Flood Risk Assessment

at
Thames Young Mariners, Riverside Drive, Richmond TW10 7RX

for
Surrey County Council

Reference: 20295/FRA Rev1.0
September 2022

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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

Surrey County Council commissioned Soils Limited to undertake a Flood Risk Assessment on land at Thames Young Mariners, Riverside Drive, Richmond TW10 7RX. The scope of the investigation was outlined in the Soils Limited quotation reference Q25989 rev 101, dated 30th March 2022.

Limitations and Disclaimers

This Flood Risk Assessment relates to the site located at Thames Young Mariners, Riverside Drive, Richmond TW10 7RX and was prepared for the sole benefit of Surrey County Council (hereafter known as the "Client"). The report was prepared solely for the brief described in Section 1.1 of this report.

The contents, recommendations and advice given in the report are subject to the Terms and Conditions given in Quotation Q25989 rev 101, dated 30th March 2022 accepted by the by Pick Everard on behalf of the Client on 1st June 2022.

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Section 1 General

1.1 Scope

The Client commissioned Soils Limited to undertake a Flood Risk Assessment (FRA) in relation to a development at Thames Young Mariners, Riverside Drive, Richmond TW10 7RX (hereafter known as “the Site”).

This FRA provides an overview of the potential risks of flooding the Site, and the risks that the development of the site poses to surrounding areas. The assessment follows the principals of National Planning Policy Framework as updated and revised in 2021. This assessment highlights the potential flood risk posed to and by the site, and recommends likely further action required.

The report provides the following information:

1. An assessment of the flood risk posed to the site based on flood information and mapping provided by the EA and local authorities.

This Flood Risk Assessment is a live document to be updated as additional information becomes available and the evolving detailed design progresses

Section 2 Regulatory Background

2.1 Regulatory Background

Details of the regulatory background used to undertake this FRA are outlined below.

This FRA has been carried out in accordance with the 20th July 2021 National Planning Policy Framework (NPPF), elements of Planning Policy Statement (PPS) 25 Appendix B of the PPS25 Development and Flood Risk-Practice Guide (withdrawn), Planning Practice Guidance and Flood risk and coastal change (www.gov.uk/guidance/flood-risk-and-coastal-change). It is to be used to assist the Local Planning Authority (LPA) and Environment Agency (EA) when considering the flooding issues of the proposed development as part of a planning application.

This FRA considers the impact of the proposed development in addition to the common ways in which flooding can occur. The conditions currently existing in the location of the site are described, together with the methods used to identify and assess potential impacts caused from the development proposals. The mitigation measures proposed have been identified in order to avoid and/or reduce the impacts caused by introducing the development proposals.

The EA has produced guidance notes for different development scenarios, based on the size of the development and the location of the site. This assessment has been produced in accordance with; “Preparing a flood risk assessment: standing advice” (www.gov.uk/guidance/flood-risk-assessment-standing-advice, visited 15/09/2022).

2.2 National Planning Policy & Planning Practice Guidance

The updated NPPF was published on 20 July 2021 and sets out the government’s planning policies and how these should apply. Policies for flood risk are incorporated in Section 14: “Meeting the challenge of climate change, flooding and coastal change.” In essence inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

The Planning Practice Guidance (PPG) accompanies the NPPF and includes flood zones and flood risk tables to assist with flood risk vulnerability classifications and development suitability.

The definition for each flood zone designation is presented in Table 2.1.

Table 2.1 Flood Zones Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 0.1% annual probability of river or sea flooding.

Flood Zone	Definition
Zone 2 Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding.
Zone 3a High Probability	Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea.
Zone 3b High Probability	This zone comprises land where water must flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

A sequential, risk-based approach should be adopted, taking account of all sources of flood risk, including current and future impact of climate change. The aim of the sequential test is to steer new development to areas of lowest risk of flooding from any source. Where it is not possible to locate the development in areas of lower risk of flooding, the exception test is undertaken.

2.3 Local Policy

Local planning practice guidance considers flood risk through relevant environmental and climate change policies, which enforce the requirements of the NPPF. The site lies within the boundaries of the London Borough of Richmond upon Thames (LBRuT). In the production of this report the following documents from the Local Authorities have been reviewed:

London Borough of Richmond Upon Thames – Local Plan (July 2018)

London Borough of Richmond Upon Thames – Preliminary Flood Risk Assessment (PFRA) (May 2011, reviewed 2017)

London Borough of Richmond Upon Thames – Strategic Flood Risk Assessment (SFRA) (March 2021)

London Borough of Richmond Upon Thames – Surface Water Management Plan (SWMP) (December 2021)

Environmental Agency – Thames Estuary 2100, Managing flood risk through London and the Thames estuary (updated 22nd February 2021).

The London Plan (March 2021)

2.4 Report Information Sources

The information used to undertake this FRA has been collected from the following sources:

1. EA (Envirocheck) Flood Screening Report (Appendix A),
2. British Geological Survey Website (accessed September 2022),

3. EA Website (accessed September 2022),
4. London Borough of Richmond Upon Thames – Local Plan (July 2018)
5. London Borough of Richmond Upon Thames – PFRA (May 2011, reviewed 2017)
6. London Borough of Richmond Upon Thames – SFRA (March 2021)
7. London Borough of Richmond Upon Thames – SWMP (December 2021)
8. Environmental Agency – Thames Estuary 2100 (updated 22nd February 2021).
9. The London Plan (March 2021)
10. National Planning Policy Framework (assessed September 2022)
11. GOV.UK Planning Practice Guidance – Flood risk and coastal change (accessed September 2022)
12. Google Earth™ (accessed September 2022).

Section 3 Site Details and Background Information

3.1 Location

The Site was located west of Riverside Drive, approximately 1.2km northeast of Teddington and 1.1km southeast of Twickenham, within the boundary of the LBRuT, at a postcode of TW10 7RX. The centre of the site had an approximate O.S Land Ranger Grid Reference of TQ 16397 72304.

The site location plan is given in Figure 4.

3.2 Site Description

The wider site area was approximately 8.9ha and located off the eastern bank of the River Thames. Approximately 3.7ha of the current site was cover by an artificial lake, formed circa 1934 and later remodelled, circa 1980 into its current shape. Surrounding the northern and eastern sides of the lake was woodland, becoming grassland with pockets of trees along the south-eastern side. Within the south-western corner was the main Thames Young Mainers (TYM) complex with comprised a cluster of single storey, brick, timber, and metal buildings, with exception of the main building, with had a lower ground floor looking out on to the lake. The remaining area southwest of the main complex was outdoor amenity space and a few storage buildings.

The proposed development area was centred around the main complex and extended along the southern side of the lake.

An aerial photograph outlining the site, development area and its close environs has been included in Figure 5.

3.3 Proposed Development

The proposal comprised demolition of the existing TYM complex and associated building and construction of new main building, guest residential accommodation, changing block, staff residential accommodation, repair workshop and camping changing block. The layout comprised the main building located in the northwest corner followed by three guest accommodation buildings arranging approximately in a circle southeast of the main building. To the east of the main building was the changing block, and along the southern boundary was the staff accommodation building. Within the southwestern corner of the site was the camping changing block and repair workshop. The use of the site would remain the same. The life span of the development was anticipated to be 100 years.

In compiling this report reliance was placed on document, Pre-Application Report 02, Issue number P01 dated March 2022 and was prepared by Pick Everard. The recommendations provided within this report are made exclusively in relation to the scheme outlined above and must not be applied to any other scheme without further

consultation with Soils Limited. Soils Limited must be notified about any change or deviation from the scheme outlined. Development plans provided by the Client are presented in Appendix B.

3.4 Published Geological Data

The 1:50,000 BGS map showed the site to be located upon Artificial Deposits, with superficial deposits of Kempton Park Gravel Member and bedrock of the London Clay Formation.

3.4.1 Artificial Deposits – Infilled Ground

Artificial Deposits (Made Ground) labelled as infilled ground exists where the natural ground surface has been excavated and subsequently partially or wholly backfilled with worked ground.

3.4.2 Kempton Park Gravel Member

The Kempton Park Gravel Member is part of the river terrace deposits, which form the base of the Maidenhead Formation. The river terrace deposits were formed by ancient floodplains associated with the rivers of south-east England. The rivers have been subject to at least three changes of level since Pleistocene times, forming a complex series of river terrace deposits. The Kempton Park Gravel is found at an elevation below the current river. The composition varies greatly, depending on the source material that was available in the river's catchment. Deposits generally consist of sands and gravels of roughly bedded flint or chert gravels commonly in a matrix of silts and clays.

3.4.3 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The upper boundary member of the London Clay Formation is known as the Claygate Member and marks the transition between the deep water, predominantly clay environment and succeeding shallow-water, sand environment of the Bagshot Formation.

The lower boundary is generally marked by a thin bed of well-rounded flint gravel and/or a glauconitic horizon. The formation overlies the Harwich Formation or where the Harwich Formation is absent the Lambeth Group.

3.5 Established Ground Conditions

An intrusive investigation was carried out by Soils Limited (ref: 20295/MIR, dated September 2022) comprising 4No. 4 to 5m deep boreholes and 1No. 20m deep borehole.

No groundwater was encountered during drilling of the borehole, with the speed of drilling likely masking any minor groundwater strikes. A single 6m borehole was installed and at the time report monitoring on a single occasion in September 2022. The groundwater was recorded at 4.00m below ground level (bgl).

The succession of ground conditions encountered in the boreholes, in descending order was summarised as:

Made Ground (MG)
Kempton Park Gravel Member (KPGR)
London Clay Formation (LC)

The ground conditions encountered in the trial holes are summarised in Table 3.1.

Table 3.1 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	G.L.	2.10 to 4.50	3.4	Variable between slightly sandy gravelly CLAY, clayey silty gravelly SAND, and sandy GRAVEL.
KPGR	Pleistocene	2.10 to 4.50	9.70	6.2	Yellowish brown slightly clayey gravelly SAND / sandy GRAVEL.
LC	Eocene	9.70	20.00[1]	>11.3[2]	Firm to stiff grey silty CLAY.

Note: [1] Final depth of trial hole. [2] Base of strata not encountered

3.6 Hydrology

The nearest surface water feature was the on-site lake, which was connected via a lock to the River Thames, located ~10m west. The lake was at an elevation similar to the River Thames of ~5m Above Ordinance Datum (AOD). The land south of the lake was rising in a southerly direction with the central point of the existing TYM complex at ~9m AOD, the land then rising to ~11m AOD along the southern boundary. The north-east section of the site and access route in from Riverside Drive had an elevation of between 8 and 9m AOD, based on Google Earth™ elevation data.

Surface water movements were anticipated to flow in an overall north direction into the lake. The infiltration rate of surface water into groundwater would be dependent on the precise cohesive or granular nature of underlying soils both vertically and laterally, which was highly variable due to the additional presence of Artificial Deposits (Made Ground).

3.7 Hydrogeology

The characteristics of the Made Ground encountered on-site was inconsistent and resulted in a wide range of highly variable permeability, the cohesive clay dominated Made Ground having relatively low to negligible permeability and the granular dominated a much higher permeability. The groundwater flow path direction would therefore be likely to be quite inconsistent, but with an overall flow direction to the north, into the lake.

Monitoring of the installed standpipe recorded groundwater at 4.00m bgl, which was approximately at an elevation of 5m AOD. The groundwater level would probably be linked to the water level within the lake and the tidal River Thames.

Section 4 Sources of Flood Risk

4.1 River and Sea Flooding

The Environmental/Natural Resources Wales (EA/NRW) (Appendix A) and LBRuT SFRA shows the flood zone to vary across the site area (red line boundary, Figure 5) and the development area (green line boundary, Figure 5). The area north of the lake and the lake itself was defined as Flood Zone 3. Flood defences were marked just south of the lake, with the southwestern corner defined as Flood Zone 1. The majority of the existing TYM complex was defined as Flood Zone 1, with exception of along the northern side beside the flood defence line. The area within the south-east corner, which also comprises the access zone was defined as Flood Zone 2. An extract from LBRuT SFRA Flood Data Map is presented in Figure 1.

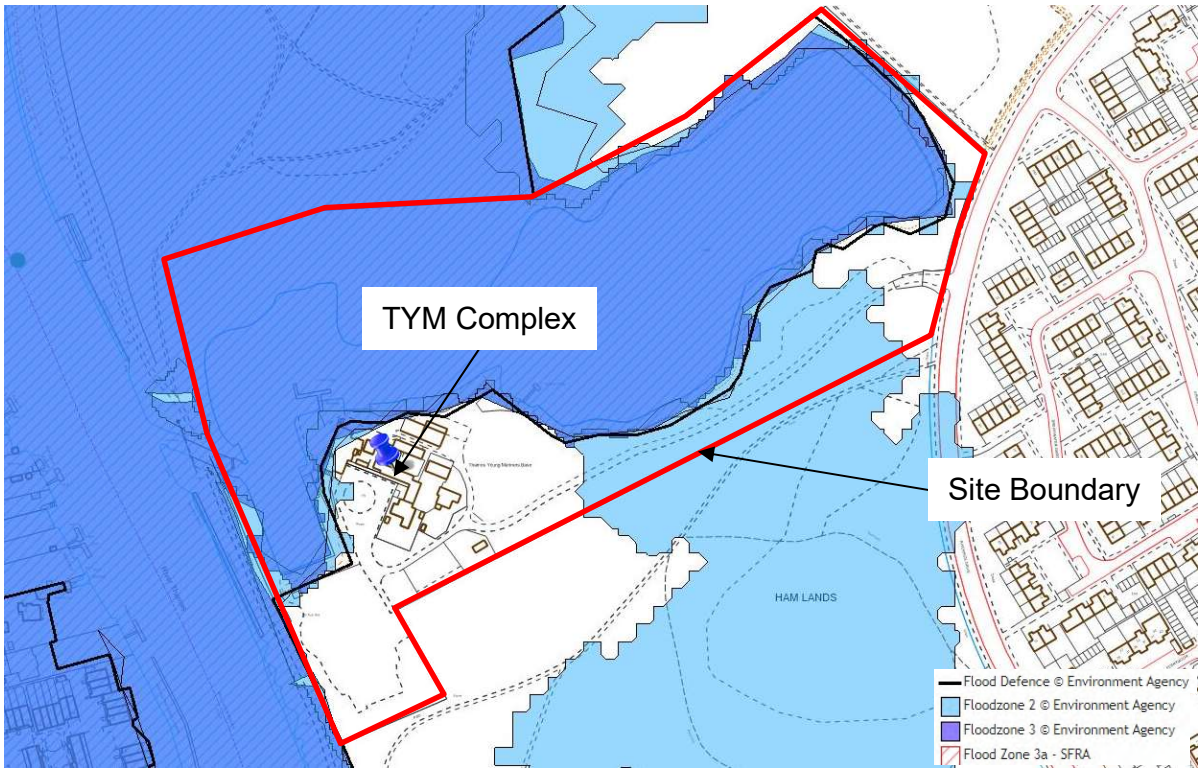

Figure 1 – Extract from LBRuT SFRA Fluvial and Tidal Flood Risk Web Map - Floodzone (Source: mapping.richmond.gov.uk)

The JBA flood maps (Appendix A) model fluvial flood depth at 75-to-1000-year returns. The 75-year return map shows minor patches of fluvial flooding of up to 1m depth past the flood defence line, but not encroaching onto the footprint of the existing TYM buildings. The flooding extended south was increasing with year return (75 to 1000 years) but there was no encroachment across the buildings until the 1000-year return. On the 1000-year return map the northwest corner of the existing main building was covered by a fluvial flood depth of 0.1 to 0.3m.

The Thames Estuary 2100 (TE2100) report undertook a study into trial flooding up to 2100. Extreme water levels were calculated for the River Thames, with the nearest TE2100 extreme water level spot height recorded at 7.05m AOD.

The proposed TYM complex buildings varied in use and vulnerability. The most vulnerable buildings, the guest/ staff accommodation buildings, were classified as more vulnerable. These buildings would be at an elevation of ~8-9m AOD, positioned in Flood Zone 1, with a low probability of flooding. The proposed main building was positioned on a similar footprint to the existing main building, with the north-west corner marked as Flood Zone 3. The remaining building was within Flood Zone 1. The north-east corner of site and access route from Riverside Drive to the TYM complex was classified as Flood Zone 2, due to slightly lower ground elevation.

There was a high to low probability of flooding from fluvial and tidal sources within the development area.

4.2 Surface Water Flooding

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. Increased run-off from developed areas consisting of impermeable surfaces can increase overland flows. If the flow paths of such overland flows are not carefully considered during detailed design and planning of the drainage, flooding from overland flows is also a potential source of flooding.

The EA/NRW surface water maps for 30-to-1000-year return showed a few minor pockets of surface water covering the body of the lake and along the southern boundary of the site. There was no surface water mapped within the proposed development area.

The LBRuT SWMP classified the site with a very low (<0.75 Caution) surface water flood hazard rating and was not within a Critical Drainage Area (CDA). There was noted very low risk of flooding from surface water within the development area.

4.3 Groundwater Flooding

Groundwater flooding can occur when water levels in the ground rise above surface elevations. Severe storm events or prolonged rainfall could cause groundwater levels to rise above ground level. Underlying geology is the principal factor that effects groundwater flooding. Groundwater flooding most commonly occurs in low-lying areas that are underlain by permeable rocks and/or aquifers.

The BGS groundwater susceptibility and LBR SFRA classified the lake with potential for groundwater flooding to occur at surface and the area to the south as potential for groundwater flooding of property situated below ground level.

The GeoSmart groundwater flood map (Appendix A) classified the eastern side of the TYM complex as negligible risk and the western side as low risk.

Groundwater was recorded at a depth of 4.0m bgl (~5m AOD) in September 2022 within the installed monitoring well. Groundwater levels are typically at their lowest elevation around September, increasing to their highest elevation around March. There was a low likelihood that groundwater would rise to ground surface within the proposed development area.

There was a low to negligible risk of groundwater flooding within the development area.

4.4 Sewer Flood Risk

Sewer flooding occurs where drainage systems are inundated exceeding system capacity or infrastructure fails. The proposed development will not materially change the site's use or expected to increase load onto the existing system. The LBRuT SFRA Thames Water Incident Map recorded 0 indoor and 0 outdoor incidents.

There was a low to negligible risk of sewer flooding within the development area.

4.5 Artificial Sources Flood Risk

Artificial flooding occurs generally because of infrastructure failure or human intervention. The EA flood risk map (Figure 2) shows the site to be at risk from reservoir flooding when there is also flooding from rivers, across the development area. The extent of the flooding is considered a worst-case and the likelihood of a reservoir breach low.

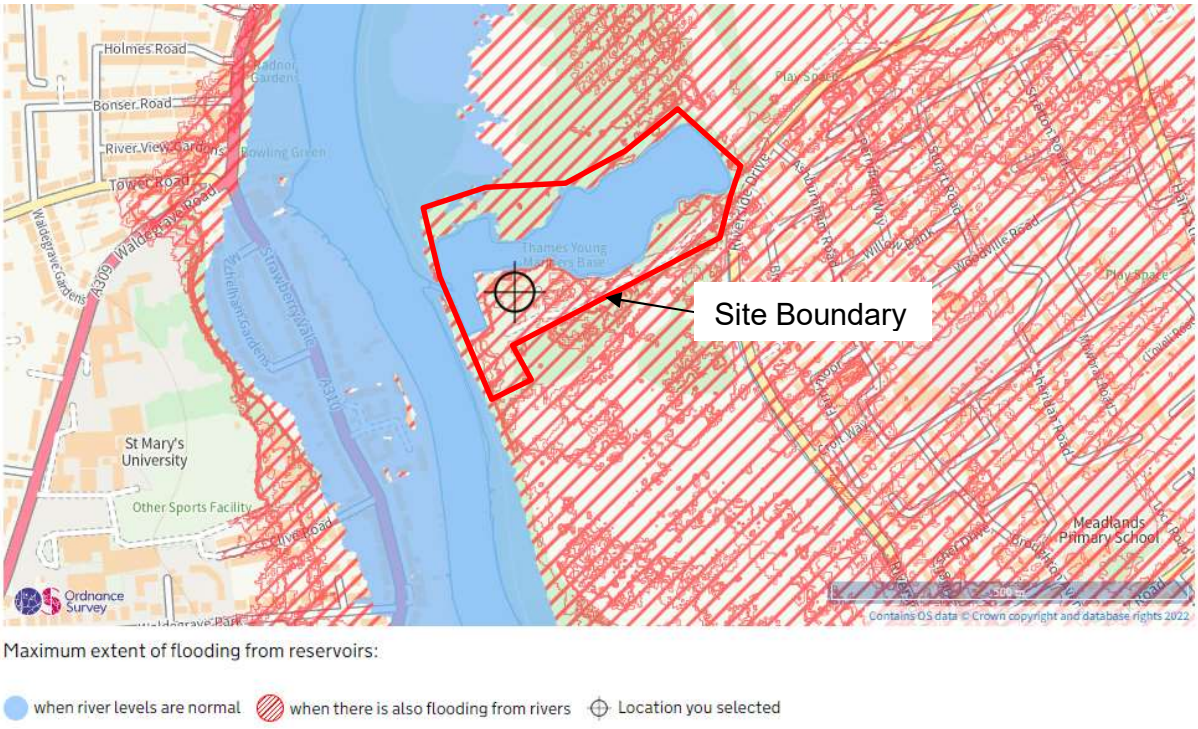

Figure 2 EA Flood Risk Map (Source: check-long-term-flood-risk.service.gov.uk)

The LBRuT SFRA did not identify any other artificial sources of flood risk within the site.

There was a low risk from of flooding from artificial sources within the development area.

4.6 Residual Risk of Flooding

The LBRuT SFRA Fluvial and Tidal Flood Risk Web Map provided details of the EA's Tidal Breach mapping. Tidal breach defences surround the southern end of the lake. On the western side of the TYM complex the tidal breach level was recorded as 7.55m AOD, dropping down to 6.18m AOD around the north-west corner and then rising to 8.3m AOD as you move eastward. The EA's maximum likely water level for 2100 was 6.45m AOD, which exceeds the minimum tidal breach level within the northwest corner. This corresponds to the tidal breach inundation zone around the northwest edge of the TYM complex, as presented in Figure 3.

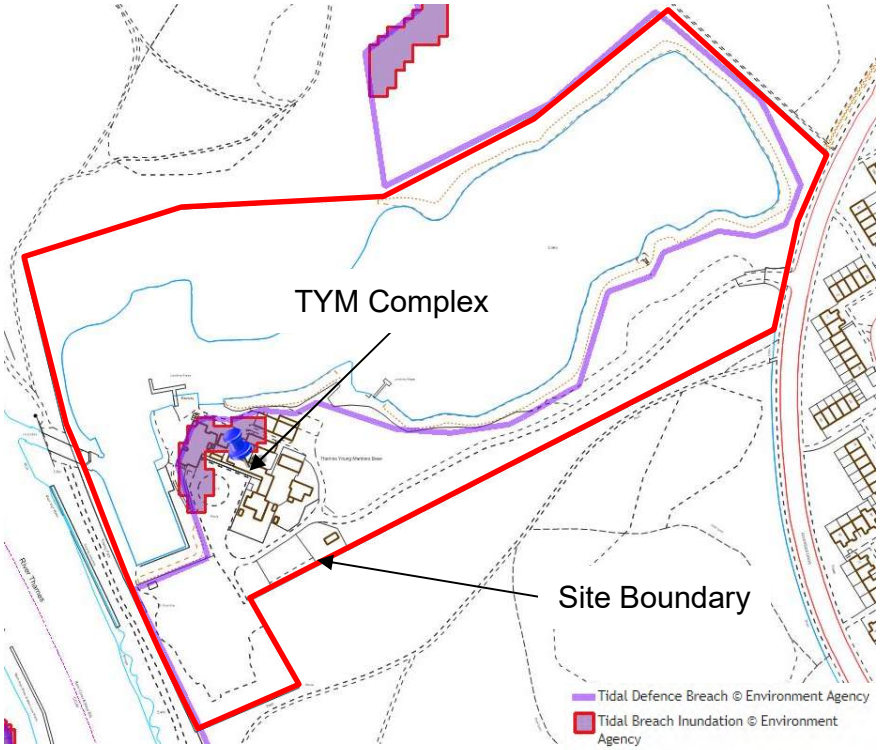

Figure 3 Extract from LBRuT SFRA Fluvial and Tidal Flood Risk Web Map – Tidal Breach (Source: mapping.richmond.gov.uk)

The majority of the TYM complex was outside the Flood Warning Area, which was general north of flood defences. However, around the north-west side the warning area extended over the footprint of the existing main building.

4.7 Historic Flooding

The EA/NRW Flood Map (Appendix A) presents historic flood incidents. The nearest historic flood was 156m south and related to fluvial flooding due to channel capacity exceeded.

The LBRuT SFRA Thames Water Incident Map recorded 0 indoor and 0 outdoor incidents around the site.

There was a low to negligible risk of flooding based on historical events.

4.8 Climate Change

EA guidance states that the end of life for current residential developments should be taken as 2115.

The climate change allowances are predictions of anticipated change for:

- peak river flow by river basin district
- peak rainfall intensity
- sea level rise
- offshore wind speed and extreme wave height

EA guidance Flood Risk Assessments: Climate Change Allowance gives data for the Thames River Basin district (www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances).

The following allowances should be made for peak rainfall allowances:

- Upper End Allowance: +40% for 2070 to 2115
- Central Allowance: +25% for 2070 to 2115

The effects of climate change must be considered in the design of the flood risk mitigation and drainage schemes for the proposed development.

Section 5 Surface Water Drainage

5.1 Sustainable Drainage Systems (SuDS)

The SWMP outlined the site to be within an area were infiltration SuDS suitable was uncertain and site investigation was required. The Soils Limited intrusive investigation (ref: 20295/MIR, dated 2022) established the ground conditions to be Made Ground (typical thickness 3.4m) overlying the Kempton Park Gravel Member (typical thickness 6.2m). The Made Ground had varying composition of clay, sand and gravel, and therefore had variable permeability. Pockets of cohesive clay soil would have low permeability and be unsuitable for SuDS but the granular deposits are likely to be suitable. The underlying Kempton Park Gravel Member was granular and expected to have a high permeability and suitability for drainage.

Two infiltration test locations were carried out to the principles of BRE 365 Soakaway Design. The tests were carried out in exploratory test holes to depths of between 2.40m and 3.20m bgl. The first location was carried out slightly gravelly sandy CLAY (reworked ground) and the second location within SAND and GRAVEL of the Kempton Park Gravel Member. The slightly gravelly sandy CLAY was found to have insufficient soakage and an infiltration rate could not be calculation. For the Kempton Park Gravel Member an infiltration rate of 1.99×10^{-3} m/sec was calculated, indicating good soakage potential and suitable for infiltration SuDS.

Due to the variability in ground conditions the development will likely have to adopt a combined system of attenuation and infiltration SuDS.

Reference must be made to The SuDS Manual C753 CIRIA November 2015 and local planning constraints as outlined in the local plans and statements for LBRuT. The SuDS design for the proposed development will implement a SuDS “management train” to use a variety of drainage techniques in series to incrementally reduce pollution, flow rates, volumes, and frequency of runoff. Run-off prevention and source control ensures that flows are managed, and silt is removed towards the beginning of the drainage system. The SuDS “management train” comprises:

- Prevention - good housekeeping measures within development
- Source control - managing runoff at or near its source where it falls as rain
- Site control - dealing with runoff within or local to the development site

The final aspect of the SuDS management train is the concept of off-site regional control, which is the control of runoff in amenity space SuDS features before final outfall.

The hierarchy above seeks to ensure that surface water run-off is controlled as near to its source as possible to mimic natural drainage systems and retain water on or near to the site, in contrast to traditional drainage approaches, which tend to pipe water off-site as quickly as possible.

Before disposal of surface water to the public sewer is considered all other options set out in the drainage hierarchy should be exhausted. When no other practicable alternative exists to dispose of surface water other than the public sewer, the Water Company or its agents should confirm that there is adequate spare capacity in the existing system taking future development requirements into account.

Section 6 Off-Site Impact

6.1 Impact Assessment

The new development would cover a similar footprint to the existing structures, but with a new building layout. The development will not change the site's use and the proportion of hard landscaping would remain approximately the same as the existing TYM complex. Most of the new development was within Flood Zone 1, with a low probability of flooding. A new drainage system will be installed in line with current LBRuT guidance, with surface water managed by a SuDS management train. The Soils Limited intrusive investigation (ref: 20295/MIR, dated 2022) comprised infiltration testing, which indicated good soakage potential in the Kempton Park Gravel, and suitable for infiltration SuDS. The Made Ground was found to be variable and in places considered unsuitable for infiltration SuDS which under current guidance should not be established in Made Ground if avoidable.

The new development will largely remain similar to the existing TYM complex, but have betterment of surface water management, which will be designed to current guidance requirements.

The new development was considered likely to have only a very low to negligible impact on off-site infrastructure.

Section 7 Conclusion

7.1 Summary

The proposed development comprised demolition of the existing TYM complex and associated building and the construction of new TYM complex auxiliary buildings. The new development would cover a similar footprint, but with a new building layout, and the addition of a staff accommodation building along the southern boundary. The layout comprised a main building located in the northwest corner followed by three guest accommodation buildings arranging approximately in a circle southeast of the main building. To the east of the main building was a changing block, and along the southern boundary was a staff accommodation building. Within the southwestern corner of the site was a camping changing block and repair workshop.

Most of the new development, including the more vulnerable guest/staff accommodation buildings were to be emplaced within Flood Zone 1, with a low probability of flooding from fluvial and tidal sources. The risk from surface water flooding was very low risk and negligible to low risk from both groundwater and sewer flooding. The site was in an area where flooding could occur due to reservoir failure, when there is also flooding from rivers. The reservoir breach models are based on a worst-case scenario and the probability of failure occurring was considered low.

However, the northwest side of the main building would be in Flood Zone 2 and the peripheral of the building within Flood Zone 3, corresponding to a medium and high probability of flooding. The JBA flood maps model for a 1000-year return showed a flood depth of 0.1 to 0.3m covering the corner of the proposed main building.

The site was accessed via a roadway that runs along the southern side of the lake connecting to Riverside Drive in the northeast corner of The Site. A section of the access road was within Flood Zone 2, with the remaining roadway within Flood Zone 1.

For residual risk of flooding the EA's maximum likely water level for 2100 was considered. Existing flood defences were located around the southern side of the lake. The lowest part of the defences was located off the northwest corner of the main building and would be breached by the estimated maximum likely water level for 2100. The extent of the tidal breach inundation (Figure 3) covers the entirety of the main building and the very northwest corner of the westernmost guest accommodation building. All remaining buildings were outside the tidal breach inundation zone.

There was a low to negligible risk of flooding based on historical events.

The effects of climate change must be considered in the design of the flood risk mitigation and drainage schemes for the proposed development.

Due to the variability in ground conditions the development will likely have to adopt a combined system of attenuation and infiltration SuDS.

The new development was considered to have a very low to negligible impact on off-site infrastructure.

7.2 Consideration of Flood Risk

The northwest side of the proposed main building was to be located within Flood Zones 2/3. Consideration should be given to the feasibility of moving the main building into an area wholly within Flood Zone 1. If this is not possible an exception test will be required to show how the development will manage the identified potential flood risk.

Where buildings cannot be located in a lower flood risk area or the ground floor level cannot be raised, flood resistance and resilience measures will be required. EA's guidance for mitigation measures for 0.3m to 0.6m flooding include:

- Using material with low permeability to at least 0.3m,
- Using flood resilient materials and design,
- Making sure there's access to all spaces to enable drying and cleaning.

Tidal breach mapping for likely water levels by 2100 indicate over topping of the existing flood defences around the northwest side of the existing main building. The lowest point of the existing flood defences was at 6.18m AOD with the likely maximum water level within this area at 6.45m AOD. The breach inundation area covers the proposed footprint of the new main building and the northwest edge of the westernmost new guest accommodation building. Even if a 75-year design life was adopted for the development, the buildings within this area are at risk of future tidal inundation unless additional mitigation measures of some form are emplaced.

Parts of the site are at risk of current and future flooding events, primarily the northwest side of the main building and a section of the access road. A Flood Emergency Plan is therefore recommended in line with LBRuT planning advice - Guidance on Producing a Flood Emergency Plan.

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Figure 4 – Site Location Map

Job Number 20295	**Project** Thames Young Mariners, Riverside Drive, Richmond TW10 7RX
Client Surrey County Council	**Date** September 2022

Figure 5 – Aerial Photograph

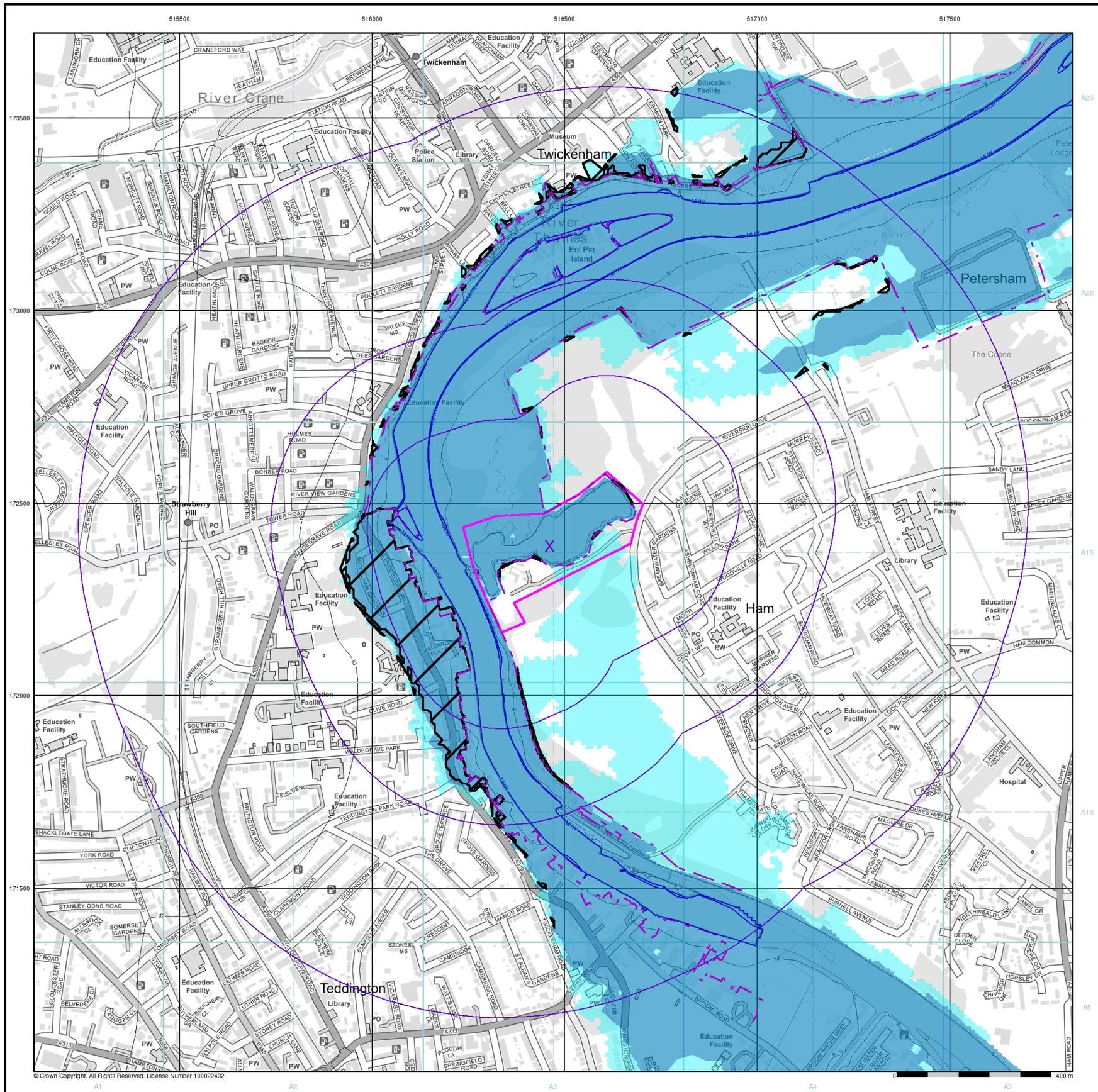
Project
Thames Young Mariners, Riverside Drive, Richmond TW10 7RX

Client
Surrey County Council

Date
September 2022

Job Number
20295

Appendix A Flood Screening Report



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EA/NRW Flood Data Map (1:10,000)

General

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

Flood Data

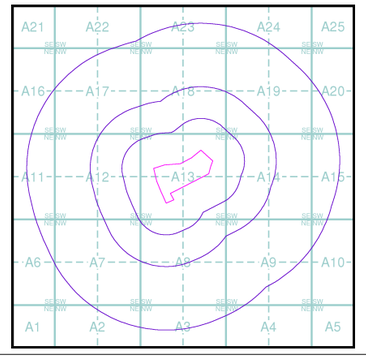
- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Contours (height in metres)

Standard Contour 105 100 95
Master Contour
Spot Height *167.8

MLW Mean Low Water
MHW Mean High Water

EA/NRW Flood Data Map - Slice A



Order Details

Order Number:	301324359_1_1
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National Grid Reference:	516460, 172390
Slice:	A
Site Area (Ha):	8.93
Search Buffer (m):	1000

Site Details

Thames Young Mariners O E C, Ham Fields, RICHMOND, TW10 7RX

Landmark INFORMATION GROUP
Tel: 0844 844 9952
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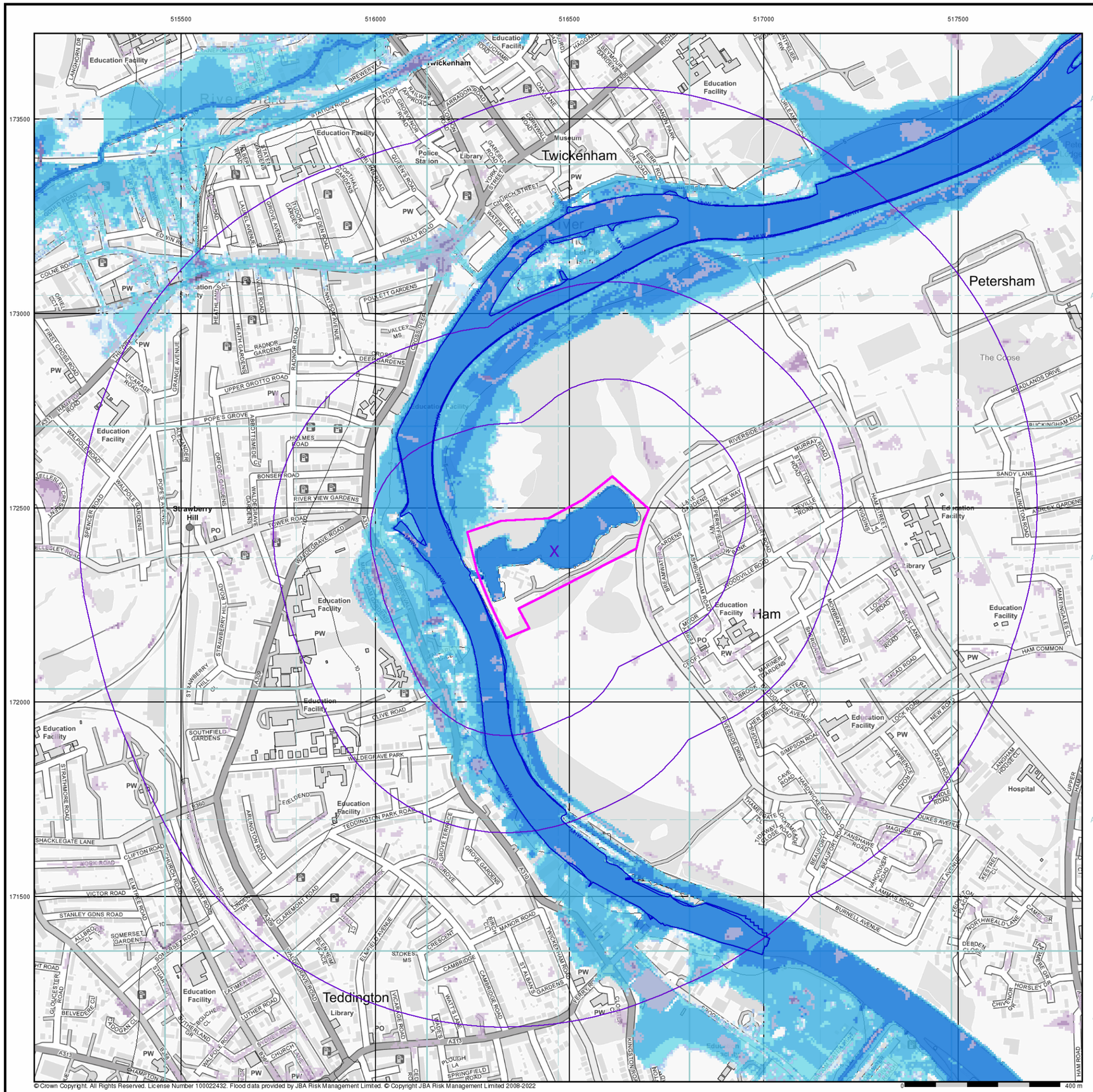

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JBA 75 Year Return Flood Map (Undefended) (1:10,000)

General

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

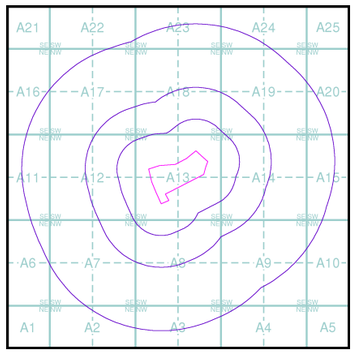
Modelled Flood Depth

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 105 100 95
Master Contour
Spot Height 157.8
MLW Mean Low Water
MHW Mean High Water

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



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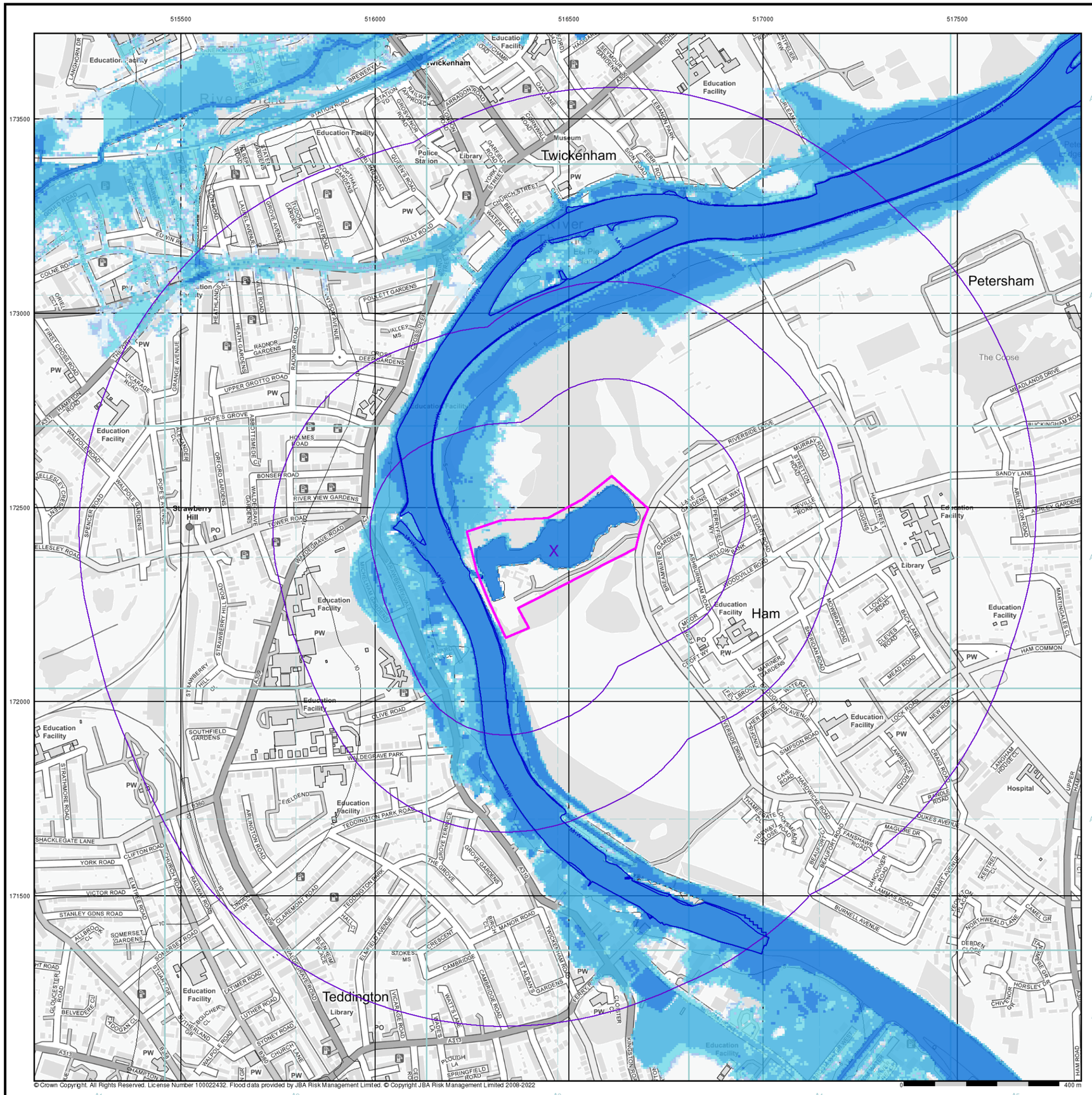

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JBA 100 Year Return Flood Map (Undefended) (1:10,000)

General

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

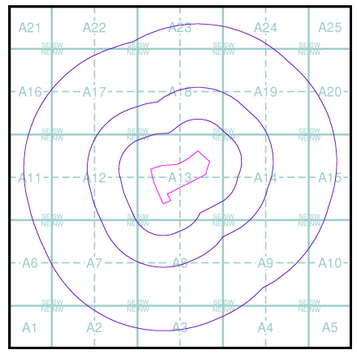
Modelled Flood Depth

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

Contours (height in metres)

Standard Contour 105 100 95 — MLW Mean Low Water
Master Contour — MHW Mean High Water
Spot Height 167.8

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



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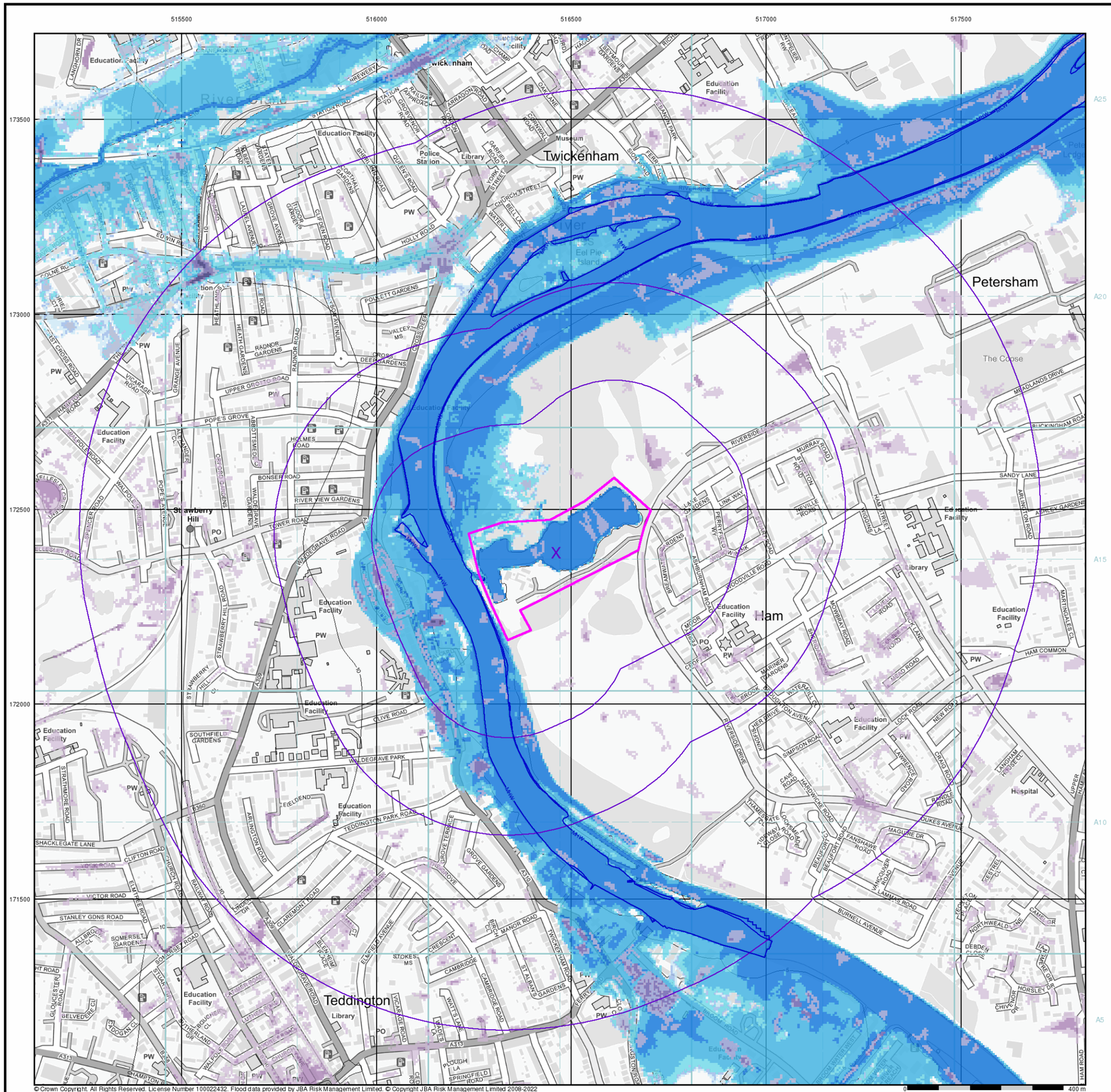

0 400 m

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

General

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

Modelled Flood Depth

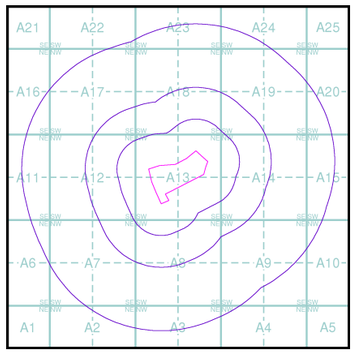
Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

Contours (height in metres)

Standard Contour 105 100 95
Master Contour
Spot Height 157.8

MLW Mean Low Water
MHW Mean High Water

JBA 200 Year Return Flood Map (Undefended) - Slice A



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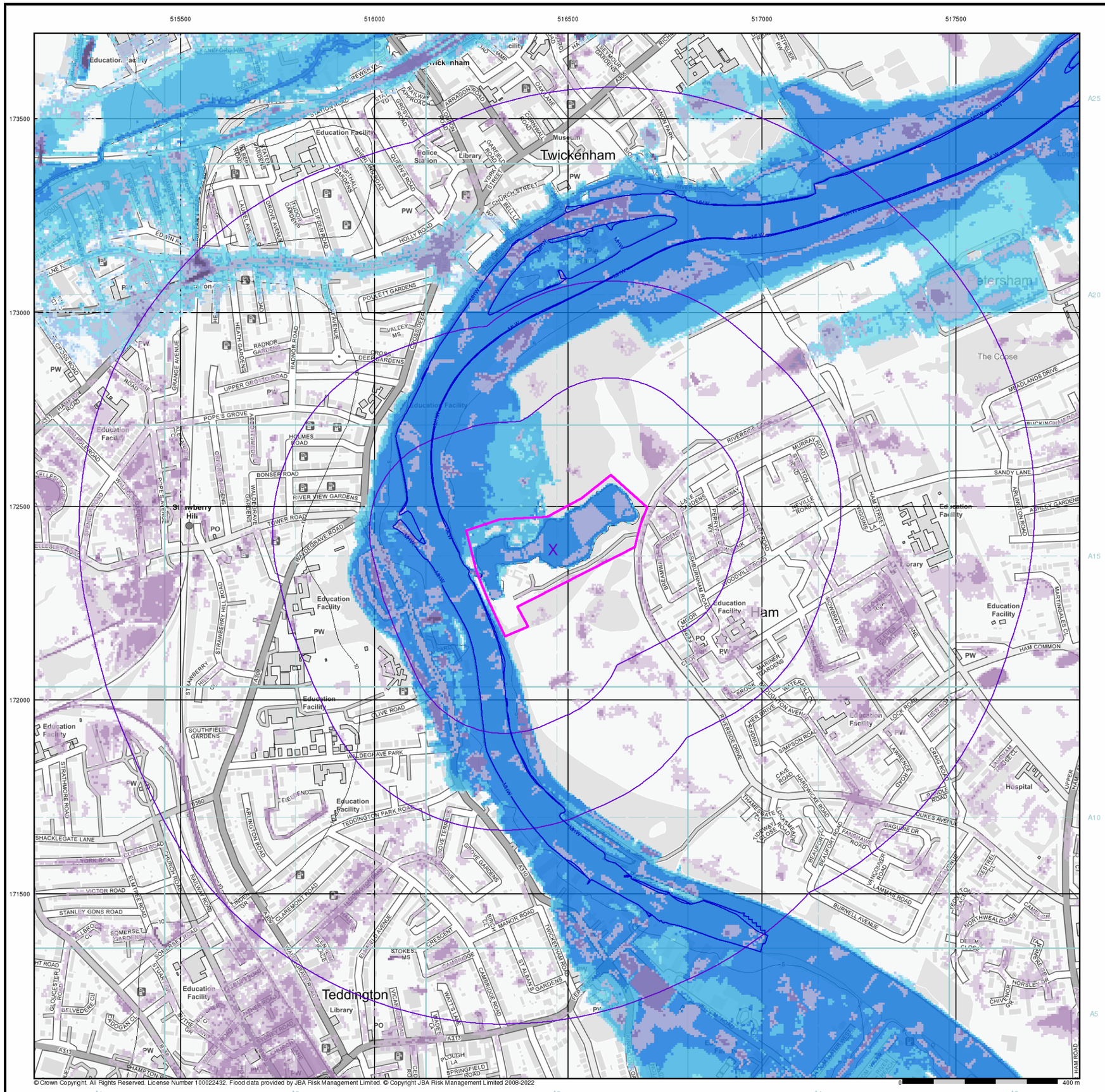

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JBA 1000 Year Return Flood Map (Undefended) (1:10,000)

General

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

Modelled Flood Depth

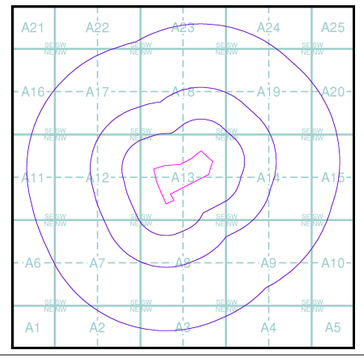
Pluvial Depth	Fluvial Depth	Coastal Depth
0.1m	0.01m - 0.05m	0.01m - 0.05m
0.1m - 0.3m	0.05m - 0.1m	0.05m - 0.1m
0.3m - 1m	0.1m - 0.3m	0.1m - 0.3m
>1m	0.3m - 1m	0.3m - 1m
	>1m	>1m

Contours (height in metres)

Standard Contour 105 100 95
Master Contour
Spot Height 157.8

MLW Mean Low Water
MHW Mean High Water

JBA 1000 Year Return Flood Map (Undefended) - Slice A



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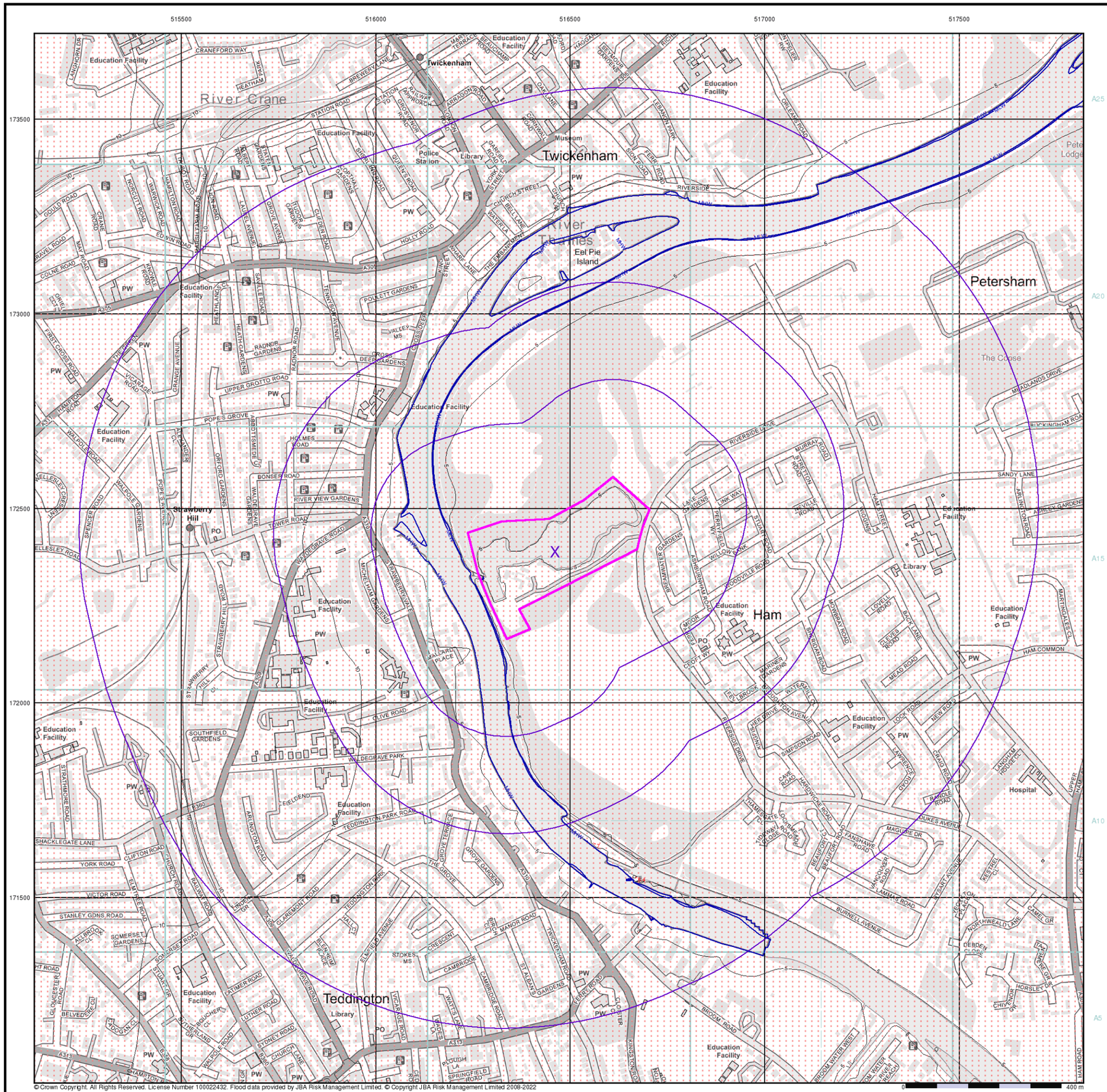

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JBA Canal Failure Map (1:10,000)

General

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

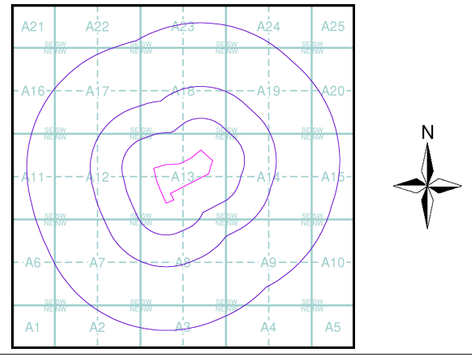
Flood Data

- Canal Failure
- Coverage

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height *167.8
- MLW Mean Low Water
- MHW Mean High Water

JBA Canal Failure Flood Map - Slice A



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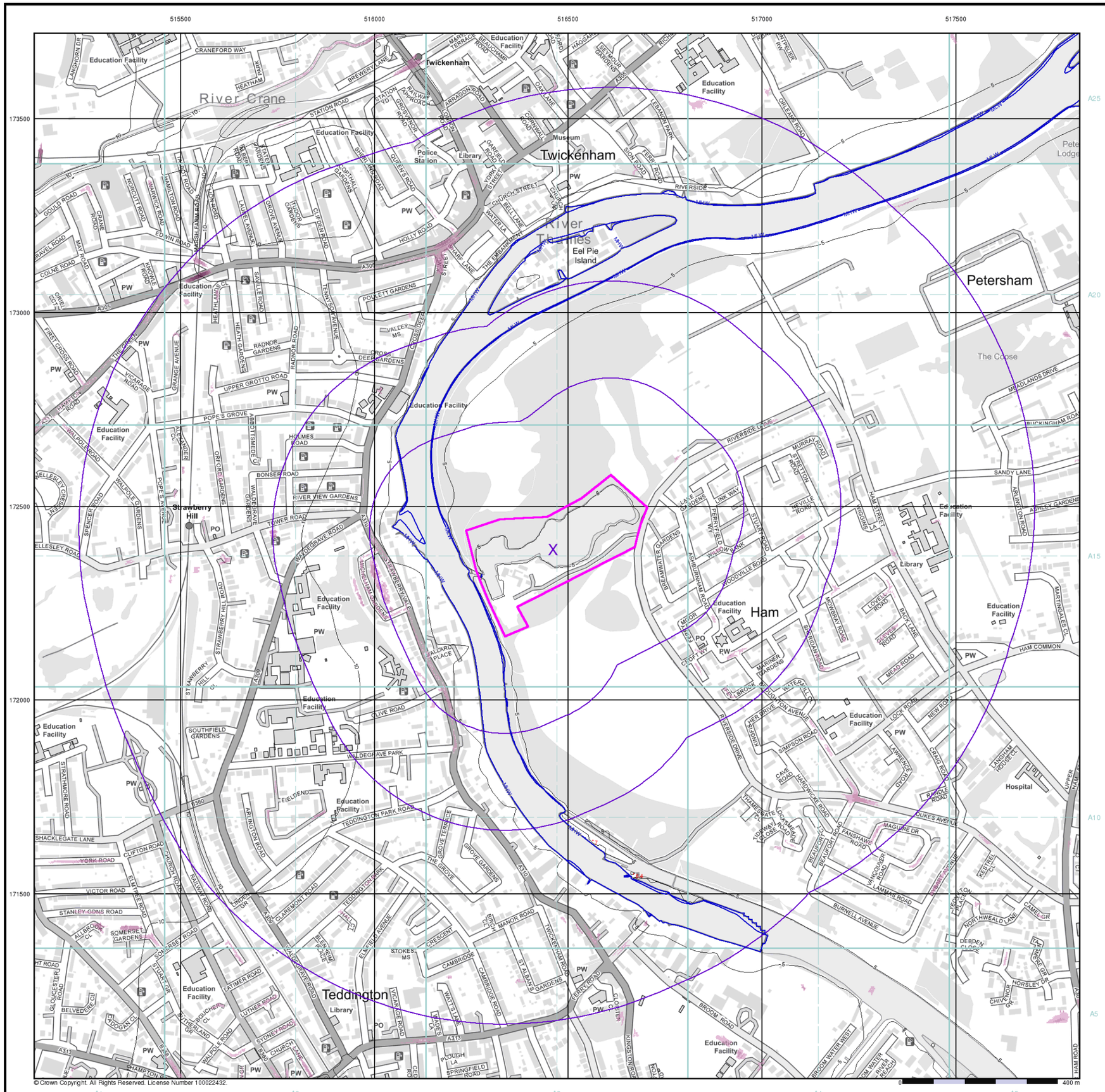

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EA/NRW Surface Water 30 Year Return Depth Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X 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 | Master Contour | Spot Height (167.8)

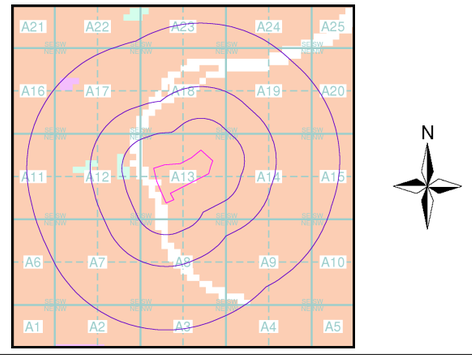
MLW Mean Low Water
MHW Mean High Water

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



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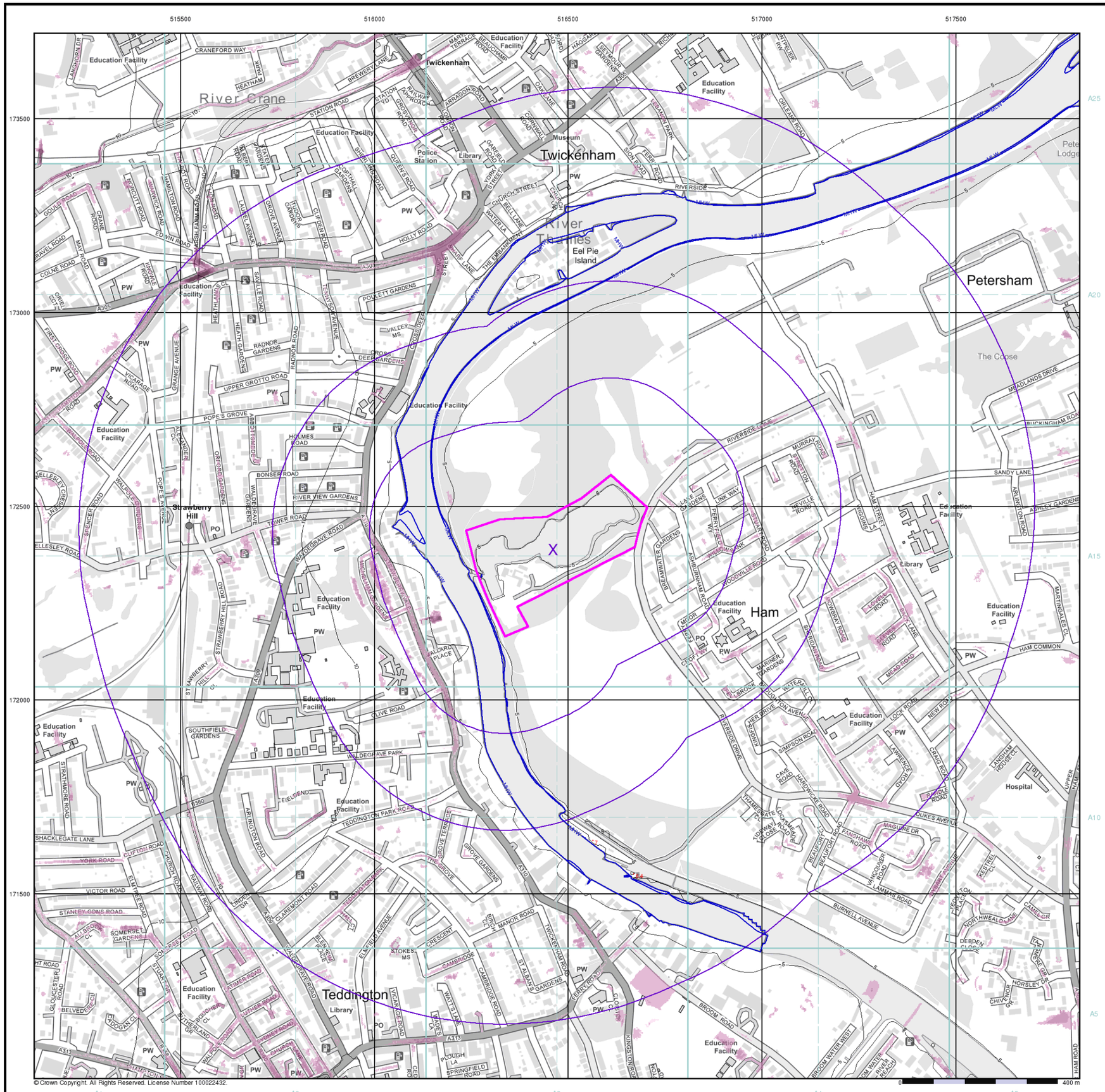


soils LIMITED
Geotechnical & Environmental Consultants

EA/NRW Surface Water 100 Year Return Depth Map

General

Specified Site | Specified Buffer(s) | X 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)

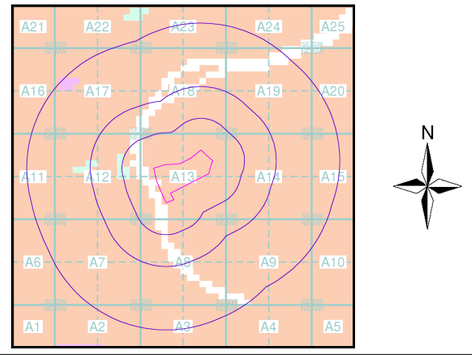
Standard Contour | Master Contour | Spot Height (167.8) | MLW Mean Low Water | MHW Mean High Water

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



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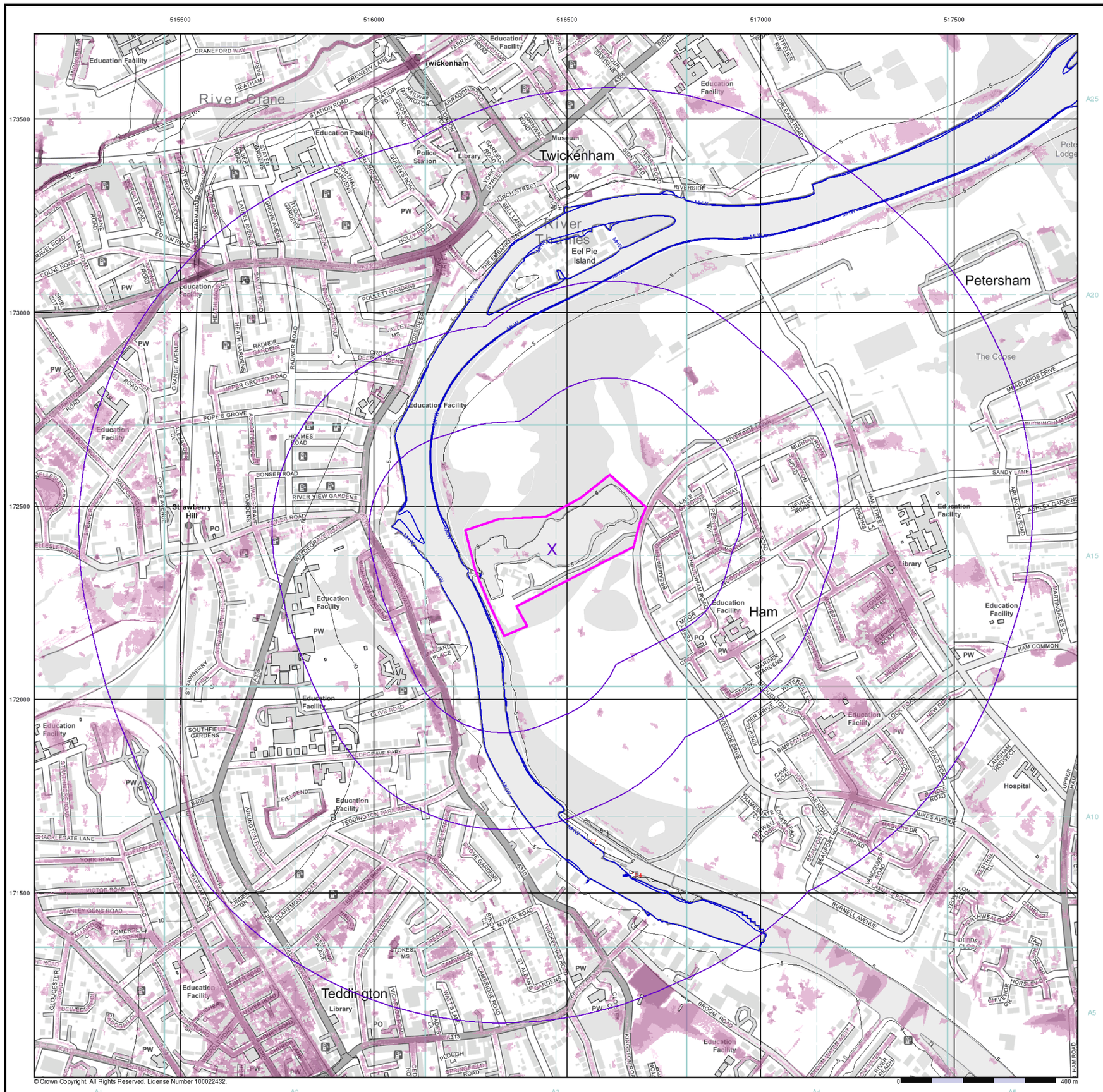

soils LIMITED
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EA/NRW Surface Water 1000 Year Return Depth Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X 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 105 100 95 — MLW Mean Low Water

Master Contour — MHW Mean High Water

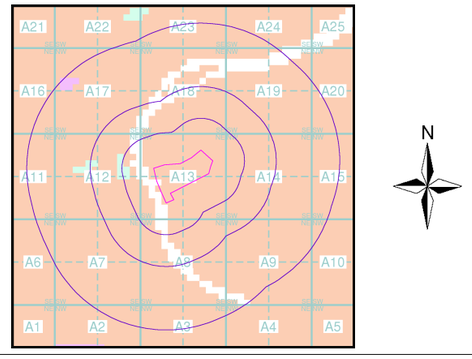
Spot Height * 167.8

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



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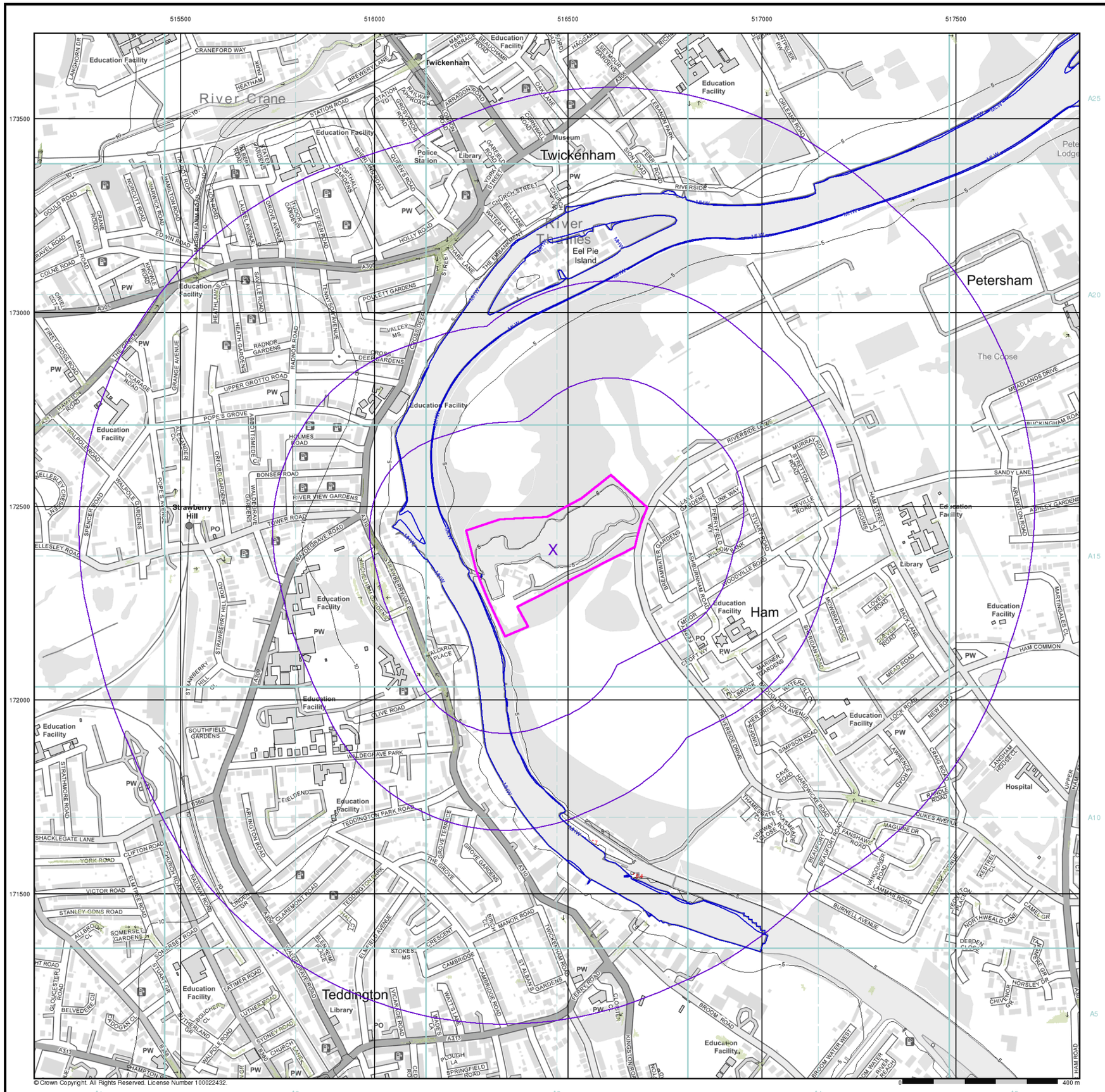

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EA/NRW Surface Water 30 Year Return Velocity and Flow Direction Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X 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 105 100 95
Master Contour
Spot Height *167.8

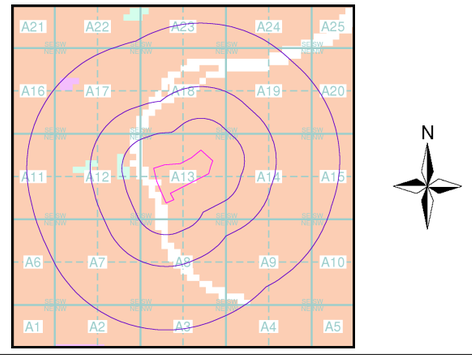
MLW Mean Low Water
MHW Mean High Water

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



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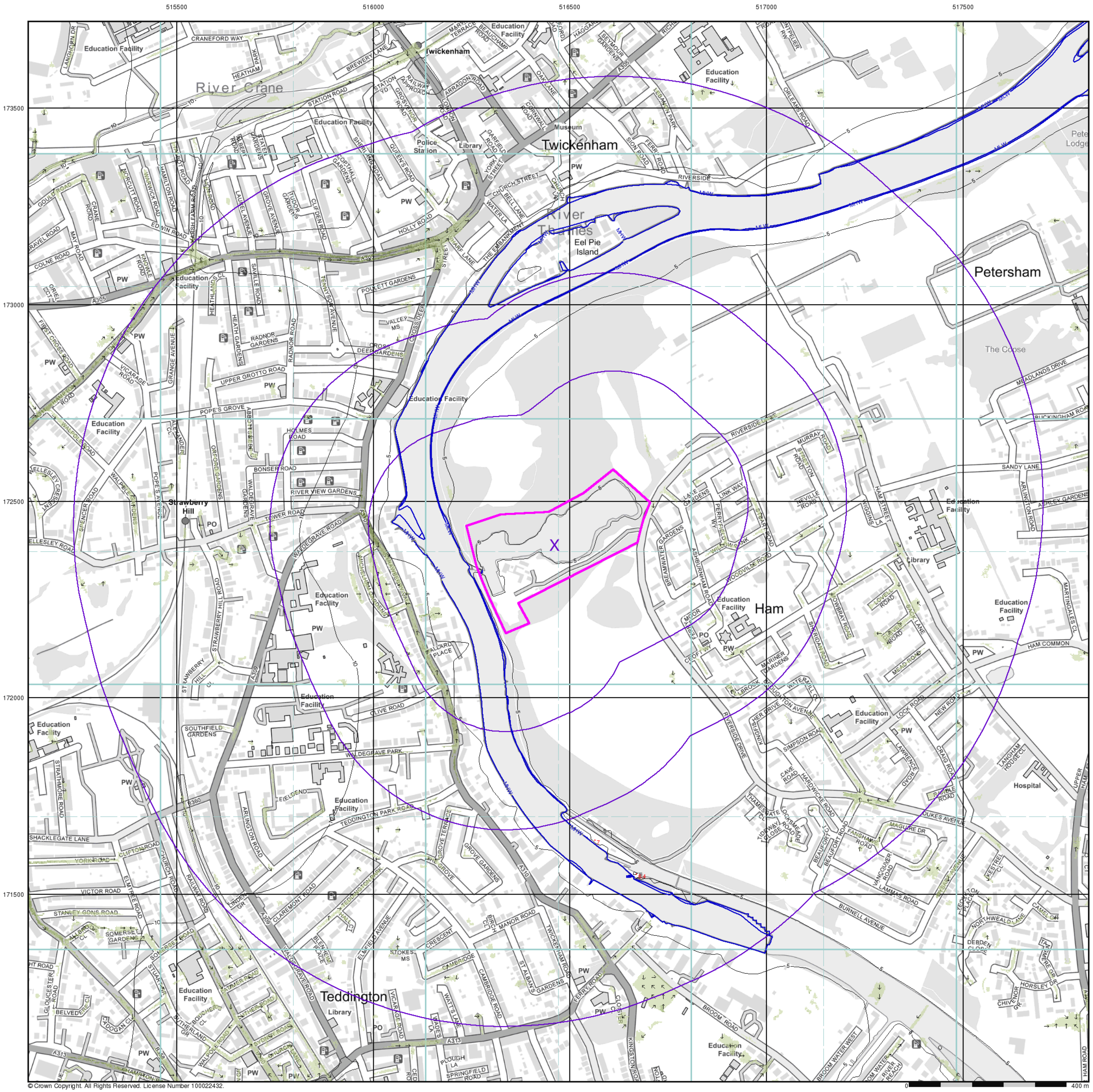

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EA/NRW Surface Water 100 Year Return Velocity and Flow Direction Map (1:10,000)

General

Specified Site
Specified Buffer(s)
X 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)

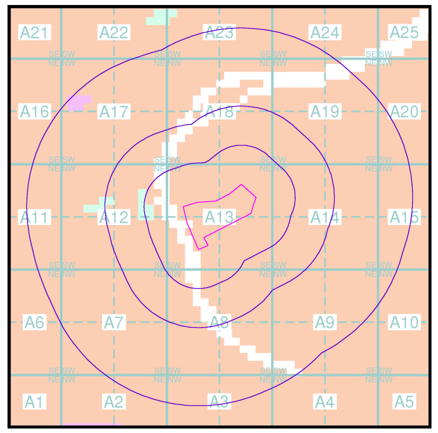
Standard Contour
Master Contour
Spot Height 167.8
MLW Mean Low Water
MHW Mean High Water

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



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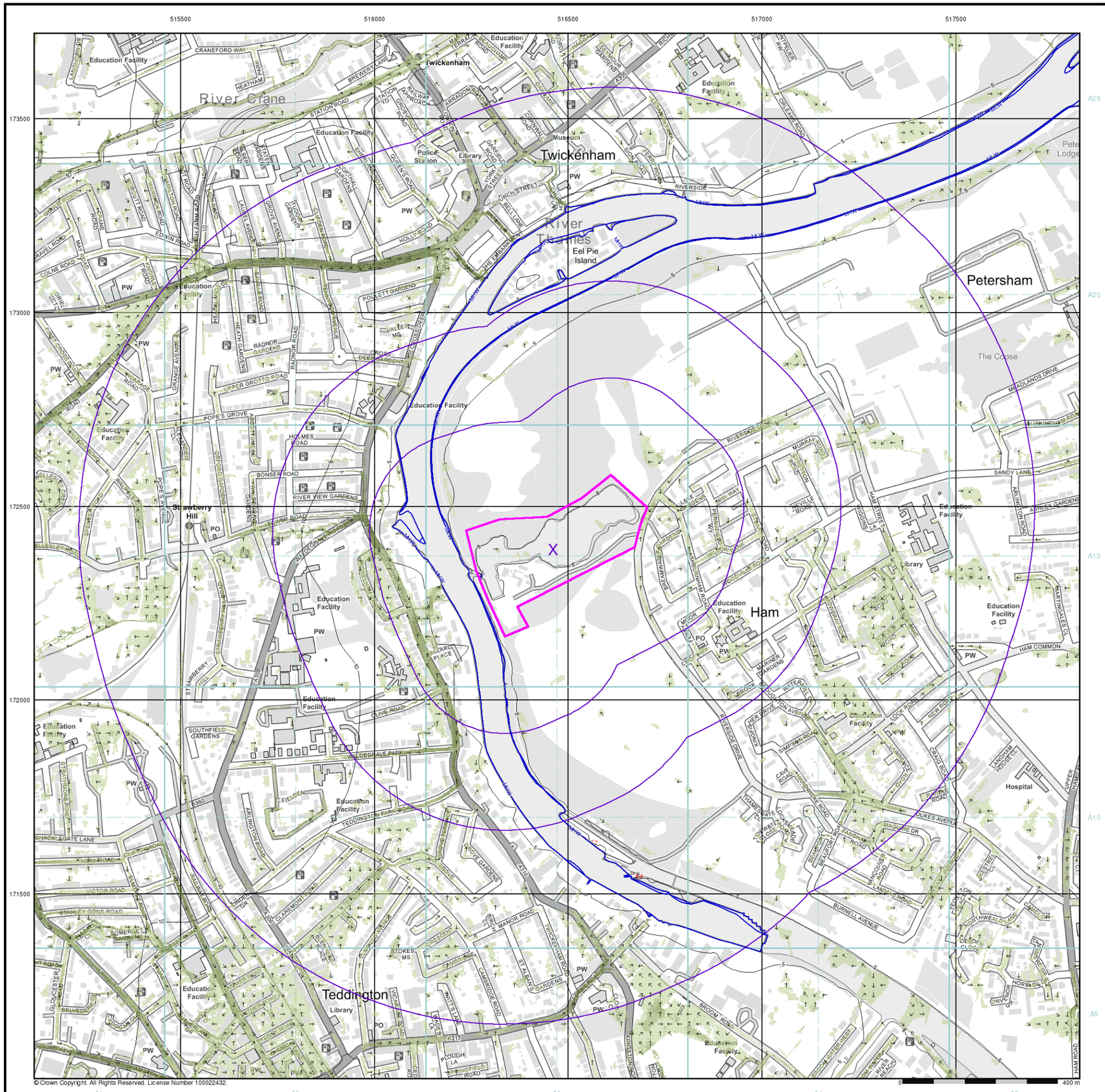

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EA/NRW Surface Water 1000 Year Return Velocity and Flow Direction Map (1:10,000)

General

Specified Site | Specified Buffer(s) | X 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 105 100 95 — MLW — Mean Low Water

Master Contour — MHW — Mean High Water

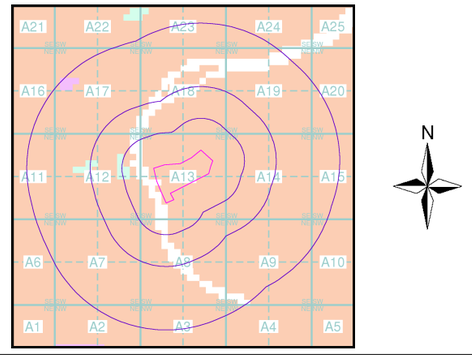
Spot Height *167.8

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



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