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Flood Risk Assessment
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Weston Homes

REPORT

Anglia Square Regeneration, Norwich, Norfolk

Flood Risk Assessment

Client: Weston Homes

Reference: 6645-RHD-ZZ-XX-RP-Z-0001
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1 Purpose Of This Update

1.1 A hybrid planning application (Ref. 22/00434/F) (the Application) was submitted by Weston Homes (the Applicant) to Norwich City Council (NCC) on 1st April 2022 for the comprehensive redevelopment of Anglia Square and various parcels of mostly open surrounding land, (the Site), as shown within a red line on drawing 'ZZ-00-DR-A-01-0200'. The Application comprised a full set of technical documents to assess the potential impacts of the proposals, including an EIA which covered several topics. In respect of the flood risk assessment, this was described and explained in the Flood Risk Assessment (31/03/22) and other associated drawings. Please refer to the original documents for further details.

1.2 Following submission of the Application, and completion of the statutory consultation exercise, the Applicant has worked with NCC to review the consultation responses received from the local community, statutory consultees and other key stakeholders, so as to identify an appropriate response where considered relevant. As a result of consideration of these comments, as well as ongoing discussions with NCC, a number of changes to the Application as originally submitted are now proposed, including the reduction in height by 1 storey of Blocks A and D; realignment of basement and ground level car park accesses to Block A; repositioning of houses and apartments forming Block B; amendments to the housing mix; raising of Block C ground level to above 100year (+climate change) flood levels; distance between Block C and 4-10 Beckham Place increased; elevational changes and repositioning of Block L (Stump Cross building); roof ridge and eaves on east side of Block M reduced in height; introduction of 2 storey podium between Blocks E and EF to provide larger car park; proposed crossings on Edward Street (opposite Beckham Place) and Pitt Street (by Tooley Lane) removed; and landscape amendments. These changes comprise the Amended Application submitted in July 2022. Overall, the Amended Application continues to seek consent for up to 1,100 dwellings and up to 8,000 Sqm (NIA) non-residential floorspace and associated development. However, since the amendments result in minor changes to the full development description, an updated version of the full Amended Application description is contained in Section 4 of this report.

1.3 The update to the Flood Risk Assessment (31/03/22) includes where necessary a response to the flood risk related comments received on the Application as originally submitted. This report then describes how the design has been developed and adapted as a result of these and other comments, and finally considers the implications of the changes to the scheme now proposed.

1.4 The clarifications and changes in the Amended Application arising from the flood risk related comments are summarised in **Table 1** and the comments are included in full in **Appendix A**.

Table 1: Comments received on the Flood Risk Assessment (31/03/22)

Comment Received	Response from Project Team
Norfolk County Council	
1) An updated Flood Risk Assessment (FRA), Drainage Strategy and Hydraulic Modelling Study that consistently provides information that interlinks each of the documents.	Cross references have been added throughout this document where appropriate.
2) Within the FRA, Drainage Strategy, Hydraulic Modelling Study and yet to be developed detailed drainage design, we	The issues identified in the Annex have been addressed within this report.

Comment Received	Response from Project Team
request these documents incorporates the evidence to address the issues identified in the Annex.	
2.1) The assessment of the greenfield and brownfield runoff rates and volumes are required to be calculated accurately using the FEH in accordance with the LLFA Developer Guidance requirements and presented clearly and consistently within the technical reports.	Addressed in Drainage Strategy Report prepared by EAS
2.2) Provide evidence to support the justification of increasing the greenfield discharge rate is required in accordance with the LLFA Developer Guidance.	Addressed in Drainage Strategy Report prepared by EAS
2.3) Apply the latest (May 2022) climate change guidance (1 in 100 +45%CC and 1 in 30+40%CC)	All model runs now include the latest climate change allowance, which were released post completion of the previous FRA. See Figures in Appendix I and J
2.4) Evidence of recent liaison with Anglian Water relevant to this new planning application that provides: 2.4.1) Confirmation from Anglian Water that no changes have occurred in the public network since 2017; 2.4.2) Obtain recent drainage assessment from Anglian Water that relates to current proposed development; 2.4.3) Provide current set of DG5 records from Anglian Water; 2.4.4) Provide evidence of 'agreement in principle' with any third parties taking on drainage maintenance and management responsibilities.	Addressed in Drainage Strategy Report prepared by EAS
2.5) Provide a more in-depth consideration and assessment of rainwater harvesting and reuse opportunities on site.	Addressed in Drainage Strategy Report prepared by EAS
2.6) Provide a more in-depth consideration of groundwater flood risk	Included at 7.10 onwards and 8.52
2.7) Provide a more in-depth consideration of sewer flood risk	Included at 7.3 and 8.59
2.8) Provide clarification on the retention of surface water runoff on the site and whether this is actually the provision of either blue or green roofs not previously included in the surface water drainage calculations	Addressed in Drainage Strategy Report prepared by EAS
2.9) Provide clarification on water depths for the return periods given at Edward Street Service Yard.	Clarified in 5.38-5.40
2.10) Prepare and provide a full detailed drainage design that includes all the proposed elements of the surface water management system. This includes clarification of the design details (including plans, modelling, calculations and supporting information in accordance with the LLFA's Developer Guidance) of	Addressed in Drainage Strategy Report prepared by EAS

Comment Received	Response from Project Team
suitable drainage featured, such as green/blue roofs, bio-retention features and tree-pits.	
2.11) Provide the proposed discreet drainage catchment areas and supporting information on a plan for each of the proposed systems in accordance with the LLFA Developer Guidance.	Addressed in Drainage Strategy Report prepared by EAS
2.12) Undertake an assessment that demonstrates how the proposed SuDS systems meets the four pillars of SuDS in accordance with the LLFA Developer guidance and in relation to Policy E9 of the Local Flood Risk Management Plan.	Addressed in Drainage Strategy Report prepared by EAS
2.13) Undertake a further assessment and consideration of the carbon impact of additional pumps operating on this site is recommended in accordance with Policy E8 of the Local Flood Risk Management Plan.	Addressed in Drainage Strategy Report prepared by EAS
2.14) Prepare a surface water drainage phasing plan for the development.	Addressed in Drainage Strategy Report prepared by EAS
2.15) Provide updated water quality assessment information that acknowledge the inclusion of all elements of the SuDS system.	Addressed in Drainage Strategy Report prepared by EAS
2.16) Provide further information regarding the water quality management approaches required for the construction of the proposed development	Addressed in Drainage Strategy Report prepared by EAS
2.17) Identify and assess the residual risk and provide suitable mitigation associated with the management of pumps and the attenuation tanks.	Addressed in Drainage Strategy Report prepared by EAS
2.18) provide a site layout plan that demonstrates all surface water drainage features sized appropriately and to ensure suitable space is available within the proposed development The design should be in accordance with both the LLFA Developer Guidance, the Ciria Suds manual, the building regulations and other relevant local and national guidance, practices and policies.	Addressed in Drainage Strategy Report prepared by EAS
2.19) Provide detailed information of the design and operation of the flood barrier for inclusions	Not required – Alternative mitigation measures discussed in Section 8
2.20) Update the hydraulic model and drainage strategy to ensure they are consistent with other technical disciplines submissions	RHDHV have further liaised with EAS and Weston Homes to ensure consistency with respect to the updates.
2.21) An assessment of the surface water treatment required for all elements of the proposed development to determine whether the SuDS system is providing an appropriate amount of water quality treatment.	Addressed in Drainage Strategy Report prepared by EAS
2.22) A surface water drainage design that includes a site plan with appropriately sized SuDS Features and conveyance with both the LLFA Developer Guidance and the Ciria SuDS Manual.	Addressed in Drainage Strategy Report prepared by EAS

Comment Received	Response from Project Team
2.23) Identification of structures to be placed below ground and assessment of groundwater flood risk and specific mitigation measures to manage this	Included at 7.10 onwards and 8.52
2.24) A Maintenance and Management Plan detailing the activities required to manage the proposed SuDS including confirmation of ownership, maintenance responsibilities and in principle agreements.	Addressed in Drainage Strategy Report prepared by EAS
2.25) Provide an updated assessment of the suitability of the different types of SuDS components on the site.	Addressed in Drainage Strategy Report prepared by EAS
2.26) Provide further evidence to support the viability of the Edward Street Service Yard residual risk mitigation and clarification on whether an automated barrier can be installed	Flood barrier no longer required – see 5.38-5.43
2.27) The Emergency Flood Plan should be prepared in accordance with the ADEPT guidance (2019) and demonstrate ongoing liaison with the relevant Emergency Planning Team	Acknowledged. Norwich City Council Emergency Planning Team were contacted and agreed the Flood Plan could be conditioned (Appendix M and 8.41)
2.28) An assessment of the potential to install some flow and level monitoring gauges to enable the site manager to monitor and manage the flood risk onsite	No longer required – Section 8 discusses amended mitigation measures
2.29) Update the assessment of the residual flood risks within the FRA for the proposed development and its components	Included at 8.59 onwards
2.30) Inclusion of an updated Exceedance Flow Routes Plan for the site with proposed finished floor levels marked on.	Addressed in Drainage Strategy Report prepared by EAS
2.31) Both the FRA and Drainage Statement require updating to address the large number of statements and conjecture that are not supported by evidence. These statements and assessments need to be evidence based.	Noted. This FRA is supported by evidence where it is available.
2.32) Provide a proposed drainage design with supporting evidence that provides evidence of inclusion and support the proposed offsite drainage of surface water for the car park entrance and service yard entrance on Edward Street. The evidence should demonstrate that the mitigation is appropriate, operable and 'agreed in principle' by Anglia Water along with identifying who will be responsible for the maintenance and management	Drainage from service yard to Anglian Water sewer in Edward Street no longer required as service yard will not flood in any event up to and including the 100 year (+45%CC) event. A drain with a flap valve has been included in this area which now connects into the onsite drainage system in the event that an event greater than the 1 in 100 year (+45%CC) occurs and floodwater reaches this area. (Discussed in 8.11)
2.33) Provide clarifications from the Applicant on whether the inclusion of flood doors have been considered on the proposed development	Flood doors are not required – all residential uses FFL raised at least 300mm above 100 year (+45%CC) flood level (Section 8 and 5.46)
2.34) Provide discussion on whether an alternative design approach and location was considered before placing the car park entrance ramp on Edward Street	Included at 3.48-3.58

Comment Received	Response from Project Team
2.35) Provide an assessment of flow entering the basement car park should mitigation not be installed or the failure of mitigation measures	Model was run for proposed scenario with no mitigation measures – 5.39-5.40 and Table 3
2.36) Provide evidence the proposed development scheme that in accordance with NPPF where "*the development should be made safe for its lifetime without increasing flood risk elsewhere*"	Discussed in Sections 6 and 8
2.37) Address all LLFA queries given in the attached Annex	Noted and included throughout this FRA
3.1) Confirmation that the key parameters (URBEXT, catchment area etc) have been checked and the parameters where appropriate adjusted accordingly	Section 6 of the hydraulic modelling report: 'Anglia Square Norwich Modelling Study (July 2022)'
3.2.1) Provide an updated model that includes sewers for the sewer network affecting parts of the site included in this application	Model has been updated to include nearby Anglian Water sewers – please refer to 'Anglia Square Norwich Modelling Study (July 2022)' and 5.25
3.2.2) Is extended to cover the full catchment to ensure the inflows are calculated correctly	Model has been extended to cover wider catchment – please refer to 'Anglia Square Norwich Modelling Study (July 2022)' and 5.23
3.3) Provide clarification on whether Anglian Water has been contacted to supply sewer data. This should be requested and included where interactions with the sewer system are likely to impact flooding.	Sections 4.26 and 7.6
3.4) The inclusion of information regarding the onset of flooding and its associated duration for vulnerable locations across the site including the basement car park entrance and the service yard and loading facilities	Time to peak flood maps included via link in Appendix I. However, alternative mitigation measures now included (Section 8) to provide safety of vulnerable areas which is not reliant on alerts from elsewhere in the catchment/site.

2 Introduction

2.1 This Flood Risk Assessment (FRA) has been prepared by Royal HaskoningDHV on behalf of Weston Homes Plc (the Applicant) in support of a hybrid (part full/part outline) planning application, (the Application), submitted to Norwich City Council (NCC) for the comprehensive redevelopment of Anglia Square and various parcels of mostly open surrounding land, (the Site), as shown within a red line on drawing '35301-ZZ-00-DR-A-01-1000' (**Appendix B**).

2.2 The Site is located in a highly accessible position within the northern part of Norwich City Centre and comprises a significant element of the Anglia Square/Magdalen Street/St Augustine's Large District Centre, (the LDC). It is thus of strategic importance to the City, and accordingly has been identified for redevelopment for many years within various local planning policy documents, including the Northern City Centre Area Action Plan 2010, (NCCAAP), (now expired), the Joint Core Strategy for Broadland, Norwich and South Norfolk 2014, (JCS), and NCC's Anglia Square and Surrounding Area Policy Guidance Note 2017, (PGN). The Site forms the principal part of an allocation (GNLP 0506) in the emerging Greater Norwich Local Plan (GNLP).

2.3 This application follows a previous application on a somewhat smaller development parcel, (NCC Ref. 18/00330/F) made jointly by Weston Homes Plc as development partner and Columbia Threadneedle Investments, (CTI), the Site's owner, for a residential-led mixed use scheme consisting of up to 1,250 dwellings with decked parking, and 11,000 sqm GEA flexible ground floor retail/commercial/non-residential institution floorspace, hotel, cinema, multi-storey public car park, place of worship, and associated public realm and highway works. This was subject to a Call-in by the Secretary of State (PINS Ref. APP/G2625/V/19/3225505) who refused planning permission on 12th November 2020, (the 'Call in Scheme').

2.4 In April 2021, following new negotiations with Site owner CTI, Weston Homes decided to explore the potential for securing planning permission for an alternative scheme via an extensive programme of public and stakeholder engagement, from the earliest concepts to a fully worked up application. The negotiations with CTI have secured a "Subject to Planning" contract to purchase the Site, (enlarged to include the southeastern part of Anglia Square fronting Magdalen Street and St Crispins Road), which has enabled a completely fresh approach to establishing a redevelopment scheme for Anglia Square. This has resulted in a different development brief for the scheme, being to create a replacement part of the larger LDC suited to the flexible needs of a wide range of retail, service, business and community uses, reflective of trends in town centre character, integrated with the introduction of homes across the Site, within a highly permeable layout, well connected to its surroundings.

2.5 The new development proposal seeks to comprehensively redevelop the Site to provide up to 1,100 dwellings and up to 8,000sqm (NIA) flexible retail, commercial and other non-residential floorspace including Community Hub, up to 450 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), car club spaces and associated works to the highway and public realm areas (the Proposed Development). These figures are maxima in view of the hybrid nature of the application. This proposes part of the scheme designed in full, to accommodate 353 dwellings, 5,411sqm non-residential floorspace, and 137 car parking spaces (at least 95% spaces for residential use, and up to 5% for non-residential use), with the remaining large part of the Site for later detailed design as a "Reserved Matters" application, up to those maxima figures.

2.6 This FRA documents the flood risks, hydraulic modelling study and impact assessment relating to the proposals. Mitigation measures have also been addressed in this section. The accompanying hydraulic modelling report (Anglia Square Norwich Modelling Study (July 2022)) details the technical aspects of the modelling study. The proposed drainage strategy and SuDS methods which could be implemented at the site are included in the Proposed Surface Water Drainage Strategy, prepared by EAS.

2.7 The site is located entirely within Flood Zone 1 on the Environment Agency (EA) Flood Zone maps, so is at a low risk of fluvial flooding (less than 1 in 1000 probability of flooding each year). As the development site is greater than 1 hectare in size, the National Planning Policy Framework (NPPF) requires a site-specific flood risk assessment to consider the other sources of flooding and drainage options for the site, to demonstrate that any additional surface water runoff from the proposed development can be managed sustainably without increasing flood risk to others.

2.8 The Norwich Surface Water Management Plan (SWMP) (Nov 2011) shows the site is located in a Critical Drainage Area (CDA), identified as CDC2: Catton Grove and Sewell. This CDA primarily occupies the historic valley of one of the lost streams of Norwich known as the Dalymond Ditch. This has resulted in surface water from the upper catchments channelling water through the local area towards the River Wensum. In addition, there is a history of sewer flooding within the CDC2 catchment. The site is located at the southern end of the CDA and mapping from the SWMP shows there to be existing surface water flow paths through the site. Given the sensitive location of the site, it was necessary to obtain, update and re-run the existing CDC2 hydraulic model to identify the vulnerable areas and recommend suitable mitigation measures.

2.9 This report is based on EA Flood Maps, the results of the amended surface water flood model covering the site, the Joint Core Strategy for Broadland, Norwich and South Norfolk, Strategic Flood Risk Assessment (SFRA), the Norwich Urban Area Flood Investigations report, BGS geological information, OS mapping, and topographic survey data.

2.10 The contents of each section of this document are as follows:

Section 2 provides an introduction to the document.
Section 3 sets out the national, regional and local flood risk policies.
Section 4 describes the site conditions.
Section 5 analyses the surface water flood risk.
Section 6 discusses the offsite impacts.
Section 7 considers other potential flood sources.
Section 8 details suitable mitigation measures.
Section 9 contains the conclusions of the study.

3 Policy Framework

National Policy

3.1 The contents of this FRA are based on the advice set out in the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG), published in July 2021.

3.2 Paragraph 167 footnote 55 of the NPPF states:

"A site-specific flood risk assessment should be provided for all developments in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use".

3.3 The flood risk zones are defined as follows:

- Flood Zone 1 – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river flooding (<0.1%).
- Flood Zone 2 – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding.
- Flood Zone 3a – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), and for tidal flooding at least a 0.5% annual probability of flooding from tidal sources.
- Flood Zone 3b – This zone comprises land where water has to flow or be stored in times of flood.

3.4 A copy of the Environment Agency's Flood Map is included in **Appendix C**. The mapping shows that the site is located entirely within Flood Zone 1 and therefore deemed to be at low risk of fluvial or tidal flooding.

3.5 Key requirements of the NPPF relating to flood risk for major developments are set out as follows:

3.6 The development should:

- be made safe for its lifetime without increasing flood risk elsewhere (NPPF Para 159)
- is appropriately flood resistant and resilient (NPPF Paragraph 167.b)
- incorporates a sustainable drainage system (NPPF Paragraph 167.c)
- have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development (NPPF Paragraph 169.c)
- have appropriate proposed minimum operational standards (NPPF Paragraph 169.b)

3.7 The FRA should:

- assess flood risk from all sources (NPPF Paragraphs 160, 161 and 162)

- steer new development away from areas of flood risk both at a strategic (NPPF Paragraph 162) and site level basis (NPPF Paragraph 167.a)
- Demonstrate that any residual risk can be managed safely (NPPF Paragraph 167.d)
- Show that safe access and escape routes are included as part of an agreed emergency plan (NPPF Paragraph 167.e)
- take account of advice from the lead local flood authority (LLFA) (NPPF Paragraph 169.a)

3.8 The above national policy guidance has been taken into account within this site-specific FRA, which should be read alongside the proposed SuDS drainage strategy which offers a reduction in the level of flood risk within the local area.

Local Policy

Greater Norwich Local Plan (GNLP)

3.9 There is an emerging development plan, the Greater Norwich Local Plan (GNLP) which is being prepared by Broadland DC, South Norfolk Council, NCC and Norfolk County Council, (the Partnership), that will supersede the Joint Core Strategy for Broadland, Norwich and South Norfolk (2014) (JCS) and Norwich Site Allocations and Site Specific Policies Local Plan (2014) (NSASSP) once adopted. The GNLP Reg 19 version was submitted to the Secretary of State for examination on 30th July 2021.

3.10 The examination process is underway, for which hearing sessions took place during February and March 2022. As a result of the hearings, many policies, including the emerging allocation for the Site were subject to debate, addressing their soundness and the consequential need for amendment, alongside requests for additional information by the Inspectors. It is therefore considered likely the Council will prepare and consult upon Modifications or at least minor changes to both policy text and supporting text, relevant to this application. This process, and the publication of the Inspectors' report may extend beyond the determination of this application, and so final GNLP policy wording may not be available at that stage.

3.11 Paragraph 48 of the National Planning Policy Framework 2021 (NPPF) requires decision makers to give weight to relevant policies of emerging Local Plans according to the stage of preparation, the extent of unresolved objections, and the degree of consistency between emerging policies and the NPPF. In this instance, there are currently unresolved objections, in respect of some of which the Inspectors have requested additional information, and accordingly there are likely to be Modifications to some policies relevant to this application before they can be considered sound. On this basis, it is considered that in respect of those policies, the emerging development plan currently holds limited weight in decision making. In this context, those policies are not considered in detail.

3.12 It is noted that Anglia Square has been identified as a new allocation under Policy GNLP0506 of the GNLP. This states:

"The capacity of Anglia Square to deliver a significant element of the plan's housing need on a highly accessible brownfield site means that is has strategic significance for Greater Norwich. The Employment, Town Centre and Retail Study (GVA, 2017) acknowledges the considerable

potential of Anglia Square to accommodate a much-enhanced retail and leisure offer including extensive public realm improvements.

Development of the site must address a number of constraints including…critical drainage catchment area."

3.13 The Sequential Test should be applied to new development sites at high risk of flooding, to direct development to areas with the lowest flood risk. However, given that the site has been allocated for a mixed-use development in the GNLP, it is considered to have already passed the Sequential Test.

Local Plan for Norwich

3.14 The Adopted Local Plan for Norwich (2014) is made up of the Joint Core Strategy (JCS) for Norwich City Council, Broadland District Council and South Norfolk District Council; the Site Allocations and Site-Specific Policies Local Plan (2014) and Development Management Policies Local Plan (2014).

3.15 Norwich City Council are working with Broadland District Council, South Norfolk District Council and Norfolk County Council to prepare the Greater Norwich Local Plan (GNLP) which will plan for development until 2036. However, this has not yet been adopted so the 2014 Local Plan is still current.

Joint Core Strategy for Broadland, Norwich and South Norfolk

3.16 The Joint Core Strategy (JCS) was adopted by Norwich City Council in March 2011, along with Broadland District Council and South Norfolk District Council. The JCS amendments were adopted in 2014. The JCS is the strategic development plan document in the Local Development Framework (LDF) and sets out principles for future development within the boroughs until 2026.

3.17 Objective 1 of the JCS is to minimise contributors to climate change and address its impacts throughout the area. With regards to flooding, this means that new developments will be generally guided away from areas with a high probability of flooding. In areas where new development is required for reasons of sustainability, flood mitigation and flood protection will be maintained and enhanced.

3.18 Policy 1: *Addressing climate change and protecting environmental assets* sets out how this objective will be achieved, highlighting that development should be located to minimise flood risk, mitigating any such risk through design and implementing sustainable drainage.

3.19 Policy 11: Norwich City Centre states:

"*Areas of the city centre will be comprehensively regenerated:….the Northern City Centre will be developed in accordance with its Area Action Plan to achieve physical and social regeneration, facilitate public transport corridor enhancements, and utilise significant redevelopment opportunities."*

3.20 This policy identifies the requirement for regeneration in the Northern City Centre, where the site is located.

3.21 The JCS discusses key areas for new development in Policy 14, and notes at paragraph 6.57 that "*New development will have to take particular account of surface water flooding issues".*

Development Management Policies Local Plan

3.22 The Development Management Policies Plan (DM policies) sets out policies which will apply across the whole city, as well as policies which apply in designated areas. The purpose of this document is to help guide and manage change and development in Norwich until 2026.

3.23 Policy DM5: Planning effectively for flood resilience details the policy for flooding, sustainable drainage and surface water flooding and surface treatment. The policy states:

"Developers will be required to show that the proposed development:

- *would not increase the vulnerability of the site, or the wider catchment, to flooding from surface water run-off from existing or predicted water flows; and*
- *would, wherever practicable, have a positive impact on the risk of surface water flooding in the wider area.*

Development must, as appropriate, incorporate mitigation measures to reduce surface water runoff, manage surface water flood risk to the development itself and to others, maximise the use of permeable materials to increase infiltration capacity, incorporate on-site water storage and make use of green roofs and walls wherever reasonably practicable.

The use of permeable materials, on-site rainwater storage, green roofs and walls will be required unless the developer can provide justification to demonstrate that this would not be practicable or feasible within the constraints or configuration of the site, or would compromise wider regeneration objectives."

3.24 The landscaping of the development in terms of surface water management is also considered in Policy DM5. This states:

"*Development proposals will be required to maximise the use of soft landscaping and permeable surfacing materials unless the developer can provide justification to demonstrate that this is not feasible.*

Where permission is required, proposals involving the provision of new or replacement paved and other impermeable surfaced areas will only be permitted:

- *in areas of impermeable soils as identified in Appendix 1;*
- *in other areas where it can be demonstrated that permeable surfaces are not practicable due to poor soil infiltration capacity, high groundwater levels or risk of subsidence; and*
- *in areas with soils with average or good infiltration capacity, where it can be demonstrated that there is an exceptional and overriding justification for such surfaces.*

In cases where poor soil infiltration capacity or other factors preclude the use of permeable surfacing materials, development proposals should seek to manage and minimise the impact of surface water run-off by suitable measures for water storage on-site."

3.25 The proposed drainage strategy will incorporate sustainable drainage (SuDS) and is detailed in the Proposed Surface Water Drainage Strategy prepared by EAS. Surface water runoff from the site will be restricted as far as possible to ensure that the risk of flooding both to the site and elsewhere is minimised, taking into account the effects of climate change.

Investigation Report into the flooding within the Norwich Urban Area during the summer of 2014 (Report Ref. 622) (January 2015)

3.26 Norfolk County Council prepared the investigation report into flooding within the Norwich Urban Area in 2015, following significant flooding within Norwich as a result of rainfall on the 27th May and 20th July 2014 where 80 properties flooded internally. The report was prepared in consultation with Norwich City Council, Broadland District Council, Anglian Water and the Fire and Rescue Service.

3.27 The key findings of the flood investigation report are as follows:

a) Maintenance is not co-ordinated between Anglian Water and the relevant Highways Authority where connected drainage systems are in multiple ownership. This contributes to flooding.
b) Access constraints within the Norwich City area limit the maintenance on drainage systems and it is difficult to determine where drainage cannot be maintained by contractors.
c) There is a lack of regular maintenance in the Norwich Urban Area, partly due to insufficient resources being allocated to regularly maintain drainage systems.
d) Highway drainage systems are not fully mapped or digitised, so it is difficult to schedule maintenance.
e) Impacts of increased impermeable surfaces at private properties (e.g. driveways) and unmaintained or insufficient property level drainage.
f) Significant flooding experienced where properties are located along natural flowpaths or low points, e.g. close to historic watercourses and historic drainage features such as ponds.
g) Localised areas experience extreme rainfall which cannot be reasonably accommodated by the design standard of the drainage system.
h) Planning decisions on some new developments (post 2012) did not fully consider the flood risk to the development or the constraints in the local drainage systems.

3.28 Of the above key findings, point (f) is particularly relevant to the site as it is located in the valley of the historic Dalymond Dyke. Points (b) and (c) will be considered in the Proposed Surface Water Drainage Strategy, to ensure that the proposed drainage system serving the development will be located in areas which are easily accessible for maintenance and a regular maintenance schedule is in place. Point (g) has also been considered with respect to the development, to ensure both the flood risk and drainage aspects have been assessed against the extreme 1 in 100 year (+45%CC) rainfall event.

3.29 The key recommendations following the Flood Investigations study fell into four categories: Maintenance of drainage systems, funding, improved understanding of drainage capacity and surface water flows, and planning. Specific recommendations were as follows:

Maintenance

a) There is a requirement for better co-ordination between the City Council, County Council and Anglian Water in relation to routine maintenance/works on the drainage systems.
b) Norwich City Council Highways, Anglian Water and Norfolk County Council should prioritise the maintenance of drainage systems where there are known flooding issues.
c) More detailed record keeping of maintenance activities by Norwich City Council on drainage systems is required.

Funding

a) Risk management authorities could work together to apply for funding to mitigate flood risk associated with their areas of responsibility, including large or small scale SuDS, provision of alternative points of discharge and property level protection.
b) Additional funding may be required to provide an increase in the level of maintenance of the drainage systems in priority areas.

Improved understanding of drainage capacity and surface water flows

a) Increase the number of rainfall gauges across Norwich to ensure all areas of high risk have access to rainfall event data.
b) Share information between risk management authorities to ensure the responsibilities and capacity of surface water, foul and combined systems are identified.
c) Utilise evidence from Anglian Water Sustainable Drainage System pilot project to identify the preferred locations for the infiltration of excess surface water.
d) Utilise updated surface water and catchment mapping across organisations to inform plans and projects.

Planning

a) Local Planning Authorities should work closely with the Lead Local Flood Authority and the Environment Agency to fully consider and incorporate lessons learnt from flood investigations in relation to the proposed development.
b) Local Planning Authorities should note that there is an automatic right to connect to the public sewer. As such, Anglian Water's ability to reduce flood risk within current systems is limited if new development is approved in a manner which does not provide appropriate mitigation. Local Planning Authorities should include Anglian Water as a consultee for significant developments.

3.30 Of the above key recommendations, the maintenance aspects of the proposed development have been discussed in the Proposed Surface Water Drainage Strategy prepared by EAS. All parts of the development drainage systems will remain private and it will be the responsibility of the site manager or owner to ensure these are regularly inspected and remain effective.

3.31 The discussions in this FRA have attempted to quantify the surface water risk at the site and the surrounding area, to enable appropriate mitigation measures to be implemented as part of the development. It is noted that the modelling carried out in the preparation of this report has assumed there is minimal drainage, therefore the development has been assessed against a 'worst case' scenario. Surface water flood risk information and modelling was shared by Norfolk County Council for the preparation of this FRA.

3.32 An Addendum to the Investigation Report into the flooding within the Norwich Urban Area during the summer of 2014 (Ref. FIR008/A) was prepared in 2019. This addendum included additional properties that flooded in summer 2014 but were only subsequently identified as being flooded internally. Properties included in the 2014 report which then experienced repeat flooding in 2015

and 2016 were also included in the addendum. The site and surrounding area were not highlighted as experiencing flooding in the addendum report. A number of specific mitigation measures were recommended in the original 2014 report; an update to the work carried out in response to the recommendations has been included in the addendum. Notably, none of the work carried out in the Dalimond Catchment is in close proximity to the site.

3.33 The key findings and recommendations of the Flood Investigation report were considered and addressed where possible during the preparation of this FRA.

Norwich Urban Area Surface Water Management Plan (2011)

3.34 A Surface Water Management Plan (SWMP) for the Norwich Urban Area was completed in 2011 to help understand the causes of surface water flooding and agree a preferred strategy for the management of surface water flood risk (flooding from land; roads; buildings; small watercourses and ditches as a result of heavy rainfall).

3.35 An outcome of the plan was detailed modelling of extreme rainfall events and surveying to identify areas that are more susceptible to surface water flooding.

3.36 North of the boundary of the site (north of Edward Street) has been identified as part of the Catton Grove and Sewell Critical Drainage Area (CDA) which follows the natural channel of the Dalymond Dyke, one of the “lost rivers” of Norwich.

Local Flood Mitigation Options Assessment (2014)

3.37 This document was produced for Norfolk County Council by Capita URS in 2014 and includes depth and hazard mapping for the Critical Drainage Catchments. This extends the modelling scope to the wider catchment for the Critical Drainage Areas identified in the SWMP.

3.38 As a result of this, surface water modelling was included for the Anglia Square site. This is discussed further in Section 4.

Greater Norwich Area Level 1 Strategic Flood Risk Assessment (2017)

3.39 Norwich City Council, Broadland District Council, South Norfolk District Council and parts of the Broads Authority administrative areas commissioned a joint Strategic Flood Risk Assessment (SFRA) in 2008 to help inform preparation of the Local Development Framework and assess the flood risk in the area. This report has been updated to inform the selection of options for the Local Plan site allocations and support determination of planning applications.

3.40 Surface water and fluvial flooding are highlighted as being the predominant flood risk sources to the study area.

3.41 Critical drainage issues are identified at Catton Grove and Sewell, with 240 properties at risk within the catchment.

3.42 The report highlights the importance of using Sustainable Urban Drainage Systems to minimise the effect that new development will have upon the existing sewer network. However, it is noted that use of infiltration in the past has resulted in collapse of cavities in the underlying chalk strata within Norwich City, which could preclude the use of infiltration SuDS in some areas.

3.43 A total of 264 sewer flooding incidents have been identified in the Greater Norwich area, taken from Anglian Water's DG5 register. There are no records of flooding from reservoirs impacting properties within the study area.

3.44 The flood risk mapping in Appendix A (Index Grid: GN_34) covers the site. The surface water map shows the overland flow path from the north of the catchment flowing towards and through the site. Parts of the Anglia Square site are shown to be within all return periods with respect to surface water flooding. One of the main areas on the site to experience surface water flooding appears to be along the southern boundary, where the overland flow is blocked by the flyover.

3.45 The western half of the site is identified as having between 50% and 75% of the area being susceptible to groundwater flooding. The eastern side of the site is shown to have between a 25% and 50% risk of being susceptible to groundwater flooding.

Greater Norwich Level 2 Strategic Flood Risk Assessment (2021)

3.46 This document builds upon the conclusions of the Level 1 SFRAs and assesses 26 of the proposed development sites in the study area. The site is not included in this document, although the Level 2 SFRA notes that much of the catchment is located within designated Critical Drainage Areas. As such, future development proposals should identify opportunities to reduce runoff rates through implementation of SuDS features, noting rainwater harvesting and reuse be included where possible.

Norfolk County Council Pre-Application Comments

3.47 The initial flood model was submitted to the Lead Local Flood Authority (LLFA) Norfolk County Council for a pre-application review. The pre-application comments are included at **Appendix D** and summarised below:

- External inflows from adjacent catchments to be scaled up to 1 in 100 year plus 40% climate change rather than 20% climate change;
- 1 hour storm duration to be considered;
- Both summer and winter storm profiles to be considered to determine critical storm;
- Concerns over infiltration parameter using 7mm/hour to represent discharge to sewers and infiltration to ground. Requested including of Anglian Water sewer network within model;
- Ground truthing checks to be carried out;
- Flyover on the southern site boundary to be better represented in 2D domain, using variable levels;
- Culvert representing subway in original model to be removed since it was infilled in 2018;
- Threshold survey carried out along Magdalen Street to better understand risk to the properties;
- Model calibration based on the 2014 storm events;

- Further sensitivity testing to be carried out;
- Model stability checks to be carried out;
- Below ground car park in Block A to be set at or above ground level. Threshold level at car park entrance to be at least 300mm higher than 1 in 100 year plus climate change flood level;

3.48 Most of the points above have been addressed within the modelling report (Anglia Square Norwich Modelling Study (July 2022)). However, one point was not considered to be feasible within the scope of this study. This is locating the below ground car park at or above ground level. The LLFA requested justification of the basement car park location, given its vulnerable location in the surface water flood risk area. The Applicant has provided the information below:

3.49 It is acknowledged that the inclusion of a basement within Block A raises concern for the LLFA in respect of flood risk due to existing off-site surface water flows. However, the inclusion of a basement within Block A is essential for the design and layout to achieve a balance amongst the numerous other site constraints such as maintaining the functioning of a successful shopping centre during construction and operational phases, viability, impact on heritage and townscape, and quality of accommodation.

3.50 NCC have highlighted that one of the fundamental considerations for the Proposed Development is to ensure the function of Anglia Square with the Large District Centre is maintained and enhanced, requiring the public square and existing businesses fronting onto it to remain accessible and operational during the construction phase so viability and vitality of the LDC as a whole is not compromised. This has had a strong influence on the layout and phasing; four blocks have been positioned around the existing public square taking account of existing buildings and routes to the square, and have a mixture of small and large format sized commercial units at ground floor. The public square and streets to access it are pedestrianised. The demolition and construction has been phased to ensure as many as businesses as possible can remain operational with access to the square.

3.51 The phasing has also taken account of works HIFF funding covers (which underpins the viability of the Proposed Development) and deadline to complete those works to receive the HIFF funding. Phase 1 includes Block A, C, D and M on the north site of the square. Phase 2 includes Block K/L and J3 on the east side of the square. Phase 3 and 4 involve the remainder of the Blocks on the south and west side of the square. Phase 1 includes the area to the north side of the square because it includes the redundant multi-storey car park which includes a substantial amount of demolition which the HIFF funding covers and results in the least disruption to the square and businesses as main routes into the square and service yard can remain open.

3.52 Phase 1 includes delivery of 239 dwellings, 1,721 sqm commercial floorspace for existing businesses in the next phase to relocate to, a 657sqm service yard, and a 695sqm community facility. Therefore delivery of 121 car parking spaces to support those uses within the first phase is essential.

3.53 Providing undercroft car parking at ground level is not an option because it would not be possible to deliver sufficient number of car parking spaces whilst also delivering the ground floor commercial floorspace and service yard required, alongside the plant rooms, refuse and cycle stores associated with residential and commercial units.

3.54 Providing car parking at first floor and above is also unfeasible, as the scale and mass of the scheme is underpinned by the careful balance of achieving approximately 1,100 dwellings within the site to ensure the development is viable whilst not adversely impacting the setting of heritage assets and wider townscape, and ensuring the number of dual aspect dwellings is maximised and amenity space and dwellings receive adequate daylight and sunlight. At the early design stages car parking was included at first floor and above within Block A, however feedback from NCC, Historic England and the Design Review Panel required reduction in height and massing of the blocks to address harm against heritage and townscape, reduce overshadowing of amenity spaces and dwellings, and improve proportion of dual aspect dwellings. The only way to achieve the balance, was to reduce the amount of car parking within the scheme to the lowest amount possible (whilst ensuring dwellings remain saleable for scheme viability) and to place majority of the spaces at basement level.

3.55 The only block within Phase 1 large enough to support a basement car park is Block A. That block also sits within the footprint of the multistorey car park and its ramp which have a substantial foundation slab, the demolition of which will already result in the formation of a hole approximately 1m deep meaning substantially less excavation and removal of waste needed to construct a basement. The demolition of the other buildings and structures do not result in the formation of a hole reducing excavation to that scale. Therefore, there is substantially less construction cost for a basement within Block A and less excavation on other parts of the site at risk of disturbing potential below ground archaeology. The placement of the basement within Block A is essential to ensure the Proposed Development remains viable to deliver with an element of affordable housing provision and minimise potential disturbance to archaeological remains.

3.56 Given that, as set out above, the inclusion of a basement car park within Block A is essential to enable the design and layout to achieve the balance of maintaining the functioning of a successful shopping centre during construction and operational phases, viability, impact on heritage and townscape, and adequate quality of accommodation, and the flood risk assessment / drainage strategy demonstrates the flood risk posed to the basement from surface water can be adequately mitigated and ensure development is safe. It is contended that the inclusion of the basement parking within Block A is acceptable and retained within the scheme.

3.57 The project team had a meeting with the LLFA on 16th June 2022. The LLFA understood the necessity of the basement. Alternative positions of the basement access were discussed, and it was agreed that in order to not compromise the pedestrianised environment and cycle routes that are fundamental to the masterplan, the access needed to be on the north side of the building off Edward Street. The LLFA requested that the basement access was relocated further west along Edward Street if this were feasible, so that it was in an area of lower surface water flood risk, and incorporated a hump or flood barrier at the top of the access. Accordingly, the Amended Application plans have relocated the basement access 12m west, which moves the access from an area with 210mm water depth to an area with less than 100mm water depth. The hazard rating remains ‘low’ hazard for both.

3.58 In addition, flood mitigation measures have been included in the form of a hump at the car park entrance to prevent flood water in all events up to and including the 1 in 100 year (+45%CC) event from entering this area. Further mitigation measures have been discussed within this Flood Risk Assessment at Section 8. The basement access has been amended as agreed at the meeting, therefore the LLFA should be in a position to withdraw their objection to the inclusion of the basement car park.

4 Site Description

4.1 The site is located at Anglia Square, Norwich and consists of a shopping precinct including stores such as Iceland and Boots and former cinema that is now vacant and unused. Disused large office blocks are also present at the site. These include the seven-storey Sovereign House which runs north-south along Boltoph Street and previously housed Her Majesty's Stationary Office (HMSO) and the six-storey Gildengate House, built over shops underneath, which is partially occupied by artists on a temporary basis.

4.2 The northern part of the site comprises a redundant multi-storey car park, which was closed in 2012, with two further surface level car parks occupying the vacant western part of the site.

4.3 The main site is bounded to the south by the A147 Ring Road, known as St Crispins Road; Pitt Street and New Boltoph Street to the west and Edward Street to the north. Magdalen Street forms the eastern boundary. The site also consists of two parcels of land north of Edward Street which are currently used as car parks.

4.4 A location plan is contained in **Appendix B**.

4.5 The proposals are for a mixed-use redevelopment of residential and commercial uses as follows:

4.6 Hybrid (part full/part outline) application on site of 4.65ha for demolition and clearance of all buildings and structures and the phased, comprehensive redevelopment of the site with 14 buildings ranging in height from 1 to 8 storeys, for a maximum of 1,100 residential dwellings, (houses, duplexes and flats) (Use Class C3); a maximum of 8,000 sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, workshops, non-residential institutions, community hub, local community uses, and other floorspace (Use Classes E/F1/F2/Sui Generis (public conveniences, drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))); service yard, cycle and refuse stores, plant rooms, car parking and other ancillary space; with associated new and amended means of access on Edward Street and Pitt Street, closure of existing means of access on Edward Street, New Botolph Street, Pitt Street and St Crispins Road flyover, formation of cycle path between Edward Street and St Crispins Road, formation of wider footways, laybys and other associated highway works on all boundaries, formation of car club parking area off New Botolph Street, up to 450 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), hard and soft landscaping of public open spaces comprising streets and squares/courtyards for pedestrians and cyclists, other landscape works within existing streets surrounding the site, service infrastructure and other associated work; (All floor areas given as maximum Net Internal Area); Comprising;

4.7 Full planning permission on 2.25ha of the site for demolition and clearance of all buildings and structures, erection of 8 buildings ranging in height from 1 to 7 storeys for 353 residential dwellings (Use Class C3) (142 dwellings in Block A, 25 dwellings in Block B, 21 dwellings in Block C, 28 dwellings in Block D, 8 dwellings in Block J3, 81 dwellings in Block K/L, and 48 dwellings in Block M) with associated cycle and refuse stores), and, for 5,411sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, workshops, non-residential institutions, community hub, local community uses, and other floorspace (Use Classes E/F1/F2/Sui Generis (public conveniences, drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to

150sqm))), service yard, cycle and refuse stores, plant rooms, car parking and other ancillary space, with associated new and amended means of access on Edward Street, closure of existing means of access on Edward Street and New Botolph Street, formation of cycle path from Edward Street to St Crispins Road, formation of wider footways, laybys and other associated highway works on Edward Street, New Botolph Street, and Magdalen Street, formation of car club parking area off New Botolph Street, 137 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses) within Blocks A and B, hard and soft landscape works to public open spaces comprising streets and squares for pedestrians and cyclists, other landscape works, service infrastructure and other associated works; (All floor areas given as maximum Net Internal Areas);
And

4.8 Outline planning permission on 2.4ha of the site, with landscaping and appearance as reserved matters, for demolition and clearance of all buildings and structures, erection of 6 buildings (Blocks E – H and J) ranging in height from 2 to 8 stories for up to 747 residential dwellings, (houses, duplexes, and flats) (Use Class C3), a maximum of 2,589 sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, non-residential institutions, local community uses and other floorspace (Use Classes E/F1/F2/Sui Generis (drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))); cycle and refuse stores, plant rooms, car parking and other ancillary space; with associated new and altered means of access on Pitt Street and St Crispins Road, closure of means of access on Pitt Street and St Crispins Road flyover, formation of wider footways, laybys and other associated highway works on Pitt Street and St Crispins Road, a maximum of 313 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), service infrastructure and other associated works (landscaping and appearance are reserved matters); (All floor areas given as maximum Net Internal Areas).

4.9 Proposed development plans are enclosed in **Appendix E**. This FRA relates to the whole application site, i.e. both the full and outline application boundaries shown on the masterplan in **Figure 1**. However, more detailed flood warning and mitigation measures in Section 8 have been discussed for the development within red line boundary, covered by the full planning application.

Figure 1: Site Boundary

4.10 The total site areas for development based on the above plans are set out in **Table 2**:

Table 2: Proposed site areas for development

Area	Size (ha)
Main development area (Anglia Square) – Full Application	2.25
Main development area (Anglia Square) – Outline Application	2.40
Site B (included in Full Application)	0.27
Site C (included in Full Application)	0.13
Total	**4.65**

4.11 The application boundaries and corresponding areas are shown in **Appendix E.**

Proximity to Watercourses

4.12 Meanders of the River Wensum are approximately 200m to the south and west of the site at their closest points. The confluence of the River Wensum and River Yare are downstream of Norwich City Centre.

4.13 A lost watercourse, known as the Dalymond Dyke, passes close to the site. Although subject to historical interpretation, it is believed that Cockeys (as they are locally known) such as the Dalymond Dyke originally followed the course of natural streams but came to form an integral part of the sewerage system of medieval Norwich.

4.14 In Rawcliffe and Wilson's book titled 'Norwich Since 1550', the following information is given about the Dalymond Dyke:

"The longest (cockey) called Dalymond Dyke, has been traced from outside the city walls near the parish boundary of St Augustine's and St Paul's thence through St Saviour's and St Edmund's to enter the river west of Whitefriars bridge. As it flowed through St Edmund's this stream connected with another, called Spitaldyke, which arose near St Paul's church, crossed Norman's Lane, then bent to cross Rotton Row before joining the Dalymond." (Rawcliffe and Wilson, 2004).

4.15 They also note that: "*river and stream accounts…indicate a system of Cockeys was more elaborate, and more artificial, than is suggested simply by tracing their courses as streams."*

Site Levels

4.16 A site-specific topographic survey is included in **Appendix F**. For the main Anglia Square site, levels vary between 5.09m AOD in the northwest corner to 2.40m AOD at the existing access road from St Crispin's Road to the south of the site. Away from this low spot, levels in the southeast corner of the site are in the region of 3.08m AOD. For the existing Anglia Square shopping centre, levels are around 3.51m AOD. The site slopes in a generally south easterly direction at a gradient of approximately 1:125.

4.17 The parcel northwest of New Boltoph Street (Site B) slopes in a southerly direction, at a gradient of approximately 1:185 with the highest level to the north west of the site at 5.40m AOD and the lowest level at 5.11m AOD at the southern extent of the parcel. The site is approximately 0.35-0.4m higher than the carriageway of New Boltoph Street/ Edward Street.

4.18 The parcel directly north of Edward Street (Site C) slopes at a gradient of approximately 1:100, with the highest point in the southwest corner at a level of 4.27m AOD and the lowest point in the north at 3.87m AOD.

Underlying Geology

4.19 With reference to the online British Geological Survey (BGS) mapping, the bedrock consists of Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation with superficial deposits of Alluvium - Clay, Silt, Sand and Gravel.

4.20 River Terrace Gravels have also been found to underlay the site (WYG Geo-Environmental Report 2010). This is supported by BGS borehole records surrounding the site:

- BGS borehole record 'TG20NW951' at the Norwich Crown Court building indicated sand and gravel at 2.8m deep overlain by silty and clayey alluvium. Groundwater ingress occurred at 4.2m BGL.

- BGS borehole record 'TG20NW636' at 77-87 Magdalen Street indicated clay to 2.0m BGL with course flint gravel to 8.0m. Groundwater was struck at 6.0m BGL. The clay was noted as 'stiff- very stiff' remoulded chalk, indicating a putty chalk with low permeability at the upper boundary. It is therefore likely that groundwater is stored within the superficial deposits before infiltrating slowly into the chalk aquifer beneath, giving rise to locally high groundwater.

4.21 The chalk bedrock is considered to be a Principal Aquifer and the superficial deposits are classed as a Secondary A Aquifer. Due to the presence of the chalk aquifer the site lies within a Source Protection Zone (SPZ) and is within Zone 2 (outer zone). This is defined on the gov.uk website as: *"This zone is defined by the 400-day travel time from a point below the water table. Additionally this zone has a minimum radius of 250 or 500 metres, depending on the size of the abstraction. The travel time is derived from consideration of the minimum time required to provide delay, dilution and attenuation of slowly degrading pollutants."*

4.22 The site is also shown to be within a medium to high groundwater vulnerability zone (https://magic.defra.gov.uk/magicmap.aspx). This indicates that pollutants could reach the underlying aquifer and groundwater resources relatively quickly in this area as a result of the permeable geology. The site is also highlighted as being in an area with soluble rock risk, due to the presence of the chalk aquifer.

4.23 A Tier 1 contaminated land report by SES (2016) notes that: *"Potential sources of contamination at the site may include heavy metals, inorganic compounds, chlorinated solvents, trichloroethene, formaldehydes, PVC, BTEX compounds from the fabric manufacturing processes. Potential VOC/ SVOCs and ground gases within made ground. Potential heavy metals, hydrocarbons and PAHs from car parking and leakage of fuels/ lubricants associated with the former engineering works. Asbestos may also be present within soils as the Anglia Square Shopping Centre was constructed in the mid-1960s, and pre-dated segregation of asbestos from other construction demolition rubble*".

4.24 The CIRIA SuDS Manual (C753) states that: *"A depth of at least 1m of unsaturated soils that are not clean gravels or similar with high permeabilities, and/or are not fractured deposits with rapid flow routes…are known to provide good protection to underlying groundwater."*

4.25 Due to the potential for contamination from the site and the potential for high groundwater levels within the chalk aquifer, infiltration is not recommended at this site as it is highly unlikely that the recommendations outlined above can be achieved, therefore posing a risk to groundwater quality. Alternative means of drainage and water treatment have been discussed in the Proposed Surface Water Drainage Strategy, which comprises the use of lined permeable paving and downstream defender interceptors.

Sewer Network

4.26 Sewer records, obtained from Anglian Water in June 2022 and included in **Appendix G**, show there to be a 675mm surface water sewer and 300mm foul sewer flowing in a south westerly direction through the main Anglia Square site.

4.27 A 300mm surface water sewer and 225mm foul sewer also run west to east adjacent to Edward Street, to the north of the main Anglia Square. Both sewers connect to the respective foul and surface water sewers in Magdalen Street before flowing southwards and discharging into the River between Fye Bridge Street and Whitefriars Bridge.

4.28 A further 525mm combined sewer flows southwards along Magdalen Street. Given the location of the sewer and the available information on the Dalymond Dyke, it is highly likely that surface water flows from the Dalymond Dyke flow within this sewer.

4.29 The sewer locations and sizes within the site boundary are shown in more detail on the topographic survey in **Appendix F**.

5 Surface Water Flooding

5.1 Surface water flooding refers to flooding caused when the intensity of rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems or does not infiltrate into the ground. The water ponds on the ground and flows towards low-lying land. This source of flood risk is also known as 'pluvial'.

5.2 Three sources of surface water flood mapping were identified: Environment Agency's Flood Map for Surface Water, the Greater Norwich Area Level 1 Strategic Flood Risk Assessment and the Local Flood Mitigations Options Assessment mapping. Further investigation and consultation with Norfolk County Council determined surface water flooding to be the primary risk to the local area. A hydraulic modelling study was carried out to quantify this risk, the details of which are in the accompanying Hydraulic Modelling Report (Anglia Square Norwich Modelling Study (July 2022)). The surface water risk to the development and the modelling results have been discussed in this section.

Flood Map for Surface Water

5.3 The Flood Risk from Surface Water mapping (**Appendix H**) is on the GOV.UK website and can be accessed here: https://check-long-term-flood-risk.service.gov.uk/map?easting=623059&northing=309421&map=SurfaceWater

5.4 This shows parts of the site to be at high risk of surface water flooding. The flood extent map suggests that there is an existing flow path thorough the site which passes down Botolph Street, Upper Green Lane and Magdalen Street to the south. The 'low risk' depth mapping is the worst case scenario on the EA surface water maps. This is an event that doesn't occur regularly but can result in the highest volumes of water passing through the site.

5.5 At the south of the site on Cherry Lane, adjacent to St Crispin's Road, an area of ponding 300-900mm is shown in the high-risk scenario, which corresponds with the low spot identified in the topographical survey. As can be seen in the photo in **Figure 2**, this is currently used as an underpass.

Figure 2: Underpass on Cherry Lane (Source: Google Maps)

5.6 Areas of flooding less than 300mm are also shown on Boltoph Street. To the north, there is a continuous flow route along Heath Road as far south as Magpie Road, where the path is shown as isolated areas of surface water flooding between buildings to the north of Edward Street

5.7 In the medium risk event, this flow path continues in a south-easterly direction along Beckham Place to Edward Street, Cowgate, Magdalen Street and southwards through Anglia Square. The mapping shows this to follow Upper Green Lane, however this is an elevated road through Anglia Square as shown in **Figure 3**. The entrance to Upper Green Lane can be seen to the right of the picture above the blue service door. Whilst it is possible that flooding of the lowered car park area could occur, no records of flooding have been identified to date.

Figure 3: Entrance to car park and Upper Green Lane (Source: Google Maps)

5.8 Flooding also occurs to the parcel north of Edward Street, with depths of between 300mm and 900mm being shown. No surface water flooding is shown on the parcel of land northwest of New Botolph Street.

5.9 A secondary flow route on the A1067 towards Boltoph Street can also be seen. The main area of flooding within the site boundary, to the north of St Crispin Road, is still within 300-900mm in the medium risk scenario.

5.10 In the low-risk scenario, the flow route from Waterloo Road and described above becomes continuous in a southerly direction through Anglia Square, Magdalen Street and in an easterly direction along Cowgate. The flow route from the A1067 also becomes continuous along Boltoph Street and joins the ponded area to the north of St Crispin Road.

5.11 The majority of flooding is less than 900mm, with very small areas to the south of Edward Street deeper than 900mm. To the north of Edward Street, a greater extent of flooding within the land parcel north of Anglia Square, with the majority of this in the 300mm to 900mm range.

5.12 In the low-risk scenario, flow routes within the site boundaries have velocities of greater than 0.25m/s.

5.13 As the surface water mapping uses a generalised methodology to account for sewer networks, it is likely that the size of the surface water sewer network both within the site and the immediate

vicinity have been underestimated in the modelling. In particular, the document "What is the Risk of Flooding from Surface Water map?" (EA, 2019) notes:

"We assumed a single drainage rate for all urban areas within the nationally produced modelling unless LLFAs were able to give us better local data. Modelled flood extents are particularly sensitive to the way drainage is taken into account. Omitting large subsurface drainage elements such as flood relief culverts and flood storage can also significantly affect the modelled pattern of flooding."

Local Flood Mitigations Options Assessment Mapping

5.14 The site is included within the mapped extents for CDC2 which are available online at https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/flood-and-water-management-policies/surface-water-management-plans/norwich-urban-area-swmp

5.15 The mapping included hazard and depth mapping for the 1 in 30, 1 in 75, 1 in 100, 1 in 100 plus climate change, and 1 in 200 year events.

5.16 For all events, the low spot to the north of St Crispin's Road was identified as a moderate-significant hazard (danger for most).

5.17 For the 1 in 75 year event, a number of areas were identified as being moderate or significant hazards:

- The flow path along the north and east of the site boundaries to the north of Edward Street was identified as significant. Due to the resolution of the mapping it is not clear whether the flow route enters the site.
- South of Edward Street was identified as being at significant risk and shows a larger flood extent than in the Risk of Surface Water Flooding map. This is most likely due to differences in the modelling technique, and is likely to represent flooding of the basement car park.
- An area to the east of Boltoph Street was identified as being a moderate hazard. In the Surface Water Flood Map this was routed around the building by the model (effectively flooding the existing car park), however in this modelling the buildings were set to a 0.1m height.

5.18 For the 1 in 100 year event plus climate change the following areas were identified as hazards:

- The parcel to the north of Edward Street was shown as a significant flood risk across the site
- Moderate flooding was still modelled to the east of Boltoph Street, although the extent increased.
- The extents of the predicted flooding to the north of the site (south of Edward Street) and the low spot to the south of the site (north of St Crispin Road) also increased.

- The areas to the northwest of New Boltoph Street and the centre of Anglia Square were not shown as being a flood hazard and therefore the two areas of flooding described above are distinct and should not be considered a flow route. Instead, flows from the north are more likely to be routed along Magdalen Street to the east, which does show a continuous flow route.

5.19 It is noted that losses to the sewer network were reduced to 7mm/hr in this modelling exercise and the hydraulic model is not integrated with the Anglian Water sewer network. Furthermore, due to the methodology used, buildings on sloped sites may be effectively modelled as basement units and therefore are more likely to be show as flooded than if the thresholds had been individually defined. Therefore, these have been considered below in more detail.

Hydraulic Modelling

5.20 Norfolk County Council were approached for initial comments on the surface water flood risk to the proposed development for an earlier application in 2018. They highlighted location of the site in the middle of an overland flow path and the requirement for further investigation of the surface water mechanisms in the local area, given that it is within a CDA. Following a meeting (between EAS and the Norfolk County Council Flood Risk Team in 2017) it was confirmed that the Norwich Urban Surface Water Management Plan Model CDC2 could be used as a basis for preparing a hydraulic model to assess the proposed development.

5.21 A similar approach has been taken for this application, with the SWMP CDC2 model being used as a base for the modelling study. However, given the age of the CDC2 model, some parts of it were updated in this modelling study. The hydraulic modelling assessment has been detailed in the modelling report entitled 'Anglia Square Norwich Modelling Study (July 2022)' and summarised below.

5.22 The surface water model provided is a 1D ESTRY-2D TUFLOW direct rainfall model representing the Catton Grove and Sewell catchment. The FEH 2013 rainfall model was used to generate hyetographs for a number of return periods. The hydraulic modelling study used a scaled-up hyetograph to simulate the 1 in 100year (+45%CC) rainfall event, as previously agreed with Norfolk CC.

5.23 The latest EA 0.50m LiDAR was used to create the ground surface. Following a request from the LLFA, the catchment boundary has been extended to encompass a wider area, to account for overland flow routes coming from areas further away from the immediate Catton Grove and Sewell catchment. Whereas the original CDC2 model accounted for these inflows through a series of additional inflow boundaries around the edge of the Catton and Sewell model, these were removed in the updated model and instead the entire model boundary was extended. The FEH Web Service did not accurately capture the catchment boundary when focussing on Anglia Square, therefore the WFD River Waterbody Catchment Boundary for the Wensum DS Norwich waterbody was used to define the catchment. The southern edge of the catchment boundary was trimmed at the River Wensum, with the assumption that any flows to the south would flow no further south than the watercourse. **Figure 4** shows the WFD catchment boundary and model boundary.

Figure 4: WFD Waterbody Catchment boundary (left) (https://data.catchmentbasedapproach.org/datasets/theriverstrust::wfd-river-water-body-catchments-cycle-2/about) and Model Boundary (right)

5.24 Initial model runs applied the gross rainfall hyetographs (i.e. with no losses accounted for), and a constant 7mm/hour was then removed from the whole catchment, to simulate runoff entering the sewer system. However, during a pre-application meeting with the LLFA, concerns were raised about the application of the 7mm/hr due to it not being representative of the whole catchment. Subsequently, the 'Net Rainfall' hyetographs were applied, which accounted for a range of losses based on the catchment characteristics. The original materials layers were included in the model, although these were reviewed in detail around the site and updated where necessary. Where the model was extended, new materials layers were generated based on OS mapping. The Manning's roughness value for buildings was 0.04 in the original model, which was considered to be too low. This was increased to 0.1 to better simulate flow through buildings. It is acknowledged that some of the buildings contain green roofs, and the Mannings value of 0.1 will also account for the roughness of these roofs. Buildings across the catchment outside of the application site were specified as having thresholds set to 0.10m above the ground level, and roads were set to 0.125m below ground level. An exception was Magdalen Street, which the LLFA commented as having lower thresholds; the buildings along Magdalen Street were instead set at ground level. Finally, analysis of aerial photography identified some new buildings just north of Edward Street which had not been represented in the original model. These were included in the new model as buildings with threshold levels of 0.10m above ground level.

5.25 The LLFA requested that local Anglian Water surface water sewers were included in the neighbouring roads to better understand the impacts to and from the sewer network. The sewers crossing the site and in the surrounding roads were included in the model as '1d_nwk' layers, based on the latest Anglian Water sewer records.

5.26 An existing and proposed scenario were built for comparison of flood extents and changes in flows.

5.27 Limitations in the original CDC2 model were that site-specific levels were not used, and the water at the southern site boundary (adjacent to St Crispins Road) flowed 'on to' the flyover whereas in reality, the flyover was significantly higher than the ground level so this would not be possible.

5.28 The model for the existing scenario was adjusted slightly to set more accurate finished floor levels across Anglia Square (informed by the topographic survey) and to include the flyover 'barrier' at

the southern boundary, which prevented runoff from the site from flowing onto the flyover. Flows instead were directed to the southeast and exited the site at Magdalen Street, which is the flood mechanism in the local area.

5.29 The model for the proposed scenario removed the existing buildings within the application boundary and replaced them with the proposed blocks, pedestrian walkways and ground/finished floor levels. The finished floor levels were typically set between 4.00m AOD and 5.00m AOD. **Figure 5** shows the finished floor levels used for each block in the hydraulic model. It should be noted that the hydraulic model and the floor levels used are illustrative for comparison purposes, to represent a worst-case scenario.

Figure 5: Illustrative finished floor levels for each block represented in Anglia Square model (m AOD)

5.30 The assumptions and limitations of the original model were acknowledged and accepted. In addition, a further limitation is that the interiors of the proposed blocks could not be divided up into individual units as these have not been finalised. As such, the flow of water 'through' a building is not completely accurately represented since there would in fact be walls between the units. However, this was commented on by the LLFA in the 2018 application and considered to be an acceptable representation of the development, as internal walls cannot be shown as preventing floodwater ingress since there would be service conduits etc. that water could pass through. Despite this limitation, the surface water model has provided some useful information on the flooding to the development and allows a comparison to determine any areas where flooding has been increased or decreased as a result of development.

5.31 The landscape consultants have included a number of vegetated features, tree pits and swales throughout the site in the walkways. As such, it was considered acceptable to include the walkways through the site as 'Natural Surfaces' in the materials layers, with a Manning's value of 0.03, rather than 'Roads' which have Manning's values of 0.02. In addition, it is understood there will be steps from many of the buildings to the main walkways, although specific details of the steps were not available during the modelling process. It was therefore considered reasonable to design the pedestrian walkways as sloped on each side to enable surface water flow paths to continue through the site, channelling water from northwest to southeast and away from the proposed buildings. The slopes were based on a cross fall of 1:80 where possible. In some places, this cross fall was not achievable, so the shallowest gradient possible was used in these locations. The sloping walkways were achieved by creating a TIN of these areas.

5.32 The final model was based on the following:

- Ground floor levels are shown in **Figure 5** (typically between 4.00m AOD and 5.00m AOD).
- The Edward Street loading bay set at a lower level of 2.85m AOD.
- A basement car park off Edward Street is set at 2.00m AOD to represent the ramp down into it. It is understood that the floor level of the basement car park will be set at 0.825m AOD.
- Sloping pedestrian walkways included for most of the external hardstandings, to enable the existing surface water flow route to pass through the proposed development and be directed away from the buildings. A slope of 1:80 was used where possible. However, in some locations is as not possible to achieve this so as shallow a slope as practicable was used.
- Flyover at the southern site boundary is represented as a sloping z-shape rising up from 4.43m AOD to 8.63m AOD, to prevent surface water flowing over it from the site.

Investigating Flooding Mechanisms

5.33 As noted earlier, a limitation of the model is that the internal areas of the buildings cannot be divided up into individual commercial/retail units. The buildings are represented as finished floor levels and water will simply flow 'through' the building to the lowest levels, where it will pool. This means that where an internal floor level suddenly falls from say 4.50m AOD to 4.05m AOD, water will flow straight into the low area. While this may be the case in some areas, it is unlikely to be the case in all instances. Following initial model runs, it was necessary to take a closer look at the flow paths at each of the vulnerable areas to determine whether water can reach them and pool or whether this is a limitation of the model.

5.34 The service yard off Edward Street is directly adjacent to the main flow route within the roads around Anglia Square. The service yard is set at 2.85m AOD which is around 1.20m lower than the adjacent buildings and the road. Given the location of the service yard, it is likely to be in the surface water flow path and therefore vulnerable to flooding. The service yard will be made water-tight to protect it from surface water and groundwater flooding. Therefore, a 'wall' which has been set at 999m high has been included around the service yard, to prevent water from the adjacent ground level buildings from flowing into the lower levels. A similar approach has been taken with

the basement car park. This means that only water entering the service yard and basement car park through the entrance would be possible.

Modelling Results

5.35 The amended hydraulic model was run for the critical 1 in 100 year (+45%CC) rainfall event, as well as the 1 in 100 year (+40%CC), 1 in 100 year (+20%CC), 1 in 75 year and 1 in 30 year and 1 in 30 year (+40%CC) rainfall events. The modelling results for the 1 in 100 year (+45%CC) event was examined and the vulnerable areas within the proposed development were highlighted. The vulnerable areas and the resulting depths and levels are summarised in **Table 3**.

Table 3: Summary of vulnerable areas and associated depths and levels for 1 in 100 year (+45%CC) surface water event

Location	Water Depth (m)	Water Level (m AOD)
Service yard off Edward Street	1.02 (prior to mitigation measure model run)	3.87
Entrance to basement car park from Edward Street	0.08	4.50
Basement Car Park	0.11 (prior to mitigation measure model run)	2.11
Block A	0.10	4.15
North of Block C	0.42	4.36
Block M	0.13	4.18
South of Block J	0.06	3.48
Southeast of Block J/Mobility Hub	0.08	3.48
East of Block H	0.18	3.83

5.36 The resulting depth and level maps for the 1 in 100 year (+45%CC) event are included at **Appendix I**, and the full set of flood maps can be downloaded from the link in **Appendix I**. It should be noted that as this is a rainfall model, it has been assumed that up to 0.05m of water could remain on the roofs and not contribute to surface water flows within buildings. However, at the request of the LLFA a band of 0.005m has been applied to all the depth maps to show the breakdown of water depths over 5mm intervals. Anything less than 5mm (0.005m) has been set to transparent.

5.37 A visual comparison of the existing and proposed flood depth maps suggests that the existing site has deeper water depths over a smaller area. The proposed development has shallower depths across a larger area.

5.38 The existing loading bay and car park to the north of the site off Edward Street is located in the same place as the proposed service yard. The modelling results showed this to be adjacent to the main surface water flow route along Edward Street. The topographic survey identifies ground level of the existing loading bay/car park at this location to be around 3.21m AOD, which is at a lower level than Edward Street. This is shown in **Figure 3**. As noted previously, there has been no historical evidence of flooding to this area.

5.39 The ground level of the proposed service yard will be set at 2.85m AOD, which is approximately 1.20m below Edward Street. The model showed surface water flows from Edward Street to fill up the loading bay, to a depth of 1.02m.

5.40 The proposed basement car park could experience flood depths of up to 0.11m assuming there were no mitigation measures in place. The ground levels at the basement car park entrance, of around 4.35m AOD, form an informal barrier to flow entering this area, with the majority of the flow remaining in the highway.

5.41 The LLFA raised concerns regarding flood risk to the basement car park and the service bay, therefore some additional modelling was carried out focussed on these areas. The water level in the 1 in 100 year (+45%CC) event in Edward Street to the immediate north of the service yard was 4.15m AOD. Discussion with the Applicant confirmed that a hump could be included across the entrance of the service yard at a level of 4.45m AOD. This provides 300mm freeboard above the 1 in 100 year (+45%CC) flood level in this area, thereby preventing any surface water from entering the service yard in this extreme scenario.

5.42 Similarly, the water level adjacent to the entrance to the basement car park in the 1 in 100 year (+45%CC) event is 4.50m AOD. The Applicant confirmed that a hump set at 300mm above this level, at 4.80m AOD, was viable.

5.43 Following the amendments to include the two humps at the service yard and basement car park entrance, the model was re-run. The resulting flood maps demonstrated that the inclusion of these mitigation measures prevented the basement car park and service yard from flooding in even the most extreme scenario considered. The flood maps including the mitigation measures in the form of the humps are included in **Appendix I** for the 1 in 100 year (+45%CC) event (all other flood maps can be downloaded from the link provided).

5.44 Flows through the northern boundary of Block M adjacent to Edward Street result in up to 0.13m water passing through the building towards the southeast.

5.45 Block A has been represented as the ground floor level of 4.05m AOD rather than the basement car park level of 0.825m AOD. However, the entrance ramp to the basement car park is set to the lower level. The ground floor of Block A may experience up to 0.10m flood depth, given it is immediately adjacent to the main flow route along Edward Street.

5.46 Block C is located in the main overland flow route and as such may experience up to 0.42m water depth externally. The ground floor habitable areas will have a finished floor level of 4.65m AOD which is 300mm above the 1 in 100 year (+45%CC) flood level in this area, and water will not enter the ground floors of the properties. Further mitigation measures have been discussed in Section 7.

5.47 The area south of Block J has been modelled with an illustrative level of 3.36m AOD to 3.41m AOD. As this is the lowest external area within the site boundary, much of the overland flow would be directed here before passing out of the site and back into Magdalen Street. Depths of up to 0.08m are recorded in this area.

5.48 The ground floor of Block J does not form part of the detailed application but has been shown for the purpose of the model to be set at 4.05m AOD to the north and 3.525m AOD to the south. Although the sloping walkway has been modelled to the north and south of Block J to try and direct

water away from this area where possible, flows can still enter this building since it is located at one of the lowest parts of the site.

5.49 The main flow routes through the site were via the new pedestrian walkways, as per the design intention. Generally, on the western half of the site the centre of the walkways convey flows of up to 0.02m depth. In the east and southeastern half of the site, the walkways could convey up to 0.13m depth in this extreme event. The upper levels of the sloping walkways tied into the adjacent buildings floor levels where possible, although it was noted that there would be steps at the front of the buildings which could affect this. Typically, the low point of the walkways were based on a cross fall of 1:80. However, this was not feasible in some places (e.g. where the walkway was particularly narrow or there was a change in the floor levels of the adjacent buildings), so in these locations the shallowest slope possible was used. The results demonstrated that water was channelled effectively around the site using the method of sloping walkways, allowing existing overland flow paths to remain in a similar manner to the existing site.

5.50 Given the predicted flood depths, as part of the construction and operational phases of the development, mitigation measures and management processes must be in place, monitored, and implemented in a timely way.

Hazard Mapping

5.51 Hazard maps were produced along with the depth mapping to determine the most vulnerable parts of the site. The hazard mapping was produced based on the methodology set out in the publication by DEFRA 'Flood Risks to People' (FD2320/TR23) 1 and the May 2008 EA/HR Wallingford supplementary guidance note[2]. This classifies hazard based on the depth and velocity of flows through a site, and is defined as shown in **Table 4**.

Table 4: Flood Hazard Clarification from Supplementary Guidance Note

Degree of Flood Hazard	Description
Low (Less than 0.75)	Caution – Flood zone with shallow flowing water or deep standing water.
Moderate (0.75 to 1.25)	Danger for some (i.e. children) – Danger: Flood zone with deep or fast flowing water.
Significant (1.25 to 2.0)	Danger for most people – Danger: Flood zone with deep or fast flowing water.
Extreme (More than 2.0)	Danger for all – Extreme danger: Flood zone with deep fast flowing water.

5.52 The hazard map for the 1 in 100 year (+45%CC) rainfall event is shown in **Appendix J**. This shows that the pedestrian walkways and all of the proposed blocks remain at low hazard, or have no hazard identified. This means that pedestrians will still be able to traverse the site even in this extreme rainfall event. On the northern and eastern half of the site, the pedestrian walkways and some of the ground floors of Blocks A and M are shown as 'Low' hazard in this scenario. Magdalen Street to the southeast of the site boundary, north of the flyover, is shown as being at 'Moderate' to 'Significant' hazard.

[1] *DEFRA and Environment Agency (March 2006) 'Flood Risks to People', FD2321/TR2, DEFRA: London*
[2] *Supplementary note on flood hazard ratings and thresholds for development planning and control purpose (2008)*

5.53 The basement car park and service yard off Edward Street have no hazard identified as the proposed hump at the entrances prevent water from entering. Edward Street to the immediate north of the service yard and basement car park is shown as being at 'Low' hazard.

5.54 Block C is within the main flow path, and the external areas to the north and east of the block are shown to experience 'Moderate' to 'Significant' hazard in the most extreme scenario. The proposed ground floor bin store is also at 'Moderate' hazard. All the ground floor accommodation is set at least 300mm above the flood level, so no hazard is identified internally.

5.55 A visual comparison of the existing and proposed 1 in 100 year (+45%CC) hazard maps shows that there appears to be a larger area of 'Moderate' and 'Significant' hazard onsite in the existing scenario. There are no areas of 'Extreme' hazard identified on the site in either the existing or proposed scenarios.

5.56 In the more frequent 1 in 30 year (+40%CC) event, the site is entirely classed as 'No hazard'. It is noted that the external area around Block C has 'No hazard' up until the 1 in 100 year (+20%CC) event, when this becomes 'Low' to 'Moderate' hazard.

5.57 Mitigation measures will be discussed in Section 8 to manage the hazard in the areas described above.

6 Impact Study

6.1 In the previous application, Norfolk County Council highlighted the importance of demonstrating that surface water flow paths are not simply obstructed by the development and forced to flow around the site, as this could increase the flood risk to others. The Norfolk CC pre-application comments on the earlier scheme requested an assessment of changes to flood depths so that local businesses are aware of the changes and how this could impact their properties. A similar exercise has been carried out for this application.

6.2 The impact assessment was based on an extreme 1 in 100 (45%CC) surface water flooding event, so presents a 'worst case' scenario upon which to base mitigation measures for offsite impacts. Maximum depth and level grids were produced from the final model and the existing and proposed were compared. These provided a clearer visual representation of the changes in the flood levels and depths. The changes have been discussed below.

Area of Impact

6.3 Analysis of the impact of the proposed scheme was carried out to determine the area of impact and the magnitude of the impact. The 1 in 100 year (+45%CC) event maximums grids were interrogated, and the existing and proposed levels and depths were compared. An afflux map was created out of the grid of differences between existing and proposed. Any red areas represent an increase in flood depth due to the proposed development, whereas green areas represent a decrease in flood depth due to the proposed development. Any increase or decrease of 0.005m (5mm) or less is considered as 'no change' as this could simply represent rainfall on a roof so is considered to be negligible. Given the accuracy of the LiDAR and error margins of the model, it should be noted that such a small increment (5mm) representing 'no change' is very low and for a modelling study of this type a larger increment would usually be used, typically 75 to 100mm. The resulting map is included in **Appendix K**.

6.4 It is clear from the map in **Appendix K** that the main impacts are within the site boundary. Roughly a third of the site experiences an increase in water depth and a third experiences a reduction as a result of the development. The remaining areas onsite demonstrate no change. There are small increases adjacent to the flyover on the southern boundary and also the pedestrian route through the site from Edward Street to Magdalen Street. The northeast and eastern section of the site shows a decrease in flood depth of up to 180mm.

6.5 Offsite impacts appear to be restricted to the immediate area adjacent to the site. To the north of Block C there is a decrease in flood depth of up to 10mm and to the east of Block C, a decrease of up to 20mm. To the immediate east and southeast of the site in Magdalen Street there is a decrease in flood depths of up to 80mm. There is also a slight improvement shown in the highway to the south along Pitt Street and then west along St Crispins Road.

6.6 The main areas offsite which demonstrate an increase in flood depth as a result of the proposed development are at the junction of Edward Street and Magdalen Street, and along Cowgate and Charlton Road south to the roundabout. These areas already flood in the existing situation and continue to flood in the proposed scenario. The increase in flood depth is around 40mm in the 1 in 100 year (+45%CC) event at the junction of Edward Street and Magdalen Street, around 20mm along Cowgate and up to 60mm at the roundabout on Charlton Road. The increase in depth is predicted to remain within the highway for the majority of this route. The only properties where

there appears to be an increase (of up to 30mm) are the two commercial buildings on the corner of Magdalen Street and Cowgate. The proposed scenario flood level here is up to 3.91m AOD, whereas in the existing situation flood level is 3.88m AOD. The topographic survey in **Appendix F** shows the floor levels of these buildings to be between 3.77m AOD and 3.87m AOD. This suggests that they would flood in both the existing and proposed scenarios.

6.7 Flood depth in the highway along Magdalen Street, Cowgate, Charlton Road and the roundabout has increased due to the raised humps located at the top of the service yard entrance, and higher ground levels on the northern part of the site. It is likely that the water which would previously have entered the site boundary in the existing loading bay and lower areas can no longer do so, and it directed instead into the highway. While this does not appear to impact any residential properties, it does increase the depth of floodwater experienced in the highway. This is not considered to be a significant increase, and it is noted that these areas are already shown to flood in the existing scenario. Therefore, the proposed scenario would not introduce a new flood risk to these areas, but at this stage it shows that some places could result in an increase in water depth/level. Notably, there are several areas identified above where there is a reduction in flood level as a result of the proposed development, such as the dwellings to the north of Block C and the commercial units along Magdalen Street.

6.8 The offsite risk was quantified across the impact area by using the grid interrogation tool in QGIS. Although it is not possible to provide levels and depths precisely for every property, the information provided indicates the likely maximum increases.

6.9 Various limitations mean that the level of flooding shown in **Appendices I** and **K** may be overestimated. Limitations are that building walls are not modelled (most buildings have flood resistance to 600mm), offsite property floor levels are consistently set at 0.10m above the ground level, and LIDAR has been used across the catchment in the absence of topographic survey data. In reality, walls could block or slow flow paths across the catchment and floor levels may be higher or lower than modelled. However, the model output provides information on the most vulnerable areas which may experience an increase in water level.

7 Other Sources of Flood Risk

Fluvial and Tidal Flooding

7.1 The Environment Agency Flood Map for Planning (**Appendix C**) shows the site is located entirely within Flood Zone 1. This indicates a probability of fluvial and tidal flooding of less than 1 in 1000 years (0.1%AEP). The historic flood map provided by the EA shows the south eastern edge of the site experienced fluvial flooding in 1912. This is before the construction of the existing Anglia Square and surrounding development (e.g. the flyover) was built. It is likely that flood defences elsewhere on the River Wensum and more recent development between the site and the river would now obstruct fluvial flows, hence the site is now located entirely in Flood Zone 1.

7.2 There are no other fluvial sources within the vicinity of the site, and the risk from the 'lost' watercourse known as the Dalymond Dyke has been considered in Section 4. Fluvial flood risk is therefore considered to be low. As the site is remote from the coast and any tidally influenced rivers, the tidal flood risk is also considered to be low.

Sewer Flooding

7.3 The Flood Investigations report for the Norwich Urban Area highlights the key issues relating to sewer flooding in Norwich, as detailed in Section 2. Although there are clearly sewer flooding issues locally, linked primarily to maintenance and insufficient capacity in the existing drainage systems, Anglian Water confirmed in their email of 24th March 2017 (**Appendix G**) that they do not hold any records of sewer flooding incidents on the existing site that can be attributed to capacity limitations in their public sewer network.

7.4 A request was made to Anglian Water by EAS for updated DG5 records covering the site and the local area in June 2022. Anglian Water responded that they are unable to provide information on individual instances of flooding as this is confidential data. They did however confirm there has been sewer flooding locally. EAS have followed up this response with a further pre-planning enquiry but have not yet received a response. The Anglian Water response is included in **Appendix G**.

7.5 According to the Anglian Water DG5 database records included within the Greater Norwich SFRA, 264 sewer flooding incidents have been identified in the Greater Norwich area between 2007 and 2017. The SWMP identified Colman Road, Heigham Road, Jessop Road and Orchard Close as areas at higher risk of sewer flooding. None of these areas are close to the site.

7.6 A pre-planning enquiry was made to Anglia Water in April 2022 and their response is also included in **Appendix G**. The pre-planning response states that there is available capacity in both the local surface water and foul sewers close to the site, and that Anglian Water agree in principle to the proposed drainage strategy. This evidence suggests that while there may be sewer flooding issues locally relating to insufficient capacity, it is unlikely to be in the immediate vicinity as the nearby sewers have the capacity to take the proposed flows from the development.

7.7 Given the level of surface water flooding at the site and in the local area, there is potential for sewers to surcharge in an extreme event. Assuming surface water is directed into the Anglian Water public sewer network in such event, this may become overwhelmed and result in

surcharging of the system. As such, the surface water sewers in the roads immediately surrounding the site were included in the surface water flood risk modelling carried out as part of this FRA, to better understand the impact to the sewers. The proposed discharge rates were included as inflows to the Anglian Water sewers in the proposed locations of the connections. The results included in **Appendices I and J** do not show surcharging of the nearby sewers because of the development.

7.8 Although no sewer flooding has been reported locally to date, there may be potential for sewer flooding in extreme events greater than those modelled, or because of blockages to the public sewers, so the risk of flooding from sewers is considered to be medium.

Groundwater

7.9 As previously noted, the Level 1 SFRA shows the western half of the site as having between 50% and 75% of the area being susceptible to groundwater flooding. The eastern side of the site is shown to have between a 25% and 50% risk of being susceptible to groundwater flooding.

7.10 The British Geological Survey (BGS) groundwater susceptibility mapping shows the site as being in an area with *"B - Potential for groundwater flooding of property situated below ground*". The mapping covering the local area is included in **Figure 6**.

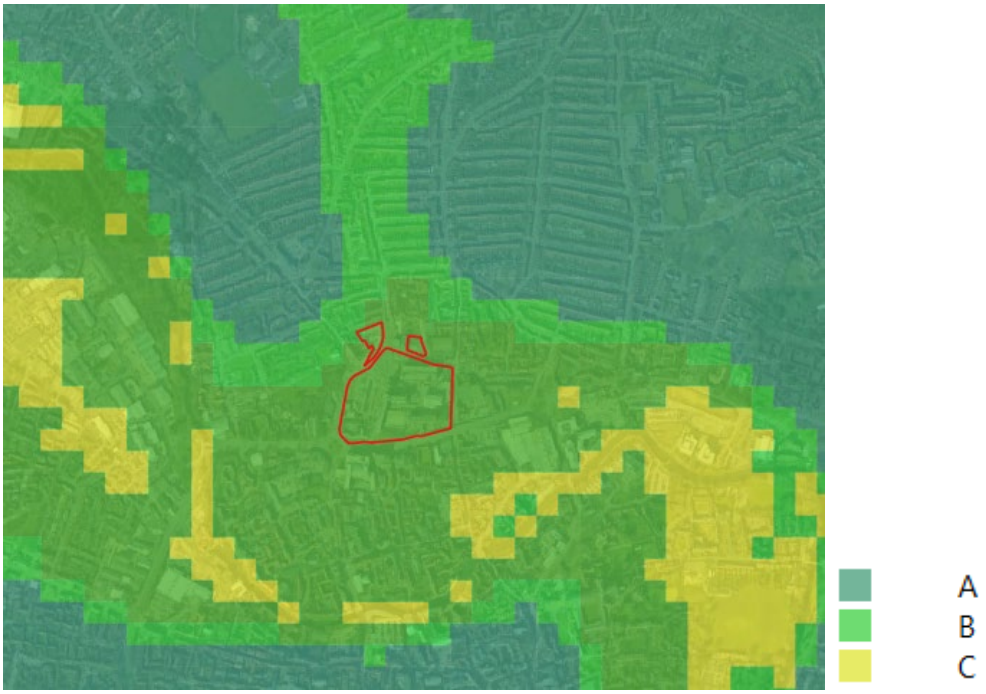


Figure 6: Susceptibility to Groundwater Flooding (BGS)

7.11 Site-specific boreholes have not yet been drilled as the site is still occupied. In addition, groundwater monitoring would be better undertaken in the wetter months, between October and February, to determine the highest groundwater levels.

7.12 Boreholes will therefore be drilled as part of the Phase 2 ground investigation works. Groundwater levels across the site can then be recorded over several months to confirm the likely levels.

Groundwater is expected to be relatively high at the site given the presence of the underlying gravels but no history of groundwater flooding at the site has been reported.

7.13 Instead, the best available information on groundwater levels on the site and in the local area is from historic borehole data, which is available on the British Geological Survey website (https://www.bgs.ac.uk/map-viewers/geology-of-britain-viewer/).

7.14 A number of historic boreholes have been identified close to or on the site. The details of each borehole and groundwater level are set out in Table 5.

Table 5: Historic Borehole Records (BGS)

Historic Borehole (BGS)	Date	Distance from Site (m)	Groundwater Level (m below ground)
TG20NW258	April 1986	100m NE	3.80m
TG20NW585	May 1993	100m NE	4.40m
TG20NW257	April 1986	90m NE	3.60m
TG20NW949	May 1977	0m (NW boundary)	3.50m
TG20NW950	May 1977	0m (onsite west side)	3.40m
TG20NW953	May 1977	0m (onsite west side)	3.50m
TG20NW954	May 1977	0m (onsite south west)	3.50m
TG20NW631/632/633/6434/635/636	June 1974	20m E	2.30m – 3.90m
TG20NW584	January 1993	30m S	2.40m
TG20NW453	January 1975	60m S	3.00m

7.15 It is noted from the above records that the boreholes within the site boundary record a groundwater rest level of between 3.40m and 3.50m below ground. These readings were taken in May which is not one of the wettest times of year, therefore it is taking a precautionary approach, it is anticipated that the groundwater rest level may rise in the wetter seasons, perhaps reaching a level 3.00m below ground. The groundwater readings taken to the south of the site are typically higher, which is likely due to the ground level reducing further south, and those taken to the north east are between 3.60m to 4.40m below ground level, which is representative of the higher ground to the north.

7.16 Given the above, the site is considered to be at moderate risk of flooding from groundwater. This could impact the proposed below ground basement car park and the service yard, which is lower than the existing ground level. Mitigation measures are included in Section 8 for areas which may be susceptible to groundwater flooding.

Artificial Sources

7.17 There are no artificial sources of flooding located in the vicinity of the site. Reference to the online EA map indicates that the site is not located within an area at risk of flooding from reservoirs.

7.18 Therefore, flood risk from artificial sources is considered to be low.

8 Mitigation Measures

8.1 Much of the proposed residential accommodation across the Anglia Square development site will be located at first floor and above, so will not be at risk of flooding for the lifetime of the development. There are however several areas where ground floor residential uses are located, within Blocks A, B and C of the detailed application boundary. The mitigation measures discussed in this section will address the flood risk to these residential dwellings, along with the flood risk to the commercial and leisure premises throughout the site, to ensure the risks are managed for the lifetime of the development.

8.2 To summarise, several parts of the proposed development are at negligible or low risk in the extreme 1 in 100 year (+45%CC) event. These are:

- Block B;
- Block D;
- Block E;
- Block F;
- Block H;
- Block G;
- Blocks J, K and L.

8.3 The parts of the development at greater risk of flooding, which the mitigation measures in this section will be focussed on, are:

- Service Yard off Edward Street;
- Basement Car Park;
- Block A;
- Block C;
- Block M;
- Block J3.

Offsite and Onsite Flows

8.4 The LLFA previously requested that the offsite overland flows are separated from the onsite drainage system. The attenuation tanks forming the onsite drainage system have not been designed to accept offsite flows in normal circumstances, but it is acknowledged that it is impractical to prevent offsite flows entering the onsite drainage system in some areas. The drainage systems serving the sloped pedestrian walkways and hard standings will channel surface water runoff through the site and there will be slot drains in the centre of the walkways in suitable locations to discharge the water to the attenuation tanks.

8.5 The proposed locations of these tanks are shown in the Proposed Surface Water Drainage Strategy prepared by EAS. Analysis demonstrated that during low return period rainfall events, there would be some capacity for offsite flows to enter the systems if required. However, sensors will be located at a level within each tank, likely around 75%, to trigger an alarm and alert the site management.

8.6 The only way to prevent offsite flows entering the site would be to install barriers along the northern site boundary, along New Botolph Street and Edward Street. This would block the existing

overland flow paths and further increase the risk to others. It is therefore recommended that overland flow paths remain where possible and an alarm detection system is installed onto the tanks serving the hardstandings. A proposed alarm system has been described below.

Attenuation Tank Alarm System

8.7 It is proposed that the attenuation tanks serving the external hardstanding areas/pedestrian walkways will have alarms fitted internally. As it is not possible to separate the offsite flows from the onsite runoff in these areas, it is recommended that alarm detection sensor is fitted at around the 75% capacity level of the tanks serving the hardstanding areas (Systems 03 to 08). The 75% capacity level was considered to be acceptable as it would ensure the alarms would not be triggered in the lower return period, every day events, but further analysis should be carried out to verify this. The specific level that the alarm sensors would be fitted within the tanks will be established during the preparation of the Flood Warning Plan, which it has been agreed with Norwich City Council Emergency Planning Team can be conditioned and prepared post-planning.

8.8 Assuming the overland flows from offsite begin to fill up the onsite surface water attenuation systems, the alarm would trigger should the tanks become 75% full. The alarm would sound an alert the Anglia Square management office, and it would be the management's responsibility to distribute the warning to each of the ground floor residential, retail, commercial and leisure uses. This would allow them time to evacuate, safeguard and close their premises.

8.9 An example of an alarm system that could be used is the RDNET1000 STM Storm Tank Level Monitoring and Alarm System (https://www.radio-data-networks.com/solutions/wastewater/stm-storm-tank-monitoring-systems/rdnet1000-stm-storm-tank-level-monitoring-alarm-system/). This system will monitor the capacity of the attenuation tank and send an alert to the onsite management office when it has reached a prescribed level. Details of this type of attenuation tank monitoring equipment and an explanation of the operation of this system are included in **Appendix L**. The flood warning strategy has been discussed below.

Specific Flood Warning and Mitigation Measures

8.10 Hydraulic modelling has demonstrated there to be several vulnerable areas within the proposed development. These are set out in **Table 6** along with the proposed mitigation measures to reduce the risk to people and property. Each of these areas have been considered in more detail below.

Table 6: Vulnerable areas within site boundary and proposed mitigation measures

Location	Water Depth (m)	Mitigation Measures
Edward Street Service Yard	1.02	Raised hump at entrance Waterproofing methods Drain/sump
Basement Car Park	0.11	Raised hump at entrance Waterproofing methods Sump pump
Block A and M	0.10 to 0.13	Evacuation Flood resilient construction
Block C	0.27	Raised Floor Level

Location	Water Depth (m)	Mitigation Measures
		Evacuation
South/South East of Block J	0.08	Evacuation Flood resilient construction
External area East of Block H	0.18	Evacuation

Edward Street Service Yard

8.11 The proposed service yard off Edward Street is predicted to flood to a depth of 1.02m during a 1 in 100 year (+45%CC) event. Based on advice from the LLFA, it was agreed with the Applicant that a raised hump would be permanently installed at the entrance to the service yard. Modelling of this scenario was completed to determine the required level to set the hump at. To provide 300mm freeboard above the 1 in 100 year (+45%CC) event, the hump at the service yard will be set at 4.45m AOD. Further modelling demonstrated that this would result in no flooding to the service yard in a 1 in 100 year (+45%CC) event. Taking a precautionary approach, it is recommended that a drain is located within the service yard in the unlikely event that a storm event higher than that modelled occurs, to ensure that any water is discharged from this area. The drain from the service yard has been connected to the onsite drainage system downstream of the attenuation tanks to ensure that any overflow from the service yard will not compromise the capacity required to manage a storm event on the site.

8.12 The service yard must be completely water-tight to prevent water from getting into this area from Edward Street (e.g. through service cable conduits or air vents) and from potentially high groundwater. By making it water-tight, this will also prevent water entering the adjacent buildings (such as Block M). No openings such as air bricks, doors or windows should be included in the neighbouring wall with Block M, to prevent water ingress into the surrounding blocks.

Basement Car Park

8.13 The basement car park finished floor level will be 0.825m AOD. As this is clearly a very vulnerable part of the development, discussions with the Applicant confirmed that a permanent hump can be installed at the basement car park entrance. Modelling of this mitigation measure determined the required hump level to be 4.80m AOD, which allowed a 300mm freeboard above the flood level in this location which is 4.50m AOD. Model runs with the inclusion of the hump at the entrance to the basement car park confirmed that no floodwater could enter the basement in any modelled scenario up to and including the 1 in 100 year (+45%CC) event. As such, no further mitigation measures are considered necessary.

8.14 As with the service yard, taking a precautionary approach, a sump pump should be included in the basement car park in the unlikely event of a more extreme storm event occurs. The sump pump will pump water into the onsite drainage system following this event, when the surface water around the site and in the drainage system has started to recede. However, the sump pump is considered as an overflow and will not compromise the attenuation volume required in the tanks to manage rainfall on the site.

8.15 It is very important that the basement car park is constructed to be water-tight to prevent water from getting into this area from Edward Street (e.g. through service cable conduits or air vents) and from potentially high groundwater.

Blocks A and M

8.16 The northern boundary of Block A, adjacent to Edward Street, is shown to flood in a 1 in 100 year (+40%CC) event, as is part of Block M. As previously discussed, there would be internal walls which would help to prevent the risk to these buildings. It is recommended that the external walls facing Edward Street are constructed using flood resilient methods to prevent water ingress at this location. The raising of internal floor levels would also help to reduce the flood risk to both Block A and Block M, but it is understood that this may not be achievable when considering other requirements such as level access.

8.17 It is recommended that the commercial development located on the ground floors of Blocks A and M is constructed using flood resilient methods based on a 'water exclusion' strategy. While it is understood that some mitigation methods such as flood barriers are unlikely to be achievable due to the type of construction, it is recommended that the internal layout of the commercial space considers flooding and uses ramps or raised platforms to allow the majority of the unit to remain above the flood level even though the entrance will be at ground level.

8.18 Flood resilient materials must be used in the construction of Blocks A and M, and the adjoining wall with the service yard should be made water-tight to prevent water ingress. Some examples of flood resilient construction methods, taken from the publication by DEFRA entitled 'Improving the Flood Performance of New Buildings' are:

Floors

- Concrete ground supported floors are preferred and concrete slabs of at least 100mm thickness.
- Hardcore and blinding – good compaction should be achieved to reduce the risk of settlement and cracking.
- Damp Proof Membranes – should be included in any design to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping.
- Insulation materials – Water will lower the insulation properties of some insulation materials. Floor insulation should be the closed-cell type to minimise the impact of flood water. Insulation should be placed above the floor slab.
- Services – Under floor services using ferrous materials should be avoided.

Walls

- For masonry walls, use good quality facing bricks for the external face of cavity walls. Do not use soft bricks such as handmade clay which can easily crumble when subjected to water.
- Concrete bricks dry quicker than Aircrete blocks. However, Aircrete blocks allow less leakage, so the design of blockwork needs to be considered and the most relevant brick work should be selected.
- External renders should not be used as they provide a barrier to water penetration and could result in structural problems.

- Internal linings – Avoid internal cement renders as these can prevent effective drying.

8.19 Where possible, some of the above flood resilience method should be implemented.

Block C

8.20 The ground floor finished floor levels of Block C have been raised 300mm above the 1 in 100 year (+45%CC) flood level. This provides freeboard above the most extreme event and as such, there is no internal flooding to the habitable areas of Block C. There is however external flooding around the building of up to 260mm to the south and up to 420mm to the north. In addition, the ground level bin store could flood up to 300mm in this extreme scenario.

8.21 It is therefore recommended that flood resilience measures are included in the construction of this block. flood resilience measures are adopted for the ground floor of this block to prevent water ingress. Some examples of flood resilience measures taken from DEFRA's publication entitled *'Improving the Flood Performance of New Buildings'* are:

Building Materials

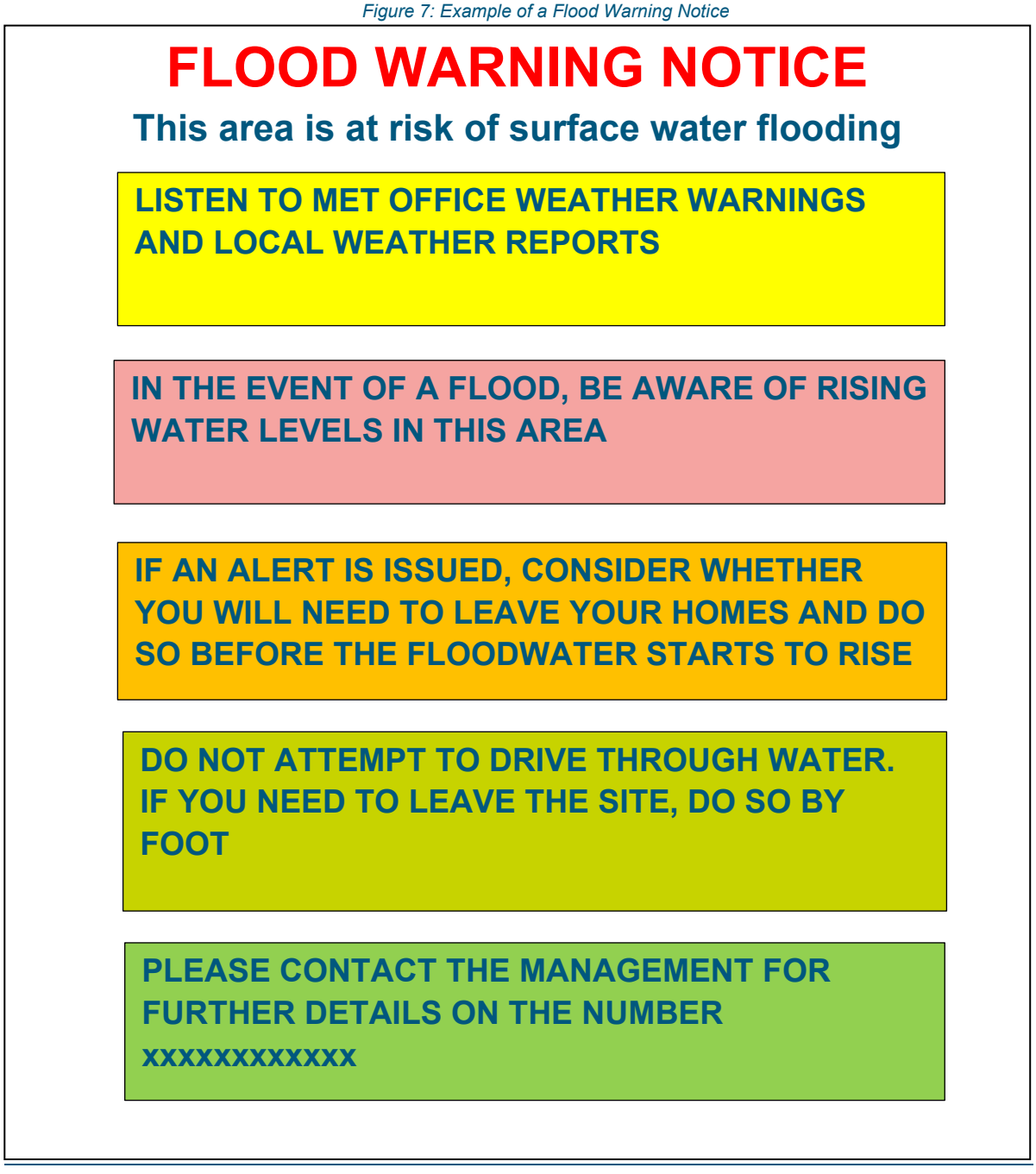
- Engineering bricks, cement based materials including water retaining concrete and dense stone.
- Masonry walls – Use good quality facing bricks for the external face of cavity walls. Concrete blocks dry more quickly than Aircrete blocks.
- Clear cavity walls (i.e. no insulation) dry more quickly than filled/part filled cavity walls.
- Avoid internal cement renders beneath flood level as these can prevent effective drying.

Doors and Windows

- Raise the door threshold as high as possible to protect the site, while still complying with level access requirements.
- Use sealed PVC external framed doors rather than wood.
- Ensure adequate sealing of any PVC window/door sills to the fabric of the building.

8.22 A flood warning notice should also be displayed in this area to notify residents of the potential risk. The flood warning notice should be located outside the building within the car park. **Figure 7** provides an example of a flood warning notice that could be displayed.

Figure 7: Example of a Flood Warning Notice



8.23 A Flood Evacuation Plan should be provided to residents moving into Block C to inform them of the risk to this area and the actions to take in the event of a flood. This could be provided as part of the 'Welcome Pack' to new residents.

Southeast of Block J

8.24 Part of Block J is shown to flood up to 0.08m during a 1 in 100 year (+45%CC) event. This is a very low-lying area and it is recommended that flood resilient construction methods are used in this block. It is assumed that this area may be publicly accessible, so a flood warning notice similar to that in **Figure 7** should be displayed.

East of Block H

8.25 The external area to the east of Block H could experience depths of up to 0.18m in the 1 in 100 year (+45%CC) event. It is unlikely that this area would flood to the depths shown in **Appendix I**, as there may be obstructions to flow paths north of the site which are not picked up in the model. The resulting risk to people using this area is likely to be low, even in an extreme event, as demonstrated by the hazard mapping. However, in the event of significant flooding to the site, the site would be evacuated. This has been discussed further below.

Site-Wide Flood Warning and Evacuation Strategy

8.26 Given the type and scale of the development, it is not possible to have raised ground floor levels within the commercial, retail and leisure units. Level access requirements mean that all door thresholds will be at ground level, and it is understood that the units will have glass windows fronting the walkways. This means that finished floor levels raised 300mm above the flood level, are not achievable.

8.27 In some areas where there are ground floor residential dwellings, it is understood that these will have steps down to the pedestrian walkways. This would provide another level of protection for the residential elements. As demonstrated by the hydraulic modelling, none of the ground floor residential areas will experience flooding even in the most extreme events.

8.28 The depths experienced in the external areas on the site and pedestrian walkways are typically no greater than 150mm, and these areas are shown to be in 'Low' risk areas on the hazard maps. It is however recommended that a site-wide flood warning and evacuation strategy is in place, which details the access and evacuation routes in a significant flood if a storm event greater than that modelled occurs.

Met Office Weather Warnings

8.29 The site operators/management staff must subscribe to weather warnings from the Met Office. These provide an indication of when weather warnings (e.g. extreme rainfall) are forecast and enable appropriate action to be taken.

8.30 The Met Office issues weather warnings up to 5 days in advance, through the National Severe Weather Warning Service, when severe weather has the potential to bring impacts to the UK. It is also possible to stay up to date with weather warnings through the Met Office app (available on both Android and Apple), social media (Twitter, Facebook) or email alerts. More information can be found at https://www.metoffice.gov.uk/weather/guides/warnings. The site management must subscribe to this, and this link should also be included in the 'Welcome Pack' of new residents to make them aware of the risk to the site.

8.31 During periods of bad weather, the site management should monitor local weather reports and Met Office UK weather warnings.

- Yellow warnings indicate low level impacts such as disruption to travel.
- Amber warnings indicate an increased likelihood of impacts from severe weather which could potentially disrupt plans. Action should be taken if an amber alert for storms or flooding is issued for the area.
- Red warnings are issued when dangerous weather is expected which could result in substantial disruption. If a red alert is issued then action must be taken.

8.32 The Met Office weather warnings should be used to set evacuation triggers. Three trigger stages have been identified, as follows:

1) Yellow Warning: to implement a review of the FWEP procedures;
2) Amber Warning: Place residents/staff on amber alert (state of readiness). If surface water begins pooling in the more vulnerable areas, such as north of Block C, notify residents/staff that they should leave the site now while safe access is still available;
3) Red Warning: Issue a red alert (site-wide evacuation of commercial/retail and publicly accessible areas).

8.33 It will be the responsibility of the site manager to alert the managers of each of the ground floor commercial and retail units to the potential flood risk. The managers of the commercial units should receive a Flood Warning and Evacuation pack when they move into their units, which will outline the actions they will need to take. It is recommended that a general Flood Warning and Evacuation Strategy is prepared at a later stage of the planning process and distributed to the individual units. Specific flood warning and evacuation packs (e.g. for Blocks A, M and C) should be compiled separately.

8.34 The flood warning strategy for the public and commercial areas would be as follows. Upon receipt of a flood warning from the site management office, the managers of the individual units should close their premises. If possible it is advised that items are moved away from the doors and windows and located at higher levels (e.g. if part of the unit is on a raised platform). It is understood that demountable barriers and the like may not be possible on glass fronted units; however if it is possible to use barriers at the doors and windows then this would be advised and once the units have been closed, the barriers should be installed.

Attenuation Tank Alarm Warnings

8.35 When offsite overland flows enter the site at the northern boundary, the attenuation tanks will begin to fill up and trigger an alarm. When this happens, the site management will be alerted to the location where the alarm has been triggered. It is likely that the northernmost attenuation tank (serving Block D hardstandings) would trigger first, as this would be in the main flow route.

8.36 As the site management would have received a Met Office weather warning at this stage, they would likely be prepared to receive an alarm alerting them that the attenuation tanks are filling up.

8.37 Upon receipt of the alarm, it is recommended that the site management inspects the area where the alarm was triggered in the first instance to ensure it was due to surface water entering the tank and no other reason (such as a burst water main, or fire-fighting run-off). Assuming the flood

mechanism is surface water from offsite, this would indicate that the site could begin to flood. At this stage, a conservative approach should be taken to ensure that the ground floor commercial development and those using the site are aware of the risk and can safeguard their premises. In addition, the management should distribute an alert via a text message to the residents of the site, to warn them of the risk.

Evacuation Route

8.38 Once the premises have been safeguarded and secured, it is necessary to leave the site. It is recommended that residents, staff and customers evacuate the site either to the west towards Pitt Street or the south towards St Crispins Road, as shown in **Figure 8**. These evacuation routes are away from the higher risk areas. People should evacuate via the safest route possible and it is not advised to drive through floodwater.

8.39 A publicly accessible area has been identified in Block D which can be accessed in an emergency. This is above ground floor level and should provide a safe place of refuge for customers or staff who are unable to leave the site through the evacuation route detailed above. The Block D emergency refuge area is circled in red in **Figure 8**.

8.40 It should be noted that if there is an immediate danger to life the emergency services will be contacted, and their advice should be followed.

Figure 8: Evacuation routes offsite

8.41 Further details on the flood warning strategy for the commercial units and the residential areas will be confirmed post planning, and an emergency plan will be provided for the site as a standalone document. Teresa Cannon, Emergency Planning Manager at Norwich City Council has confirmed that it is acceptable to prepare the emergency flood plan as part of a condition (Email in **Appendix M**).

Commercial Units

8.42 It is recommended that the final occupants of the commercial units install flood resilience methods. Some examples of the types of methods used are detailed in the publication by DEFRA entitled 'Improving the Flood Performance of New Buildings.' Some specific flood resistant methods, taken from the DEFRA publication, are summarised below:

8.43 Fixtures and Fittings

- Electrical sockets should be located above ground level and above the flood level where possible.
- Durable fittings should be used that are not significantly affected by floodwater and can be easily cleaned.

- Electrical appliances should be placed on plinths as high as practicable above the floor to ensure they are above the flood level.
- Ensure adequate sealing of joints between kitchen units and surfaces to prevent penetration of water behind fittings.

- Provide means for effective drainage and cleaning e.g. gaps behind kitchen units will facilitate drainage and will allow access for forced drying, if proved to be necessary.

8.44 Some of the commercial units will have a first floor or mezzanine level. These areas will remain above the flood level even during a 1 in 100 year (+45%CC) event so it would not be necessary to use flood resilient construction measures here.

8.45 It is recommended that threshold drains are installed along the entrances of each unit to collect surface water. The threshold drains will have a connection to the attenuation tanks serving the adjacent hardstandings. A no-return valve should be used on the connections to prevent water backing up into the threshold drains.

Residential Units

8.46 Most of the residential units are at first floor level and above. However, as previously noted, there are some ground floor residential dwellings, which will be set at least 300mm higher than the extreme flood level. In the event of a flood, the site management will distribute a flood alert to the residents. As all accommodation is located above the flood level, the residents will have the option to remain in their homes which will be safe and dry for the events considered. However, if the residents wish to do so, they can evacuate their homes prior to an extreme event. The flood warning and evacuation procedure will be set out in the Flood Warning and Evacuation Strategy provided to them when they move in.

8.47 The safest route offsite will be via the main pedestrian walkways to the west and southwest, as these are away from the main overland flow paths. The evacuation routes would be the same as that proposed for the commercial premises at **Figure 8**.

8.48 A visual comparison between the ground floor plan (**Appendix E**) and the modelled depth maps (**Appendix I**) shows the residential lobbies in the eastern sections of Block A, western side of Block M may be flooded in a 1 in 100 year (+45%CC) event. It is not possible to include raised floor levels in these areas due to level access requirements, although it is advised that sealed door thresholds should be used if possible to provide some protection to these areas. It should be noted that in the 1 in 30 year (+40%CC) event, the depths in these areas are very low and unlikely to pose a significant risk.

Utility Plants

8.49 Electrical substations and plant rooms throughout the site are identified at ground floor level in **Figure 9**.

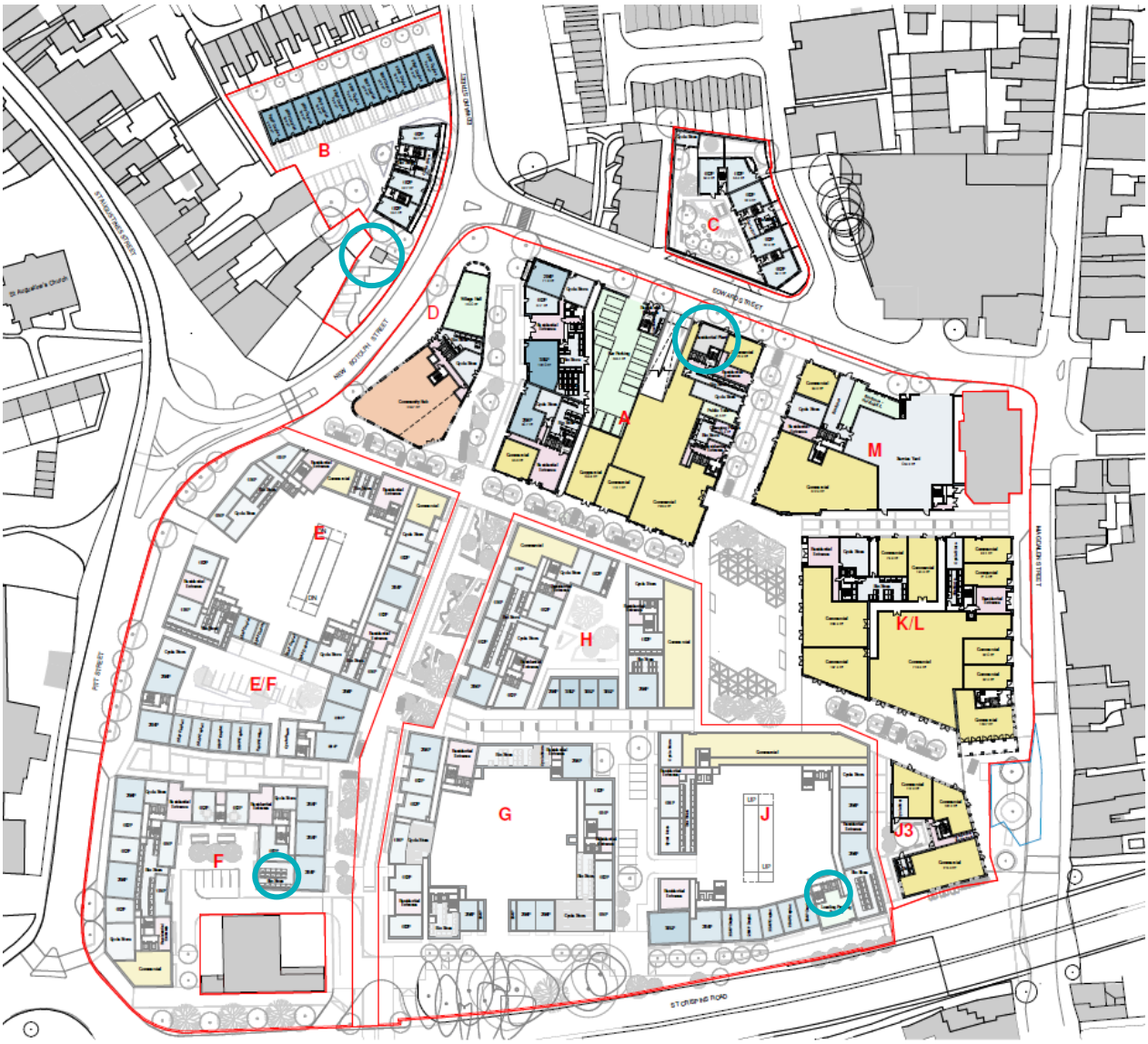


Figure 9: Locations of electrical substations

8.50 Norfolk CC commented in their previous pre-application response that utility plants should be considered during a 1 in 100 year (+45%CC) flood event, so that the site can remain operational even during a flood. A visual comparison with the 1 in 100 year (+45%CC) depth map indicates that it is unlikely that any of the substations would be flooded in an extreme event.

8.51 As a precautionary measure, it is recommended that any substations and utility plant apparatus is located individually on plinths above the ground floor level.

Groundwater

8.52 As indicated in Section 7 of this report, the chalk geology beneath the site could result in moderately high groundwater levels. Analysis of nearby historic borehole records suggest that the groundwater level could be around 3.40m to 3.50m below ground. However, adopting a

precautionary approach, it is more likely that in the wetter seasons the groundwater level could rise to around 3.00m below ground. Groundwater monitoring will be carried out during the Phase 2 ground investigation works, to better understand this. However, as the BGS groundwater susceptibility mapping indicates the site to be in an area with potential risk to property located below ground level, this could result in a groundwater risk to the below ground basement car park (Block A) and service yard (Block M).

8.53 Mitigation measures will be included to ensure that high groundwater levels will not pose a flood risk to the below ground structures. The basement car park and service yard are not habitable uses, but it is important to ensure that groundwater does not reach these areas. Therefore, both the basement car park and service yard will be made water-tight ('tanked') to prevent water ingress.

8.54 Although measures will be taken to make the basement car park and service yard water-tight, a sump pump will be included in both of these areas as a failsafe, so that in the highly unlikely event that groundwater does reach these areas, it can be pumped out.

8.55 Perched groundwater could be present below areas of the site and may be encountered during the below ground civil engineering works. The perched groundwater, if encountered, would need to be mitigated for by appropriate construction techniques and in accordance with an appropriate method statement, to ensure Health and Safety and Environmental permitting requirements are satisfied.

8.56 If groundwater is encountered during construction, mitigation measures should be implemented in accordance with the advice of a Geo-Technical Engineer experienced in hydro-geological processes.

8.57 All subsurface surface water drainage infrastructure must be designed with high groundwater levels in mind at the detailed design stage, so that rising groundwater levels will not compromise the attenuation volume available in the cellular storage tanks. Cellular storage tanks will be lined accordingly.

8.58 It is not anticipated that groundwater would emerge at the surface. However, in the highly unlikely event of groundwater emerging within the Anglia Square site boundary, it is noted that all residential dwellings are typically set higher than ground level up a number of steps so it is highly unlikely they would be impacted by groundwater flooding. Groundwater flooding occurs slowly so there would be ample time for ground level commercial uses to prepare for flooding and implement measures to prevent significant damage.

Residual Flood Risk

8.59 Mitigation measures have been provided to reduce the potential risk of flooding from surface water and groundwater. However, in the event of a rainfall event greater than that considered in this assessment, the external areas may experience some flooding. The likely exceedance routes in this event have been considered in the Proposed Surface Water Drainage Strategy, prepared by EAS. However, even in these extreme circumstances, it is likely that the residential units would remain safe and dry as they are all raised at least 300mm above the 1 in 100 year (+45%CC) surface water flood level.

8.60 There remains a residual risk of exceedance and blockage of the designed drainage system. Maintenance measures should be carried out regularly to ensure the surface water drainage system is effective for the lifetime of the development. Suitable maintenance measures have been considered in the Proposed Surface Water Drainage Strategy.

8.61 The drainage systems serving the proposed development will be managed by the managers/owners of the site, and it is recommended that regular inspections of the surface water drainage systems are carried out to ensure that they continue to work effectively.

9 Summary and Conclusions

9.1 This Flood Risk Assessment has been prepared for the proposed mixed-use development at Anglia Square, Norwich. The proposed development would provide residential, commercial, retail, and leisure uses across the site, along with car and cycle parking. The site is currently occupied by the Anglia Square shopping precinct, a disused multi-storey car park and office blocks which are not in permanent use.

9.2 The LLFA provided comments during their pre-application review of the hydraulic model and a follow-up meeting. Further comments were received from the LLFA following the submission of an earlier version of the scheme. Their flood risk comments have been addressed in this report and the accompanying hydraulic modelling report.

9.3 The Environment Agency's Flood Map for Planning illustrates that the site is located entirely within Flood Zone 1 and therefore deemed to be at a low risk of fluvial and tidal flooding. The local geology and location in Source Protection Zone 2 suggests that groundwater may be relatively high. However, there is no evidence of groundwater flooding and the existing site is almost entirely impermeable, which would prevent groundwater emergence at the site.

9.4 The Flood Risk from Surface Water mapping indicates that the risk of surface water flooding is medium/high. This is most likely due to the presence of the Dalymond/ Dalimond ditch, a "lost" river which is likely to have been incorporated into the public sewer networks. Due to the generalised methodology used for modelling surface water, it is likely that the risk is overestimated. The existing surface water model for Norwich City Centre has been updated, amended and re-run for several existing and proposed scenarios. This process has helped to determine the most vulnerable parts of the proposed development, and to quantify the risks to the development. This also helped to compare the existing and proposed risks offsite to determine whether there would be a significant increase in flows as a result of the proposed development.

9.5 The areas at highest surface water risk have been identified as the Edward Street service yard, basement car park in Block A, part of the ground floor of Block A, Block C and the area south of Block J. A number of mitigation measures were discussed which include installing humps at the entrances of the service yard and basement car park, having a flood warning and evacuation plan in place across the site, using flood resilient construction methods and tanking the low-lying areas of the site.

9.6 It is not possible to prevent offsite flows from entering the onsite drainage system, so separate alarms fitted to the attenuation tanks serving the pedestrian walkways/hardstandings are proposed. These would alert the site management who would then send out a warning to the residents and staff of the individual ground floor units.

9.7 The lowering of part of the pedestrian walkways has the benefit of directing runoff away from the proposed buildings while also routing surface water through the site, and maintaining the existing flow routes. It is acknowledged that the central sections of the pedestrian walkways may flood in places, but an evacuation route has been identified to guide people offsite to the west and southwest, away from the main overland flow paths.

9.8 An offsite impact study indicated the area where the proposed development would increase flood levels. Most of the areas identified would already be classified as being at risk of flooding in the present day scenario, however there was a section of the road in Magdalen Street and Cowgate

which could experience an increase in flood depth as a result of the development. Several areas, such as the area south of St Crispins Road and properties north of Block C, experience a reduction in flood depth as a result of the development.

9.9 Areas where residential lobbies and utility plants are located were compared to the depth maps. Mitigation measures are proposed where possible.

9.10 A flood warning and evacuation strategy for the site has been outlined and it is expected that a more detailed flood warning strategy will be provided at a later design stage.

9.11 We believe that the development proposals comply with the guidance provided in the NPPF, and with the recommendations of Anglian Water and Norwich City Council, and that no reason exists to object to the proposals in terms of flood risk.

9.12 Comments provided by Norfolk County Council (the LLFA) have been considered and addressed, although it is acknowledged that in some cases further details will need to be supplied at a later stage of the design process.

Appendix A LLFA Comments

Norfolk County Council
Community and Environmental Services
County Hall
Martineau Lane
Norwich
NR1 2SG
NCC contact number: 0344 800 8020
Textphone: 0344 800 8011

via e-mail
Tracy Armitage
Planning Services
Norwich City Council
City Hall
Norwich
NR2 1NH

Your Ref:	22/00434/F	My Ref:	FW2022_0423
Date:	26 May 2022	Tel No.:	0344 800 8020
NCC Member:	Jamie Osborn	Email:	llfa@norfolk.gov.uk

Dear Ms Armitage,

Town and County Planning (Development Management Procedure) (England) Order 2015

Hybrid (Part Full/Part Outline) application for the comprehensive redevelopment of Anglia Square, and car parks fronting Pitt Street and Edward Street for: up to 1,100 dwellings and up to 8,000sqm (NIA) flexible retail, commercial and other non-residential floorspace including Community Hub, up to 450 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), car club spaces and associated works to the highway and public realm areas at Anglia Square Including Land And Buildings To The North And West Norwich

Thank you for your consultation on the above site, received on 21 April 2022. We have reviewed the application as submitted and wish to make the following comments.

The hybrid application is for the re-development of Anglia Square in central Norwich. The proposed development will involve the mixed use development in 15 blocks. The full application area of the site is mostly located in the northern area of the proposed site, while the remaining area is seeking outline permission. The applicant is working on a rapid timescale due to the need to access HIF funding that underpins the Viability Assessment for this proposed development. This has prompted the applicant to begin work on the reserved matters application at this time.

A prior application for the site, which was unsuccessful, saw several points of contact between Norwich City Council and the LLFA on behalf of the developers between 2016 to 2019.

In this new hybrid application, the applicant has submitted the following documents for review in this consultation:

Continued…/

- Anglia Square Norwich Flood Risk Assessment, Royal HaskoningDHV, Ref: 6645-RHD-ZZ-RP-Z-0001, 31 March 2022;
- Proposed Surface Water Drainage Strategy for Anglia Square Regeneration Norwich Norfolk, EAS, Ref: SUDS/3831/2022 Rev B – Final, 1st April 2022; and
- Anglia Square Norwich Hydraulic Modelling Study, Royal HaskoningDHV, Ref: 6645-RHD-ZZ-RP-Z-0001, 31 March 2022.

The LLFA has reviewed the submitted documents has significant concerns that the submission lacks information in many aspects of this application, lacks the evidence to support the current submission and is shown to increase flood risk to a number of properties and highways elsewhere.

We **object** to this planning application in the absence of an acceptable Flood Risk Assessment (FRA), Drainage Strategy and supporting information such as drainage design and hydraulic modelling relating to:

- The demonstration that the development is in accordance with National Planning Policy Framework (NPPF) with regard to the risk of flooding. There is currently insufficient information to demonstrate that surface water arising from the development would not result in flooding of the proposed building or by discharging it to a location which would lead to the increased risk of flooding elsewhere.
- The lack of sufficient detail for the drainage proposals for the relevant stages of planning to show how the SuDS drainage hierarchy has been achieved, each parcel of land will drain, greenfield runoff rates and volumes, the brownfield runoff rate and volumes proposed to prevent an increased risk of flooding elsewhere.
- Additional information is needed to show there is no adverse risks of flooding elsewhere from the proposed development. This includes both the proposed development and ensuring that the proposed surface water drainage scheme would be operational and not overwhelmed by the overland flow path from offsite.

Reason
To prevent flooding in accordance with National Planning Policy Framework paragraph 167, 169 and 174 by ensuring the satisfactory management of local flood risk, surface water flow paths, storage and disposal of surface water from the site in a range of rainfall events and ensuring the SuDS proposed operates as designed for the lifetime of the development.

We will consider reviewing this objection if the following issues are adequately addressed.

1. An updated Flood Risk Assessment (FRA), Drainage Strategy and Hydraulic Modelling Study that consistently provides information that interlinks each of the documents.
2. Within the FRA, Drainage Strategy, Hydraulic Modelling Study and yet to be developed detailed drainage design, we request these documents incorporates the evidence to address the issues identified in the Annex.
    2.1. The assessment of the greenfield and brownfield runoff rates and volumes are required to be calculated accurately using the FEH in accordance with the LLFA Developer Guidance requirements and presented clearly and consistently within the technical reports.

Continued…/

2.2. Provide evidence to support the justification of increasing the greenfield discharge rate is required in accordance with the LLFA Developer Guidance.

2.3. Apply the latest (May 2022) Climate change guidance, which would require the application of a 45% climate change allowance to the 1% AEP and to apply the appropriate climate change allowance of 40% to the 3.3% AEP calculations.

2.4. Evidence of recent liaison with Anglian Water relevant to this new planning application that provides:

2.4.1. confirmation from Anglian Water that no changes have occurred in the public network since 2017.

2.4.2. Obtain a recent drainage assessment from Anglian Water that relates to the current proposed development.

2.4.3. Provide a current set of DG5 records from Anglian Water.

2.4.4. provide evidence of an “agreement in principle” with any third parties taking on surface water drainage management and maintenance responsibly.

2.5. Provide a more in-depth consideration and assessment of rainwater harvesting and reuse opportunities on site.

2.6. Provide a more in-depth consideration and assessment of groundwater flood risk.

2.7. Provide a more in-depth consideration and assessment of sewer flood risk.

2.8. Provide clarification on the retention of surface water runoff on the site and whether this is actually the provision of either blue or green roofs not previously included in the surface water drainage calculations.

2.9. Provide clarification on the water depths for the return periods given at Edward Street Service Yard as there are significant discrepancies.

2.10. Prepare and provide a full detailed drainage design that includes all the proposed elements of the surface water management system. This includes clarification of design details (including plans, modelling, calculations and supporting information in accordance with the LLFA’s Developer Guidance) of the suitable drainage features, such as green / blue roofs, bio-retention features and tree pits.

2.11. Provide the proposed discreet drainage catchment areas and supporting information on a plan for each of the proposed systems in accordance with the LLFA Developer Guidance.

2.12. Undertake an assessment that demonstrates how the proposed SuDS systems meets the four pillars of SuDS in accordance with LLFA Developer guidance and in relation to Policy E9 of the Local Flood Risk Management Plan.

2.13. Undertake further assessment and consideration of the carbon impact of additional pumps operating on this site is recommended in accordance with Policy E8 of the Local Flood Risk Management Plan.

2.14. Prepare a surface water drainage phasing plan for the proposed development.

2.15. Provide updated water quality assessment information that acknowledge the inclusion of all elements of the SuDS system.

2.16. Provide further information regarding the water quality management approaches required for the construction of the proposed development.

2.17. Identify and assess the residual risk and provide suitable mitigation associated with the management of the pumps and the attenuation tanks.

2.18. Provide a site layout plan that demonstrates all surface water drainage features sized appropriated and to ensure suitable space is available within the proposed development. The design should be in accordance with both the LLFA Developer Guidance, the Ciria SuDS Manual, the building regulations and other relevant local and national guidance, practises and policies.

2.19. Provide detailed information of the design and operation of the flood barrier for inclusion within the hydraulic model as part of this full application.

2.20. Update the hydraulic model and the drainage strategy to ensure they are consistent with other technical disciplines' submissions.

2.21. An assessment of the surface water treatment required for all elements of the proposed development to determine whether the SuDS system is providing an appropriate amount of water quality treatment.

2.22. A surface water drainage design that includes a site plan with appropriated sized SuDS features and conveyance structures to ensure space is available. The design should be in accordance with both the LLFA Developer Guidance and the Ciria SuDS Manual.

2.23. Identification of the structures to be placed below ground and an assessment of the risk of groundwater flooding and specific mitigation measures to manage the groundwater flood risk to those structures where required.

2.24. A maintenance and management plan detailing the activities required to manage the proposed SuDS including confirmation of ownership, maintenance responsibilities and in principle agreements.

2.25. Provide an updated assessment of the suitability of the different types of SuDS components on the site.

2.26. Provide further evidence to support the viability of the Edward Street Service Yard residual risk mitigation and provide clarification on whether an automated flood barrier could be installed.

2.27. The Emergency Flood Plan should be prepared in accordance with the ADEPT guidance (2019), available at https://adeptnet.org.uk/floodriskemergencyplan and demonstrate ongoing liaison with the relevant Emergency Planning Team

2.28. An assessment of the potential to install some flow and level monitoring gauges to enable the site manager to monitor and manage the flood risk on site.

2.29. Update the assessment of the residual flood risks within the FRA for the proposed development and its components.

2.30. Inclusion of an updated Exceedance Flow Routes plan for the site with proposed finished ground and floor levels marked on.

2.31. Both the FRA and the Drainage Strategy require updating to address the large number of statements and conjecture that are not supported by evidence. These

statements and assessment need to be evidence based for the statements to validated.

2.32. Provide a proposed drainage design with supporting evidence (plans, calculations, modelling and detailed design) that provide evidence of inclusion and support the proposed offsite drainage of surface water for the car park entrance and the service yard entrance on Edward Street. The evidence should demonstrate that the mitigation is appropriate, operable and “agreed in principle” by Anglian Water along with identifying who will be responsible for the maintenance and management.

2.33. Provide clarifications from the applicant on whether the inclusion of flood doors have been considered on the proposed development.

2.34. Provide discussion on whether an alternative design approach and location was considered before placing the car park entrance ramp on Edward Street.

2.35. Provide an assessment of flow entering the basement car park should mitigation not be installed or the failure of mitigation measures.

2.36. Provide evidence the proposed development scheme that in accordance with NPPF where “the development should be made safe for its lifetime without increasing flood risk elsewhere.”.

2.37. Address all LLFA queries given in the attached Annex.

3. The hydraulic modelling report and model requires updating to include;

3.1. confirmation that the key parameters (URBEXT, Catchment area, etc.) have been checked and the parameters where appropriate adjusted accordingly.

3.2. Provide an updated hydraulic model that:

3.2.1. Includes sewers in the hydraulic model for the sewer network affecting the parts of the site included in this application to support the full application that demonstrates there is no increase in flood risk elsewhere.

3.2.2. Is extended to cover the full catchment to ensure the inflows are calculated correctly, or includes sensitivity testing showing that these inflows do not impact flood risk at the site

3.3. Provide clarification on whether Anglian Water has been contacted to supply sewer data. This should be requested and included where interactions with the sewer system are likely to impact flooding.

3.4. The inclusion of information regarding the onset of flooding and its associated duration for vulnerable locations across the site including the basement car park entrance and the service yard and loading facilities.

We would like to highlight that Flood Re insurance is not available for houses built after 1 January 2009. This is to ensure that the risks of flooding are appropriately considered and mitigated at the planning stage. Thus, new developments are subject to risk reflective pricing, meaning those built without due consideration of flood risk may struggle to access affordable insurance. We advise the applicant that they fully consider the potential available finance and insurance for the future owners and / or tenants of the proposed dwellings.

Further detailed comments can be found in the attached Annex.

Further guidance on the information required by the LLFA from applicants can be found at https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers.

If you, the Local Planning Authority review and wish to determine this application against our advice you should notify us, the Lead Local Flood Authority, by email at llfa@norfolk.gov.uk. Alternatively, if further information is submitted, we request we are re-consulted and we will aim to provide bespoke comments within 21 days of the formal consultation date.

Yours sincerely,

Sarah

Sarah Luff
Strategic Flood Risk Planning Officer
Lead Local Flood Authority

Continued…/

Annex: Norfolk County Council LLFA Additional Information to LPA

LPA Application Ref: 22/00434/F	LPA: Norwich City Council
LLFA Ref: FW2022_0423	Applicant name: Weston Homes
Site name/Description: Anglia Square, Norwich	Greenfield or Brownfield Development: Brownfield
Planning Stage: Hybrid	Summary of Surface Water Drainage Proposed: A new submission for the redevelopment of Anglia Square. The current proposed drainage system is a traditional system that is focused on the use of underground surface water attenuation tanks that discharge to the existing surface water sewer and combined sewer networks. Half of the systems will require a pumped discharge. Some areas of permeable paving are proposed prior to discharge to attenuation tanks. The attenuation will not be to the greenfield runoff rate but does seek some betterment on the existing brownfield rate. The level of betterment is not clear at this time as the drainage strategy indicates there is the potential to include some green roofs, tree pits and bio-retention features, however these features are not included in the plans or design calculations. Therefore, LLFA has low confidence that these features will be included at this time. SuDS quantity benefit: included – better definition required SuDS quality benefit: Unclear – better definition required SuDS amenity benefit: Unclear – better definition required SuDS biodiversity benefit: Unclear – better definition required

Local Flood Risk: Summary of Local Flood risks in the vicinity of the site

- **Surface water -** There are areas at risk of surface water flooding within and adjacent to the development site boundary of 3.33% and 1% annual probability flood event as shown in the Environment Agency's (EA) Risk of Flooding from Surface Water (RoFSW) maps. The LLFA consider that the 0.1% annual probability flood map can provide an indication of the 1% annual probability flood including an allowance for climate change. The current surface water flood risk mapping undertaken by the Environment Agency indicates that a surface water flood flow routes run along Edward Street through to other streets that include Magdalen Street, Botolph Street and Upper Green Lane. Surface water is also shown on St Crispins. A Surface Water Management Plan for the Norwich Urban area was undertaken in 2010 and adopted in 2012. This led to the detailed modelling of areas most at risk in Norwich including the Anglia Square catchment that was later confirmed to be a Critical Drainage Catchment. This modelling identified surface water flow paths is similar locations

with hazard ratings that included “Caution – Very Low Hazard, “Moderate - Danger to Some”, “Significant - Danger to Most” and some small areas of “Extreme - Danger to All”. This modelling has been updated within the application and appears to demonstrate a small extent of flood risk and lower associated hazards. Further discussion on the review of the updated hydraulic modelling undertaken by the developer will occur in the Annex.

- **Critical Drainage Catchments (CDC)** - The application site falls within a CDC as defined by the District Council and the LLFA. This is the Catton Grove and Sewell CDC and can be viewed at https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/flood-and-water-management-policies/surface-water-management-plans/norwich-urban-area-swmp

- **Ordinary Watercourses –** There are no watercourses known to exist within or on the boundary of the site. It is noted that the surface water flow path overlaps with the historic watercourse that has since been incorporated in part into the existing local surface water and combined sewer network.

  The site does not lie within an Internal Drainage Board (IDB) area for the regulation of ordinary watercourses.

- ***Groundwater* –** The Norwich Urban Area Surface Water Management Plan contains a Groundwater Assessment supported by a Flooding Susceptibility Plans (publicly available on the website - https://www.norfolk.gov.uk/what-we-do-and-how-we-work/policy-performance-and-partnerships/policies-and-strategies/flood-and-water-management-policies/surface-water-management-plans/norwich-urban-area-swmp). This plan shows Anglia Square is in an area of ‘High’ susceptibility. Furthermore, the Environment Agency undertook a MODFLOW of water levels to represent the conditions in December 1993 (a period of high groundwater levels). Anglia Square is also shown to be within this MODFLOW area too. The FRA did not refer to any of this readily available groundwater flood risk information.

- **Source Protection Zones –** The application site is within a source protection zone 2 and 3.

- ***Sewers*** – We are aware of a record of sewer flooding in the area surrounding Anglia Square, however this would need to be confirmed with Anglian Water. It is noted that the surface water flow path overlaps with the historic watercourse that has since been incorporated in part into the existing local surface water and combined sewer network.

- **Artificial Waterbodies –** The site is identified as being at risk of flooding from reservoirs when there is also flooding from rivers on the Environment Agency Flood Risk from Reservoirs mapping (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map). The site is not in proximity to any canal or other artificial waterbody.

- **Historical Flooding –** The Norwich Surface Water Management Plan was undertaken due to a history of surface water flooding in the Catton Grove and Sewell catchment. In the downstream catchment area around the Anglia Square area, a couple of internal flooding events have occurred in the winter of 20/21 with a couple of external flooding events

reported for the flood event. There are no LLFA records of incidents of internal flooding on the site. However, it should be noted that our records only cover the period of 2011 to the present day.

Assessment: Summary of assessment of local flood risk and submitted drainage proposals

A review of the LLFA's records in relation to the new application identify that Norwich City Council approached the LLFA on behalf of the developers for pre-app advice in 2021. Since then, the LLFA has only received one contact solely in relation to the surface water modelling (FW2021_1109 – March 2022) which was responded to by the LLFA. A prior application for the site that was unsuccessful saw several points of contact between Norwich City Council and the LLFA on behalf of the developers. These contacts occurred between 2016 to 2019.

In this new hybrid application, the applicant has submitted the following documents for review in this consultation:

- Anglia Square Norwich Flood Risk Assessment, Royal HaskoningDHV, Ref: 6645-RHD-ZZ-RP-Z-0001, 31 March 2022;
- Proposed Surface Water Drainage Strategy for Anglia Square Regeneration Norwich Norfolk, EAS, Ref: SUDS/3831/2022 Rev B – Final, 1st April 2022; and
- Anglia Square Norwich Hydraulic Modelling Study, Royal HaskoningDHV, Ref: 6645-RHD-ZZ-RP-Z-0001, 31 March 2022.

These documents have been assessed against the latest National Planning Policy Framework (NPPF), Planning Practice Guidance, the SuDS Non-Statutory Technical Standards (NSTS) (March 2015) and the policies of the latest adopted Norfolk Local Flood Risk Management Strategy as follows:

The Proposed Surface Water Drainage Strategy (EAS, 2022) has been reviewed:

- The drainage strategy includes a topographic survey in Appendix C, which shows that site levels vary between 5.09m AOD in the northwest corner and 2.40m AOD at the existing access road from St Crispins to the south of the site. Slopes within the site are generally a south easterly direction with a typical gradient of 1:125. The area of the site to the northwest of New Boltoph Street slopes to the south with a highest ground level of 5.4m AOD and lowest level of 5.11m AOD. Which is approximately 0.4 m higher than the road. While the site area north of Edward Street slopes north with a high point of 4.27m AOD and low point of 3.87m AOD.

- The existing site has a number of public sewers running across the site. These include a 300mm foul water sewer and a 675mm surface water sewer that run in a southwesterly direction across the site and a 300mm surface water sewer and 225mm foul water sewer running west along Edward Street. Both these sewers discharge into sewers on Magdalen Street. The surface water sewer then discharges into the River Wensum at Fye Bridge. A further 525mm combined sewer flows along Magdalen Street. The LLFA notes that the Flood Risk Assessment and the Drainage Strategy are informed by plans that were obtained by the applicant in 2017 as part of the previous unsuccessful application. No more recent and relevant information has been obtained from Anglian Water or used to base the

assessment on. The LLFA requires the applicant to provide confirmation from Anglian Water that no changes have occurred in the public network since 2017.

- The LLFA notes that the site is within the River Wensum area which is subject to new requirements relating to the maintenance of nutrient neutrality.

- A historic watercourse, the Dalymound Dyke, is thought to have been incorporated into the sewer network. A review of the available information is limited in the drainage strategy and the flood risk assessment. The LLFA did a brief review of online information and confirmed through an available plan the historic alignment of the watercourse, which is shown to be through the middle of the Anglia Square site. Therefore, it is reasonable for the applicant to assume that the watercourse was included within the local sewer network, most likely split across a couple of sewers.

- The LLFA notes that in section 3.19 to 3.20, the applicant is planning to divert the public sewers crossing the site and acknowledges the removal of the private sewers as part of the redevelopment.

- The pre-development runoff rates have been calculated using two methods. When calculating the brownfield runoff rate the Modified Rational Method was applied. While the calculation for the pre-development greenfield runoff rate used an unspecified approach was applied.

- The greenfield runoff rate was calculated in MicroDrainage as a Qbar of 0.3 l/s/ha and a Q100 of 1.2l/s/ha (Appendix H and Section 4.8). The site is understood to have a total area of 4.65ha (Section 1) with an impermeable area of 4.51ha (section 4.8). Therefore, a Q100 greenfield runoff rate would be approximately 5.6 l/s for the whole site, although this is not stated in the drainage strategy but has been calculated by the LLFA for review purposes. The LLFA notes that there is reference to Table 3 in the report, yet no Table 3 has been located.

- The drainage strategy identifies the site is in a critical drainage catchment within Norwich (Section 4.10) and reports that “there also appears to be local flooding issues relating to the capacity issues in of the local sewer network.”

- In section 4.9, the applicant identifies that to achieve this level of attenuation “it would be necessary to include huge attenuation tanks below the site”, yet there is no evidence to support this statement. Furthermore, there is no consideration of source control or water reuse potential. Further evidence to support the justification of increasing the greenfield discharge rate is required in accordance with the LLFA Developer Guidance is required.

- In sections 3.10 to 3.15, an assessment of the existing brownfield (impermeable area) runoff rate was undertaken. This used the modified rational method which is not in accordance with the LLFA Developer Guidance that requires the use of the FEH methods. These calculations that applied a fixed rainfall intensity of 50mm/hour (as shown in Appendix E) estimated the Q for the existing site to be 565.44l/s with an impermeable area of 4.07 ha. The calculations given in appendix E do not identify a return period. However, in section 3.13, unevidenced calculations are reported that suggest the 100% rainfall intensity is 30.99mm/hour, the 3.33% rainfall intensity is 76.03mm/hour and the 1% rainfall intensity

is 98.68mm/hour. How these intensities were derived is not shown within the drainage strategy or its supporting appendices. However, should you attempt to compare these unjustified brownfield runoff rates given in section 3.13 to the in appropriately calculated greenfield runoff rates based on the information given in section 4.8, for the total site the Q100 (which is for a slightly smaller area) is thought to be reported as 1115.97 l/s. The LLFA require clarification of both the greenfield and brownfield pre-development runoff rates in accordance with the required methods that used the latest datasets and hydrological methods to be presented.

- In section 4.12, the applicant reports on previous discussions that were undertaken in relation to a previous unsuccessful planning application. This section indicates an assessment of the areas draining to the existing Anglian Water sewers should be used to define the runoff rates for the whole site. This assessment was undertaken and is presented in Appendix F.

- The LLFA reviewed the sewer catchments defined in Appendix F that support the calculations, the LLFA considers the assessment of the catchments is not suitable for use. For example, an above ground spoil heap is considered to be a permeable area, yet there is no assessment of what surface that spoil heap is sited on. A quick review of the Google Streetview maps indicates the spoil heap appears to have a high amount of rubble and demolition waste that is positioned right at the edge of the public pedestrian footway. As there is no positive drainage, the runoff from that spoil heap is likely to discharge to both the existing highway drainage within the carriageway alongside the road and the existing car parking area on the site. Therefore, it is not appropriate to consider this an undrained greenfield area. The next most significant area of greenfield landscaping is between the southern side of the Anglian Square complex and St Crispins Road. This greenfield area has a couple of slopes that direct surface water towards either the private access road (Cherry Lane) or towards the supporting wall of the flyover before being directed to the area of positive drainage under the flyover at Cherry Lane. Therefore again, while this area is green with some visible permeability in low significant rainfall events, it would likely discharge the surface water into the adjoining positive drainage system. The same principles could be easily applied to all the other areas marked up in green on the catchment plan in Appendix F. Therefore, the LLFA would disagree with the accuracy and use of this assessment. Again, further clarification on the brownfield runoff rates and the approach applied is required by the LLFA.

- In section 4.13 and 4.56, the applicant also indicates that Anglian Water have agreed a total allowable outfall rate of 242 l/s. This rate relates to the previous unsuccessful application for site development with the agreement date to 2017 (as shown in Appendix I). Since this is a new application for the development site and the previous agreement was for an unsuccessful application on the site that was over five years ago. The LLFA requests the applicant provide recent evidence they have reconsulted Anglian Water to ensure that Anglian Water continue to support this discharge rate for the latest new application to redevelopment this site.

- In section 4.56, the applicant summarises the proposed site total discharge rate is 243.2 l/s from the 8 discreet drainage areas with varying discharge rates.

- In sections 3.16 to 3.18 of the Drainage Strategy an assessment of the pre-development storage volume of the private sewer network was undertaken. At present, it is known there is insufficient storage within this Critical Drainage Catchment and that the private sewers all discharge into the public sewer network where again capacity is very limited. It is not clear to the LLFA as to the purpose of undertaking this capacity assessment or the accuracy as the calculated areas are assumed to be based upon those given in Appendix F.

- In section 4.1, the applicant incorrectly references the superseded version of NPPF to Flood Zone 1. The latest version of NPPF was updated in July 2021 and refers to all sources of flood risk.

- In section 4.3, the applicant clearly references the discharge hierarchy in NPPF. However, The LLFA Developer Guidance is supportive of the hierarchy approach in the Sewerage Section Guidance Appendix C, which requires the through consideration of the reuse of surface water runoff prior to discharge before continuing the NPPF approach. The LLFA reminds the applicant that in the latest version of NPPF, paragraph 169 point .a), requires applicants to "take account of advice from the lead local flood authority". It is becoming clear that the applicant has not reviewed and taken account of the LLFA's advice, which is publicly available on the LLFA's webpage (https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management).

- In section 4.6, the applicant identifies that the discharge to ground via infiltration is not possible due to contamination and high groundwater, however, no evidence is provided to support this statement. The LLFA acknowledges that there is presently no open watercourse on the site. Therefore, the applicant seeks to connect to the existing sewer network. The LLFA requires that further evidence is submitted to support these statements.

- On review of Table 4.1, the LLFA supports the majority of the assessment although further consideration of the potential for living walls (such as the ones in Chantry Place, Norwich on the side of the shops) and wet ponds (or urban pond like features that are incorporated in places such as London). Alternative more creative solutions such as the dual use of public spaces for both water storage and open space have not been considered within this table. In addition, the LLFA does not consider underground attenuation tanks as a sustainable drainage approach as these features do not meet the four pillars of SuDS. Further discussion on the four pillars of SuDS can be found in the LLFA Developer Guidance.

- Section 4.15 marks the beginning of the information on the proposed drainage system. The system proposes the development to be divided into eight discreet drainage systems. Each system is listed to reference to the development blocks that it serves. However, on review of the proposed Surface Water Drainage Strategy plan in Appendix K, there is no indication of the drainage catchment areas for each of the systems. The LLFA requires this plan to be provided to support the proposed drainage design information.

- Each system is then presented between sections 4.19 to 4.55. The details provided for each system in these paragraphs includes an overview of the proposed drainage approach, the impermeable area, the discharge rate for the 1% AEP +40% climate change allowance and an overview of water quality. It is in these descriptions that first reference to the potential inclusion of other SuDS features such as green roofs, and bio-retention areas.

The associated drainage calculations have not been undertaken for these features. A review of the MicroDrainage hydraulic modelling output data provided in Appendix J and the proposed Surface Water Drainage Strategy plan in Appendix K confirms the features are not included within the outline drainage strategy. Therefore, the drainage design is considered incomplete.

- We note that some assessment of water quality has been undertaken however it is not possible to determine whether the assessment is appropriate or not as the location and areas of these systems is not defined.

- It is clear to the LLFA from the information proposed that at present the proposed drainage system is not designed to discharge at a greenfield runoff rate. This relates to a previous comment earlier in the Annex.

- The consideration of underground tanks should be considered as a last choice. However, it appears to be promoted as a first choice within the current application due to the lack of evidence provided.

- In section 5, the applicant discusses the potential inclusion of green roofs and bioretention features into the surface water drainage design, however it is not confirmed that these features will be included in the proposed system. As no drainage design for these features has been submitted, the LLFA has low confidence that these features would be included in the drainage strategy and design.

- The proposed drainage design lacks a significant amount of design information and the information that is provided by admission of the drainage strategy is incomplete both for the Full and Outline aspects of the planning application. The Plan in Appendix K shows new roof, impermeable paving, planters (treated as impermeable), permeable paving, surface water crated tanks, pumps, hydro-brakes and some of the proposed sewers to be diverted. The applicant's lack of commitment within the drainage strategy does not give the LLFA confidence that the applicant is committed to the inclusion of green roof, tree pits and bio-retention features and swales as these are also not visible on the surface water drainage layout plan in Appendix K. This is the only layout plan of the proposed drainage system. The LLFA Developer Guidance clearly lists the drainage information requirements for a full and outline planning application in Table 2. For the outline application the information is considered incomplete as there are contradictions on what will be contained within the proposed drainage design and the information provided lack the suitable details.

- In relation to the full application, no detailed drainage design (detailed layout and design plans, modelling, calculations and other relevant supporting information) has been provided for the areas. No drainage area plans were provided for full or outline.

- The Surface Water Drainage Layout Plan identified four pumping stations supported by very limited mentions in section 4 text for Systems 1, 2, 5 and 6. No design information and no evidence supporting the design justification for the need of these four pumps has been provided. Some pumped flow discharge rates information has been included in the MicroDrainage calculations but this is very limited.

- In section 6.3 the applicant has indicated that a secondary pump with separate pumping chambers. The secondary pumps will be alarmed and programmed to mitigate for pump failure. However, in accordance with section 19.2 of the LLFA Developer Guidance, it states;

  > "pumping of surface water drainage as part of SuDS will only be acceptable if it can be demonstrated that it is not reasonably practical to drain those parts of a site by gravity (as stated in standard S12 of SuDS Non-Statutory Technical Standards (2015)). Where pumping is proposed, it should be demonstrated that the site cannot be developed without it and appropriate maintenance proposals are included e.g. back up pumps."

  Further information about the resilience and resistance of pumping stations is provided in section 20 of the LLFA Developer Guidance.

- There is no assessment or consideration of the carbon footprint for the inclusion of four pumps in relation to the drainage system. Policy within the Norfolk Local Flood Risk Management Strategy was updated in 2021 and contains three new policies, two of these new policies are relevant to this development; Policy E8: Towards Net Zero and Policy E9: Biodiversity and Environmental Net Gain.

  > "Policy E8: Towards Net Zero - The Lead Local Flood Authority and Risk Management Authorities will expect all parties, involved in design and construction of local flood risk and water management structures associated with development, to make reasonable efforts to minimise carbon footprint, while maximising opportunities to contribute to environmental and climate improvements.
  >
  > Policy E9: Biodiversity and Environmental Net Gain - The Lead Local Flood Authority and Risk Management Authorities, using all available legislative and regulatory measures, will seek to ensure that new local flood risk and water management structures will protect and enhance the environment in a manner that results in biodiversity and environmental net gain for local communities."

  Further assessment and consideration of the carbon impact of additional pumps operating on this is site occasion is recommended in accordance with Policy E8.

- While no information regarding the biodiversity pillar and the biodiversity and environmental net gain policy of the proposed surface water drainage design has been provided within the submitted information. While further information on the Biodiversity and Environmental gain that the surface water drainage system will offer is recommended in accordance with Policy E9 and I relation to the four pillars of SuDS.

- The LLFA note in Section 4.58 of the drainage strategy that the surface water drainage has not considered the offsite flows in the modelling. As the site is proposing to increase the resident and visiting population significantly on this site and as the drainage system is within a critical drainage catchment with both the applicant and the Anglian Water acknowledging significant sewer network capacity limitations in part due to a historic watercourse being incorporated into the existing sewer network. In accordance with NPPF paragraph 164 (b), the LLFA requires the applicant to demonstrate “the development will

be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.", by better incorporation of the sewer network into all the relevant hydraulic modelling calculations.

- Furthermore, the LLFA Developer Guidance supports this approach by stating that "the layout of the development site and drainage system should be designed so that surface water that enters the site from off-site sources is conveyed safely around or through the site, without compromising the level of service of the proposed drainage system or introducing unacceptable additional risk on-site or downstream". Therefore, it is necessary for the applicant to fully understand the impact of the offsite flows on the drainage system through modelling, which would preferably be an integrated model. A surface water model has been developed for the site so it should be possible to quantify offsite flows. Further consideration and more detailed assessment should be undertaken to identify which systems are likely to at risk and appropriate mitigation and design allowances should be incorporated and modelled as appropriate to demonstrate that these measures would reduce the level of risk posed to residents and visitors alike.

- The LLFA observe that there is no plan that shows the surface water drainage layout in combination with the updated modelled flood extents. Therefore, it is not possible to identify whether the surface water drainage system is at risk.

- A review of the limited MicroDrainage calculations for the attenuation tanks and permeable paving has been carried out. The LLFA notes that there is no hydrological information associated with MicroDrainage calculations, which means it is not possible to assess whether the correct parameters have been applied to the calculations. These calculations will need to be updated to include this information.

- The LLFA observes that the factor of safety for the permeable paving is not appropriate and is considered to be too low. The current guidance provided in The SuDS Manual (section 20.5.1 a)) states that a factor of safety of 10 should be applied not 2.

- At present a 40% climate change allowance has been included within the design parameters. However, the climate change guidance was recently updated in May 2022. As this drainage design is in the early design stages and as the site is located in a Critical Drainage Catchment the LLFA will expect this development to adhere to the latest national guidance. This would require the applicant to apply a 45% climate change allowance and to apply the appropriate climate change allowance of 40% to the 3.3% calculations.

- In section 6 of the drainage strategy, maintenance and management information is limited to a maintenance schedule. No information regarding who will be responsible for adopting the proposed drainage systems has been identified or agreed. As this is a hybrid application, the LLFA will require the applicant to provide an "agreement in principle" with any third parties indicated to be taking on maintenance responsibly for the surface water drainage network.

- A review of the Anglian Water Foul Water Capacity check (Appendix M of the Surface Water Drainage Strategy) indicates that this capacity check was undertaken in 2017, over five years previously and is for the current development proposed on this site. It is

appropriate for the LLFA to request that this information is at very least reviewed by Anglian Water to consider whether they consider the 5 year old report is still valid or not.

- Residual risk mitigation associated with the management of the pumps and the attenuation tanks is requested by the LLFA. At present with so many controlling parameters and a significant amount of the drainage design not provided, it is not possible for the LLFA to assess whether these measures are appropriate or not at this time. The LLFA will review this information once further drainage design details are either updated or provided.

- The applicant has undertaken some initial consideration of the flow exceedance routes are given in section 4.59 with a supporting high level figure provided in Figure 1 of the drainage strategy. While the LLFA considers the general direction of the exceedance flow routes is suitable, this plan and information will be to be updated and re-evaluated once the hydraulic modelling and the surface water drainage design is prepared appropriately.

- At present limited information relating to the phasing of the proposed development has been provided. While the LLFA is aware that phasing is a crucial part of the project it is not clear how the phasing of development will provide suitable and continued surface water drainage to site during its redevelopment. The LLFA requires the submission of a surface water drainage phasing plan for this proposed development. Furthermore, the LLFA expects further information regarding the water quality management approaches required for the construction of the proposed development.

In relation to the Hydraulic Modelling Study (Royal HaskoningDHV, 2022) the following comments are:

A review of the hydrology within the Hydraulic Modelling Study shows that;

- The hydraulic model was based in on the SWMP hydraulic model built and published in 2011.

- The rainfall for the hydrology was generated using ReFH2 and net rainfall was applied.

- An Areal Reduction Factor has been applied. The URBEXT values have not been detailed. Losses have been represented by using net rainfall. The LLFA requires confirmation that the key parameters (URBEXT, Catchment area, etc) have been checked and the parameters where appropriate adjusted accordingly. This is particularly important given the difference between the FEH catchment and the one used as outlined in Section 6.1.

- The key return periods of 3.3%, 1.3%, 1% and 1% plus climate change events have been modelled as per the LLFA guidance and advice.

- Both winter and summer storms have been considered, with a sensitivity undertaken using the winter storm profiles.

- Direct Rainfall - surface water is key flooding mechanism. However, some inflows have been used from the SWMP model. These have been scaled but the approach is not fully justified. Details of how these have been scaled are not included, the 40% allowance are guidance for rainfall not flows. The LLFA observes the increase in flow in the 20% scenario

is greater than 20%, therefore, scaling is likely to under-estimate the flows. The LLFA expects that either the model should be extended or it should be shown with sensitivity that these flows do not impact flows at the site. The LLFA notes the applicant have committed to looking at these in more detail in section 10.3 which states "Discussions with the LLFA also highlighted that further work will be required to better represent the Anglian Water sewer network in the vicinity of the site and the external flows coming from adjacent catchments. This work will be carried out following submission and provided to the LLFA in due course." The LLFA will require the inclusion of sewers in the hydraulic model for the sewer network affecting the parts of the site included in this application. This work would be needed to support the full application as is therefore expected at this time.

- At present a 40% allowance for climate change has been applied for rainfall, previously inflows from other catchments use a 20% climate change allowance and the model should be extended to cover the full catchment. This led to the applicant scaling the flows, however the method used has not been fully justified and the flows have been scaled rather than the rainfall. In addition, a new peak rainfall intensity climate change guidance for flood risk assessments has been recently released in May 2022 (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances). The LLFA has reviewed this guidance which is now locationally based. For the Norwich area, for residential property it is expected that the Upper End 2100 allowances will be applied for both the 1% and 3.3% events. For the 1% event, the guidance stipulates that a 45% allowance must be applied, while for a 3.3% allowance a 40% allowance must be applied. As the site is within a critical drainage catchment due to its sensitivity to rainfall events, the LLFA require that the applicant apply the most recent climate change guidance to the hydraulic model.

- At present the documentation lacks information on the flow estimation. The LLFA requires the applicant to confirm the key parameters (URBEXT, Catchment area) have been checked and parameters adjusted accordingly. This is particularly important given the difference between the FEH catchment and the one used as outlined in Section 6.1.

A review of the hydraulics within the Hydraulic Modelling Study shows that;

- The original SWMP model drainage approach to represent flood risk from sewers used blanket 7mm/hr. However, analysis undertaken for the SWMP showed that this varied across the catchment. A review of the information within the hydraulic modelling study report implies that net rainfall has now been used and infiltration removed. Therefore, no drainage is represented within the hydraulic model and flooding is likely to be conservative. The LLFA require clarification on whether Anglian Water has been contacted to supply sewer data. This should be requested and included where interactions with the sewer system are likely to impact flooding.

- A 2m cell mesh size is used and is in accordance with guidance.

- Latest LiDAR used with site specific survey. The applicant has undertaken checks of the LiDAR against the survey data.

- In relation to the model extents, section 6.3 of the modelling report states "The LLFA pre-application comments requested the model to be extended to cover the adjacent

catchments and simulated for the 1 in 100 year (+40%CC) rainfall event. However, this was beyond the scope of the study, therefore the external flows were simply scaled up, using the 1 in 100 year and 1 in 100 year (+20%CC) event, to create external inflows for the 1 in 100 year (+40%CC) event". Details of how these have been scaled are not included, the 40% allowance are guidance for rainfall not flows. The LLFA observes the increase in flow in the 20% scenario is greater than 20%, therefore, scaling is likely to under-estimate the flows. The LLFA expects that either the model should be extended or it should be shown with sensitivity that these flows do not impact flows at the site. The LLFA notes the applicant have committed to looking at these in more detail in section 10.3 which states "Discussions with the LLFA also highlighted that further work will be required to better represent the Anglian Water sewer network in the vicinity of the site and the external flows coming from adjacent catchments. This work will be carried out following submission and provided to the LLFA in due course." The LLFA will require the inclusion of sewers in the hydraulic model for the sewer network affecting the parts of the site included in this application. This work would be needed to support the full application as is therefore expected at this time.

- With regard to the representation of buildings in this urban surface water hydraulic model, section 7.2.2 of modelling study report outlines buildings are set to 100mm, apart from on Magdalen Street. A visual inspection of the mapping shows some buildings missing however, these are not on key flow routes, so this is not considered critical. While the LLFA welcomes the applicant's changes on Magdalen Street where the lowering to ground level has been applied, the LLFA confirm that Magdalen Street was an example of this issue and further visual inspection work is expected to validate threshold levels and kerb levels along key flow routes. The LLFA requires a visual check of publicly accessible areas to identify any properties in a similar situation as those on Magdalen Street.

- The roughnesses are based on mastermap data. This is considered acceptable and the roughness values generally look appropriate.

- The LLFA notes the applicant has updated the representation of the flyover in the hydraulic model in accordance with the LLFA's previous advice.

- It is not possible to undertake a comparison of the input LiDAR data and the DEMZ file to check that topographic adjustments have been appropriately picked up in the modelling as it is not available.

- The LLFA notes the applicant has removed the representation of the St Crispins Subway that was demolished several years ago from the hydraulic model in accordance with the LLFA's previous advice.

- A review of the downstream boundaries shows that they appear appropriate to be located at an appropriate distance. However, no sensitivity testing to the downstream boundary conditions has been undertaken to confirm this. The LLFA requires sensitivity testing to be undertaken.

- The LLFA notes the sensitivity to inflow shows depth change of approximately 30mm. The LLFA expects this depth change to be taken into account when allowing and including

suitable freeboard in the proposed development design through the adherence of the LLFA's standard freeboard requirements.

- Validation of the hydraulic model has been undertaken against other models and the data in the flood investigation reports.

- The applicant has provided the tlf files and the mass balance is less than 1%, which is considered acceptable on this occasion.

- The critical storm duration is the 3-hour storm.

- No information has been observed regarding the onset of flooding and its associated duration. This information should be available from the hydraulic model and should be reported in both the modelling study report and the flood risk assessment.

In relation to the Flood Risk Assessment (Royal HaskoningDHV, 2022) the following comments are:

- The LLFA acknowledges that a Flood Risk Assessment (FRA) is required as the site is greater than one hectare in flood zone 1 (an area of low fluvial and coastal flood risk), is within a critical drainage catchment, is land that may be subject to sewer and groundwater flooding and involves a development proposal that would introduce a more vulnerable use due to the inclusion of residential properties.

- Section 2.1 to 2.5 on national policy in the FRA omits to mention the further key requirements of the FRA and the associated risk management requirements applicable to major developments, which are:
    - "the development should be made safe for its lifetime without increasing flood risk elsewhere." (NPPF Para 159)
    - Should assess flood risk from all sources (NPPF Paragraphs 160, 161 and 162)
    - Should steer new development away from areas of flood risk both at a strategic (NPPF Paragraph 162) and site level basis (NPPF Paragraph 167.a)
    - The development is appropriately flood resistant and resilient (NPPF Paragraph 167.b)
    - The development incorporates a sustainable drainage system (NPPF Paragraph 167.c)
    - Any residual risk can be managed safely (NPPF Paragraph 167.d)
    - Safe Access and escape routes are included as prt of an agreed emergency plan (NPPF Paragraph 167.e)
    - Should take account of advice from the lead local flood authority (LLFA) (NPPF Paragraph 169.a)
    - have appropriate proposed minimum operational standards (NPPF Paragraph 169.b)
    - have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development (NPPF Paragraph 169.c)

- The proposed development site is allocated in the Local Plan (GNLP0506), although the previous indication based on the historic application was for a surface mounted development, while the current proposal includes the excavation of a basement in an area

of surface water (and potentially groundwater – although no further information has been provided in the assessment) flood risk. The LLFA notes the potential relevance of paragraph 166 of the latest version of NPPF.

- The development is proposed at a time of transition between the current Adopted Local Plan and a new local plan that was submitted for Regulation 19 review in 2021.

- The current adopted plan relevant policy is DM5 and to a lesser extent DM3.

- On reflection of section 2.8 of the FRA which requires the decision makers to give to the relevant policies of the emerging Local Plans. While the FRA indicates the emerging Local Plan is likely to require modifications and "currently holds limited weight" so the details are not held in detail.

- However, the yet to be adopted Greater Norwich Local Plan policies are support by the Greater Norwich Level 2 Strategic Flood Risk Assessment (SFRA) (JBA, 2021). Key points to note from the SFRA 2 (JBA, 2021) are:
    - That the Anglia Square site (GNLP0506) is not specifically referenced as an assessed site within the SFRA 2, despite having significant surface water flood risk and being in a critical drainage catchment. The majority of sites assessed appear to have been selected due to their current and future fluvial flood risk which is empathised particular in Table 6.2 that solely focuses on future fluvial flood risk.
    - Section 5.4 identifies the "mapping of surface water flood risk in Greater Norwich has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping". This section goes on to indicate that should a site be indicated at surface water flood risk then further detailed modelling will be necessary.
    - Section 5.5 indicates **"**Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGWF) dataset." and goes on to state that "it should not be used as sole evidence for specific flood risk management, land use planning or other decisions at any scale. The data can help to identify areas for assessment at a local scale where finer resolution datasets exist."
    - Section 6.3.1.4 states that "developers should seek to incorporate rainwater harvesting and reuse within developments as part of the surface water management strategy."
    - Section 7.2 requires developers to "consider and contribute to wider flood mitigation strategy and measures in Greater Norwich and apply the relevant local planning policy Wherever possible, developments should seek to help reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site. Developers must demonstrate in an FRA how they are contributing towards this vision."

- Some of these issues have been addressed partly in the submitted FRA for the proposed development while a few issues remain outstanding such as a more in-depth assessment of potential rainwater harvesting / re-use opportunities on the site and the site-specific assessment of groundwater flood risk. In section 4.3, the applicant references discharge hierarchy, which on this occasion does not reflect the approach required in the Sewerage Section Guidance that Anglian Water adheres to. This guidance requires the through

consideration of the reuse of surface water runoff prior to discharge. The LLFA's Developer Guidance supports the Sewerage Sector Guidance approach. The LLFA expects the inclusion of a more in-depth consideration and assessment of rainwater harvesting and reuse opportunities on site.

- A review of the assessment of groundwater flood risk in section 6.10 consists of one short paragraph that dismisses the “High” potential groundwater flood risk at the site due to the presences of gravels (no GI presented to evidence this point) and a lack of historic flood records that specifically site groundwater flood risk (again no evidence provided to support where this information was sought). Therefore, in accordance with the NPPF principle of assessing “all sources of flood risk” the LLFA also expects a more in-depth consideration and assessment of groundwater flood risk in the FRA due to the initial screening SFRA Level 2 (JBA, 2021) of the site being in an area of high groundwater flood risk.

- The LLFA notes the incorrect reporting that the SFRAs do not specifically cover groundwater flood risk in section 6.7. As previously mentioned, the SFRA Level 2 (JBA, 2021) provides information on groundwater flood risk from the AStGWF dataset. On review of this dataset, the proposed development site is identified as being in an area of “high” groundwater flood risk and yet the flood risk assessment has not undertaken a more detailed assessment of the risk and nature of groundwater flood risk on this site. This is especially pertinent due to the development proposals to excavate a car park under Block A for residential purposes. The LLFA reminds the applicant that it is for the applicant to assess the site-specific flood risks in accordance with paragraph 167 of NPPF. The LLFA expects further information and assessment to be provided on the groundwater flood risk in accordance with the principles given in NPPF that requires “all sources of flood risk” to be considered. For example, the inclusion of measured groundwater levels in the FRA would better inform the FRA.

- When reviewing the historic development and watercourses in this area, the FRA (2022) briefly described historic alignment of the River Dalymound (also known as River Balymondyke) that passed through the proposed development site in section 2.25 and 2.33. The river is understood to have been incorporated into the sewer system. In section 2.24 of the FRA (2022), the key findings of the May and July 2014 flooding in Norwich identifies the sensitive and intrinsic nature of the sewer network to the wider surface water drainage in Norwich urban area, in part demonstrated in section 2.40 of the FRA where it states there have been 264 sewer flooding events (Identified from a DG5 extract from Anglian Water in 2017).

- In relation to section 6.5 of the FRA, it is not clear to the LLFA where the evidence base for this statement is provided as the Hydraulic Modelling Study indicates that a blanket 7mm/hr rate that was applied to the original SWMP catchment model remained unaltered in the updated site-specific hydraulic model. Furthermore, no recent liaison or information from Anglian water has been provided since the previous unsuccessful application back in 2017. The LLFA has previously requested the inclusion of sewers that could have an impact on this site within the detailed hydraulic model. This request has been declined by the applicant who stated in section 2.45, bullet point 1 that “This request is not reasonable given the scope of the study, which is to support the redevelopment of a site within the catchment, and not to undertake a strategic surface water catchment study, which would be the responsibility of the LLFA.” The LLFA reminds the developer that the request was

specifical for the sewers that have an impact on the proposed development which is in a critical drainage catchment where Anglian Water confirmed back in 2017 that drainage capacity was limited. The LLFA notes that the original SWMP model was built and published in 2011. Therefore, the original model that was used as a based was prepared over 10 years ago. As numerous changes have occurred in the industry over the last 10 years, the LLFA considers it reasonable in in accordance with NPPF that the developer should provide the evidence base that determines that there is the development should be made safe for its lifetime without increasing flood risk elsewhere." (NPPF Para 159). At present, the current model is not able to determine that as the interaction of the existing and the proposed sewers has not been specifically considered. Therefore, the LLFA expects the model to be updated to account for sewers that either impact on or are impacted by the proposed development to demonstrate that there is no increase in flood risk elsewhere.

- The applicant provides further context for the need of the basement residential car parking in Block A with the key points including;
    - The need to consider the HIF funding that underpins the viability of the proposed development in combination with the deadline to complete the works to receive the HIF funding and the phasing requirements.
    - The need for the Phase 1 scheme to include the delivery of commercial spaces for the displaced businesses to relocate to.
    - The need for the car parking has been considered in relation to the viability assessment along with other influencing factors such as light, heritage and townscape. The height, scale and mass limitations of any proposed development based on the concerns raised in relation to the previously unsuccessful application on this development site.
    - The need for parking for increase in residents due to this proposed development in central Norwich.
    - Block A is considered the only block of an adequate size to provide parking. The LLFA notes that this is only achievable when spaces are also made available on the ground level too.
    - The LLFA notes that the FRA states that the residential basement parking is "to achieve the balance of maintaining the functioning of a successful shopping centre during construction and operational phases". The LLFA requests clarification on how the residential basement park is relevant to maintaining an operational shopping centre if the parking is for the sole purpose of residents.

- The topographic overview is consistent with the Hydraulic modelling report and Drainage strategy, therefore further to the previous comments in those sections.

- In section 4 of the FRA, there is discussion around the existing Risk of Flooding from Surface Water Mapping available from the Environment Agency and the local SWMP modelling from 2011. The applicant notes that this mapping is normally based on a single rate for drainage unless the LLFA were able to provide better local information.

- The site-specific hydraulic modelling has been based upon the original SWMP model. Comments on the Hydraulic Modelling Study is given in the previous section of this appendix.

- The finished ground floor levels of the proposed development that were included in the hydraulic model are shown in Figure 4 with levels between 4m – 5m AOD. The LLFA notes the existing buildings along Magdalen Street have the lowest finished floor levels at between 3.52m to 4.05m AOD. Edward Street loading bay has a level of 2.85m AOD. The basement car park off Edward Street is set at 0.825m AOD.

- In section 4.30, the basement car park is proposed to have a flood barrier installed at the top of the ramp.in the model this is represented as a 10m high barrier rather than as the anticipated design solution. As this is on the first phase of development and is being applied for in full, the flood barrier design and size should be known at this time and be included within the hydraulic modelling. Further information was sought in section 7.19, where there was no certainty of what could be expected to be included in the design. Therefore, was a suggestion that "the flood barrier could be self-closing" based off triggers either onsite or offsite or that alternatively the site management company could manually close the barrier. The LLFA fails to see how the offsite trigger option could successfully operate using information from further up in the catchment when the hydraulic modelling lacks the information. The LLFA requires further detailed information of the flood barrier and operation to be included in the hydraulic model and submitted as part of this full application. It is considered very likely that further more detailed consideration of the hydraulics will need to be included within the model to ensure this would be possible.

- The FRA acknowledges that the landscape consultants have included a number of vegetated features, tree pits and swales in section 4.29. There is no mention of green roofs. The LLFA has not been provided this information in the drainage strategy and therefore observes there is an inconsistency between the landscape strategy and the drainage strategy. In addition, it is possible the hydraulic model is consistent with the landscape strategy but not the drainage strategy. The LLFA requires the applicant to resolve these inconsistencies to ensure the hydraulic model and the drainage strategy is consistent with other technical disciplines' strategies too.

- In Table 2, the LLFA notes there are nine vulnerable areas identified with water depths for the 1% plus 40% climate change event of between 0.04m to 1.25m, although typical water depths that are given are approximately 0.1m.

- Section 4.35 of the flood risk assessment states: "The resulting depth and level maps are included at Appendix H. It should be noted that as this is a rainfall model, it has been assumed that up to 0.05m of water could remain on the roofs and not contribute to surface water flows within buildings. Therefore, the band of 0m to 0.05m has been set to transparent, and it is assumed that any water depth greater than 0.05m can be attributed to overland flow. The main concern of this modelling study was to understand the flow paths and any areas where there were significant depths of overland flow." A review of the model provided as part of the pre-application consultation shows a total rainfall depth of 0.005m of rain through the event, therefore a filter of 0.05m is greater than the likely depth caused by the direct rainfall.

- The LLFA notes in section 4.32 of the FRA provides an overview on the risk posed to vulnerable areas of the service yard off Edward Street and Block M of the proposed development which are shown to flood. The flooding mechanism for the Edward Street service yard area is likely due to its presences in a flow path and lower ground level of

2.85m AOD. At the entrance of the service yard, flood depths are reported as 0.4m for a 1% plus 40% climate change event while within the service yard area a water depth of 1.25m is modelled. This is different to the flooded depths reported in section 7.13 of the FRA which identifies that for a 1% event a 0.04m depth of flooding has been modelled, which also does not appear to include climate change. This depth is significantly different to the 1.25m depth previously given in section 4.32. Hazard mapping in section 4.48 identifies that the Edward Street Service Yard is at significant hazard of flooding and would provide a Danger for most people. The LLFA requires clarification on the water depths for the return periods given at Edward Street Service Yard as there are significant discrepancies.

- In section 4.32 it is acknowledged that while the threshold of the entrance to the service yard could be raised it is not confirmed by how much, although the report indicated “that it may not be possible to raise the threshold very high, given the large vehicles accessing this area.” In section 7.11 to 7.16, mitigation measures are proposed include a drainage arrangement that aims to reduce water entering the service yard from Edward Street by discharging directly to the surface water sewer in Magdalen Street rather than the onsite drainage network which has not been designed to accept offsite flows. The LLFA is not able to confirm any of this as no evidence has been provided in either the detailed drainage design or the Anglian Water indication of whether there is suitable capacity within the Magdalen Street for this additional discharge. The FRA then identifies there is a risk of the Magdalen Street surface water sewer potentially backing up and flooding the service yard due to this connection, so a non-return valve is suggested as a potential solution to this issue. However, the concern implies there is not suitable capacity within the Magdalen Street surface water sewer to accept this additional direct discharge from the service yard in the first place and further that consultation with Anglian Water has not occurred on this matter, which is not appropriate given this aspect is associated with the full planning permission area. The LLFA requires a proposed drainage design with supporting evidence (plans, calculations, modelling and detailed design) that support this mitigation strategy to demonstrate that it is appropriate, operable and “agreed in principle” by Anglian Water. The LLFA will require details relating to who will be responsible for the maintenance and management of this drainage arrangement as it is not discussed in either the drainage strategy or the FRA.

- The residual risk at the Edward Street Service Yard is proposed to be mitigated by the installation of an alarm / warning system, although it is not clear where the alarm sensor would be mounted to operate this proposed system. There is no detailed available design available for review, so at the full planning stage the proposal lacks credibility especially as the local sewer network impacted by the proposed development has not been included within the hydraulic model. Therefore, it is not possible to identify the best location for a sensor or a trigger level / flow. In section 7.13 the applicant indicates that as the flood depths in the 3.3% are estimated to be 30mm and 40mm in the 1% event and trigger should be set at 100mm as it is not publicly accessible, however, no mention of the velocity makes it difficult for the LLFA to assess this information fully or consider its accuracy. The LLFA requires further evidence to support the viability of this residual risk mitigation and to complete its assessment as an option. The LLFA notes that an automated flood barrier has not been considered as an option. As the current mitigation approach proposes to prevent vehicles being driven into the service yard “while it is flooding” and therefore preventing its

use, the LLFA requests clarification on the reasons for not including an automated flood barrier as a mitigation approach.

- The residential basement car park is also accessed off Edward Street which presents a high risk of surface water flooding to a vulnerable area the proposed site. The applicant proposes to install a barrier across the entrance to prevent water ingress. It is unclear at this time whether this would be a manual or automated barrier within the submitted information in section 7.20. The applicant proposes to have a 24-hour management and maintenance company to respond to an alarm quickly, although it is not clear whether they would be onsite 24-hours a day or not. As with the service yard the entrance would have a linear drain positioned to collect the surface water flood that is proposed to connect directly to the sewer network in Edwards Street. The LLFA notes that no evidence of the viability of this drainage solution is given. The LLFA notes that in a significant event the drain is likely to flood quickly due to the limited existing capacity of the sewer. The use of a non-return valve is proposed for inclusion on the network to prevent flooding of the basement car park due to the backing up of the drainage connection. However, the concern implies there is not suitable capacity within the Edward Street leading to the Magdalen Street surface water sewer to accept this additional direct discharge in the first place and further that consultation with Anglian Water has not occurred on this matter. This lack of consultation is not appropriate given this is associated with the full planning permission area. The applicate proposes to include a sump pump to remove water from the basement although it is not clear where the applicant proposes to discharge this water to either in a low flow or a high flow situation as no design information has been included. As this proposal is within the full planning application area, the LLFA requires a proposed drainage design with supporting evidence (plans, calculations, modelling and detailed design) that support this mitigation strategy to demonstrate that it is appropriate, operable and “agreed in principle” by Anglian Water. The LLFA will require details relating to who will be responsible for the maintenance and management of this drainage arrangement as it is not discussed in either the drainage strategy or the FRA.

- With regard to the construction of the buildings and ensuring the inclusion of flood resilience features the applicant proposes to use suitable measures on blocks A, C, L, and M that align with the practise given in DEFRA’s publication entitled 'Improving the Flood Performance of New Buildings’. However, the LLFA notes on Block C the applicant is suggesting that removable flood barriers are installed at the entrances as the flood depth of 0.27m is less than 0.6m. The LLFA would suggest the use of flood doors on all vulnerable entrances as these do not rely on an operative locating, obtaining and installing the correct barriers at an appropriate time prior to flooding occurring. The LLFA seeks clarifications from the applicant on whether the inclusion of flood doors has been considered.

- The LLFA queries whether the applicant considered moving the basement car parking entrance ramp to a position in an area of lower flood risk. This would reduce the potential of water ingress and reduce the need for ongoing mitigation and management approaches suggested. The LLFA would expect discussion on whether this design approach was considered before placing the carp park entrance ramp in its proposed position within the updated FRA.

- The LLFA agrees with the applicant’s identified need of an Emergency Flood Evacuation Plan being developed for both the site as a whole including the external public access

areas, specifically for each of the blocks identified as vulnerable to surface water flood risk (Blocks A, C, H, J, L and M). The LLFA notes in section 7.36 that an alarm will prompt the site manager to contact each of the retail and commercial units, although the LLFA queries why an automated alarm response is not issued instead of relying on the site manager? It is also not clear whether the applicant will provide each of the retail and commercial units with flood barriers and doors prior to occupation of the properties. The LLFA notes the evacuation route encourages building occupants to leave the site through some areas of high risk. The Emergency Flood Evacuation Plan should consider whether this is appropriate for vulnerable people and ensure information is available to help determine when it is no longer suitable for vulnerable site users to use these routes and seek refuge instead. The LLFA advises the applicant to demonstrate ongoing liaison with the relevant Emergency Planning Team. The LLFA advises the applicant uses the ADEPT and Environment Agency Emergency Flood Plan Guidance to support the development of any such plan for the site available at https://www.adeptnet.org.uk/floodriskemergencyplan.

- The LLFA highlights that Flood Re insurance is not available for houses built after 1 January 2009. This is to ensure that the risks of flooding are appropriately considered and mitigated at the planning stage.

- In relation to the modelled flooding of Block M, the applicant indicates that this is possible due to the water pooling in the Edward Street Service Yard and eventually entering Block M in the model. The applicant indicates that is due to the representation of internal walls of buildings in the model not being possible. The LLFA acknowledge it isn't possible to model internal walls in detail due to the grid size. However there are methods available to account for this. The hydraulic modelling report states that building roughness has been increased to 0.1, this is a method used to represent the impedance to flow posed by internal walls. Flow will be able to pass through buildings via features such as air bricks, doors and windows. The LLFA will require evidence to be provided that Block M has been designed such that any openings are above the adjacent modelled water levels and water cannot enter the building.

- Section 5.3 to 5.10 and Appendix J of the FRA clearly indicates there is an increase in offsite flood risk due to the proposed development. The impact is to the existing highways of New Botolph Street (200mm increase in water depth), Edward Street (in the centre and at the junction with Magdalen Street depth increase of approximately 50mm) and on Magdalen Street (at the junction with Cowgate Street an increase of approximately 40mm)) and a couple of properties not previously flooded on Magdalen Street appear to now be within the flood extent for the 1% AEP plus 40% for climate change event. The applicant proposes to undertake a threshold survey of these properties to determine whether water will flow into the properties or not. The FRA also acknowledges in section 5.8 that some properties in the pre-development scenario are at risk of flooding and in the post development scenario the proposed development would increase the flood depth and risk of flooding at these already affected properties. The applicant proposes to undertake a threshold survey of these properties too. The LLFA notes there some discussion on identifying the impacts of flooding. However, there is no discussion on the mitigation of the increase of this flood risk in section 7 of the FRA. Therefore, the development proposals submitted by the applicant are not in accordance with NPPF, paragraph 159. "The LLFA will require the applicant to redress this issue to increase that the proposed development

aligns with this guiding national policy principle of "the development should be made safe for its lifetime without increasing flood risk elsewhere.".

- In section 6, the other sources of flood risk are briefly discussed. The LLFA notes that sewer flooding records have not been requested since 2017 from Anglian Water. The assessment of the risk of sewer flooding is not underpinned by any recent or substantial evidence. Again, the LLFA requires the applicant to provide suitable information to base the assessment upon. The LLFA requests the applicant to provide a current set of DG5 records, an update from Anglian Water on the capacity within the network and use of the updated surface water model to support the assessment of flood risk.

- The LLFA notes there is no information provided about the amount of water that could enter the basement car park in either a no mitigation or failure of the mitigation measures scenario. This information would be expected to understand the extend of the hazard, the emergency management procedures and assist in the appropriate sizing of the sump pumps in the basement. The LLFA would expect this assessment of flow entering the basement to be included in the FRA, drainage strategy and the hydraulic modelling report.

SuDS Standards: Summary of alignment to relevant Non-Statutory Technical Standards for Sustainable Drainage systems

S3 (Brownfield) – *Incomplete - due to various updates required on the greenfield and brownfield runoff calculations and further methods* - **further information required.**

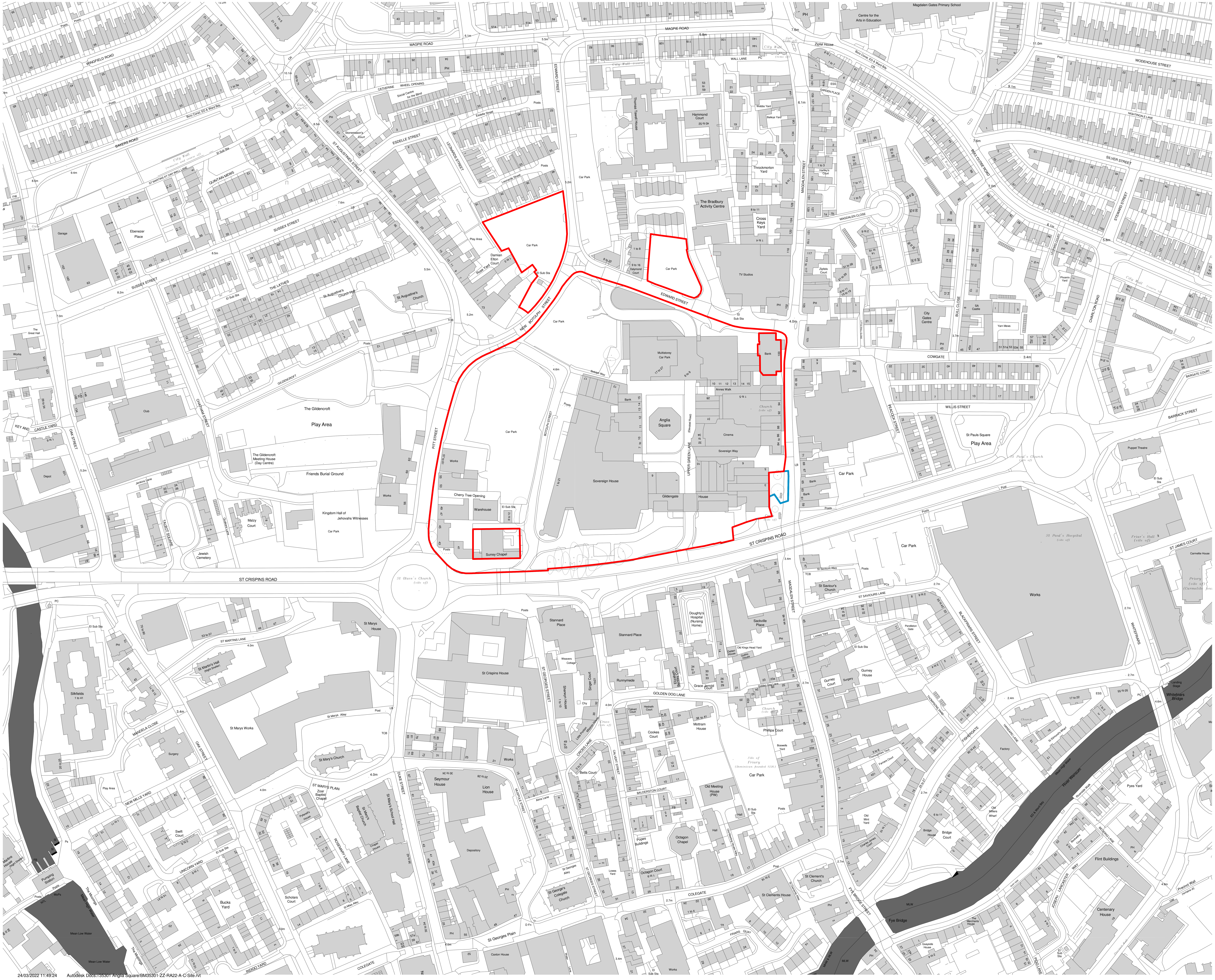
S5/S6 (Brownfield) – Incomplete - due to a lack of drainage design information, *various updates required on the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling* - **further information required.**

S7 – Incomplete - due to a lack of drainage design information - **further information required.**

S8 – Incomplete - due to a lack of drainage design information - **further information required**

S9 – Unable to complete - due to a lack of drainage design information, *various updates required on the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling required to enable appropriate evidence to assess and determine whether the mitigation measures are appropriate* - **further information required**

Appendix B Location Plan



Contractors and consultants are not to scale dimensions from this drawing

The survey information shown on this drawing is based on a topographical survey prepared by a third party and Broadway Malyan Limited accept no responsibility for the accuracy or completeness of the survey.

Drawings to be read in conjunction with the associated Design & Access Statement, associated consultant desin team documents & reports and landscape information

Landscape shown is for illustrative purposes only. For detailed landscape information, please refer to the landscape information & documents.

0m 62.5m 125m

N

General Notes

All figures and areas are approximate only and subject to statutory constraints, detail design & design development

Structural Design: Subject to structural input & coordination

Services Design: Subject to services input & coordination

Fire Strategy: Subject to fire input & coordination

Application Boundary

Land Owned by CT to be subject to separate application for part of the Mobility Hub

Revision	Date	Drawn By	Description
D0-1	31.03.22		Issued For Planning

BroadwayMalyan BM

4 Pear Place
London
SE1 8BT

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Client
Weston Homes

Project
Anglia Square
Norwich

Description
Hybrid Application - Location Plan on Existing OS Base

Status
For Planning

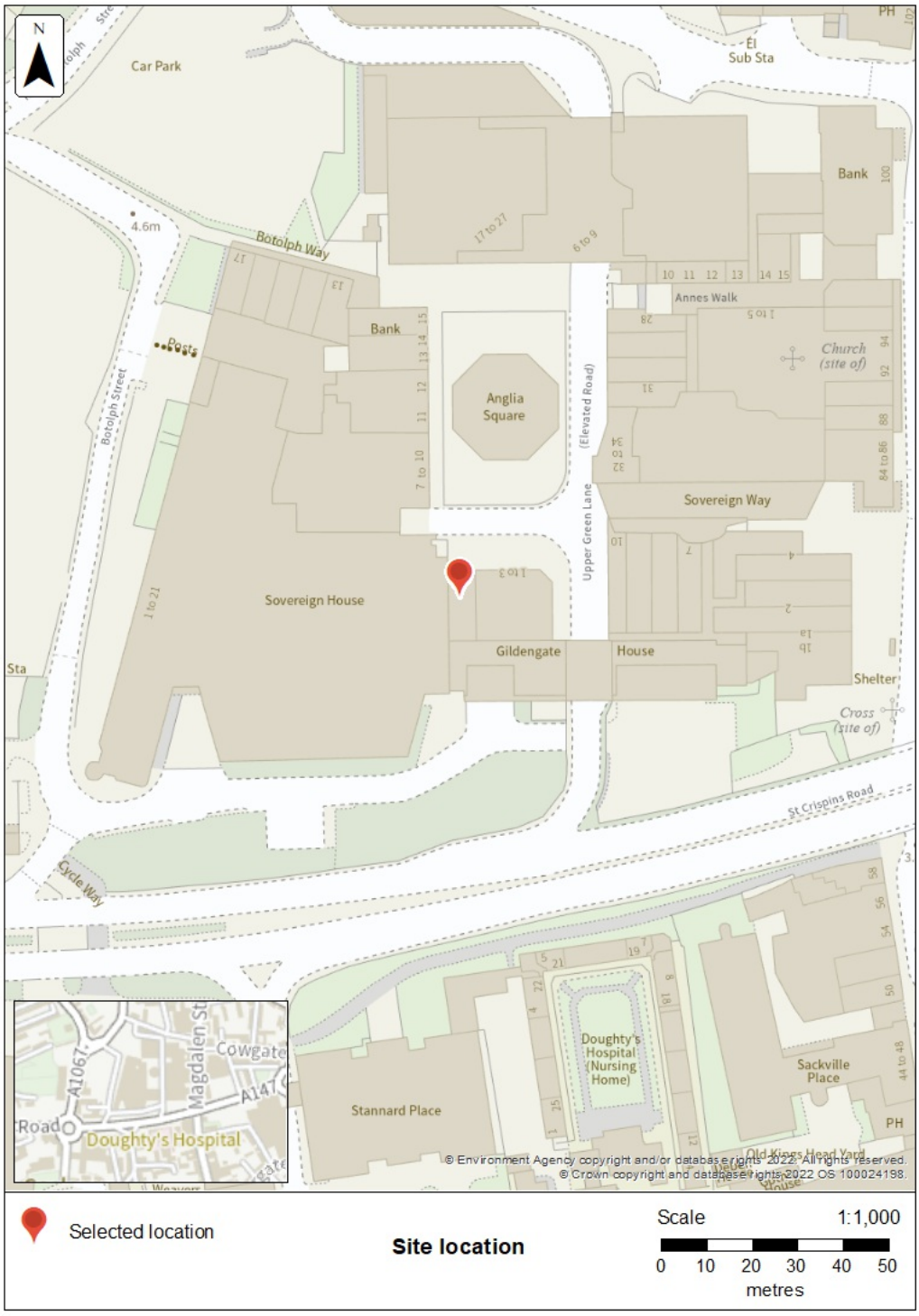
Scale	Drawn By	Date
1:1250@A1	BM	31.03.22
Job Number	**Drawing Number**	**Revision**
35301	ZZ-00-DR-A-01-1000	D0-1

Appendix C EA Floodmap for Planning

Flood risk assessment data

Location of site: 623056 / 309335 (shown as easting and northing coordinates)
Document created on: 24 January 2022
This information was previously known as a product 4.
Customer reference number: BKM8MJJ342UA

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
- information on the models used
- definitions for the terminology used throughout
- flood map for planning (rivers and the sea)
- historic flooding
- flood defences and attributes
- modelled data
- climate change modelled data
- information about strategic flood risk assessments
- information about this data
- information about flood risk activity permits
- help and advice

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

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

About the models used

Model name: River Wensum, Norwich, Norfolk, 2017
Scenario(s): Defended fluvial, defences removed fluvial, defended climate change fluvial, defences removed climate change fluvial
Date: 1 August 2017

These models contain the most relevant data for your area of interest.

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 occuring 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 development is in flood zone 1.

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

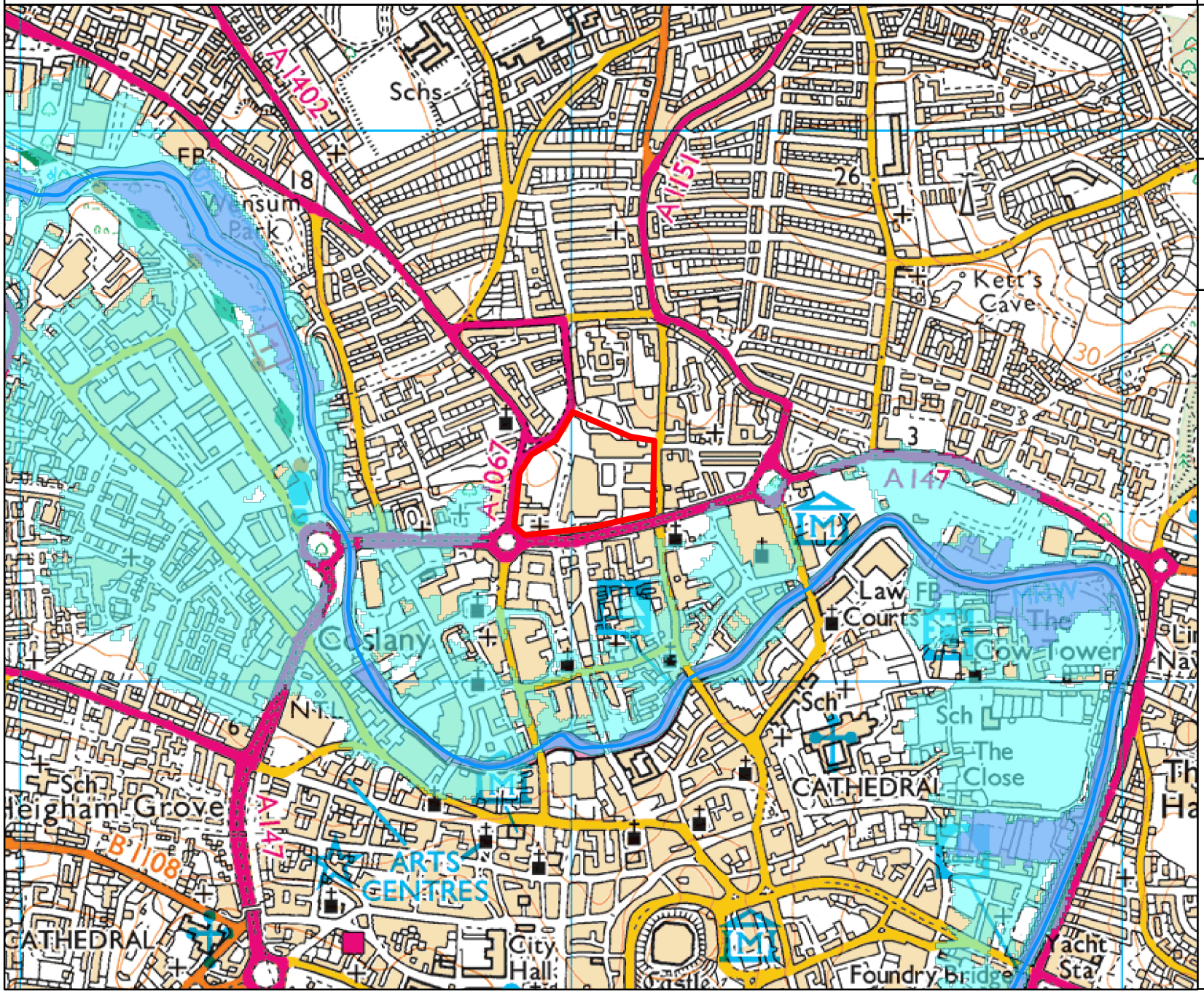
It's important to remember that the flood zones on this map:

- 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

This data is updated on a quarterly basis as better data becomes available.

Flood Map for Planning

At: 623056, 309335 Created: 24/01/202 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 120 240 480

Metres

1:10,000

Legend

- Site Location
- Main Rivers
- Flood Zone 3
- Flood Zone 2

Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

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Produced by: Partnership & Strategic Overview
East Anglia: Essex, Norfolk & Suffolk

Historic flooding

This map is an indicative outline of areas that have previously flooded. Remember that:

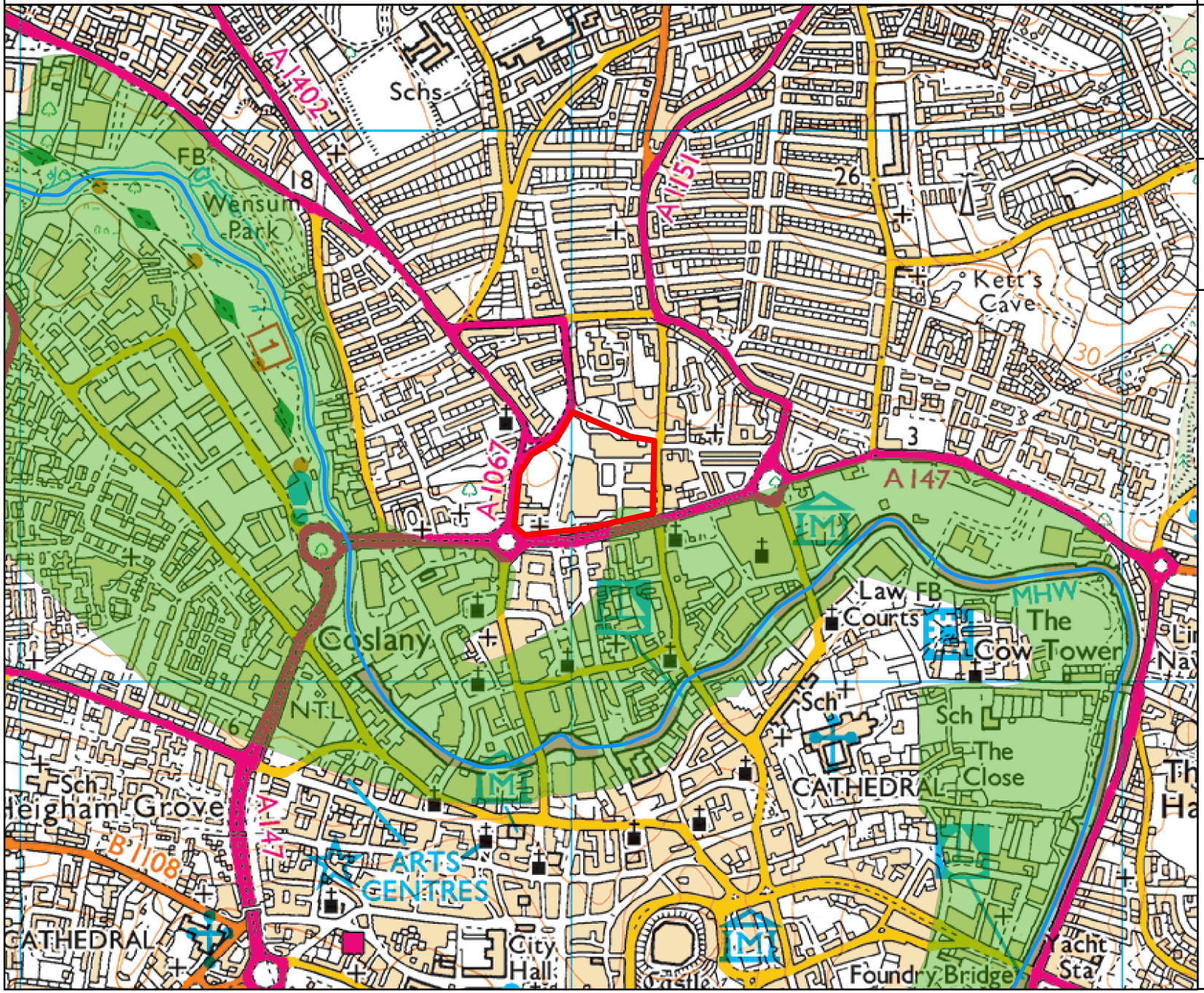
- our records are incomplete, so the information here is based on the best available data
- it is possible not all properties within this area will have flooded
- other flooding may have occurred that we do not have records for
- flooding can come from a range of different sources - we can only supply flood risk data relating to flooding from rivers or the sea

You can also 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.

Download recorded flood outlines in GIS format

Recorded Flood Outlines

At: 623056, 309335 Created: 24/01/202 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 120 240 480

Metres

1:10,000

Legend

- Site Location
- Main Rivers
- 1912 Flood Outline

The historic flood event outlines are based on a combination of anecdotal evidence, Environment Agency staff observations and survey.
Our historic flood event outlines do not provide a definitive record of flooding.
It is possible that there will be an absence of datain places where we have not been able to record the extent of flooding.
It is also possible for errors occur in the digitisation of historic records of flooding.

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Historic flood event data

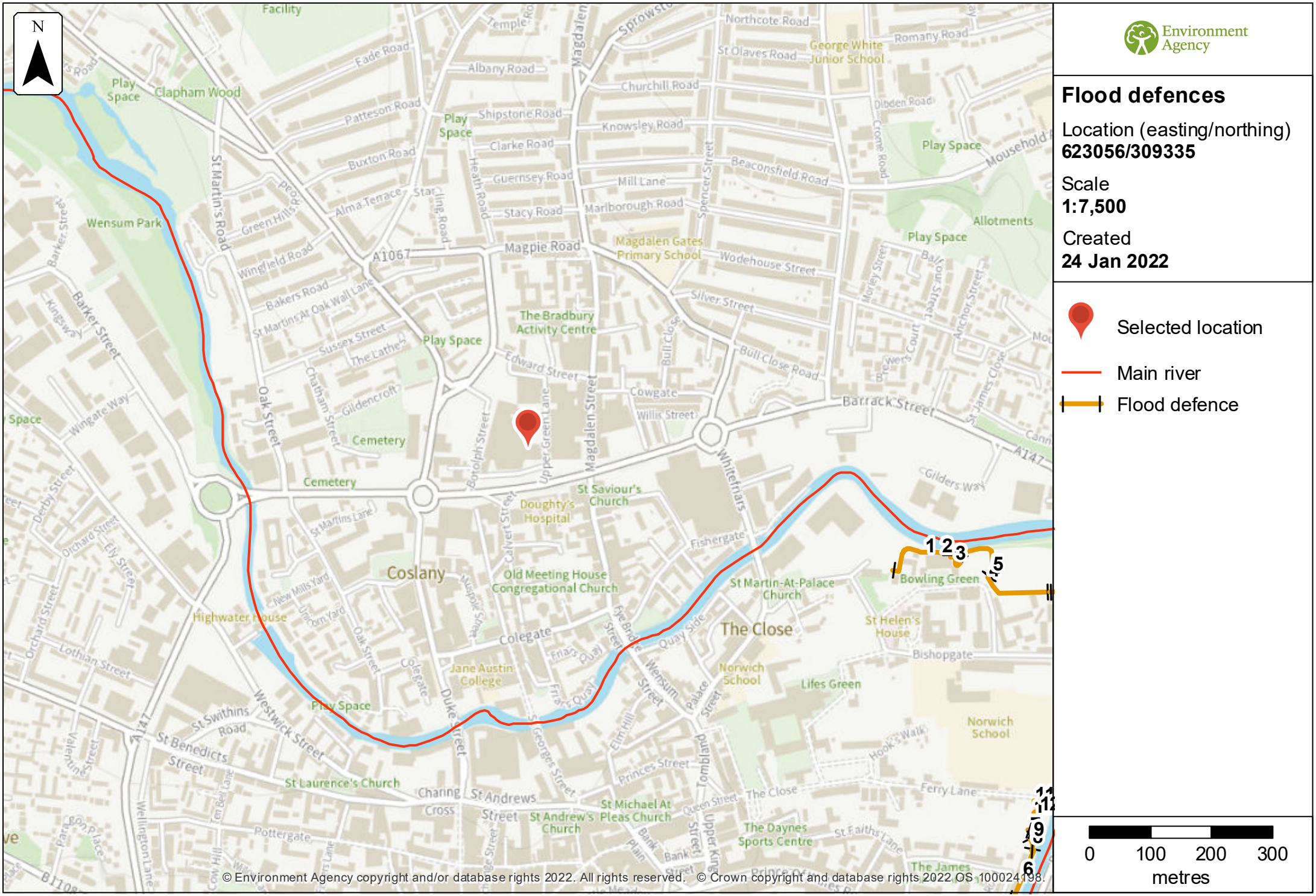
Start date	End date	Source of flood	Cause of flood	Affects location
27 September 1912	28 September 1912	main river	unknown	No

Flood defences and attributes

The flood defences map shows the location of the flood defences present.

The flood defences data table shows the type of defences, their condition and the standard of protection. It shows the height above sea level of the top of the flood defence (crest level). The height is In mAOD which is the metres above the mean sea level at Newlyn, Cornwall.

It's important to remember that flood defence data may not be updated on a regular basis. The information here is based on the best available data.



Flood defences data

Label	Asset ID	Asset Type	Standard of protection (years)	Current condition	Downstream actual crest level (mAOD)	Upstream actual crest level (mAOD)	Effective crest level (mAOD)
1	185573	wall	100	Good	3.65	4.71	2.45
2	333453	demountable defence		Fair	3.65	3.65	3.65
3	185572	wall	100	Good	2.62	2.41	2.45
4	332179	flood gate		Good	2.79	2.79	2.79
5	185571	wall	100	Good	2.72	3.56	2.45
6	184354	wall	100		2.30	2.30	2.30
7	184357	wall	100	Good	2.46	2.47	2.48
8	184355	wall	100	Good	2.47	2.48	2.48
9	184356	wall	100	Fair	2.35	2.35	2.42
10	332189	demountable defence			2.40	2.40	2.40
11	332191	demountable defence			2.40	2.40	2.40
12	332190	demountable defence			2.40	2.40	2.40

Any blank cells show where a particular value has not been recorded for an asset.

Modelled data

This section provides details of different scenarios we have modelled and includes the following (where available):

- outline maps showing the area at risk from flooding in different modelled scenarios
- modelled node point map(s) showing the points used to get the data to model the scenarios and table(s) providing details of the flood risk for different return periods
- map(s) showing the approximate water levels for the return period with the largest flood extent for a scenario and table(s) of sample points providing details of the flood risk for different return periods

Climate change

The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

The Environment Agency will incorporate the new allowances into future modelling studies. For now, it's your responsibility to demonstrate that new developments will be safe in flood risk terms for their lifetime.

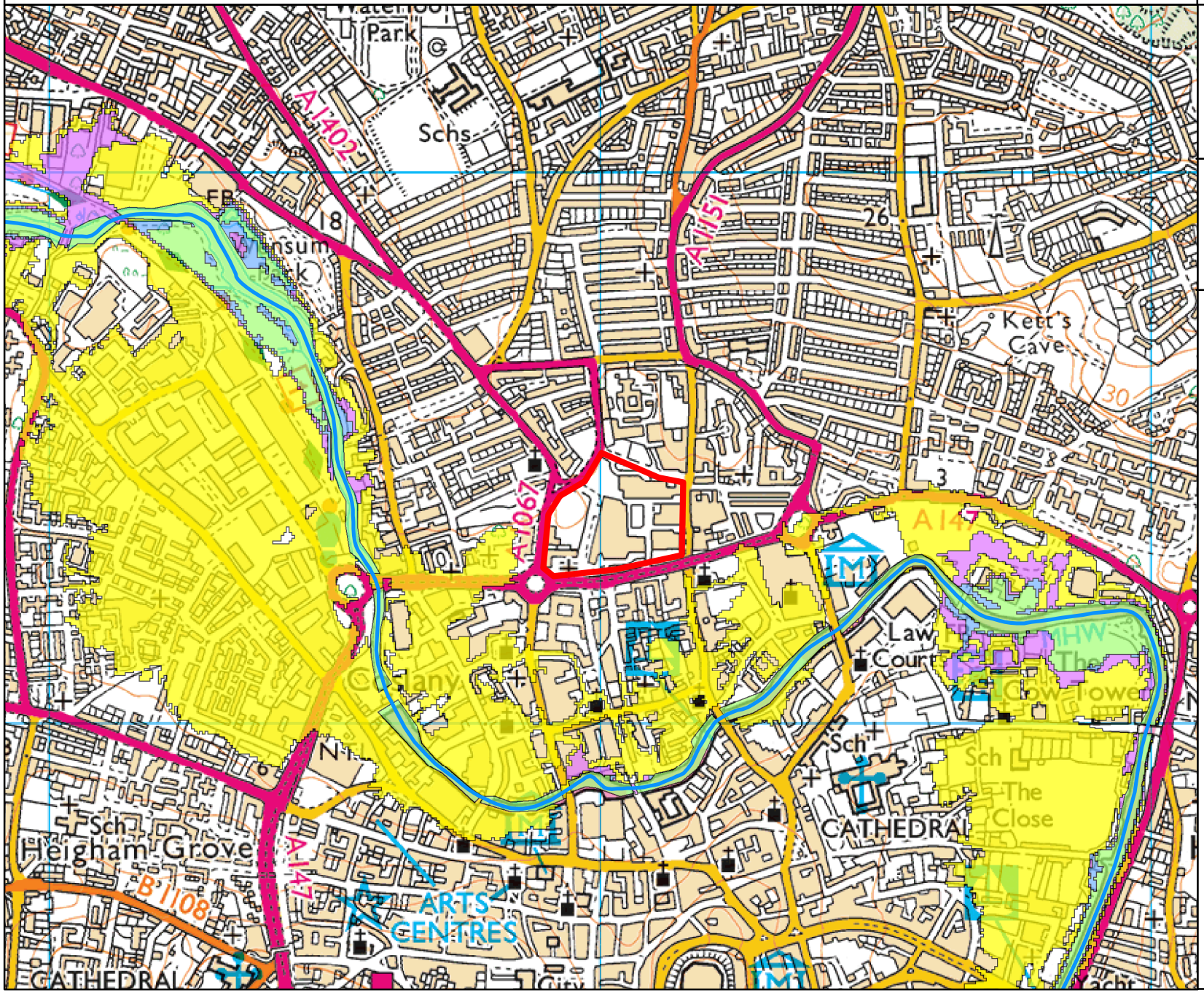
Modelled scenarios

The following scenarios are included:

- Defended modelled fluvial: risk of flooding from rivers where there are flood defences
- Defences removed modelled fluvial: risk of flooding from rivers where flood defences have been removed
- No defences exist modelled fluvial: risk of flooding from rivers where there are no flood defences
- Defended climate change modelled fluvial: risk of flooding from rivers where there are flood defences, including estimated impact of climate change
- Defences removed climate change modelled fluvial: risk of flooding from rivers where flood defences have been removed, including estimated impact of climate change

Modelled (Defended) Outlines

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 120 240 480

Metres

1:10,000

Legend

- Site Location
- Main Rivers
- 1 in 20 (5%)
- 1 in 100 (1%)
- 1 in 200 (0.5%)
- 1 in 1000 (0.1%)

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

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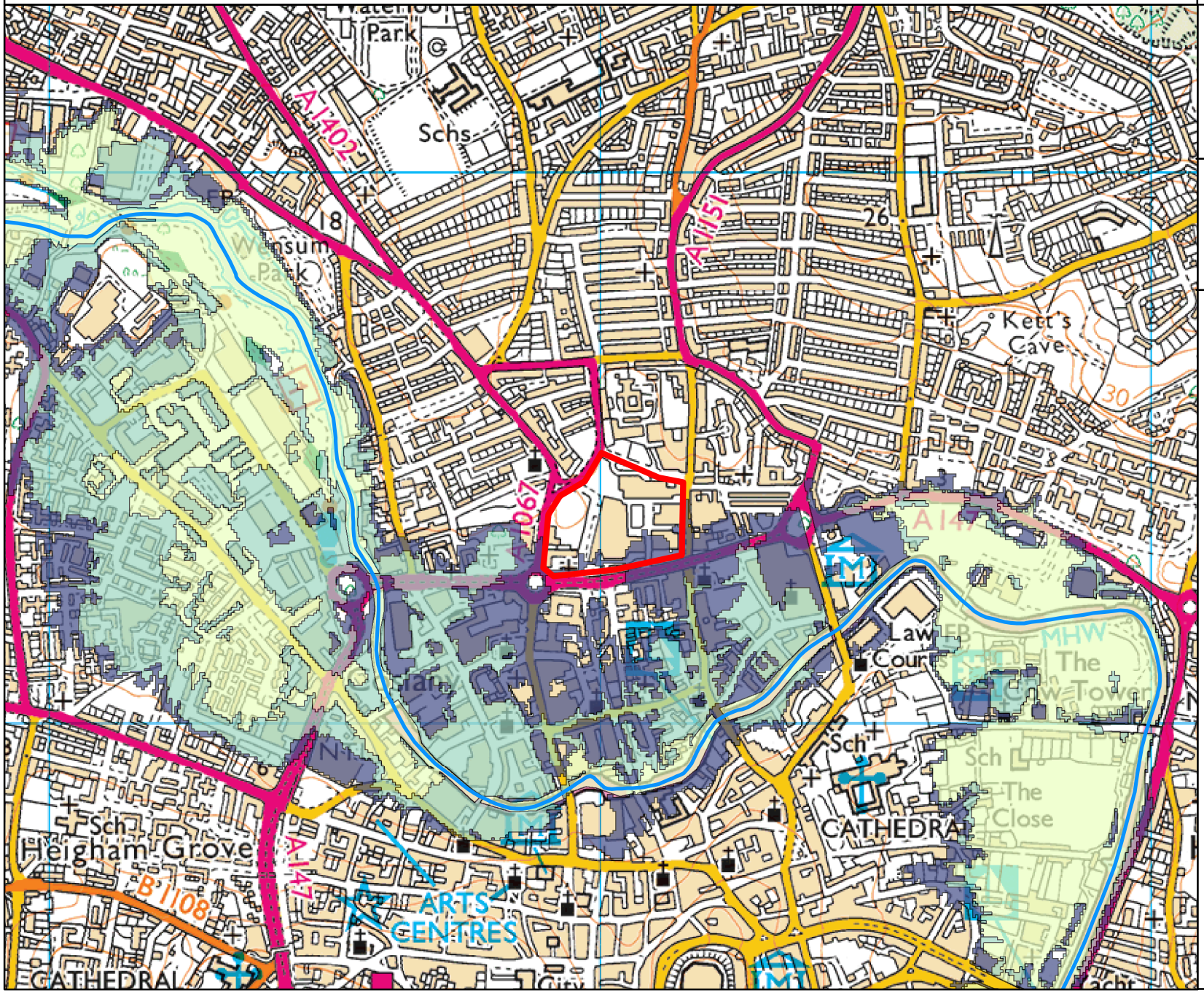
Modelled (Defended) Climate Change Outlines

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 120 240 480

Metres

1:10,000

Legend

- Site Location
- Main Rivers
- 1 in 100 + 25% (*CC)
- 1 in 200 + 25% (* CC)
- 1 in 1000 + 25% (*CC)

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

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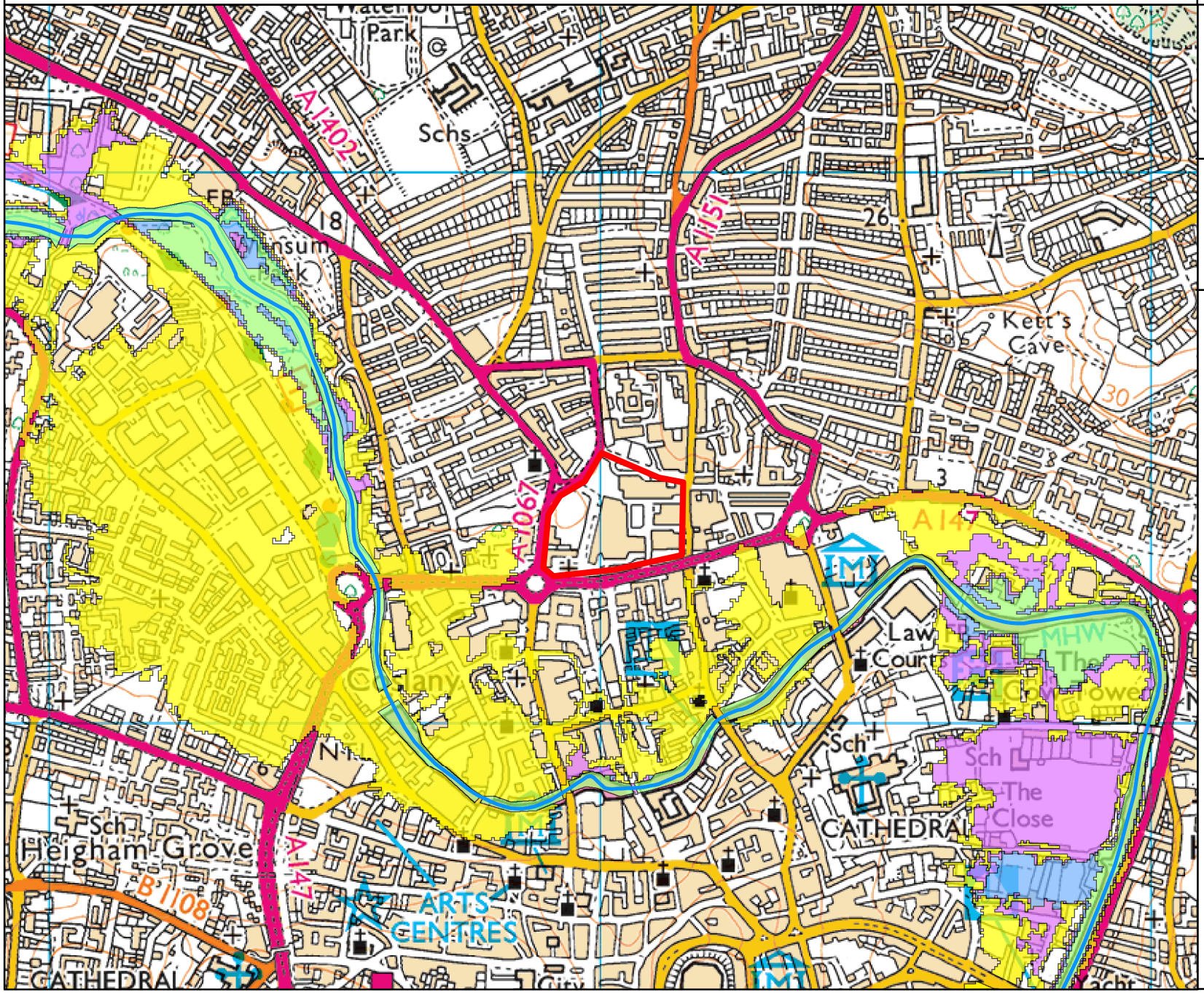
Modelled (Undefended) Outlines

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 120 240 480

Metres

1:10,000

Legend

- Site Location
- Main Rivers
- 1 in 20 (5%)
- 1 in 100 (1%)
- 1 in 200 (0.5%)
- 1 in 1000 (0.1%)

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

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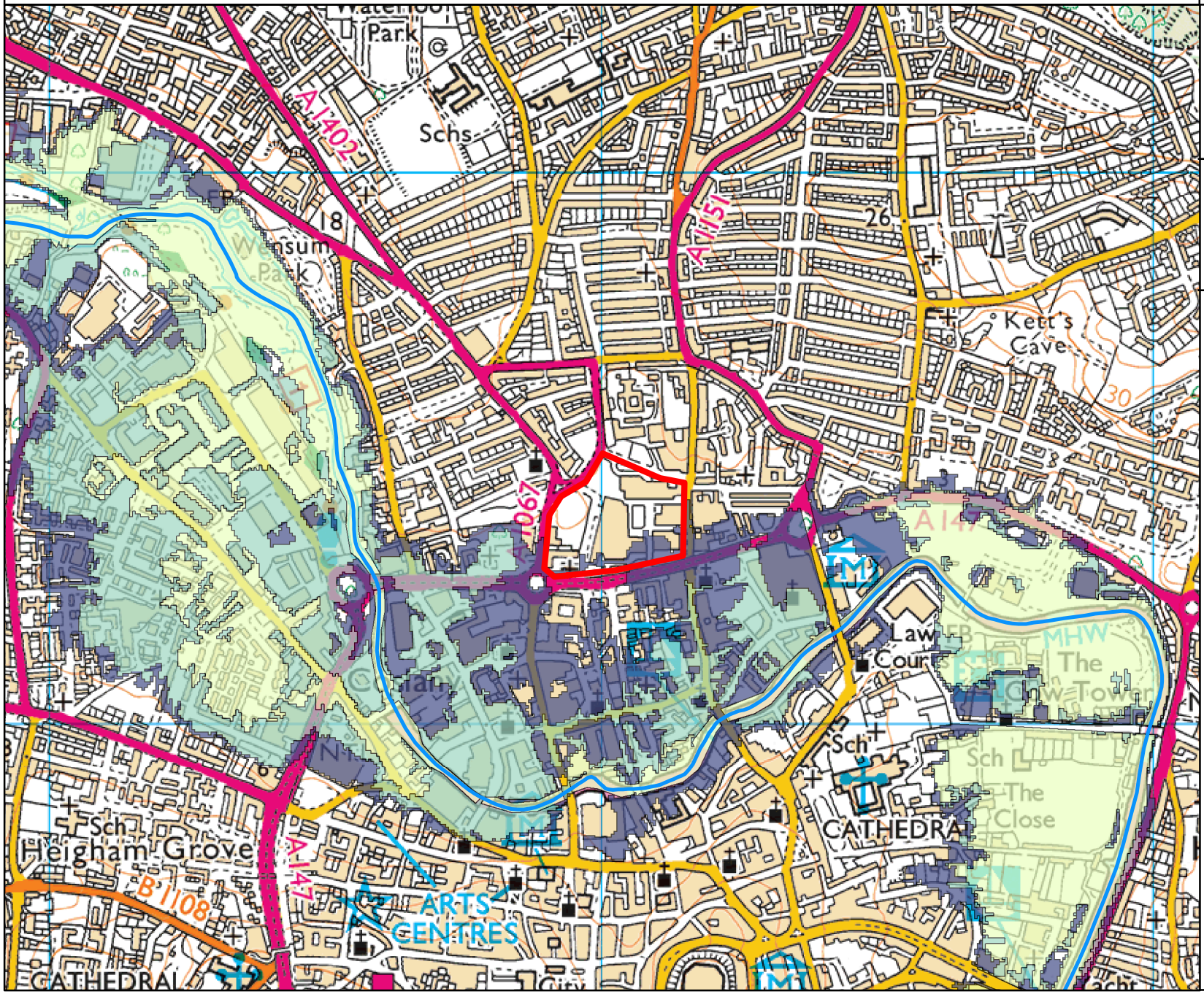
Produced by: Partnership & Strategic Overview
East Anglia: Essex, Norfolk & Suffolk

Modelled (Undefended) Climate Change Outlines At:

623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 120 240 480

Metres

1:10,000

Legend

- Site Location
- Main Rivers
- 1 in 100 +25% (*CC)
- 1 in 200 + 25% (*CC)
- 1 in 1000 + 25% (*CC)

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

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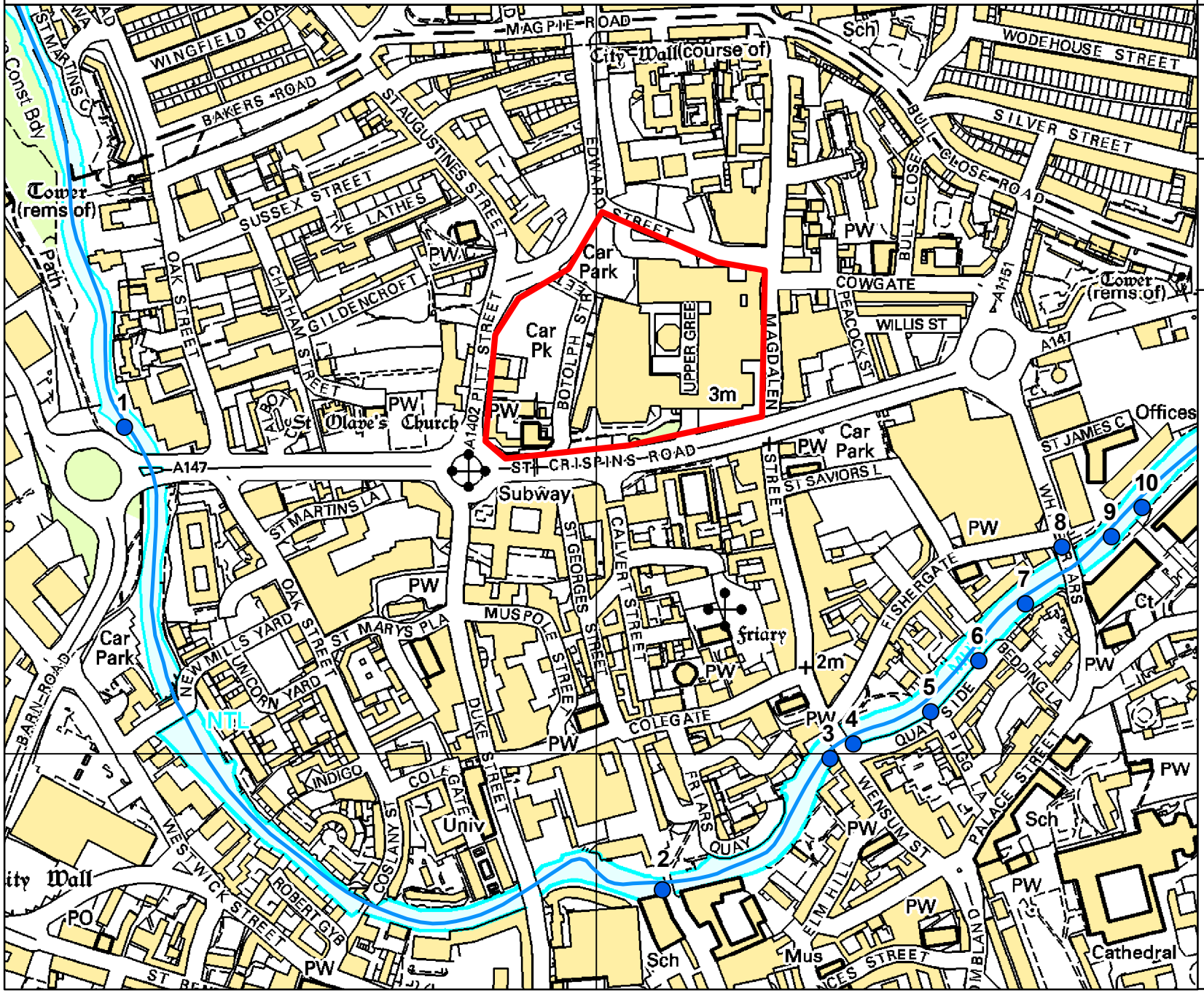
Modelled Node Locations 1D Levels

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 60 120 240

Metres

1:5,000

Legend

- Site Location
- Main Rivers
- Node Location

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

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East Anglia: Essex, Norfolk & Suffolk

Modelled node locations data

Defended

Label	Modelled location ID	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	919031	622571	309299	2.44	NoData	2.72	NoData	2.87	NoData	2.94	NoData	2.44	NoData	4.51	NoData
2	919234	623060	308880	2.03	NoData	2.20	NoData	2.32	NoData	2.38	NoData	1.47	NoData	1.52	NoData
3	919143	623212	308999	1.38	NoData	2.14	NoData	2.24	NoData	2.30	NoData	1.46	NoData	3.16	NoData
4	919104	623233	309012	1.96	NoData	2.13	NoData	2.24	NoData	2.29	NoData	1.46	NoData	1.51	NoData
5	919149	623303	309042	1.38	NoData	2.11	NoData	2.22	NoData	2.27	NoData	1.46	NoData	1.50	NoData
6	919260	623347	309088	1.94	NoData	2.10	NoData	2.21	NoData	2.26	NoData	2.60	NoData	3.06	NoData
7	919282	623390	309139	1.93	NoData	2.10	NoData	2.20	NoData	2.25	NoData	1.46	NoData	1.50	NoData
8	919202	623423	309190	1.38	NoData	2.09	NoData	2.19	NoData	2.25	NoData	2.58	NoData	3.04	NoData
9	919165	623466	309201	1.92	NoData	2.08	NoData	2.18	NoData	2.23	NoData	1.46	NoData	2.99	NoData
10	919191	623494	309227	1.38	NoData	2.05	NoData	2.15	NoData	2.20	NoData	1.46	NoData	2.95	NoData

Data in this table comes from the River Wensum, Norwich, Norfolk, 2017 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

Modelled node locations data

Defences removed

Label	Modelled location ID	Easting	Northing	5% AEP		2% AEP		1.33% AEP		1% AEP		0.5% AEP		0.1% AEP	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	919031	622571	309299	2.57	NoData	2.72	NoData	2.87	NoData	2.94	NoData	3.41	NoData	4.50	NoData
2	919234	623060	308880	2.03	NoData	2.20	NoData	2.32	NoData	2.38	NoData	2.76	NoData	1.52	NoData
3	919143	623212	308999	1.97	NoData	2.13	NoData	2.24	NoData	2.30	NoData	2.63	NoData	3.14	NoData
4	919104	623233	309012	1.96	NoData	2.13	NoData	2.23	NoData	2.29	NoData	2.62	NoData	3.09	NoData
5	919149	623303	309042	1.95	NoData	2.11	NoData	2.22	NoData	2.27	NoData	2.60	NoData	3.07	NoData
6	919260	623347	309088	1.94	NoData	2.10	NoData	2.20	NoData	2.26	NoData	2.58	NoData	3.05	NoData
7	919282	623390	309139	1.38	NoData	2.09	NoData	2.20	NoData	2.25	NoData	2.57	NoData	3.03	NoData
8	919202	623423	309190	1.93	NoData	2.09	NoData	2.19	NoData	2.24	NoData	1.46	NoData	3.02	NoData
9	919165	623466	309201	1.92	NoData	2.07	NoData	2.18	NoData	2.23	NoData	2.54	NoData	2.98	NoData
10	919191	623494	309227	1.90	NoData	2.05	NoData	2.15	NoData	2.20	NoData	2.51	NoData	2.93	NoData

Data in this table comes from the River Wensum, Norwich, Norfolk, 2017 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

Modelled node locations data

Defended climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+20%)		1.0% AEP (+25%)		1.0% AEP (+35%)		1.0% AEP (+65%)		0.5% AEP (+20%)		0.5% AEP (+25%)		0.5% AEP (+35%)		0.5% AEP (+65%)		0.1% AEP (+20%)		0.1% AEP (+25%)	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	919031	622571	309299	3.53	NoData	3.73	NoData	3.90	NoData	4.69	NoData	4.27	NoData	4.40	NoData	4.66	NoData	5.0	NoData	4.84	NoData	4.89	NoData
2	919234	623060	308880	2.89	NoData	3.02	NoData	3.08	NoData	3.82	NoData	3.27	NoData	3.37	NoData	3.76	NoData	4.30	NoData	4.03	NoData	4.14	NoData
3	919143	623212	308999	2.76	NoData	2.88	NoData	2.93	NoData	3.42	NoData	3.06	NoData	3.12	NoData	3.37	NoData	3.91	NoData	3.58	NoData	3.72	NoData
4	919104	623233	309012	2.75	NoData	2.86	NoData	2.91	NoData	3.32	NoData	3.03	NoData	3.08	NoData	3.28	NoData	3.74	NoData	3.44	NoData	3.55	NoData
5	919149	623303	309042	2.73	NoData	2.84	NoData	2.89	NoData	3.30	NoData	3.0	NoData	3.06	NoData	3.26	NoData	3.71	NoData	3.41	NoData	3.52	NoData
6	919260	623347	309088	2.71	NoData	2.82	NoData	2.88	NoData	3.28	NoData	2.99	NoData	3.04	NoData	3.24	NoData	3.69	NoData	3.39	NoData	3.50	NoData
7	919282	623390	309139	2.70	NoData	2.81	NoData	2.87	NoData	3.26	NoData	2.98	NoData	3.02	NoData	3.22	NoData	3.66	NoData	3.37	NoData	3.48	NoData
8	919202	623423	309190	2.70	NoData	2.81	NoData	2.86	NoData	3.26	NoData	2.97	NoData	3.02	NoData	3.22	NoData	3.65	NoData	3.36	NoData	3.47	NoData
9	919165	623466	309201	2.67	NoData	2.78	NoData	2.83	NoData	3.21	NoData	2.93	NoData	2.98	NoData	3.17	NoData	3.58	NoData	3.30	NoData	3.41	NoData
10	919191	623494	309227	2.64	NoData	2.75	NoData	2.80	NoData	3.16	NoData	2.89	NoData	2.94	NoData	3.12	NoData	3.52	NoData	3.25	NoData	3.35	NoData

Data in this table comes from the River Wensum, Norwich, Norfolk, 2017 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

Modelled node locations data

Defences removed climate change

Label	Modelled location ID	Easting	Northing	1.0% AEP (+25%)		1.0% AEP (+35%)		1.0% AEP (+65%)		0.5% AEP (+25%)		0.5% AEP (+65%)		0.1% AEP (+20%)		0.1% AEP (+25%)	
				Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
1	919031	622571	309299	3.72	NoData	3.88	NoData	4.69	NoData	4.39	NoData	5.0	NoData	5.08	NoData	4.89	NoData
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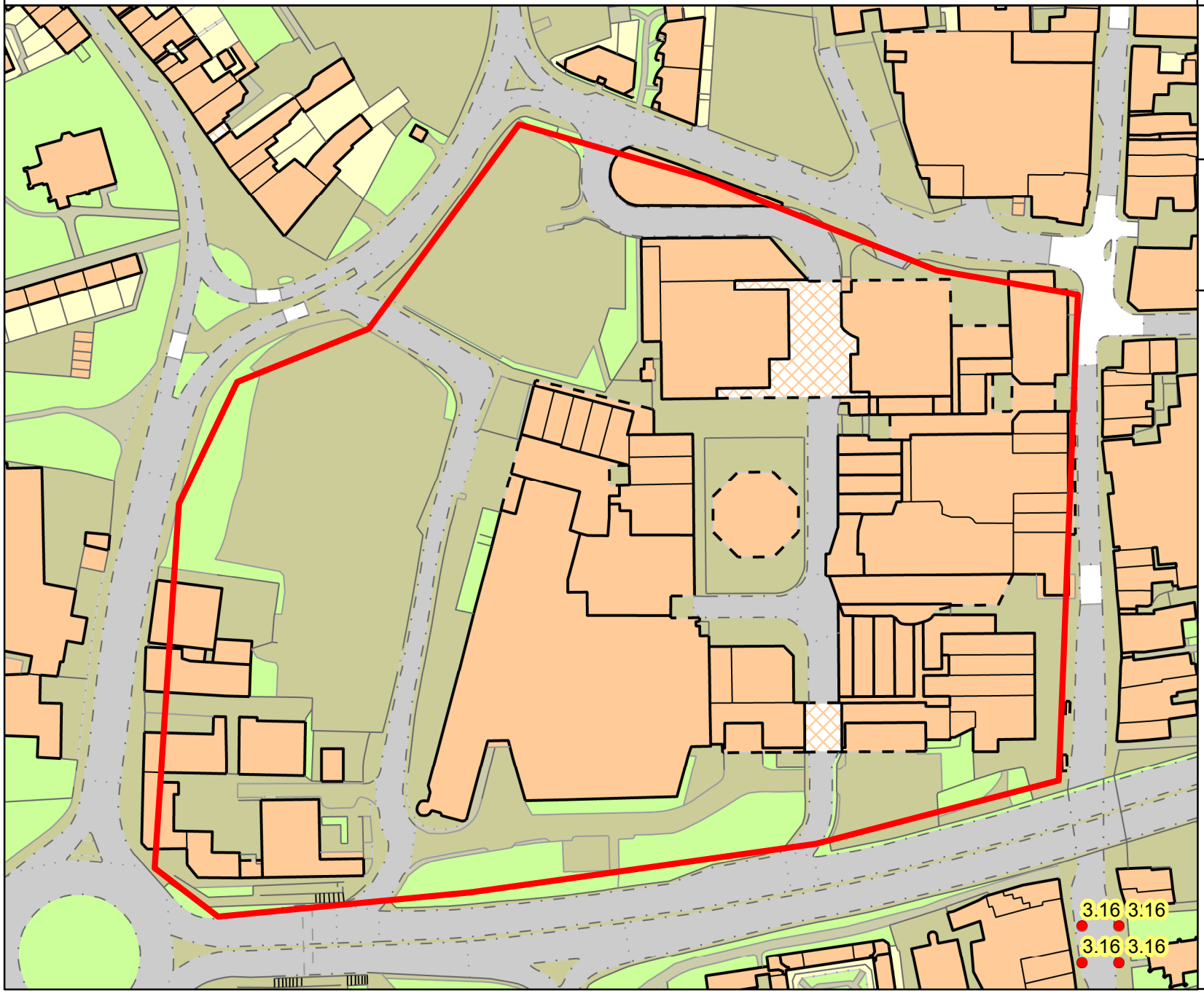
3	919143	623212	308999	2.86	NoData	2.92	NoData	3.42	NoData	3.11	NoData	3.91	NoData	4.05	NoData	3.72	NoData
4	919104	623233	309012	2.85	NoData	2.90	NoData	3.32	NoData	3.07	NoData	3.74	NoData	3.88	NoData	3.55	NoData
5	919149	623303	309042	2.83	NoData	2.88	NoData	3.30	NoData	3.04	NoData	3.70	NoData	3.84	NoData	3.52	NoData
6	919260	623347	309088	2.81	NoData	2.87	NoData	3.28	NoData	3.03	NoData	3.68	NoData	3.82	NoData	3.50	NoData
7	919282	623390	309139	2.80	NoData	2.86	NoData	3.26	NoData	3.02	NoData	3.66	NoData	3.79	NoData	3.48	NoData
8	919202	623423	309190	2.80	NoData	2.85	NoData	3.25	NoData	3.01	NoData	3.64	NoData	3.77	NoData	3.47	NoData
9	919165	623466	309201	2.77	NoData	2.82	NoData	3.20	NoData	2.97	NoData	3.58	NoData	3.70	NoData	3.41	NoData
10	919191	623494	309227	2.73	NoData	2.79	NoData	3.15	NoData	2.93	NoData	3.52	NoData	3.63	NoData	3.35	NoData

Data in this table comes from the River Wensum, Norwich, Norfolk, 2017 model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

Modelled (Defended) 2D Levels

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency

Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 15 30 60

Metres

1:1,500

Legend

- Site Location
- Main Rivers
- 1 in 1000 (0.1%)

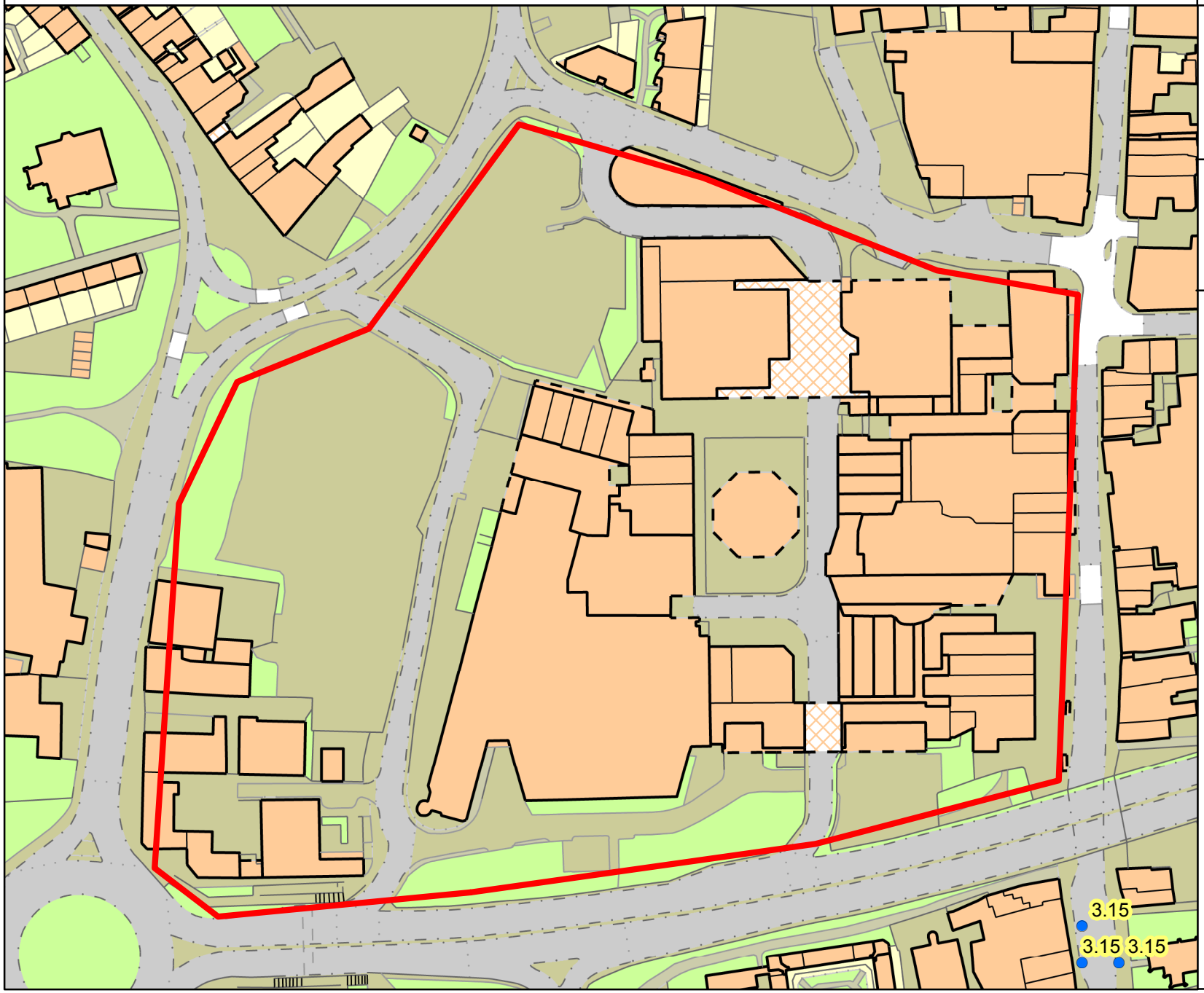
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Produced by: Partnership & Strategic Overview
East Anglia: Essex, Norfolk & Suffolk

Modelled (Undefended) 2D Levels

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency

Environment Agency
Iceni House
Cobham Road
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Suffolk
IP3 9JD

N

0 15 30 60

Metres

1:1,500

Legend

- Site Location
- Main Rivers
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Produced by: Partnership & Strategic Overview
East Anglia: Essex, Norfolk & Suffolk

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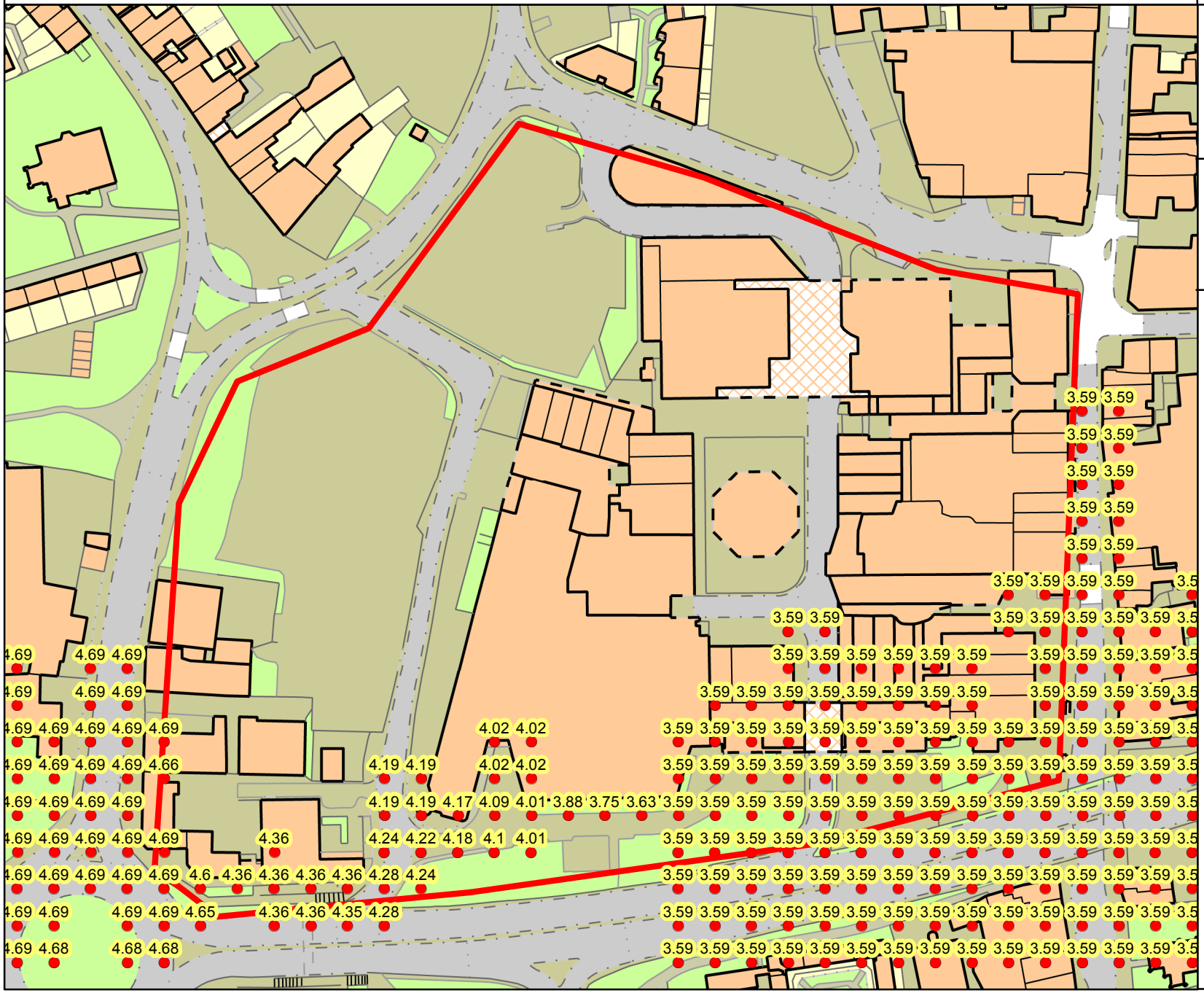
At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 15 30 60

Metres

1:1,500

Legend

- Site Location
- Main Rivers
- 1 in 1000+25%(*CC)

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

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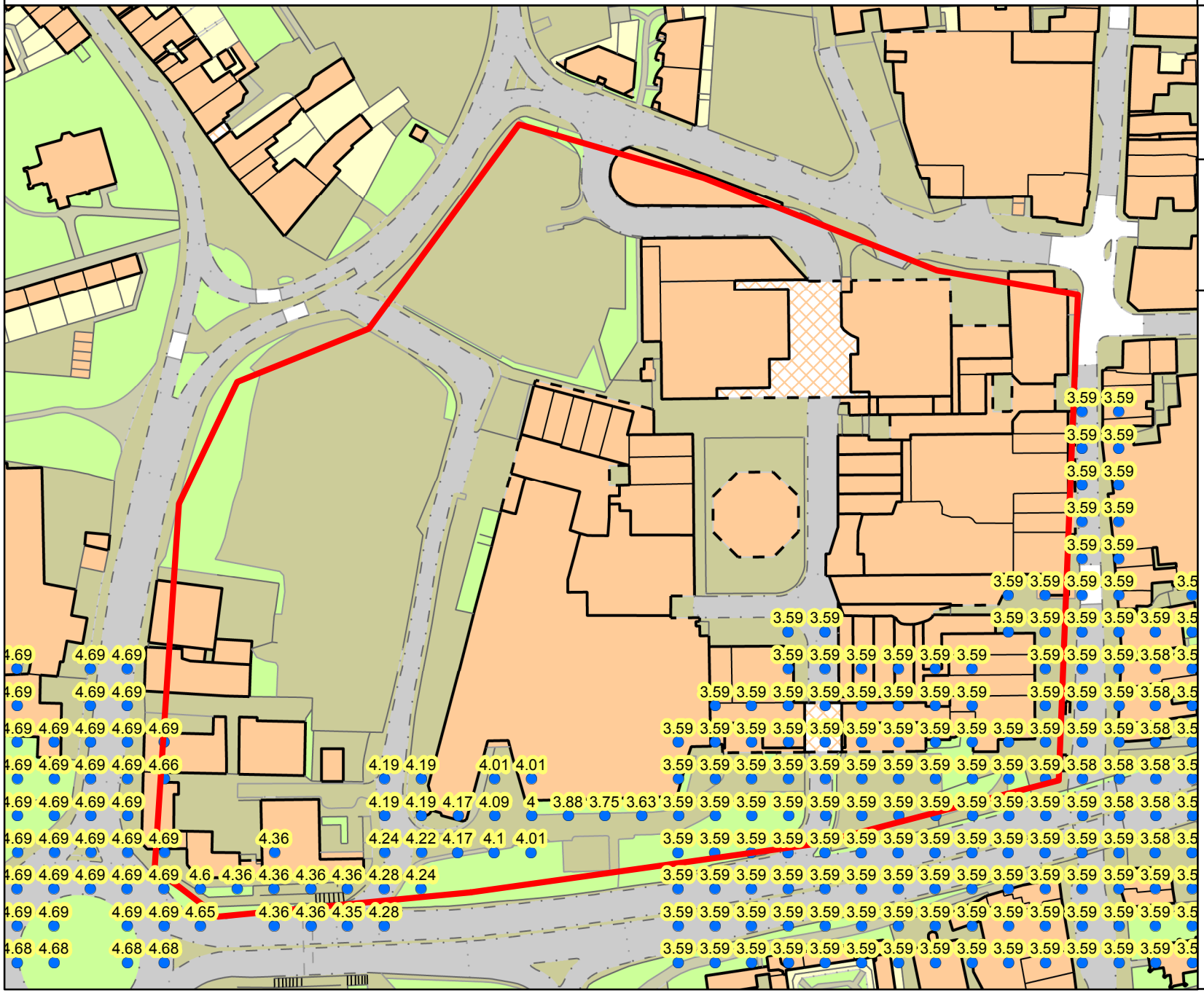
Produced by: Partnership & Strategic Overview East Anglia: Essex, Norfolk & Suffolk

Modelled (Undefended) 2D Levels

At: 623056, 309335 Created: 24/01/2022 Ref: EAN/2022/248079



Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD

N

0 15 30 60

Metres

1:1,500

Legend

- Site Location
- Main Rivers
- 1 in 1000+25%(*CC)

This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within the catchment. Modelled outlines take into account catchment wide defences if present.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Produced by: Partnership & Strategic Overview
East Anglia: Essex, Norfolk & Suffolk

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

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

Appendix D Norfolk County Council Pre-Application Comments

Norfolk County Council
Community and Environmental Services
County Hall
Martineau Lane
Norwich
NR1 2SG

via e-mail
Louisa Wade
Royal HaskoningDHV UK LTD
Burns House
Harlands Road
Haywards Heath
West Sussex
RH16 1PG

NCC contact number: 0344 800 8020
Textphone: 0344 800 8011

Your Ref:	PC3230-WM-CO-220210-1516	My Ref:	FW2021_1109
Date:	14th March 2022	Tel No:	0344 800 8020
		Email:	llfa@norfolk.gov.uk

Dear Ms Wade

Pre-application Advice for the hydraulic modelling of redevelopment at Anglia Square, Norwich

Thank you for your pre-application advice request in relation to the hydraulic modelling for the redevelopment of Anglia Square in Norwich that we received on 11 February 2022.

Previously, the LLFA were consulted on several occasions for a development at Anglia Square between 2016 and 2019. The LLFA are aware that the previous development proposal was unsuccessful and since then there have been updates to both National Planning Policy Framework (NPPF) and the LLFA Developer Guidance. Therefore, as both the site plan and the policy environment has changed significantly the LLFA will treat this as a new application and advice will be provided in accordance with the current policies. We note the intention of the applicant to submit a hybrid planning application for the proposed development. Therefore, as the hydraulic model will support a full application further refinement of the hydraulic model will be required as an effective evidence base for this aspect of the application.

The documents provided for review are:

- Email received from Louisa Wade on 11 February 2022 titled “Anglia Square Norwich – Flood Risk Pre-Application Advice Request” with the following attachments
  - 20220210 - Pre-Application Request - Anglia Square Norwich.pdf
  - FIG 1_ EXISTING 1 IN 100 YR (PLUS 40_CC).pdf
  - Ground Floor Master Plan - Application Boundary.pdf
  - Pre App Form - ANGLIA SQUARE NORWICH.pdf
  - FEH Hydrology.zip
- Hydraulic model received via Royal HaskoningDHV UK Ltd’s internal share site on 28 February 2022
- Additional information provided by email on 3 March 2022

Continued…/

We wish to make the following comments on the data provided as follows.

Modelling Approach

Model Hydrology

The updating of the model hydrology to use FEH2013 and REFH2 to generate updated rainfall is welcomed by the LLFA. The LLFA will expect documentation to be provided in support of the planning application detailing the hydrological parameters including those used within the REFH software.

We note that 2d_bc inflow boundaries have been used from the Norwich Surface Water Management Plan (SWMP) Model with 20% climate change allowance. These originated from the broadscale model used for the SWMP that covers the whole of Norwich. The LLFA has provided the model build report for reference and use. The LLFA does not consider it acceptable to use the 20% climate change values for these flows. It expects the model to be extended, based on the local topography, to ensure all upstream flows are covered by the direct rainfall boundary as per LLFA Developer Guidance .

The information provided by the applicant states that a peak storm duration of 3 hours has been used. Evidence to demonstrate should be provided that the critical storm duration is 3 hours. Section 10.2.3 of the LLFA Developer Guidance states that

> "storm durations for the critical storm, 1hr and 3hr should be run."

Therefore, a 1 hour duration storm should also be simulated. Additionally, both the summer and winter storm profiles should be tested to determine the critical event type for the catchment.

An infiltration rate of 7mm per hour has been applied across the catchment to represent flows to the sewer network and infiltration. The SWMP model build report, paragraph 2.5, states that the capacity of the drainage system varies across the catchment. The Anglian Water surface water system is likely to influence the flooding locations local to the site. Additionally, where drainage carrying onsite flows is connecting to the Anglian Water sewer, water levels in the sewer may prevent discharge from the site at the agreed design flow and consequently cause additional flooding to the site. Therefore, Anglian Water should be consulted regarding the capacity of their system local to the site. It is also recommended that the Anglian Water sewer system is included in the model. The LLFA will require evidence of consultation with Anglian Water within any planning submission.

We would encourage the applicant's early engagement with regards to anything being proposed for adoption by Anglian Water, who offer a free service. These gives both the developer and Anglian Water an early opportunity to develop a design as it comes through planning and align with both your requirements as well as adoptable standards and encourage good SuDS designs. Anglian Water have developed a form for developers to submit information that they request to support developers in their design development process which can be found at https://www.anglianwater.co.uk/developing/planning--capacity/planning-and-capacity/.

Model Geometry

We welcome the inclusion of the latest Environment Agency LiDAR to update the model . The LLFA Developer Guidance in section 10.2.3 states

> "Ground truthing checks should be undertaken to understand and improve accuracy of any base digital terrain model such as artificial ground height at tops of trees, creating cuttings in linear features to represent culverts or bridges etc"

The LLFA queries whether ground truthing checks been undertaken for this model?

The LLFA is concerned that the representation of the St Crispins Road flyover that is indicated to be enforced at a level of 8m. The considers that the current representation may not accurately reflect the surface water flow paths across the road at the western end where finished road and ground levels are lower. We recommend this is enforced using variable levels to represent the road as it rises steadily toward St Magdalen Street.

The LLFA note that a 1d_nwk_NOR2_culverts layer is included in the hydraulic model that represents culverts across the catchment. A review of this layer shows only one culvert included, which represents a subway under St Crispins Road near the Cherry Lane exit. This subway was infilled in 2018 and should be removed from the model. Further details and confirmation of these works can be found at https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/norwich/city-centre-improvements/improvement-projects/recently-completed/st-crispins-road-crossing

We understand the building thresholds have been included in the model at a standard threshold level of 100mm. We note that the road level was lowered by 125mm to allow for the street kerbs to be represented. However, it is observed that many properties on Magdalen Street, both adjacent to the development and to the south of the development, have thresholds level with the existing pavement. The LLFA expects a suitable level survey should be undertaken along key flow routes impacting the proposed site and the offsite area to ensure that the assumed 100mm threshold level is appropriate for use.

Model Proving

In the information provided to date, there are no details of model calibration. The LLFA Developer Guidance confirms in section 10.2.3 that

> "Calibration modelling scenarios should be run using historic flooding information to the actual recorded rainfall event return period."

A significant rainfall event occurred in the catchment in 2014, after the SWMP model was developed. This event is detailed in Flood Investigation Report FIR008 (https://www.norfolk.gov.uk/-/media/norfolk/downloads/rubbish-recycling-planning/flood-and-water-management/flood-investigation-reports/norwich-and-broadland-2014.pdf). The model should be run for this event and flooding locations compared.

Sensitivity testing should also be undertaken on key parameters. These should include as a minimum sensitivity on inflows, roughness, blockage of any culverts or structures, losses applied to the model and boundary conditions. Please see Environment Agency hydraulic modelling best practice guidance at https://www.gov.uk/government/publications/river-modelling-technical-standards-and-assessment/hydraulic-modelling-best-practice-model-approach for further information.

In addition, model stability checks should be undertaken on the finished model runs to ensure the mass balance is acceptable and erratic flow profiles are not seen within the results. These should be reported upon within the hydraulic modelling report accompanying the application. Where a mass balance of <1% cannot be achieved in both the time varying and overall mass balance outputs the report should provide evidence that this is not impacting predicted flooding.

Post Scheme

At present, the post scheme model has not been reviewed as your letter indicates it is not yet finalised. However, the LLFA would be concerned about the proposal to channel overland flow through the site as this may result in an increase in peak flows from the site causing offsite impacts. Any modelling would need to demonstrate no increase in flood risk elsewhere as per paragraph 164 of NPPF. The site drainage should be included in the model as per design.

Local Flood Risk

For details on particular flood risk or drainage issues relating to the site or surrounding area please see attached desktop study.

Offsite Impacts

The LLFA would expect to see no increase in flood risk as per paragraph 164 of NPPF. Where an increase in flood depths occur the LLFA will require an explanation for the increase with an accompanying hazard assessment and details of impacted receptors.

Flood Risk Management Approach

With regard to your proposed details of the attenuation tanks flood warning system, we are unable to provide any meaningful comment at this time due to a lack of appropriate information that demonstrates the appropriateness for this system. In order to provide further comment on this we will require full context of flood risk on site. The applicant should confirm that the development has been designed appropriately and according to latest LLFA Developer Guidance. Prior to consideration of flood warning systems we would require evidence that:

- Flood risk has been appropriately assessed. We would require the above updates to the hydraulic model to be undertaken to ensure flood risk has been assessed accurately.
- Following the above assessment a masterplan should be developed that takes into account land use vulnerability and the modelled future flood risk. For example, more vulnerable development should be placed outside of the surface water flood risk area for the 1% AEP event plus climate change where possible (See Section 10.2.1 of LLFA developer guidance). Some key things to consider are
    - The below ground carpark in Block A is in an area of known flood risk and therefore should be situated at or above ground level. At a minimum any opening to the carpark should be 300mm above the 1% AEP event plus climate change level as per policy box 9 in Section 20 of the LLFA guidance.
    - Site drainage has been designed in line with Section 11 of the LLFA developer guidance which outlines drainage hierarchies in policy boxes 2 and 3. In particular rainwater harvesting should be included in the design where there is a demand for non-potable water.

We remind the applicant that avoidance of risk should always be the starting point of any design. A flood warning system would be considered to a last resort management option. Therefore, an evidence base that demonstrates and supports the design decisions will be required.

Should you have any further questions then please contact us by email at llfa@norfolk.gov.uk. Alternatively further guidance on the information required by the LLFA from applicants can be found at https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers.

Yours sincerely,

Sarah

Sarah Sims
Flood Risk Officer

Lead Local Flood Authority

Disclaimer
We have relied on the accuracy and completeness of the information supplied to us in providing the above advice and can take no responsibility for incorrect data or interpretation, or omissions, in such information. If we have not referred to a particular issue in our response, it should not be assumed that there is no impact associated with that issue.

Appendix E Proposed Development Plans

Contractors and consultants are not to scale dimensions from this drawing

The survey information shown on this drawing is based on a topographical survey prepared by a third party and Broadway Malyan Limited accept no responsibility for the accuracy or completeness of the survey.

Drawings to be read in conjunction with the associated Design & Access Statement, associated consultant desin team documents & reports and landscape information

Landscape shown is for illustrative purposes only. For detailed landscape information, please refer to the landscape information & documents.

0m 25m 50m

N

General Notes

All figures and areas are approximate only and subject to statutory constraints, detail design & design development

Structural Design: Subject to structural input & coordination

Services Design: Subject to services input & coordination

Fire Strategy: Subject to fire input & coordination

Application Boundary

Land Ownerd by CT to be subject to separate application for part of the Mobility Hub

Existing Buildings

- Site B - Area 0.27 ha

- Site C - Area 0.13 ha

- Applcation Boundary (All Blocks) and public realm - Area 4.65ha

- Detailed Application (Block A,B,C,D,M,KL & J3) and public realm - Area 2.25ha

Revision	Date	Drawn By	Description
D0-2	24.06.22		Rev A Consultant Design Freeze
D0-1	31.03.22		Issued for Planning

BroadwayMalyan BM

4 Pear Place
London
SE1 8BT

T: +44 (0)20 7261 4200
F: +44 (0)20 7261 4300
E: Lon@BroadwayMalyan.com

www.BroadwayMalyan.com

Client
Weston Homes

Project
Anglia Square
Norwich

Description
Hybrid Application Site Plan
Block Plan on Proposed layout

Status
For Planning

Scale	Drawn By	Date
1:500@A1	BM	31.03.22
Job Number	**Drawing Number**	**Revision**
35301	ZZ-00-DR-A-01-0300	D0-2

Contractors and consultants are not to scale dimensions from this drawing

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Revision	Date	Drawn By	Description
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D0-1	31.03.22		Issued for Planning

BroadwayMalyan BM

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London
SE1 8BT

T: +44 (0)20 7261 4200
F: +44 (0)20 7261 4300
E: Lon@BroadwayMalyan.com

www.BroadwayMalyan.com

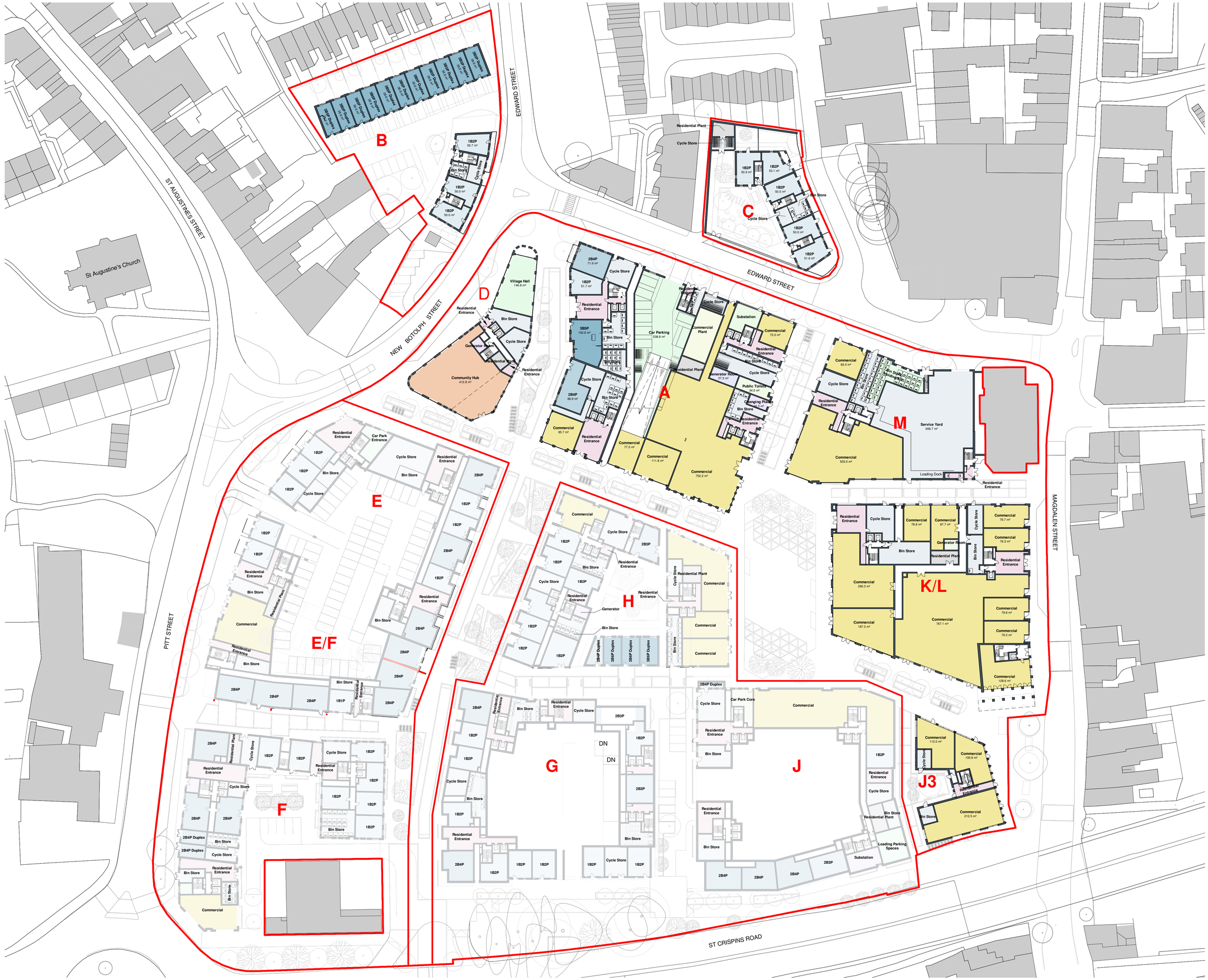
Client
Weston Homes

Project
Anglia Square
Norwich

Description
Detailed Application Plan
Block plan on proposed layout

Status
For Planning

Scale	Drawn By	Date
1:500@A1	BM	31.03.22
Job Number	Drawing Number	Revision
35301	ZZ-00-DR-A-01-0301	D0-2



Contractors and consultants are not to scale dimensions from this drawing

The survey information shown on this drawing is based on a topographical survey prepared by a third party and Broadway Malyan Limited accept no responsibility for the accuracy or completeness of the survey.

Drawings to be read in conjunction with the associated Design & Access Statement, associated consultant desin team documents & reports and landscape information

Landscape shown is for illustrative purposes only. For detailed landscape information, please refer to the landscape information & documents.

0m 25m 50m

N

General Notes

All figures and areas are approximate only and subject to statutory constraints, detail design & design development

Structural Design: Subject to structural input & coordination

Services Design: Subject to services input & coordination

Fire Strategy: Subject to fire input & coordination

Hybrid Application Boundary

Land Owned by CT

Detail Application Boundary

Note: Indicative Outline Buildings: E, F, E/F, G, H & J shown faded

Revision	Date	Drawn By	Description
D0-2	24.06.22		Rev A Consultant Design Freeze
D0-1	31.03.22		Issued for Planning

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SE1 8BT

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F: +44 (0)20 7261 4300
E: Lon@BroadwayMalyan.com

www.BroadwayMalyan.com

Client
Weston Homes

Project
Anglia Square
Norwich

Description
Masterplan
Level 00

Status
For Planning

Scale	Drawn By	Date
1:500@A1	BM	26.01.22
Job Number	Drawing Number	Revision
35301	ZZ-00-DR-A-01-0100	D0-2

Contractors and consultants are not to scale dimensions from this drawing

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0m 25m 50m

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Hybrid Application Boundary

Land Owned by CT

Detail Application Boundary

Note: Indicative Outline Buildings: E, F, E/F, G, H & J shown faded

Revision	Date	Drawn By	Description
D0-2	24.06.22		Rev A Consultant Design Freeze
D0-1	31.03.22		Issued for Planning

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SE1 8BT

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F: +44 (0)20 7261 4300
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www.BroadwayMalyan.com

Client
Weston Homes

Project
Anglia Square
Norwich

Description
Masterplan
Level B01

Status
For Planning

Scale	Drawn By	Date
1:500@A1	BM	26.01.22
Job Number	**Drawing Number**	**Revision**
35301	ZZ-99-DR-A-01-0099	D0-2

Contractors and consultants are not to scale dimensions from this drawing

The survey information shown on this drawing is based on a topographical survey prepared by a third party and Broadway Malyan Limited accept no responsibility for the accuracy or completeness of the survey.

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0m 25m 50m

N

General Notes

All figures and areas are approximate only and subject to statutory constraints, detail design & design development

Structural Design: Subject to structural input & coordination

Services Design: Subject to services input & coordination

Fire Strategy: Subject to fire input & coordination

Hybrid Application Boundary

Land Owned by CT

Detail Application Boundary

Note: Indicative Outline Buildings: E, F, E/F, G, H & J shown faded

Revision	Date	Drawn By	Description
D0-2	24.06.22		Rev A Consultant Design Freeze
D0-1	31.03.22		Issued for Planning

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Client
Weston Homes

Project
Anglia Square
Norwich

Description
Masterplan
Level 01

Status
For Planning

Scale	Drawn By	Date
1:500@A1	BM	08.02.22
Job Number	Drawing Number	Revision
35301	ZZ-01-DR-A-01-0101	D0-2

Appendix F Topographic Survey


Barclays Bank
N 309,300
E 623,000
N 309,300
E 623,100
N 309,300
E 622,900
SERVICE LEGEND
FOUL DRAINAGE
SURFACE WATER DRAINAGE
WATER
GAS
ELECTRICITY
TELEPHONE
CABLE TV
MERCURY
TRAFFIC SIGNAL
OIL
UNKNOWN SERVICE
NEW DETAIL
UNDERGROUND CHAMBER

Co-ordinate Table

Station	Type	Easting (mE)	Northing (mN)	Level (mZ)
S1	PK Nail	623069.621	309475.003	4.361
S2	PK Nail	623093.713	309454.169	4.169
S3	PK Nail	623119.843	309432.051	3.236
S10	PK Nail	622976.209	309342.800	4.532
S11	PK Nail	622970.620	309300.125	4.260
S12	PK Nail	622949.383	309334.130	4.737
M1	PK Nail	623004.807	309485.626	5.149

SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
SURVEY DETAIL WITHIN ROADWAYS SURROUNDING ANGLIA SQUARE MAYBE LIMITED IN PLACES DUE TO HEAVY TRAFFIC AT TIME OF SURVEY.

N

Grid North

NOTES

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2. ALL LEVELS ON KERB LINES ARE CHANNEL LEVELS UNLESS NOTED OTHERWISE.
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Revisions	
A	TOPO AREA CHECKED AND ADDITIONAL TOPO AREA SURVEYED. MARCH 2022.
B	TOPO AREA EXTENDED 31/05/2022
C	

Drawing No: SJG2136 — Revision B — Sheet 1/1

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:-
Weston Homes PLC

Scale:-
1:200

Project:-
Anglia Square,
Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
CHY	Chimney	OSBM	Ordnance Bench Mark
CL	Cover Level	P	Post Or Pillar
CONC	Concrete	PM	Parking Meter
CTV	Cable TV	RE	Rodding Eye
DK	Drop Kerb	RS	Road Sign
DP	Down Pipe	SAP	Sapling
DR	Drain	SC	Stop Cock
ELC	Electricity	SL	Sump Level
EP	Elec.Pole	ST	Stop Tap
ER	Earth Rod	SV	Sluice Valve
FB	Flower Bed	TAR	Tarmac
FH	Fire Hydrant	TC	Telecom Cover
FP	Footpath	TCB	Telephone Call Box
GP	Gate Post	TL	Traffic Lights
GV	Gas Valve	TP	Telegraph Pole
IC	Inspec. Cover	TV	Television Box
IL	Invert Level	UTL	Unable to lift
JB	Junction Box	VP	Vent Pipe
KO	Kerb Outlet	WL	Water Level
LB	Letter Box	WM	Water Meter
LP	Lamp Post	WO	Wash Out

FENCE TYPES

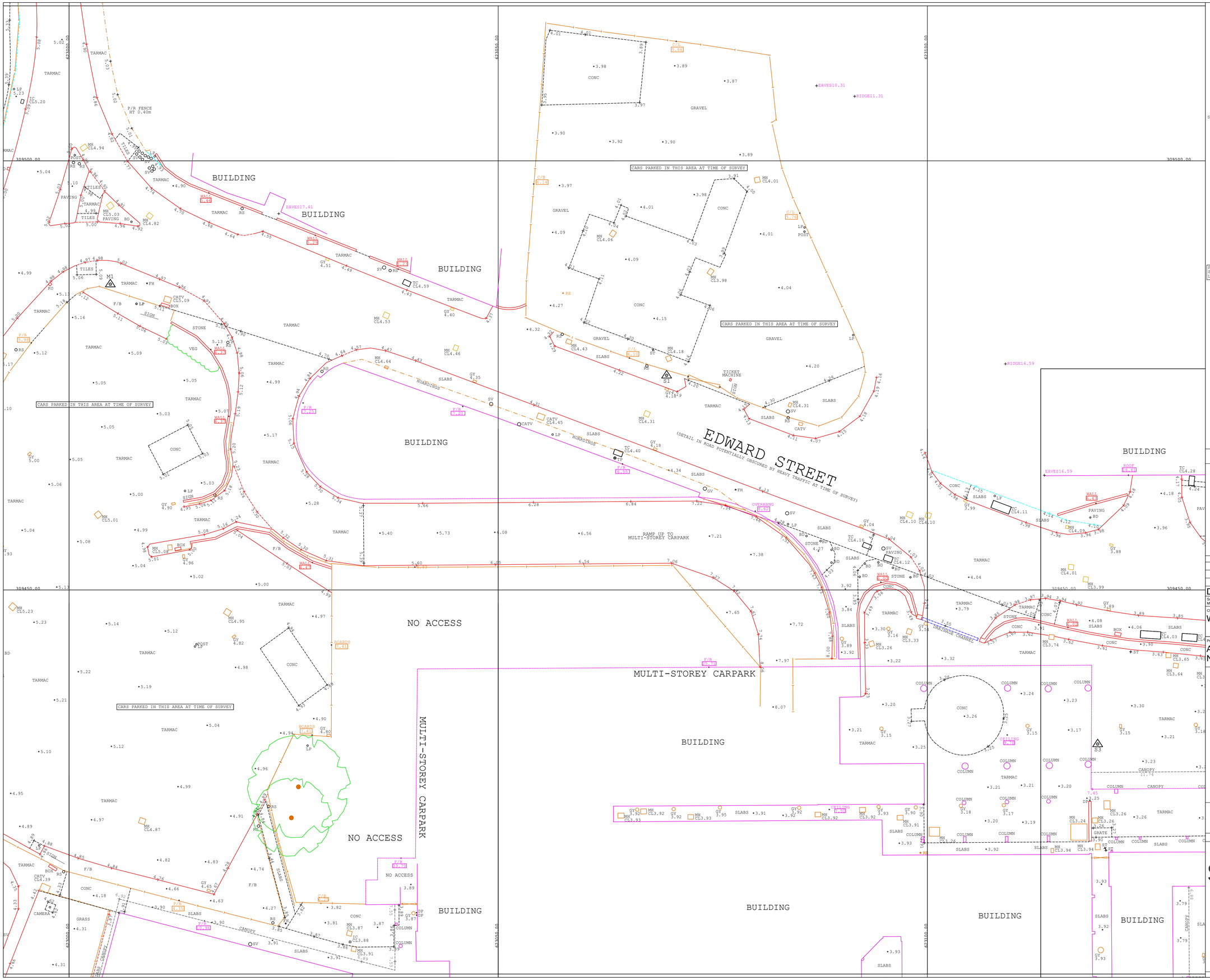
B/W	Barbed Wire	C/P	Chestnut Paling
C/B	Close Boarded	I/R	Iron Railing
C/I	Corrugated Iron	I/W	Interwoven
C/L	Chainlink	P/A	Panel Fencing
P/R	Post & Rail		
P/S	Palisade		
P/W	Post & Wire		

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - e.g. WALL 4.89

SURVEYED BY:-

SJ GEOMATICS
SURVEYORS
48c Thoroughfare
Halesworth
Suffolk
IP19 8AR
Tel. 01986 872716
email. mail@sjgeomatics.co.uk
web. www.sjgeomatics.co.uk

Company Registration Number 8081329



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S12	PK Nail	622949.383	309334.130	4.737
M1	PK Nail	623004.807	309485.626	5.149

SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
SURVEY DETAIL WITHIN ROADWAYS SURROUNDING ANGLIA SQUARE MAYBE LIMITED IN PLACES DUE TO HEAVY TRAFFIC AT TIME OF SURVEY.

N

Grid North

NOTES

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Revisions	
A	TOPO AREA CHECKED AND ADDITIONAL TOPO AREA SURVEYED. MARCH 2022.
B	TOPO AREA EXTENDED 31/05/2022
C	

Drawing No: SJG2136 — Revision B — Sheet 2/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:-
Weston Homes PLC

Scale:- 1:200

Project:-
Anglia Square,
Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
CHY	Chimney	OSBM	Ordnance Bench Mark
CL	Cover Level	P	Post Or Pillar
CONC	Concrete	PM	Parking Meter
CTV	Cable TV	RE	Rodding Eye
DK	Drop Kerb	RS	Road Sign
DP	Down Pipe	SAP	Sapling
DR	Drain	SC	Stop Cock
ELC	Electricity	SL	Sump Level
EP	Elec.Pole	ST	Stop Tap
ER	Earth Rod	SV	Sluice Valve
FB	Flower Bed	TAR	Tarmac
FH	Fire Hydrant	TC	Telecom Cover
FP	Footpath	TCB	Telephone Call Box
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GV	Gas Valve	TP	Telegraph Pole
IC	Inspec. Cover	TV	Television Box
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KO	Kerb Outlet	WL	Water Level
LB	Letter Box	WM	Water Meter
LP	Lamp Post	WO	Wash Out

FENCE TYPES

B/M	Barbed Wire	C/P	Chestnut Paling
C/B	Close Boarded	I/R	Iron Railing
C/I	Corrugated Iron	I/W	Interwoven
C/L	Chainlink	P/A	Panel Fencing
		P/R	Post & Rail
		P/S	Palisade
		P/W	Post & Wire

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE — ON SOLID WALL

SURVEYED BY:-

SJ GEOMATICS
SURVEYORS

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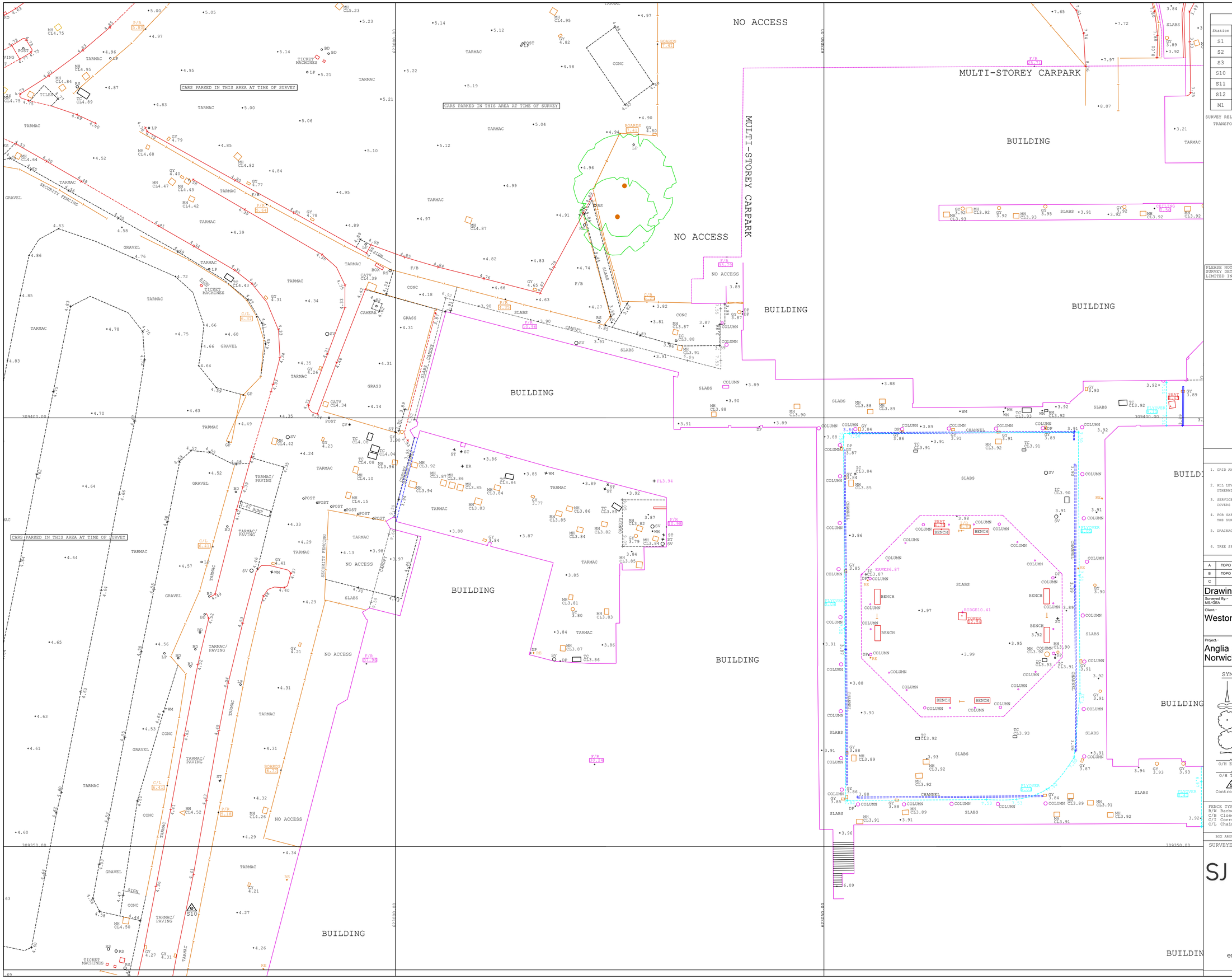
Halesworth
Suffolk
IP19 8AR
Tel. 01986 872716
email. mail@sjgeomatics.co.uk
web. www.sjgeomatics.co.uk

Company Registration Number 8081329



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SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
SURVEY DETAIL WITHIN ROADWAYS SURROUNDING ANGLIA SQUARE MAYBE LIMITED IN PLACES DUE TO HEAVY TRAFFIC AT TIME OF SURVEY.

N

Grid North

NOTES

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Revisions	
A	TOPO AREA CHECKED AND ADDITIONAL TOPO AREA SURVEYED. MARCH 2022.
B	TOPO AREA EXTENDED 31/05/2022
C	

Drawing No: SJG2136 — Revision B — Sheet 3/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:-
Weston Homes PLC

Scale:- 1:200

Project:-
Anglia Square,
Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
CHY	Chimney	OSBM	Ordnance Bench Mark
CL	Cover Level	CONC	Concrete
CTV	Cable TV	P	Post Or Pillar
DK	Drop Kerb	PM	Parking Meter
DP	Down Pipe	RE	Rodding Eye
DR	Drain	RS	Road Sign
ELC	Electricity	SAP	Sapling
EP	Elec.Pole	SC	Stop Cock
ER	Earth Rod	SL	Sump Level
FB	Flower Bed	ST	Stop Tap
FH	Fire Hydrant	SV	Sluice Valve
FP	Footpath	TAR	Tarmac
GY	Gully	TC	Telecom Cover
GP	Gate Post	TCB	Telephone Call Box
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KO	Kerb Outlet	VP	Vent Pipe
LB	Letter Box	WL	Water Level
LP	Lamp Post	WM	Water Meter
		WO	Wash Out

FENCE TYPES

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C/B	Close Boarded	I/R	Iron Railing
C/I	Corrugated Iron	I/W	Interwoven
C/L	Chainlink	P/A	Panel Fencing
P/R	Post & Rail		
P/S	Palisade		
P/W	Post & Wire		

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - RS SHARP ARROW

SURVEYED BY:-

SJ GEOMATICS
SURVEYORS
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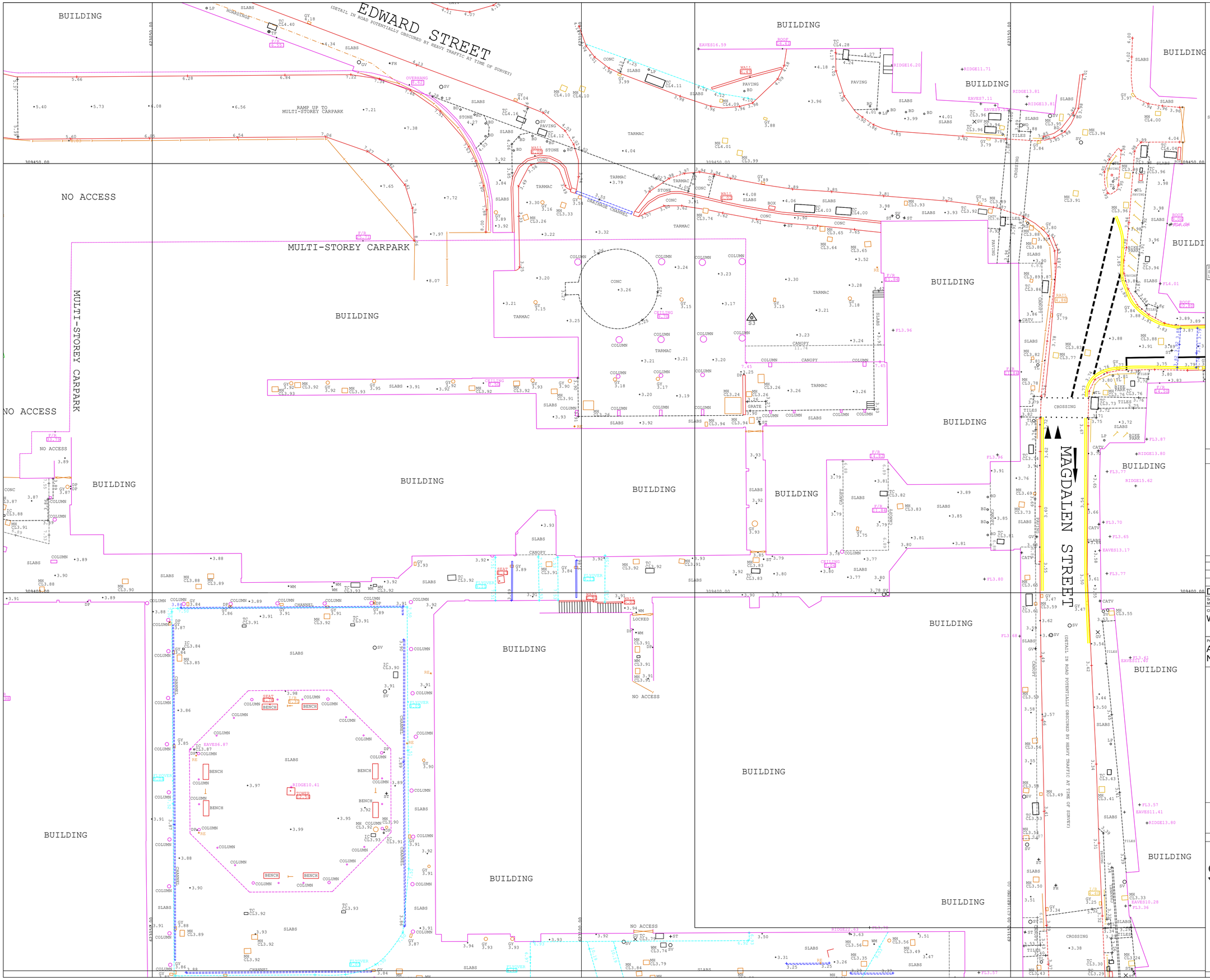
Halesworth
Suffolk
IP19 8AR
Tel. 01986 872716
email. mail@sjgeomatics.co.uk
web. www.sjgeomatics.co.uk
Company Registration Number 8081329



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M1	PK Nail	623004.807	309485.626	5.149

SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
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N

Grid North

NOTES

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C	

Drawing No: SJG2136 — Revision B — Sheet 4/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:- Weston Homes PLC

Scale:- 1:200

Project:- Anglia Square, Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
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GV	Gas Valve	TV	Television Box
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FENCE TYPES

B/M	Barbed Wire	C/P	Chestnut Paling
C/B	Close Boarded	I/R	Iron Railing
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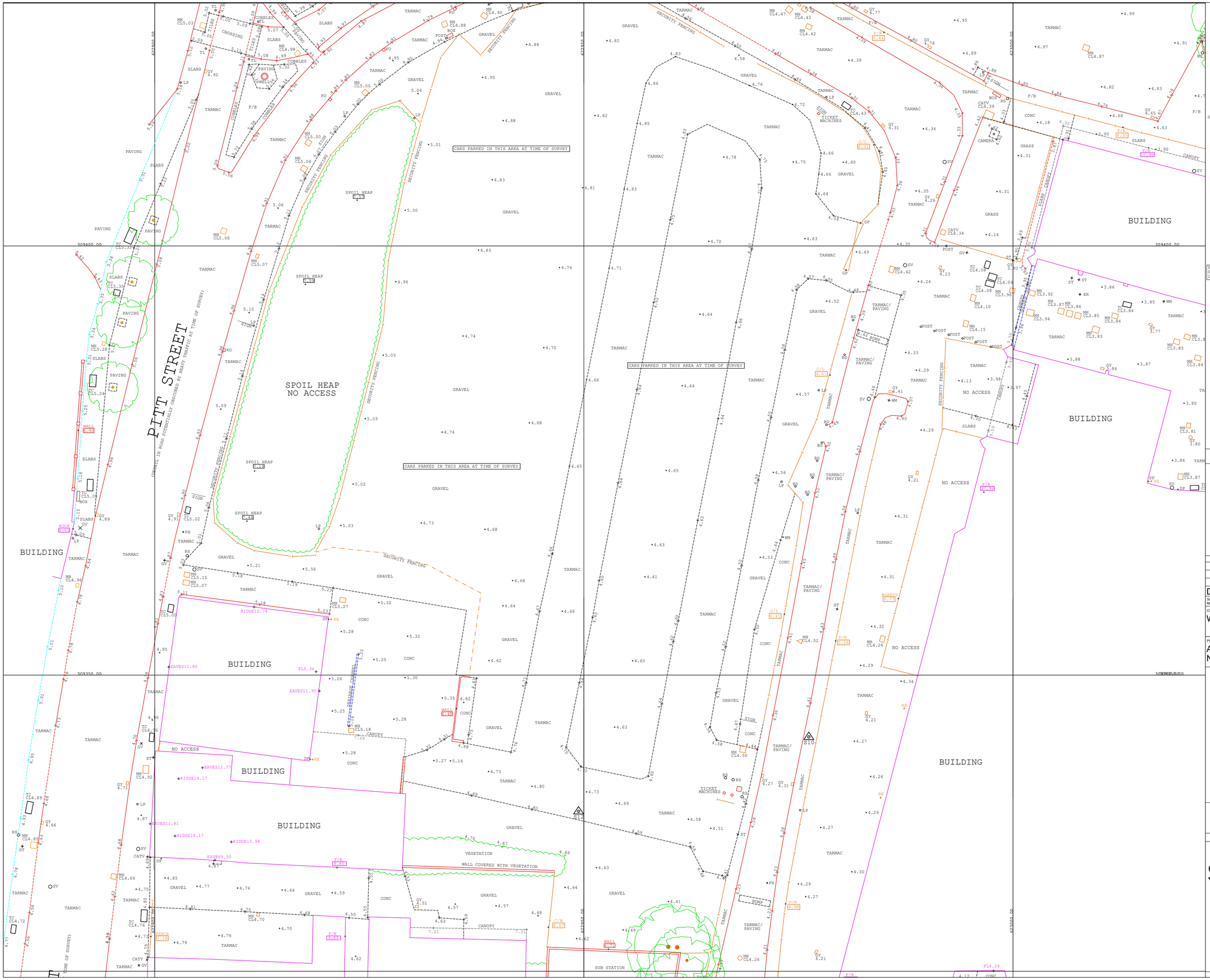
C/L	Chainlink	P/A	Panel Fencing
P/R	Post & Rail		
P/S	Palisade		
P/W	Post & Wire		

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - EG SUNKEN WALL 4.00

SURVEYED BY:-

SJ GEOMATICS SURVEYORS
48c Thoroughfare
Halesworth
Suffolk
IP19 8AR
Tel. 01986 872716
email. mail@sjgeomatics.co.uk
web. www.sjgeomatics.co.uk
Company Registration Number 8081329



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N
Grid North

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Drawing No: SJG2136 — Revision: B — Sheet: S/ft

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:-
Weston Homes PLC

Scale:-
1:200

Project:-
Anglia Square,
Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

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JB	Junction Box	VP	Vent Pipe
KO	Kerb Outlet	WL	Water Level
LB	Letter Box	WM	Water Meter
LP	Lamp Post	WO	Wash Out

FENCE TYPES

B/W	Barbed Wire	C/P	Chestnut Paling
C/B	Close Boarded	I/R	Iron Railing
C/I	Corrugated Iron	I/W	Interwoven
C/L	Chainlink	P/A	Panel Fencing
		P/R	Post & Rail
		P/S	Palisade
		P/W	Post & Wire

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - EG EXAMPLE WALL 4.99

SURVEYED BY:-

SJ GEOMATICS
SURVEYORS
48c Thoroughfare
Halesworth
Suffolk
IP19 8AR
Tel. 01986 872716
email. mail@sjgeomatics.co.uk
web. www.sjgeomatics.co.uk
Company Registration Number 8081329

Co-ordinate Table				
Station	Type	Easting (mE)	Northing (mN)	Level (mZ)
S1	PK Nail	623069.621	309475.003	4.361
S2	PK Nail	623093.713	309454.169	4.169
S3	PK Nail	623119.843	309432.051	3.236
S10	PK Nail	622976.209	309342.800	4.532
S11	PK Nail	622970.620	309300.125	4.260
S12	PK Nail	622949.383	309334.130	4.737
M1	PK Nail	623004.807	309485.626	5.149

SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
SURVEY DETAIL WITHIN ROADWAYS SURROUNDING ANGLIA SQUARE MAYBE LIMITED IN PLACES DUE TO HEAVY TRAFFIC AT TIME OF SURVEY.

N

Grid North

NOTES

1. GRID AND LEVELS RELATED TO ORDNANCE SURVEY GPS NETWORK
2. ALL LEVELS ON KERB LINES ARE CHANNEL LEVELS UNLESS NOTED OTHERWISE.
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Revisions	
A	TOPO AREA CHECKED AND ADDITIONAL TOPO AREA SURVEYED. MARCH 2022.
B	TOPO AREA EXTENDED 31/05/2022
C	

Drawing No: SJG2136 — Revision B — Sheet 6/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:-
Weston Homes PLC

Scale:- 1:200

Project:-
Anglia Square,
Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecon, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
CHY	Chimney	OSBM	Ordnance Bench Mark
CL	Cover Level	P	Post Or Pillar
CONC	Concrete	PM	Parking Meter
CTV	Cable TV	RE	Rodding Eye
DK	Drop Kerb	RS	Road Sign
DP	Down Pipe	SAP	Sapling
DR	Drain	SC	Stop Cock
ELC	Electricity	SL	Sump Level
EP	Elec.Pole	ST	Stop Tap
ER	Earth Rod	SV	Sluice Valve
FB	Flower Bed	TAR	Tarmac
FH	Fire Hydrant	TC	Telecom Cover
FP	Footpath	TCB	Telephone Call Box
GP	Gate Post	TL	Traffic Lights
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C/L	Chainlink	P/A	Panel Fencing
P/R	Post & Rail		
P/S	Palisade		
P/W	Post & Wire		

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE – e.g. EXAMPLE WALL 4.56

SURVEYED BY:-

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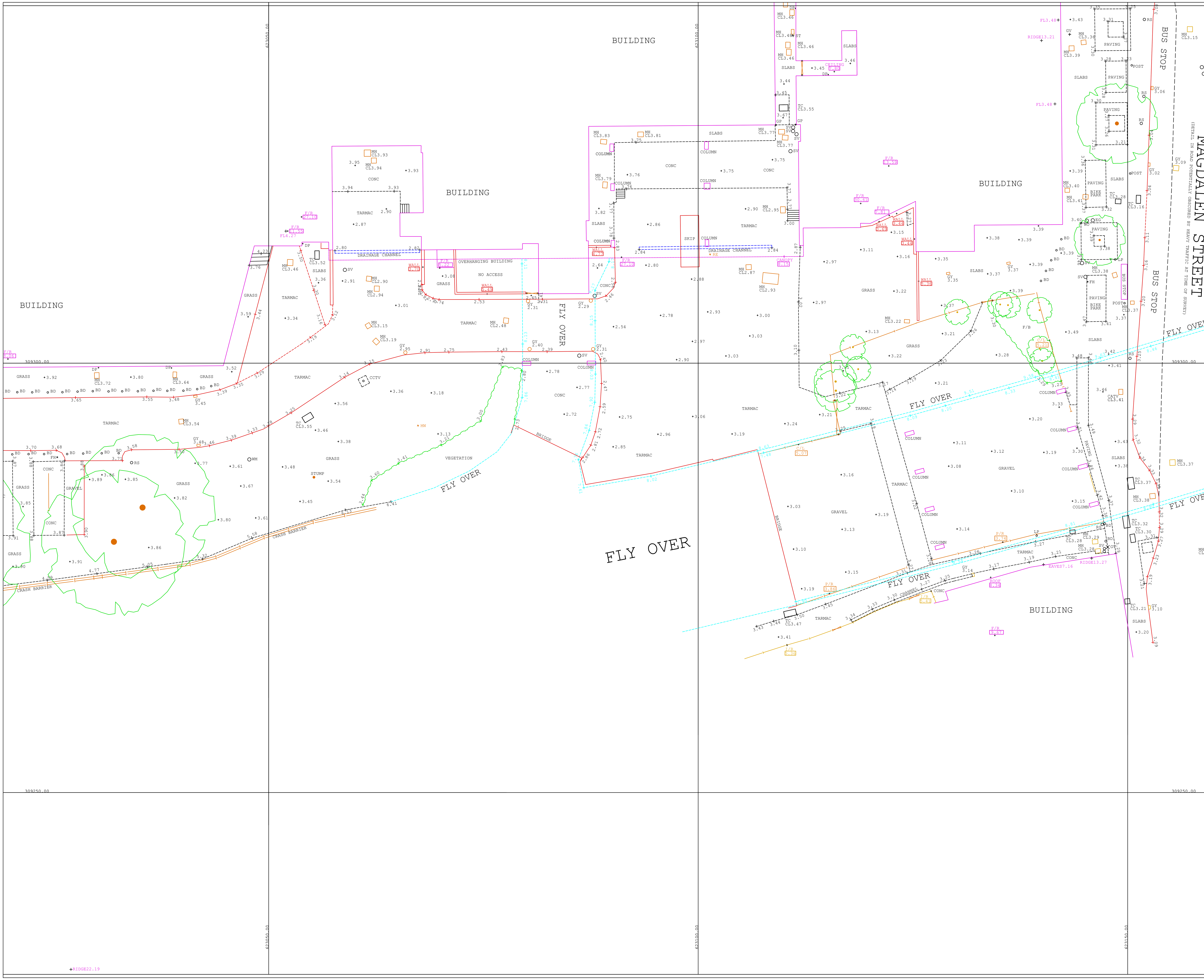

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M1	PK Nail	623004.807	309485.626	5.149

SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
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N

Grid North

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B	TOPO AREA EXTENDED 31/05/2022
C	

Drawing No: SJG2136 — Revision: B — Sheet: 7/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:- Weston Homes PLC

Scale:- 1:200

Project:- Anglia Square, Norwich

SYMBOLS

Banking
Hedge
Tree
Bush
Gate
O/H Electric
O/H Telecom
S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
CHY	Chimney	OSBM	Ordnance Bench Mark
CL	Cover Level	P	Post Or Pillar
CONC	Concrete	PM	Parking Meter
CTV	Cable TV	RE	Rodding Eye
DK	Drop Kerb	RS	Road Sign
DP	Down Pipe	SAP	Sapling
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FENCE TYPES

B/W	Barbed Wire	C/P	Chestnut Paling	P/R	Post & Rail
C/B	Close Boarded	I/R	Iron Railing	P/S	Palisade
C/I	Corrugated Iron	I/W	Interwoven	P/W	Post & Wire
C/L	Chainlink	P/A	Panel Fencing		

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - FOR EXAMPLE - WALL 1.35

SURVEYED BY:-

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SURVEYORS

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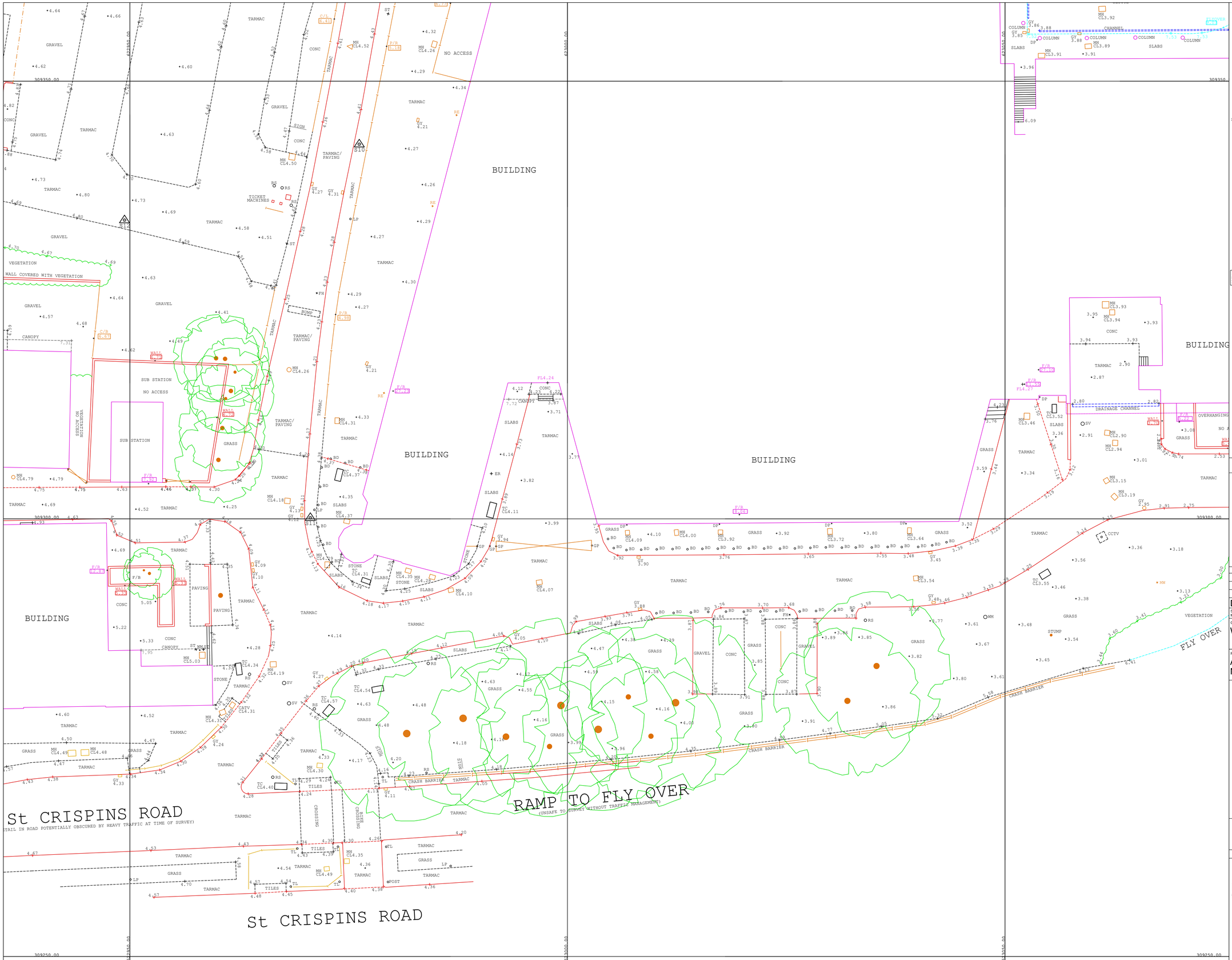

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SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES
TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
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N
Grid North

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B	TOPO AREA EXTENDED 31/05/2022
C	

Drawing No: SJG2136 — Revision B — Sheet 8/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:-
Weston Homes PLC

Scale:-
1:200

Project:-
Anglia Square,
Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
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LP	Lamp Post		

FENCE TYPES

B/W Barbed Wire	C/P Chestnut Paling	P/R Post & Rail
C/B Close Boarded	I/R Iron Railing	P/S Palisade
C/I Corrugated Iron	I/W Interwoven	P/W Post & Wire
C/L Chainlink	P/A Panel Fencing	

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE – FOR EXAMPLE WALL 4.39

SURVEYED BY:-

SJ GEOMATICS
SURVEYORS

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Suffolk
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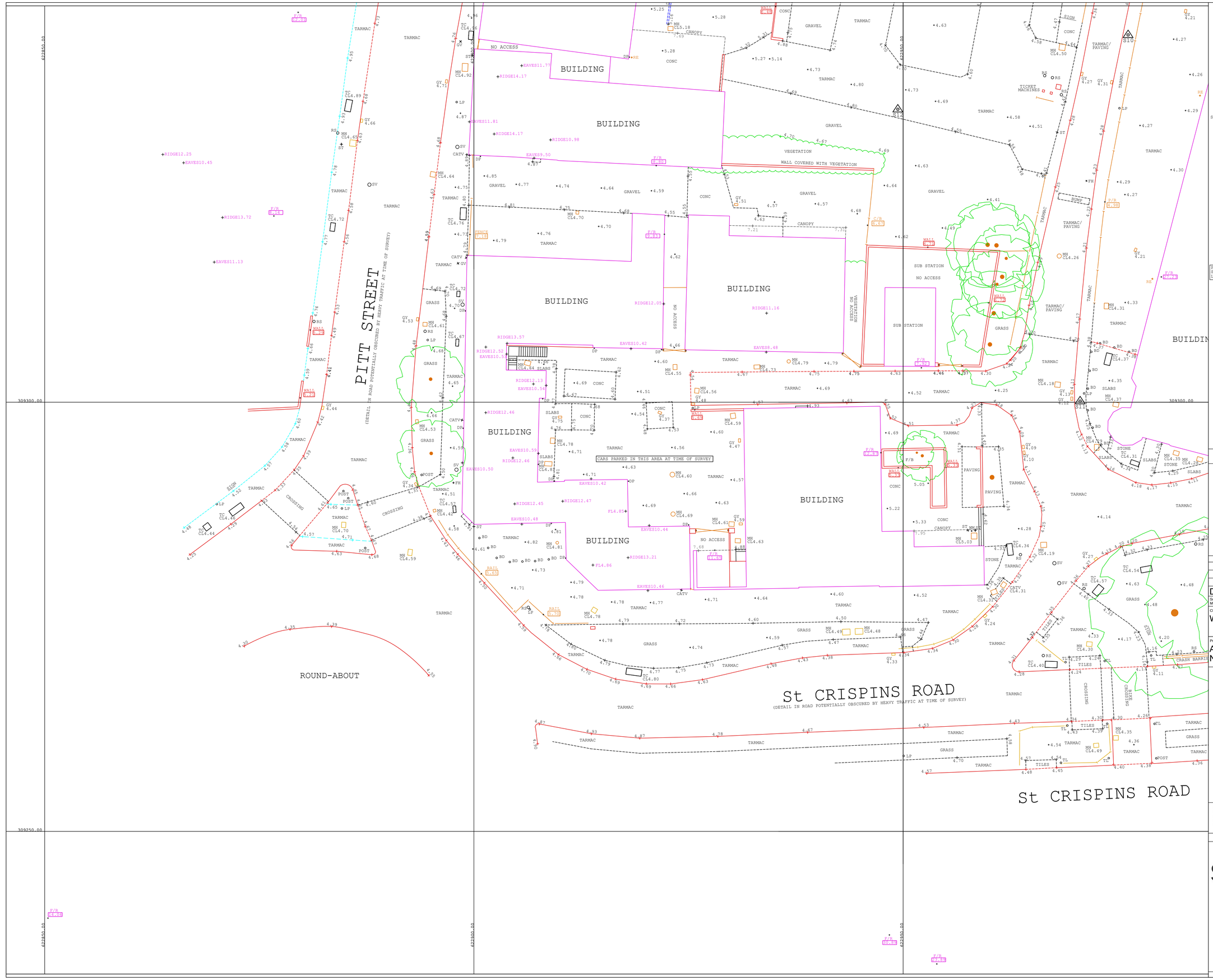
Company Registration Number 8081329



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SURVEY RELATED TO OSGB36(02) ORDNANCE SURVEY GRID CO-ORDINATES TRANSFORMED FROM ETRS89 USING GEIOD MODELS OSGM02/OSTN02

PLEASE NOTE:
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N
Grid North

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B	TOPO AREA EXTENDED 31/05/2022
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Drawing No: SJG2136 — Revision B — Sheet 9/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:- Weston Homes PLC

Scale:- 1:200

Project:- Anglia Square, Norwich

SYMBOLS

Banking, Hedge, Tree, Bush, Gate, O/H Electric, O/H Telecom, S1 Control Station

LEGEND

AV	Air Valve	MH	Manhole
BD	Bollard	MK	Marker
BH	Borehole	NP	Name Plate
CB	Cable Box	O/H	Overhead
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BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - EG EXAMPLE WALL 4.89

SURVEYED BY:-

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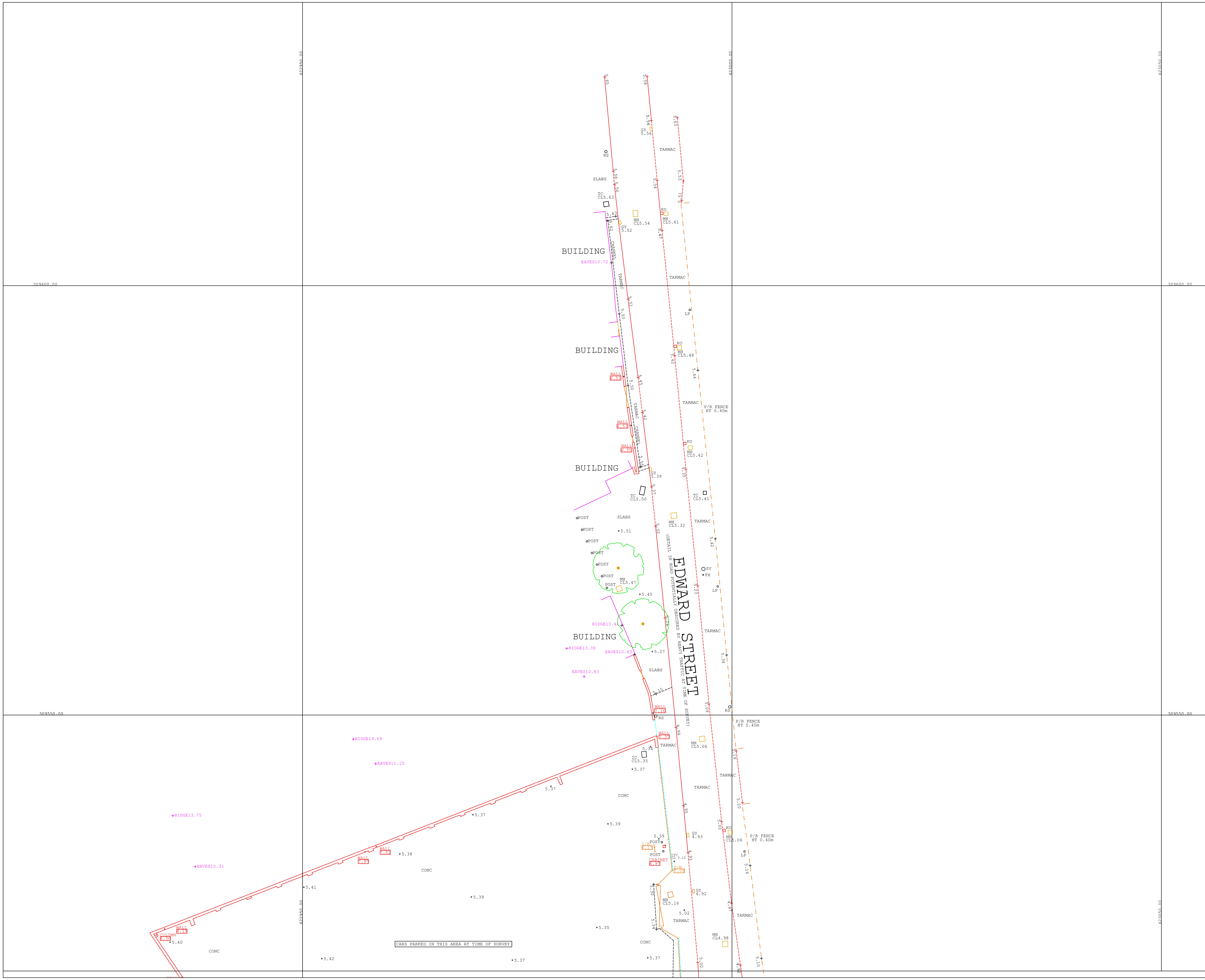

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N

Grid North

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B	TOPO AREA EXTENDED 31/05/2022
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Drawing No: SJG2136 — Revision: B — Sheet: 10/11

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
MS/GEA	MS/GEA	SJ	A1	30/09/2016

Client:- Weston Homes PLC

Scale:- 1:200

Project:- Anglia Square, Norwich

SYMBOLS

Banking
Hedge
Tree
Bush
Gate
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O/H Telecom
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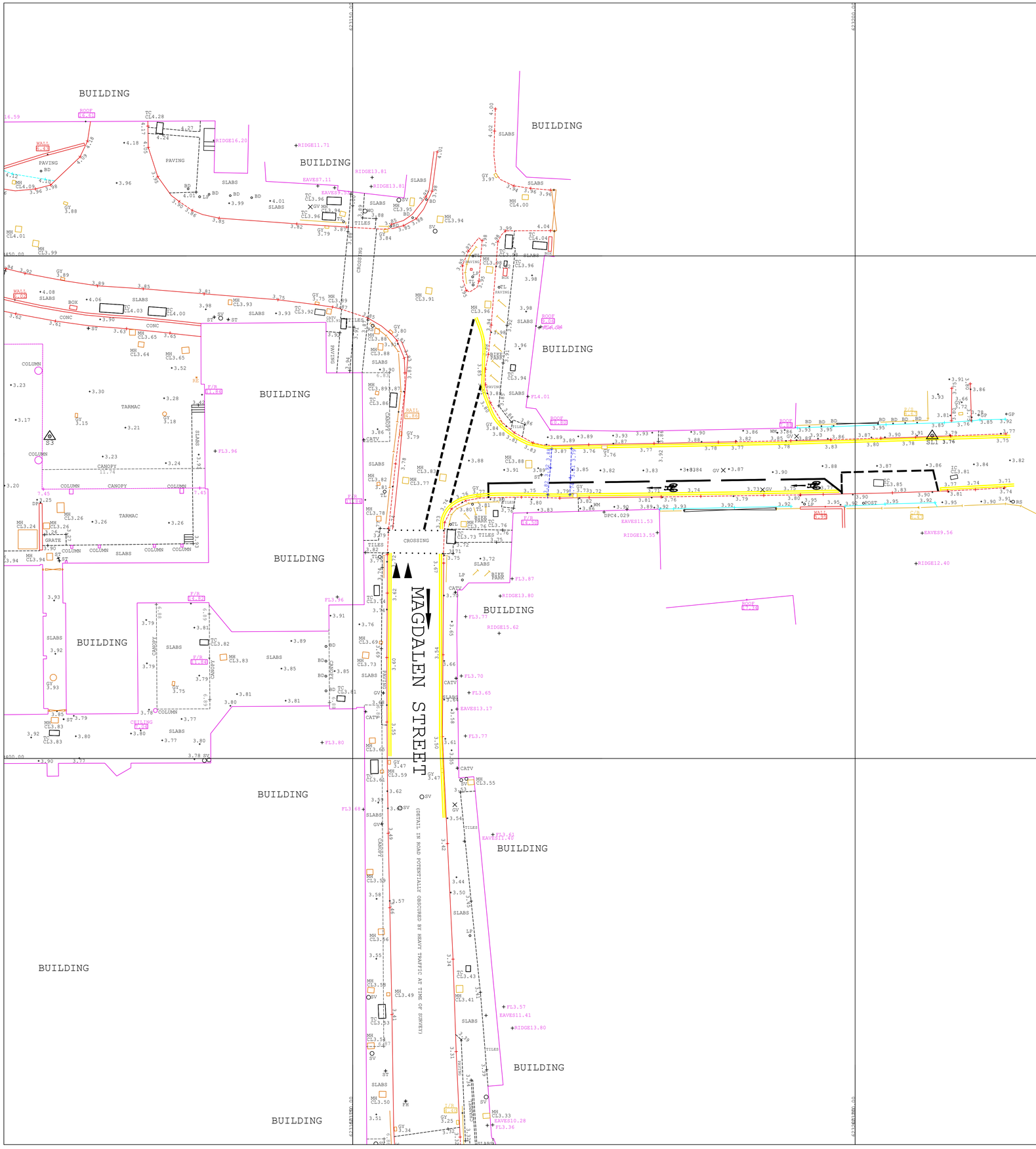

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N

Grid North

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Drawing No: SJG2136 — Revision B — Sheet 1 of 1

Surveyed By:-	Drawn By:-	Checked By:-	Sheet Size	Date
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Weston Homes PLC

Scale:- 1:200

Project:-
Anglia Square,
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IL	Invert Level	VP	Vent Pipe
JB	Junction Box	WL	Water Level
KO	Kerb Outlet	WM	Water Meter
LB	Letter Box	WO	Wash Out
LP	Lamp Post		

FENCE TYPES

B/W Barbed Wire	C/P Chestnut Paling	P/R Post & Rail
C/B Close Boarded	I/R Iron Railing	P/S Palisade
C/I Corrugated Iron	I/W Interwoven	P/W Post & Wire
C/L Chainlink	P/A Panel Fencing	

BOX AROUND LEVEL INDICATES LEVEL AT TOP OF FEATURE - FOR EXAMPLE 4.11

SURVEYED BY:-

SJ GEOMATICS SURVEYORS

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Appendix G Anglian Water Sewer Records