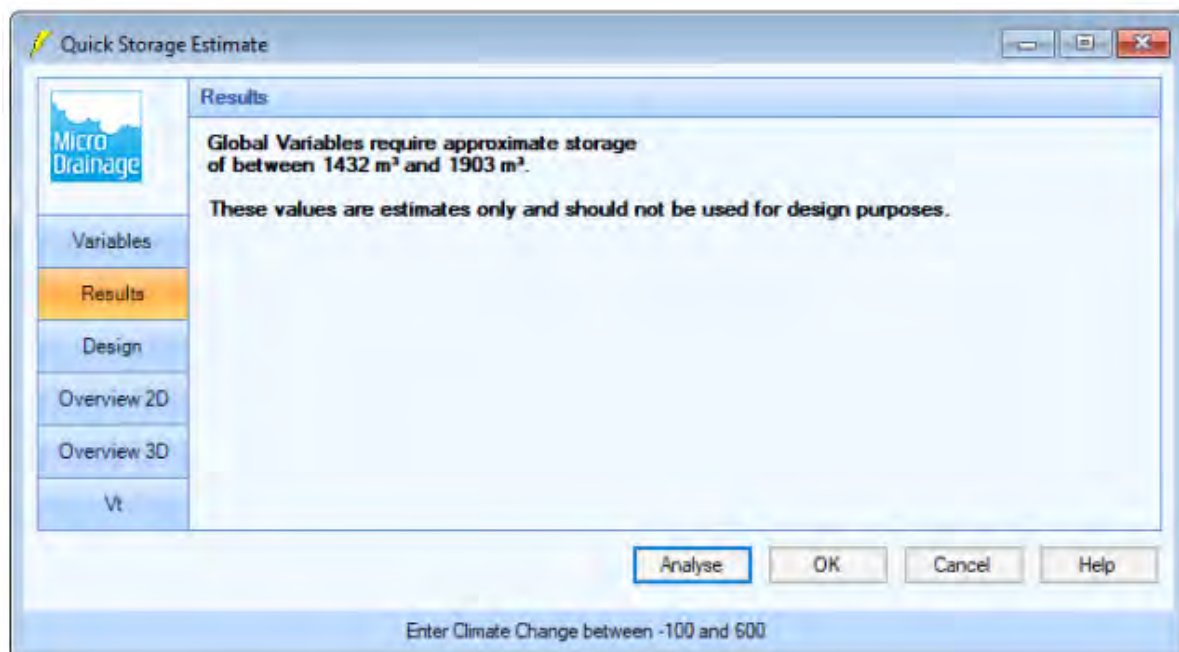
QBAR 4.07l/s (the greenfield runoff rate for 1.84 ha).



The 'Quick Storage Estimate' dialog box is shown with the 'Variables' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area contains the following fields:

Variable	Value
FSR Rainfall	[Dropdown]
Return Period (years)	100
Region	England and Wales
Map	[Button]
M5-60 (mm)	19.000
Ratio R	0.400
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	1.840
Maximum Allowable Discharge (l/s)	4.1
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	45

Buttons at the bottom: Analyse, OK, Cancel, Help. A footer note states: 'Enter Climate Change between -100 and 600'.



The 'Quick Storage Estimate' dialog box is shown with the 'Results' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area displays the following text:

Global Variables require approximate storage of between 1432 m³ and 1903 m³.

These values are estimates only and should not be used for design purposes.

Buttons at the bottom: Analyse, OK, Cancel, Help. A footer note states: 'Enter Climate Change between -100 and 600'.

Western Parcel Catchment B

Impermeable area assumed to be 2.57 ha (60% impermeable)

QBAR 5.68l/s (the greenfield runoff rate for 2.57 ha).

The 'Quick Storage Estimate' dialog box is shown with the 'Variables' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area contains the following settings:

Variable	Value
FSR Rainfall	England and Wales
Return Period (years)	100
Region	England and Wales
Map	M5-60 (mm)
M5-60 (mm)	19 000
Ratio R	0.400
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	2.570
Maximum Allowable Discharge (l/s)	5.68
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	45

Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer text: Enter Maximum Allowable Discharge between 0.0 and 999999.0

The 'Quick Storage Estimate' dialog box is shown with the 'Results' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area displays the following results:

Global Variables require approximate storage of between 2003 m³ and 2661 m³.

These values are estimates only and should not be used for design purposes.

Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer text: Enter Maximum Allowable Discharge between 0.0 and 999999.0

Eastern Parcel Catchment A

Impermeable area assumed to be 1.19 ha (60% impermeable)

QBAR 2.63l/s (the greenfield runoff rate for 1.19 ha).

Quick Storage Estimate

Variables

FSR Rainfall:
Return Period (years):
Region:
Map:
Ratio R:
Cv (Summer):
Cv (Winter):
Impermeable Area (ha):
Maximum Allowable Discharge (l/s):
Infiltration Coefficient (m/hr):
Safety Factor:
Climate Change (%):

Enter Maximum Allowable Discharge between 0.0 and 999999.0

Quick Storage Estimate

Results

Global Variables require approximate storage of between 931 m³ and 1236 m³.

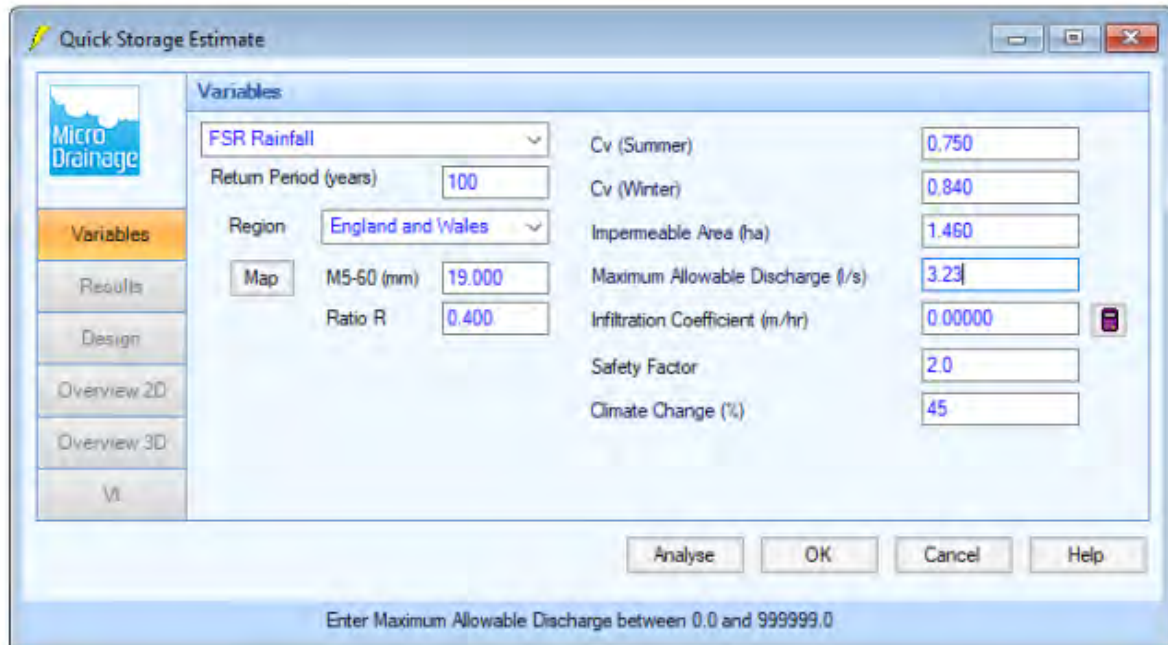
These values are estimates only and should not be used for design purposes.

Enter Maximum Allowable Discharge between 0.0 and 999999.0

Eastern Parcel Catchment B

Impermeable area assumed to be 1.46 ha (60% impermeable)

QBAR 3.23l/s (the greenfield runoff rate for 1.46 ha).

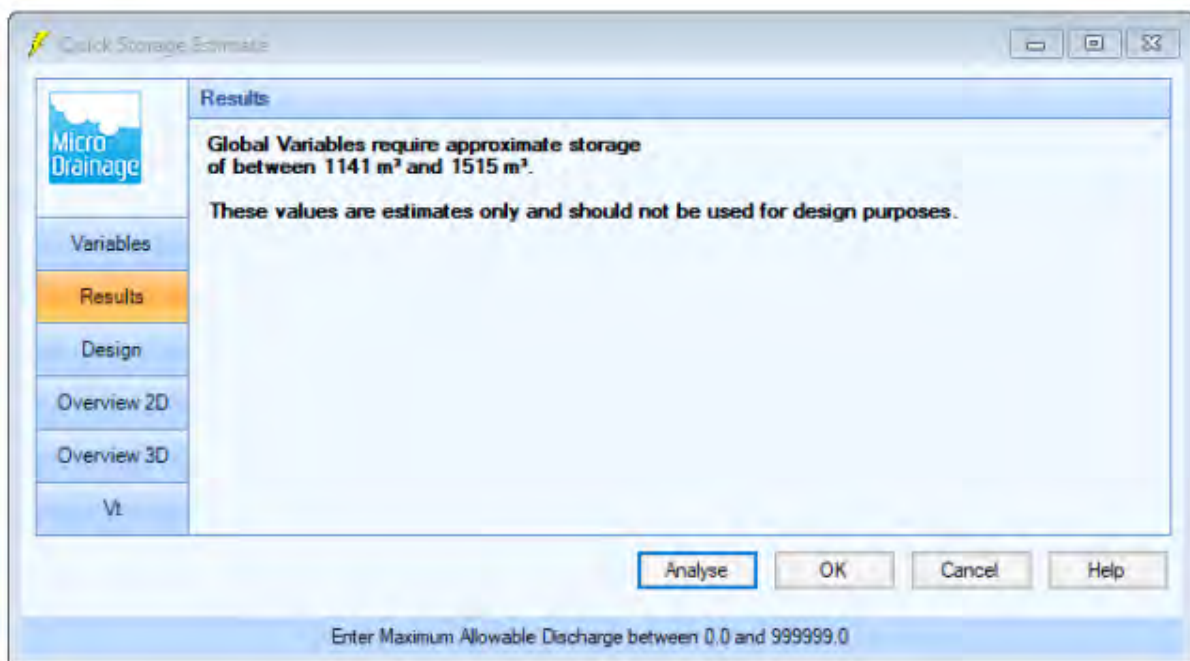


The 'Quick Storage Estimate' dialog box is shown with the 'Variables' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area contains the following fields:

Variable	Value
FSR Rainfall	100
Return Period (years)	100
Region	England and Wales
Map	M5-60 (mm)
Ratio R	19.000
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	1.460
Maximum Allowable Discharge (l/s)	3.23
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	45

Buttons at the bottom: Analyse, OK, Cancel, Help.

Enter Maximum Allowable Discharge between 0.0 and 999999.0



The 'Quick Storage Estimate' dialog box is shown with the 'Results' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area displays the following results:

Global Variables require approximate storage of between 1141 m³ and 1515 m³.

These values are estimates only and should not be used for design purposes.

Buttons at the bottom: Analyse, OK, Cancel, Help.

Enter Maximum Allowable Discharge between 0.0 and 999999.0

Eastern Parcel Catchment C

Impermeable area assumed to be 0.44 ha (60% impermeable)

QBAR 0.97l/s (the greenfield runoff rate for 0.44 ha) practical minimum 2l/s.

The 'Quick Storage Estimate' dialog box is shown with the 'Variables' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area contains the following fields:

Variable	Value
FSR Rainfall	[Dropdown]
Return Period (years)	100
Region	England and Wales
Map	M5-60 (mm)
Ratio R	19.000
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	0.440
Maximum Allowable Discharge (l/s)	2
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	45

Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer: Enter Maximum Allowable Discharge between 0.0 and 999999.0

The 'Quick Storage Estimate' dialog box is shown with the 'Results' tab selected. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area displays the following text:

Global Variables require approximate storage of between 286 m³ and 385 m³.

These values are estimates only and should not be used for design purposes.

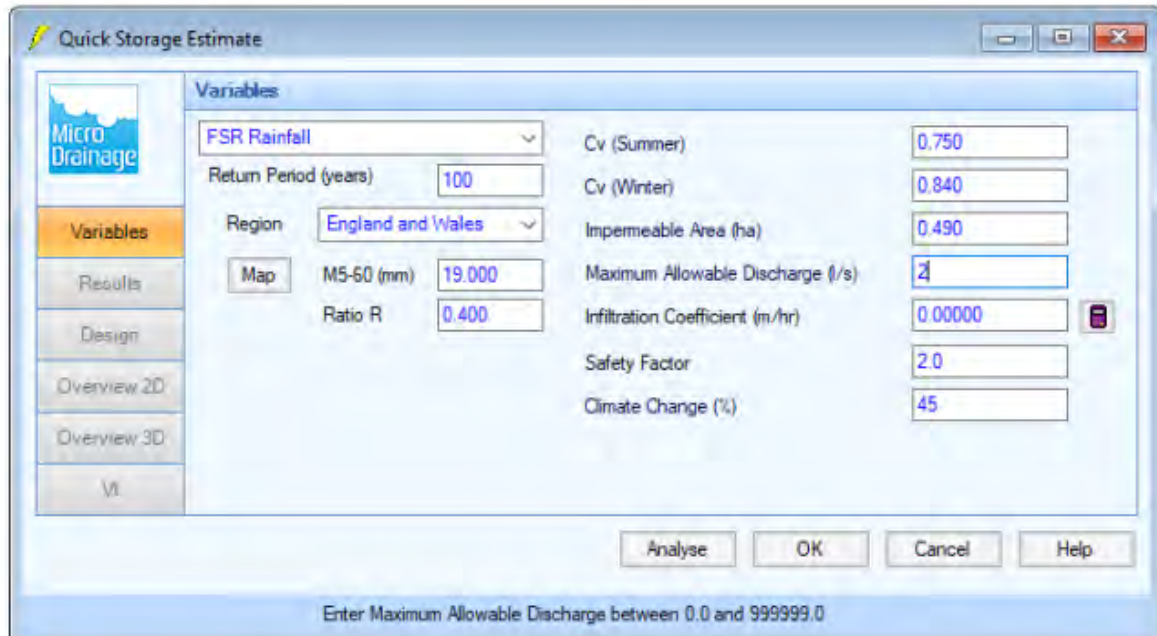
Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer: Enter Maximum Allowable Discharge between 0.0 and 999999.0

Northern Parcel Catchment A

Impermeable area assumed to be 0.49 ha (60% impermeable)

QBAR 1.08l/s (the greenfield runoff rate for 0.49 ha) practical minimum 2l/s.

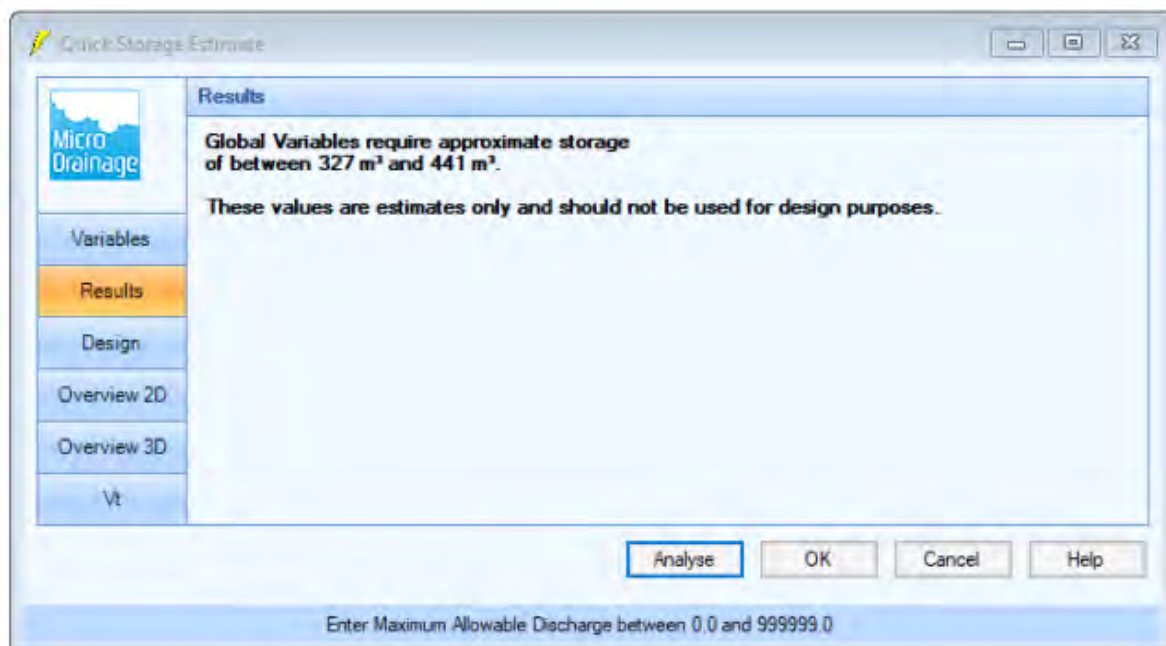


The screenshot shows the 'Variables' tab of the 'Quick Storage Estimate' window. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area contains the following fields:

Variable	Value
FSR Rainfall	[Dropdown]
Return Period (years)	100
Region	England and Wales
Map	[Button]
M5-60 (mm)	19.000
Ratio R	0.400
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	0.490
Maximum Allowable Discharge (l/s)	2
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	45

Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer: Enter Maximum Allowable Discharge between 0.0 and 999999.0



The screenshot shows the 'Results' tab of the 'Quick Storage Estimate' window. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area displays the following text:

Global Variables require approximate storage of between 327 m³ and 441 m³.

These values are estimates only and should not be used for design purposes.

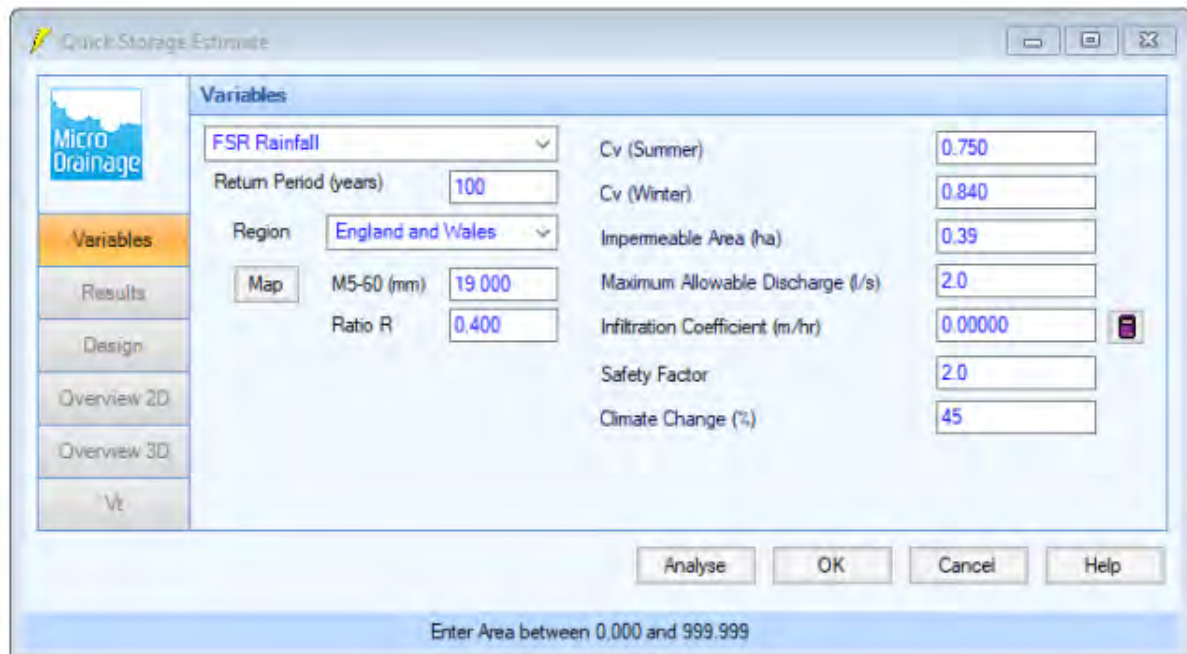
Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer: Enter Maximum Allowable Discharge between 0.0 and 999999.0

Northern Parcel Catchment B

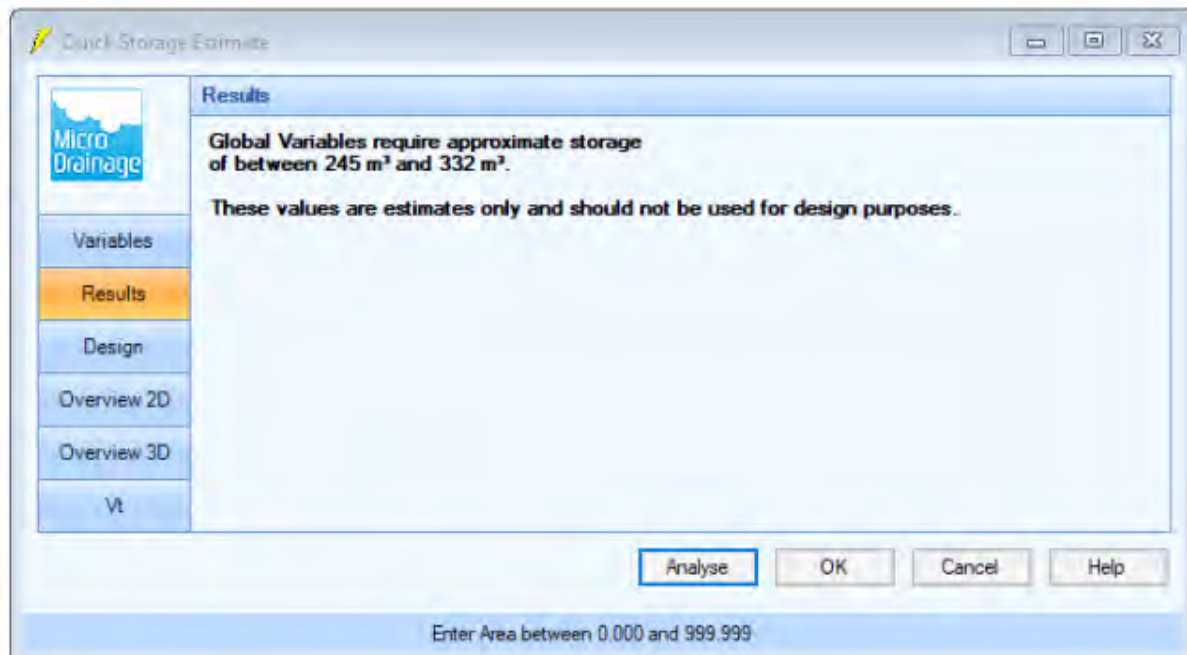
Impermeable area assumed to be 0.39 ha (60% impermeable)

QBAR 0.86l/s (the greenfield runoff rate for 0.39 ha) practical minimum 2l/s.



The screenshot shows the 'Variables' tab of the 'Quick Storage Estimate' window. The left sidebar contains buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area is divided into two columns of input fields. The first column includes a dropdown for 'FSR Rainfall', a text box for 'Return Period (years)' set to '100', a dropdown for 'Region' set to 'England and Wales', a 'Map' button, a text box for 'M5-50 (mm)' set to '19 000', and a text box for 'Ratio R' set to '0.400'. The second column includes text boxes for 'Cv (Summer)' (0.750), 'Cv (Winter)' (0.840), 'Impermeable Area (ha)' (0.39), 'Maximum Allowable Discharge (l/s)' (2.0), 'Infiltration Coefficient (m/hr)' (0.00000), 'Safety Factor' (2.0), and 'Climate Change (%)' (45). At the bottom are 'Analyse', 'OK', 'Cancel', and 'Help' buttons. A status bar at the very bottom reads 'Enter Area between 0.000 and 999.999'.

Variable	Value
FSR Rainfall	[Dropdown]
Return Period (years)	100
Region	England and Wales
M5-50 (mm)	19 000
Ratio R	0.400
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	0.39
Maximum Allowable Discharge (l/s)	2.0
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	45



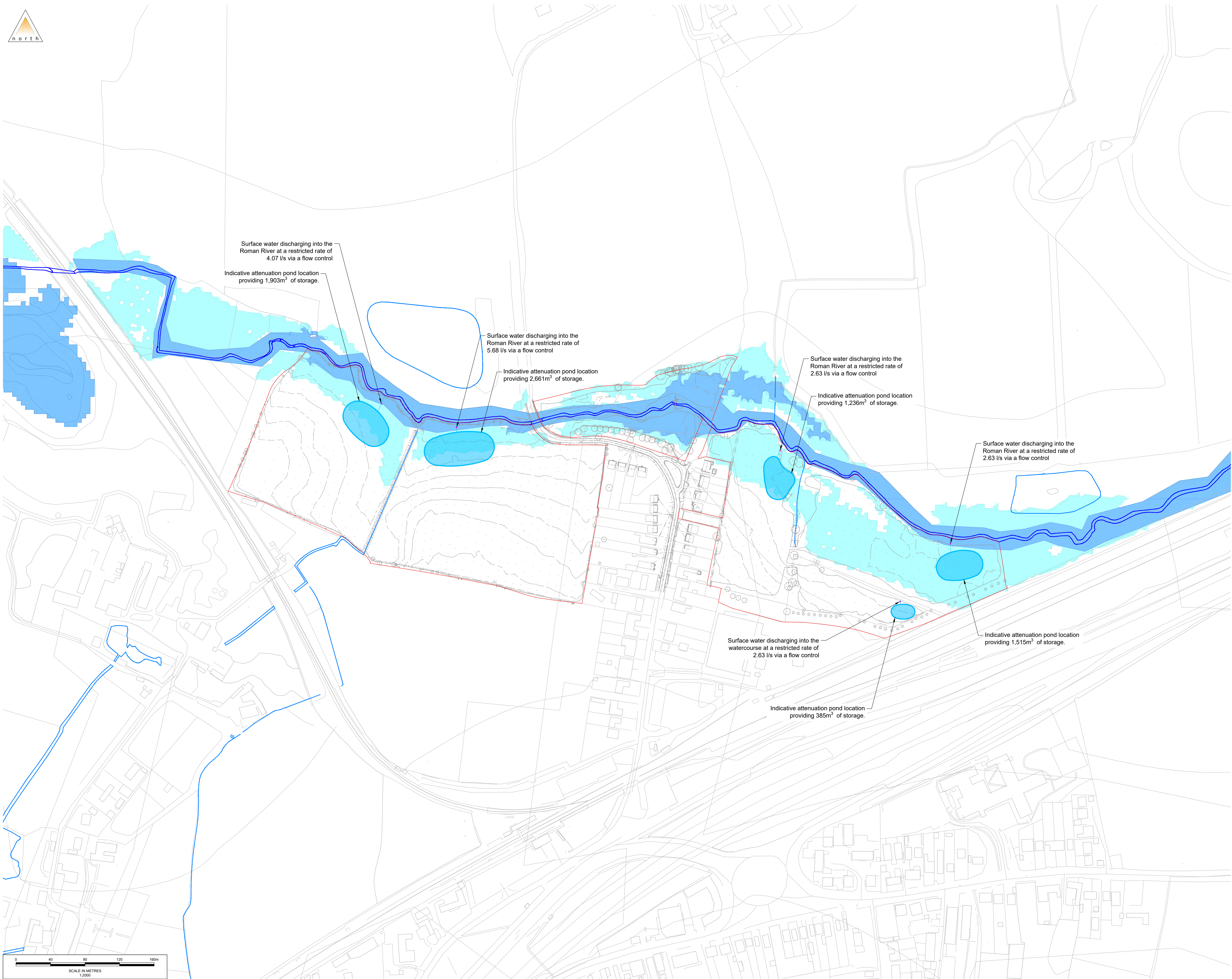
The screenshot shows the 'Results' tab of the 'Quick Storage Estimate' window. The left sidebar is the same as the previous screen. The main area displays the following text: 'Global Variables require approximate storage of between 245 m³ and 332 m³.' followed by 'These values are estimates only and should not be used for design purposes..'. At the bottom are 'Analyse', 'OK', 'Cancel', and 'Help' buttons. The status bar at the very bottom reads 'Enter Area between 0.000 and 999.999'.

Global Variables require approximate storage of between 245 m³ and 332 m³.

These values are estimates only and should not be used for design purposes..

Appendix I

Indicative SuDS Layout



- Legend
- EA Flood Map For Planning Rivers And Sea Flood Zone 2 - chance of flooding in any year of between 1 in 100 and 1 in 1000 extent
 - EA Flood Map For Planning Rivers And Sea Flood Zone 3 - chance of flooding in any year of between 1 in 30 and 1 in 100 extent
 - EA Main River - Roman River
 - Watercourse

P01	First Issue	ST	VBH	JM	10/10/2024
Rev.	Description	Drm	Chk	App	Date

Drawing Status:

DRAFT
NOT FOR CONSTRUCTION



Client:
Bidwells

Project:
Land at North Lane, Marks Tey, Colchester

Title:
Indicative SuDS Layout

Scale: 1:2000 (@ A1)

Drawing:
2408044-SK-01

Revision:
P01

APPENDIX 7

PRE-PLANNING FOUL WATER ASSESSMENT REPORT



Pre-Planning Assessment Report

Land at North Lane, Marks Tey, Colchester

InFlow Reference: PPE-0218439

Assessment Type: Used Water

Report published: 15/11/2024



Thank you for submitting a pre-planning enquiry.

This has been produced for Motion.

Your reference number is **PPE-0218439**.

This report can be submitted as a drainage strategy for the development should it seek planning permission.

If you have any questions upon receipt of this report, you can submit a further question via InFlow. Alternatively, please contact the Planning & Capacity team on **07929 786 955** or email planningliaison@anglianwater.co.uk

Section 1 - Proposed development

The response within this report has been based on the following information which was submitted as part of your application:

List of planned developments	
Type of development	No. Of units
Dwellings	160

The anticipated residential build rate is:

Year	Y1	Y2	Y3	Y4
Build rate	50	50	60	0

Development type: Greenfield

Planning application status: Unknown

Site grid reference number: TL9175624219

The comments contained within this report relate to the public water mains and sewers indicated on our records.

Your attention is drawn to the disclaimer in the useful information section of this report.

Section 2 - Assets affected

Our records indicate that we have the following types of assets within or overlapping the boundary of your development site as listed in the table below.

Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence. We are unable to permit development either over or within the easement strip without our prior consent. The extent of the easement is provided in the table below. Please be aware that the existing water mains/public sewers should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair and this should be taken into consideration when planning your site layout.

Water and Used water easement information		
Asset type	Pipe size (mm)	Total easement required (m)
Water mains	146	4.50 m overall easement
Sewer mains	100	3.00 m either side of the centre line
Sewer mains	150	3.00 m either side of the centre line

If it is not possible to avoid our assets then these may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). You will need to make a formal application if you would like a diversion to be considered.

Pumping Station

The development site is within 15 metres of a sewage pumping station. This asset requires access for maintenance and will have sewerage infrastructure leading to it. For practical reasons therefore it cannot be easily relocated. Anglian Water consider that dwellings located within 15 metres of the pumping station would place them at risk of nuisance in the form of noise, odour or the general disruption from maintenance work caused by the normal operation of the pumping station. The site layout should take this into account and accommodate this infrastructure type through a necessary cordon sanitaire, through public space or highway infrastructure to ensure that no development within 15 metres from the boundary of a sewage pumping station if the development is potentially sensitive to noise or other disturbance or to ensure future amenity issues are not created.

Due to the private sewer transfer in October 2011 many newly adopted public used water assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

Section 3 - Water recycling services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and effluent quality arising from your development.

Water recycling centre

This development is within the catchment of Copford water recycling centre (WRC), which currently can accommodate the additional flows that would be generated by the proposed development. However, Copford WRC is included within our submitted Business Plan as a named growth scheme with investment delivery planned between 2025-2030. Our Business Plan is waiting for approval from Ofwat, December 2024, and until such time we cannot confirm this scheme will be included.

Once Final Determination has been received from Ofwat we will update stakeholders, if a scheme has not been included we will update our planning responses. To ensure there is no pollution or deterioration in the receiving watercourse due to the development foul flows we recommend a planning condition is applied if permission is granted:

Condition - Prior to occupation written confirmation from Anglian Water must be submitted confirming the upgrades at Copford water recycling centre have been completed, and there is sufficient headroom to accommodate the foul flows from the development site. Reason: to prevent possible deterioration to the receiving watercourse and pollution

Used water network

Our assessment has been based on development flows connecting to the nearest foul water sewer of the same size or greater pipe diameter to that required to drain the site. The infrastructure to convey foul water flows to the receiving sewerage network is assumed to be the responsibility of the developer. Conveyance to the connection point is considered as Onsite Work and includes all work carried out upstream from of the point of connection, including making the connection to our existing network.

This connection point has been determined in reference to the calculated discharge flow and on this basis, a 150mm internal diameter pipe is required to drain the development site. We have assessed your preferred connection point which is to the 150mm sewer at manhole MH7301 located in North lane at National Grid reference (NGR) TL 91797 24333. The cover level is 30.334m AOD and the invert level is 27.874m AOD. Anglian Water has assessed the impact of a pumped conveyance from the planned development to the public foul sewerage network and we can confirm that this connection is acceptable as the foul sewerage system, at present, has available capacity for your site. In line with Sewers for Adoption, the pumped discharge will need to connect via an intermediate manhole and at least 5 metres of an appropriately sized gravity sewer. The pump rate and configuration of the connection will be determined with your detailed design. You should submit this detail with your Section 106 new connection application.

Please note that Anglian Water will request a suitably worded condition at planning application stage to ensure this strategy is implemented to mitigate the risk of flooding.

It is assumed that the developer will provide the necessary infrastructure to convey flows from the site to the network. Consequently, this report does not include any costs for the conveyance of flows.

Surface water disposal

You indicated on the Pre-Planning Application form that a connection to the public surface water sewer network is not required as a connection to a watercourse is to be utilised. A new surface water sewer can be used as a mechanism to discharge surface water to a watercourse or as part of a Suds scheme where appropriate. Subject to the sewer being designed in accordance with the current version of DCG, the sewer can be put forward for adoption by Anglian Water under S104 of the Water Industry Act 1991. If the outfall is to a watercourse, the applicant will be required to obtain consent to discharge via the appropriate body. Therefore a capacity assessment has not been made on the public surface water network. However, should this situation change and you wish to have a surface water connection assessment on the local network, then we will provide this free of charge if requested within 12 months of this report and you are able to provide the relevant evidence that your original strategy was unviable.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our [website](#). We will adopt features located in public open space that are designed and constructed, in conjunction with the Local Authority and Lead Local Flood Authority (LLFA), to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and
3. Effective maintenance schedule demonstrating that the assets can be maintained both now and in the future with adequate access.

If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our [website](#)

As the proposed method of surface water disposal is not relevant to Anglian Water; we suggest that you contact the relevant Local Authority, Lead Local Flood Authority, the Environment Agency or the Internal Drainage Board, as appropriate.

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

Your development site will be required to pay an Infrastructure charge for each new property connecting to the public water and sewerage network that benefits from Full planning permission. The infrastructure charge replaces the zonal charge as previously identified.

You will be required to pay an infrastructure charge upon connection for each new plot on your development site. The infrastructure charge are types of charges set out in Section 146(2) of the Water Industry Act 1991.

The charge should be paid by anyone who wishes to build or develop a property and is payable upon request of connection.

- The Infrastructure Charge is based on the cost of any reinforcement and upgrades to our existing network (“Network Reinforcements”), whether designed to address strategic or local capacity issues. For more information on our Infrastructure Charge, please see the ‘Useful Information’ section of this report.

Infrastructure charges are raised on a standard basis of one charge per new connection (one for water and one for sewerage).

The Water Recycling Infrastructure charge for your dwellings is:

Infrastructure charge	Number of units	Total
£ 403	160	£64,480.00

Please note that you should also budget for infrastructure charges on non-household premises where applicable and these will be calculated according to the number and type of water fittings in the premises. This is called the “relevant multiplier” method of calculating the charge and the relevant multiplier will be applied to the figures set out in our 2024-25 Developer Charging Arrangements to arrive at the amount payable. Details of the relevant multiplier for each fitting can be found on our [website](#).

Section 4 - Useful information



Figure 1: Showing your connection for foul water

Section 5 - Useful information

Water Industry Act – Key used water sections

Section 98:

This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

Section 102:

This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.

Section 104:

This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.

Section 106:

This provides you with the right to have your constructed sewer connected to the public sewer.

Section 185

This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our [website](#) or via our Development Services team on **0345 60 66 087**.

Sustainable drainage systems

Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. .

Our preferred method of surface water disposal is through the use of Sustainable Drainage Systems or SuDS.

SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our [website](#)

We recommend that you contact the Local Authority and Lead Local Flood Authority (LLFA) for your site to discuss your application.

Private sewer transfers

Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

Surface water sewers and lateral drains that do not discharge to the public sewer, e.g. those that discharged to a watercourse.

Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.

Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

It is anticipated that all new sewer applications will need to have an approved Section104 application ahead of a Section 106 connection

Encroachment

Anglian Water operates a risk based approach to development encroaching close to our used water infrastructure. We assess the issue of encroachment if you are planning to build within 400 metres of a water recycling centre or, within 15 metres to 100 metres of a pumping station. We have more information available on our [website](#)

Locating our assets

Maps detailing the location of our water and used water infrastructure including both underground assets and above ground assets such as pumping stations and recycling centres are available from [digdat](#)

All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge.

We have more information on our [website](#)

Charging arrangements

Our charging arrangements and summary for this year's water and used water connection and infrastructure charges can be found on our [website](#)

Section 6 - Disclaimer

The information provided in this report is based on data currently held by Anglian Water Services Limited ('Anglian Water') or provided by a third party. Accordingly, the information in this report is provided with no guarantee of accuracy, timeliness, completeness and is without indemnity or warranty of any kind (express or implied).

This report should not be considered in isolation and does not nullify the need for the enquirer to make additional appropriate searches, inspections and enquiries. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework ('NPPF') and any infrastructure needs identified in this report must be considered in the context of current, adopted and/or emerging local plans. Where local plans are absent, silent or have expired these needs should be considered against the definition of sustainability holistically as set out in the NPPF.

Whilst the information in this report is based on the presumption that proposed development obtains planning permission, nothing in this report confirms that planning permission will be granted or that Anglian Water will be bound to carry out the works/proposals contained within this report.

No liability whatsoever, including liability for negligence is accepted by Anglian Water or its partners, employees or agents, for any error or omission, or for the results obtained from the use of this report and/or its content.

Furthermore, in no event will any of those parties be liable to the applicant or any third party for any decision made or action taken as a result of reliance on this report.

This report is valid from the date issued and the enquirer is advised to resubmit their request for an up to date report should there be a delay in submitting any subsequent application for water supply/sewer connection(s). Our pre-planning reports are valid for 12 months, however please note Anglian Water cannot reserve capacity and available capacity in our network can be reduced at any time due to increased requirements from existing businesses and houses as well as from new housing and new commercial developments.

APPENDIX 8

INITIAL GEODIVERSITY ASSESSMENT



Document: Initial Geodiversity Statement

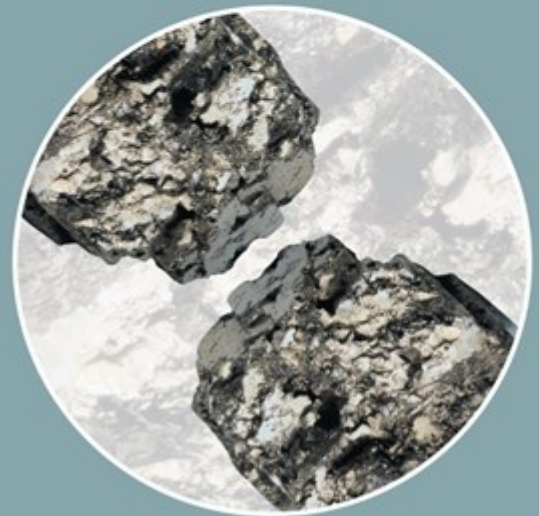
Project: North Lane, Marks Tey

Reference No: GN26917_IGS

Date: November 2024

Prepared for: Mr Richard Hines

harrisongeotechnical
ENGINEERING



HARRISON GROUP ENVIRONMENTAL LIMITED

Document: Initial Geodiversity Statement

Project: North Lane, Marks Tey

Reference No: GN26917_IGS

Date: November 2024

Prepared For: Mr Richard Hines

REPORT STATUS

Revision	Comments	Prepared By	Approved By	Audited By	Issued By
0	First Issue	INITIALS THW DATE 01/11/24	INITIALS EO DATE 02/11/24	INITIALS SW DATE 04/11/24	INITIALS EO DATE 04/11/24
		INITIALS DATE	INITIALS DATE	INITIALS DATE	INITIALS DATE
		INITIALS DATE	INITIALS DATE	INITIALS DATE	INITIALS DATE
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FOREWORD

General Conditions Relating to an Initial Geodiversity Statement

Some items of the investigation have been provided by third parties and whilst Harrison Group have no reason to doubt their accuracy, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report.

This report is produced in accordance with the scope of Harrison Group's appointment and is subject to the terms of appointment. Harrison Group accepts no liability for any use of this document other than by its client, and only for the purposes for which it was designed and produced. No responsibility can be accepted for any consequences of this information being passed to a third party who may act upon its contents and recommendations.

Any advice, opinions, or recommendations within this document should be read and relied upon only in the context of the document as a whole. The contents of this document are not to be construed as providing legal, business or tax advice or opinion.

INITIAL GEODIVERSITY STATEMENT

FOR LAND AT

NORTH LANE, MARKS TEY

1 TERMS OF REFERENCE & INTRODUCTION

The work covered by this statement was undertaken on behalf of Mr Richard Hines (the client). The assessment is in accordance Harrison Group Environmental Limited's quotation dated 16 October 2024. An emailed instruction to proceed was received from the client dated 22 October 2024.

The purpose of this study was to produce an initial geodiversity statement as part of site areas which are being promoted through the emerging Colchester Local Plan for proposed residential development.

This study was carried out using desk-based research and a field survey. It presents an initial report on the potential impacts of any built development on key geodiversity assets within the study area. However, it does not report in detail on biodiversity, flood risk, hydrology, landscape character, post-Palaeolithic archaeology and other statutory environmental impact categories in the spatial planning process.

2 SITE LOCATION AND DESIGNATION

The area of study for this statement comprises farmland (arable and meadow), woodland, hedges and scrub within the Roman River valley. It is part of the Gosfield Wooded Farmland landscape character area, and the landscape facets include floodplain land and adjacent rising ground. In part this land abuts Marks Tey Brick Pit, a Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981. The centroid grid reference for the SSSI is given as TL911243 (Appendix 1) but it has more widely designated boundaries as shown in Figure 1 below. The site details for the SSSI are published online at <https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=s1004027>.

The nature conservation interest of the Marks Tey SSSI relates to its geological assets identified under the Geological Conservation Review (GCR), <https://jncc.gov.uk/our-work/geological-conservation/#the-geological-conservation-review>, specifically the GCR block 'Quaternary of East Anglia and the Midlands' (In preparation; see Appendix 3).

Non-statutory geological interest may be conserved through the Local Sites system (ODPM, 2005, p.32); this category of site in Essex is termed Local Geological Sites (LoGS) (<http://www.geoessex.org.uk/sites/>). Marks Tey Brick Pit is not a designated LoGS because it is already a SSSI (Gerald Lucy, GeoEssex, pers. comm.)



Figure 1 Study Area Plan, showing boundaries of SSSI, proposed development area and areas of outcrop and subcrop of the Marks Tey Lake Beds (derived from BGS GeoIndex mapping data).

3 SITE HISTORY

The Essex Historic Environment Record database records the following archaeological assets within or immediately adjacent to the study area -

- **SMR 11427** – Monument, Brickworks North of Primrose House / Colliers Brickworks.
- **SMR 11817** – Findspot, Roman coin (dupondius of Titus) found 1928, Brickworks, North of Marks Tey.
- **SMR 11818** – Find Spot, Palaeolithic axe found in 1929, Brickworks, North of Marks Tey.
- **SMR 11837** – Monument, two conical brick kilns, brick drying sheds, associated works, WH Collier & Sons.
- **SMR 19394** – Find Spot, Fieldwalking finds of Roman pot and tile, south of Roman River.

The Marks Tey Brick Works was established in 1863 and is currently worked by WH Collier Limited (<https://whcollier.co.uk>) to produce specialist brick types. The site is marked as 'Clay Mills' and 'Brick Field' on the first edition OS 6"/1 mile map series (1881), and subsequent OS maps of 1925, 1963 and 1968. Bricks are hand-made on site and the complex retains traditional buildings and equipment including two derelict 19th century kilns.

4 OVERVIEW OF GEODIVERSITY INTEREST

Geodiversity has been defined as “The natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landforms, topography, physical processes), soil and hydrological features. It includes their assemblages, structures, systems and contributions to landscapes” (Gray, 2013, p. 12). Geodiversity is the physical, abiotic part of Nature, but it is intimately linked with the biosphere, atmosphere and anthroposphere.

The potential sensitivity of geodiversity assets in an area can be evaluated using a sensitivity assessment methodology developed for Environmental Impact Assessment purposes. A baseline survey is used to scope assets, which are categorised as having both conservation and Ecosystem Services value. The aim is to produce well-founded advice for mitigation of impact on geodiversity features through the development planning process (Norfolk Geodiversity Partnership, 2023, p.2). In the case of this study, only those elements of geodiversity relevant to the SSSI have been considered in depth.

4.1 Geomorphology

The study area lies in the valley of the Roman River, a right-bank tributary of the estuarine River Colne which has its headwaters in the adjacent parish of Great Tey. The river flows in an easterly direction at Marks Tey through a shallow valley developed in a very gently undulating plateau landscape with gently sloping valley sides. The river has an average gradient of some 4m per km (as measured from Teybrook Ford to Copford Hall). The valley is floored by a narrow floodplain, ranging in width from 30 to 90m in the study area. This may be flooded in winter (local resident, pers. comm.).

4.2 Geology and Geoarchaeology

The bedrock of the study area is mapped as London Clay Formation (marine clays of Eocene age) overlain by a variety of superficial deposits including the Kesgrave Formation (river gravels; early to middle Pleistocene), the Lowestoft Formation (till and associated sands and gravels; middle Pleistocene glacial), lacustrine (lake) deposits (middle Pleistocene interglacial), head and alluvium (late Pleistocene and Holocene). (British Geological Survey, 1982; Ellison & Lake, 1986). Deposits of the Kesgrave and Lowestoft formations underlie the plateau landscape of the area.

The lacustrine deposits are developed in a channel feature cut into deposits of the Lowestoft Formation (British Geological Survey, *ibid*, Cross Section 1). They occupy an elongate depression up to 35 m deep, 450m wide and which can be traced for over 900m northeast-southwest across the area (Keen (undated) – see Appendix 3). On the basis of their fossil fauna and flora, these deposits are attributed to the Marks Tey Formation of Hoxnian interglacial age, circa 400,000 years BP, correlated with Marine Oxygen Isotope Stage (MIS) 11) (Bowen (ed), 1999, pp.5, 26). The lake persisted into post-Hoxnian ('Wolstonian') times. The mapped boundaries of the Hoxnian lake basin at Marks Tey are indicated in Figure 1. They are intersected by the Roman River valley, which means that these deposits outcrop along the valley sides within the study area.

The Hoxnian was a predominantly warm, temperate interglacial period during which a rich biodiversity flourished, including early humans (Ashton, 2017, p.153; Pettitt & White, 2012, chap.3). A long history of geological and palaeontological research has underlined the significance of the Marks Tey Formation for Quaternary studies, notably Dalton (1880), Turner (1970), Candy et al. (2014), Horne et al. (2014), O'Connor (2015), Tye et al. (2016). The beds are thickest at the centre of the basin and thin out around its edges. The full sequence near the centre of the basin is given in Table 1 below. It is truncated towards the basin margins, where only beds 3a and above are represented (Ellison & Lake, *ibid*). Exploitation for brickmaking has been most intensive where the clay beds are thickest (Turner, *ibid*, p.387). The basin extends further in a north-easterly direction under the A12 trunk road towards Copford (Turner, *ibid*, p.377; Ellison & Lake, *ibid*, pp. 40-43). A simplified stratigraphy follows in Table 1 below.

Beds	Deposits	Stratigraphic stage / substage
nn	Head (solifluction deposits)	
nn	Orange-brown and grey mottled silt with basal sand and gravel	
Bed 5	Clayey silt and clay, dark grey, with carbonate nodules and chalk	['Wolstonian']
Bed 4	Clayey silt and silty clay, grey, with carbonate nodules and chalk	Early 'Wolstonian'
Bed 3b	Brown, organic detrital silts, resembling peat	
Bed 3a	Clayey silt, microbrecciated, with organic and laminated silt	Hoxnian 4a
Bed 2	Brown silt, fissile, hard and overconsolidated	Hoxnian 3b
Bed 1	Clayey silt, and silty clay, dark to greenish grey; finely laminated	Hoxnian 1 and 2

Table 1 Simplified Stratigraphy Adapted from Ellison & Lake (1986) p.43.

Due to the sporadic nature of the brickearth extraction only parts of the sequence are currently exposed, although the full sequence is still accessible through cores and borehole sampling.

4.3 Palaeolithic Archaeology

Archaeological deposits can be considered to be aspects of geodiversity in that, before their discovery, they are stratified materials intimately linked to their geological and hence palaeo-environmental context. This is especially true of deeply buried Palaeolithic deposits, which cannot, in many cases, be assayed from surface prospection (White et al, 2016, pp.6,7); they can be evaluated using predictive modelling (O'Connor, *ibid*, p.1). Archaeological evidence is considered to be found in either primary or secondary context: primary sites are those where evidence of human activity is found in undisturbed position; secondary sites are those where the evidence has been disturbed from its original context, by whatever processes. The most archaeologically sensitive sites are primary context ones, because the spatial distribution of finds is most closely linked to their original environment of deposition. The most significant Palaeolithic primary context site in Essex is Clacton-on-Sea, which includes flint artefacts linked with plant and animal fossils in a riverside environment dated to the Hoxnian Interglacial (Wymer, 1985, pp.264-285). Numerous finds of Palaeolithic material in secondary context have also been found in Essex, for example a solitary handaxe in ploughsoil at Feering and one from a small pit at Kelvedon (Wymer, *ibid*, pp.252, 253). These finds will have been derived at some time from primary context sites and reached their present locations through transport over several Pleistocene climatic cycles.

The Marks Tey Formation has significant Palaeolithic archaeological potential. This has been evaluated in *Managing the Essex Pleistocene - Final Project Report for Essex County Council*, and Marks Tey is one of the sites mapped as part of Lithological Unit 8 (Glacial-Interglacial Lacustrine Deposits) (O'Connor, *ibid*, p.69).

The Palaeolithic archaeological interest at Marks Tey and Copford is centred on the whole palaeo-lake basin, which is developed in a 'deep plateau surface depression' (O'Connor, *ibid*). The site is of international importance as the Hoxnian parastratotype, 'arguably with a more complete record than the stratotype' at Hoxne (*ibid*, p.72). Two handaxes are recorded from the site (Wymer, 1985, p.252) (one of which is recorded as Essex Historic Environment Record no. 11818). The surface find of another has recently been made (Prof. Ian Candy, pers.comm.). Despite this meagre tally, given the presence of early humans at other Hoxnian interglacial sites in south-east England (notably Beeches Pit Icklingham, Clacton, East Farm Barnham, Elveden, Foxhall Road Ipswich, Hoxne, Swanscombe), Marks Tey has significant archaeological potential.

“Archaeological sites of great importance may well lie around the fringes of this old lake basin and remain undiscovered because of the commercial exploitation of the centre of it where, obviously, the valuable brickearth is thicker”. (Wymer, ibid).

“The palaeoenvironmental potential of [Landscape Unit] 8 deposits is high as lakes are comparatively quiet environments with limited chance of reworking or other disturbance of fossil material. The lake margins are particularly significant. Any archaeological or palaeontological material on the margins would be gently covered by sediments when water levels rose, thereby facilitating preservation. The deeper parts of the lake would be less likely to yield artefacts, apart from odd cases such as the Marks Tey handaxe that appears to have been thrown into the lake. The focus of Palaeolithic potential is in zones near, and beyond, the edge of mapped outcrops, where shallow marginal deposits with Palaeolithic evidence are more likely to be present”. (O’Connor, ibid, pp.70-71)

The adjacent site of Copford has lake beds of equivalent age and geoarchaeological potential and is in subsurface continuity with the Marks Tey beds.

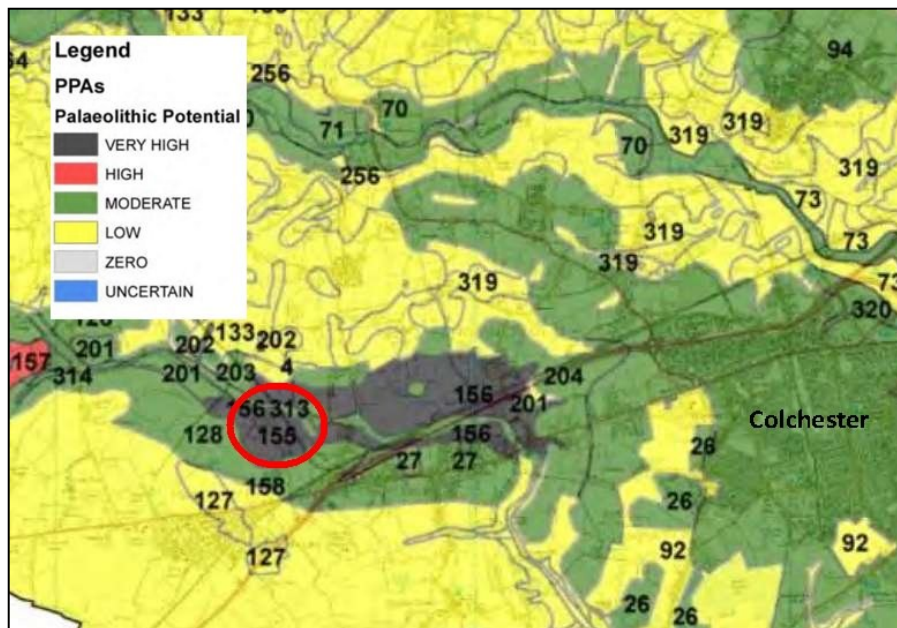


Figure 2 Map adapted from O’Connor, T. (2015), Figure 22, annotated to indicate the location of Marks Tey. Reproduced with permission of Essex County Council.

4.4 Soils

The soils of the study area have been classified by the Soil Survey of England and Wales as belonging to the Wix Association (code 573b) (Soil Survey), gleyic argillic brown earths (Soil Survey, 1983). This association is described as being mostly formed on glaciofluvial material over Eocene London Clay bedrock with an admixture of loessic silt. In many places the underlying clay impedes water flow and soils are waterlogged for varied periods in winter. (Hodge et al. 1984, p.363). The ploughsoil in the study area has high clay content, most likely derived from the glacial till and lacustrine deposits which contain a high proportion of clayey material derived from bedrock of the London Clay Formation. This influences its hydrological properties, and hence liability to rapid flood runoff and retaining standing water.

4.5 Landscape Character

The area of study is located in the Gosfield Wooded Farmland Landscape Character Area (code B4) (ECC & SSBC, 2002, pp.62-66) which has a flat to gently undulating character founded on Glacial Till (Chalky Boulder Clay) from the Anglian glacial period. This landscape is rated as having high sensitivity for any built development over 5 Ha in size (ibid, p.66). The area of study amounts to an area of some 13 Ha.

5 GEOCONSERVATION

In summary, there is a significant outcrop of Middle Pleistocene lake beds at Marks Tey associated with a long history of scientific research. Fossil faunal and floral evidence has shown that the deposits span all the Hoxnian interglacial period and the early part of the following cold period. They occupy an east-west trending basin in the till landscape underlying the Roman River valley. The deepest part of the basin has been designated as a geological SSSI. The fringes of the basin are undesignated but are flagged up as areas of high Palaeolithic archaeological as well as Pleistocene geological and palaeontological potential.

5.1 Sensitivity And Impact Assessment

NPPF Section 186b states that development within or outside a SSSI which is likely to have an adverse effect on the site should not normally be permitted. This study considers potential impact on assets within and outside the SSSI boundary which are mapped by the BGS as Lacustrine Deposits.

The sensitivity of geological conservation assets is coded under the Earth Science Conservation Classification System (ESCC) (Prosser et al. 2006, p.20; Evans et al. 2023, p.23). The lake beds at Marks Tey may be classified under three ESCC categories:

- Code EA – Active Pits and Quarries (the active brickearth pits of WH Collier Ltd).
- Code ED – Disused Quarries and Pits (former areas of brickearth extraction now abandoned).
- Code FB – Finite Buried Interest (all areas not covered by the above).

This study assesses that the proposed development will have no direct or indirect impact on EA or ED category lacustrine deposits lying within the SSSI boundary. However, there is likely to be direct or indirect impact on FB category lake deposits and Palaeolithic archaeology in the areas outside the SSSI boundary, amounting to some 7.5 hectares.

Geoconservation principles for category FB deposits are set out in Evans et al. 2023 (pp.118-121):

“The primary management principles on buried interest sites are to limit disturbance or removal of the geological interest and to maintain the sites in a condition whereby it is possible to access the geology by boreholes and/or temporary excavations. Activities which can cause permanent damage to buried interest sites include deep ploughing, digging of drains, tree planting, quarrying and general development works, such as construction of buildings on top of the geological features. Recreational activities such as off-road driving and mountain biking may be damaging if they disturb the buried geological interest. Finite features are particularly sensitive to removal of material and other activities which can deplete or conceal the resource. When assessing the potential impacts of such activities, it is important to understand the distribution of the geological features, as these may be laterally variable”.

Possible threats and management issues relating to category FB deposits are listed in Table 2 below.

Potential Threats And Management Issues	Relevance	Examples of Possible Harm at Marks Tey
Inappropriate agricultural practices	Yes	Subsoiling, deep ploughing
Tree planting	Yes	Root damage
Development	Yes	Embanking, footings, trenching, tarmacing
Quarrying	Yes	Creation of drainage lagoons
Removal of material	Yes	Excavations
Irresponsible specimen collecting	Yes	Damage to stratified fossil remains
Inappropriate recreational activities	Yes	Mountain biking

Table 2 Possible Threats and Management Issues

Possible mitigation measures for category FB geological deposits are illustrated in Figure 3 below. Approaches are similar for lake and channel deposits, and for any Palaeolithic archaeological sites stratified within them.

Channel deposits of limited extent below open ground (FB)

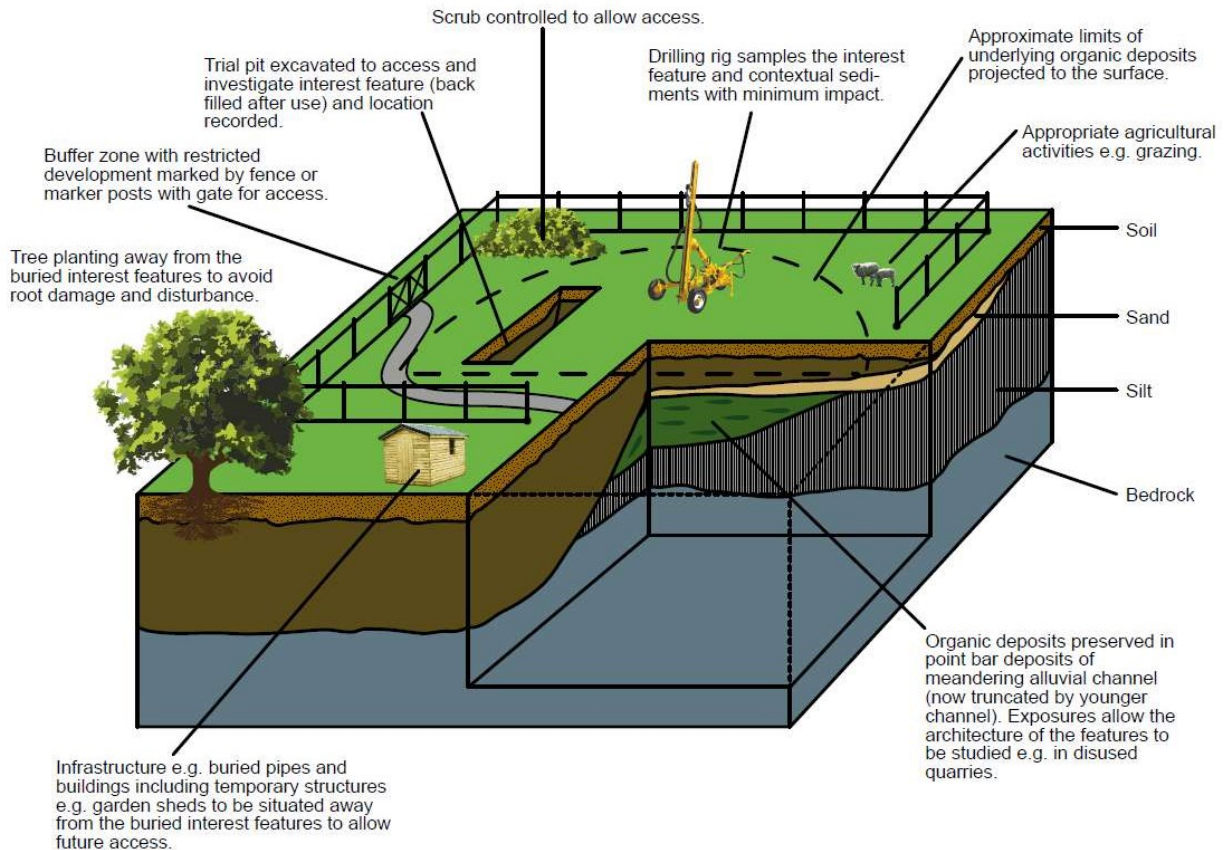


Figure 3 Techniques for mitigating impact on category FB Pleistocene alluvial deposits. Image courtesy Evans et al. 2023 (p.120).

Procedures for conserving Palaeolithic assets are set out in ‘Curating the Palaeolithic’ (Historic England, 2023). This includes carrying out a Palaeolithic/Pleistocene Assessment which includes desk-based assessment, deposit modelling and field evaluation, followed by an assessment of significance and mitigation measures (ibid, sections 3 and 4).

“The most important Palaeolithic assets have equivalent significance to Scheduled Monuments, and should therefore be considered of national importance and subject to policies for designated heritage assets”. (p.28)

6 RECOMMENDATIONS

Based on this study, deposits of the Marks Tey Formation within the study area should be treated as though they may contain nationally important geological and archaeological assets.

In order to evaluate the geography and sensitivity of deposits, as a first step it is strongly recommended that the two relevant national agencies be contacted for their scoping opinions.

- **Natural England** – for evaluation of potential impact of development within or outside the SSSI on deposits of the Marks Tey Formation. Contact West Anglia Team: westanglia@naturalengland.org.uk.
- **Historic England** – for evaluation of potential impact on possible buried archaeological assets in the Marks Tey Formation. Contact East of England regional Office: eastofengland@HistoricEngland.org.uk.

It would also be advantageous to contact:

- **Essex County Council Place Services** – the Historic Environment Manager Tim.Murphy@essex.gov.uk.

Harrison Group Environmental Limited would be pleased to offer further assistance with the advice provided above, and if the client has any comments or questions, we would be glad to discuss them.

Report prepared by:



Tim Holt-Wilson BA (Hons)
Geological Specialist

Report checked by:



Ed Orchin BSc (Hons) FGS
Senior Geotechnical Engineer

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LIST OF APPENDICES

Appendix 1	Marks Tey Brickpit SSSI Citation
Appendix 2	1A - Policy Guidance
Appendix 2	1B - Baseline Information
Appendix 3	Extract From: Allen, P., Keen, D.H. And Lewis, S.G. (Eds). Quaternary Of East Anglia And The Midlands. Geological Conservation Review (Chapter 6, Author's Draft; Forthcoming).

APPENDIX 1 MARKS TEY BRICKPIT SSSI CITATION

County: Essex

Site Name: Marks Tey Brickpit

District: Colchester

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Colchester Borough Council

National Grid Reference: TL 911243

Area: 29.5 (ha) 72.9 (ac)

Ordnance Survey Sheet 1: 50 000: 168 1: 10 000: TL 92 SW

Date Notified (Under 1949 Act): 1979 Date of Last Revision: -

Date Notified (Under 1981 Act): 1986 Date of Last Revision: -

Reasons for Notification:

Marks Tey has uniquely important Pleistocene sediments, which have yielded a continuous pollen record through the entire Hoxnian Interglacial. No other site in the British Isles has so far produced a comparable vegetational record for this or any other interglacial. Of considerable interest also are the laminations (seasonal layers) within these lacustrine (lake) sediments which have made it possible to estimate the duration in years of the Hoxnian Interglacial

APPENDIX 2

1A. POLICY GUIDANCE

This report is written in conjunction with guidance provided by the following national planning policy documents:

- The National Planning Policy Framework (NPPF), specifically section 15 (*Conserving and Enhancing the Natural Environment*) and section 16 (*Conserving and Enhancing the Historic Environment*). Ministry of Housing, Communities and Local Government, 2023. Online at <https://www.gov.uk/government/publications/national-planning-policy-framework--2>.
- *Planning for Biodiversity and Geological Conservation – A Guide to Good Practice*. Office of the Deputy Prime Minister, 2006. Online at <https://www.gov.uk/government/publications/planning-for-biodiversity-and-geological-conservation-a-guide-to-good-practice>.
- *Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System*. Office of the Deputy Prime Minister, Circular 06, 2005. Online at <https://www.gov.uk/government/publications/biodiversity-and-geological-conservation-circular-06-2005>.
- The Environmental Impact Assessment (Town and Country Planning (Environmental Impact Assessment) Regulations, 2017. Online at <https://www.gov.uk/guidance/environmental-impact-assessment>.
- *Guidance. Historic Environment*. Ministry of Housing, Communities and Local Government, 2014/2019. Online at <https://www.gov.uk/guidance/conserving-and-enhancing-the-historic-environment>.
- *Guidance. Natural Environment*. Ministry of Housing, Communities and Local Government, 2016/2024. Online at <https://www.gov.uk/guidance/natural-environment>

APPENDIX 2

1B. BASELINE INFORMATION

The baseline information used to prepare this statement is derived from desktop and field survey.

Desktop Survey

- Natural England's MAGIC map web portal.
- The British Geological Survey map and associated memoir; also, the online 'GeoIndex' web portal.
- Specialist geological, geomorphological, pedological, hydrological and archaeological literature.
- Essex Historic Environment Record database, via the Heritage Gateway web portal.
- Essex Landscape Character Assessment report.
- Historic OS maps and aerial photographs, via National Library of Scotland online.
- 'Google Maps' and 'Google Earth' historical imagery.

Field Survey (31 October 2024)

- A visit to the Marks Tey Brickpit, courtesy W.H. Collier Ltd.
- A visual survey of the area of study from roads and footpaths.

APPENDIX 3

EXTRACT FROM: ALLEN, P., KEEN, D.H. AND LEWIS, S.G. (EDS). QUATERNARY OF EAST ANGLIA AND THE MIDLANDS. GEOLOGICAL CONSERVATION REVIEW (CHAPTER 6, AUTHOR'S DRAFT; FORTHCOMING).

MARKS TEY, ESSEX

(TL 912242)

D.H. Keen

Highlights

The lacustrine deposits at Marks Tey have provided one of the most important palaeobotanical records from any British Pleistocene site because they contain a complete palynological record through a full temperate stage, the Hoxnian. This not only gives an insight into this particular interglacial, but also gives more generally applicable information into the climatic development of temperate stages. The sediments exhibit annual rhythmites for part of their thickness which may allow a calculation of the length of time occupied by the interglacial. The presence of an anomalous "low arboreal pollen" phase which might provide evidence of a forest fire of widespread extent in the East Anglian Hoxnian is also of interest. The lacustrine deposits post-date the local glacial succession and so provide evidence for dating these deposits.

Introduction

Although the lacustrine deposits at Marks Tey have been known since the geological survey of the district in 1873-75 (Dalton, 1880) and were the subject of limited studies in the 1950s and early 1960s (Andrews, 1963) a full account of them was only completed by Turner in 1970. The lacustrine deposits occupy an elongate depression up to 35 m deep, 450 m wide and which can be traced for over 900 m northeast-southwest across the area (Fig. 6.22). The depression is cut into London Clay, but its base contains glacial gravels for part of its extent. The whole sequence is cut into the southern edge of the East Anglian till plateau, so demonstrably post-dates the major glaciation of the area. It is probable that the lake basin which contains the Marks Tey deposits is a sub-glacial valley (tunnel valley) and Turner (1970) notes that it is only one of a number in the area which share the same general origin and age.

Description

The sedimentary infill of the basin as investigated by boreholes close to the Marks Tey Brick and Tile Works consists of around 1.5 m of gravel and sand of hillwash origin overlying up to 35 m of lacustrine deposits in the axis of the basin (Fig. 6.23). In general, these deposits are fine-grained being composed of muds, silts and clays, although sands and fine gravel occur to a limited extent. The top 12 m of the succession is affected by brecciation and reworking of clays and muds from earlier units. Below this the succession, which is between 12 and 18 m thick, is laminated with clay-silt couplets 1-3 mm thick, but also with some sequences of coarser (up to 2-3 cm) rhythmites in the basal levels. The lowest units below 21 m were of silty sand with a gravel of chalk fragments.

Marginal sequences of the lake basin infill were thinner than those of the axis of the basin, Turner's boreholes AA and BB (Turner, 1970) reaching to c.8 m before encountering the sand and gravel fill of the bottom of the basin. As is usual with lake marginal facies, the size grade of the sediment is somewhat coarser than in the centre of the basin, but despite the restricted thickness of sediment, the same general depositional units can be recognised.

The lake sediments yielded Mollusca and plant macrofossils, but both of these groups were of restricted development and mostly found in the marginal facies, so the palaeontological interpretation of the deposits has largely been through pollen analysis. Turner (1970) provides four diagrams, one each from the upper and lower units from the deepest part of the basin, and two from the marginal facies. In these sequences six zones can be recognised (Fig. 6.24). The earliest (IAn) has high non-arboreal pollen and low tree pollen, of which *Betula* is the most numerous tree genus. Very abundant pollen of the shrub genus *Hippophaë* also typifies this zone. This is followed by the first of the tree pollen zones (Hol), a zone of boreal woodland with pollen of *Pinus* and *Betula* being the majority types. This boreal forest is followed by mixed oak forest (Holl), a forest zone of *Carpinus* and *Abies* (HollII), and then the return of a *Pinus*-*Betula* woodland of HolIV. At the top of this zone heath vegetation with *Empetrum* and grass becomes increasingly important and in the final zone (eWo) become dominant over the tree pollen record.

Notable pollen records include those of *Pterocarya* from HolII and IV, *Vitis* in HolIII, and *Megasporangia* of *Azolla* in Ho IV. These taxa are exotic to the British Isles at present and have climatic and biostratigraphic significance (see below). The pollen record is complemented by the plant macrofossils. These were largely recovered from the marginal areas of the lake sediments and are dominated by waterside taxa such as *Potamogeton*.

As well as the pollen, the laminated section of the sediments contained abundant diatom remains which were dominated by *Stephanodiscus astraea* var. *minuta* and which make up one part of each of the couplets in this section of the deposits.

An important feature of the pollen record at Marks Tey is the non-arboreal pollen phase in zone HolIc. The record of forest development from *Betula-Pinus* woods in Hol to mixed oak forest in HolI was interrupted by a phase of regression to grassland and scrub. Tree pollen values for *Corylus* declined from 30-50% to 20%, *Taxus* from 14% to 2% and *Ulmus* from 6% to 2%. *Quercus* pollen was, however, hardly affected. In contrast the pollen of grass rose from 2% to 25% over the same zone. The low tree pollen zone is laminated throughout and counts of the couplets suggest a duration of 350 years from the abrupt tree decline to full regeneration of the forest. At this level the sediments contain abundant charcoal, in the centre of the basin of microscopic size, in the marginal facies of macroscopic size.

Interpretation

Deep lake basins are characterised by fine, uniform sedimentation ideal for the preservation of pollen. The sediments at Marks Tey were deposited through the whole of a temperate stage. The development of the vegetation follows the classic progression from the open landscape of the end of the preceding glaciation, through the *Betula-Pinus* woods of the early interglacial, the mixed oak forest of the peak of the temperate stage, the *Carpinus-Abies* zone at the end of temperate conditions, and into the *Betula-Pinus* and open vegetation of the decline into the cold of the next glacial stage. Marks Tey has one of the most complete temperate stage pollen spectra of any British Pleistocene site and an unrivalled record of vegetation development which provides a model with which to compare other more fragmentary interglacial successions.

The vegetation record at Marks Tey is diverse and in the most temperate parts of zones HolI and III gives indications of a climate no cooler than now and perhaps somewhat warmer if the records of southern European taxa such as *Pterocarya* and *Vitis* are regarded as characterising the climate as a whole. The marginal facies of the lake show some evidence of lake level fluctuation in zone HolIVa which might be evidence of a drier climate at this juncture, although lake levels soon recover and an alternative cause such as variation of the levels of input or outflow streams might be an explanation for this level change.

The laminated sections of the core, with their abundance of the diatom *S. astraea*, seem to show that the couplets of the laminae represent an autumn/winter layer with abundant diatoms and a spring/summer layer with more organic sediments. Assuming that the laminae are annual and do not represent some other timespan, they show that zone HolI and the laminated part of HolIII were deposited over about 4,700 years. Extrapolations of this rate of sedimentation to the rest of the core indicates a length of time of deposition of the lake sediments of 30,000 to 50,000 years (Shackleton and Turner, 1967; Turner, 1970), a value later revised by Turner (1975) to 20,000-25,000 years.

The laminated part of HolIc gives a duration for the high non-arboreal pollen phase of about 350 years from start to re-establishment of mixed oak forest. The occurrence of both macro and micro charcoal at this level suggests the possibility that a forest fire could have been responsible for the destruction of the forest, although as Turner notes (1970) destructive forest fires are unusual in European mixed oak forest. The same low tree pollen phase occurs at Hoxne, also in lake sediments (see site report below). If the same forest fire was responsible for both low tree pollen episodes, it was a significant episode in East Anglian forest development during the Hoxnian.

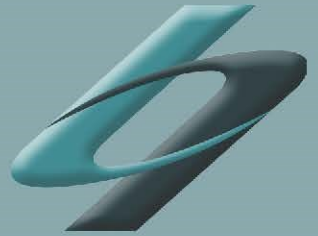
The pollen spectra from Marks Tey compare closely with those from the Hoxnian typesite at Hoxne not only in the order of immigration of the various tree taxa, but also in the species present, even down to rare exotics. The occurrence of such events as the low arboreal pollen phase which occurs in HolIc and appears to represent the same period of time at both sites, leaves little doubt that the same temperate phase is represented at both localities. Although the sequence at Hoxne is a little less complete than that at Marks Tey, with the latter part of HolIII and IV being absent, it is clear that both represent the same temperate episode. As the deposits at Marks Tey rest on glacial sand and gravel and have a pollen record which starts with a late glacial vegetation succession, it seems likely that the full sequence at the site represents

a glacial stage followed by an interglacial. The decline of the vegetation into an open habitat cold stage sequence at the top of the Marks Tey lake infill also indicates that the interglacial is succeeded by a further glacial episode. However, the lake muds are covered with a only small thickness of sand and gravel, believed by Turner (1970) to be of solifluction origin, and there is no trace of a further till on top of the sequence.

As the pollen record at Marks Tey is so similar to that from the Hoxnian typesite, it is very probable that the lake deposits are of Hoxnian interglacial age. The occurrence in the Marks Tey deposits of taxa such as *Azolla* give a distinct Middle Pleistocene aspect to the flora as this genus is unknown in deposits younger than MIS 9 but is abundant in earlier temperate stages. In the stratigraphic scheme for the British Pleistocene of Mitchell *et al.* (1973) the preceding glaciation would then be the Anglian and the cold stage at the top of the sequence would then be the start of the Wolstonian (referred to by Turner (1970) as the Gipping). However, modern stratigraphic schemes are more complicated than that of Mitchell *et al.* (1973), and although the sequence of Anglian Glacial-Hoxnian Interglacial still holds good, the age of the later cold stage is uncertain. The correlation of the Anglian and Hoxnian with universal Pleistocene records such as that of the ocean basins is not yet certain, so that correlations of the Marks Tey record more widely than with local East Anglian successions may be premature.

Conclusion

The lake sequence at Marks Tey is almost unique in the British Pleistocene as it represents the whole of an interglacial without any breaks in the succession. Its pollen record allows a detailed reconstruction of East Anglian forest history for the stage and permits close correlation with the typesite of the Hoxnian Stage. Although the Marks Tey record gives a valuable interglacial datum for the East Anglian Pleistocene, its exact geochronometric age is still uncertain.



Norwich (Registered Office)

Kimberley Street
Norwich
Norfolk
NR2 2RJ

Tel: 01603 613111

London

12 Waterways Business Centre
Navigation Drive
South Ordnance Road
Enfield, EN3 6JJ

Tel: 020 7537 9233

Cambridge

1 Francis Court
High Ditch Road
Fen Ditton, Cambridge
CB5 8TE

Tel: 01223 781585

Colchester

Colchester Business Centre
1 George Williams Way
Colchester
CO1 2JS

Tel: 01206 986675

APPENDIX 9

INITIAL ARCHAEOLOGY ASSESSMENT



consultancy | project management | expert witness

Land west and east of North Lane Marks Tey



Initial Archaeological Assessment January 2025

E:mail andyjosephs@hotmail.com • Telephone 07990 571908

Offices in Thirsk•Bury•Leamington Spa•Bath

Correspondence and Accounts: 43 Middle Green, Higham, IP28 6NY

Andrew Josephs Associates Ltd. Registered Office, Fulford House, Newbold Terrace, Leamington Spa, England, CV32 4EA

Registration no. 13428825. VAT No. 390520313

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Appendix A Martin R. Bates (2024) *Land west and east of North Lane Marks Tey, A geoarchaeological desk based assessment of the Palaeolithic archaeological potential of The Site*

Appendix B Martin R. Bates (2025) *Land west and east of North Lane Marks Tey Preliminary investigation of the sediments at The Site*

Cover: OS 1", circa 1873

1. Introduction

1.1 SCOPE OF THIS REPORT

1.1.1 Description of the proposed development

This report, commissioned by Bidwells, presents the findings of an archaeological desk-based assessment of land to the west and east of North Lane, Marks Tey to inform the promotion of that land for residential development. The Proposed Development Area (PDA) is formed of three parcels (**Figure 1**) and comprises approximately agricultural land.



Figure 1 Location of Proposed Development Area (PDA)

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1.1.2 Scope of archaeology and this assessment

Archaeology is represented by a wide range of features that result from past human use of the landscape. These include historic structures, many still in use, above ground and buried archaeological monuments and remains of all periods, artefacts of anthropological origin and evidence that can help reconstruct past human environments.

This assessment considers potential direct effects upon archaeology based upon archival and database research, map regression and aerial photography.

Potential offsite effects upon the setting of built heritage assets, such as listed buildings and Conservation Areas, will be addressed separately.

1.2 RELEVANT LEGISLATION, POLICY AND GUIDANCE

1.2.1 Statutory Legislation

Table 1 summarises the statutory legislation relevant to archaeology.

Table 1 Statutory protection for archaeological sites

Legislation	Key Issues
Burial Act (1857)	Under Section 25 of the 1857 Act, it is a criminal offence to remove human remains from any place of burial without a licence from the Ministry of Justice.
Ancient Monuments and Archaeological Areas Act (1979)	It is a criminal offence to carry out any works on or near to a Scheduled Ancient Monument without a Scheduled Monument Consent.
Protection of Military Remains Act (1986)	The Act outlines the criteria for designating a military crash site. Certain activities are prohibited at protected sites, without the authority of the Secretary of State.
Treasure Act (1996)	The 1996 Act defines 'Treasure' as any object that is at least 10% gold or silver, associated coins or groups of coins which are over 300 years old, objects formerly classed as 'treasure trove' (i.e. deliberately deposited items with a high content of gold or silver) and any objects found in association with the above. Any find of 'Treasure' must be reported to the local Coroner.
Hedgerow Regulations (1997)	It is against the law to remove most countryside hedgerows without permission. A local authority can prohibit the removal of an 'important' hedgerow. The 1997 Regulations define the criteria for determining whether a hedgerow is important, and these include historical and archaeological criteria.

1.2.2 Non-Statutory Protection

Table 2 summarises the relevant non-statutory protection relating to archaeology and the historic environment.

Table 2 Non-statutory protection for archaeological sites

Policy	Key Issues
The National Planning Policy Framework (NPPF) 2024	Sets out the Government's planning policies for England and how these are expected to be applied. The Framework includes a section detailing requirements to conserve and enhance the historic environment.
Register of Parks and Gardens of Special Historic Interest in England	The Register is maintained by Historic England and identifies important historic parks and gardens, which should be considered by the local planning authority in planning decisions or consultations.
Register of Historic Battlefields	Historic England's Register identifies 46 important English battlefields and allows their protection through the planning system.

The most relevant policies within NPPF 2024 to this proposal are reproduced below:

207. In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. As a minimum the relevant historic environment record should have been consulted and the heritage assets assessed using appropriate expertise where necessary. Where a site on which development is proposed includes, or has the potential to include, heritage assets with archaeological interest, local planning authorities should require developers to submit an appropriate desk-based assessment and, where necessary, a field evaluation.

212. When considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the asset's conservation (and the more important the asset, the greater the weight should be). This is irrespective of whether any potential harm amounts to substantial harm, total loss or less than substantial harm to its significance.

216. The effect of an application on the significance of a non-designated heritage asset should be taken into account in determining the application. In weighing applications that directly or indirectly affect non-designated heritage assets, a balanced judgement will be required having regard to the scale of any harm or loss and the significance of the heritage asset.

218. Local planning authorities should require developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and the impact, and to make this evidence (and any archive generated) publicly accessible. However, the ability to record evidence of our past should not be a factor in deciding whether such loss should be permitted.

1.2.3 Historic England Guidance

The guidance below, produced by Historic England, has been identified as relevant to this study:

- Historic England¹ 2008. *Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment*.
- Historic England 2017. *The Setting of Heritage Assets* (GPA3)

¹ Historic England includes its former name English Heritage

- Historic England 2019 *Statements of Heritage Significance* (HE Advice Note 12)
- Historic England 2023 *Curating the Palaeolithic* (HEAG313).

1.2.4 Other Guidance

- Standard and Guidance for Historic Environment Desk-Based Assessment (Chartered Institute for Archaeologists 2014, revised 2017)

1.2.5 Local Planning Policy

The PDA is situated within the administrative area of Colchester City Council. The Colchester Local Plan 2017-2033 provides the policy framework, site allocations and development management policies for the City up to 2033. This was Adopted by Colchester City Council on 4 July 2022.

Policy DM16 refers to Heritage.

Policy DM16: Historic Environment

Development that will lead to substantial harm to or total loss of significance of a listed building, conservation area, historic park or garden or important archaeological remains (including the setting of heritage assets) will only be permitted in exceptional circumstances where the harm or loss is necessary to achieve substantial public benefits that outweigh the harm or loss. Where development will lead to less than substantial harm this harm should be weighed against the public benefits of the proposal.

Development affecting the historic environment should seek to conserve and enhance the significance of the heritage asset and any features of specific historic, archaeological, architectural or artistic interest. In all cases there will be an expectation that any new development will enhance the historic environment or better reveal the significance of the heritage asset unless there are no identifiable opportunities available. In instances where existing features have a negative impact on the historic environment, as identified through character appraisals (or other method of identification of historic assets), the Local Planning Authority will request the removal of the features that undermine the historic environment as part of any proposed development. The Local Planning Authority will request the provision of creative and accessible interpretations of heritage assets impacted by development.

Conservation of the historic environment will also be ensured by:

- (i) Identifying, characterising, protecting and enhancing Conservation Areas;
- (ii) Protection and enhancement of existing buildings and built areas which do not have Listed Building or Conservation Area status but have a particular local importance or character which it is desirable to keep;
- (iii) Preserving and enhancing Listed Buildings, Scheduled Monuments, Historic Parks and Gardens, including their respective settings, and other features, which contribute to the heritage of the Borough; and
- (iv) Sites of archaeological interest will be clearly identified and protected, and sites that become known, whether through formal evaluation as part of a Planning Application or otherwise, will similarly be protected according to their importance.

Heritage Impact Assessments and/or Archaeological Evaluations will be required for proposals related to or impacting on the setting of heritage assets and/or known or possible archaeological sites, and where there is potential for encountering archaeological sites so that sufficient information is provided to assess the significance of the heritage assets and to assess the impacts of development on historic assets together with any proposed mitigation measures.

1.3 AUTHORSHIP

This Assessment has been written by Andrew Josephs, Managing Director of Andrew Josephs Associates, a consultancy specialising in archaeology and cultural heritage founded in 2002. He has extensive experience of all periods and facets of cultural heritage, including the authorship of over 1200 Archaeological Assessments. He was previously Principal Consultant (Director of Heritage and Archaeology) at AMEC and Wardell Armstrong, where he started in 1992, becoming of the UK's first consultants in the post-PPG16 era of developer-funded archaeology. Prior to 1992, he worked as a field-based archaeologist and researcher for universities and units in the UK, Europe and the USA. He graduated with a BA (Honours) in Archaeology and Environmental Studies in 1985.

A palaeolithic and geoarchaeological study was undertaken by Professor Martin Bates, a geoarchaeologist who specialises in the investigation of deeply stratified sequences in river valleys, the coastal sector and in shallow marine waters. His work includes the use of geological geophysics, boreholes and geotechnical data to model the distribution of buried sediments and potential archaeological remains. He specialises in the Palaeolithic and later Prehistoric records of East and S E England but has also worked extensively in Orkney and on both sides of the English Channel and Severn estuary, as well as the Middle East and East Africa. He has published extensively, and these works include monographs on the Holocene sediments of High Speed 1, as well as contributing to Lost Landscapes of the Palaeolithic.

He has worked extensively in the area between Chelmsford and Colchester including the Pleistocene and Palaeolithic investigation works associated with the A12 widening proposals in 2022, and the quarries to the east of Witham (Coleman's Quarry) since 2014.

2. Baseline Conditions

2.1 DESIGNATED ARCHAEOLOGICAL ASSETS

One scheduled monument (list entry 1020999) sits within 1km of the PDA (**Figures 2 and 3**). This comprises two circular kilns and their associated brick working floor, flues and chimney base located within W H Collier Brick and Tile Works, Church Lane, Marks Tey. The western kiln is also a Listed Building Grade II (**Figure 4**).



Figure 2 Scheduled brick kilns, 100m south west of the PDA
© Google base photo



Figure 3 Scheduled brick kilns within current brickyard setting
© Google base photo



Figure 4 The western circular brick kiln, scheduled and Grade II listed
© WH Collier website

The scheduling description states that:

The circular kilns at Marks Tey give testimony to an earlier brickmaking process, and represent an exceptional survival of a form of industrial monument now extremely rare nationally. The kilns are of particular importance because all the elements of the firing operation are present: the kilns themselves, the brick-floored working area surrounding the kilns, the flues and the chimney. Thus, the whole working operation of the kilns is clearly understandable: the chimney and flues providing the necessary draught to fire the kilns and the brick flooring providing a hard work-surface over which brick-laden wheelbarrows could easily run. The well-preserved internal and external features of the kilns add detail to our understanding of their operation: all the fireholes complete with firebars are present; the pulley operating the damper on the most easterly kiln is still in place. The presence of all of these features allows us to draw a complete picture of the firing process in operation at Marks Tey during the late 19th century.

The monument is situated 100m from the nearest boundary of the PDA. It sits to the west of the railway line within woodland, and as can be seen on **Figure 3** its setting is still the brickworks that it served. There would be no effect upon the setting of the monument from development within the PDA due to distance, the physical separation of the railway line and the fact that the monument's historical setting would be maintained within the brickyard. It is highly unlikely there would be visual linkage, even in winter, due to woodland (**Figure 5**).



Figure 5 Setting and context of scheduled monument and the PDA

© Google base photo

2.2 ARCHAEOLOGICAL BACKGROUND

A search for sites within a 1km radius of the PDA was made of the online Colchester Historic Environment Record². This produced 10 local list records, over 50 monument records and 14 event records. Of these, one HER record lies within the PDA. The results are shown on **Figures 6, 7 and 8** and discussed below.

² Should a planning application come forward a formal search of the CHER would be required

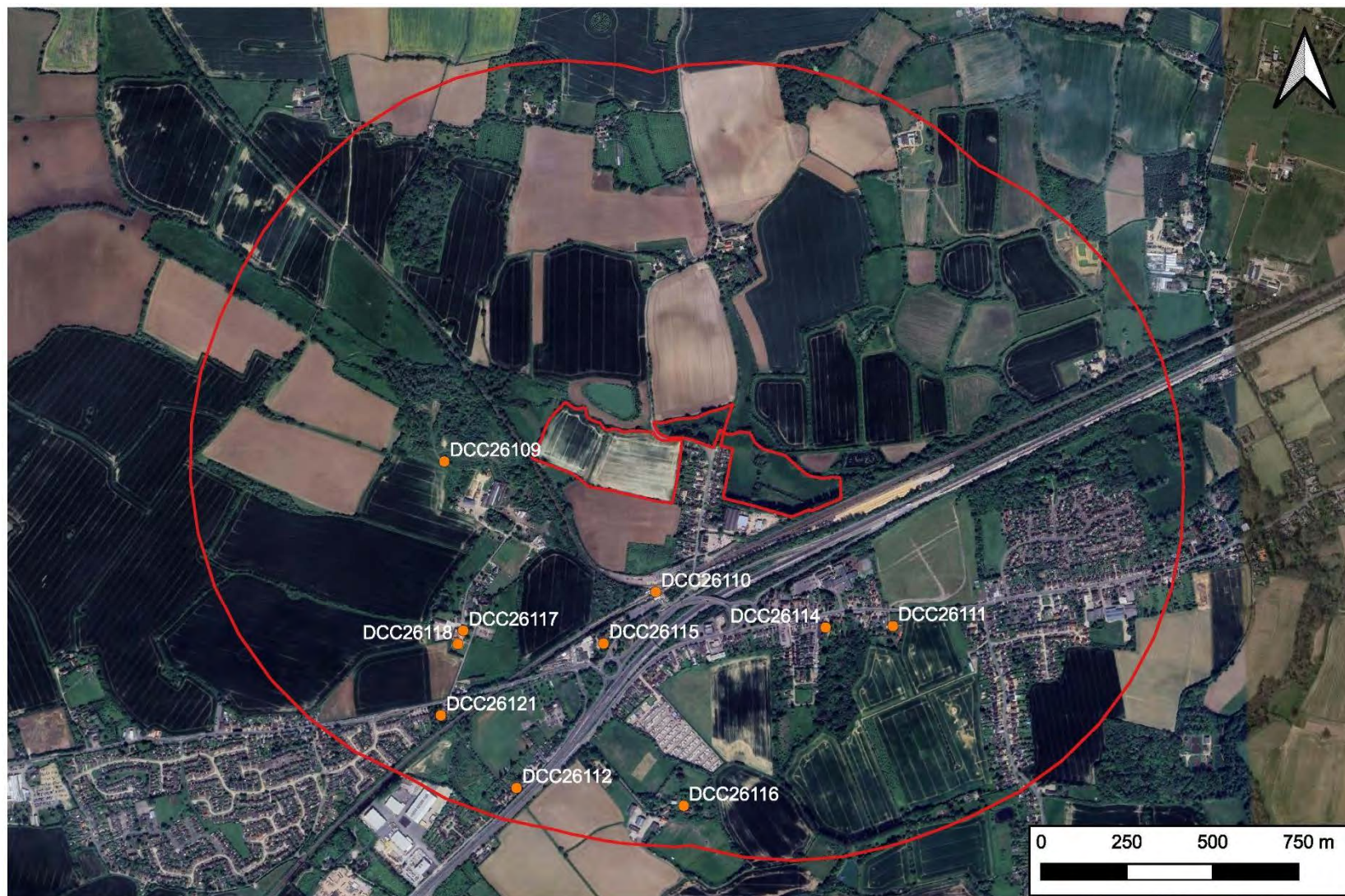


Figure 6 Local List records within 1km of the PDA. Background image © Google accessed via QGIS QuickMapServices

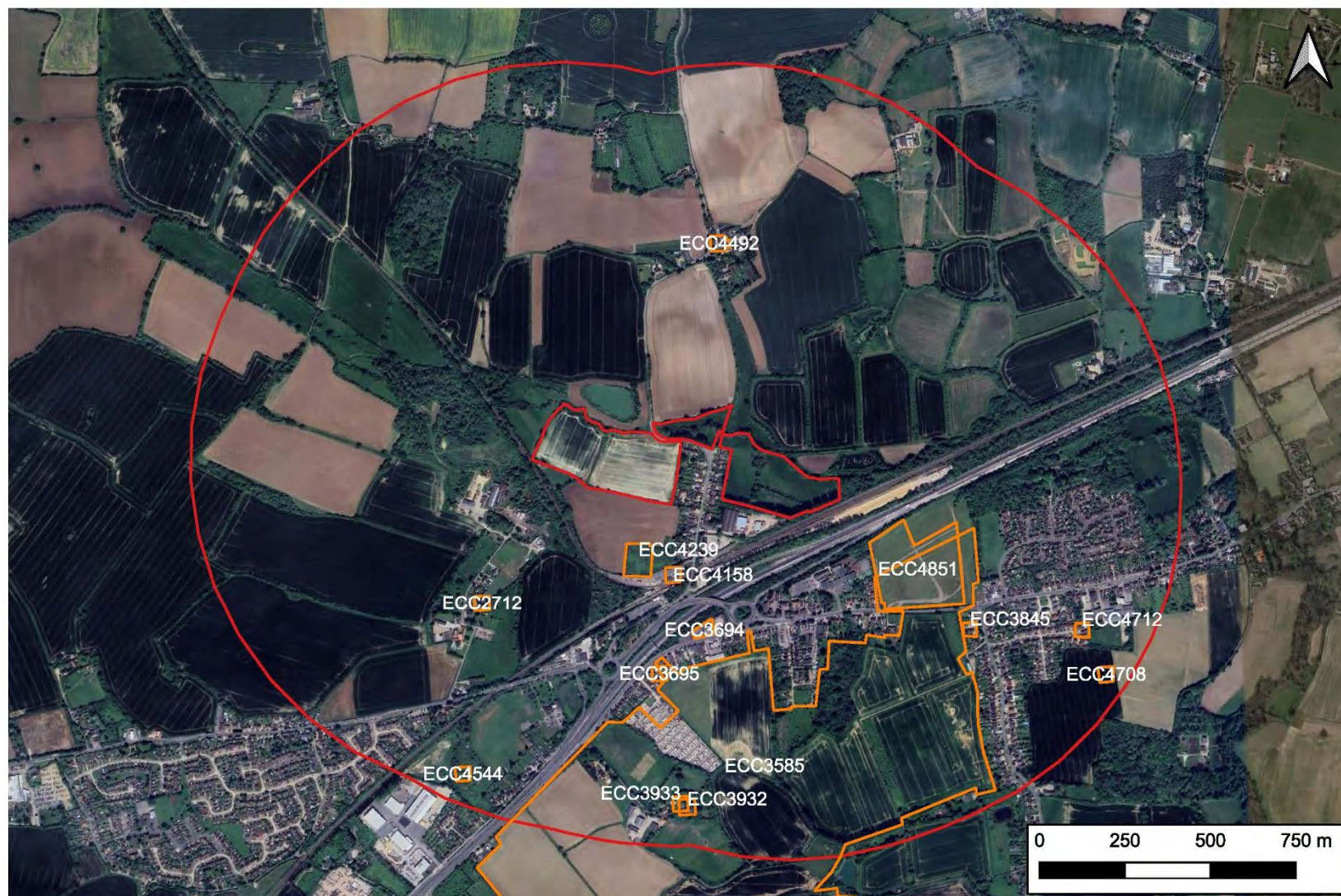


Figure 7 Event records within 1km of the PDA. Background image © Google accessed via QGIS QuickMapServices

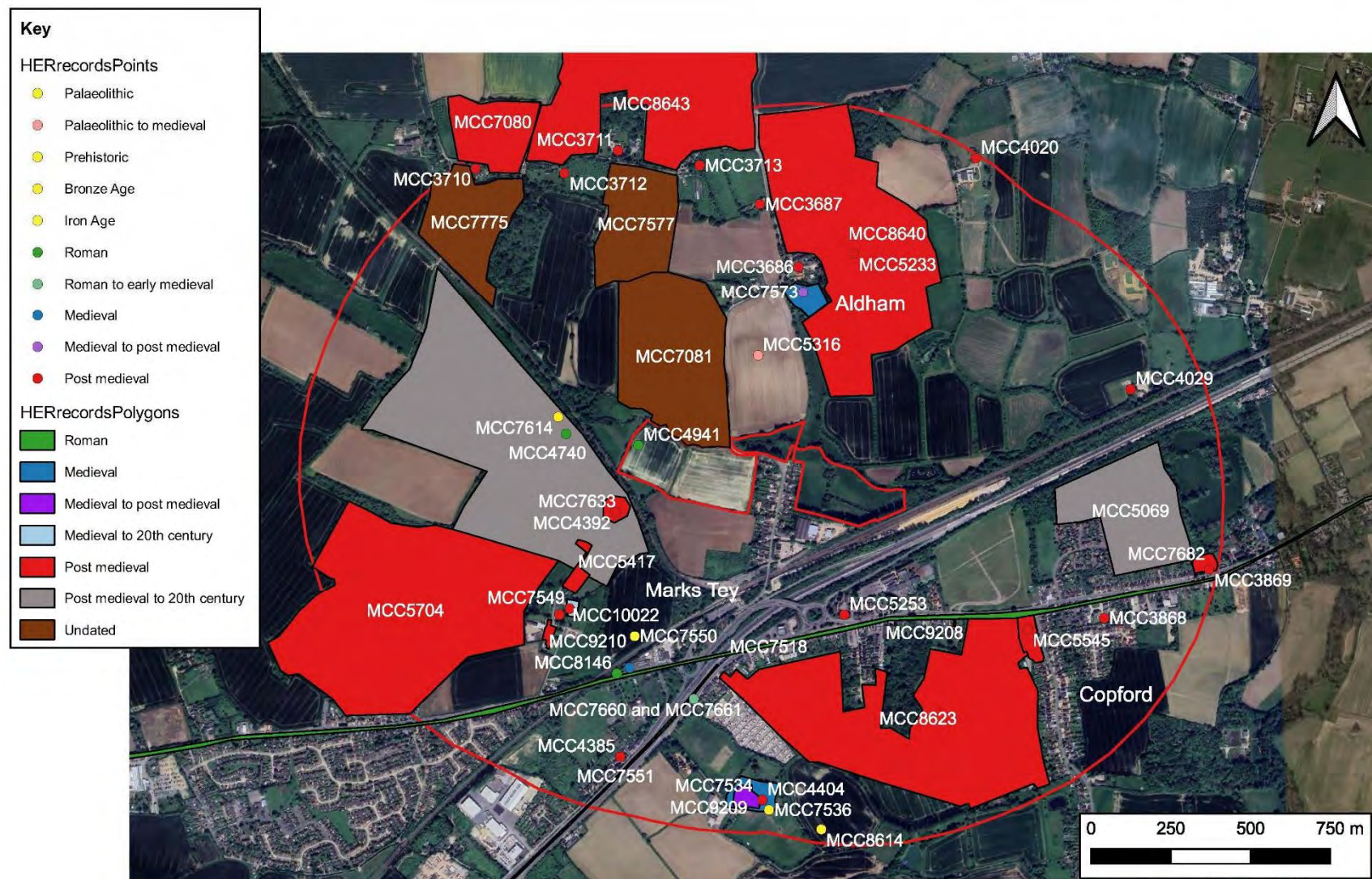


Figure 8 Monument records within 1km of the PDA. Background image © Google accessed via QGIS QuickMapServices

2.2.1 Colchester Local List

The 10 local list records cover one medieval site, post-medieval buildings and two 20th-century buildings. None is within the PDA. Five are also covered by monument records (MCC4740, MCC7534, MCC9208 and MCC9210).

Sections of a medieval moat survive as archaeological earthworks at Marks Tey Hall (DCC26116). They are located about 820m to the south of the PDA. Part of the moated enclosure is a Scheduled Monument (National Heritage List 1477794).

Three of the post-medieval buildings stand alongside London Road, Marks Tey. 180-188 London Road is a row of timber-framed buildings (DCC26112) approximately 900m to the southwest of the PDA. Wynscroft (DCC26111) was built as an open hall house in the late 15th or early 16th century, later extended and is situated c.400m to the southeast of the PDA. The Old Rectory (DCC26115) is about 440m south of the PDA and dates from the late 18th century to 20th century.

Church Farm, Marks Tey, is approximately 560m to the southwest of the PDA. Its two-storey brick stable block is early 19th-century (DCC26117). The brick farmhouse is late 19th-century (DCC26118).

West of the PDA, the entire extent of W.H. Collier brick and tile works, Marks Tey, is included on the local list (DCC26109). Within this site, two kilns and their associated brick working floor, flues and chimney bases are a Scheduled Monument (see section 2.1).

Marks Tey railway station (DCC26110) is c.260m to the south of the PDA. The original building opened in 1843.

A former Methodist church (DCC26114), constructed in 1902-3, stands around 340m to the south of the eastern part of the PDA. 25 Coggeshall Road, Marks Tey (DCC26121), is a 1930s red brick bungalow located just under 800m southwest of the PDA.

2.2.2 Archaeological Events

The fourteen event records relate to three desk-based assessments, two heritage impact assessments, two geophysical surveys, three trial trenching projects, two archaeological monitoring projects, and two historic building recording projects.

In 2023 a geophysical survey north of London Road, Marks Tey, revealed modern disturbance, anomalies of agricultural origin and variations in geological deposits (ECC4851). At its closest, the survey area came within about 150m of the PDA. The results of a geophysical survey at Allendale Drive, Copford, are awaited (ECC4708).

In 1999 trial trenching took place at Old London Road, Marks Tey, around 890m southwest of the PDA (ECC4544). A few archaeological features were excavated, three of which contained medieval or post-medieval pottery. No archaeological remains were found in trenches on a site about 350m south of the PDA (ECC3694) and the results of trenching a site c.780m to the southeast are not yet available (ECC4712).

The two historic building projects within the 1km radius recorded a post-medieval farmhouse at Mascott's Farm (ECC3845) and post-medieval farm buildings at Aldham Hall (ECC4492).

The results of archaeological monitoring at St Andrew's, Marks Tey, are described below (ECC2712). No archaeological remains were found during monitoring at 121 London Road, Marks Tey (ECC3695).

2.2.3 Monuments

One monument record is located within the PDA. During fieldwalking, Roman pottery, tile (including tessera) and a quern were found in the western field (MCC4941).

Prehistoric

Six of the monument records are assigned prehistoric dates, the earliest of which are two records for Palaeolithic handaxes. One was found within W.H. Collier brick and tile works in 1929 about 240m west of the PDA (MCC7614). The other was found on the line of the railway at Marks Tey (MCC7659).

Prehistoric flint artefacts have been found on Crapes Fruit Farm (MCC5316). A Bronze Age spearhead (MCC7536) may have been recovered from the garden of Marks Tey Hall in 1925. Burnt flints (MCC8614), possibly of prehistoric origin, have been found about 190m southeast of the Hall. Approximately 450m south of the PDA is the recorded findspot of an Iron Age coin hoard (MCC7550).

Roman

The routes of two Roman roads are located within 1km of the PDA. Stane Street connected Colchester and Coggeshall (NHER 7518) and, at its closest, was within about 300m of the PDA. The second road is recorded by the Ordnance Survey as aligned northeast to southeast, branching off Stane Street approximately 450m south of the PDA (MCC7551).

In addition to the site within the PDA, Roman objects have been gathered from three locations. The closest to the PDA is a coin found in 1928 at W.H. Collier brick and tile works (MCC7613), around 200m to the west. A second Roman coin and brooch came from close to Marks Tey railway station c.575m southwest of the PDA (MCC8146). North of the PDA, fieldwalking in the 1970s resulted in the discovery of Roman pottery (MCC5316).

Medieval

Glass beads of Anglo-Saxon (or possibly Roman) date are recorded as coming from the route of railway (MCC7660 and MCC7661). Their recorded findspot is c.600m south of the PDA.

The church of St Andrew's, Marks Tey, is 450m southwest of the PDA. It has a Norman nave, a 14th-century chancel, a rebuilt tower and a 17th-century porch (MCC7548 and MCC7549). Grade I listed, it is located within a churchyard (MCC10022). In 2006 archaeological monitoring during the lowering of the floor level recorded a wall beneath the present chancel arch, possibly from an earlier east end to the church or from an earlier narrow chancel arch. Four vaults were uncovered in the chancel, with a marble tomb slab, piece of marble and sections of window tracery found under floorboards (ECC2712).

Within the moat at Marks Tey Hall is a barn built around 1400 (MCC9209). It is a Grade II* listed building.

There is a possible medieval moat (MCC7572) at Aldham Hall, approximately 325m north of the PDA. This Grade II* listed Hall may be a 14th-century timber-framed house with 16th and 17th-century additions (MCC7573). North of the hall is a 17th-century wagon lodge (MCC3686; Grade II listed building).

Two monument records cover medieval objects. These are a coin found about 550m southwest of the PDA (MCC8147) and pottery discovered to the north (MCC5316). Medieval pottery was also found during trial trenching at Old London Road, Marks Tey, in 2017 (ECC4544).

Post- medieval

There are many post-medieval buildings within 1km of the PDA. They include farm buildings, houses and industrial structures. Many are listed buildings. Those included on the local list are described above.

Timber-framed Marks Tey Hall is mainly 16th-century (MCC7535 and MCC4404). As well as the barn of c.1400, as 17th-century barn stands close by (MCC4405).

At Eight Ash Green, Chippetts Farmhouse was built in the late 16th century. It is timber-framed and about 990m northeast of the PDA. Approximately 770m to the east is Kemps Farmhouse (MCC4029), which is slightly later in date and also timber-framed and in the parish of Eight Ash Green. The farmhouse at Mascott's Farm, Copford is mid to late 16th-century with possible earlier elements (MCC5545 and MCC9207; ECC3845). It is c.500m southeast of the PDA.

The parish of Aldham contains several post-medieval houses, all of which are located north of the PDA. Motts Cottage is late 15th or early 16th-century (MCC3712). Half a Loaf Cottage dates to the 16th century (MCC3710). There are late-17th century cottages (MCC3687), and a late 17th/18th-century house called Grapes (MCC3713). The Old Rectory was built in the mid-19th century.

Copford's post-medieval houses are southeast of the PDA. They include Old Mill House (early 18th-century; MCC3869), the early 19th-century Shrub House (MCC3870) and the early 19th-century Windmill Hotel (MCC3868). Close to the Old Mill House is part of a post-medieval windmill mound (MCC7682).

The Vicarage at Marks Tey is 19th-century with later additions (MCC4395). It stands c.500m southwest of the PDA. 280m south of the PDA is the site of a 19th-century boundary post (MCC5253).

Close to the southeast corner of W.H. Collier brick and tile works, are five workers cottages (MCC5417). The earliest appear to be a pair of late 1800s semi-detached houses. The other three date to the 1920s.

There was a second brickworks within the 1km radius, east of the PDA at Copford (MCC5069). It was operated by the Ambrose family between 1789 and the early 1900s. It later became a brass foundry.

Eight monument records cover cropmarks identified from aerial photographs. Five of these include boundaries visible on Ordnance Survey maps, which indicates they were in use during the post-medieval period (MCC5704, MCC8640, MCC8643, MCC8623 and MCC7080). The features recorded in the other records are undated (MCC7081, MCC7577 and MCC7775). Of these eight records, the closest is directly north of the PDA's western field. This record is of a trackway (MCC7081). The second closest covers former field and woodland boundaries and is within 110m of the central field (MCC8640).

Two monument records described the discovery of post-medieval objects: one north of the PDA (MCC5316) and one to the northeast (MCC5233). The latter record is of a silver finger ring. The former covers pottery found during fieldwalking. Post-medieval pottery was also found during trial trenching at Old London Road, Marks Tey, in 2017 (ECC4544).

20th-century

A war memorial stands in the churchyard of St Andrew's, Marks Tey (MCC10021).

2.3 PALAEOLITHIC AND GEOARCHAEOLOGY

Professor Martin Bates carried out desk-based and field-based evaluation. The locality is well-known for its Palaeoenvironmental and Palaeolithic archaeological potential.

The desk-based study concluded that two basins existed in the local area through much of the Hoxnian and that lake sequences accumulated within the PDA at that time. These two basins were linked by a fluvial system draining from the Marks Tey basin into the Copford Basin and that human activity in the vicinity of these lakes are attested to by the presence of handaxes and flakes. Professor Bates recommended that, even at this early stage in the planning process, some fieldwork would be beneficial to refine the edge of the lake and identify constraints and opportunities.

Fieldwork was undertaken between 20th and 22nd January 2025 and twenty two boreholes were drilled.

The objectives of the fieldwork were to ascertain whether the mapping by the British Geological Survey is accurate, to identify the nature of Pleistocene sediments in the area of proposed development, to begin to understand the likely contexts, distribution and depth of burial of any sediments that might contain Palaeolithic archaeological material, to understand the likely nature, distribution and depth of burial of any palaeoenvironmental and/or dating material and to identify appropriate strategies for dealing with the potential buried Palaeolithic archaeological resource in the future and its scientific significance.

The auger survey identified that sedimentary sequences associated with the lake are present within the PDA. Furthermore, these sequences have been shown to thin out against the rising till surface in places that matches the BGS mapping but in other places appears to contradict the nature of sequences predicted from the mapping. Sequences have been shown to contain visible biological material in places and the presence of charcoal in at least one borehole (BH 4) could indicate possible human presence within PDA or equally a product of a natural fire.

Professor Bates' reports are attached as Appendices.

2.4 HISTORICAL BACKGROUND

The readily available historic maps for the PDA and its environs were consulted.

The Tithe Map for the parish of Marks Tey, dated 1841 (**Figure 9**), shows regularly defined and enclosed fields within the western part of the PDA, a recent phenomenon created by the Enclosure Act. The Roman River has influenced the location of boundaries, presumably above the flooding limits. The western part of the PDA was under arable cultivation.

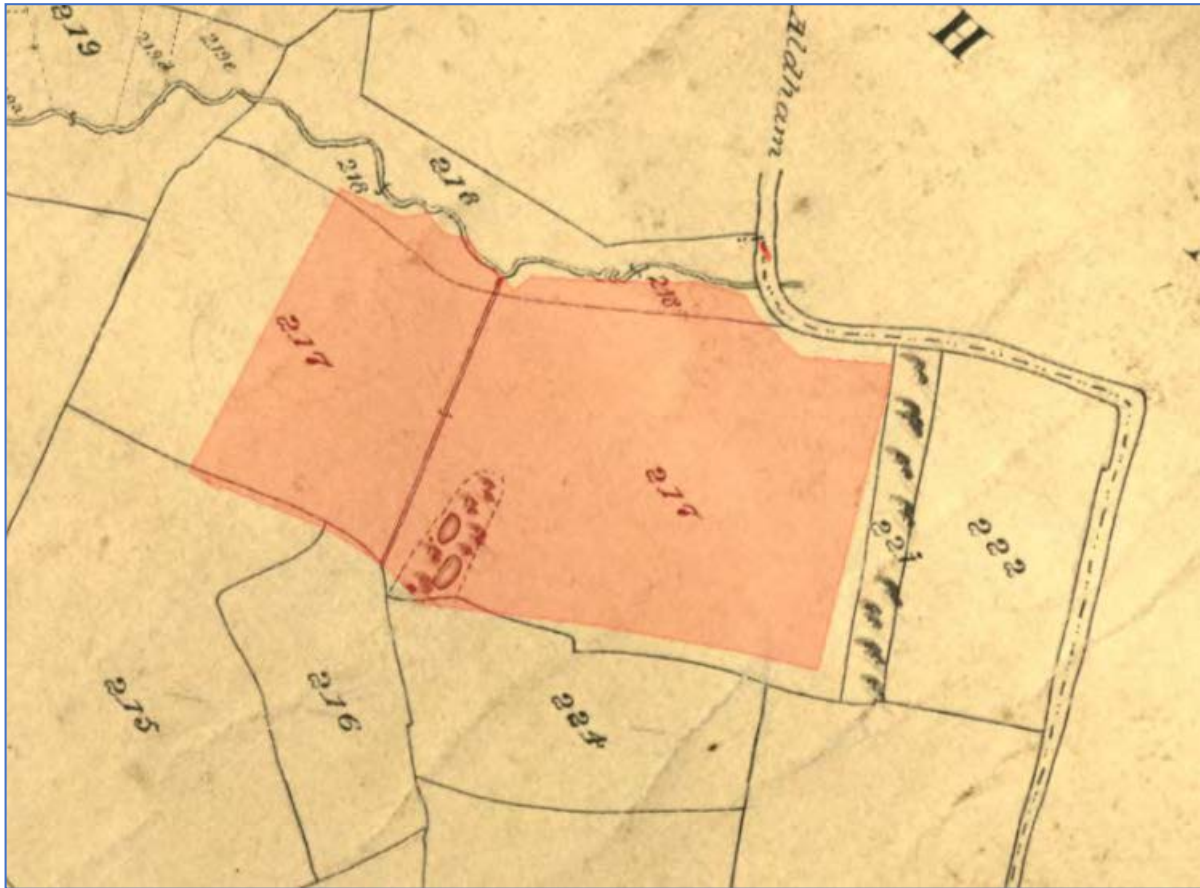


Figure 9 Extract from the Marks Tey Tithe Map, 1841

Western Thomas Burch	Lithgow George	217	Thursling Land	Arable
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Figure 10 Extract from the Marks Tey Tithe Apportionment, 1841

The eastern part lay in the parish of Aldham (**Figure 11**). Some of the land was owned by The Eastern Counties Railway Company.

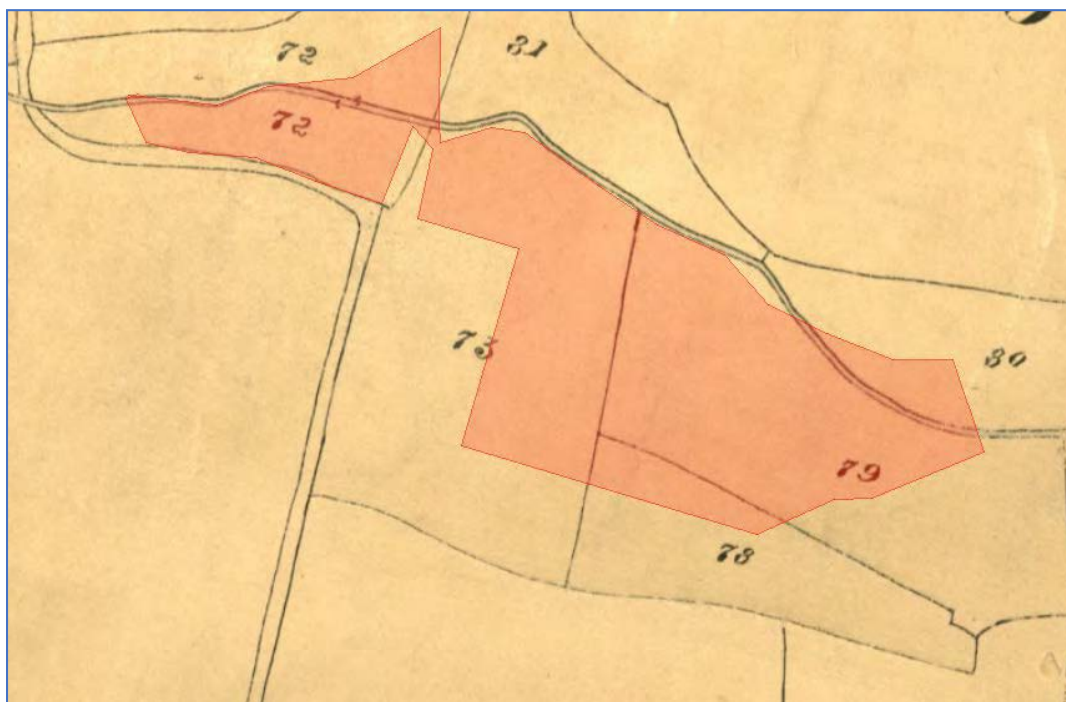


Figure 11 Extract from the Aldham Tithe Map, 1841

Landowners	Occupiers	Standard acreage of the plot	Name and Description of Lands and premises	State Cultivation
Round George Trustees viz Round George and Round Charles Gray	Ambrose John	74	Sand pit Field (part of)	Arable
		75	Peat Field (part of)	Arable
Eastern Counties Railway Company	Themselves	74 ^a	Sand pit Field (part of)	
		75 ^a	Peat Field (part of)	
Round George Trustees viz Round George and Round Charles Gray	Ambrose John	76	Part of Great Field	Arable
		77	Hart Moor (part of)	Arable
Eastern Counties Railway Company	Themselves	77 ^a	Hart Moor (part of)	
			<u>Widham Hall</u>	
		78 ^a	High Ground Meadow (part of)	
		79 ^a	Long Low Area Meadow (part of)	
Western Thomas Burch	Lithgow George	78	High Ground Meadow (part of)	3 . 1 . 34
		79	Long Low Area Meadow (part of)	5 . 2 . 34 and the residue of the lands comprised in the original total
			Totals in Original Apportionment	

Figure 12 Extract from the Aldham Tithe Apportionment, 1841

The Ordnance Survey first edition of 1897 (**Figure 13**) shows very little change to the PDA, but the local landscape has dramatically changed with the construction of the Great Eastern Railway to the south (in 1843) and the Marks Tey, Sudbury and Bury Branchline that was opened in 1849. To the west the Marks Tey Tile Works are shown.



Figure 13 Ordnance Survey, 25 inch, 1897 (red line approximate)

2.5 AERIAL PHOTOGRAPHY AND LIDAR

Aerial photographs from 1946 to the current day were examined: no archaeological features are evident. There are no specific photographs of the PDA recorded by Historic England or maintained in their archives. The site of the Roman finds recovered from field walking (ref MCC4941, section 2.3.3, above). does not show evidence of cropmarks (**Figure 14**), nor any earthworks on LiDAR.

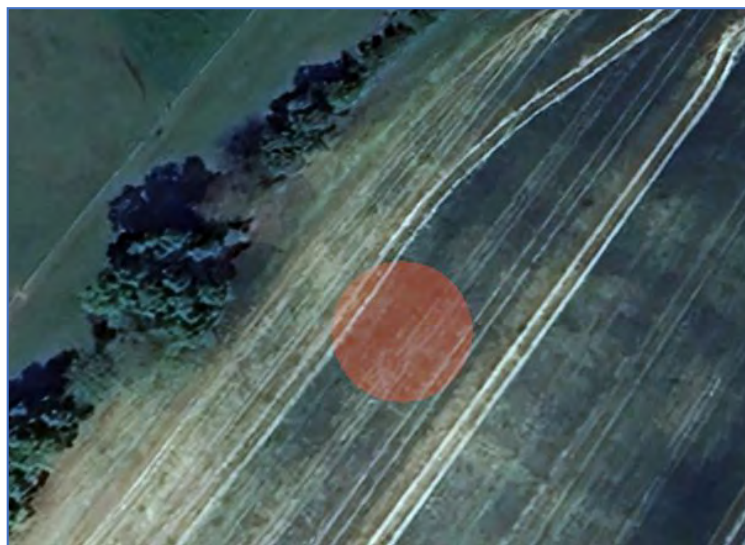


Figure 14 Aerial image (2024) showing location of Roman finds
Background image © Google

3. Opportunities and Constraints

3.1 ARCHAEOLOGY

The desk-based assessment has identified one archaeological site probably within the PDA – Roman pottery, tile (including tessera - that is a piece of stone or glass used in mosaics) and a quern were found in the western field before 1999. This suggests that a Roman building of high status is located close-by, although not necessarily within the PDA. The finds were located “*within Field 217 of the Marks Tey tithe map*” and whilst the western part of the PDA lies within that field, a further 3ha lies outside the PDA, to the east of the railway line and south of the Roman river.

The wider landscape is quite rich in archaeology, in particular of Roman date, including the routes of two Roman roads within 1km and Roman coins, with a brooch and pottery also found within 1km.

Based upon this, the overall potential for buried archaeology within the PDA is considered to be moderate. Intensive ploughing across the PDA will however have truncated that which is present, so preservation is likely to be of low-moderate quality.

Field-based evaluation would be required in advance of a planning application.

3.2 PALAEOLOGIC AND GEOARCHAEOLOGY

The potential of the PDA is considerable in terms of its ability to tell stories of both the climate history of the Hoxnian period as well as that of Palaeolithic peoples (who might have left their mark through the presence of stone artefacts, charcoal from burning vegetation and possibly butchered bone). The development offers the potential to document changing climate/vegetation and fire record history through the drilling of a number of boreholes at key points in PDA and the analysis of the contained biological material. The site also offers the potential to find and recover evidence for direct human activity at the site (perhaps in association with some of the fluvial/river sediments hinted at in the coring). These strands of evidence could be illustrated by interpretation boards along guided footpaths, pamphlets/website, short audiovisual reconstructions of the past and inform, perhaps, the nature of the vegetation and/or animals encouraged around the proposed ponds at the site. The identified key area of the PDA (**Figure 15**) could be preserved in situ within the PDA and lends itself to a circular, educational walk.

Such geowalks and activities based on Essex Geology are clearly signposted in the GeoEssex website (<http://www.geoessex.org.uk/>) demonstrating a vibrant community for consumption of these stories. The proposed development can feed into this narrative due to the rich archive of deposits within its boundaries.



Figure 15 Approximate edge of lake where highest potential exists for palaeolithic archaeology (shaded blue, arrowed) that could be preserved in situ and included within the development as a circular geoarchaeological walk (Bates 2025)

3.3 SETTING OF DESIGNATED ARCHAEOLOGICAL ASSETS

One scheduled monument (list entry 1020999) sits within 1km of the PDA. This comprises two circular kilns and their associated brick working floor, flues and chimney base located within W H Collier Brick and Tile Works. The western kiln is also a Listed Building Grade II.

The monument is situated 100m from the nearest boundary of the PDA. It sits to the west of the railway line within woodland. There would be no effect upon the setting of the monument from development within the PDA due to distance, the physical separation of the railway line and the fact that the monument's historical setting would be maintained within the brickyard. It is highly unlikely there would be visual linkage, even in winter, due to woodland.

4. Conclusion

On current evidence there are no over-riding constraints to the promotion of the PDA for development. There are significant opportunities to increase our knowledge of the Hoxnian period as well as that of Palaeolithic peoples – a research priority in English archaeology – whilst preserving the most sensitive locations on the edge of the former Marks Tey Lake in situ and provide educational opportunities within the proposed development.

Further field-based evaluation would be required in advance of a planning application.

Appendix A

Land west and east of North Lane Marks Tey

A geoarchaeological desk based assessment of the Palaeolithic archaeological potential of The Site

Martin R. Bates

December 2024

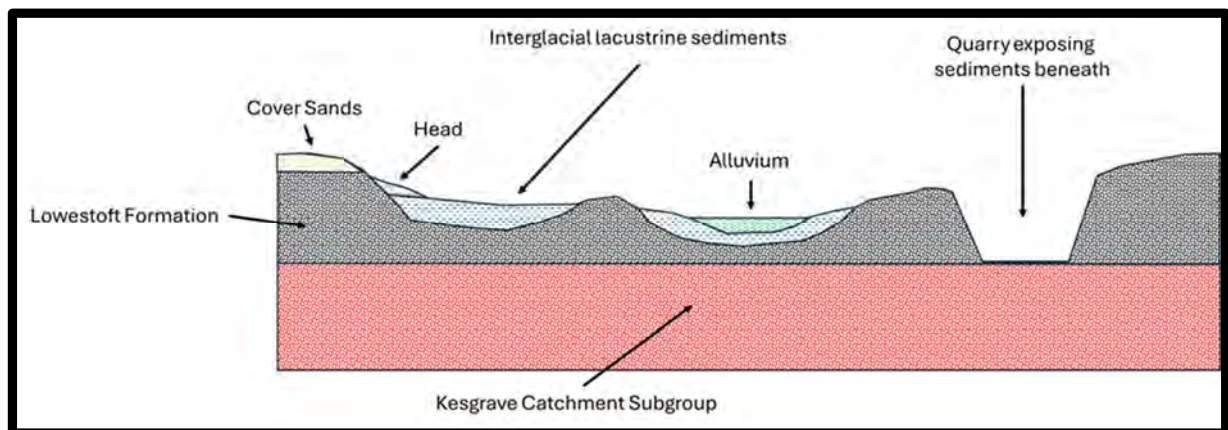


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Table 5. Marks Tey No. 3 borehole logs (simplified after Ellison and Lake, 1986), Copford Basin. Ground level 25.2m O.D.

EXECUTIVE SUMMARY

This report was commissioned by Bidwells and presents the findings of a geo-archaeological desk-based assessment of the Palaeolithic archaeological potential of land to the west and east of North Lane, Marks Tey in order to inform the promotion of that land for residential development. No field based observations have been undertaken in the preparation of this report however the author has worked extensively in the area between Chelmsford and Colchester including the Pleistocene and Palaeolithic investigation works associated with the A12 widening proposals and the quarries to the east of Witham (Colemans Quarry).

The objectives of the report were to i) understand the likely nature of Pleistocene sediments in the area of proposed development, ii) understand the likely nature, distribution and depth of burial of any Palaeolithic archaeological material, ,iii) understand the likely nature, distribution and depth of burial of any palaeoenvironmental and/or dating material and iv) identify appropriate strategies for dealing with the potential buried Palaeolithic archaeological resource in the future.

The report concludes that two basins existed in the area through much of the Hoxnian and that lake sequences must have accumulated in the area of The Site at times in the Hoxnian. These two basins were linked by a fluvial system draining from the Marks Tey basin into the Copford Basin and that human activity in the vicinity of these lakes are attested to by the presence of handaxes and flakes.

The following conclusions are drawn:

- Palaeolithic archaeological artefacts may be present in association with fluvial sediments in the areas connecting the two basins.**
- Palaeolithic archaeological material may be present at the margins of the lakes.**
- Proxy evidence of human activity such as charcoal in lake sediments and micro debitage may be present in the lake sediments.**
- The area of the proposed development would be regarded as one of high potential for the presence of Palaeolithic archaeological material.**

A phased approach to fieldwork is suggested if the proposed scheme is adopted. This would lead to a zoning of the site into areas of low, medium and high Palaeolithic archaeological potential. Areas of the site that require formal investigations would be highlighted where required.

1.0 Introduction

This report was commissioned by Bidwells and presents the findings of a geo-archaeological desk-based assessment of the Palaeolithic archaeological potential of land to the west and east of North Lane, Marks Tey in order to inform the promotion of that land for residential development. The Proposed Development Area (PDA) is formed of three parcels (Figure 1) and currently consists of agricultural land.

No field based observations have been undertaken in the preparation of this report however the author has worked extensively in the area between Chelmsford and Colchester including the Pleistocene and Palaeolithic investigation works associated with the A12 widening proposals (Headland Archaeology, 2022) and the quarries to the east of Witham (Colemans Quarry) (Bates, 2014, 2015, 2019, 2021, 2024).

2.0 Aims and objectives of the report

The aims of this report were identified to:

- Describe the regional and local geology and its associated palaeoenvironmental remains.
- Describe the Palaeolithic archaeological context of the identified geological units.

The objectives of the report were to:

- Understand the likely nature of Pleistocene sediments in the area of proposed development.
- Understand the likely nature, distribution and depth of burial of any Palaeolithic archaeological material.
- Understand the likely nature, distribution and depth of burial of any palaeoenvironmental and/or dating material.
- Identify appropriate strategies for dealing with the potential buried Palaeolithic archaeological resource in the future.

The discussion of the nature and significance of Palaeolithic archaeological remains is poorly understood in many planning environments however, Historic England (2023) have previously outlined both strategic research and conservation themes that include the following that are pertinent to the investigation of The Site:

- Understanding areas
- Understanding the record

- Dating frameworks
- Collections and records enhancement

Typically these themes refer to both areas in which Palaeolithic archaeological remains are identified to be present but also those areas where sequences containing palaeoenvironmental remains and/or dateable material have the potential to shed light on the nature, context and age of Palaeolithic archaeological remains for the region.

3.0 Regional geology

Today the drainage in the area of The Site is dominated by a NW to SE flowing Roman River that drops from c.37m O.D. west of The Site to less than 25m O.D. to the east (Figure 2). It lies on the northern boundary of the London Basin (Brenchley and Rawson, 2006). Bedrock geology in the area belongs to the London Clay Formation ([BGS Lexicon of Named Rock Units - Result Details](#), consulted 5/12/24). This rock consists of sandy clay that is typically blue grey in colour when fresh and grey brown when weathered. It often contains carbonate concretions (septarian nodules) as well as pyrite. Locally thin beds of shells may be present. The deposit is of Eocene Age.

Pleistocene sediments have been mapped by the British Geological Survey (BGS) and are shown in Figures 2 and 3¹. Six major groups of deposits have been mapped by the BGS (Table 1). Only deposits that typically have horizontal distributions greater than 100m are shown by the BGS mapping and the mapping only shows those deposits that are close to the ground surface, i.e.. below the topsoil. In some cases older deposits may lie beneath those deposits close to the ground surface. Thus, for example, Coversands are likely to blanket large areas of the Lowestoft Formation, while the Kesgrave Catchment Subgroup deposits are often only exposed beneath the Lowestoft Formation in quarries. A simplified model showing the relationships of these units to each other is shown in Figure 4.

Key to our understanding of the context of The Site are the sediments mapped as Interglacial lacustrine deposits (Figure 2 and 4). These occur in the vicinity of The Site, adjacent to the line of the A12 and further to the south around Witham (Ellison and Lake, 1986). These sediments have been ascribed to the Hoxnian interglacial, or MIS 11(c) (Figure 3). Key characteristics of these lacustrine sediments are shown in Figures 5-7 from the Colemans Quarry at Witham where lacustrine sediments (dark grey and pale white sediments) can be seen resting on sands and gravels belonging to the Anglian glaciation (MIS 12) at the quarry (Figure 5). In detail these lacustrine sediments consist of a basal grey unit (in places rich in terrestrial molluscs) overlain by white, calcareous sediments with a sparse freshwater snail fauna (Figure 6). In places these sediments are truncated by further fossiliferous sediments following probable drying and downcutting through the older sediments (Figure 7). This evidence attests to a

¹ Marine Isotope Stages (MIS) are used to form a common referencing system for correlating sites in the Pleistocene. These are shown in Figure 3 as peaks and troughs relating to warmer and cold episodes in the Pleistocene. In this figure MIS 12 refers to the Anglian Glaciation which was responsible for the deposition of the Lowestoft Formation while MIS 11 (a warm interglacial) is a period often referred to as the Hoxnian during which the lacustrine sediments (lake deposits) at Marks Tey, Hoxne and Colemans Quarry were deposited.

complex history of sedimentation in the lake. Sporadic finds including a large core have been made in these sediments (Figure 8).

4.0 The context of Palaeolithic archaeology in the landscape

Palaeolithic occupation of the British Isles currently spans the better part of 1 million years (Table 2). The nature and distribution of Palaeolithic archaeology in East Anglia has been summarised by a number of authors at a variety of scales. For example Ashton (2017), O'Connor (2015) and Wymer (1985, 1999) have examined the distribution of sites at the level of the county. By contrast workers such as Ashton and others have looked at specific sites, specific geological contexts associated with Palaeolithic archaeology or across specific time periods. For example Ashton and Lewis (2012) have examined the context of a number of sites in East Anglia while Ashton *et al.* (2006) have examined lacustrine (lake) contexts and Ashton has looked specifically at Marine Isotope Stage 11, or the Hoxnian period (Ashton, 2016). At a larger scale, and pertinent to the present study, projects such as the Ebbsfleet Elephant excavation, associated with HS 1, are significant due to the context of the discovery of the faunal and archaeological remains in marsh sediments subsequently buried by colluvium (Wenban-Smith, 2013).

Key to the study of The Site is the period of the Hoxnian interglacial, or MIS 11. Considerable investigation has gone into the study of this period from sites such as Barham, Hoxne, Hitchin (Ashton *et al.*, 1998, 2005, 2006) among others. Wymer (1999) argued hominins in this period were routinely using lacustrine environments however, more recently Ashton *et al.* (2006) suggested this is not the case and the relationship between hominins and lakes is more nuanced. Recent excavations at Southfleet Road in Ebbsfleet (Wenban-Smith, 2013) demonstrated that the remains of a straight tusked elephant were associated with stone tools at the edge of a marsh that was subsequently buried by slope was (colluvial) sediments.

Although the association between lacustrine sediments and Palaeolithic archaeology, at sites such as Marks Tey remains equivocal, a number of factors need to be addressed when considered when determining whether or not archaeology has been found in such places or indeed where archaeology might be found in such places. These are:

- How big an exposure is being examined?
- When was the investigation undertaken (was investigation by hand or mechanical excavator)?
- Were local collectors active in the region?
- What sort of sediments were exposed? Were lake edge sequences examined? Was there evidence of drying in the lake indicating shifts in margin of the lake through time?

In the absence of direct evidence of human activity (i.e. the presence of stone tools) Ashton *et al.* (2006) suggest other lines of evidence may be used to establish a human presence.

These include the presence of cut marked bone, lithic micro-debitage and charcoal from hearths. Despite these issues it should be noted that in Essex O'Connor (p. 70, 2015) has noted that

“The palaeoenvironmental potential of LU 8 deposits (*lake sediments*) is high as lakes are comparatively quiet environments with limited chance of reworking or other disturbance of fossil material. The lake margins are particularly significant.”

Furthermore O'Connor goes on to say (p. 71, 2015)

“Thus the focus of Palaeolithic potential is in zones near, and beyond, the edge of mapped outcrops, where shallow marginal deposits with Palaeolithic evidence are more likely to be present.”

5.0 Local geology and geomorphology

Brown first drew attention to the presence of fossiliferous deposits in the area in the early to mid-19th century when he reported on finding shells in association with marl and blue clay (1834/1836) in the Copford Brickworks (E1, Figure 9). Further work in 1843 describes in more detail the sequence of deposits and provides extensive lists of land and freshwater molluscs recovered along with the bones of elephants and, deer and ox (Brown, 1843). The most extensive record of sequences in the area was provided by Brown in 1852 where in addition to the detailed listing of species found in the varying deposits he illustrates a general section (Figure 10) that show how the deposits dip in a generally northwards direction towards the centre of the lake. Brown was the first author to draw attention to the main characteristic of these lake deposits consisting of blue clays and shell marls (Figure 10). A full listing of all species from the Copford brick pit is not easily put together however alongside the molluscan faunas, ostracods and vertebrates (elephant (*Elephas*), bison (*Bos*), red deer (*Cervus*), bear (*Ursus*) and giant beaver (*Trogontherium*)) are listed. The well preserved Hoxnian pollen record from the lake sediments was described by Turner (1973). Dating of these sediments has not been undertaken but it is known that *Trogontherium* became extinct during the Middle Pleistocene. The presence of this species, in association with a post-Anglian context, is sufficient to demonstrate an age within MIS 11 (Schreve, 2001) for the Copford sequences.

The most extensive works in the area have been undertaken at the Marks Tey brick pit by Turner (1966, 1970; Figure 11) who undertook geological investigation of the lake sediments as well as a major investigation of the pollen in the sediments. Pollen zonation by Turner (1966, 1970) indicates that much of the time period between the end of the Anglian glaciation (MIS 12) and the start of the subsequent cold period (MIS 10, called the Wolstonian by Turner but shown as “Saalian” in Table 2) including the Hoxnian is recorded in the Marks Tey sequences. More recent work by Candy *et al.* (2014, 2021) has expanded on this work. Turner (1966) showed clearly two distinct basins were present in the area, one at Marks Tey and a second in the Copford area (Figure 12).

Although the geometry of the two basins are imprecisely known (Ellison and Lake, 1986) their basic outline can be determined (Figure 12) and profiles through the basins have been

constructed (Figures 13 and 14). Key boreholes in the two lakes are presented in Tables 3-5. This evidence shows clearly that the Marks Tey basin is deeper than the Copford Basin (Figure 14). By contrast the Copford Basin appears significantly larger than the Marks Tey basin (Figure 12).

Structurally the sequences within the basins are complex (Figure 14) and summarised profiles through these sequences are provided in Tables 3-5. While correlation is difficult between the basins certain sediments, such as the fissile or brecciated sediments, are present in both lakes (and indeed within the sequences from Colemans Quarry to the south (Figure 6) and some boreholes in the A12 works (Headland Archaeology, 2022) suggesting that a regional signal is preserved within the sequences.

No marginal lacustrine sediments are preserved in either basin according to Ellison and Lake, (1986) although they postulate such sequences once existed. Sequences in the Colemans Quarry do appear to represent edge marginal environments where the lake deposits wedge out against the rising sands and gravels of Late Anglian age (Figure 15). However, it is still uncertain if such sequences mark the true edge of lake or simply the extent of sedimentation within the former lake.

For much of the Hoxnian Turner (1970) suggests that the Marks Tey basin drained into the Copford Basin. However, in the middle part of the Hoxnian water levels dropped in both lakes leading to dewatering and desiccation of parts of the sequence. It is interesting to note that in the Colemans Quarry sequences as well as those investigated for the widening of the A12 (Headland) show fluctuating lake levels in the Hoxnian. This has significant implications for the areas in which Palaeolithic archaeology may occur (see below).

Drawing these strands of information together we can postulate the following:

- Two basins existed in the area through much of the Hoxnian with the central parts of these basins to the east and west of The Site.
- Lake sequences must have accumulated in the area of The Site at times in the Hoxnian.
- The basins were linked by a fluvial system draining from the Marks Tey basin into the Copford Basin that must have passed through The Site area at times.
- Lake levels fluctuated in the Hoxnian and consequently the margins of the lakes will have moved with shrinking lakes and extending fluvial systems during times of low lake level. Lake margins will have moved through the area of The Site at times during the interglacial.
- Evidence of the changing environments is recorded in the lake sequences in the form of pollen, plant macrofossils, ostracods, molluscs and vertebrates.
- Human activity in the vicinity of these lakes are attested to by the presence of handaxes (F3/F4, Figure 2) and flakes (F10/F11, Figure 10) in or close to the lake deposits.

6.0 Likely locations of archaeological material in the study area

On the basis of the mapped geology and the reconstruction of the sequences within the lakes we can consider where, and under what circumstances, Palaeolithic archaeology may be present within The Site area. Firstly however, a number of considerations need to be made:

- What do lake marginal sediments look like? Do they look like those seen at Colemans Quarry (Figure 15) or not?
- Where is the edge of the lake and is it represented by sediments or simply an eroded ledge into the underlying Lowestoft Formation?
- What lines of evidence are we using to look for indications of human activity (flint artefacts only or cut-marked bone, micro debitage and charcoal)?

The mapped boundary according to Turner (1970) of the lake sequences for the Marks Tey basin are shown in Figure 15 along with the thickness of the sediments infilling the Marks Tey Basin. The northern boundary of this reconstruction is shown to impact on The Site in places. Turner's southern boundary is shown to the south of The Site. However, it should be noted that Turner was not attempting to delineate the edge of the lake for further investigation and his reconstructions are based on a very limited data set. In contrast, the BGS mapping of the edge of lake deposits (Figures 2 and 9) shows only the southern boundary of the mapped sediments as within, or close to, the proposed development. The northern boundary of the mapped sediments lies at least 200m to the north of the proposed development. However, the mapping of sedimentary units by the BGS has been shown to be accurate to only about 100m and consequently the discrepancies in the mapping between the BGS and Turner suggest that the margins of the body of lake sediments is equivocal. As a consequence it is probably safe to assume that lake marginal sediments are present within the footprint of The Site. Furthermore, these boundaries also fall in the area of the presumed fluvial link between the two basins which is, according to Ashton *et al.* (2006), the area most likely to contain Palaeolithic archaeology close to a lake basin.

The following conclusions might be drawn:

- The boundary of mapped lake sediments may only be a partial proxy of the extent of the lake in the past. At times the lake boundaries may have extended beyond that of the mapped lake sediments (Figure 2). At other times, during the shrinkage of the lake, the boundary of the extant lake may be within the mapped boundary of the lake deposits.
- Palaeolithic archaeological material may be present at the margins of the lakes associated with marshland subsequently buried by colluvium. These might produce primary context material associated with faunal remains. This boundary would have fluctuated during the lifespan of the lake and would have migrated through time.

- Palaeolithic archaeological artefacts may be present in association with fluvial sediments in the areas connecting the two basins. These might be reworked in places and elsewhere be in primary context depending on the nature of the sequences.
- Proxy evidence of human activity such as charcoal in lake sediments and micro debitage may be present in the lake sediments, sometimes at considerable distances from the edge of the lake from where the material is derived.
- Evidence of human activity may be in the form of cut marked bone in primary or secondary context in both fluvial and lacustrine environments.
- Archaeological material is likely to be in the form of handaxe material (Acheulian) (as supported by the small, but significant number of finds from the area (Figure 2) or as a series of flakes and cores (Clactonian) such as the material from the Southfleet Road site (Wenban-Smith, 2013).
- The area of the proposed development would be regarded as one of high potential for the presence of Palaeolithic archaeological material. It is also considered a highly significant one for our understanding the ways in which hominids used landscapes during the Hoxnian interglacial.

7.0 Future work

Presently little or no data exists on the nature of the sediments in the vicinity of The Site (with the exception of Marks Tey Borehole No.2 (Table 4). Direct evidence of sediments and sequences within The Site will be required in order to implement any future investigations. The following strategy is therefore recommended:

1. Initial hand auger investigation of The Site in order to gain a first order understanding of the nature of the sediments and their likely environments of deposition (already agreed). The impact of arable agriculture will also be assessed. (Figure 17).
2. Monitoring any trial trenching and ground investigation works. Close cooperation between the archaeological team and any geotechnical investigations will be needed to make maximum use of this survey. It is advisable that when drawing up ground investigation specifications the archaeological team is consulted on borehole/test pit locations to ensure maximum use of resources is made.
3. On the basis of 1 and 2 a phase of purposive field work is instigated to refine a site wide geological model. This would include geophysics capable of mapping the edge of lacustrine sediments alongside purposive test pitting to refine the geological models of the area. This phase would also include some assessment of samples to improve our understanding of the nature of the sequences and their ages. This would

lead to a preliminary zoning of the site into areas of low, medium and high Palaeolithic archaeological potential.

4. Focused test pitting to test areas of The Site for the presence of flint artefacts, bones etc. This would lead to a refined zoning of the site into areas of low, medium and high Palaeolithic archaeological potential. The outcome of this might be the removal of some areas of The Site from development, for example preserved under areas of Public Open Space, where archaeological potential is high. Alternatively it may lead to the excavation of areas in which the development of The Site cannot be adjusted to leave undisturbed important sequences but where early excavation leads to minimal disruption to site development.

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Top depth below ground surface (m)	Basal depth below ground surface (m)	Unit	Description	Interpretation
0.00	2.00	-	Orange brown and grey mottled silt with sand and gravel at the base.	Head
2.00	5.14	Bed 5	Dark grey to greenish grey clay-silt. Soft and unconsolidated with chalk pellets.	Lacustrine
5.14	12.9	Bed 4	Grey to greenish grey and olive grey silt and clay silt. Often finely brecciated and with scattered shells and organic material. Organic material becomes common towards the base.	Lacustrine
12.9	14.00	Bed 3b	Brown organic silts. Fissile (?Peat)	Lacustrine
14.00	20.00	Bed 3a	Clay and silt clay exhibiting microbrecciation, interbedded with organic silt and finely laminated silt.	Lacustrine
20.00	25.00	Bed 2	Brown silt. Hard, compact and fissile.	Lacustrine
25.00	36.40	Bed 1	Dark grey to greenish grey finely laminated clay and silt.	Lacustrine
			---borehole not bottomed--	

Table 3. Marks Tey No. 1 borehole logs (simplified after Ellison and Lake, 1986), Marks Tey basin. Ground level 32.1m O.D.

Top depth below ground surface (m)	Basal depth below ground surface (m)	Unit	Description	Interpretation
0.00	0.50		Slightly clayey gravel with angular to subrounded clasts. Coarse sand matrix.	Head
0.50	1.50		Clay with sand and gravel. Occasional carbonate nodules.	Lowestoft Formation
1.50	19.70		Olive grey clay with pebbles and chalk clasts.	Lowestoft Formation
19.70	24.00		Olive to brownish olive clay with clay silt laminations.	Lowestoft Formation
24.00			Coarse sandy gravel	Lacustrine
			---borehole not bottomed 30.00m--	

Table 4. Marks Tey No. 2 borehole logs (simplified after Ellison and Lake, 1986), Marks Tey basin. Ground level 28.8m O.D.

Top depth below ground surface (m)	Basal depth below ground surface (m)	Unit	Description	Interpretation
0.00	2.00	-	Sand, silt and gravel.	Head
2.00	3.23		Dark grey laminated calcareous silt.	Lacustrine
3.23	3.60	?Bed 3	Black fissile organic silt.	Lacustrine
3.60	4.20		Missing	
4.20	12.50		Grey to greenish grey silt clay. Laminated with shells and some chalk pellets.	Lacustrine
12.50	c.14.00		No recovery	
c.14.00			Silty sand with chalk fragments.	Glacial outwash
			---borehole not bottomed--	

Table 5. Marks Tey No. 3 borehole logs (simplified after Ellison and Lake, 1986), Copford Basin. Ground level 25.2m O.D.

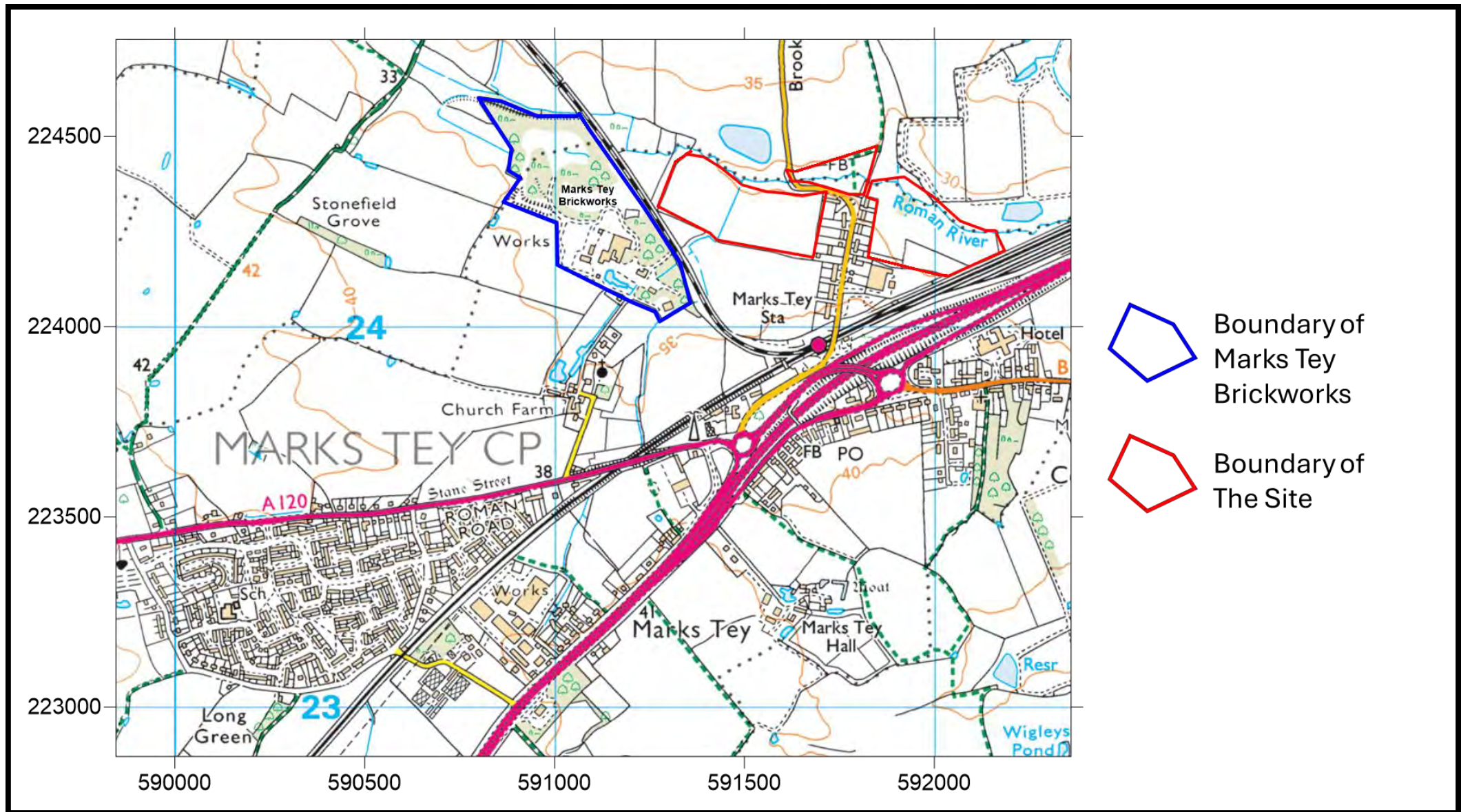


Figure 1. Site location plan of The Site and the nearby Marks Tey Brickworks.

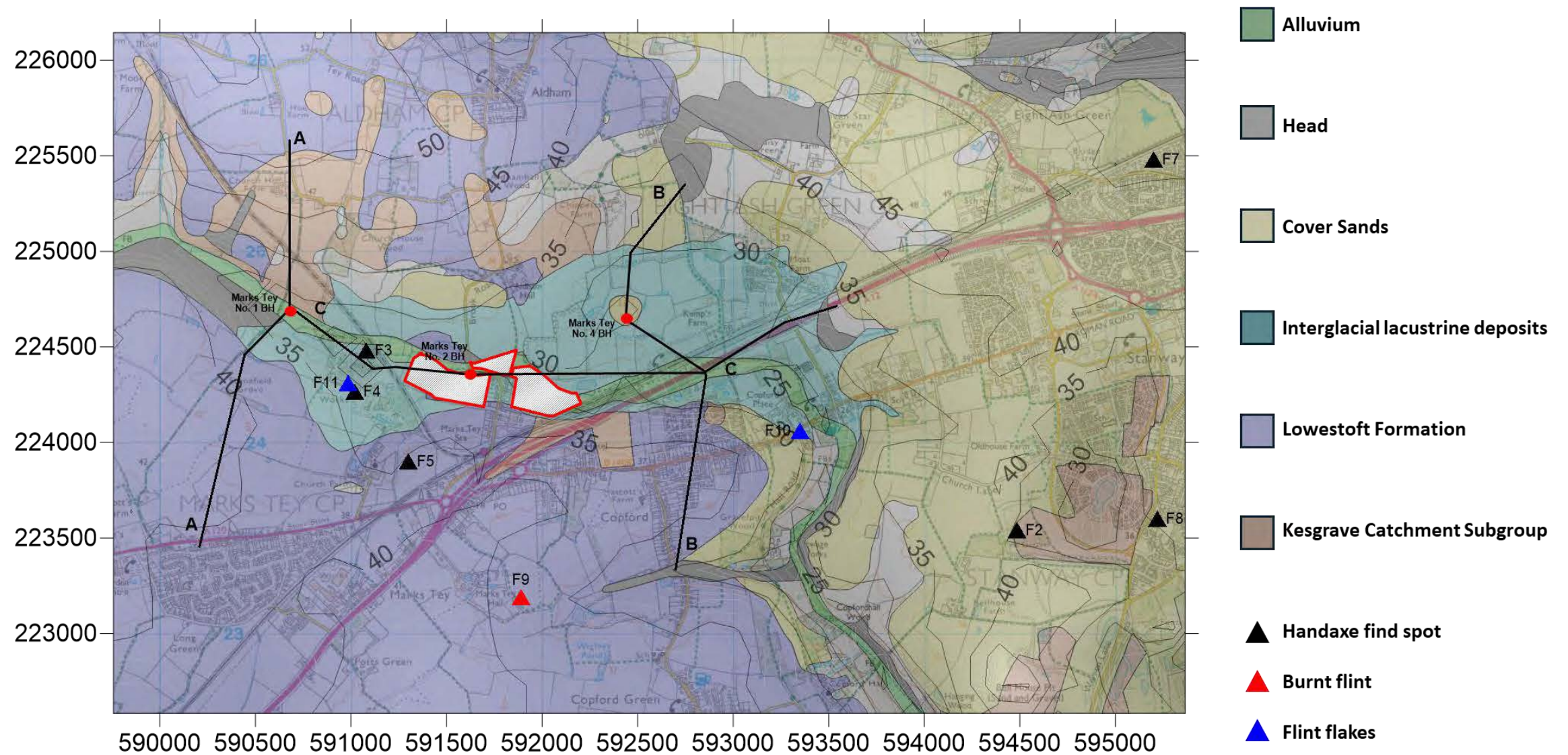


Figure 2. Site location plan of The Site (red line boundary), mapped superficial geology, transects (after Ellison and Lake, 1986) and Palaeolithic archaeological find spots.

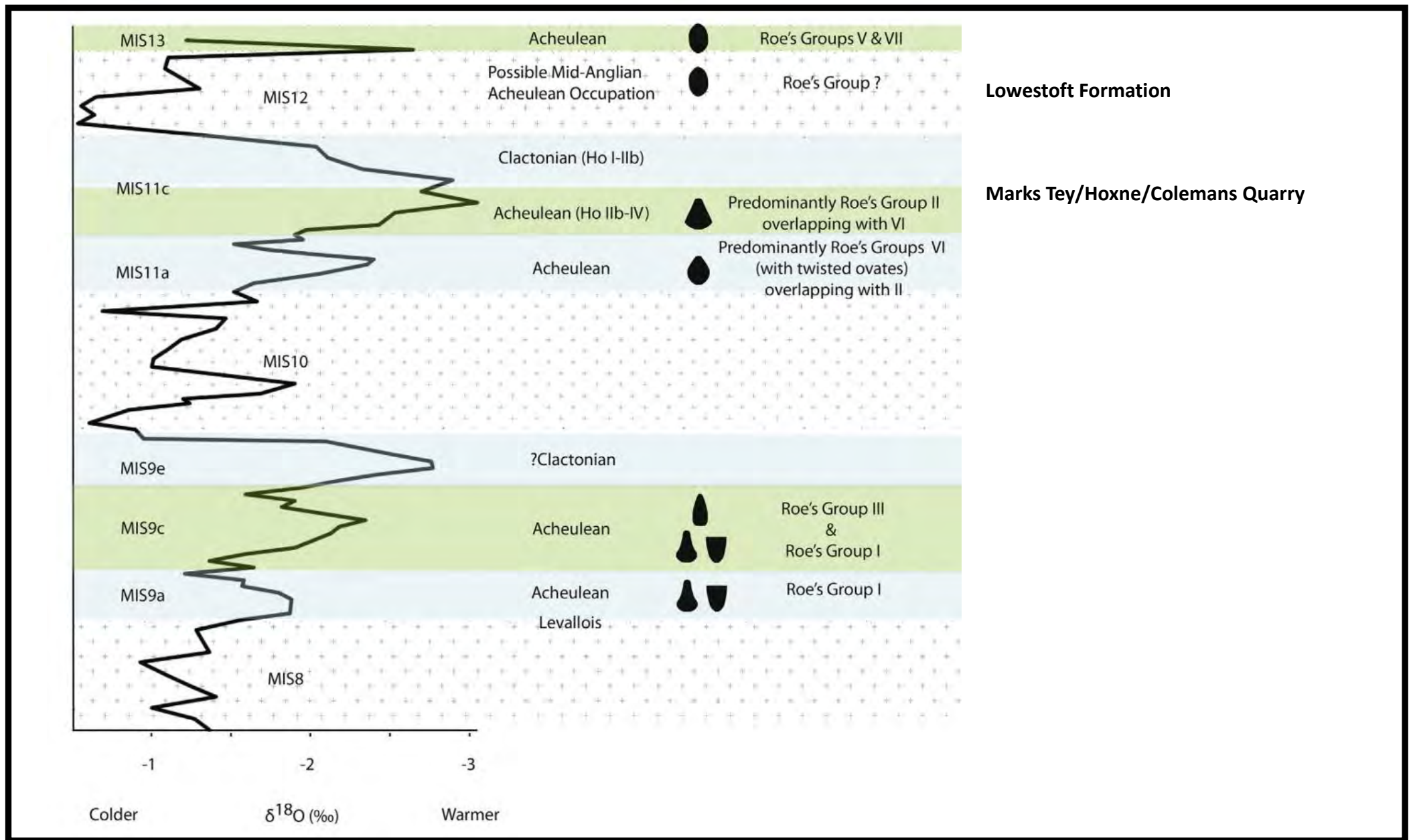


Figure 3. Marine Isotope Stages (left hand side) and key Palaeolithic trends set against the position of the Marks Tey site (based on White *et al.*, 2018).

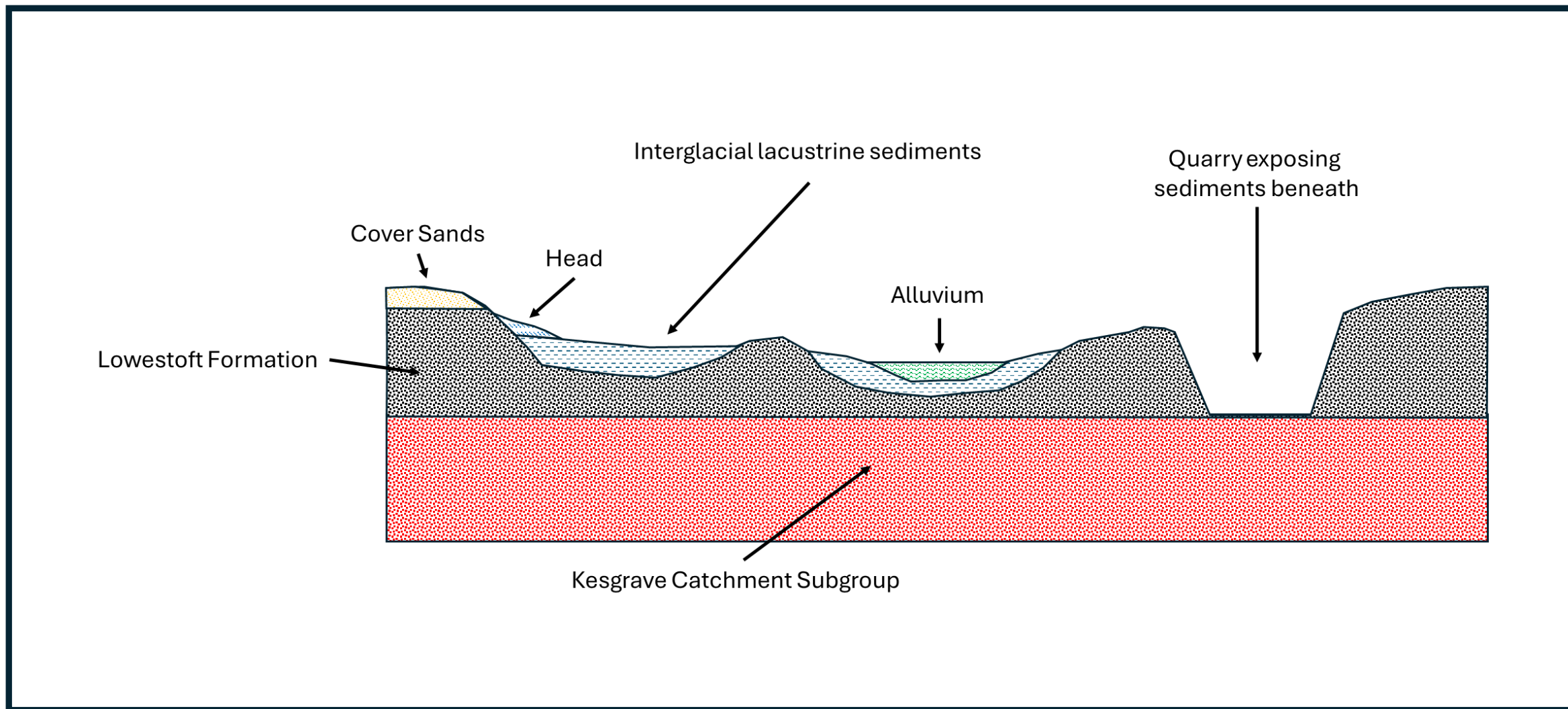


Figure 4. Simplified model showing key mapped units (BGS, Table 1) and their stratigraphic relationships in the study area.



Figure 5. Full sequence of deposits Colemans Quarry, Witham.



Figure 6. Full sequence showing complexity in calcareous deposits Coleman's Quarry, Witham.



Figure 7. Lake sediments cut out by redeposited lake sequences and sands in working face at Coleman's Quarry.

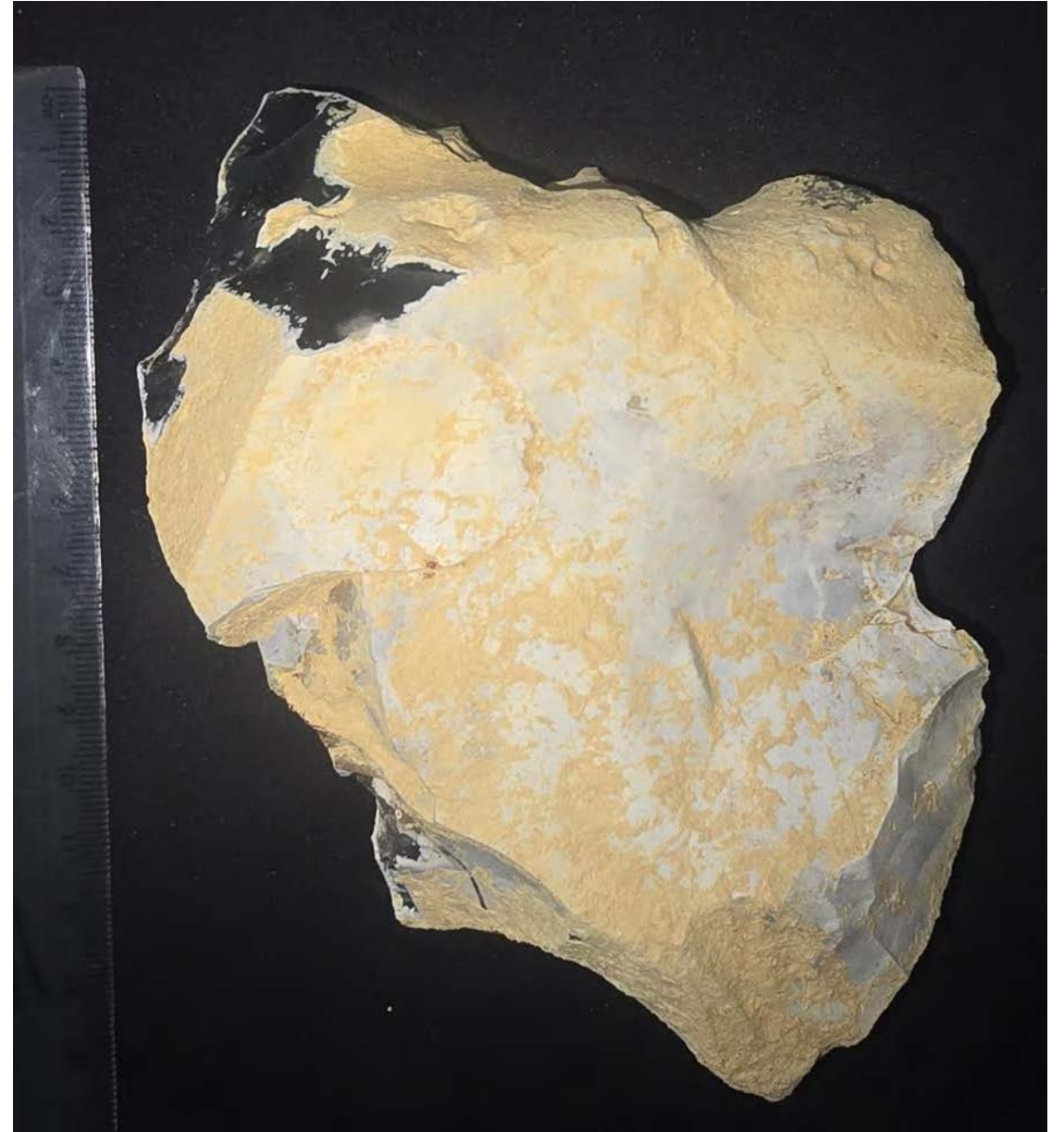


Figure 8. Large core like nodule from calcareous sediments at Colemans Quarry.

Fig. 1.—*Diagram showing the relations of the Freshwater Beds of the Copford Brickfield.*

N. "Eastern Section."

"Southern Section."

S.



1. Brown clay with pebbles, &c.

1'. Brown sandy loam.

2. Shell-marl and ferruginous sands (furrowed surface). Bones and shells.

2'. The same, passing into clay, rich with shells.

3. Vegetable bed.

Shells.

4. Blue clay (brick-earth) } (not laminated).

4'. Yellow clay, with "race," }

Bones and shells.

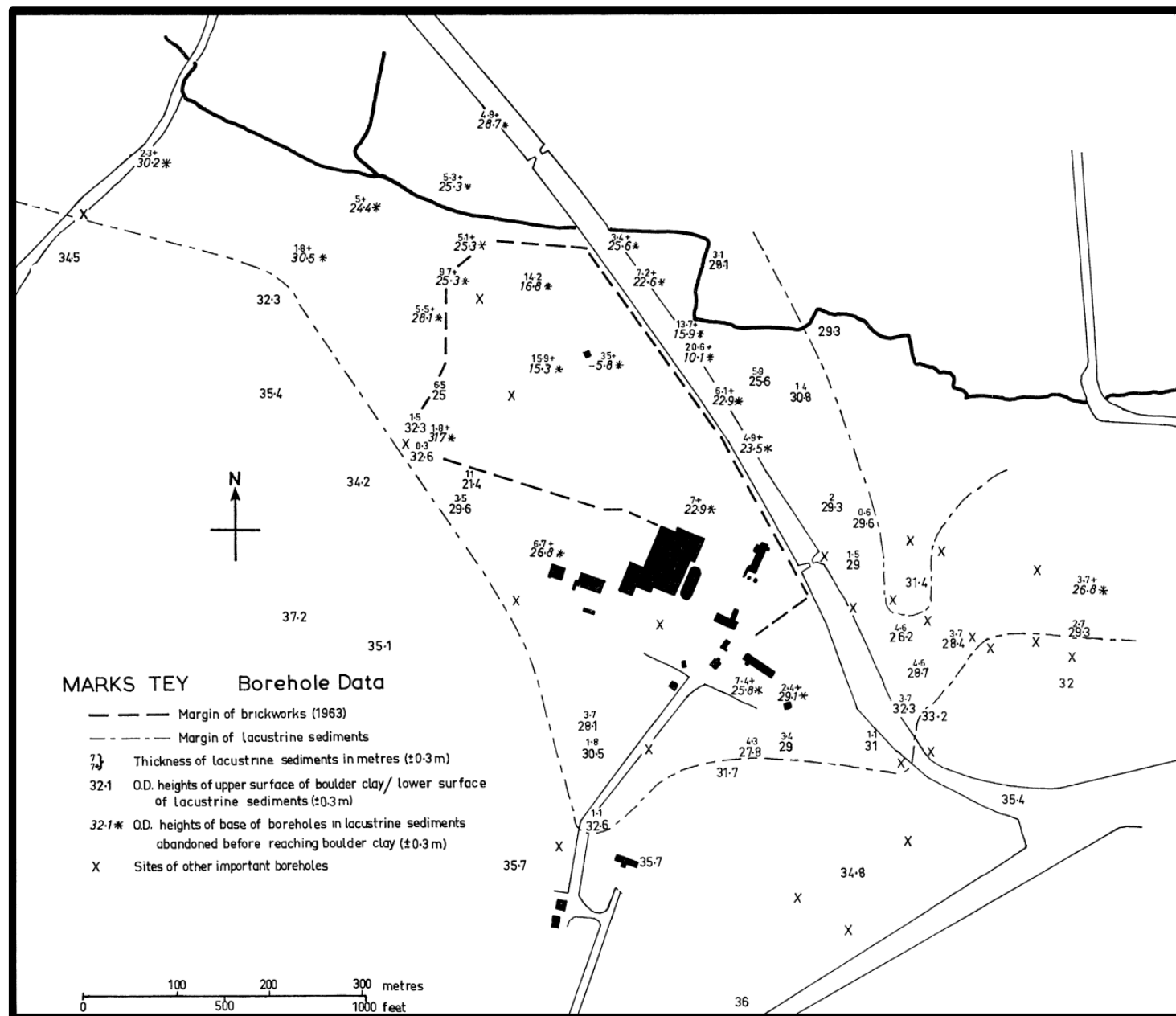
4''. Yellow and blue clays, laminated.

5. Grey sandy gravel.

Shells and drifted fossils.

5'. Sandy gravel.

Figure 10. Cross section drawn by Brown at Copford Brickfield (Brown, 1852).



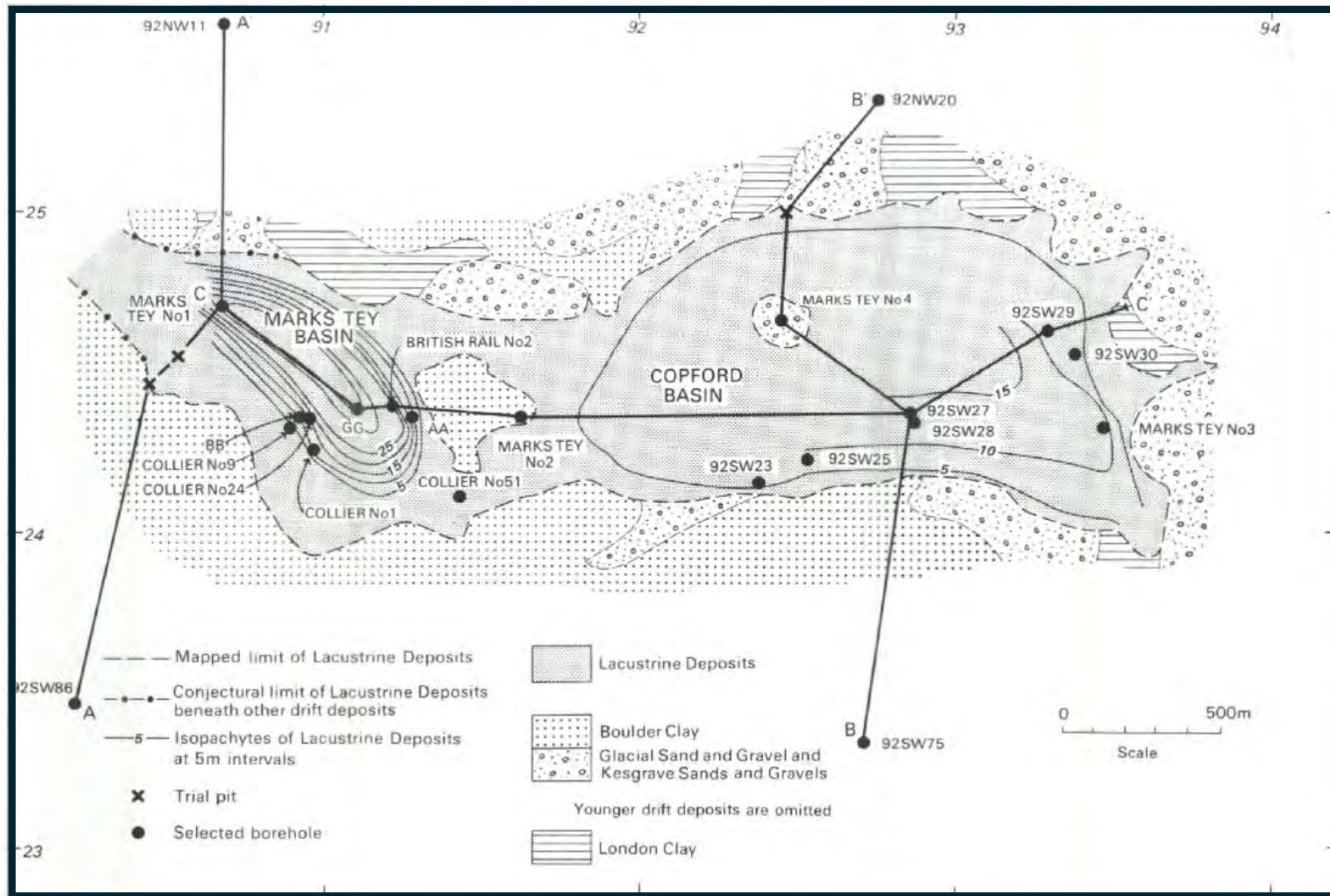


Figure 12. Reconstruction of the Hoxnian lakes at Marks Tey and Copford (from Ellison and Lake, 1986).

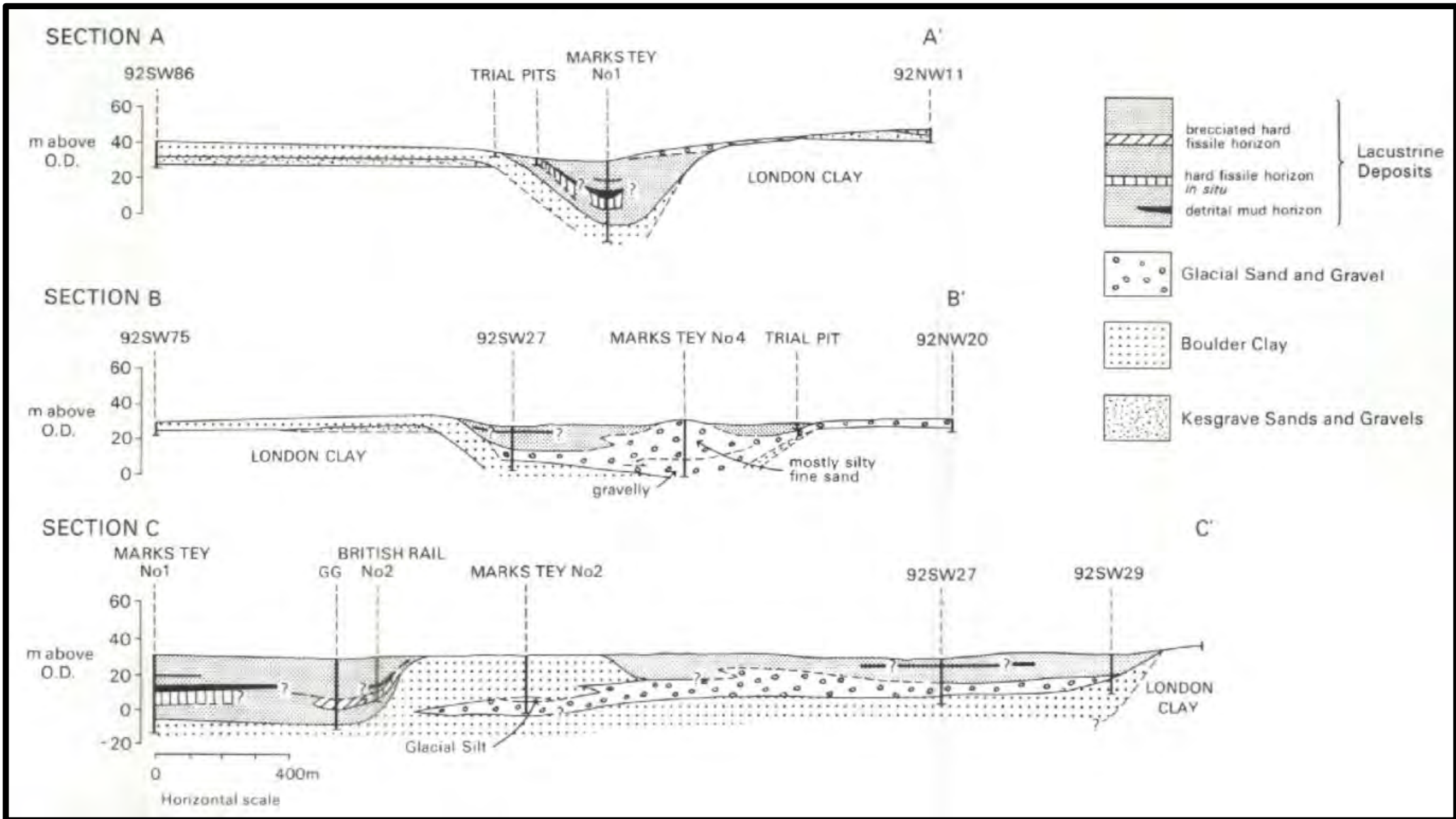


Figure 13. Reconstructed profiles across the Hoxnian lakes at Marks Tey and Copford (from Ellison and Lake, 1986).

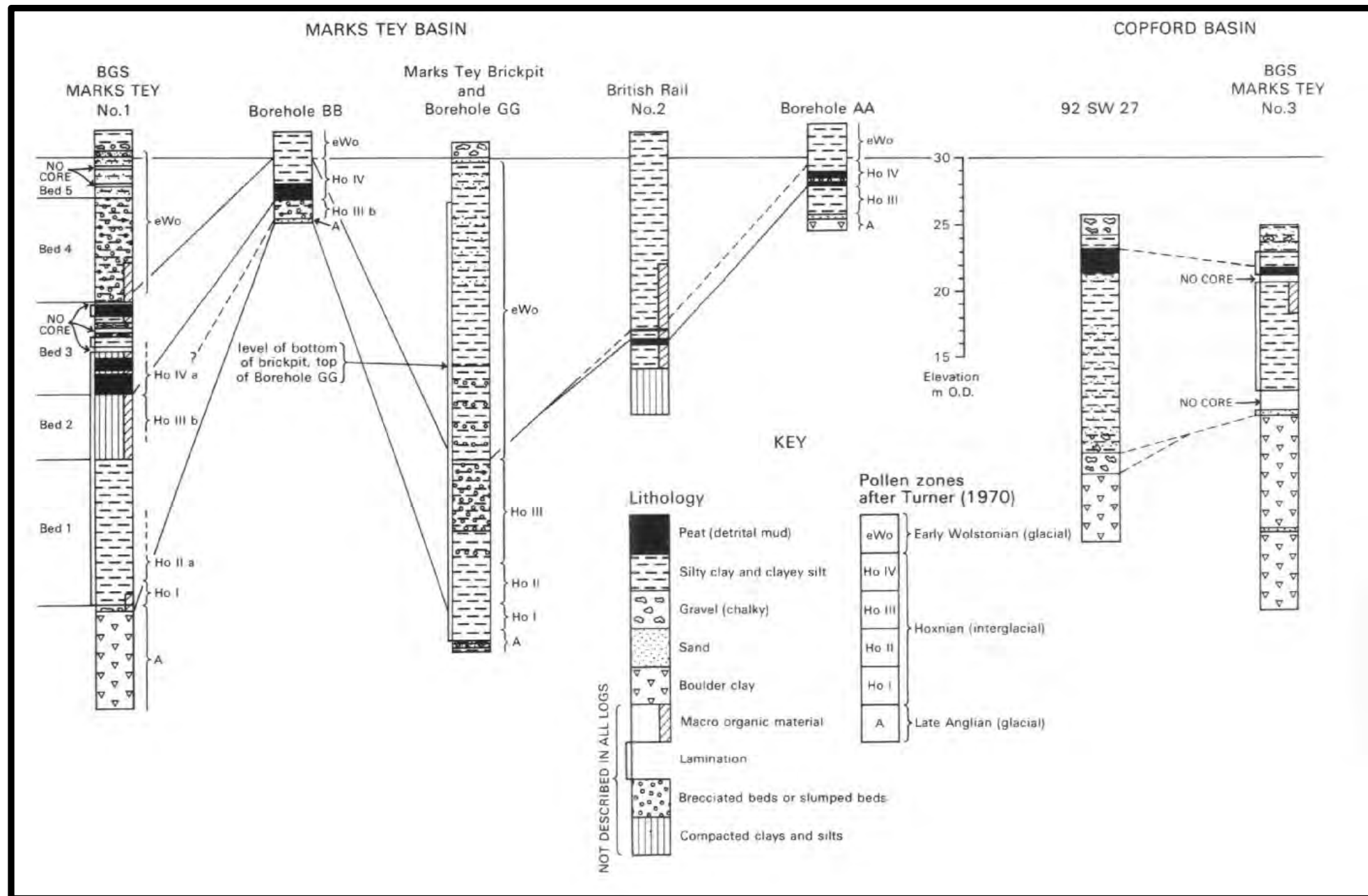


Figure 14. Borehole profiles from the sequences at Marks Tey and Copford (from Ellison and Lake, 1986).



Figure 15. Pale calcareous silts wedging out at edge of lake at Colemans Quarry, Witham.

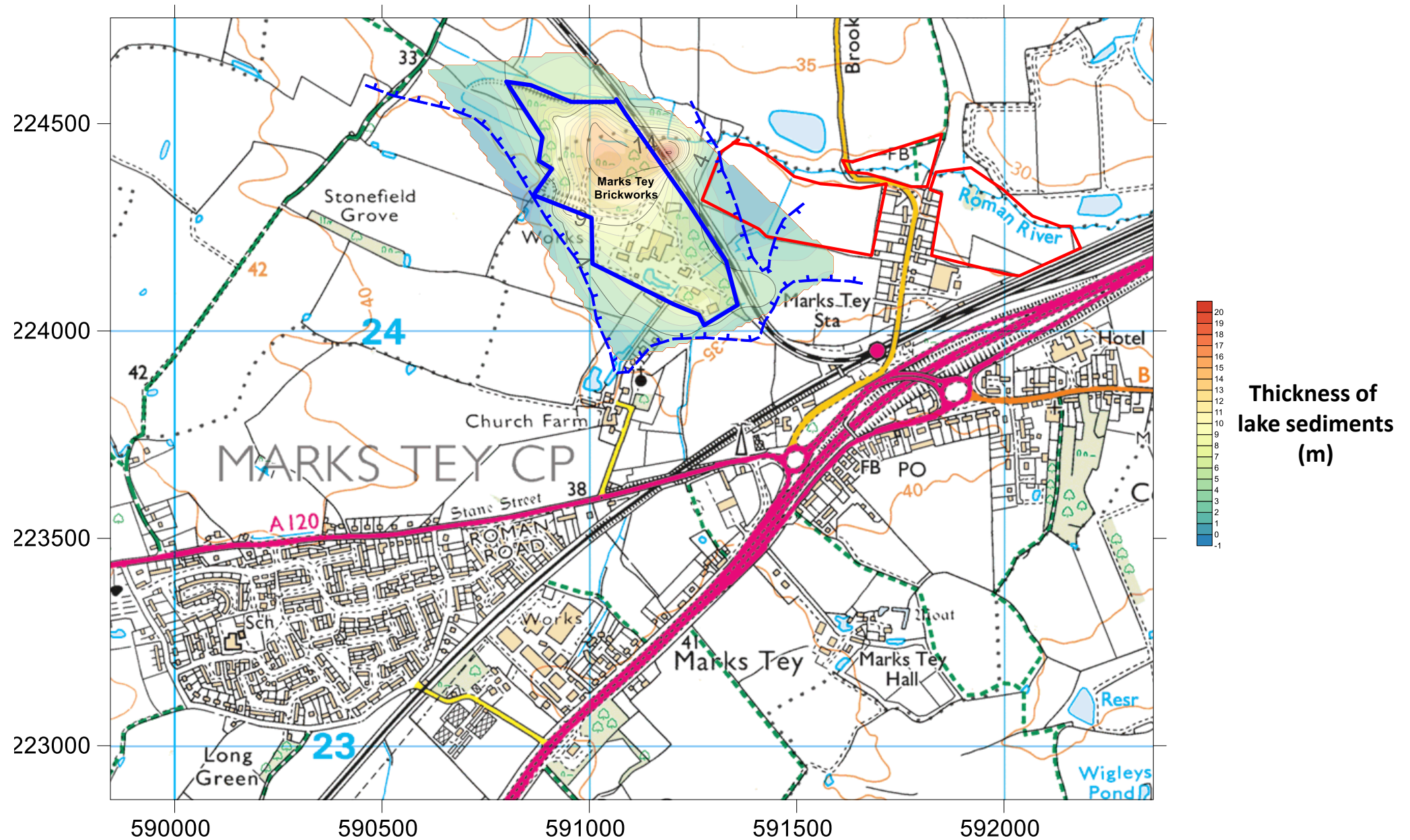


Figure 16. Modelled thickness of Marks Tey lake sediments and mapped edge of lake basin (based on Turner, 1970).

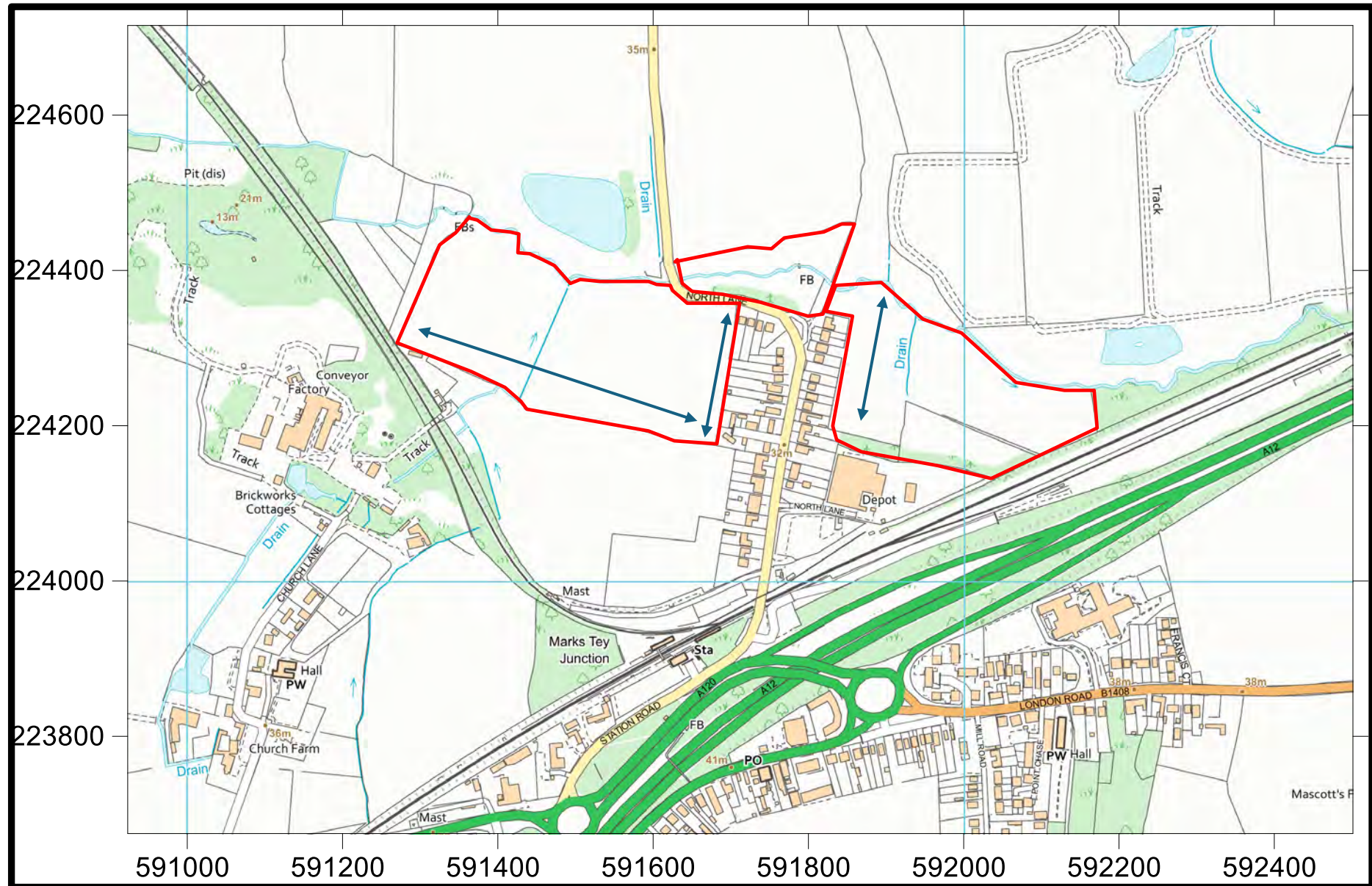


Figure 17. Potential transect lines for augering.

Land west and east of North Lane Marks Tey

Preliminary investigation of the sediments at The Site

Martin R. Bates

January 2025

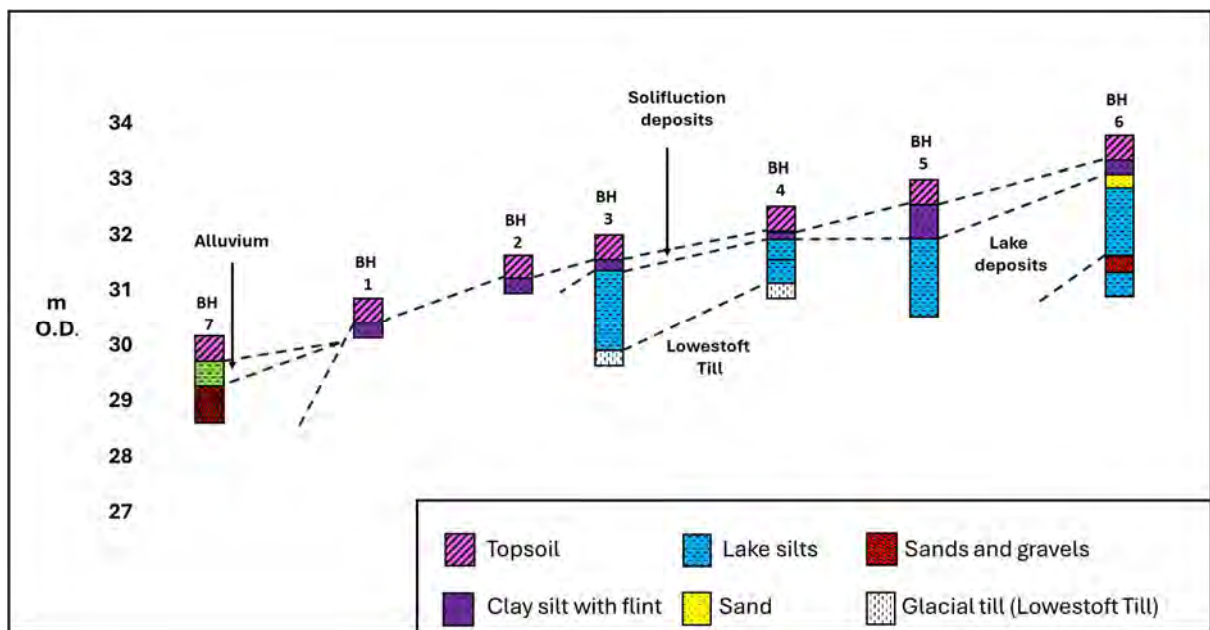


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EXECUTIVE SUMMARY

This report was commissioned by Andrew Josephs Associates Ltd and presents the findings of an initial geo-archaeological fieldwork assessment of the Palaeoenvironmental and Palaeolithic archaeological potential of land to the west and east of North Lane, Marks Tey in order to inform the promotion of that land for residential development. This report is to be read in conjunction with a previous desk based report summarising the known sequences for the area (Bates, 2024). Fieldwork was undertaken between 20th and 22nd January 2025 and twenty two boreholes were drilled.

The objectives of the work were to ascertain whether the mapping by the British Geological Survey (see Bates, 2024) is accurate, to identify the nature of Pleistocene sediments in the area of proposed development, to begin to understand the likely contexts, distribution and depth of burial of any sediments that might contain Palaeolithic archaeological material, to understand the likely nature, distribution and depth of burial of any palaeoenvironmental and/or dating material and to identify appropriate strategies for dealing with the potential buried Palaeolithic archaeological resource in the future and its scientific significance.

The hand auger survey was undertaken using an Eijkelkamp soil auger. No samples were retained for laboratory study.

The auger survey identified that sedimentary sequences associated with the lake are present at The Site. Furthermore these sequences have been shown to thin out against the rising till surface in places that matches the BGS mapping but in other places appears to contradict the nature of sequences predicted from the mapping. Sequences have been shown to contain visible biological material in places and the presence of charcoal in at least one borehole (BH 4) could indicate possible human presence within The Site area or equally a product of a natural fire. Future work at The Site is required to:

- Map the boundary of lake sediments with underlying till to a greater accuracy than illustrated in the BGS mapping.
- Characterise the nature of the sequences in terms of environments of deposition and associated floral and faunal material.
- Better understand whether or not true lake edge sequences are present at The Site and if semi terrestrial fluvial sequences (that may contain Palaeolithic archaeology) are present and associated with the fluvial gravels encountered in places.

These objectives can be achieved through the combination of geophysical survey, test pitting and mechanical drilling for core recovery.

1.0 Introduction

This report was commissioned by Andrew Josephs Associates and presents the findings of an initial geo-archaeological fieldwork assessment of the Palaeoenvironmental and Palaeolithic archaeological potential of land to the west and east of North Lane, Marks Tey in order to inform the promotion of that land for residential development. This report is to be read in conjunction with a previous desk based report summarising the known sequences for the area (Bates, 2024). The Proposed Development Area (PDA) is formed of three parcels (Figure 1) and currently consists of agricultural land.

Fieldwork was undertaken between 20th and 22nd January 2025 and twenty two boreholes were drilled. The findings are interpreted in light of other work from the area (Candy *et al.*, 2014, 2021; Ellison and Lake, 1986; Turner, 1966, 1970) as well as the authors own work in the area between Chelmsford and Colchester including the Pleistocene and Palaeolithic investigation works associated with the A12 widening proposals (Headland Archaeology, 2022) and the quarries to the east of Witham (Colemans Quarry) (Bates, 2014, 2015, 2019, 2021, 2024).

2.0 Aims and objectives of the report

The aim of this survey was to undertake a hand auger survey across key parts of The Site.

The objectives of the work were to:

- Ascertain whether the mapping by the British Geological Survey (see Bates, 2024) is accurate.
- To identify the nature of Pleistocene sediments in the area of proposed development.
- To begin to understand the likely contexts, distribution and depth of burial of any sediments that might contain Palaeolithic archaeological material.
- To understand the likely nature, distribution and depth of burial of any palaeoenvironmental and/or dating material.
- To identify appropriate strategies for dealing with the potential buried Palaeolithic archaeological resource in the future and its scientific significance.

The discussion of the nature and significance of Palaeolithic archaeological remains is poorly understood in many planning environments. However, Historic England (2023) have outlined both strategic research and conservation themes that include the following that are pertinent to the investigation of The Site:

- Understanding areas
- Understanding the record

- Dating frameworks
- Collections and records enhancement

Typically these themes refer to both areas in which Palaeolithic archaeological remains are identified to be present but also those areas where sequences containing palaeoenvironmental remains and/or dateable material have the potential to shed light on the nature, context and age of Palaeolithic archaeological remains for the region.

3.0 Background

The geological and Palaeolithic archaeological background to The Site has previously been described (Bates, 2024) and only a summary of the key points are provided here in order to avoid extensive repetition:

- Bedrock geology in the area belongs to the London Clay Formation.
- The Site is dominated by interglacial lacustrine deposits (Figure 1). These sediments have been ascribed to the Hoxnian interglacial, or MIS 11(c). These may be rich in biological material in places.
- Turner (1966) showed that two distinct basins were present in the area, one at Marks Tey and a second in the Copford area.
- No marginal lacustrine sediments are preserved in either basin according to Ellison and Lake, (1986) although they postulate such sequences once existed.
- For much of the Hoxnian Turner (1970) suggests that the Marks Tey basin drained into the Copford Basin. However, in the middle part of the Hoxnian water levels dropped in both lakes suggesting that semi terrestrial environments (perhaps suited to human activity) may have existed in the area between the two basins.
- Wymer (1999) argued hominins in the Hoxnian were routinely using lacustrine environments however, more recently Ashton *et al.* (2006) suggested this is not the case.
- Ashton *et al.* (2006) suggest that the presence of charcoal may be used to establish a human presence in the absence of stone tools.

4.0 Investigation methodology

A hand auger survey was undertaken at The Site between 20th and 22nd January 2025. The survey was conducted using an Eijkelkamp soil auger in which a Riverside auger was used to remove approximately 10cm increments of the sedimentary sequence downhole. Drilling

depth was measured downhole. Depth of drilling varied between boreholes and depended on the density of the sediments and their ability to maintain an open hole down profile. A gouge auger was tried but the sediments were too compact to use this tool.

No samples were retained for laboratory study.

Surveying was conducted using a hand held GPS logger to an accuracy of 2m. Levelling was undertaken by Dumpy level from a known point.

The location of all boreholes drilled are shown in Figure 1. Twenty two boreholes were drilled in the three days along a series of transects (Transects 1-4) that were orientated in reference to the likely distribution of lake deposits. Full logs and survey details for all boreholes drilled are given in Appendix 1.

5.0 Sequences present at The Site

The sequences recorded and interpreted are presented in Appendix 1 and illustrated in a series of transects (Figures 2, 4, 5). In most boreholes a thin sequence of clay silt with flint clasts was present beneath topsoil. These deposits probably represent cold climate sediments moved through spring melt of the permafrost (solifluction deposits).

Transect 1 (Figure 2) was undertaken in an approximate North to South direction from the mapped alluvium (northern end) across the lake deposits to the mapped edge of the lake deposits in the south. The transect consisted of boreholes 1-7. Lake deposits were identified in four of the boreholes (BH 3-6) (Figure 3) consisting of pale yellow white to grey clay silts. In boreholes 3 and 4 the underlying till was reached (this zone of shallow depth to till is shown in Figure 7). In BH 4 charcoal was located in the top of the weathered till. Lake sequence thickness appeared to increase upslope towards BH 6. Boreholes 1 and 2 encountered gravels close to the surface through which it was not possible to drill. Whether or not lake deposits exist beneath these gravels can only be ascertained through the use of a mechanical auger or through test pitting. At the northern end of the transect BH 7 exhibited sediments interpreted to be Holocene alluvium overlying Late Pleistocene fluvial gravels.

The sequences in Transect 1 conform in part to those anticipated by the BGS mapping. Holocene alluvium was confirmed to the north end of the transect. However, to the south rather than thinning towards the margin of the lake basin lake sediment sequences appear to thicken suggesting that the edge of lake deposits as mapped by the BGS is wrong and is further south than shown on their maps. Significantly charcoal has been recovered in this transect in BH 4 which Ashton *et al.* (2006) suggest may be used to establish a human presence in the absence of stone tools.

Transect 2 (Figure 4) was undertaken in an approximate East South East to West North West direction across a mapped area of glacial till where the assumed edge of the lake may be present on either side of the till. The transect consisted of boreholes 4, 8-13. Lake deposits are present above the weathered till sequence in boreholes 4, 8 and 9. In BH 10 the till is present below the topsoil. The edge of the lake sequence is therefore inferred between

boreholes 9 and 10. BH 11 was drilled at the base of the valley like feature extending from south to north through the transect and weathered till was present in this borehole. Till was also present in BH 12 to the west. The westernmost borehole (13) had lake deposits that were not bottomed. The edge of the lake sequence is therefore inferred between boreholes 12 and 13.

The sequences in this transect appear to confirm the BGS mapping is broadly correct and that there is a boundary between the lake deposits and the till within this part of The Site. This boundary zone is shown in Figure 7.

Transect 3 (Figure 5, top) was undertaken in an approximate North to South direction from the mapped alluvium (northern end) across the lake deposits towards the mapped edge of the lake deposits in the south. The transect consisted of boreholes 14-17. A thick sequence of lake deposits was encountered in BH 14. In boreholes 15 and 16 to the north sands and gravels were present close to the ground surface. Whether or not lake deposits exist beneath these gravels can only be ascertained through the use of a mechanical auger or through test pitting. At the northern end of the transect a sequence interpreted as Holocene alluvium over late Pleistocene fluvial sediments was encountered. Underlying till was not reached in any boreholes in this transect.

The sequences in Transect 3 conform in part to those anticipated by the BGS mapping. Holocene alluvium was confirmed to the north end of the transect in BH 17. However, to the south rather than thinning towards the margin of the lake basin lake sediment sequences appear to thicken suggesting that the edge of lake deposits as mapped by the BGS may require reconsideration. The presence of gravels in BH 15 and 16 (as well as BH 18/19, not shown in transects) means much of this part of The Site remains difficult to understand. Lake deposits may be present beneath these sediments. Alternatively they may form part of the semi terrestrial environments that may have existed in the area between the two lake basins when lake levels are inferred to have fallen in the interglacial (see above).

Transect 2 (Figure 5, bottom) was undertaken in an approximate East South East to West North West direction across the lake deposits. The transect consisted of boreholes 14, 20-22. A thick sequence of lake deposits was encountered in BH 14. Lake deposits were encountered in all other boreholes to the east. Organic rich sediments were encountered in boreholes 21 and 22 (Figure 6) that were very different to those encountered to the west. Underlying till was not reached in any boreholes in this transect.

The sequences in Transect 4 confirm the presence of lake sediments in this area. Sequences in BH 21/22 appear distinctly different to those encountered elsewhere in the auger survey. Whether or not this relates to internal changes in the lake environment or possibly that the sediments in this area of The Site perhaps belong to the Copford rather than Marks Tey lake.

6.0 Future work

The auger survey has identified that sedimentary sequences associated with the lake are present at The Site. Furthermore these sequences have been shown to thin out against the

rising till surface in places that matches the BGS mapping (Transect 2) but in other places appears to contradict the nature of sequences predicted from the mapping. Sequences have been shown to contain visible biological material in places and the presence of charcoal in at least one borehole (BH 4) has intriguing implications for a possible human presence within The Site area, although equally the charcoal could be the result of a natural fire. Future work at The Site is required to:

- Map the boundary of lake sediments with underlying till to a greater accuracy than illustrated in the BGS mapping.
- Characterise the nature of the sequences in terms of environments of deposition and associated floral and faunal material.
- Better understand whether or not true lake edge sequences are present at The Site and if semi terrestrial fluvial sequences (that may contain Palaeolithic archaeology) are present and associated with the fluvial gravels encountered in places.

These objectives can be achieved through the combination of geophysical survey, test pitting and mechanical drilling for core recovery.

Further research has the potential to contribute significantly to our knowledge of the climate history of the Hoxnian period as well as that of Palaeolithic peoples.

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Site Marks Tey

BH	x	y	z	Top	Base	Lithology	Interpretation
BH 1	591699	224349	30.86	0 0.38 0.69	0.38 0.69	Topsoil ---abrupt contact--- Yellow brown clay silt with occasional gravel clasts. Compact and firm. Becomes slightly sandy with depth containing gravel clasts <3cm in size, sub-angular in shape. ---abrupt contact--- Yellow brown sandy clay silt with common gravel clasts. Compact and firm. Gravel clasts <3cm in size, sub-angular in shape. ---base of borehole 0.75m gravel too hard to drill---	Possible slope wash colluvium, Pleistocene in age
BH 2	591593	224309	31.60	0.00 0.35	0.35 0.47	Topsoil ---abrupt contact--- Yellow brown clay silt with occasional gravel clasts. Compact and firm. Becomes slightly sandy with depth containing gravel clasts <3cm in size, sub-angular in shape. ---base of borehole 0.47m gravel too hard to drill---	Possible slope wash colluvium, Pleistocene in age
BH 3	591692	224289	31.99	0.00 0.40	0.40 0.60	Topsoil ---abrupt contact--- Yellow brown clay silt with some sand. ---abrupt contact---	Possible slope wash colluvium, Pleistocene in age

				0.60	2.00	Pale yellow slightly gravelly clay silt with patches of grey clay silt. Becomes whiter and more granular with depth. Free of any clastic material. Below 0.92m iron staining appears ---abrupt contact--- Yellow brown becoming grey clay silt. Very dense and compact. Common chalk and flint clasts throughout (rounded to subangular in shape and rolled). Structureless ---base of borehole 2.42m---	Weathered lake sediments, Pleistocene in age Weathered Anglian Till, Pleistocene in age
BH 4	591686	224251	32.46	0.00	0.30	Topsoil ---abrupt contact--- Yellow brown clay silt with occasional small (<5cm) subangular flint clasts. Firm and compact. Occasional manganese staining ---not seen--- Pale yellow brown gravelly sand with coarse flint clasts <5cm, subangular in shape. Dense and compact. ---sharp contact--- Yellow brown sandy gravel with clasts 2-4cm in size, subangular in shape. Matrix supported. Dense and compact. ---abrupt contact--- Yellow brown to grey clay silt. Pliable and soft. Patches of white clay silt ---not seen---	Possible slope wash colluvium, Pleistocene in age Possible slope wash colluvium, Pleistocene in age Possible fluvial channel deposits, Pleistocene in age Lake deposits, Pleistocene in age

				1.25	1.80	Grey clay silt. Very dense and compact. Clasts of chalk and flint common. Black charcoal fragments towards top of unit ---base of borehole 1.80m---	Weathered Anglian Till, Pleistocene in age
BH 5	591681	224218	32.95	0.00	0.30	Topsoil ---abrupt contact---	Possible slope wash colluvium, Pleistocene in age Edge marginal lake deposits with some moving water, Pleistocene in age Lake deposits, Pleistocene in age Fluvial sediments, Pleistocene in age Fluvial sediments, Pleistocene in age Fluvial sediments, Pleistocene in age Lake deposits, Pleistocene in age
				0.30	1.00	Yellow brown clay silt with some gravel clasts. Manganese staining. ---abrupt contact---	
				1.00	1.20	Yellow brown clay wilt with some gravel clasts. ---abrupt contact---	
				1.20	1.30	Pale grey to yellowish brown to white carbonate silts. Structureless and soft, no clasts.	
				1.30	1.40	Yellow grown sandy gravel	
				1.40	1.55	Yellow brown gravel with clay silt matrix	
				1.55	1.60	Red brown sand	
				1.60	2.50	Yellow brown to grey clay silt. Structureless and plastic ---base of borehole 2.50m---	
BH 6	591671	224185	33.59	0.00	0.30	Topsoil ---abrupt contact---	

				0.30	0.60	Red brown sandy clay silt. Structureless and pliable. Manganese staining common. ---abrupt contact---	Possible slope wash colluvium, Pleistocene in age
				0.60	0.85	Red brown silty sand. Firm and compact.	Fluvial sediments, Pleistocene in age
				0.85	2.00	Yellow brown clay silt. Firm and compact.	Lake deposits, Pleistocene in age
				2.00	2.20	Red brown sand with occasional grey clay silt lenses.	Fluvial sediments, Pleistocene in age
				2.20	2.30	Fine light brown sand.	Fluvial sediments, Pleistocene in age
				2.30	2.80	Grey clay silt. Firm and compact. ---base of borehole 2.80m---	?lake deposits, Pleistocene in age
BH 7	591689	224390	30.13	0.00	0.30	Topsoil ---abrupt contact---	Holocene alluvium High energy fluvial gravels, Late Pleistocene age High energy fluvial gravels, Late Pleistocene age
				0.30	0.65	Dark grey silty sand. Firm and compact. ---diffuse contact---	
				0.65	0.80	Yellow brown silts with some sand and gravel clasts. Clasts <2cm, sub-angular in shape. Compact and firm. ---abrupt contact---	
				0.80	1.00	Yellow brown sandy gravel. Clasts 1-3cm, sub-angular and rolled. Loose and unconsolidated. ---base of borehole 1.00m---	
BH 8	591632	224260	33.00	0.00	0.40	Topsoil	

				0.40	0.50	---abrupt contact--- Yellow brown clay silt with manganese staining. Small flint clasts <2cm, sub-angular. Firm and compact. ---abrupt contact---	Solifluction deposits, Pleistocene age
				0.50	0.70	Pale yellow brown silts and some flint clasts. ---diffuse contact---	Reworked Pleistocene lake deposits/solifluction
				0.70	1.05	White silt with some flint clasts. ---abrupt contact---	Reworked Pleistocene lake deposits/solifluction
				1.05	1.15	Yellowish brown slightly sandy silt with some gravel clasts. Structureless and compact. ---abrupt contact---	Reworked Pleistocene lake deposits/solifluction
				1.15	1.95	Pale yellow to whitish yellow clay silt. Firm and compact. ---abrupt contact---	Lake deposits, Pleistocene in age
				1.95	2.60	Grey to greenish grey clay silt. Very firm and compact. ---not seen---	Lake deposits, Pleistocene in age
				2.60	2.70	---base of borehole 2.70m---	
BH 9	591577	224271	33.22	0.00	0.35	Topsoil ---abrupt contact---	
				0.35	0.70	Strong yellowish brown clay silt with gravel clasts. Manganese staining. ---abrupt contact---	Solifluction slope deposits, Pleistocene in age

				0.70	0.75	Yellow brown to greyish brown sandy gravel. ---abrupt contact---	Fluvial deposits, Pleistocene in age
				0.75	0.80	Grey to brown clay silt. Dense and compact. ---abrupt contact---	Reworked Pleistocene lake deposits/solifluction
				0.80	1.25	Pale white silt with thin beds of yellow brown sands. ---abrupt contact---	Reworked Pleistocene lake deposits/solifluction
				1.25	1.30	Red brown sandy gravel. ---abrupt contact---	Fluvial deposits, Pleistocene in age
				1.30	2.00	Grey brown clay silt. Dense and compact. ---abrupt contact---	Lake deposits, Pleistocene in age
				2.00	2.40	Grey clay silt. Compact and firm. ---abrupt contact---	Lake deposits, Pleistocene in age
				2.40	2.60	Grey clay with common chalk and flint clasts. ---base of borehole 2.60m---	Anglian Till, Pleistocene in age
BH 10	591503	224282	33.15	0.00	0.30	Topsoil ---abrupt contact---	Weathered Anglian Till, Pleistocene in age
				0.30	1.50	Grey to yellow brown clay silt. Common chalk and flint clasts. Some iron staining. ---base of borehole 1.50m---	

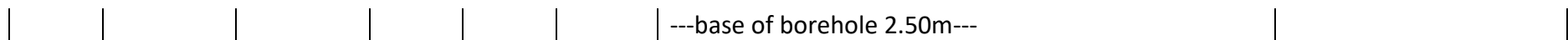
BH 11	591441	224294	31.04	0.00	0.30	Top soil ---abrupt contact---	Solifluction deposits, Pleistocene age Weathered Anglian Till, Pleistocene in age Weathered Anglian Till, Pleistocene in age
				0.30	0.55	Yellow brown clay silt with some charcoal flecks. Some flint clasts. ---abrupt contact---	
				0.55	0.70	Yellow brown clay silt with flint clasts. ---abrupt contact---	
				0.70	1.20	Yellow brown to grey clay silt with common flint and chalk clasts. Very dense and compact. ---base of borehole 1.20m---	
BH 12	591383	224310	32.34	0.00	0.30	Top soil ---abrupt contact---	Solifluction deposits, Pleistocene age Weathered Anglian Till, Pleistocene in age Weathered Anglian Till, Pleistocene in age
				0.30	1.00	Yellow brown clay silt with some charcoal flecks. Some flint clasts. ---abrupt contact---	
				1.00	1.10	Yellow brown clay silt with flint clasts. ---abrupt contact---	
				1.10	1.30	Yellow brown to grey clay silt with common flint and chalk clasts. Very dense and compact. ---base of borehole 1.30m---	
BH 13	591327	224335	33.42	0.00	0.30	Top soil ---abrupt contact---	Solifluction deposits, Pleistocene age
				0.30	0.65	Yellow brown clay silt with some charcoal flecks. Some flint clasts. ---abrupt contact---	

				0.65	1.05	Yellow brown to greyish brown clay silt. Manganese staining. ---abrupt contact---	Reworked Pleistocene lake deposits/solifluction
				1.05	1.55	White to yellowish white silt. Iron staining in places. Firm and compact. ---abrupt contact---	Lake deposits, Pleistocene in age
				1.55	1.60	Red brown coarse sands. ---base of borehole 1.60m---	High energy fluvial, Pleistocene in age
BH 14	591842	224210	31.24	0.00	0.30	Topsoil. ---abrupt contact---	
				0.30	0.40	Yellow brown clay silt with occasional gravel clasts. ---abrupt contact---	Solifluction deposits, Pleistocene age
				0.40	0.75	Pale yellow white silt. Friable and loose. ---abrupt contact---	Lake deposits, Pleistocene in age
				0.75	0.80	Grey white silt. Cohesive and structureless. ---abrupt contact---	Lake deposits, Pleistocene in age
				0.80	1.10	Grey white clay silt. Soft and friable. Becomes more clayey with depth. ---diffuse contact---	Lake deposits, Pleistocene in age
				1.10	1.40	Grey green clay silt. Compact and structureless. ---diffuse contact---	Lake deposits, Pleistocene in age
				1.40	3.20	As above, possibly bedded. Occasional iron staining.	Lake deposits, Pleistocene in age

						---base of borehole 3.20m---	
BH 15	591851	224268	30.46	0.00	0.30	Topsoil ---abrupt contact---	Solifluction deposits, Pleistocene age High energy fluvial, Pleistocene in age
				0.30	0.45	Yellow brown clay silt with occasional flints. ---abrupt contact---	
				0.45	1.10	Yellow brown sandy gravel. ---base of borehole 1.10m---	
BH 16	591856	224306	29.92	0.00	0.30	Topsoil ---abrupt contact---	Solifluction deposits, Pleistocene age High energy fluvial, Pleistocene in age
				0.30	0.40	Yellow brown clay silt with occasional flints. ---abrupt contact---	
				0.40	0.55	Yellow brown sandy gravel. ---base of borehole 0.55m---	
BH 17	591864	224339	29.48	0.00	0.30	Topsoil ---abrupt contact---	Alluvium, Holocene age Alluvium, Holocene age High energy fluvial, Pleistocene in age
				0.30	0.70	Yellow brown clay silt with occasional flints. ---abrupt contact---	
				0.70	1.00	Grey clay silt that is firm and compact. Occasional flint clasts ---abrupt contact---	
				1.00	1.20	Yellow brown flint gravel ---base of borehole 1.20m---	

BH 18	591877	224263	30.09	0.00	0.30	Topsoil ---abrupt contact---	Solifluction deposits, Pleistocene age
				0.30	0.50	Yellow brown clay silt with occasional flints. ---abrupt contact--- ---base of borehole 0.50m---	
BH 19	591899	224256	29.74	0.00	0.30	Topsoil ---abrupt contact---	Solifluction deposits, Pleistocene age High energy fluvial, Pleistocene in age
				0.30	0.60	Yellow brown clay silt with occasional flints. ---diffuse contact---	
				0.60	1.30	As above becoming increasingly sand with depth. Loose and unconsolidated. ---base of borehole 1.30m---	
BH 20	591896	224194	30.50	0.00	0.30	Topsoil ---abrupt contact---	Solifluction deposits, Pleistocene age Lake deposits, Pleistocene in age Lake deposits, Pleistocene in age
				0.30	0.90	Yellow brown clay silt with occasional flints. ---diffuse contact---	
				0.90	1.10	Yellow brown to grey brown clay silt. Some flint clasts present, occasional nodules of carbonate. ---diffuse contact---	
				1.10	1.30	White silt. Fine and friable. ---base of borehole 1.30m---	
BH 21	591971	224172	30.06	0.00	0.30	Topsoil	

				0.30	0.40	---abrupt contact--- Yellow brown clay silt with occasional flints. ---diffuse contact--- Brown yellow clay silt with white patches. Becomes coarser with depth. ---diffuse contact--- Grey clay silt with some charcoal flecks. Some shell fragments. Slightly organic. Firm and compact. ---sharp contact--- Dark grey brown to brown clay silt. Dense and compact. Some organic material. ---base of borehole 1.85m---	Solifluction deposits, Pleistocene age Solifluction deposits, Pleistocene age Lake deposits, Pleistocene in age Lake deposits, Pleistocene in age
BH 22	592007	241171	29.88	0.00	0.30	Topsoil ---abrupt contact--- 0.30 0.55 Yellow brown clay silt with occasional flints. ---abrupt contact--- Grey clay silt with some sand. Firm and compact. 0.55 1.30 Becoming sandier with depth. ---abrupt contact--- 1.30 1.50 Yellow brown sandy gravel. ---abrupt contact--- Pale brown silt with organics and shell fragments. 1.50 2.20 Soft and unconsolidated. ---not seen--- 2.20 2.50 Dark brown organic silt.	Solifluction deposits, Pleistocene age Lake deposits, Pleistocene in age Lake deposits, Pleistocene in age Lake deposits, Pleistocene in age Lake deposits, Pleistocene in age



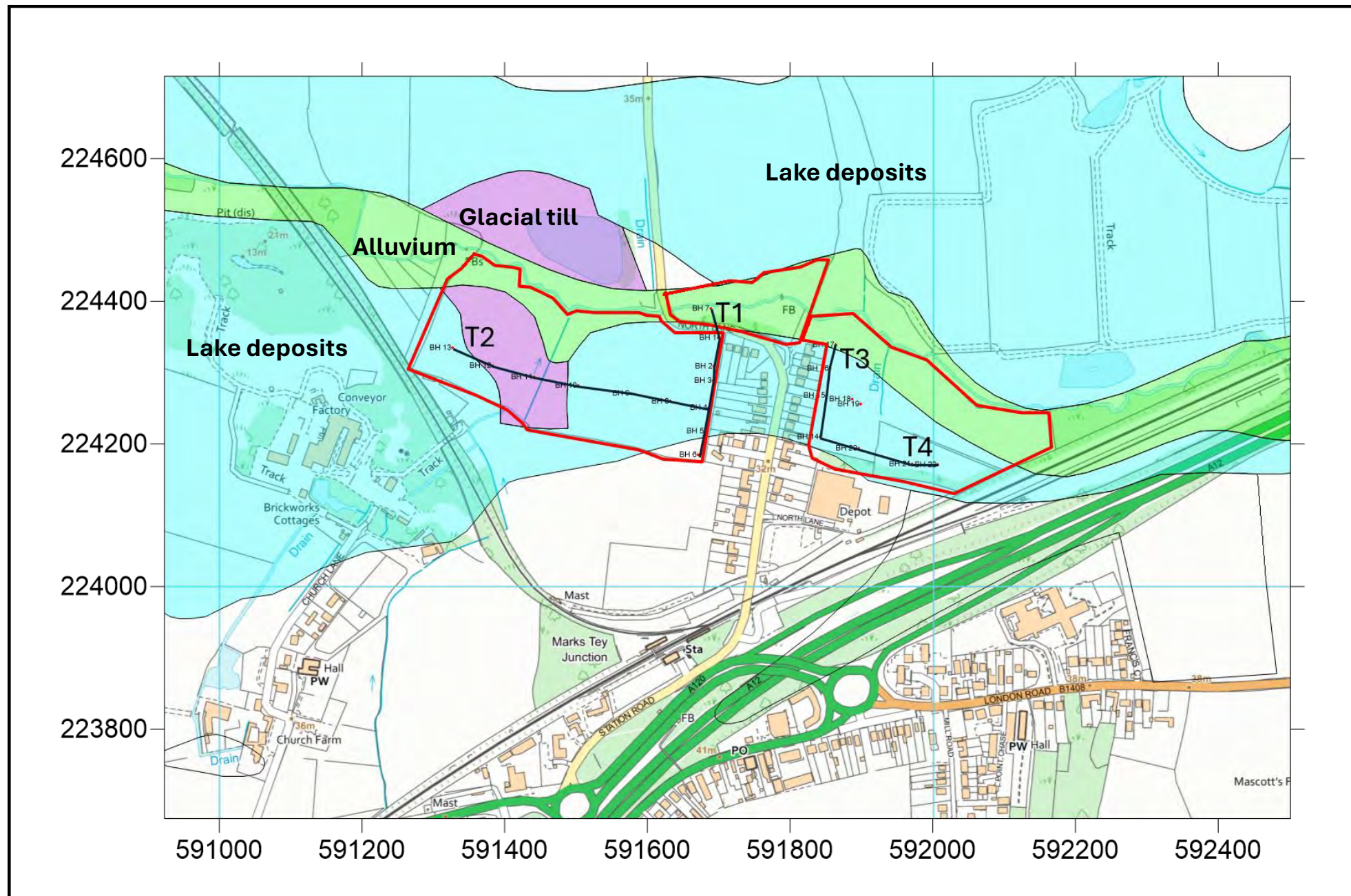


Figure 1. Site location plan showing borehole and transect locations (mapping based on British Geological Survey data).

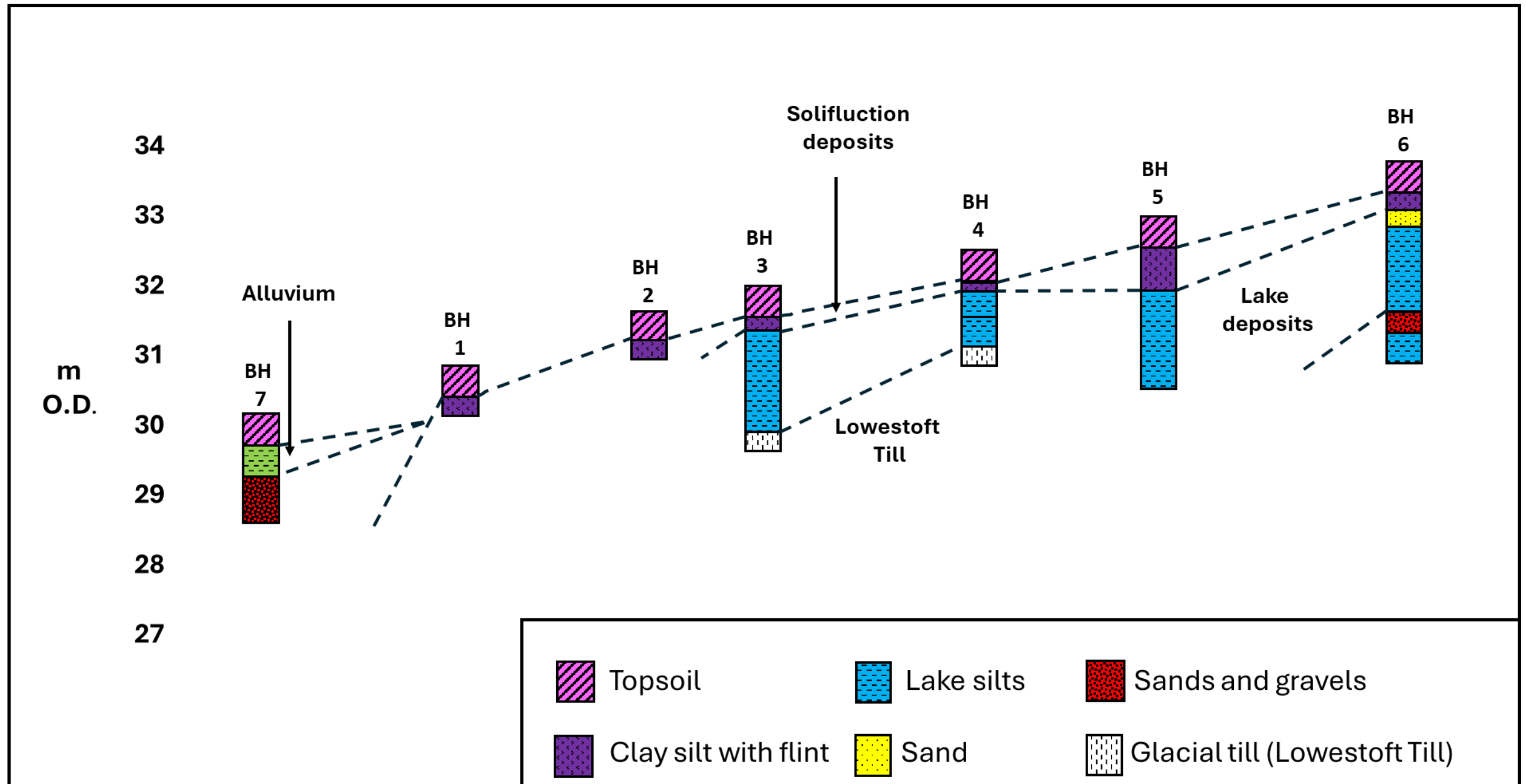


Figure 2. Transect T1.



Figure 3. Typical lake sediments (left) and lake sediments containing charcoal fragments (right) from BH 4.

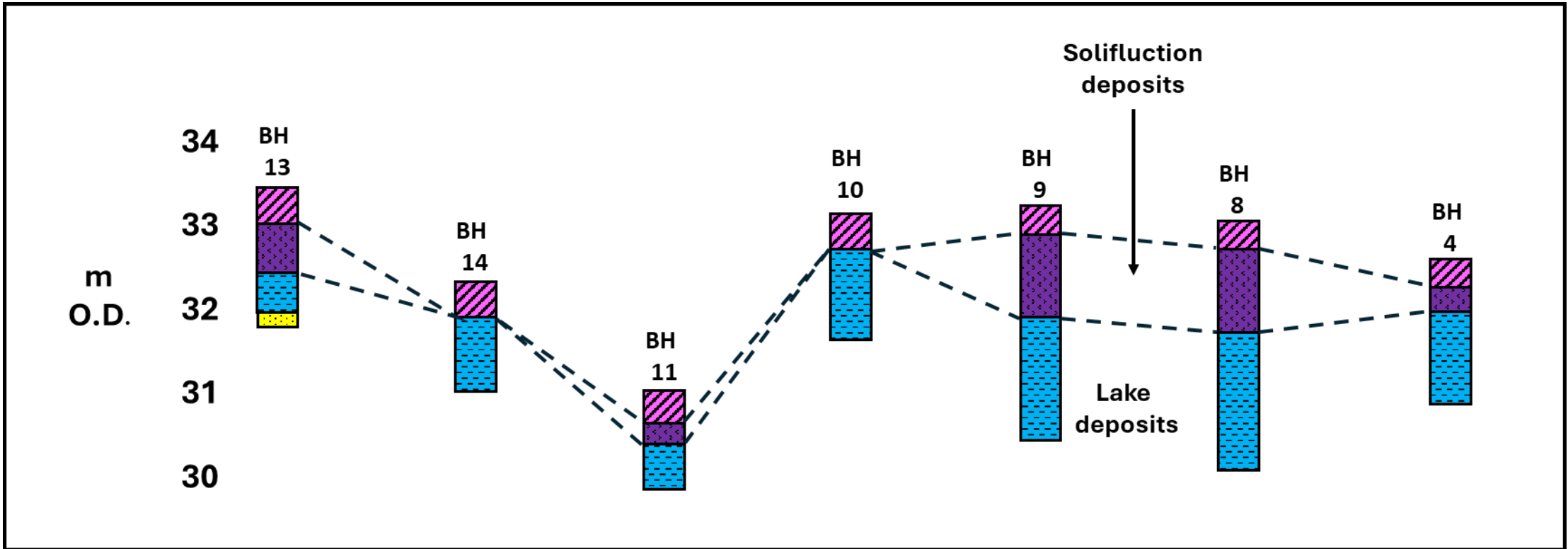


Figure 4. Transect T2.

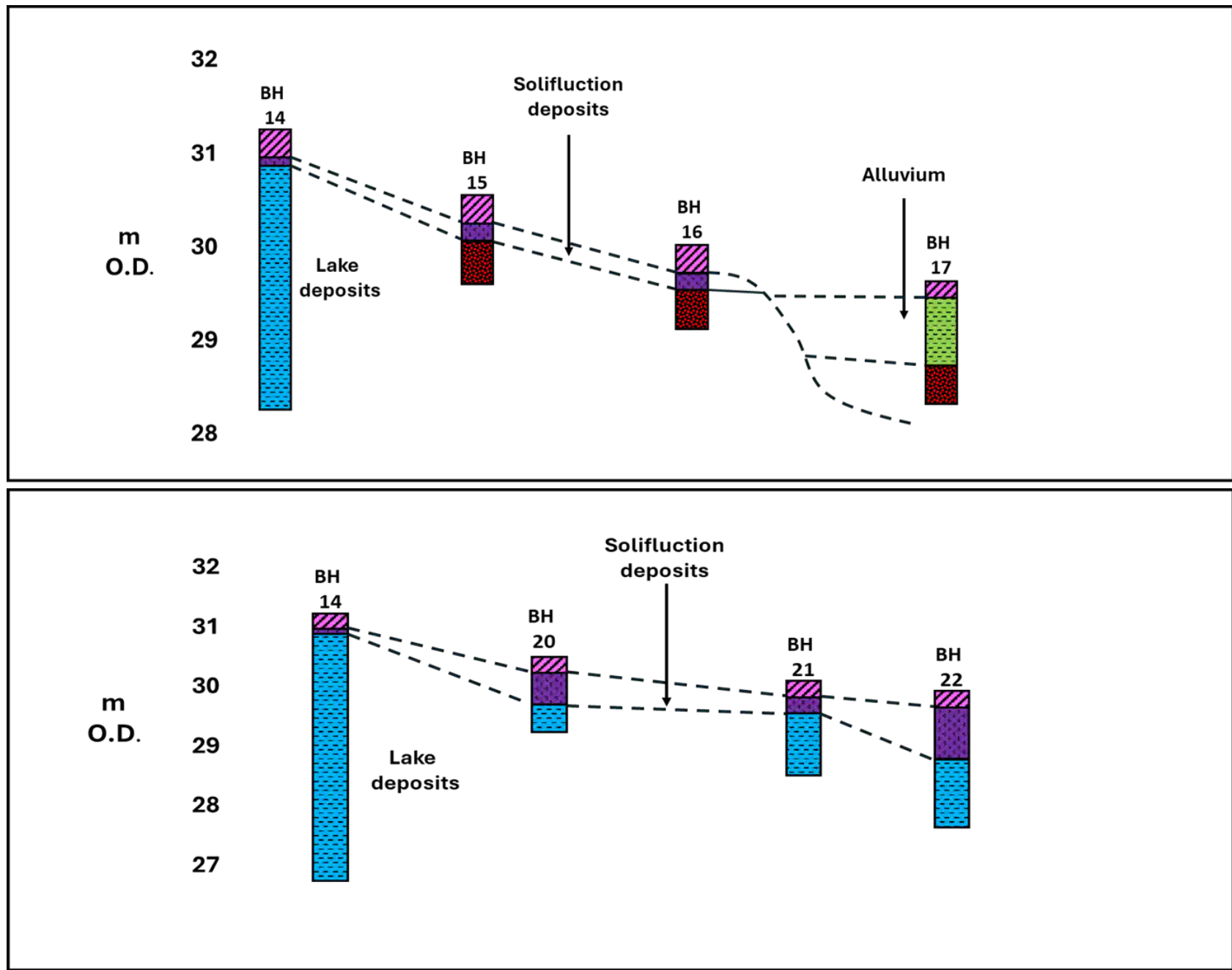


Figure 5. Transects T3 (top) and T4 (base).



Figure 6. Organic rich lake sediments containing plant macrofossils from BH 22.

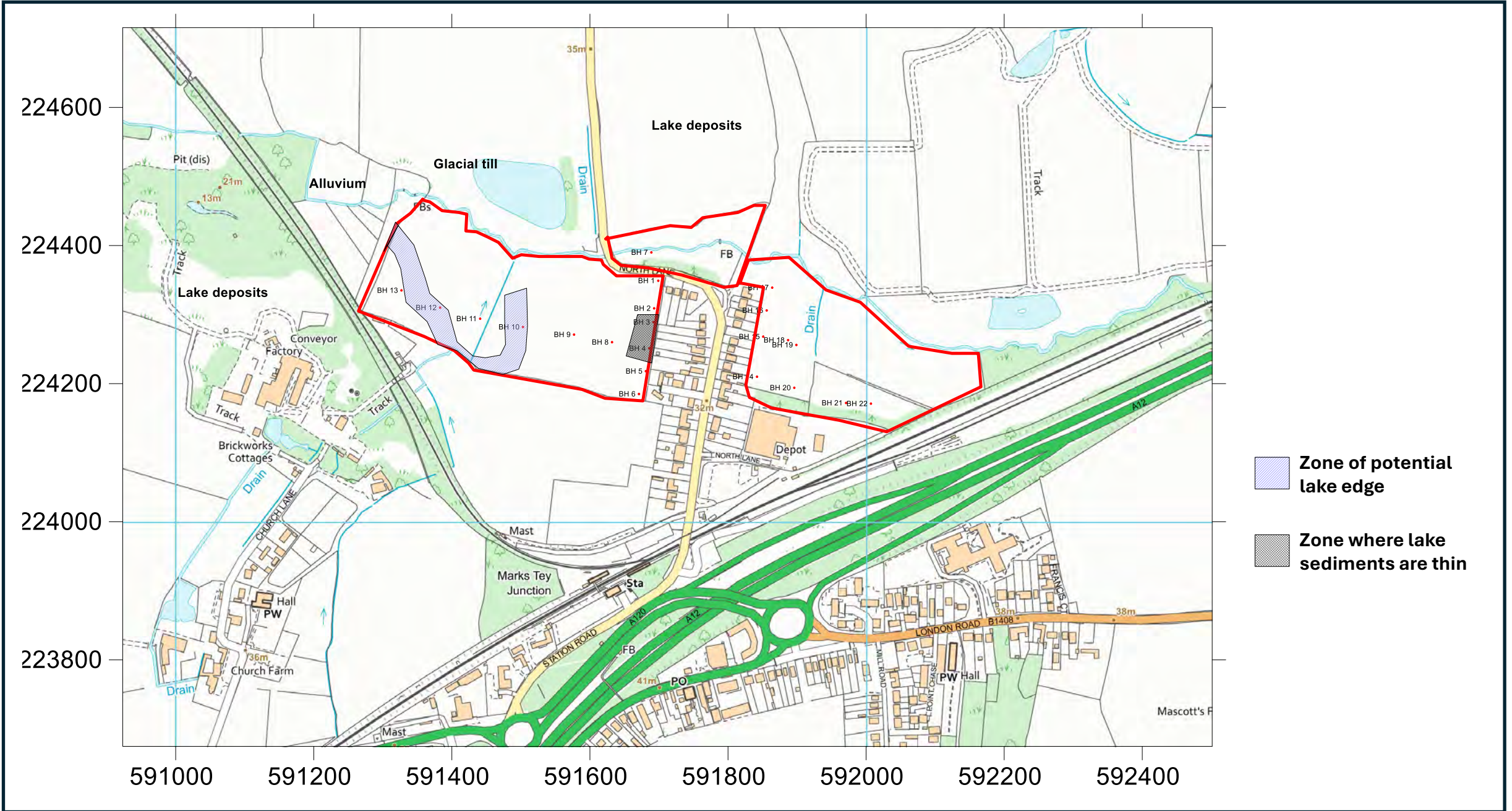


Figure 7. The site showing areas of potential lake edge and where the base of the lake is close to the ground surface.

Appendix B



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