	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Newham Leisure Centre, N10.SA3**
Address	Newham Leisure Centre, Prince Regent Lane, E13 8
Area	7.74ha
Current land use	Leisure centre including a swimming pool, outdoor and indoor athletics tracks, studios, a gymnasium, a mixed-use games area, a sports hall, playing pitches, an outdoor football stadium and a car park.
Proposed land use	Residential, open space, childcare facility and leisure uses.
Flood Risk Vulnerability	Mixed - More vulnerable, less vulnerable and water compatible development.
Sources of flood risk	
Location of the site within the catchment	The site is located in the London Management Catchment. The catchment area is 1487km² and is very densely populated. The site lies approximately 1.8km east of the River Lea and 1.2km north of the River Thames. The site is located within a very urbanised part of the catchment. The site is located within the south of Plaistow. It comprises Newham Leisure Centre, Prince Regent Lane Playing Fields and Terrence MacMillan Stadium. The site is bordered by Prince Regent Lane and residential streets to the east. To the north, the site is bordered by the playing fields of Cumberland Community School. To the west the site is bordered by Gateway Surgical Centre and Newham Centre for Mental Health/The Coborn Centre for Adolescent Mental Health. To the south the site is bordered by Newham Way (A13).
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is comprised of predominantly open space, however the surrounding area is heavily urbanised and LiDAR data is unlikely to be representative of the actual topography, which may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found along parts of the site border and to the northern edge of the Prince Regent Lane Playing Fields at around 1.2m AOD. The rest of the site lies higher at around 1.8 to 2.1m AOD. The carpark lies at a lower elevation of between 1.6 and 1.7m AOD.
Existing drainage features	The site is located 1.7km east of the lower section of the River Lee, and approximately 2km north from the River Thames. There are no drainage ditches within the site. The site likely drains into the urban surface water sewer network.
Critical Drainage Area	The site is bordered to the south by Critical Drainage Area Group4_039. This is described as ponding at the A13 underpass beneath Prince Regent Lane (A112), Newham.
Fluvial and tidal	**The proportion of site at risk FMfP:** **FZ3 – 0%** **FZ2 – 81%** **FZ1 – 19%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at*

	flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The site is located within a Reduction of Flooding from Rivers and Sea due to Defences area. This means that the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.5% Max depth – 0.3–0.6m Max velocity – 0.25–0.5m/s **1% AEP** – 5.2% Max depth – 0.3–0.6m Max velocity – 0.25–0.5m/s **0.1% AEP** – 25.4% Max depth – 0.6-0.9m Max velocity – 1-2m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. In the 3.3% AEP event, surface water flooding only covers 1.5% of the site. Water ponds in a small area of the site in the carpark at the centre of the site. Flood depths are up to 0.6m, with the deepest depths at the centre of the ponding, where ground levels are slightly lower. velocities are <0.5m/s. The resulting flood hazard varies from "Very Low"/"Caution" to "Danger for Some". Flooding during the 1% AEP event covers 5.2% of the site. Ponding in the carpark area (at the centre of the site) increases. There is additional flooding along the eastern border of the site and in the north-eastern corner of the running track. Flood depths are up to 0.6m. Most of the flood depths are 0.15 to 0.3m with smaller areas of flooding up to 0.6m in the centre of the

	ponding. The water generally flows at <0.25m/s with smaller areas of 0.25 to 0.5m/s. Flood hazard during this event varies from "Very Low"/"Caution" to "Danger for Some". In the 0.1% AEP event, flooding covers 25.4% of the site. Again, ponding occurs in the carpark, around the running track, along the eastern border and additionally on the northern side of the football pitches. There is also a large area of ponding towards the north-eastern corner of the playing fields. Flood depths vary from 0.15 to 0.9m. Most of the flooding within the site is between 0.15 and 0.3m in depth with areas of deeper flooding at the centre of the ponding. The water generally flows at 0 to 0.25m/s with smaller areas with water moving at 0.25 to 0.5m/s and a very small area with water flowing at up to 2.00m/s. This area is the footpath between the carpark and the running track. Flood hazard during the event varies from "Very Low"/"Caution" to "Danger for Most".
Reservoir	The majority of the site is at risk of Dry Day reservoir flooding from the King George V and William Girling Reservoirs according to the Environment Agency's reservoir flood mapping. Both reservoirs are managed by Thames Water and are deemed as high-risk. During the Wet Day scenario, the entire site is at risk of flooding from the following reservoirs: Banbury, King George V, Lockwood and William Girling. The majority of the site (excluding the north-eastern border) is at risk of flooding from the following reservoirs in the Wet-Day scenario: High Maynard, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East and Wraybury. All of these reservoirs are owned by Thames Water and are all deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The southern half of the site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. The northern part of the site (where the running track is located) is shown to have a moderate risk of groundwater flooding in this area, and any groundwater flooding incidence has a 1% annual probability of occurrence. Further consideration of the local level of risk and mitigation is recommended.
Sewers	The site is located within two postcode areas. The E13 8 postcode has 293 and the E16 3 postcode has 206 incidences of sewer flooding according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets do not record any flooding within the site or surrounding area. Newham Borough Council's flood records show no flooding within the site. The nearest recorded flood incident occurred on Prince Regent Lane (approximately 40m west of the site) in 2012. This flooding is thought to have been caused by blocked road gullies and the maximum flood depth is thought to have been 100mm.
Flood risk management infrastructure	

Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within the site. The nearest flood defences are situated along both banks of Bow Creek (River Lee) approximately 1.75km west of the site. These consist of flood walls and embankments. The design standard of protection of these defences is 1000 years. The area is also protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal 2005 epoch event proportion of site at risk – 45.2%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 61.0%** The southern/western section of the site is flooded in the 2005 epoch 0.5% AEP Thames Upriver Tidal Breach event. Flood depths across these areas of the site vary up to 0.77m. Flooding is deepest where there are topographical lows in the site, mainly along the site border. The velocity of flooding is 0m/s. The flood hazard classification within the site varies from 'Very Low' to 'Danger for Most'. Flooding encroaches onto more of the site during the 2100 epoch 0.5% AEP Thames Upriver Tidal Breach event. It is predicted that this flooding will additionally affect the leisure centre building and parts of the running track. Flood depths across the site vary from 0.002 to 0.95m. The velocity of flooding is largely 0m/s with very small areas of velocities up to 0.75m/s along the southern site border. During this event, the flood hazard classification within the site varies from 'Very Low' to 'Danger for Most'. It is noted that LiDAR for the site and surrounding area may not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside of the flooded area may actually be at risk. Flood defences along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is believed to be very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of the development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The southern half of the site is located in an Environment Agency Flood Warning and Flood Alert area. It is located within the '063WAT233N Tidal Thames in the boroughs of Havering, Barking, Dagenham and Newham' Flood Alert Area. The southern half of the site is also located in the 'Tidal Thames at Mill Meads and East Plaistow' and 'Tidal Thames at Beckton' Flood Warning Areas.
Access and egress	Vehicular and pedestrian access and egress to the site is currently via Prince Regent Lane to the west. There is additional pedestrian access via a walkway over Newham Way. According to the Newham Draft Local Plan (2022) additional pedestrian and vehicular access to the site from the north via

	Bennet Road and Maybury Road is proposed. Pedestrian access via a cycle path to the south-east is also proposed. Safe access and egress is possible via Maybury Road, then travelling north on Prince Regent Lane during the 2005 (present day) epoch and 2100 (climate change) epoch Thames Tidal breach events. The hazard classification along Maybury Road during both epoch tidal breach events is 'Very Low'. Maybury Road can be used to travel north and out of the flood extent. During the 3.3% AEP surface water event, access and egress is possible via all previously mentioned routes. However, there is some ponding, of approximately 150m in length, directly north of the site access and egress point on Prince Regent Lane. This flooding is at depths of between 0.15 and 0.6m, with the majority of flooding moving at a velocity of 0 to 0.25m/s. This flooding has a hazard rating of up to 'Danger for Most'. It is likely that vehicular access and egress may be possible during this event. During the 1% AEP event, the aforementioned ponding on Prince Regent Lane increases in size. Vehicular and pedestrian access and egress via Maybury/Bennett Road, travelling north along Prince Regent Lane may be possible during this event. During the 0.1% AEP event, there is further ponding on Prince Regent Lane with depths of up to 1.2m. Flood water moves at a speed of up to 2.0m/s and the resulting hazard rating is 'Danger for Most' in large parts of the road. Flooding also increases on Bennett and Maybury Road. The hazard classification on Maybury Road is largely "Very Low". Therefore, vehicular and pedestrian access and egress via Maybury Road, then travelling north along Prince Regent Lane, may be possible in this event. During the surface water 1% AEP plus 40% allowance for climate change (design) event, the extent, velocity and hazard rating of flooding is similar to the 0.1% AEP event. Flood hazard rating along Maybury Road is largely 'Very Low'. Therefore, access and egress via Maybury Road, travelling north along Prince Regent Lane may be possible during the event.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** In comparison to the 2005 epoch Thames Tidal Upriver 0.5% AEP event, during the 2100 epoch 0.5% AEP event, there is further flooding to the east and north of the site. The amount of flooding with a hazard rating 'Danger for Most' increases, and flood depths and velocities also increase. The 2100 epoch Thames Tidal Upriver 0.5% AEP event encroaches onto 60.97% of the site. Flooding mostly affects the southern half of the site but there is also some flooding to the northern half. Flood depths range from 0.02 to 0.89m and flood hazard rating ranges from 'Very Low' to 'Danger for Most'. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario.

	In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. Ponding increases in the southern half of the site and also around the running track in the northern half of the site. Flood depths remain largely the same as the 1% AEP event. In one small area, depths increase from around 0 to 0.6m (1% AEP event) to 0.65m in the 1% AEP +40% climate chance event. This shows that the site is somewhat sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand). This is sedimentary bedrock.
	  ○ Superficial – The superficial geology of the southern half of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	  ○ Superficial geology in the northern tip of the site is Taplow Gravel Member (sand and gravel) which is a sedimentary superficial deposit.
	• Soils at the site consist of:
	  ○ In the southern half of the site: Loamy and clayey soils of coastal flats with naturally high groundwater.
	  ○ In the northern tip of the site: Loamy soils with naturally high groundwater.
	
	SuDS
	• The southern half of the site is shown to have negligible risk of groundwater flooding. The northern part of the site (where the running track is located) is shown to have a moderate risk of groundwater flooding. This should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt and sand with superficial deposits also containing peat and gravel. This ground is likely to have highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone.
	• The site has areas within its boundary designated by the Environment Agency as being a historic landfill site. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.

	- The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP +40% climate change event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. - If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner. - Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. - Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
Opportunities for wider sustainability benefits and integrated flood risk management	- Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. - Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. - Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. - SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential institutions including childcare facilities as 'More Vulnerable' development. Leisure uses are classed as 'less vulnerable development,' and open space as 'water compatible development.' As there are several flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 2, and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. - Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. - At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2005 epoch 0.5% AEP breach event and the 2100 epoch 0.5% AEP and 0.1% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events.

	- As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. - Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. - All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. - Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. - Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. - Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. **Guidance for site design and making development safe:** - The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). - Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures. - The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. - Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. - Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. - Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. - Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor

levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
    - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
- The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
- The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
- London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2, it at risk of flooding during the 3.3%, 1% and 0.1% AEP surface water food events and is at risk of flooding if there Thames was to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'More Vulnerable' development, like residential, proposed within Flood Zone 2 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, 1% AEP fluvial and the 1% AEP surface water event, including an allowance for climate change. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are test to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping. Modelled tidal breach flood extents have been taken from the Environment Agency's Thames Estuary Upriver Breach Assessment model.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial depth, velocity and hazard mapping	Tidal - This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

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Site details	
Site Code	**N2.SA1**
Address	North Woolwich Gateway, Pier Road, North Woolwich, E16 2
Area	2.46ha
Current land use	Former railway station last used as a museum, and vacant brownfield land.
Proposed land use	Residential, employment, community facilities and open space.
Flood Risk Vulnerability	Mixed – 'More vulnerable,' 'Less Vulnerable' and 'Water Compatible'
Sources of flood risk	
Location of the site within the catchment	The site is located within North Woolwich to the south-east of Newham. The site is bounded by the River Thames to the south and the A117 Pier Road/ Dockland Light Railway (DLR) line to the north-east. The west of the site is bounded by industrial buildings, including the Store Road Pumping Station, which are accessed via Store Road. There are a number of transport infrastructure services within the site. This includes the north entrance of the Woolwich foot tunnel, and adjacent to the southern site boundary, the A117 Pier Road runs from east to west within the site. The North Woolwich terminal of the Woolwich Ferry service is located approximately 80m south of the site. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is adjacent to the River Thames and is 300m south of the King George V Dock (as part of the Royal Docks). The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations vary between 1.75 and 5.34mAOD. The southern half of the site has a significantly higher elevation, as the land surrounding Pier Road has been raised to between 4.20 and 5.34mAOD. The elevations across the rest of the site are significantly lower, with the gently site sloping downwards to the north west with a gradient under 2%. The lowest elevations within the site (1.75mAOD) is found in the north western tip of the site.
Existing drainage features	The site is located approximately 3m north of the River Thames. The King George V Dock (part of the Royal Docks) is approximately 300m north of the site. No drainage ditches or ordinary watercourses are found within the site.
Critical Drainage Area	The site is not located within a CDA.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** Almost the entire site is located within the Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the southern-most edge of the site, bordering the River Thames. This means the site benefits from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.0% **1% AEP** – 0.4% Max depth – 0.15-0.30m Max velocity – 0.25-0.50m/s **0.1% AEP** – 9.0% Max depth – 0.3-0.6m Max velocity – 0.50-1.00m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 0.8% Max depth – 0.27m Max velocity – 0.09m/s **1% AEP** – 0.8% Max depth – 0.27m Max velocity – 0.09m/s **0.1% AEP** – 4.3% Max depth – 0.32m Max velocity – 0.16m/s

	The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %). *The Silvertown ICM surface water model was used in the assessment of surface water flooding.* *Where ICM modelling is available, this modelling is more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset.* **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding only covers just 0.8% of the site. This floodwater is concentrated as a small area of surface water pooling to the south-west of the site, located just to the north of Pier Road. This flooding has a relatively shallow depth (0.27m maximum depth) and slow velocity (0.09m/s maximum velocity), with associated hazard rated as 'very low' or 'danger for some.' In the 1.0% AEP event, surface water flooding across the site is almost identical to the 3.3% AEP event, with similar flood depths, velocities and associated hazard ratings. In the 0.1% AEP event, surface water flooding occurs over a slightly larger proportion of the site (equivalent to 4.3% of the total site area). During this event, floodwater pools across four separate isolated ponds across the site. Three of these pools are located to the south-west of the site surrounding Pier Road, and one within a car park to the north of the site. This flooding has a depth of 0.32m, with a maximum velocity of 0.16m/s, and associated hazard rated as 'very low' or 'danger for some.'
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the north western corner of the site is at risk of flooding during the 'dry day' reservoir flood. This risk is posed by the William Girling Reservoir, which is managed by Thames Water. During the 'wet day' scenario, the entire site is at risk from the following reservoirs: King George V, Lockwood and William Girling. The majority of the site – almost all the site except Pier Road to the south east of the site – is at risk of flooding from the Banbury reservoir. Additionally, the north-west corner of the site is at risk from the Walthamstow No.4 and Walthamstow No.5. reservoirs. All of these reservoirs are managed by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The majority of the site is classed as having a 'low' risk of groundwater flooding, with any groundwater flooding incidence having a chance of greater than 1% annual probability of occurrence. A small portion of the south of the site parallel to the River Thames is classed as having a negligible risk of groundwater flooding, so any groundwater flooding incidence has a less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Sewers	The site is located within a postcode area with 94 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Recorded Flood Outlines dataset, there has been one recorded incident of flooding within the site. This occurred in January 1928, and occurred due to the overtopping of the River Thames defences which were in place at the time. This flooding was concentrated to the south of the site surrounding the A117 Pier Road. It is unknown how many properties were affected by this flooding. Please note that since this flood event occurred, there have been several changes to site topography and upgrades to flood defences surrounding the River Thames. According to the London Borough of Newham's historic flood incident database, have been no recorded flooding incidents within the site itself.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal flood gates and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 99.4%** **0.5% AEP tidal 2115 epoch event proportion of site at risk – 99.4%** **0.1% AEP tidal present day epoch event proportion of site at risk – 99.4%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 99.4%** The site is almost entirely flooded during the present day 0.5% AEP Thames Tidal Breach event (99.4% flooded). Flood depths across the site extend to a maximum of 2.36m, with flood depths highest to the north of the site, corresponding with the topographically lowest area within the site. Floodwater velocities are most rapid, extending up to 3.25m/s parallel to the north-east site boundary, with water funnelling along the existing DLR railway line. However, floodwater velocities across the centre of the site are still reasonable fast, with velocities of at least 1.0m/s. The resulting flood hazard classification varies from 'Very low' to 'danger for all.' Flood hazard is rated as 'danger for all' adjacent to the north-eastern and southern site boundaries, and 'danger for most' across the centre of the site. Flood hazard is rated as either 'danger for some' or 'very low' for a small area of the site located to the north of Pier Road. It is noted that Lidar for the site will likely not accurately represent the topography, and it is likely that some areas identified as being at higher elevation may actually be at a higher risk of flooding. During the present day 0.1% AEP Thames Tidal Breach event (99.4%), flood depths and velocities now extend to 2.51m and 3.37m/s. Flood hazard during this event is rated as 'danger for all' across a greater proportion of the site relative to the 0.5% AEP present day event.

	The site is almost entirely located within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within Environment Agency flood warning area (063FWT23RDockA) which extends around River Thames from the Beckton Sewage works to the River Lea. There are also two Environment Agency flood alert areas located within the site. The entire site is located within Environment Agency flood alert area 063WAT233N, which extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham. Additionally, the southern half of the site is located in flood alert area 063WAT23East surrounding the River Thames riverside from Dartford Creek and The Mardyke to the Thames Barrier.
Access and egress	Access and egress to the site is currently possible via a number of routes. The site can be exited to the west along the A117 Pier Road, and then onto Henley Road and Factory Road. The site can also be exited to the north, again along the A117 Pier Road. Careful consideration of safe access and egress will be needed for this site. Safe access and egress is shown to be affected during all modelled tidal breach events in the present day epoch and the 2115 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site, resulting in a flood hazard of 'Danger for All' at all roads. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. During the 0.5% AEP present day Thames tidal breach, flood extents cover the entire site and surrounding access roads. Flood hazard along these roads is classed as 'danger for all.' Vehicular access to the site using these roads would be extremely challenging. Additionally, the surface water 1% AEP plus 40% allowance for climate change flood event impacts access and egress routes from the site. Site exit to the west via Factory Road would be extremely challenging, with flood depths up to 0.6m and associated flood hazard along this road classed as 'danger for most.' However, site exit to the north via Pier Road and then east onto Albert Road would still possible as there is limited flooding along these roads. Maximum flood depths on these roads is 0.34m, with associated flood hazard classed as either 'very low' or 'danger for some.' Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.

Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment.** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The site is also almost entirely flooded during the 0.5% 2100 tidal Thames flood (99.4% inundated). Flooding patterns within the site are broadly similar to the 0.5% AEP present day tidal Thames flood event, although flood depths now extend to 3.09m, and flood velocities up to 3.71m/s. Almost the entire site is classed as 'danger for all,' except an area in the centre of the site adjacent to Pier Road, which is now classed as either 'danger for some' or 'danger for most.' During the 0.1% AEP 2115 epoch Thames tidal flood, the same proportion of the site is inundated (99.4% inundation) but hazard now extends to 'danger for all' for almost the entire site. Due to the increase in flood depths and velocities, the site is sensitive to increases in flooding from the tidal Thames due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Silvertown ICM surface water model to indicate the impact of climate change on pluvial flood risk. The 1% AEP plus 40% climate change allowance corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. With approximately 3% of the site flooding, flood extents during the 1% AEP plus 40% climate change surface water event are marginally more extensive than the 1% AEP present day event. However, flood extents are not as widespread as the 0.1% AEP present day event. Associated flood depth and velocities are during the 1% AEP plus 40% climate change surface water event are still broadly similar to the 1% AEP event, with hazard remaining as either 'very low' or 'danger for some.' Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is defined as Lewes nodular, Seaford and Newhaven chalk formation. Chalk is permeable and allows for the storage and movement of groundwater.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS

	- The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. - BGS data indicates that the underlying geology is chalk which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. - The site is not located within a historic landfill or a nitrate vulnerable zone. - The entire site is located within a principal bedrock, and Secondary (undifferentiated) superficial deposit aquifer designation zones. - The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. - Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. - The site is located approximately 200m east of the Henley Road sewer discharge outfall (owned by Thames Water). Outfalls discharging surface water from the site to the River Thames or another watercourse will need early consultation with Thames Water in order to meet the requirements set out by the Thames Water DWMP. The condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	- Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. - Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. - Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. - Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. - The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as ‘More Vulnerable’ and employment and industrial development as ‘Less Vulnerable’. Open space is classed as ‘water compatible development.’ As there are different flood risk

	vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable). **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).

- London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
- Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
    - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
- The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
- The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

	• As this development (including redevelopment of existing buildings and sites) is adjacent to a main river (River Thames), a buffer strip of 8m is required from the toe of any Main River and 16m from tidal defence structures, taking into account the requirements set by the Flood Risk Activities: Environmental Permits guidance (and any subsequent updates). Where flood defences are present, as relevant for this site, these distances should be taken from the toe of the defence.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water event, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- As this development (including redevelopment of existing buildings and sites) is adjacent to a main river (River Thames), a buffer strip of 8m is required from the toe of any Main River and 16m from tidal defence structures, taking into account the requirements set by the Flood Risk Activities: Environmental Permits guidance (and any subsequent updates). Where flood defences are present, these distances should be taken from the toe of the defence.

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Silvertown ICM Surface Water Model and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.
Tidal extents, depth, velocity	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.

and hazard mapping	
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables

Site details

Site Code	**Parcelforce, N7.SA2**
Address	Land at Stephenson Street and Bromley by Bow Gasholders, Three Mills, E3 3.
Area	19.97ha
Current land use	Essential utility infrastructure (natural gas supply station), residential dwellings, vacant industrial and employment.
Proposed land use	Residential, employment uses, community facilities (if needed), health centre, education uses, town centre uses and open space.
Flood Risk Vulnerability	Mixed – essential infrastructure, more vulnerable, less vulnerable and water compatible.

Sources of flood risk

Location of the site within the catchment	The site is located within the Three Mills neighbourhood, and includes the former Bromley-by-Bow gasworks. The western site boundary is parallel to the River Lea (Bow Creek). The northern site boundary is adjacent to the London Tilbury and Southend Railway and London Underground (District and Hammersmith and City) lines, and eastern site boundary parallel to the Docklands Light Railway (DLR) and Jubilee lines (including the West Ham DLR station). The south of the site is bounded by Twelvetrees Crescent and the Canning Town Business Park. There is a Pressure Reduction Station to the south-west of the site, which is the only operational part of the Bromley-by-Bow gasworks. This part of the site is currently used for the supply of natural gas to homes and businesses in the area. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is adjacent to the Rivers Lee and Thames, and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations vary between -0.39 to 9.57mAOD. Site elevations are significantly greater (> 4.52mAOD) in the western half of the site associated with the former Bromley-by-Bow gasworks. To the east of the site (including the Twelvetrees Crescent/ Crows Road), site elevations are generally lower (below 3.0mAOD) although there are some isolated areas of raised ground. The lowest site elevations (below 1.0mAOD) are located to the northern boundary and north-east of the site, where the minimum the minimum site elevation of -0.39mAOD is located.
Existing drainage features	The site is boarded by the River Lee (Bow Creek) to the west, which converges with the River Thames approximately 2.5km south of the site. Additionally, approximately 50m north of the site are the Three Mills Rivers (including Abbey Creek, the Channelsea River, Prescott Channel and Three Mills River). There are no other identified main rivers or ordinary watercourses within, and in the vicinity of the site.

Critical Drainage Area	The site is not located within a Critical Drainage Area (CDA). However, the eastern site boundary is adjacent to the CDA 'Group4_031' which covers the Jubilee Line at West Ham Station.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 15%** **FZ2 – 43%** **FZ1 – 57%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames and Lee are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. This site is parallel to the River Lee. However, the River Lee remains in bank adjacent to the site for all modelled defended flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. **Flood characteristics:** The east of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area, including Crows Road and a portion of Twelve Trees Park. This means that the east of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% and 0.1% AEP modelled events.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.8% Max depth – 0.6-0.9m Max velocity – 0.25-0.5m/s **1% AEP** – 2.8% Max depth – >1.2m Max velocity – 0.5-1.0m/s **0.1% AEP** – 17.2% Max depth – >1.2m Max velocity – 1.0-2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, there is negligible surface water flooding (0.8%) across the site, occurring as isolated surface water ponding around Twelvetrees Crescent/ Crows Road and across the eastern half of the site. Flood depths and velocities are generally below 0.30m and 0.25m/s, with associated hazard rated as either 'very low' or 'danger for some.' However, there is one surface water pool to the north of the site on Crows Road, where flood depths extend between 0.6-0.9m, with velocities extending between 0.35-0.50m/s. The hazard of this surface water pool is rated as 'danger for most.' During the 1% AEP event, there is slightly more surface water flooding (2.8%) across the site. This flooding is again concentrated to the centre and east of the site, although there is a surface water pool within the Pressure Reduction System to the south-west of the site. Flood depths, velocities and hazard ratings are broadly similar to the 3.3% AEP event. However, flood depths on the surface water pool to the north of the site on Crows Road now extend above 1.2m, with the pool still rated as 'danger for most.' Finally, during the 0.1% AEP event, there is considerably more surface water flooding (17.2%) across the site. This includes a surface flow path travelling in a northwards direction along Twelvetrees Crescent/ Crow Road, alongside large surface water pools to the north-east and south-east of the site where the lowest site elevations are located. There is also some isolated surface water ponding to the west of the site, notably surrounding the gasholders for the former Bromley-by-Bow Gasworks. Flood depths and velocities during this event are still reasonably shallow at a gradual velocity, generally between 0.3-0.6m and under 0.25m/s. However, in some places, notably Crow Road, flood depths extend above 1.2m, with associated velocities between 1.0-2.0m/s. Flood depths across the majority of the site are classed between 'very low' and 'danger for most,' although this extends to 'danger for all' where the deepest and fastest flooding is located.
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, during the 'dry day' flood, five different reservoirs flood the site. The Banbury, High Maynard and Lockwood Reservoirs flood the north-eastern corner and eastern fringes of the site. Additionally, the King George V and William Girling reservoirs flood the majority of the eastern half of the site, including Twelvetrees Crescent and Crows Road. All of these reservoirs are managed by Thames Water.

	Alternatively, during the 'wet day' flood, the site is inundated by 11 reservoirs. Almost the entire site (except some raised ground to the west of the site parallel to the River Lea) is inundated by the following reservoirs: Banbury, King George V, Lockwood and William Girling reservoirs. Additionally, the eastern half of the site (including Twelvetrees Crescent and Crows Road) is flooded by the following reservoirs: High Maynard, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, West Warwick and Wraysbury. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The Thames Water Hydraulic Sewer Flood Risk Register has not provided any sewer flooding data for the E3 3 postcode area. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's recorded flood outlines, there was minor flooding to the west of the site parallel to the River Lea (Bow Creek) in September 1947. According to the London Borough of Newham Flood Incident database, there are no recorded incidents of flooding within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 46.9%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 78.5%** During the 0.5% AEP tidal present day flood event, approximately 46.9% of the site is inundated. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. This flooding is concentrated in the eastern half of the site, including the Twelvetrees Crescent/ Crows Road, as well as the south-western corner of the site within the Bromley-by-Bow Pressure Reduction System. Flood depths across the site during this event are generally below 0.3m, although extend to 0.65m in the low-lying areas within the site. Flood velocities within the site are also generally below 0.5m/s across most of the site. However, flood depths extend to 2.6m and velocities to 2.3m/s

	at the northern-most end of Crows Road. Associated flood hazard across the site is rated between 'very low' and 'danger for some,' with hazard rated as 'danger for all' at the northern-most end of Crows Road. A larger portion of the site (78.5%) is located within the 2100 epoch 0.5% AEP event Thames tidal downriver breach extent. This is described in the climate change section below. Flood defence structures along the Lee and Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. The eastern half of the site, and area parallel to the River Lee, is located in Environment Agency Flood Alert Area 063WAT233N for flooding from the Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham. The western edge of the site which also borders the River Lee is also located within Environment Agency Flood Alert Areas 062WAF53 for flooding along Lower River Lee from Hoddesdon to Canning Town and 063WAT23Central for flooding at the tidal Thames riverside from the Thames Barrier to Putney Bridge. Additionally, the site is located across two different Environment Agency Flood Warning Areas. The eastern half of the site, as well as the western fringes of the site parallel to the River Lee, is located in Flood Warning Area 063FWTRDockC for the Tidal Thames at Mill Meads and East Plaistow. Additionally, a small portion of the west of the site, adjacent to the River Lee, is within Flood Warning area 062FWB53TidalLee covering the Lower Lee from West Ham to Canning Town.
Access and egress	There are currently no public access and egress routes into the site as Twelvetrees Road/ Crows Road are private roads where access is managed. However, it is assumed that planned site access will be via North Crescent onto Cody Road, and then travelling eastwards. Safe access and egress will be an important consideration for this site. During the 0.5% AEP 2115 Thames tidal breach, the safe access and egress route from the site is impacted. There is flooding on North Crescent up to 0.54m, extending to 0.95m on Cody Road. Associated flood hazard is classed as either 'danger for some' or 'danger for most' on these roads. Therefore, providing safe access and egress during this event would be extremely challenging. Safe access and egress is not impacted by River Lee flooding. Although the site is adjacent to the River Lee, the River Lee remains in bank adjacent to the site and associated access roads for all modelled defended flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. Finally, during the 1% AEP plus 40% climate change surface water event, there is flooding on both North Crescent and Cody Road. This is to a depth of 0.32m on North Crescent, stretching to 1.0m on Cody Road. Associated flood hazard is rated between 'danger for some' and 'danger for most.' Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance

	for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Fluvial** As the development includes 'Essential Infrastructure' the higher central climate change allowance should be assessed. According to the River Lee hydraulic model, the site is not at an increased risk of fluvial flooding during the 3.3% AEP +27% climate change (higher central allowance), 1% AEP + 27% climate change and 0.5% AEP + 27% climate change as these extents remain in bank and do not enter the site. **Tidal Breaches:** During the 0.5% AEP tidal 2100 epoch flood event, a greater portion of the site (78.5%) is inundated relative to the present day flood event. There is now flooding across the majority of the west of the site. Flood depths during this event are generally below 1.1m across the majority of the site, although extend to 3.1m on the northern end of Crows Road, and up to 5.5m at a topographic low point to the west of the site, adjacent to the Bromley-by-Bow Gasworks former No.2. gasholder. Flood velocities within the site are generally beneath 0.6m/s, although extend to 3.9m/s to the north of the site adjacent to Crows Road. During the 0.5% AEP tidal present day flood event, approximately 46.9% of the site is inundated. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. This flooding is concentrated in the eastern half of the site, including the Twelvetrees Crescent/ Crows Road, as well as the south-western corner of the site within the Bromley-by-Bow Pressure Reduction System. Associated flood hazard varies across the site. The west of the site is generally rated as 'very low' or 'danger for some' and the east of the site as 'danger for most' and some isolated areas. However, hazard is rated as 'danger for all' at the northern end of Crows Road, adjacent to the West Ham DLR station, parallel to the River Lee and adjacent to the No.2. gasholder in the Bromley-by-Bow gasworks. The site is therefore very sensitive to increases in flooding caused by tidal breaches due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to (although not as extensive as) the 0.1% AEP event. The flooding extends

	further into the low-lying areas in the north-east and south-east of the site. Maximum flood depths also increase from around 0.6 to 0.9m (1% AEP event) to around 2.6m in the 1% plus 40% climate change event. Associated flood hazard across the site is generally rated as either 'very low' or 'danger for some,' extending to 'danger for most' or 'danger for all' where the greatest depths and velocities are located. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology across the majority of the site is London Clay Formation (clay, silt and sand), which is a sedimentary bedrock. The geology in the north-western corner of the site is Lambeth Group (clay, silt and sand) which is also a sedimentary bedrock.
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	
	• The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone (NVZ).
	• The majority of the site is located within unproductive bedrock, with the north-western corner of the site identified as a Secondary A bedrock aquifer designation zone. The entire site is a secondary (undifferentiated) superficial deposit aquifer designation zone.
	• The site is not located within a historic landfill.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset

	should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies 'essential transport infrastructure' as essential infrastructure. Additionally, residential development, educational uses and health centres are classed as 'More Vulnerable' development. Employment uses and non-residential institutions (which are not health centres, educational or nursery establishments) are classed as 'Less Vulnerable.' Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, Canal and Rivers Trust and the Environment Agency should be undertaken at an early stage. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lee. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part

	of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 epoch 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe :** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard

	outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g., raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at Leest 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at Leest 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at Leest 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, pLeese refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model, the Silvertown ICM Surface Water model, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk. This fluvial climate change allowances have been assessed using the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	Fluvial - This has been assessed using the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal breach – This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map and Silvertown ICM Surface Water model (2015) has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Pudding Mill, N8.SA9**
Address	Land to the south of Queen Elizabeth Olympic Park, E15 2.
Area	15.26ha
Current land use	Mixed use including Pudding Mill Docklands Light Railway (DLR) station.
Proposed land use	Residential, health centre, employment, community uses, town centre uses and open space.
Flood Risk Vulnerability	Mixed – Essential Infrastructure, More Vulnerable, Less Vulnerable and Water Compatible development.
Sources of flood risk	
Location of the site within the catchment	The site is located within Stratford and borders the DLR line to the north and the River Lee to the west. City Mill River flows along the site's eastern boundary whilst Bow Back Creek flows to the south. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site's western boundary borders the River Lee. The southern and eastern boundaries border the Bow Back Creek and City Mill River, respectively, both of which converge with the River Lee in the site's site-western corner. The site is also situated approximately 3.2km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that most of the topography is relatively consistent. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. Despite the majority of the site being relatively flat, the lowest elevations are located along Cook's Road and the northern part of Marshgate Lane, ranging between 2.58 to 3.57m AOD. The north-western corner has slightly higher elevations of approximately 5.53m AOD. The highest elevations are situated along most of the northern boundary of the site which range from 7.45 to 10.72m AOD.
Existing drainage features	The site's western boundary borders the River Lee. The southern and eastern boundaries border the Bow Back Creek and City Mill River, respectively, both of which converge with the River Lee in the site's south-western corner. Land adjacent to these watercourses slopes down towards them, potentially acting as drainage ditches. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 92%** **FZ2 – 99%** **FZ1 – 1%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2*

	includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Defended model outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. This site is parallel to the River Lee. However, the River Lee remains in bank adjacent to the site for all modelled defended flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent are the northern boundary and a small area within the west of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the defended 3.3%, 1%, 0.5% and 0.1% AEP modelled events. The nearest modelled fluvial flood extent is located approximately 15m north of the site along the Greenway Link footpath during the 1%, 0.5% and 0.1% AEP modelled fluvial events. During the 1% AEP event, maximum flood depths reach 2.0m whilst depths during the 0.5% AEP event reach 2.2m and the 0.1% AEP event depths reach 2.4m. Maximum velocities during the 1% AEP event are 1.3m/s whilst during the 0.1% AEP event, velocities reach 1.5m/s. The resulting flood hazard during both the 1% and 0.1% AEP event varies greatly from 'Very Low' to 'Danger for All'.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.9% Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s **1% AEP** – 3.0% Max depth – >1.2m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 14.5% Max depth – >1.2m

	Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 3.3%, 1% and 0.1% AEP events. The 3.3% AEP surface water event covers 0.9% of the site. The flooding only produces small areas of ponding across the site including along Marshgate Lane, Cooks Road and the Crossrail Pudding Mill substation. Flood depths vary from 0 to 0.9m, with the deepest located towards the northern tip of the site along Marshgate Lane. The water flows at 0 to 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most'. The 1% AEP event surface water covers 3.0% of the site. The flooding produces more areas of ponding than the 3.3% AEP event across the site, with the ponding in Cook's Road extending further along this street into Barbers Road. Flood depths vary from 0 to >1.2m, with the deepest located towards the northern tip of the site along Marshgate Lane. The water flows at 0 to 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most'. The 0.1% AEP event surface water covers 14.5% of the site. In this event the aforementioned areas of ponding further extends into the site from the 1% AEP outline. Ponding along Marshgate Lane connects to form a flow path which crosses the DLR line and extends almost the entire width of the site. The ponding along Cook's Road and Barbers Road also forms a flow path, however this flow path remains along these streets and does not join any other nearby flow path. Ponding is more pronounced within this AEP event with the majority of roads and infrastructure being affected by some degree of ponding. The three adjacent watercourses to the site have water channelled into their banks due to low topography. These watercourses border the south, west and east of the site. Flood depths vary greatly from <0.15 to >1.2m. Most of the flood depths are 0.15 to 0.6m, with smaller areas of >1.2m situated along Marshgate Lane and several small areas of ponding including along Barbers Road, Pudding Mill Lane station and Crossrail Pudding Mill substation. Flood water flows at around 0 to 0.5m/s across most of the site, with smaller areas where it flows around 0.5 to 2.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where the lowest elevations are located along Barbers Road, Cook's Road and Marshgate Lane, there are areas of 'Danger for Most'.
Reservoir	The entirety of the site, excluding small isolated areas across the site, is at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. This risk is posed by the William Girling and King George V reservoirs, both of which are managed by Thames Water Limited and are deemed as high-risk. There are several other reservoirs which affect the site during the Dry Day reservoir flood extent. However, these only extend along the site's southern, western and eastern boundaries with one section of flooding encroaching approximately 50m into the site from the eastern boundary. These reservoirs are West Warwick, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Lockwood, High Maynard and Banbury. These reservoirs are all managed by Thames Water and are deemed as high-risk. The entirety of the site, excluding small isolated areas across the site, is at risk of Wet Day reservoir flooding from the following reservoirs: Wraysbury, William Girling, West Warwick, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Stoke Newington (East), Stoke Newington (West), Queen Elizabeth II, Lockwood, King George V, High Maynard and Banbury. These reservoirs are all deemed as high-risk and are all managed by Thames Water Limited, except Stoke

	Newington (West) which is managed by Hackney Council. Despite the risk being residual, in the very unlikely event that the reservoir fails, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 33 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within and surrounding the site. This covers the majority of the site excluding the northern tip and a small section of the north-western boundary. This occurred in 1947 due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show three records of flooding within the site. These all occurred in July 2021 along Marshgate Lane under the DLR bridge, Corn House, Marshgate Lane, and Pudding Mill DLR station, Barbers Road. The latter was caused by a trunk storm sewer issue causing surcharge back into the station.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are formal flood defences along the site's southern, eastern and western boundaries, along the banks of the Bow Back Creek, City Mill River and the River Lee, respectively. These consist of flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal Present Day event proportion of site at risk – 1.20%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 82.65%** The eastern, southern and western boundary of the site is encroached very minimally during the Present Day 0.5% AEP Thames Tidal Breach event. The rest of the site is unaffected by flooding during this event. During the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent, the majority of the site is affected by flooding. This excludes the northern tip and some sections along the northern boundary as well as isolated dry islands across the site. Flood depths reach approximately 2.17m with velocities of up to 1.71m/s. The resulting flood hazard ranges from 'Very Low' to 'Danger for All'. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely.

	The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The entire site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The entire site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, access is gained via Marshgate Lane. To the south, access is possible via Marshgate Lane (leading into Pudding Mill Lane) from Stratford High Street. Further along Stratford High Street, access can also be gained to the south of the site via Cook's Road. According to the Newham Draft Local Plan (2022), there are additional pedestrian access routes proposed. These include along Marshgate Lane to the south of the site, leading into Pudding Mill Lane as well as a footpath branching west from Barbers Road across the River Lee. Safe access and egress is only possible along Marshgate Lane to the north of the site during the Present Day 0.5% AEP tidal upriver breach event. All other access routes are affected by flooding during this event. All access and egress routes are affected by flooding during the 2100 epoch 0.5% AEP tidal upriver breach event. Flood depths reach approximately 2.17m along the north of Marshgate Lane with velocities here of up to 1.71m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for All' where flood depths are deepest. This means that in the extreme 2100 epoch breach event, vehicular access and egress is not possible to the site. Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site is unaffected by flooding in this event, therefore safe access and egress is possible in this event. During the 3.3% AEP surface water event, access and egress is possible to the south of the site via Marshgate Lane, Cook's Road and the proposed pedestrian access across the River Lee. However, surface water ponding along Cook's Road and Barbers Road may hinder access to the latter two routes. Marshgate Lane to the north of the site is affected by ponding where the road is situated underneath the DLR line bridge. The depth of these areas of flooding reaches 0.3 – 0.6m. Flood water is fastest along Cook's Road at 0.5 – 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. It is likely that vehicular access and egress may not be possible in areas where flooding is deepest and water is fast flowing. During the 1% AEP surface water event, access and egress routes are affected in the same way as during the 3.3% AEP event. However, flood depths reach 0.6 – 0.9m along Cook's Road and >1.2m along Marshgate Lane in the north of the site. Flood water is fastest along Cook's Road at 0.5 – 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. It is likely that vehicular access and egress may not be possible in areas where flooding is deepest and water is fast flowing. During the 0.1% AEP surface water event, all access and egress routes are affected with ponding occurring along Stratford High Street between the access points to Marshgate Lane and Cook's Road in the south of the site. Flood depths reach >1.2m along Marshgate Lane in the north of the site. Flood water is fastest along Marshgate Lane at 1.0 – 2.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. It is likely that vehicular access and egress may not be possible in areas where flooding is deepest and water is fast flowing.

	During the surface water 1% AEP plus 40% allowance for climate change event, the extent is very similar to that of the 0.1% AEP event, hence affecting the same access and egress routes. The flood hazard 'Very Low' to 'Danger for Some' with Cook's Road and Marshgate Lane to the north of the site reaching 'Danger for Most'. Therefore, vehicular access and egress may not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site is unaffected by flooding in this event. **Tidal Breaches:** The Thames Upriver Present Day epoch and 2100 epoch 0.5% AEP event are the only breach events to encroach the site. The latter encroaches the majority of the site, excluding the northern tip, some sections of the northern boundary and isolated dry islands across the site. The 2100 epoch extent is 81% larger than the Present Day extent. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a large percentage of the site is at risk during the 2100 epoch 0.5% AEP breach event, the site is considered to be at high risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas across the site, accumulating on the roads and streets and other impermeable surfaces. Flood depths increase from an average of 0.15 to 0.6m (1% AEP event) to around 1.86m in the 1% plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change, particularly the depths of flooding. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the majority of the site is the London Clay Formation (clay, silt and sand). The eastern boundary of the site consists of the Lambeth Group (clay, silt and sand). These are both sedimentary bedrocks.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is located within a Nitrate Vulnerable Zone.
	• The entire site is located within the Secondary (undifferentiated) superficial aquifer designation zone.
	• The site is not located within an historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

	• Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential uses for health centres as 'More Vulnerable.' Non-residential uses (excluding educational and nursery establishments and health centres) and employment development is classed as 'Less Vulnerable'. Open space is classed as 'water compatible development.' Part of the site is also considered as 'Essential Infrastructure' due to the presence of Pudding Mill Lane Station. As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, classified as 'Essential Infrastructure' and 'More Vulnerable' and has some surface water flood risk, the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to

- the site. Careful consideration will also need to be given to the surface water flood risk on site.
- Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
- Development within 20m of a main river or flood defence will require specific planning permissions.
- The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lea.
- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
- Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable).

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level

	- by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. • The proposed development is located within 20m of a Thames Water Sewage Pumping Station. Thames Water consider that any occupied premises should be located at least 20m away from the pumping station. Given the close proximity of the proposed development to the pumping station, Thames Water consider that it is likely that amenity will be impacted and therefore object. Notwithstanding this objection, in the event that the Local Planning Authority resolve to grant planning permission for the development, Thames Water would request that the following informative is attached to the planning permission: "The proposed development is located within 20m of a Thames Water Sewage Pumping Station and this is contrary to best practice set out in Codes for Adoption." Future occupiers of the development should be made aware that they could periodically experience adverse amenity impacts from the pumping station in the form of odour; light; vibration and/or noise. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 and Flood Zone 3 as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'Highly Vulnerable' and further 'Essential Infrastructure' development is not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change fluvial and surface water events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping. Modelled tidal breach flood extents have been taken from the Environment Agency's Thames Estuary Upriver Breach Assessment model.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial & Tidal depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables

Site details

Site Code	**Rick Roberts Way, N8.SA7**
Address	Rick Roberts Way, Stratford, London, E15 2.
Area	4.32ha
Current land use	Temporary community facility, vacant land, storage use and gasholder infrastructure.
Proposed land use	Residential, employment, education facilities (special educational needs school), leisure facilities and open space.
Flood Risk Vulnerability	Mixed - More Vulnerable, Essential Infrastructure and Less Vulnerable

Sources of flood risk

Location of the site within the catchment	The site is located south of Stratford extending from Stratford High Street to the north-west, to Abbey Lane in the south. The Abbey Lane Open Space park runs adjacent to the site's south-western boundary whilst Rick Roberts Way follows the site's north-eastern boundary. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies 55m east of Three Mills Wall River, 450m north of Channelsea River and approximately 2.7km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found where there are areas with vegetation. These include a small area towards the north of the site and a vegetation corridor that extends from the southern half of the north-eastern boundary, cutting across the south of the site and following a small section of the south-western boundary. Elevations range between 2.89 to 3.35m AOD. The highest elevations (up to 8.65m AOD) are situated with the south of the site and correspond with a gas depot. The rest of the site is relatively flat and lies at slightly lower elevations than this, ranging between approximately 4.48m AOD and 5.99m AOD.
Existing drainage features	The site lies 55m east of Three Mills Wall River, 450m north of Channelsea River and approximately 2.7km north of the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are points of lower elevation towards the north of the site and a strip that extends from the southern half of the north-eastern boundary, cutting across the south of the site and following a small section of the south-western boundary. These correspond to areas of vegetation which may act as drainage ditches.
Critical Drainage Area	The site is not located within a CDA.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 50%** **FZ2 – 63%** **FZ1 – 37%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended model outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent are some of the northern and southern quarters of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site and surrounding areas are unaffected by fluvial flooding during the 3.3%, 1%, 0.5% and 0.1% AEP modelled events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.4% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 1.9% Max depth – 0.9 – 1.2m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 6.2% Max depth – >1.2m

	Max velocity – 0.5 – 1.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event surface water flooding only covers 0.4% of the site. Flooding occurs where it ponds in the access road into the site from Rick Roberts Way in the south of the site, entering from the eastern boundary. There are also small areas of ponding along Rick Roberts Way which marginally encroaches sections of the eastern, south and south-western boundaries. Maximum flood depths are 0.3 to 0.6m. Most flood water velocity within the site is 0 to 0.25 with small areas along the aforementioned access road reaching a maximum of 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' in areas where ponding is deepest. The 1% AEP event surface water covers 1.9% of the site. The flooding extends further around the 3.3% AEP outlines along the southern access road from Rick Roberts Way. Additional small areas of ponding begin to form within the centre of the site and the southern tip within the gas depot which corresponds to low-lying land. Flood depths vary from 0 to 0.6m, deepest in the lower-lying parts of the site. The majority of the water flows at 0 to 0.25m/s, with some small areas along the southern access road reaching 0.25 to 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. There are very small areas of 'Danger to Most' where flooding is deepest along the southern access road from Rick Roberts Way. The 0.1% AEP event surface water covers 6.2% of the site. In this event the aforementioned areas of ponding further extend from the 1% AEP outlines within the centre and southern tip of the site. A flow path forms, connecting ponding on the access road within the south to ponding on the opposite side of the site adjacent to Abbey Lane Open Space Park. Flood depths vary from <0.15m to 1.2m. Most of the flood depths are 0.15 to 0.6m with smaller areas of 0.6 – 0.9m on the southern access road and ponding within the southern tip of the site. The deepest flooding occurs in a small low-lying area of ponding towards the north of the site where flood depths are 0.9 to 1.2m. Flood water flows at around 0 to 0.25m/s across most of the site, with smaller areas where it flows around 0.25 to 1m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where flood water is deeper, there are areas of 'Danger for Most'.
Reservoir	The Dry Day reservoir flood events encroach the north-eastern boundary of the site, extending along a flow path in the south of the site to the southern boundary, with some ponding in the southern tip. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood and William Girling. The aforementioned ponding at the southern tip of the site only occurs in the Dry Day extent for the William Girling reservoir. These reservoirs are all managed by Thames Water Limited and are deemed as high-risk. A similar area is encroached during the Wet Day reservoir flood event, however flooding extends across the majority of the site's centre, with only the north of the site and the majority of the south-western boundary being unaffected. The site is also within a dry island. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Stoke Newington (East), Stoke Newington (West), Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick, William Girling and Wraysbury. These reservoirs are all managed by Thames Water Limited apart from Stoke

	Newington (West) which is managed by Hackney Council. These reservoirs are all deemed as high-risk. The most extensive Wet Day and Dry Day reservoir flood extent is the William Girling reservoir. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 33 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has no records of flooding within the site. However, the nearest recorded flood outline is located adjacent to the site's southern and south-western boundaries with the closest extent situated 14m south of the site. This occurred in 1947 due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show one record of flooding which bordered some of the site's north-eastern boundary. This occurred in 2014 along a 225m stretch of Rick Roberts Way. Another flooding incident which occurred near the site was at Halo Tower, the High Street which is located approximately 60m north-west of the site in 2021.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within the site. The nearest formal flood defences are situated along both banks of the Waterworks River approximately 50m west of the site. These consist of flood walls. The design standard of protection of these defences ranges from 200 to 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day event proportion of site at risk – 8.80%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 24.24%** The southern tip of the site and part of the south-western boundary is affected by flooding as well as there being a flow path across the site and along a section of the eastern boundary. This is during the Present Day 0.5% AEP Thames Tidal Breach event. Similar areas of the site are also located within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood depths reach around 2.40m with velocities of up to 2.04m/s. The resulting flood hazard is 'Very Low' to 'Danger for All'. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely.

	The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The entirety of the site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The entire site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	Access and egress to the site is currently via Rick Roberts Way to the north and further south along the same road. According to the Newham Draft Local Plan (2022), there will be an additional pedestrian route halfway between the previously mentioned access route as well as from Stratford High Street to the north-west of the site. The original vehicular access road to the south of the site along Rick Roberts Way will be extended to Abbey Lane to the south of the site. Safe access and egress along Rick Roberts Way and Abbey Lane is shown to be affected during the modelled tidal upriver breach 0.5% AEP events in the present day epoch and the 2100 epoch. Flood depths are up to 3.2m along Abbey Lane. The resulting flood hazard varies from 'Very Low' to 'Danger for All' where flood depths are deepest. This means that in the extreme 2100 epoch breach event, vehicular access and egress is not possible to the site. Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. Flood waters are impounded along the railway line that borders the western to northern area of the site. The roads surrounding the site remain unaffected. During the 3.3% AEP surface water event access and egress is possible on all mentioned routes into the site. There is, however, a small area of ponding within the southern access road to the site from Rick Roberts Way as well as along Abbey Lane to the south of the site. Flood depths reach 0.3 to 0.6m, with flood water flowing up to 0.5 to 1m/s. The resulting hazard is 'Very Low' to 'Danger for Some'. During the 1% AEP event, there is further surface water flooding along the affected roads mentioned during the 3.3% AEP event. There is also some ponding along Rick Roberts Way which encroaches the access point to the proposed pedestrian route located between the two existing points of access. The depths of this flooding are 0.15 to 0.9m. Flood water velocities vary between 0 to 1.0m/s. The resulting hazard is 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. along Rick Roberts Way. During the 0.1% AEP event, flooding affects a larger stretch of Rick Roberts Way and Abbey Lane. Flood depths vary from <0.15m to small areas of up to 1.2m along some of Rick Roberts Way and Abbey Lane. Flood waters reach up to 1.0 to 2.0m/s. The resulting flood hazard along Rick Roberts Way is 'Very Low' to 'Danger for Most'. Along Abbey Lane, the flood hazard is also 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. along Rick Roberts Way and Abbey Lane. Access to the north-west of the site via Stratford High Street remains accessible during all AEP surface events. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects the same access routes as those mentioned during the 0.1% AEP event because these extents are very similar in size. The flood hazard along Rick Roberts Way and Abbey Lane is 'Very Low' to 'Danger for Most'. Therefore,

	vehicular access will not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site remains unaffected by flooding. **Tidal Breaches:** The Thames Upriver Present Day epoch and 2100 epoch 0.5% AEP event are the only breach events to encroach the site along the southern tip, a small section of the south-western boundary and some of the eastern boundary. The 2100 epoch extent increases by approximately 16% from the Present Day extent. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a small percentage of the site is at risk during two breach events, the site is considered to be at medium risk in the aforementioned breach scenarios. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the south of the site and along the eastern boundary, accumulating on the roads and streets and other impermeable surfaces. Flood depths also increase from around 0 to 0.6m (1% AEP event) to around 1.03m in the 1% plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology in the north of the site is the Lambeth Group (clay, silt and sand) whilst the rest of the site is the London Clay Formation (clay, silt and sand). These are sedimentary bedrocks.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is also located within a Nitrate Vulnerable Zone.
	• The entire site is also located within the Secondary (undifferentiated) aquifer designation (superficial drift) zone.
	• The site has areas within its boundary designated by the Environment Agency as being an historic landfill site. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths beginning to form in areas surrounding the site during the 0.1% AEP event, connecting areas of ponding that were present in the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into

	account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential institutions including educational establishments. as 'More Vulnerable' development. Leisure and employment development is classed as 'Less Vulnerable'. As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and classified as 'More Vulnerable' and having 'Essential Infrastructure', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day epoch and 2100 epoch for the 0.5% AEP breach events of the River Thames (upriver), and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the Waterworks River.

	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
	• Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable).
	
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan.
	• The Pressure Reduction Station, electricity mast and sub-station should be retained or re-provided on the site. The district heating network connection to the north-west of the site should be retained.

	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 and Flood Zone 3, as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- ‘Highly Vulnerable’ and ‘Essential Infrastructure’ development or retained site features are not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. ‘More Vulnerable’ development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency’s Flood Map for Planning, the Environment Agency’s Risk of Flooding from Surface Water map and the Environment Agency’s Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency’s Flood Map for Planning mapping. Modelled tidal breach flood extents have been taken from the Environment Agency’s Thames Estuary Upriver Breach Assessment model.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency’s Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial & Tidal depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill’s River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency’s Thames Estuary Upriver 2017 Breach Assessment model.

Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from the Environment Agency's RoFSW dataset, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	N4.SA1
Address	Land North of Royal Albert Dock, Beckton, E6 1 and E6 2.
Area	29.9ha
Current land use	Mixed Use
Proposed land use	Residential, employment, community facilities, education uses, sports facility, main town centre uses and open space.
Flood Risk Vulnerability	Mixed – essential infrastructure, more vulnerable, less vulnerable and water compatible.
Sources of flood risk	
Location of the site within the catchment	The site is located within Beckton and Canning Town, adjacent to the Royal Albert Dock/ Royal Victoria Dock (as part of the Royal Group of Docks). The large site is bounded to the north by the the A1020 Royal Albert Way and A112 Victoria Dock Road. The north-west of the site encompasses this road. The London Design and Engineering University Technical College is located to the east of the site. The southern boundary of the site is confined by the Royal Albert Dock, London Borough of Newham Council Offices, Connaught Passage, the Royal Victoria Dock and the Dockland Light Railway line. The north-west of the site is adjacent to the Prince Regent DLR Station. There are a number of transport connections located within the site, including London Underground Elizabeth Line, Docklands Light Railway, A1020 Connaught Bridge/ Royal Albert Way and A112 Victoria Dock Road. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Thames and Royal Docks. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies slightly. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The elevation of the site varies between -4.92 and 8.33mAOD. Site elevations are lowest to the north-west of the site, where the London Underground Elizabeth Line transitions from overground to underground below Royal Albert Way. Additionally, site elevations are also below sea level at an underpass where the A1020 Royal Albert Way passes below Connaught Bridge. The elevations across the rest of the site are relatively consistent, and are generally above 4.5mAOD. The greatest elevations within the site are located at a small area of raised ground to the east of the site, adjacent to Lascars Avenue.
Existing drainage features	The southern boundary of the site is adjacent to the Connaught Passage, Royal Albert Dock and Royal Victoria Dock, which as part of the Royal Group of Docks within the London Borough of Newham. The site is approximately 800m north of the River Thames. There are no drainage ditches within or in the vicinity of the site.
Critical Drainage Area	The Critical Drainage Area (CDA) 'Group4_032' is located within the site boundary. This CDA is specifically located to the north-west of the site,

	extending across the Royal Albert Way (A1020) underpass beneath Connaught Roundabout, Canning Town.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 69%** **FZ2 – 98%** **FZ1 – 2%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** Almost the entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent are six isolated areas to the east of the site (largest 0.1 hectares). This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.8% Max depth – 0.9 – 1.2m Max velocity – 0.5 – 1.0m/s **1% AEP** – 1.8% Max depth – 0.9 – 1.2m Max velocity – 1.0 – 2.0m/s **0.1% AEP** – 6.3% Max depth – 0.9 – 1.2m Max velocity - >2.0m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 1.1% Max depth – 2.36m Max velocity – 0.59m/s **1% AEP** – 2.2% Max depth – 2.89m Max velocity – 0.80m/s **0.1% AEP** – 5.0%

	Max depth – 4.45m Max velocity – 1.17m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The entire site is covered by the Environment Agency's Risk of Flooding from Surface Water mapping. The Silvertown ICM surface water model was also available to assess surface water flood risk in the west of the site (west of Millman Road).* *Where the ICM modelling is available, this modelling is more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset. For the rest of the site (east of Millman Road) the Environment Agency's Risk of Flooding from Surface Water mapping was used.* **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding extends across 0.8% of the site according to the RoFSW dataset. This flooding is predominantly isolated surface water ponding in topographic depressions within the site. Maximum flood depths (0.9 to 1.2m) and velocities (0.5 to 1.0m/s) during this event are situated where the Elizabeth Line transitions between an overground and underground railway line. Associated flood hazard at this section of the site is rated as 'danger for most.' According to the Silvertown ICM model, during the 3.3% AEP event, surface water pooling locations generally correspond with the RoFSW dataset. However, there are also additional pools of flooding surrounding Connaught Bridge and the Royal Albert DLR station. Flood depths during this event are largely below 0.5m, with hazard rated as either 'very low' or 'danger for some.' Maximum surface water flooding depths and velocities are located adjacent to the Elizabeth Line, where the flood depths and velocities extend to 2.36m and 0.59m/s, with associated flood hazard rated as 'danger for all.' During the 1% AEP event, according to the RoFSW dataset, surface water flooding extends across 1.8% of the site. Surface water flooding patterns, and associated flood depths and velocities, are largely similar to the 3.3% AEP event, just with a slightly more widespread extent. Hazard is still rated as 'very low' or 'danger for some' across the site during this event. According to the Silvertown ICM model, during the 1% AEP event, surface water flooding occurs in a similar located to the 1% AEP event, although flooding is notably more extensive surrounding Connaught Bridge and Festoon Way. Maximum flood depths and velocities during this event are still greatest surrounding the Elizabeth Line railway. Across the rest of the site, flood depths are generally below 0.5m (although extend up to 0.74m surrounding Royal Albert Way), with velocities extending to 0.35m/s. Associated flood hazard is rated between 'very low' or 'danger for most.' During the 0.1% AEP event, according to the RoFSW dataset, surface water flooding extends across 5.0% of the site. Surface water pooling is now significantly more extensive across the site, notably surrounding Connaught Bridge and the region between Millman Road and University Way. A significantly greater portion of the site is now rated as 'danger for most,' with maximum depths and velocities now between 0.9 to 1.2m, and over 2m/s. These maximum depths and velocities are located within the Elizabeth Line railway to the west of the site.

	According to the Silvertown ICM model, during the 0.1% AEP event, surface water flooding is now significantly more extensive across the site, notably around the Connaught Bridge area. Excluding the flooding within the Elizabeth Line (which now reaches a maximum of 4.45m and 1.17m/s), flood depths and velocities across the rest of the site now reach 1.67m and 0.59m/s. Associated flood hazard is now rated as 'danger for most.'
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, three isolated areas to the north-west (corresponding with the London Underground Elizabeth Line), centre and east of the site are at risk of flooding during the 'dry day' flood. This risk is posed by the King George V and William Girling Reservoir, which are both managed by Thames Water. During the 'wet day' scenario, the site is at risk from 10 reservoirs. Almost the entire site – except isolated areas of higher elevation to the west and southern boundary of the site – is at risk of flooding from the Banbury, King George V, Lockwood and William Girling Reservoirs. The north and centre of the site, including the Royal Albert Way and Docklands Light Railway, are at risk of flooding from the High Maynard, Queen Elizabeth II and Wraysbury Reservoirs. The northern fringes of the site (including the Royal Albert Way) are at risk of flooding from the Walthamstow No4, Walthamstow No5 and Warwick East Reservoirs. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located across two different postcode areas E16 1 and E16 2, located west and east of Connaught Bridge respectively. According to the Thames Water Hydraulic Sewer Flood Risk Register, there are 32 incidents of flooding in the E16 1 postcode, and 94 incidents in the E16 2 postcode area. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's historic flooding and recorded flood outlines database, there are no incidents of flooding within the site. As per the London Borough of Newham's flood incident database, there are three recorded incidents of flooding within, and in 50m of, the site: • In December 2012, there was recorded flooding on Royal Albert Way underpass beneath the Connaught roundabout. This flood lasted for 10 days, although the source was not recorded. • In May 2018, there was a recorded flooding incident at the London Regatta Centre, Dockside Road, E16 2. The source of, and further details regarding, this flooding were not recorded. • In August 2021, there was a recorded flooding incident on Festoon Way, E16 1. The source of, and further details regarding, this flooding were not recorded.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the

	Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 0.3%** **0.1% AEP tidal present day event proportion of site at risk – 0.5%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 17.6%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 38.0%** A negligible portion of the site is located within the flood extent for the Thames tidal present day 0.5% AEP event (0.3% total site area) and 0.1% AEP event (0.5% total site area). A larger portion of the site (17.6%) is located within the 2100 epoch 0.5% AEP event Thames tidal downriver breach extent. This is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. The site is located in Environment Agency Flood Alert Area 063WAT233N for flooding from the Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham. Additionally, the site is located across two different Environment Agency Flood Alert Areas. The south, centre and west of the site is located in Flood Alert Area 063FWT23RDockA for the Tidal Thames between Beckton Sewage Works to the River Lee. The north-west and east of the site is located in Flood Warning Area 063FWT23RDockB for the Tidal Thames at Beckton including Canning Town, Custom House, and Beckton.
Access and egress	Vehicular access and egress to the site is currently via a number of routes. The site can be exited to the west using Sandstone Lane and travelling west, or via the A1020 where you can travel west (via Victoria Dock Road) or north (via the A112 Prince Regent Lane). Additionally, the site can be exited to the south using the A1020 Connaught Bridge into North Woolwich or Silvertown. The site can exited to the north via the A1020 Royal Albert Way and then into Beckton, Canning Town or Cyprus. Only the London Design and Engineering University Technical College can be exited to the east, onto University Way into Cyprus. The site can be exited to the west and east as a pedestrian using a footpath adjacent to the southern site boundary and Royal Group of Docks. Additionally, the site can be exited to the north as a pedestrian using a footpath over the A1020 Royal Albert Way between Dockside Road and Jake Russell Walk. During the 0.5% AEP 2115 Thames tidal breach, only two of the access and egress routes from the site are impacted. There is flooding on the A1020 Connaught Bridge which is rated as 'danger for all' with flood depths up to

	1.0m, so vehicular access would be challenging. Additionally, there is isolated flooding on the pedestrian footpath adjacent to the southern site boundary, with flood hazard during this event rated as 'danger for most' with flood depths up to 0.47m. During the 0.1% AEP 2115 Thames tidal breach, another two access and egress routes from the site are impacted in addition to the A1020 Connaught Bridge and pedestrian footpath adjacent to the southern site boundary. There is now extensive flooding on the A1020 Royal Albert Way which is rated as a maximum of 'danger for all,' with flood depths up to 2.8m. Additionally, there is also flooding on University Way for the access and egress from the London Design and Engineering University Technical College. Flooding on this road is rated as 'danger for most,' with flood depths up to 1.65m. Therefore, safe access and egress will be severely impacted during all Thames tidal breach events. Access and egress have also been assessed against the Risk of Flooding from Surface Water dataset as this covers all access and egress routes to/from the site. During the 1% AEP plus 40% climate change surface water flood, the majority of access and egress routes from the site are impacted by surface water flooding. Access and egress from the site would be challenging if travelling north onto the A1020 Royal Albert Road, as flood depths on the road during this event extend to 0.55m, with associated flood hazard rated up to 'danger for most.' Additionally, access and egress to the west via Prince Regent Lane would also be extremely challenging, as flood depths on this road extend to 0.88m, with hazard rated as 'danger for most.' Alternatively, access and egress may be possible, although still challenging by travelling west onto Sandstone Lane, west onto Victoria Dock Road, or south onto the A1020 Connaught Bridge. Flooding occurs as isolated patches and ponds along these roads, with associated flood hazard rated as 'danger for some,' with depths generally below 0.3m. Finally, access and egress for the London Design and Engineering University Technical College would still be possible, as Knowledge Road and University Way remain 'flood free' during this event. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Tidal Breaches:** A greater proportion of the site (17.6%) of the site is flooded during the 0.5% AEP 2115 epoch Thames tidal breach compared to the 0.5% AEP present day tidal breach (0.3%). Flood depths and velocities during this event are generally between 0.1-0.5m and 0.5-1.0m/s. However, these extend up to 1.10m and up to 1.18m/s surrounding Lascars Avenue and the Dock Managers Office. Hazard during this event is generally either 'very low'

	or 'danger for some,' although this extends to 'danger for most' where the deepest and fastest flooding is located. During the 0.1% AEP Thames tidal breach event, approximately 38.0% of the site is predicted to flood. There is now flooding on A1020 Royal Albert Way as well as the access routes within the Royal Albert Dock. Flood depths on the A1020 Royal Albert Way are reasonably shallow, but extend up to 0.54m in some areas. Velocities extend to 1.53m/s, with associated hazard rated as 'danger for most.' Flood depths on access routes within the Royal Albert Dock are generally below 0.5m, but extend to 2.35m surrounding the Dock Manager's office. Velocities are up to 0.5m/s in this area of the site, with associated flood hazard rated between 'very low' and 'danger for all' surrounding the Dock Manager's office. The site is therefore very sensitive to increases in flooding caused by tidal breaches due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. The sensitivity of the site to surface water flooding was first assessed using the Risk of Flooding from Surface Water dataset. During the 1% AEP plus 40% climate change event, the flood extent increases slightly from the 1% AEP event, to a similar extent as the 0.1% AEP event. Flood depths within the site are generally below 1.0m, except at the DLR line to the west of the site where flood depths extend to 2.9m. Flood hazard is generally rated as either 'very low' or 'danger for some' across the majority of the site, extending to 'danger for most' or 'danger for all' at some isolated areas within the site surrounding the DLR line and Dock Manager's Office. The sensitivity of the site to surface water flooding was then assessed using the ICM Silvertown model (which is only relevant for the portion of the site west of Millman Road). During the 1% AEP plus 40% climate change event, the flood extent within the site slightly increases, notably on Dockside Road and surrounding the Royal Albert DLR station. Flood depths during this event are generally below 1.6m, although these extend to 3.46m to the west of the site by the DLR line. Flood hazard during this event is generally rated between 'very low' and 'danger for most,' although flooding at the DLR line is rated as 'danger for all.' The site is therefore very sensitive to increases in surface water flooding caused due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology across the majority of the site is Lambeth Group (clay, silt and sand). This is a sedimentary bedrock. However, the bedrock geology of the north-western corner of the site is the London Clay Formation (clay, silt and sand), which is also a sedimentary bedrock.
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit

	formed of unconsolidated detrital material deposited by a body of running water. • Soils at the site consist of: o Loamy and clayey soils of coastal flats with naturally high groundwater. **SuDS** • The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. • BGS data indicates that the underlying geology is clay, silt and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a Nitrate Vulnerable Zone. • The majority of the site is located within Secondary A bedrock, with the north-west of the site located within an 'unproductive' aquifer designation zone. The entire site is located within a secondary (undifferentiated) superficial aquifer designation zones. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Silvertown ICM and the Environment Agency's Risk of Flooding from Surface Water results mapping indicates the presence of surface water flow flooding within the site during the 0.1% AEP surface water flood. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.

	• The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies 'essential transport infrastructure' as essential infrastructure. Additionally, residential development, and non-residential uses for educational establishments, are classed as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, in a critical drainage area (CDA), is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.

	- Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. - The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 epoch 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe :** - The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). - Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. - The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site. - The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. - Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. - Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site. - Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. - London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. - Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. - Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g., raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to: - raise them as much as possible - consider moving vulnerable uses to upper floors - include extra flood resistance and resilience measures.

	• Other examples of flood resistance and resilience measures include:
	  • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.

If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Silvertown ICM Surface Water Model and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.
Tidal extents, depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N2.SA2**
Address	Rymill Street, E16 2
Area	0.59ha
Current land use	Vacant land and former temporary school
Proposed land use	Residential, retail, health centre, community facilities (if there is a need) and open space.
Flood Risk Vulnerability	Mixed - More vulnerable, Less Vulnerable and Water Compatible Development.
Sources of flood risk	
Location of the site within the catchment	The site is located within the North Woolwich neighbourhood approximately 90m south of the King George V Dock. The site is bounded by Dockland Street to the west, Rymill Street to the south, and Pier Road to the East. The Docklands Light Railway (DLR) line and King George V station are adjacent to the northern boundary of the site. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Thames and Royal Docks. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies slightly. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The site is relatively flat, with site elevations varying between 1.14 and 3.68mAOD. Site elevations are generally highest to the north and centre of the site, with the maximum site elevations (3.68mAOD) found to the north-east of the site. Conversely, site elevations are lowest to the west, south and south-east of the site, with a minimum site elevation of 1.14mAOD observed to the south-east of the site.
Existing drainage features	The site is located approximately 90m south of the King George V Dock, one of the three Royal Docks within the London Borough of Newham. The site is approximately 320m north of the River Thames. There are no drainage ditches within or in the vicinity of the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*

	Available data: Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This indicates that the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.0% **1% AEP** – 0.0% **0.1% AEP** – 3.6% Max depth – 0.30-0.60m Max velocity – 0.25-0.5m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 0.0% **1% AEP** – 0.0% **0.1% AEP** – 2.88% Max depth – 0.23m Max velocity – 0.16m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The Silvertown ICM surface water model was used in the assessment of surface water flooding.* *Where ICM modelling is available, this modelling is more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset.* **Description of surface water flow paths:** The site is not affected by surface water flooding during the 3.3% AEP and 1.0% AEP events. In the 0.1% AEP event, surface water flooding covers 2.88% of the site. This flooding is concentrated in the south-east corner of the site – where the lowest site elevations are found – as an overspill of floodwater flowing eastwards down Rymill Street. Maximum flood depths during this event are 0.23m, with maximum velocity extending to 0.16m/s. The resulting flood hazard is rated as 'Very Low.'

Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the western and southern fringes – especially the south-eastern corner – of the site is at risk during the 'dry day flood.' This risk is posed by the William Girling Reservoir, which is managed by Thames Water. During the 'wet day' scenario, the entire site is at risk from the following reservoirs: Banbury, King George V, Lockwood and William Girling. Additionally, the western and southern fringes of the site, notably the south-eastern corner, are at risk from the following reservoirs: Walthamstow No.4, Walthamstow No.5 and Warwick East. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The entire site is classed as having a 'low' risk of groundwater flooding, with any groundwater flooding incidence having a chance of greater than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site is located within a postcode area with 94 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Flood Incident Database and the LBN Council's Flood Incident database, there have been no recorded incidents of flooding within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 66.4%** **0.1% AEP tidal present day event proportion of site at risk – 82.7%** **0.5% AEP tidal 2115 epoch event proportion of site at risk – 100%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 100%** During the 0.5% AEP present day tidal breach, approximately 66.4% of the site is inundated, which is concentrated to the west, south and east of the site. Flood depths vary between 0.2 and 2.4m, with the deepest flood depths concentrated in the south-eastern corner of the site. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and

	outside the flooded area may actually be at risk. The velocity of flood waters varies between 0.1 and 1.1m/s, and is again highest in the south-east of the site. The resulting flood hazard classification is considered to be 'danger for all' across most of the site, although a small portion in the centre of the site is classed between 'very low hazard – caution' and 'danger for some.' During the 0.1% AEP present day tidal breach, approximately 82.7% of the site is inundated, with almost the entire site inundated with the exception of the area of raised ground to the centre of the site. Maximum flood depths during this event within the site now extend to 2.5m, and maximum velocities to 1.1m/s, both occurring in the south-eastern corner of the site. The site is located wholly within the 2115 epoch 0.5% and 0.1% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within Environment Agency flood warning area (063FWT23RDockA) – extends around River Thames from the Beckton Sewage works to the River Lea. Additionally the Environment Agency flood alert area (063WAT233N) extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham.
Access and egress	Access and egress to the site is currently possible via a number of routes. After exiting the site to the south, access to the site is possible by travelling west onto Dockland Street, or travelling east onto Pier Road. There is no direct access between the site and the King George V DLR station, and instead pedestrian access to the station is possible via Pier Road/ Claremont Close or via Dockland Street. Safe access and egress is shown to be affected during all modelled tidal breach events in the present day epoch and the 2115 epoch. During the 0.5% AEP present day Thames tidal breach, flood extents cover the majority of the site (66.4%) and surrounding access roads. During this event, flood hazard down Rymill Lane, Pier Road and Dockland Street is rated as 'danger for all.' Flood depths along these roads are above 2.2, with the greatest flood depths extending to 2.7m at the junction between Rymill Street and Pier Road. During the 0.5% AEP 2115 epoch tidal breach, flood hazard is rated as 'danger for all' on Dockland Street, Rymill Street and Pier Road. Flood depths vary from 2.8m on Dockland Street, to 3.3m at the Rymill Street/ Pier Road junction. Vehicular access during this event would be extremely challenging. The site itself does not flood during the surface water 1% AEP plus 40% for climate change allowance event. However, during this event, all access and egress routes from the site are impacted by surface water flooding. However, the flood hazard along Rymill Street, Pier Road and Docklands Street during this event is rated as 'Very Low' to 'Danger for Some,' with flood depths between 0.1 to 0.4m. Therefore, vehicular access and egress may still be possible. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for

	climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	During the 0.5% present day tidal Thames breach, there is no predicted flooding in the centre of the site. This part of the site is a 'dry island' as flood depths on the surrounding Docklands Street, Rymill Street and Pier road extend between 2.2 and 2.7m, with associated flood hazard rated as 'danger for all' on each of these roads.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** Whereas only 66.4% is inundated during the present day 0.5% AEP event Thames tidal breach, the site is located wholly within the 2115 epoch 0.5% AEP event Thames tidal upriver breach extent. During this 2115 epoch event, flood depths are significantly deeper than the present day event, extending to 3.06m, although flood velocities remain similar at 1.1m/s. For the resulting flood hazard, the centre and north of the site is classed as either 'danger for some' or 'danger for most,' with the rest of the site classed as 'danger for all.' This suggests the site is considered to be at 'high risk' during both breach scenarios. During the 0.1% AEP Thames tidal breach, the entire site is flooded, with increases in maximum flood depths and flood velocities. Flood hazard to the west, south and east of the site is rated as 'danger for all,' with the rest of the site classed 'danger for some.' **Surface Water:** The latest climate change allowances have also been applied to the Silvertown ICM surface water model to indicate the impact of climate change on pluvial flood risk. The 1% AEP plus 40% climate change allowance corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. As with the 1% AEP present day surface water flood, the site also does not flood during the 1% AEP plus 40% climate change allowance surface water flood. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is defined as Lewes nodular, Seaford and Newhaven chalk formation. Chalk is permeable and allows for the storage and movement of groundwater.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is chalk which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a historic landfill or a nitrate vulnerable zone.
	• The entire site is located within a principal bedrock, and Secondary (undifferentiated) superficial deposit aquifer designation zones.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• For the greenfield part of the site, surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	•
	• The Silvertown ICM results mapping indicates the presence of surface water flow flooding within the site during the 0.1% AEP surface water flood. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface

	water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as attenuation basins, green roofs, permeable surfaces and rain gardens must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential uses for health services as 'More Vulnerable' development. Buildings used for shops are classed as 'less vulnerable development.' Open space as 'water compatible development'. As there are three different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.

- Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal flood extents, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
    - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
- The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the

	occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also pluvial flood risk at the site in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'More vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water event, including an allowance for climate change, is needed. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Given the proposed site usage, safe access and egress is an important consideration for this site. Safe access and egress should be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial, and 0.5% AEP tidal breach plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning…

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.

Tidal breach extents, depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment **Detailed Site Summary Tables**
Site details	
Site Code	**Silvertown Way East, N5.SA2**
Address	Silvertown Way East, land on the east side of Silvertown Way and Caxton Street North, E16 1.
Area	0.77ha
Current land use	Local Mixed Use - Residential, industrial and employment uses, community facilities.
Proposed land use	Residential, employment, leisure uses and open space.
Flood Risk Vulnerability	Mixed – Less Vulnerable and More Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located south of Canning Town, east to the A1011 (Silvertown Way) and the underground line. Nelson Street borders the north of the site and Huntingdon Street to the East. Fen Street runs east-west through the site. To River Lea flows in close proximity to the west of the site. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lea and is close to the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies slightly. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found to the north-west site corner at around 0.8mAOD, and the southernmost tip of the site where the highest lying land is around 1.1mAOD. The rest of the site lies at around 0.8 to 1.3mAOD.
Existing drainage features	The site is located approximately 280m east from the lower section of the River Lee, and approximately 500m north from the River Thames, which also marks the location of the confluence of the two rivers. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Flood characteristics:**

	The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the northern-most tip of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% Max depth – N/A Max velocity – N/A **1% AEP** – 9.6% Max depth – 0.30 - 0.60m Max velocity – 0.25 - 0.50m/s **0.1% AEP** – 41.1% Max depth – 0.60 - 0.90m Max velocity – 0.25 - 0.50m/s **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events. During the 3.3% AEP event the site is not directly affected by surface water flooding. The 1% AEP event surface water covers 9.6% of the site. Flooding occurs along Caxton Street North, Fen Street, Nelson Street and Huntingdon Street where they join to form a flow path. Flood depths vary from 0 to >0.6m, with the deepest located along the western area of the site along Caxton Street North. The water flows at 0 to 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most'. The 0.1% AEP event surface water covers 41.1% of the site. In this event the aforementioned areas of flooding extend further into the site from the 1% AEP outline, and the flow paths along the roads surrounding and into the site become more extensive. The entirety of Huntingdon Street, Nelson Street, Hoy Street and Caxton Street North are flooded. Several new flow paths form extending out from those on the roads mentioned above, and flood the areas around the buildings within the site. Flood depths vary greatly from 0.15 to 0.90m. Most of the flood depths are 0.15 to 0.60m, with smaller areas of 0.90m situated along Caxton Street North. Flood water flows at around 0 to 0.5m/s across most of the site. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. There are some areas of 'Danger for Most' along Caxton Street North, Nelson Street and Fen Street into the site.
Reservoir	The entire site is shown to be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the whole site from the following reservoirs; Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, the entire site are at risk of flooding from King George V and William Girling reservoirs. All these reservoirs are managed and operated by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.

Sewers	The site is located within a postcode area (E16 1) with 32 incidences of sewer flooding, with two incidences nearby the site on Appleby Road, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets has two records of flooding within and surrounding the site. This occurred in 1947 and 1953 due to channel capacity exceeded and overtopping of defences. It is unknown how many properties were affected by this flooding and if it has directly impacted the site. Newham Borough Council's flood records do not show record of flooding within the site. but three incidents were recorded near site at Canning Town Bus Station, Rogers Road and Lawrence Street during summer 2021.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lea and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 100%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 100%** The site is completely flooded in the Present Day 0.5% AEP Thames Tidal Breach event. Flood depths across the site vary from 1.0 to 2.0m. Flooding is deepest where there are topographic lows in the site, at the south corner, and the around the site. Velocity of flood waters varies from 0.0-2.0m/s, and is highest at Caxton Street North, where water is channelled into existing streets and roads. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Danger for Some' to 'Danger for Most' and even areas of 'Danger for All' where flood depths are deepest. The site is also located wholly within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development,

	this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062FWB53TidalLee, Tidal Lee in the Boroughs of Havering, Barking and Dagenham and Newham flood alert area and within the 063FWT23RDockA, Tidal Thames from Beckton Sewage Works to the River Lee flood warning area. The site is also part of the 062FWB53TidalLee, The Lower River Lee from Hoddesdon to Canning Town flood alert area and the Lower Rover Lee from West Ham and Canning Town flood waring area.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, access is gained via Caxton Street North and Hoy Street (via Tarling Road). To the south of the site, access is possible via Victoria Dock Road. Safe access and egress are shown to be affected during all modelled tidal breach events in the present-day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. Flood depths are up to 2.0m along all access roads mentioned above. The resulting flood hazard varies from 'Danger to Most' to 'Danger for All' where flood depths are deepest.In the 2100 epoch, flood depths increase slightly along the access roads, and therefore the flood hazard rating increases to 'Danger for Most' to 'Danger for All'. This means that in this extreme breach event, vehicular access and egress is not possible to the site. During the 1% AEP surface water event, there is some surface water flooding along the roads mentioned above. The depths of this flooding are 0 to 0.60m. Flood water is slow moving at 0 to 0.25m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. It is likely that vehicular access and egress may be possible during this event. During the 0.1% AEP event, flooding affects all the roads. Flood depths vary from 0.15 to up to 0.9m. The resulting flood hazard along Caxton St North, Nelson Street, Fen Street and Hoy Street the flood hazard is up to 'Danger for Most'. Flood depths along these streets are up to 0.90m and the velocity varies between 0 to 0.5m/s. The flood hazard category in these areas 'Danger for Some' and 'Danger for Most' along most parts of these streets. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. at the junction of Fen Street and Caxton St North. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects all access and egress routes, the extent is similar to that of the 0.1% AEP event. The flood hazard along this road is 'Danger for Some' to 'Danger for Most'. Therefore, vehicular access and egress may be possible. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment**

	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The 2100 epoch 0.5% AEP event shows slightly deeper flood waters, with a very slight increase in flood extent versus the 2005 epoch 0.5% AEP event, covering most of the site. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during both breach extents, the site is considered to be at high risk in both breach scenarios and slightly sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the north of the site, and also in the south-eastern part of the site, accumulating on the roads and streets and other impermeable surfaces. Flood depths also increase from around 0.3 to 0.6m (1% AEP event) to around 0.5 to 1.3m in the 1% plus 40% climate change event. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.

	• The site is not located within a historic landfill site. • The site is not located within a historic landfill or is not a nitrate vulnerable zone. • The entire site is located within a Secondary (undifferentiated) superficial deposit aquifer designation zone. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment and leisure development as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN.

	• Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal and fluvial or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.

	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  • raise them as much as possible
	  • consider moving vulnerable uses to upper floors
	  • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 1% plus climate change and 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'Highly Vulnerable' development is not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water and fluvial events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial, and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal breach and fluvial depth, velocity and hazard mapping	This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N3.SA1**
Address	Land at Silvertown Quays, North Woolwich Road, E16 2
Area	21.0 ha
Current land use	Vacant land, vacant heritage assets and waste use.
Proposed land use	Residential, employment, community facilities (if needed), leisure, open space and main town centre uses.
Flood Risk Vulnerability	Mixed– 'More vulnerable,' 'Less Vulnerable' and 'water compatible development.'
Sources of flood risk	
Location of the site within the catchment	The site is located within central Silvertown. The site is bounded by the A1020 North Woolwich Road/ Connaught Bridge Road to the east and south of the site, and the Royal Docks (Royal Victoria and Pontoon Dock) to the north of the site. The west of the site is bounded by residential houses along Mill Road and Rayleigh Road. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lea and is close to the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Additionally, the site boundary extends beyond the current land boundary into the Royal Group of Docks (specifically Pontoon Dock), where land reclamation is planned. The national LiDAR programme only contains elevation data for the land surface, with elevation values for areas of no data – such as water bodies – filled in to ensure there are no gaps within the model. As a result, LiDAR data will not be accurate for part of the site within Pontoon Dock. Excluding the area of the site within the Pontoon Dock, site elevation varies between 1.10m and 10.74mAOD. Site elevations are lowest (between 1.10 and 1.70mAOD) to the south-east of the site between Burt Road and the A1020 Connaught Bridge. The rest of the site is relatively flat with the exception of three areas of raised ground to the west of the site, where the maximum site elevations (up to 10.74mAOD) are located. These areas of raised ground are likely remnants of previous industrial activity which occurred surrounding the Pontoon Dock. There is also a private road to the north-east of the site extending from the Connaught Bridge/ Connaught Road roundabout into Silverworks Island, the elevation of which is above 6.60mAOD.
Existing drainage features	The northern boundary of the site is adjacent to, and includes, the Pontoon Dock as part of the Royal Group of Docks within the London Borough of Newham. No other main rivers or ordinary watercourses have been identified within, or in the vicinity of, the site.

Critical Drainage Area	The south and south-eastern corner of the site are located within Critical Drainage Area 'Group4_036' which extends across the Woolwich Industrial Estate.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 90%** **FZ2 – 94%** **FZ1 – 6%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent are two of the regions of raised ground to the west of the site, and the road stretching from the Connaught Bridge/ Connaught Road roundabout. This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.8% Max depth – 0.3-0.6m Max velocity – 0.5-1.0m/s **1% AEP** – 5.1% Max depth – 0.6-0.9m Max velocity – 0.5-1.0m/s **0.1% AEP** – 16.0% Max depth – 0.9-1.2m Max velocity – 0.5-1.0m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 3.21% Max depth – 0.85m Max velocity – 0.43m/s **1% AEP** – 5.81% Max depth – 0.86m Max velocity – 0.43m/s

	0.1% AEP – 20.35% Max depth – 0.97m Max velocity – 1.03m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The Silvertown ICM surface water model was used in the assessment of surface water flooding.* *Where ICM modelling is available, this modelling is more detailed assessment of surface water flood risk and should take precedence over the RoFfSW dataset, and therefore this is what has been used to describe the risk below.* **Description of surface water flow paths:** The site is impacted by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding covers 3.21% of the site. Flooding mainly occurs as isolated surface water ponding across the site, notably surrounding Millenium Mills, Silverworks Island, Charles Street and surrounding roads within the industrial estate. Flood depths during this event are generally under 0.4m, with the maximum flood depth of 0.85m adjacent to the Rank Hovis Premier Mill. Additionally, flood velocities are generally below 0.2m, with the exception of Charles Street where floodwater velocity extends to 0.37m/s. Hazard during this event is predominantly 'very low' or 'danger for some,' although hazard classifications extend to 'danger for most' surrounding the Rank Hovis Premier Mill. During the 1.0% AEP event, surface water flooding now covers 5.81% of the site. The surface water ponding patterns (extents, depths and velocities) within the site are extremely similar to the 3.3% AEP event. Hazard within the site is still generally rated as 'very low' or 'danger for some,' although hazard across a larger proportion of the site (now Rank Bovis Premier Mill and Charles Street) is now classed as 'danger for most.' Finally, during the 0.1% AEP event, surface water flooding now covers 20.35% of the site. Flooding across the site now entirely covers the south-east of the site, with further surface water pooling to the north-west of the site surrounding Millenium Mills, and in the centre of the site within the car parks. There is also now a surface water flow path extending between Mill Road (beyond the site boundary) and Millenium Mills. Flood depths within the site are generally up to 1.0m, with the greatest depths surrounding the Rank Hovis Premier Mill and Charles Street. Flood velocities are predominantly below 0.5m/s, although this extends to 0.95m/s along the Mill Road/ Millenium Mills flow path. Hazard ratings across the site are now rated between 'very low' and 'danger for most,' with a significantly greater proportion of the south-east corner of the site rated as 'danger for most.' It is noted that there are some extreme depth and velocity values in small isolated areas within the site, these are likely due to a discrepancy in the underlying LiDAR data used in the Silvertown ICM model. This is unlikely to be representative of the actual site topography in this part of the site.
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the south-eastern corner of the site is at risk of flooding during the 'dry day' flood. This risk is posed by the William Girling Reservoir, which is managed by Thames Water. During the 'wet day' scenario, the site is at risk from eight reservoirs. Almost the entire site – except isolated areas of higher elevation within

	Silvertown Quays and Silverworks Island – is at risk of flooding from the Lockwood Reservoir. Additionally, the majority of the site is at risk from the William Girling reservoir, with flooding predicted to inundate the south-east corner of the site – extending into Silverworks Island, the southern and western fringes of the site, and the topographically low areas of the site within Silvertown Quays. The south-eastern corner, southern, western and northern fringes of the site are at risk from the Banbury and King George V reservoirs. Finally, the south-eastern corner and southern fringes of the site are predicted to be inundated during the High Maynard, Walthamstow No.4., Walthamstow No.5. and Warwick East reservoir floods. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site is located within a postcode area across the E16 1 (north-western corner of the site) and E16 2 (rest of the site) postcode areas. According to the Thames Water Hydraulic Sewer Flood Risk Register, the E16 1 postcode has 32 recorded incidences of sewer flooding, and E16 2 postcode has 94 recorded incidences of sewer flooding. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets has one record of flooding a small (800m^2) part of the west of the site adjacent to Mill Road. This occurred in March 1947 due to channel capacity exceeded and overtopping of defences. It is unknown how many properties were affected by this flooding. There are no incidents of flooding recorded within, or in 50m of, the site as per the London Borough of Newham Council's flood incident database
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 26.5%** **0.1% AEP tidal present day event proportion of site at risk – 27.1%**

	0.5% AEP tidal 2115 epoch event proportion of site at risk – 38.8% **0.1% AEP tidal 2115 epoch event proportion of site at risk – 47.2%** During the 0.5% AEP present day tidal breach, approximately 26.5% of the site is inundated. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. This flooding is concentrated in the centre of the site, within and surrounding Pontoon Dock, and also to the south-east of the site, where site topography is lowest. In the centre of the site, within and surrounding Pontoon Dock, flood depths are reasonably shallow (generally under 0.25m), with flood velocities generally below 0.23m/s. Associated flood hazard is rated as 'very low.' Alternatively, to the south-east of the site, flood depth and velocities are more significant, extending to 1.78m and 1.81m/s within and surrounding Charles Street. Associated flood hazard is rated as either 'danger for most' or 'danger for all,' with the highest hazard ratings adjacent to Charles Street and the southern boundary of the site. During the 0.1% AEP present day tidal breach, only a slightly larger portion of the site (27.1%) is inundated, with maximum flood depths and velocities now extending to 2.0m and 1.85m/s respectively. Flood hazard ratings within the site are largely similar to the 0.5% AEP present day event, although flooding within and surrounding Pontoon Dock is now rated as 'danger for some.' A larger proportion of the site is located within the 2115 epoch 0.5% and 0.1% AEP event Thames tidal downriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	Almost the entire site (except the areas of raised ground to the west and north-east of the site) is located within Environment Agency flood alert area (063WAT233N). This flood alert area surrounds the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham. Almost the entire site (except the areas of raised ground to the west and north-east of the site) is located within Environment Agency flood warning area (063FWT23RDockA). This flood warning area surrounds the Tidal Thames from Beckton Sewage Works to the River Lee.
Access and egress	The only current access and egress route into the site is Charles Street, accessed via North Woolwich Road. However, it is assumed that planned site access will be via Connaught Bridge, Mill Road/ Rayleigh Road or North Woolwich Road. Safe access and egress is shown to be affected during all modelling breach event in the present day and 2115 epoch. During the 0.5% 2115 present day Thames tidal breach, flood extents cover the majority (26.5%) of the site and surrounding access roads. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded

	area may actually be at risk, impacting safe access and egress routes into and from the site. On Mill Road/ Rayleigh Road, there is no flooding on the northern half of the road, so site access and egress would be possible from this part of the site. However, flood hazard to the south of the road is rated as 'danger for most' or 'danger for all' with flood depths during this event extending to 2.5m. Vehicular access and egress onto this southern half of the road would be extremely challenging. On North Woolwich Road, the entire road is inundated, with flood hazard rated as 'danger for all' with flood depths up to 2.7m. Vehicular access and egress using this road would be extremely challenging. Connaught Bridge road is also flooded during the 0.5% AEP 2115 epoch event, with flood hazard rated as 'danger for all' with flood depths up to 2.6m. Therefore, vehicular access and egress to and from the site using these roads would be extremely challenging. During the 1% AEP plus 40% allowance for climate change surface water flood event, there is flooding on all access routes to/ from the site. Flooding is the most extensive on North Woolwich Road, where flood hazard is rated as 'danger for most' along the road, with associated flood depths up to 0.66m. Alternatively, on Mill Road/ Rayleigh Road, there is only flooding on the southern half of the road, which is rated as either 'very low' or 'danger for some,' with a maximum depth of under 0.4m. Finally, with the exception of a small area of surface water pooling (rated as 'danger for most') on Connaught Bridge, there is minimal flooding. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal breaches** A greater proportion of the site (38.8%) is inundated during the 0.5% AEP 2115 epoch tidal breach compared to the 0.5% AEP present day tidal breach (26.5%). During this event, flooding is more extensive surrounding the Pontoon Dock, with floodwater now inundating a larger proportion of Silvertown Quays (now extending to Millennium Mills) and the car parks adjacent to the south of the Pontoon Dock. Flood depths surrounding Pontoon Dock still remain relatively shallow, although flood depths to the south-east of the site now extend up to 2.9m. However, flood velocities are still similar to the 0.5% AEP present day tidal breach, reaching a maximum of 1.82m/s in the south-east of the site. Resulting flood hazard is now rated as 'danger for most' surrounding Pontoon Dock and Silvertown Quays, and all of the south-east corner of the site is now rated as 'danger for all.' During the 0.1% AEP Thames tidal breach, 47.2% of the site is inundated, with flooding now inundating a greater proportion of Silvertown Quays, with floodwater extending to the Hovis Premier Mill and Silo D. There are

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increases in flood depths (now up to 3.24m) and velocities (now up to 1.85m/s). Associated flood hazard is rated as 'very low' in Silvertown Quays, 'danger for most' surrounding Pontoon Dock and still 'danger for all' in the south-east corner of the site.
The site is therefore very sensitive to increases in flooding caused by tidal breaches due to climate change.
Surface Water:
The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario.
In the 1% AEP plus 40% climate change event, the flood extent increases slightly from the 1% AEP event (and is not as extensive as the 0.1% AEP event). During the 1% AEP plus 40% climate change event, flooding in the south-east corner of the site is more widespread. Maximum flood depths now extend to 0.88m, and maximum velocities to 0.76m/s, with associated flood hazard generally classed as 'very low' or 'danger for some,' although hazard across some of the site (now Rank Bovis Premier Mill and Charles Street) is now classed as 'danger for most.' Therefore, the site is only slightly sensitive to changes in surface water flood patterns and magnitudes due to climate change.
Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
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<tr><td colspan="2">Requirements for drainage control and impact mitigation</td></tr>
<tr><td>Broad-scale assessment of possible SuDS</td><td>
Geology & Soils

Geology at the site consists of:

Bedrock – Bedrock geology across the majority of the site is the Lambeth Group (clay, silt and sand), which is a sedimentary bedrock. Bedrock geology in the north-west corner of the site is London Clay Formation (clay, silt and sand), which is also a sedimentary bedrock.
Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.

Soils at the site consist of:

Loamy and clayey soils of coastal flats with naturally high groundwater.

SuDS

The site is considered to have a moderate susceptibility to groundwater. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
BGS data indicates that the underlying geology is clay, silt and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance

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	with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a Nitrate Vulnerable Zone. • The majority of the site is located within Secondary A bedrock, with the north-west of the site located within an 'unproductive' aquifer designation zone. The entire site is located within a secondary (undifferentiated) superficial aquifer designation zones. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Silvertown ICM results mapping indicates the presence of surface water flow flooding within the site during the 0.1% AEP surface water flood. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development, and non-residential uses for educational establishments, as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception

	Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, in a critical drainage area (CDA), is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe :** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).

	• Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
	• The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the

	occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Silvertown ICM Surface Water Model and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.
Tidal extents, depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.

Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Stratford High Street Bingo Hall N8.SA4**
Address	Stratford High Street Bingo Hall, 341-353, High Street, Newham, E15 2 to E15 3.
Area	0.64ha
Current land use	Commercial (bingo hall and car park)
Proposed land use	Local Mixed Use – Residential and employment.
Flood Risk Vulnerability	Mixed - More Vulnerable and Less Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located within Stratford and borders the High Street (A118) to the north and Cam Road to the west and south. Burford Road runs parallel to the sites eastern boundary. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies approximately 470m east of the Waterworks River which flows into the River Lee. The site is also situated approximately 3.3km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography is relatively consistent. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. The lowest elevations are found in the south-eastern corner at around 3.48m AOD, and a small section along the site's eastern boundary where the elevations are approximately 3.94m AOD. The southern half of the site appears to be relatively uniform with elevations ranging from 4.20 to 4.73m AOD. The northern half of the site contains the highest elevations of between 5.21 to 5.92m AOD, the latter located near the northern tip of the site.
Existing drainage features	The south-western corner of the site is located approximately 440m east of the Waterworks River which flows into the River Lee 1.7km south of the site. The site is also approximately 3.5km north of the River Thames, which also marks the location of the confluence of the River Lee and the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are no drainage ditches within the site, however, LiDAR suggests the south-eastern corner of the site slopes in a southerly direction.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 12%** **FZ2 – 96%** **FZ1 – 4%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area*

	covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the northern tip of the site adjacent to Burford Road. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1%, 0.5% and 0.1% AEP modelled events. The nearest modelled fluvial flood extent is located along the railway line approximately 20m north of the site during the 0.1% AEP modelled fluvial event. Flood depths here reach around 0.8m with maximum velocities of <0.1m/s. The resulting hazard is 'Very Low' to 'Danger for Most'.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.0% Max depth – 0m Max velocity – 0m/s **1% AEP** – 2.5% Max depth – 0.3 – 0.6m Max velocity – 0 – 0.25m/s **0.1% AEP** – 9.9% Max depth – 0.3 – 0.6m Max velocity – 0.5 – 1.0m/s

	The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %). The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events only. The 1% AEP event surface water covers 2.5% of the site. The flooding only ponds in a small area of the east of the site across a section of the car park. Flood depths vary from 0 to 0.6m, with the deepest located in a small section along the eastern boundary where ground levels slope down slightly. The water flows at 0 to 0.25m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. The 0.1% AEP event surface water covers 9.9% of the site. In this event the aforementioned area of ponding extends further into the site from the 1% AEP outline. This ponding connects to a flow path along Burford Road to the east and south-east of the site. There is also ponding towards the south of the site near the entrance to the car park off Cam Road as well as along the southern boundary. The latter connects to a flow path which forms along Cam Road to the south of the site and Burford Road to the east and south-east. Flood depths vary from <0.15 to 0.6m. Most of the flood depths are 0.15 to 0.3m, with smaller areas of 0.3 to 0.6m situated in all three areas of ponding previously mentioned. Flood water flows at around 0 to 0.25m/s across most of the site, with smaller areas where it flows around 0.25 to 1m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where the lowest elevations are located within the south of the site and therefore water depths are greater, there are areas of 'Danger for Most'.
Reservoir	The southern half of the site is at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood and William Girling. These reservoirs are all managed by Thames Water and are deemed as high-risk. The southern half of the site is also at risk of Wet Day reservoir flooding from the following reservoirs: Wraysbury, West Warwick, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Stoke Newington (East), Stoke Newington (West), Queen Elizabeth II, King George V and High Maynard. These reservoirs are all deemed as high-risk and are all managed by Thames Water, except Stoke Newington (West) which is managed by Hackney Council. The William Girling, Banbury and Lockwood reservoirs pose a risk to the majority of the site, excluding the northern tip, during the Wet Day scenario. These reservoirs are all managed by Thames Water and are deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoir fails, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 109 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early

	development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within and surrounding the site. This occurred in 1947 due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest record of a flooding incident was on Ward Road, 105m west of the site, which occurred in 2018.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within the site. The nearest formal flood defences are situated along both banks of the Waterworks River approximately 420m south-west of the site. These consist of flood walls. The design standard of protection of these defences ranges from 200 to 1000 years. The area is also protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day epoch event proportion of site at risk – 0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 13.52%** The south and south-eastern section of the site is flooded in the 2100 epoch 0.5% AEP event Thames Upriver Tidal Breach event. Flood depths across these areas of the site vary from 0.004 to 0.82m. Flooding is deepest where there are topographic lows in the site, along the southern boundary and along a small section of the eastern boundary. Velocity of flood waters is 0m/s. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Very Low' to 'Danger for Most'. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062WAF53 Lower Lee Flood Alert Area in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire. The entire site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, pedestrian access is gained via a footpath on to Stratford High Street. Current vehicular access into the car park is possible via Cam Road to the west of the

	site. According to the Newham Draft Local Plan (2022), there is an additional pedestrian access route proposed located along Cam Road to the west of the site (adjacent to the current vehicular access) which will extend across the site to another access point along Burford Road towards the north-east of the site. It is also proposed that Burford Road will be accessed by vehicles from Stratford High Street. Burford Road leads into Cam Road, making it possible to access the site from the west along Cam Road. Safe access and egress is possible via all previously mentioned routes during all modelled tidal breach events in the present day epoch and the 2100 epoch. The one exception is along the proposed vehicular access route on Burford Road through to Cam Road during the 2100 epoch 0.5% AEP event. This is due to flooding on these roads to the east and south of the site. Flood depths are up to 1.30m along Cam Road. The resulting flood hazard varies from 'Very Low' to 'Danger for Most' where flood depths are deepest. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the 3.3% AEP surface water event, access and egress is possible on all mentioned routes into the site. However, there is some ponding along Cam Road to the south of the site which may impact the proposed vehicular access route from Stratford High Street on to Burford Road. Flood depths here reach 0.3 to 0.6m with velocities reaching 0.25 to 0.5m/s. The resulting hazard is 'Very Low' to 'Danger for Some'. It is likely that vehicular access and egress may be possible during this event. During the 1% AEP event, flooding affects a larger stretch of Cam Road, which encroaches Burford Road to the south of the site. Flood depths here are 0.15 to 0.6m. Flood water velocities are 0 to 0.5m/s with small areas along Cam Road and Burford Road reaching 0.5 to 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. There are small areas along Cam Road that are 'Danger for Most' meaning where flood waters are deepest and fast flowing, vehicular access will not be possible. During the 0.1% AEP event, flooding affects large sections of Cam Road to the south of the site and similarly large sections of Burford Road to the south and east of the site. Flood depths vary from <0.15m to areas along Cam Road that reach 0.9m. Flood water velocities reach 0.5 to 1.0m/s. The resulting flood hazard along Cam Road and Burford Road is 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access will not be possible. Access via Stratford High Street remains possible during the 0.1% AEP surface water event. During the surface water 1% AEP plus 40% allowance for climate change event, the extent is very similar to that of the 0.1% AEP event, hence affecting the same access and egress routes. The flood hazard along Cam Road and Burford Road is 'Very Low' to 'Danger for Most'. Therefore, vehicular access and egress may not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during these breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment**

	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The Thames Upriver 2100 epoch 0.5% AEP event is the only breach event to encroach the site in the south and along some of the eastern boundary. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a small percentage of the site is at risk during one breach event, the site is considered to be at medium risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the south and east of the site, and also towards the south of the site near the entrance to the car park off Cam Road. Flood depths also increase from around 0 to 0.6m (1% AEP event) to around 0.77m in the 1% plus 40% climate change event. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology of the site is the Lambeth Group (clay, silt and sand). This is sedimentary bedrock.
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in

	accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is also located within a Nitrate Vulnerable Zone. • The entire site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones. • The site is not located within an historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths beginning to form in areas surrounding the site during the 1% AEP event which become more pronounced during the 0.1% AEP event, connecting areas of ponding that were present in the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-	**Flood Risk Assessment:**

specific Flood Risk Assessment	Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2100 epoch for the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. • Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable). **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help

	inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 3 and Flood Zone 2, as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Central climate change surface water and fluvial events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee to indicate the impact on flood risk.
Fluvial & Tidal breach depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 **Strategic Flood Risk Assessment** **Detailed Site Summary Tables**

Site details

Site Code	**Stratford Station, N8.SA2**
Address	Stratford station and surrounds including land bounded by Montfichet Road, Stratford bus station and Jubilee, Broadway and Bridge House (E15 1 to E15 2).
Area	11.79ha
Current land use	Stratford station, tracks and depot, Stratford bus station, vacant land, school and office buildings.
Proposed land use	Re-provision of bus station and re-configured station for increased capacity, residential, town centre uses, education, open space and community facilities (if needed).
Flood Risk Vulnerability	Mixed - 'essential infrastructure,' 'more vulnerable,' 'less vulnerable' and 'water compatible development.'

Sources of flood risk

Location of the site within the catchment	The site is bounded by Montfichet Road to the west, and Stratford High Street and Great Eastern Road to the east. A car park is situated to the north of the site whilst the south of the site borders the railway line, Gibbins Road, Kennard Road and land east of Jupp Road. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies approximately 235m north-east of the Waterworks River. The Waterworks River flows from the River Lee approximately 630m west of the site before eventually converging with the River Lee again 1.8km south of the site. The site is also situated approximately 3.7km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations follow the paths of the Jubilee Line and the Docklands Light Railway (DLR) which cut diagonally across the site from the centre to south-eastern tip of the site. Elevations here range between around 1.20 to 3.69m AOD. The land surrounding this infrastructure and watercourse is relatively flat at around 4.12 to 4.92m AOD, with the south of the site being slightly more elevated at approximately 5.80m AOD. The area of the site in which the majority of the railway lines are located (from the south-west to the north of the site) has the highest elevations which range from 6.18 to 14.72mAOD.
Existing drainage features	The Waterworks River flows from the River Lee approximately 630m west of the site, before eventually converging with the River Lee again 1.8km south of the site. The site is also situated approximately 3.7km north of the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. Within the site there are two areas of vegetation within the south adjacent to Stratford Station Jubilee Line Offices, and in the south-western corner which is bounded by railway lines. These could act as drainage ditches. The former of these vegetated areas is also the location of the Channelsea River, which flows out of the site to the south. The lower lying land along the Jubilee line and the DLR could also act as a drainage ditch as this low elevation continues south of the site. There is also the Tommy Lee Sewer East Culvert which runs parallel to the railway line along a small section of the site's

	southern boundary. It runs from the south-western tip of the site to the Building Crafts College along Gibbins Road.
Critical Drainage Area	There is a Critical Drainage Area encroaching a small section of the northern boundary of the site. This is due to the flooded railway cutting as a result of runoff from land to the north.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 28%** **FZ2 – 33%** **FZ1 – 67%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 6.39%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The south-western corner and some of the southern boundary of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. There is also an area extending from the centre to the south-east of the site across Station Street which is within this dataset. These are the only areas within the site that are shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% AEP modelled events. During the 0.1% AEP fluvial modelled flood event, the area flooded follows the path of the Docklands Light Railway line which extends from the northern boundary through to the south-eastern corner of the site. Flood depths here reach around 0.8m with maximum velocities of 1.0m/s. The resulting hazard is 'Very Low' to

	'Danger for Most', the latter being located in the south-eastern corner of the site where flood depths are deepest.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.3% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 4.7% Max depth – >1.2m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 16.9% Max depth – >1.2m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event, surface water flooding only covers 1.3% of the site. Ponding occurs in locations across the site including along several sections of Station Street, the southern tip adjacent to Stratford High Street and the small section of land in the west adjacent to Montfichet Road. The 1% AEP event surface water extent covers 4.7% of the site. The flooding extends further around the 3.3% AEP outlines. There are also more areas of ponding within the site including along the railway line and in a vegetated area within the south of the site adjacent to Stratford Station Jubilee Line Offices. Flood depths vary greatly from 0 to >1.2m, with the majority of flooded areas having depths of between 0.15 to 0.6m. Most of the water flows at 0 to 0.25m/s, but there are small areas where water flows at between 0.25 to 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most', the latter being located in areas where flooding is deepest, including the south-eastern corner of the site and areas along the railway lines in the south-west and north. The 0.1% AEP event surface water extent covers 16.9% of the site. In this event the aforementioned areas of ponding across the site develop into flow paths. This is particularly prevalent in the south-east of the site where the majority of Station Street is encroached, and the flow paths follow the entire length of the DLR that runs south from Stratford Station. Flood depths vary greatly from <0.15 to >1.2m. Most of the flood depths are 0.15 to 0.6m. Flood water flows at around 0 to 1.0m/s across most of the site, with a small area in the south-east of the site where it flows up to 1.0 to 2.0m/s. The resulting flood hazard across the site is 'Very Low' to 'Danger for Most'. There are small areas in the southern tip and north of the site that are 'Danger for All' where flood depths are deepest.
Reservoir	The most extensive Dry Day reservoir flood event is the William Girling reservoir extent which encroaches the majority of the site, excluding the south-eastern tip of the site, and most of the railway line which runs from the south-west to the northern tip of the site. The Lockwood, High Maynard, Banbury and King George V reservoirs also encroach similar areas within the site, albeit not as extensively. These reservoirs are all managed by Thames Water Limited and are deemed high-risk. The William Girling reservoir extent covers the largest area in the site during the Wet Day reservoir flood event. This excludes small areas in the south-eastern corner and areas along the railway line from the south-west to the north of the site. Other reservoirs which encroach the site in similar areas but to a lesser extent

	include: Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Stoke Newington (East), Stoke Newington (West), Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick, William Girling and Wraysbury. These reservoirs are all managed by Thames Water Limited, except Stoke Newington (West) which is managed by Hackney Council. These reservoirs are all deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 373 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within the centre of the site. This occurred in 1947 due to the channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest incident occurred 112m east of the site at The Mall, Stratford, E15 in July 2021. This was due to heavy rain causing surcharging from sewers.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there is a formal flood defence along a small section of the site's southern boundary. This Natural High Ground runs parallel with the railway line from land south of Carpenters Road to the Building Crafts College off Gibbins Road. The design standard of protection of this defence is 5 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day epoch event proportion of site at risk – 0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 11.63%** The site is unaffected by flooding during the Present Day 0.5% AEP Thames Tidal Upriver Breach event. There are sections within the site that are affected by flooding during the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent. This includes the strip of land from the centre of the site (Stratford Station) to the south-eastern corner of the site, following the route of the DLR and Jubilee line. The majority of the southern boundary is also encroached, including the area of vegetation where the Channelsea River is situated. Excluding the previously mentioned flooding, this extent does not extend further into the site. Flood depths reach up to 2.78m in the south-eastern corner of the site. Water flows at a maximum velocity of 0.78m/s. The resulting hazard is between 'Very Low' to 'Danger for All', the latter being within the south-eastern corner where flood depths and velocities are greatest.

	Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in Environment Agency Flood Warning and Flood Alert Areas. It is located in the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest. The site is also located within the 063FWT23RDockC Flood Warning Area. This is situated within Mill Meads and East Plaistow.
Access and egress	Access and egress to the site is currently via a number of routes. At ground level to the west, pedestrian access is gained via Montfichet Road and proposed pedestrian access, as laid out in the Newham Draft Local Plan (2022), is via Westfield Avenue. Further proposed pedestrian access is to the south of the site through car parks off Gibbins Road and Kennard Road. To the east, there are two proposed pedestrian access routes on Great Eastern Road in addition to pedestrian and vehicular access which is already present along Station Street, connecting to Great Eastern Road. According to the Newham Draft Local Plan (2022), the proposal for a new raised street and bridge will offer additional pedestrian access to the south-eastern corner of the site from Stratford High Street, enabling access from this route to all previously mentioned pedestrian routes. Safe access and egress is possible along most routes during the 2100 epoch 0.5% AEP upriver breach scenario. The routes affected include the car parks off Gibbins Road and Kennard Road in the south of the site. Despite the area of the proposed access point in the south-east of the site on to Stratford High Street being flooded, this access will be raised and therefore may not be affected. During the 2100 epoch 0.5% AEP event, flood depths reach up to 2.78m in the south-eastern corner of the site. Water flows at a maximum velocity of 0.78m/s. The resulting hazard is between 'Very Low' to 'Danger for All', the latter being within the south-eastern corner where flood depths and velocities are greatest. This means that in the extreme 2100 epoch breach event, vehicular access and egress may not be possible along these access routes to the site. Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site is unaffected by flooding in this event, therefore safe access and egress is possible in this event. During the 3.3% AEP surface water event, access and egress via Station Street and on to Great Eastern Road is affected by small areas of ponding. The depth of this flooding is mostly 0.15 to 0.30m with mall areas on both roads reaching 0.30 to 0.60m. Flood water is mostly between 0 to 0.25m/s with small areas along Station Street and Great Eastern Road reaching 0.25 to 0.5m. The resulting flood hazard is 'Very Low' to 'Danger for Some' with small areas along Station Street reaching 'Danger for Most'. It is likely that vehicular access and egress may be impeded during this event. During the 1% AEP surface water event, the two aforementioned roads are the only affected access routes. The ponding extends further from the 3.3% AEP event covering both sides of Great Eastern Road adjacent to Station Street. Access is possible via all other routes. The depth of this flooding is 0.15 to 0.30m with small areas of 0.3 to 0.6m along both roads. Flood water generally flows at 0 to 0.25m/s

	with some areas along both roads reaching 0.5 to 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some' with small areas along Station Street and Great Eastern Road reaching 'Danger for Most'. It is likely that vehicular access and egress may be impeded during this event, particularly along Great Eastern Road and Station Street. During the 0.1% AEP surface water event, most access routes are affected by flooding. This excludes access via Westfield Avenue to the west and the footbridge access point in the south-east of the site. The pedestrian access via the car park off Gibbins Road in the south of the site is unaffected, however, Gibbins Road is affected by flooding either side of this access point. The depth of flooding along the affected routes varies from <0.15 to 0.9 to 1.2m. Flood water is fastest along Great Eastern Road and Station Street at 1.0m/s to 2.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. It is likely that vehicular access and egress is not possible during this event. During the surface water 1% AEP plus 40% allowance for climate change event, the extent covers a similar area to that of the 0.1% AEP event with similar flood depths and flood water velocities. The flood hazard along these routes is 'Very Low' to 'Danger for Most'. Therefore, vehicular access and egress may not be possible during this event. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site is unaffected by flooding in this event. **Tidal Breaches:** The Thames Upriver 2100 epoch 0.5% AEP event is the only breach event to encroach parts of the site. This includes the strip of land from the centre of the site (Stratford Station) to the south-eastern corner of the site, following the route of the DLR and Jubilee lines. The majority of the southern boundary is also encroached, including the area of vegetation where the Channelsea River is situated. Excluding the previously mentioned flooding, this extent does not extend further into the site. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a percentage of the site is at risk during this breach event, the site is considered to be at medium risk in the aforementioned breach scenario. This shows that the site is sensitive to increases in flooding from breach scenarios due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus

	40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. In this event the areas of ponding during the 1% AEP event across the site develop into flow paths. This is particularly prevalent in the south-east of the site where the majority of Station Street is encroached and the flow paths follow the entire length of the DLR that runs south from Stratford Station. Flood depths vary greatly from approximately 0.09 to 2.50m which is an increase from the majority of flood depths being 0.15 to 0.60m in the 1% AEP event. Flood water flows at between approximately 0.02 to 2.27m/s. The resulting flood hazard across the site is 'Very Low' to 'Danger for All'. This shows that the site is sensitive to increases in pluvial flooding due to climate change.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology within the site is the Lambeth Group (clay, silt and sand). This is sedimentary bedrock.
	  ○ Superficial - The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is located within Groundwater Source Protection Zones 1, 2 and 3. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints.
	• The site is also located within a Nitrate Vulnerable Zone.
	• The entirety of the site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones.
	• The site is not located within an historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths within the site during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies Stratford Train and Bus Station as 'Essential Infrastructure.' Residential and non-residential development (including educational institutions) are classed as 'More Vulnerable' development. Employment and non-residential institutions (excluding health centre, educational and nursery institutions) are classed as 'Less Vulnerable' development. As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test ('Essential Infrastructure'). As the site is within Flood Zone 3 and Flood Zone 2, classified as 'Essential Infrastructure' and has some surface water flood risk, the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2100 epoch for the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 3.3%, 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface

	Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development within 20m of a main river or flood defence will require specific planning permissions. • All major development and any new development falling within a Critical Drainage Area must reduce surface water run-off to greenfield run-off rates through the application of Sustainable Urban Drainage Systems and other design considerations. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. • Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable). **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to: • raise them as much as possible

	- consider moving vulnerable uses to upper floors - include extra flood resistance and resilience measures. • Other examples of flood resistance and resilience measures include: - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zones 2 and 3 as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'Highly Vulnerable' development is not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. 'More Vulnerable' and 'Essential Infrastructure' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event and the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change fluvial and surface water events, as well as the 0.5% AEP tidal event plus an allowance for climate change. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial & Tidal extent, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Stratford Town Centre West, N8.SA5**
Address	Land at Westfield Stratford City, north of London Aquatics Centre, E20 1.
Area	34.07ha
Current land use	Stratford International Station, Westfield shopping centre, vacant land, office, retail and leisure uses.
Proposed land use	Residential, employment, town centre uses, community facilities (if needed) and open space.
Flood Risk Vulnerability	Mixed - Essential Infrastructure, More Vulnerable, Less Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located within Stratford and borders Penny Brookes Street to the north. There are railway lines which border the east, south and west of the site. There is a small section along the eastern boundary which borders the A112. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies approximately 190m north of the Waterworks River which flows from the River Lee approximately 215m west of the site, before once more converging with the River Lee approximately 2km south of the site. The site is also situated approximately 4.1km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. The lowest elevations are found across a strip of land towards the north of the site at around -14.54 to -3.65m AOD. These elevations correspond with the excavated Stratford International railway station and the associated railway lines routed into and out of this station. Ground levels are highest in the south of the site reaching around 15.78m AOD which corresponds with the shopping centre, Westfield Stratford City. The section of the eastern boundary that juts out towards the A112 and the part of the site north of the aforementioned strip of land has relatively uniform elevation of between approximately 6.46 to 9.85m AOD. There are two areas within the north of the site which are low lying (along the northern boundary and extending north from the lowest lying strip of land) at around 0.94 to 2.38m AOD.
Existing drainage features	The site lies approximately 190m north of the Waterworks River which flows from the River Lee approximately 215m west of the site before once more converging with the River Lee approximately 2km south of the site. The site is also situated approximately 4.1km north of the River Thames, which also marks the location of the confluence of the River Lee and the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are no drainage ditches within the site. However, there is a wetlands area 130m north-west of the site which is fed by the River Lee via the Channelsea River. The latter is then culverted away from the site to the north via the Olympic

	Site North Culvert. As this wetland is topographically lower than the site, this could act as a drainage ditch for some of the site.
Critical Drainage Area	There is a Critical Drainage Area encroaching a small section of the northern boundary of the site. There is no further information pertaining to this CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 2%** **FZ2 – 28%** **FZ1 – 72%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 3.95%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency’s Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA’s Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency’s 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding **Flood characteristics:** The entirety of the site is outside of the Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The closest area that is within this dataset is located 2m south-west of the site along the railway. This area is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% AEP modelled events. During the 0.1% AEP modelled fluvial flood event, the area flooded follows the path of the Dockland Light Railway line which borders the west of the site before running through the south of the site from Endeavour Square to Montfichet Road in the south-east of the site. Flood depths reach around 0.2m

	with maximum velocities of 0.2m/s. The resulting hazard is 'Very Low' to 'Danger for Some'.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.2% Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s **1% AEP** – 3.3% Max depth – >1.2m Max velocity – 1.0 – 2.0m/s **0.1% AEP** – 12.8% Max depth – >1.2m Max velocity - >2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event surface water flooding only covers 1.2% of the site. There are small areas of ponding across the site, including within the railway cutting at Stratford International Station as well as along Westfield Avenue, Stratford City bus station and International Way. In the 1% AEP event surface water covers 3.3% of the site. The flooding extends further around the 3.3% AEP outlines, especially at the bus station, International Way and within Westfield Stratford City. There are also more areas of ponding and water impoundment within the railway cutting at Stratford International Station. Flood depths vary greatly from 0 to >1.2m, with the deepest in a low-lying strip of land between Westfield Avenue and The Street within Westfield Stratford City. The majority of the water flows at 0 to 0.25m/s, but varies from 0 to 2.0m/s. The fastest flowing water is mainly along the railway cutting and Montfichet Road. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. There are areas of 'Danger to Most' where flooding is deepest in areas including along the railway cutting, Westfield Avenue and the bus station. In the 0.1% AEP event surface water covers 12.8% of the site. In this event, flows paths begin to form within the railway cutting as well as along International Way and Penny Brookes in the north of the site. There is also more ponding at the bus station which connects to a flow path along Montfichet Road. There are more areas of ponding than during the 1% AEP event, which join to form a flow path along Westfield Avenue and within Westfield Stratford City. Flood depths vary greatly from <0.15 to >1.2m. Most of the flood depths are 0.15 to 0.6m. The deepest flooding occurs within Westfield Stratford City on low-lying land adjacent to Westfield Avenue. Flood water flows at around 0 to 1.0m/s, with very small areas where flows reach 1.0 to >2.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Most'. Where flood water is deepest on land between Westfield Avenue and The Street in Westfield Stratford City, there are areas of 'Danger for All'.
Reservoir	The railway cuttings for Stratford International and Stratford International DLR stations are at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping due to impoundment of water. The section of the site's eastern boundary that juts out towards the A112 is entirely encroached during the Dry Day extents as is the site's western and southern perimeter. This risk is posed by several reservoirs including

	Lockwood, King George V and William Girling, the latter of which has the largest extent within the site. These reservoirs are all managed by Thames Water and are deemed as high-risk. Similar areas are at risk of Wet Day reservoir flooding, although these extents are slightly larger with the only unaffected area in the north of site being land north of International Way. The south of the site is located within a dry island during both the Wet Day and Dry Day events. Although the aforementioned unaffected area within the north of the site is accessible from roads outside the site, this north-western corner of the London Borough of Newham is itself within a dry island during the Wet Day and Dry Day events. This Wet Day risk is posed by the following reservoirs: William Girling, West Warwick, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Stoke Newington (East), Stoke Newington (West), Lockwood, King George V, Highams Park Lake, High Maynard and Banbury. These reservoirs are all deemed as high-risk and are all managed by Thames Water, except Stoke Newington (West) which is managed by Hackney Council, and Highams Park Lake which is managed by City of London Corporation. These reservoirs are all managed by Thames Water and are deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoir fails, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 340 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within part of, and surrounding the site. This occurred in 1947 due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show one record of flooding within the site. This occurred in June 2021 at the Premier Inn which is situated along International Square, Westfield Stratford City, Montfichet Road towards the centre of the site.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within the site. The nearest formal flood defence is situated approximately 140m south-west of the site along the Waterworks River. This consists of a flood wall which has a design standard of protection of 0 years. There is also Natural High Ground approximately 200m west of the site along the Channelsea River with design standard of protection which ranges from 25 to 1000 years. The River Lee which flows approximately 215m west of the site has a flood wall along its left bank which has a design standard of protection of 1000 years. The area is also protected by the Thames Barrier and other secondary tidal defences along the Thames frontage and River

	Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee. The site is not at risk from an overtopping or breach of defences along the River Thames during the Present Day epoch and 2100 epoch 0.5% AEP Thames Upriver breach events. The nearest area affected by the 2100 epoch 0.5% AEP upriver breach event is situated approximately 90m south-east of the site at Stratford Station.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. The west and south of the site is located within the 062WAF53 Lower Lee Flood Alert Area in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire. The same area is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, vehicular and pedestrian access is gained via Celebration Avenue which leads on to International Way, and Montfichet Road which leads on to Penny Brookes Street. According to the Draft Newham Local Plan (2022), there will be two additional vehicular access routes between International Way and Penny Brookes Street. To the east, there are two proposed vehicular access routes via a car park, one which will lead over the railway cutting to an unnamed road and the other on to Angel Lane (A112). There is also a proposed pedestrian access route from the east of the site to footpath south of the site which crosses over the railway and leads on to Montfichet Road. To the south of the site, access is gained via Montfichet Road. To the west, current access is via Waterden Road which becomes Westfield Avenue within the site. There are also three proposed vehicular access routes which will stem from Westfield Avenue to the site’s south-western boundary, however it is not clear whether or not these will be routed over the railway line and on to Carpenters Road. Safe access and egress is possible via all previously mentioned routes during all modelled tidal breach events in the present day epoch and the 2100 epoch. The only affected route is when Montfichet Road becomes Warton Road 415m south of the site where there is some flooding during the 2100 epoch 0.5% AEP breach event. Flood depths here are up to 0.96m. The resulting flood hazard varies from ‘Very Low’ to ‘Danger for Most’ where flood depths are deepest. Since the site has ‘Essential Infrastructure’ the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. Flood waters are impounded along the railway line that borders the western to northern area of the site. The roads surrounding the site remain unaffected. During the 3.3% AEP surface water event, access and egress is possible on most of the previously mentioned routes into the site. However, there is some ponding along International Way and Westfield Avenue within the site as well as some ponding on the roundabout on Montfichet Road to the south of the site. Flood depths reach 0.15 to 0.6m with velocities mainly between 0 to 0.5m/s with the fastest water flowing at 0.5 to 1.0m/s along Westfield Avenue. The resulting hazard is ‘Very Low’ to ‘Danger for Some’. Where water is fastest flowing along Westfield Avenue, the flood hazard is ‘Danger for Most’. It is likely that vehicular access and egress may not be possible during this event, particularly where water is flowing faster.

	During the 1% AEP event, flooding affects a larger stretch of International Way and Westfield Avenue. There is also some ponding along some sections of Montfichet Road in the east of the site. Flood depths are mainly between 0 to 0.3m with areas along Montfichet Road reaching 0.3 to 0.6m, and ponding along Westfield Avenue reaching 0.6 to 0.9m. Flood water velocities are 0 to 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. There is a small area Westfield Avenue that is 'Danger for Most' meaning where flood waters are fastest flowing, vehicular access may not be possible. During the 0.1% AEP event, flooding affects a large section of International Way where there is flow path flowing along this road, Celebration Avenue and Penny Brookes Street in the north of the site. Surface water extends further along Montfichet Road, forming small flow paths, one of which connects to ponding on Westfield Avenue. A flow path also forms along the north of Westfield Avenue, connecting to a flow path along International Way. Flood depths vary from <0.15m to the section in the north of Westfield Avenue that reaches 0.6 to 0.9m. Flood water velocities vary from 0 to 2.0m/s along all aforementioned roads. The resulting flood hazard along these roads is 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access may not be possible. During the surface water 1% AEP plus 40% allowance for climate change event, the extent is very similar to that of the 0.1% AEP event, hence affecting the same access and egress routes. The flood hazard along these roads is 'Very Low' to 'Danger for Most'. Therefore, vehicular access and egress may not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during these surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The section of the site south of the railway cutting is located within a dry island during both the 'wet day' and 'dry day' reservoir flood events. Although the north of International Way within the north of the site is accessible from roads outside the site, this north-western corner of the London Borough of Newham is itself within a dry island during the Wet Day and Dry Day reservoir flood events, however this is considered to be residual risk. This must be considered in a flood warning and evacuation plan.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The western boundary of the site floods. This area of the site did not experience flooding during the 1% AEP event, and therefore the site is slightly sensitive to climate change. **Tidal Breaches:** The Thames Upriver 2100 epoch 0.5% AEP event does not encroach the site or surrounding access routes. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually

	be at risk. Since the site is not at risk during this breach event, the site is considered to be at low risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event, the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. Flows paths begin to form within the railway cutting as well as along International Way and Penny Brookes in the north of the site. There is also more ponding at the bus station which connects to a flow path along Montfichet Road. There are more areas of ponding than during the 1% AEP event along Westfield Avenue and within Westfield Stratford City. Flood depths also increase from being mainly around 0.15 to 0.6m during the 1% AEP event to a maximum of 3.95m on land where flood water is the deepest between Westfield Avenue and The Street in the 1% plus 40% climate change event. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the Lambeth Group (clay, silt and sand). This is sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Predominantly loamy and clayey soils of coastal flats with naturally high groundwater. There is a small area along the tip of the section along the eastern boundary adjacent to the A112 that consists of loamy soils with naturally high groundwater.
	
	SuDS
	
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is located within Groundwater Source Protection Zones. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints.
	• The entirety of the site is located within a Nitrate Vulnerable Zone.

	• The entire site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones. • The site is not located within an historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths within the site during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies railway stations as 'Essential Infrastructure' and residential development as 'More Vulnerable.' Non-residential institutions (excluding health centres, educational and nursery establishments) and employment development are classed as 'Less Vulnerable'. As there are multiple different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and classified as 'Essential Infrastructure' as well as being at risk of surface water flooding, the Exception Test is required for this site.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • All major development and any new development falling within a Critical Drainage Area must reduce surface water run-off to greenfield run-off rates through the application of Sustainable Urban Drainage Systems and other design considerations. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the Waterworks River. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. • Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable). **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.

	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ○ raise them as much as possible
	  ○ consider moving vulnerable uses to upper floors
	  ○ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ○ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ○ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ○ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at risk of flooding in Flood Zone 3 and Flood Zone 2, as well as being at pluvial flood risk in the 1% and 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in

	the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties. • A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA. • Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change fluvial and surface water events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan. • If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial & Tidal extent, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Sugar House Island, N7.SA3**
Address	Sugar House Island, land south of Stratford High Street and west of Three Mills Wall River, E15 2 to E3 3.
Area	10.47ha
Current land use	Vacant land cleared for development. Recently completed development on the site provides residential, industrial and employment uses, a school and retail.
Proposed land use	Residential, employment, open space, community facilities (if needed) and town centre uses.
Flood Risk Vulnerability	Mixed – More vulnerable,Less Vulnerable and open spaces
Sources of flood risk	
Location of the site within the catchment	The site is located south of Stratford extending from Stratford High Steet to the north, to Three Mills Wall River to the south and east. The London Borough of Tower Hamlets borders the west and south of the site along the River Lee. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies adjacent to Three Mills Wall River to the east and the River Lee to the west and south. St Thomas Creek lies approximately 105m north of the site, converging with the River Lee approximately 70m west of the site. The site is also approximately 2.7km north of the River Thames. The site is situated within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found within the centre and east of the site, which appear to correspond to areas that may have been excavated for development purposes. Elevations range between 1.68 to 2.71m AOD. The highest elevations (up to 7.62m AOD) are situated within the centre of the site, south of Cloud Street and east of Sugar House Lane. This corresponds to a residential building unit. The topography slopes down, dropping approximately 2.00m AOD towards the site's western boundary which borders the River Lee.
Existing drainage features	The site lies adjacent to Three Mills Wall River to the east and the River Lee to the west and south. St Thomas Creek lies approximately 105m north of the site, converging with the River Lee approximately 70m west of the site. The site is also approximately 2.7km north of the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. The land near the site's western boundary, which slopes down towards the River Lee, may act as a flow route to drain the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 54%**

	FZ2 – 100% **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended model outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0.13%** **0.5% AEP fluvial event – 1.52%** **0.1% AEP fluvial event – 14.91%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent are the southern tip, a small area of the northern tip and some of the northern boundary. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3% AEP modelled fluvial event. Less than 1% of the site is affected during the 1% AEP modelled fluvial event. During the 0.5% AEP modelled fluvial event, there are two small areas of flooding in the south and east of the site. Flood depths reach 0.1m. During the 0.1% AEP modelled fluvial event, a flow path forms along Sugar House Lane in the south of the site which branches off in several locations to form areas of ponding in the south and east of the site along Carpet Street and Zinc Street. Flood depths reach around 0.3m with maximum velocities of 0.6m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 2.2% Max depth – 0.3 – 0.6m Max velocity – 0.5 – 1.0m/s **1% AEP** – 5.0% Max depth – 0.6 – 0.9m Max velocity – 1.0 – 2.0m/s **0.1% AEP** – 16.0% Max depth – 0.6 – 0.9m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event, surface water flooding only covers 2.2% of the site. Flooding occurs where it ponds in some roads across the site, such as along Sugar House Lane and Carpet Street within the centre of the site. Maximum flood depths are 0.3 – 0.6m. Flood water velocity within the site varies from 0 to 0.25 to a maximum of 0.5 – 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' in areas where ponding is deepest. The 1% AEP event surface water covers 5.0% of the site. The flooding extends further around the 3.3% AEP outlines along the roads, such as from Sugar House Lane and Carpet Street. Flood depths vary from 0 to 0.15m, to small areas of 0.6 – 0.9m along Sugar House Lane. The majority of the water flows at 0 to 0.25m/s, but varies from 0 to 1.0m/s, with a small area along Sugar House Lane flowing between 1.0 – 2.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. There are very small areas of 'Danger to Most' where flooding is deepest along the corner of Carpet Street and Sugar House Lane and further north along Sugar House Lane. The 0.1% AEP event surface water covers 16% of the site. In this event the aforementioned areas of ponding further extend from the 1% AEP outlines along the entire stretch of Sugar House Lane, Carpet Street and almost the entire length of Hunt's Lane. Ponding also forms in the western corner of the site as well as Zinc Street and a fairly substantial section of Copperworks Wharf and the land adjacent to it. Flood depths vary from 0.15 to 0.9m. Most of the flood depths are 0.15 to 0.6m, with a small area of 0.9 to 1.2m located along Sugar House Lane. Flood water flows at around 0 to 0.25m/s across most of the site, with smaller areas where it flows up to 1.0 – 2.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where water is deeper, there are areas of 'Danger for Most'.
Reservoir	The Dry Day reservoir flood events encroach the site along its western, southern and eastern boundaries, entering the site from the east and forming areas of ponding in the centre. The King George V reservoir Dry Day flood event is the most extensive in this regard whilst the William Girling reservoir encroaches the entirety of the site except for small areas of dry islands present throughout the site. The other reservoirs that pose this risk include High Maynard and Lockwood. All these reservoirs are managed by Thames Water Limited and are deemed high-risk. The majority of the site is encroached by the Wet Day reservoir extents with small areas of dry islands present throughout the site, including along

	the western and southern boundaries as well as the northern tip of the site. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Stoke Newington (East), Stoke Newington (West), Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick, William Girling and Wraysbury. These reservoirs are all managed by Thames Water Limited, except Stoke Newington (West) which is managed by Hackney Council. These reservoirs are all deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 33 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding which encroached the entirety of the site. This occurred in 1947 due to the channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest incident occurred 90m north of the site in 2021.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are formal flood defences situated along the site's western, southern and eastern boundaries. These are along the banks of the River Lee and the Three Mill Wall River and consist of flood walls. The design standard of protection of these defences ranges from 5 to 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day event proportion of site at risk – 64.70%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 98.23%** The majority of the site is affected by flooding during the Present Day 0.5% AEP Thames Tidal Breach event. The areas not affected include the northern boundary, northern tip and some areas within the south of the site.

	The entirety of the site is affected by flooding during the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent. This excludes a very small section of the northern and western tips of the site. Flood depths across the site vary from 0.01m to 2.60m. Water flows at a maximum velocity of 2.05m/s with a resulting hazard between 'Very Low' to 'Danger for All'. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The entirety of the site is located in Environment Agency Flood Warning and Flood Alert Areas. It is located within the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The majority of the site, excluding some of the west of the site, is located within the 063WAT233N Tidal Thames in the London Boroughs of Havering, Barking and Dagenham, and Newham Flood Alert Area. The entire site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest. The majority of the site, excluding some of the west of the site, is located within the 063FWT23RDockC Flood Warning Area. This is situated within Mill Meads and East Plaistow.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, access is gained via Stratford High Street on to Sugar House Lane. To the west of the site, access is possible via Stratford High Street on to Hunt's Lane and an unnamed smaller road which leads on to Hunt's Lane. The latter two access points are the proposed vehicular and pedestrian route set out in the Newham Draft Local Plan (2022). Safe access and egress is only possible along Hunt's Lane along the northern boundary of the site during the Present Day 0.5% AEP upriver breach scenario. All other access routes during this event and the 2100 epoch 0.5% AEP upriver breach scenario are affected by flooding. During the 2100 epoch 0.5% AEP event, flood depths are up to 2.44m along Sugar House Lane. The resulting flood hazard varies from 'Very Low' along the unnamed road leading on to Hunt's Lane to 'Danger for All' along Sugar House Lane where flood depths are deepest. This means that in the extreme 2100 epoch breach event, vehicular access and egress is not possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the 3.3% and 1% AEP surface water events, access and egress is possible on all mentioned routes into the site. During the 0.1% AEP event, there is some surface water flooding along the roads mentioned above, except the unnamed smaller road which leads on to Hunt's Lane. The depth of this flooding is <0.15 to 0.6m. Flood water is fastest along Sugar House Lane on to Stratford High Street at 0.5 – 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. It is likely that vehicular access and egress may be possible during this event.

	During the surface water 1% AEP plus 40% allowance for climate change event, the extent covers a similar area to that of the 0.1% AEP event, hence the unnamed smaller road still being unaffected. The flood hazard along these routes is 'Very Low' to 'Danger for Some'. Therefore, vehicular access and egress should be possible. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island. However, during the Wet and Dry Day reservoir flood events, there are small isolated dry islands within the site along the western and southern boundaries as well as the northern tip of the site.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, there is no significant increase in fluvial flooding at the site during the 3.3% AEP +17% climate change (Central allowance) event, compared to the present day 3.3% AEP event. Flooding only occurs in a very small area along the site's southern boundary. There is a significant increase in fluvial flooding during the 1% AEP +17% climate change event, compared to its present day counterpart. During this climate change fluvial event, a flow path forms along parts of Zinc Street, Carpet Street and Sugar House Lane. Flood depths in the south of the site, where ponding increases in size, reaches a maximum of 0.17m, compared to the present day depths of 0.06m. Flooding also increases significantly during the 0.5% AEP +17% climate change compared to the present day 0.5% AEP event, from two areas of ponding in the latter to connecting flow paths which extend along the majority of Sugar House Lane. Maximum flood depths in the south of the site increase from around 0.03m to around 0.32m. This shows that the site is sensitive to climate change. **Tidal Breaches:** The Thames Upriver 2100 epoch 0.5% AEP event covers 33.53% more of the site than the Present Day epoch 0.5% AEP event. This excludes the northern and western tips and some areas within the south of the site. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a large percentage of the site is at risk during two breach events, the site is considered to be at high risk in the aforementioned breach scenarios. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario.

	In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. In this event, the ponding further extends from the 1% AEP outlines along the entire stretch of Sugar House Lane, Carpet Street and almost the entire length of Hunt's Lane. Ponding also forms in the western corner of the site as well as Zinc Street and a fairly substantial section of Copperworks Wharf and the land adjacent to it. Flood depths increase from an average of around 0 to 0.15m (1% AEP event) to around 0.7m in the 1% plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology within the western corner of the site is the London Clay Formation (clay, silt and sand) whilst the rest of the site is the Lambeth Group (clay, silt and sand). These are sedimentary bedrocks.
	  ○ Superficial - The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is located within a Nitrate Vulnerable Zone.
	• The majority of the site is located within the Secondary A aquifer (bedrock) designation zone. The entirety of the site is located within the Secondary (undifferentiated) aquifer designation (superficial drift) zone.
	• The site is not located within an historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event, however these do not connect with any areas of ponding within the site. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' development. Non-residential institutions (not including health centres, educational and nursery establishments) and employment development is classed as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are several flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception TestAs the site is within Flood Zone 3 and Flood Zone 2, classified as 'More Vulnerable' and has some surface water flood risk, the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2100 epoch for the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way.

- Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.
- All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.
- Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
- Development within 20m of a main river or flood defence will require specific planning permissions.
- The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lea.
- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
- Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable).

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.

	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  • raise them as much as possible
	  • consider moving vulnerable uses to upper floors
	  • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 and 3 as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Central climate change fluvial and surface water events, as well as the 0.5% AEP tidal event plus an allowance for climate change. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information	
The key datasets used to make planning recommendations for this site were the Environment Agency’s Flood Map for Planning, the Environment Agency’s Risk of Flooding from Surface Water map and the Environment Agency’s Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency’s Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency’s Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial & Tidal depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill’s River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency’s Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency’s RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N3.SA4**
Address	Land At Thameside West and Carlsberg Tetley Dock Road, Silvertown, E16 1
Area	18.53ha
Current land use	Mixed Use
Proposed land use	Essential transport infrastructure, residential, employment, community facilities (if needed), education, main town centre uses and open space.
Flood Risk Vulnerability	Mixed – Essential Infrastructure, More Vulnerable, Less Vulnerable and Water Compatible.
Sources of flood risk	
Location of the site within the catchment	The site is located to the south-west of Newham within the Royal Victoria neighbourhood. The western site boundary is parallel to the River Lee (Bow Creek) and southern site boundary parallel to the River Thames, with the western corner of the site adjacent to the confluence of the Rivers Lee and Thames. The east of the site is bounded by Bell Lane, and north of the site by the A1020 Lower Lee Crossing/ Silverton Way. There are a number of transport infrastructure services within the site. The Docklands Light Railway (DLR) dissects the centre of the site from the north-west to south-east. The site also contains a mooring point for the Riverbus Service and sits within the IFS Cloud Cable Car protection zone, which runs over the site. Finally, the site also includes the proposed entrance of the Silvertown Tunnel, linking Silvertown with the Greenwich Peninsula, which has a proposed opening date of 2025. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is adjacent to the Rivers Lee and Thames, and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations vary between -0.16 and 9.24mAOD. Site elevations are greatest parallel to the Rivers Lee and Thames, where elevations are raised between 4.40mAOD and 9.24mAOD. The elevations across the site are significantly lower to the centre of the site, surrounding Scarab Close, and to the south-east of the site, adjacent to Bell Lane. The lowest elevations within the site (-0.16mAOD) are found in an area of lowered ground to the centre of the site adjacent to the DLR line.
Existing drainage features	The site is adjacent to the River Lee (Bow Creek) and River Thames.
Critical Drainage Area	The site is not located within a CDA.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 88%** **FZ2 – 99%** **FZ1 – 1%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames and Lee are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. This site is parallel to the River Lee. However, the River Lee remains in bank adjacent to the site for all modelled defended flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the north-western tip of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.3% Max depth – 0.30-0.60m Max velocity – 0.25-0.50m/s **1% AEP** – 3.5% Max depth – 0.60-0.90m Max velocity – 0.50-1.00m/s **0.1% AEP** – 11.8% Max depth – >1.20m Max velocity – 1.00-2.00m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 1.6% Max depth – 0.27m Max velocity – 0.43m/s **1% AEP** – 2.0% Max depth – 0.27m Max velocity – 0.41m/s

	0.1% AEP – 4.1% Max depth – 0.30m Max velocity – 0.77m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The entire site is covered by the Environment Agency's Risk of Flooding from Surface Water mapping. The Silvertown ICM surface water model was also available to assess surface water flood risk in the south-eastern third of the site (extending from the south-east corner of the site westwards up to the Expressway London Community Centre).* *Where the ICM modelling is available, this modelling is more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset. For the rest of the site (westwards from the Expressway London Community Centre) the Environment Agency's Risk of Flooding from Surface Water mapping was used.* **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding extends across 1.3% of the site according to the RoFSW dataset. This flooding is predominantly isolated surface water ponding in topographic depressions within the site. Maximum flood depths (0.3-0.6m) and velocities (0.25-0.50m/s) are located in the centre of the site surrounding Scarab Close and the DLR line. Associated flood hazard across the site is rated as either 'very low' or 'danger for some.' According to the Silvertown ICM model, during 3.3% AEP event, there are three isolated surface water pools in the south-eastern corner of the site. Only one of these pools – which is adjacent to Bell Lane – are present in the RoFSW dataset. Maximum flood depths are 0.27m and 0.43m/s, both located in the south-eastern corner of the site. Associated flood hazard is rated as either 'very low' or 'danger for some.' During the 1% AEP event, according to the RoFSW dataset, surface water flooding extends across 3.5% of the site. Flooding across the site is more extensive during this event, with further surface water pools appearing in the north, centre and south-east of the site. Maximum flood depths (0.6-0.9m) and velocities (0.5-1.0m/s) are still located to the centre of the site surrounding Scarab Close. Flood hazard during this event is generally rated as either 'very low' or 'danger for some,' although extends to 'danger for most' where the deepest and fastest floodwaters are found in the centre and north of the site. According to the Silvertown ICM model, during the 1% AEP event, flooding in the south-eastern corner of the site is slightly more extensive. Maximum flood depths (0.27m) and velocities (0.41m/s) are extremely similar to the 3.3% AEP Silvertown ICM modelling, and still located adjacent to Bell Lane. Flood hazard is still rated as either 'very low' or 'danger for some' during this event. During the 0.1% AEP event, according to the RoFSW dataset, surface water flooding extends across 11.8% of the site. Flooding across the north, centre and south-east of the site is significantly more extensive. This flooding is most notable on Scarab Close, the A1020 Lower Lee Crossing/ Scarab Close roundabout, and beneath the DLR line adjacent to the topographic low point within the site. Maximum flood depths (>1.2m) are located surrounding Scarab Close and beneath the DLR line and maximum flood

	velocities (1.0-2.0m/s) on Scarab Close. Flood depths within the site range between 'very low' and 'danger for most' during this event. According to the Silvertown ICM model, during the 0.1% event, flooding in the south-eastern corner of the site is extremely similar to the 0.1% AEP RoFSW outputs. Maximum flood depths and velocities extend to 0.30m and 0.77m/s, which are located in the easternmost corner of the side on the DLR line. Associated flood depths are still rated as 'very low' or 'danger for some.'
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the north-eastern and south-eastern corners of the site are at risk of flooding during the 'dry day' reservoir flood. This risk is posed by the William Girling Reservoir, which is managed by Thames Water. During the 'wet day' scenario, almost the entire site (except some isolated areas of raised ground across the site) are at risk from the following reservoirs: Banbury, King George V, Lockwood and William Girling. Additionally, the centre and north-east of the site are at risk from the following reservoirs: Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5 and Wraysbury. Finally, the north-eastern and south-eastern corners of the site are at risk from the High Maynard and Warwick East reservoirs. All of these reservoirs are managed by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within the E16 1 postcode area which has 32 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's recorded flood outlines database, there have been two recorded flood incidents within the site. The majority of the site – with the exception of two areas of raised ground to the north and centre – flooded in Spring 1947. This was caused by the channel capacity of the River Lee/ Thames exceeded, prior to raised defences being installed. Additionally, the centre of the site flooded during the January 1953 flood event. This was a tidal and fluvial flood event, where the channel capacity of the River Lee/ Thames was exceeded, again prior to raised defences being installed. As per the London Borough of Newham's flood incident database, there are no recorded incidents of flooding within, and in 50m of, the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and

	tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. Tidal flooding at the site was assessed using the Environment Agency's Thames Estuary Upriver Breach Assessment model and the Environment Agency's Thames Estuary Downriver Breach Assessment. As both tidal breach assessment datasets are available, the breach assessment with the conservative model outputs for the site should take precedence in this assessment of residual risk. As such, the Environment Agency's Upriver Breach Assessment model was used within this assessment of tidal flooding. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 64.7%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 75.2%** During the 0.5% AEP tidal present day flood event, approximately 64.7% of the site is inundated. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. This flooding is concentrated to the north-east of the site, surrounding the A1020 Lower Lee Crossing/ A1011 Silvertown Way, and in the south-eastern corner of the site. The maximum flood depths within the site (2.01m) are located to the north-east of the site adjacent to the A1020 Lower Lee Crossing/ A1011 Silvertown Way roundabout. The maximum flood velocities extend to 5.04m/s, located to the south-east of the site adjacent to the River Thames. Nevertheless, flood depths and velocities across the majority of the site are below 0.01m and below 0.02m/s. Associated flood hazard is classed as 'danger for most' across the majority of the site, with three isolated areas to the north, north-east and south-east of the site classed as 'danger for all,' corresponding with where the greatest flood depths and velocities within the site are located. A larger proportion of the site is located within the 2110 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames and Lee are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site within Environment Agency Flood Warning and Flood Alert Areas. The site is located across three Environment Agency Flood Alert Area. The western-most and south-west of the site parallel to the River Thames is located in Flood Alert Area 063WAT23Central for River Thames riverside from the Thames Barrier to Putney Bridge. The majority of the site – with the exception of two isolated areas to the north and centre – is located in Flood Alert Area 063WAT233N for flooding from the Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham. Finally, the north and centre of the site is located within Flood Alert Area

	062WAF53LowerLee covering the Lower River Lee from Hoddesdon to Canning Town. The site is located across two different Environment Agency Flood Warning Areas. The majority the site – with the exception of two isolated areas to the north and centre of the site – is located in Flood Alert Area 063FWT23RDockA for the Tidal Thames between Beckton Sewage Works to the River Lee. Additionally, the west of the site is located within Flood Alert Area 062FWB53TidalLee covering the lower River Lee from West Ham to Canning Town.
Access and egress	Access and egress to the site is currently available via two routes. Firstly, there is a roundabout in the north-eastern corner of the site which can be accessed when travelling from Scarab Close. From here, the site can be exited to the north-west using the A1020 Lower Lee Crossing, to the east via the Western Gateway, and to the south-east via the A1020 Silvertown Way. Additionally, the site can be exited to the east via Bell Lane and Dock Road onto the North Woolwich Way. North Woolwich Road Leeds onto the A1020 Silvertown Way, where from here you can travel in a north-westerly or easterly direction. Safe access and egress is shown to be affected during all modelled Thames tidal breach events in the present day and 2100 epoch. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. During the 0.5% AEP 2100 Thames tidal breach, flood hazard on all identified access and egress routes is rated as 'danger for all,' with flood depths on these roads extending to 2.1m. Therefore, vehicular access to and from the site would be extremely challenging during this event. Safe access and egress is not impacted by River Lee flooding. Although the site is adjacent to the River Lee, the River Lee remains in bank adjacent to the site for all modelled defended flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. Surface water flooding access and egress routes were assessed using the RoFSW dataset as this covers the entire site and surrounding access and egress routes. During the 1% AEP plus 40% allowance for climate change surface water flood event, there is flooding on all access and egress routes to from the site. Access and egress via the Scarab Close exit routes would be extremely challenging, with flood depths surrounding the roundabout extending to 1.1m, with flood hazard rated as 'danger for most.' Access and egress via Dock Road/ Bell Lane/ North Woolwich Road would be challenging, with flood depths extending to 0.5m on North Woolwich Road, and associated hazard classed as 'danger for most.' Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	During the 0.5% present day tidal Thames breach, there is no predicted flooding in the centre and west of the site. This part of the site is a 'dry island' as flood depths on the surrounding A1020 Lower Lee Crossing, Heartwell Avenue and A1020 Lower Lee Crossing/ Silvertown Way extend up to 1.64m, with associated flood hazard rated as either 'danger for most' or 'danger for all.'

Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** As the development includes 'Essential Infrastructure' the higher central climate change allowance should be assessed. According to the River Lee hydraulic model, the site is not at an increased risk of fluvial flooding during the 3.3% AEP +27% climate change (higher central allowance), 1% AEP + 27% climate change and 0.5% AEP + 27% climate change as these extents remain in bank and do not enter the site. **Tidal Breaches:** During the 0.5% AEP 2100 epoch Thames tidal upriver breach, the majority of the site (75.2%) is inundated by floodwater. There is significantly more extensive flooding in the centre of the site surrounding the DLR line compared to the 0.5% AEP present day event. This event is associated with extreme flood depths – extending to 4.7m in the centre of the site adjacent to the DLR line – and velocities – extending to 5.4m/s to the north-west of the site along the DLR line. During this event, the majority of the site is classed as 'danger for all,' although the south-west of the site is classed between 'very low' and 'danger for most' as flood depths and velocities are significantly shallower in this part of the site. The site is therefore very sensitive to increases in flooding caused by tidal breaches due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the north-east and south-east of the site, accumulating on the roads and streets and other impermeable surfaces. Flood depths also increase from around 0.6 to 0.9m (1% AEP event) to around 1.5m in the 1% plus 40% climate change event. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology across the site is London Clay Formation (clay, silt and sand), which is also a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial

	deposit formed of unconsolidated detrital material deposited by a body of running water. • Soils at the site consist of: ○ Loamy and clayey soils of coastal flats with naturally high groundwater. **SuDS** • The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. • BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a Nitrate Vulnerable Zone (NVZ). • The entire site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones. • There is a historic landfill (Western Entrance Lock) located to the southeast of the site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public

	open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies 'essential transport infrastructure' as essential infrastructure. Additionally, residential development is classed as 'More Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, Canal and Rivers Trust and the Environment Agency should be undertaken at an early stage. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lee. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan,

including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.

- The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 epoch 0.5% AEP Thames tidal breach extents.

Guidance for site design and making development safe :

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
- The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
- Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
- London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g., raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.

	• Other examples of flood resistance and resilience measures include:
	  • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, least refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model, the Silvertown ICM Surface Water model, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk. This fluvial climate change allowances have been assessed using the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	Fluvial - This has been assessed using the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal breach – This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map and Silvertown ICM Surface Water model (2015) has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Stratford Central, N8.SA1**
Address	Land at Great Eastern Road, Stratford High Street, the Grove and the Broadway including Stratford Centre, E15 1 & E15 4.
Area	21.0ha
Current land use	Commercial (Stratford Shopping Centre), parking and road infrastructure, education, hotel, office, leisure and food and drink uses.
Proposed land use	Residential, town centre uses, employment, community facilities, civic uses, health centre and open space.
Flood Risk Vulnerability	Mixed – 'More Vulnerable,' 'Less Vulnerable' and 'water compatible development.'
Sources of flood risk	
Location of the site within the catchment	The site is located within Stratford and borders Great Eastern Road to the west and north. Park Avenue also borders a small section of the northern boundary in the north-eastern corner. Stratford High Street, which becomes the Broadway, dissects the site from the south-western corner through to the eastern boundary. The south and eastern boundaries of the site run parallel with several residential streets south of the Broadway, including Victoria Street and Mantle Way. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies approximately 560m east of the Waterworks River which flows into the River Lee. The site is also situated approximately 3.6km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. Generally, the western half of the site is of lower elevation than the eastern half. The lowest elevations are found in the south-western corner at around 3.60m AOD, with small pockets of lower elevations predominantly found along the site's southern and eastern boundaries. The lowest of these elevations is around 0.96m AOD which corresponds to the Stratford Magistrates Court custody vehicles underground entrance. The highest elevations within the eastern half of the site are around 9.04 to 9.62m AOD, the highest of which corresponds to a raised car park off Great Eastern Road to the north of the site.
Existing drainage features	The south-western corner of the site lies approximately 560m east of the Waterworks River which flows into the River Lee. The site is also situated approximately 3.6km north of the River Thames, which also marks the location of the confluence of the River Lee and the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are small areas of vegetation within the residential south of the site. The largest area of vegetation, however, is within the centre of the site, north of the Broadway on land surrounding St John's Church. This may be able to act as a drainage ditch.

Critical Drainage Area	There is a Critical Drainage Area encroaching a small section of the south-western tip of the site. This is due to the flooded railway cutting as a result of runoff from land to the north.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 3%** **FZ2 – 4%** **FZ1 – 96%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended model outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0.04%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The southern tip of the site and a section of the western boundary are located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. These are the only areas within the site that are shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% AEP modelled events. During the 0.1% AEP fluvial modelled event, there is a very small section of the south-western boundary which is encroached, however this flooding does not extend further into the site. Flood depths here reach 0.8m with maximum velocities of <0.1m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.8% Max depth – >1.2m Max velocity – >2.0m/s **1% AEP** – 5.4% Max depth – >1.2m Max velocity – >2.0m/s **0.1% AEP** – 18.2% Max depth – >1.2m Max velocity - >2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. The 3.3% AEP surface water event covers 1.8% of the site. Small areas of ponding are present throughout the site, the largest being in the north of the site across the access road to car parks off Great Eastern Road. Most flood depths vary from 0 to 0.6m. The entrance to Stratford Centre in the north and the underground custody vehicles entrance in the south have ponding where flood depths reach 0.9 to 1.2m and >1.2m, respectively. The water mainly flows at 0 to 0.5m/s with the aforementioned areas in the north reaching 0.5 to 1.0m/s and the previously mentioned ponding in the south reaching >2.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for All', however the latter is only situated in a small area of ponding in the south of the site where flood water is deepest and fastest flowing. The 1% AEP surface water event covers 5.4% of the site. The number of areas of ponding throughout the site increases from the 3.3% AEP event with there being a noticeable increase in ponding along the Broadway in the south of the site. Flood depths vary from 0 to 0.6m, with the deepest reaching between 0.6 to >1.2m in small, low lying sections along the southern, eastern and towards the northern boundaries. The water mainly flows at 0 to 0.5m/s with small sections in the south reaching >2.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most'. Where water is deepest and fastest flowing, the flood hazard is 'Danger for All'. The 0.1% AEP surface water event covers 18.2% of the site. In this event, the aforementioned areas of ponding extend further from the 1% AEP event with some connecting to form paths. This is especially the case along the Broadway, the Grove, Stratford High Street and Great Eastern Road. Flood depths vary greatly from <0.15 to >1.2m. Most of the flood depths are <0.15 to 0.3m, with the deepest water located in small pockets of land which are low lying. Flood water flows at around 0 to 2.0m/s across most of the site, with the previously mentioned area in the south of the site reaching velocities of >2.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Most'. Where the lowest elevations are located within the south of the site and therefore water depths are greater, there are areas of 'Danger for All'.
Reservoir	The western and southern sections of the site are at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. The William Girling reservoir has the largest extent where there are also some dry islands within these areas of the site. The King George V, Lockwood, High Maynard and Banbury only encroach small sections along the site's southern

	and western boundaries. These reservoirs are all managed by Thames Water and are deemed as high-risk. A larger area within the west and south of the site is also at risk of Wet Day reservoir flooding from the following reservoirs: Wraysbury, West Warwick, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Stoke Newington (East), Stoke Newington (West), Queen Elizabeth II, King George V, High Maynard, Banbury, Lockwood and William Girling. These reservoirs are all deemed as high-risk and are all managed by Thames Water, except Stoke Newington (West) which is managed by Hackney Council. There are also areas of dry islands during the Wet Day reservoir event, the largest of which are within the south of the site. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The western third of the site is shown to have negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. The eastern third of the site is shown to be at low risk of groundwater flooding, and any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. The central third of the site, along with a small section adjacent to the eastern boundary, is shown to be at moderate risk of groundwater flooding, and any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. Further consideration of the local level of risk and mitigation is recommended.
Sewers	The site is located within a postcode area with 786 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has no records of flooding within the site. The nearest recorded event took place approximately 30m south of the site in 1947. This was due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show four records of flooding within the site. These occurred along Chant Street (September 2014) and the Broadway (July 2021) in the south, The Mall (July 2021) in the west, and along Broadway (September 2014) in the centre of the site. Of these, the flood incident along the Mall is the only one which has a known cause and was due to heavy rain causing the sewer system not to cope. The causes of the other flooding incidents are not known.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.

	The Environment Agency's AIMS dataset also shows there are no formal flood defences within the site. The nearest formal flood defences are situated along both banks of the Waterworks River approximately 560m west of the site. These consist of flood walls. The design standard of protection of these defences ranges from 0 to 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal 2005 epoch event proportion of site at risk – 0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 1.69%** The site is unaffected by flooding during the Present Day 0.5% AEP Thames Upriver Tidal Breach event. The southern tip of the site is the only area affected by flooding during the 2100 epoch 0.5% AEP event Thames Upriver Tidal Breach event. Flood depths in this area of the site are around 0.01 to 0.62m with the deepest flood water found in topographic low spots along the boundary of the southern tip of the site. Velocity of flood waters is 0m/s in this area. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Very Low' to 'Danger for Most'. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	Section along the western and southern boundaries of the site are located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062WAF53 Lower Lee Flood Alert Area in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire. The site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	At ground floor level, there are several access and egress routes. To the south of the site, vehicular access and egress is gained via Stratford High Street, Tramway Avenue (which becomes West Ham Lane), Chant Street (which becomes Pitchford Street) and Bridge Road. According to the Draft Newham Local Plan (2022), proposed pedestrian access in the south is via Stratford High Street and Bridge Road. To the north, vehicular access is via Angel Lane and the Grove whilst pedestrian access is gained via Manbey Street where there is a footpath leading on to Park Avenue. There is a proposed pedestrian access route which will be via Lavender Street. To the east, vehicular access is via Romford Road (A118). The Newham Draft Local Plan (2022) also proposes various pedestrian access routes at a new roof level. To the west, access is gained via a footpath from West Mall, across Great Eastern Road to Meridian Square as well as a second route across Great Eastern Road to Station Street. To the north, access is gained via a footpath connecting Great Eastern Court to Great Eastern Road. All these roof level pedestrian routes converge at Stratford Shopping Centre.

	Safe access and egress is possible via all previously mentioned routes during all modelled tidal breach events in the present day epoch. Most routes are also unaffected during the 2100 epoch 0.5% AEP breach event, excluding some routes within the south of the site. This includes access via Bridge Road and Chant Street. Flood depths are up to 0.75m along Bridge Road. The resulting flood hazard varies from 'Very Low' to 'Danger for Most' where flood depths are deepest. Access and egress may be compromised along Bridge Road. Safe access and egress is possible during all present day modelled AEP fluvial flood events, including during the 1% AEP +17% CC fluvial event. The only exception to this is during the 0.1% AEP modelled fluvial flood event, where the access routes via Stratford High Street and Bridge Road are affected. Flood depths here reach 0.8m along Stratford High Street with maximum velocities of <0.1m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. During the 3.3% AEP surface water event, access and egress is possible on all routes into the site. There is some ponding along Great Eastern Road in the west of the site which may affect this vehicular route which connects to previously mentioned access points. Flood depths here are 0.15 to 0.3m with velocities between 0 to 0.25m/s. The resulting hazard is 'Very Low'. It is likely that vehicular access and egress will not be affected during this event. During the 1% AEP event, flooding affects several more access routes. Ponding extends across both sides of Great Eastern Road in the west of the site whilst ponding in Manbey Street will affect pedestrian access to Park Avenue in the north. There is also ponding along Stratford High Street and the Broadway in the south. A flow path forms along Bridge Road approximately 255m south of the site which will affect access and egress via this route. Flood depths reach up to 0.3 to 0.6m. Flood water velocities reach a maximum of 0.5 to 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. It is likely that vehicular access and egress will not be affected during this event. During the 0.1% AEP event, ponding and flow paths affect all previously mentioned access routes, either at the point of access or further down the roads where it is not possible to avoid. Flood depths vary from <0.15m to 0.6m with water velocities reaching 1.0 to 2.0m/s. The resulting flood hazard along these roads is 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access may not be possible. During the surface water 1% AEP plus 40% allowance for climate change event, the extent is very similar to that of the 0.1% AEP event, hence affecting the same access and egress routes. The flood hazard along these roads is 'Very Low' to 'Danger for Most'. Therefore, vehicular access and egress may not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during these surface water and breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	There are sections within the west and south of the site which are in dry islands during both the Wet Day and Dry Day reservoir flood events. There are also some very small dry islands in the north of the site during the Wet Day reservoir flood event.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment**

	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The Thames Upriver 2100 epoch 0.5% AEP event is the only breach event to encroach the site. This event only encroaches the southern tip of the site. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a small percentage of the site is at risk during one breach event, the site is considered to be at medium risk in the aforementioned breach scenario and is sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. In this event, the areas of ponding extend further from the 1% AEP event with some connecting to form paths. This is especially the case along the Broadway, the Grove, Stratford High Street and Great Eastern Road. The flooding extends further into the low-lying areas in the south and east of the site, and also towards the south of the site near the entrance to the car park off Cam Road. Flood depths increase from what was mainly around 0 to 0.6m (1% AEP event) to a maximum 4.74m in the 1% plus 40% climate change event within the south of the site. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology of the site is the Lambeth Group (clay, silt and sand). This is sedimentary bedrock.
	    ○ Superficial – The superficial geology of the western half of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water. The eastern half of the site is Taplow Gravel Member (sand and gravel).
	• Soils at the site consist of:
	    ○ The western half of the site is loamy and clayey soils of coastal flats with naturally high groundwater. The eastern half the site is loamy soils with naturally high groundwater.

	SuDS • Part of the site is considered to have low to moderate susceptibility to groundwater flooding. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site. • BGS data indicates that the underlying geology is a mixture of clay, silt, sand, peat and gravel which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is not located within a Nitrate Vulnerable Zone. • The entire site is located within the Secondary A bedrock aquifer designation zone. The west of the site is within the Secondary (undifferentiated) superficial zone whilst the east of the site is within the Secondary A superficial aquifer designation zone. • The site is not located within an historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.

	• SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and health centres as 'More Vulnerable' development. Employment uses and non-residential institutions (not including health centres, education and nursery developments) are classed as 'Less Vulnerable'. Open spaces is classed as 'water compatible development.' As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, classified as 'More Vulnerable' and at risk of surface water flooding, the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2100 epoch for the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • All Major development and any new development falling within a Critical Drainage Area must reduce surface water run-off to greenfield run-off rates through the application of Sustainable Urban Drainage Systems and other design considerations. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance;

	London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
	
	Guidance for site design and making development safe:
	
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the

	requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at risk of flooding in Flood Zone 3 and Flood Zone 2, as well as being at pluvial flood risk in the 1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Central climate change fluvial and surface water events, as well as the 0.5% AEP tidal event plus an allowance for climate change. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee to indicate the impact on flood risk.
Fluvial & Tidal breach extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N1.SA1 Beckton Riverside**
Address	Gallions Reach Retail Park and Beckton Gas Works, Beckton, E6 7
Area	84.7 ha
Current land use	Local Mixed Use – Essential transport infrastructure, industrial and employment uses, retail, car parks, vacant industrial land and open space.
Proposed land use	Essential transport infrastructure, residential, employment uses, community facilities, health centre, education uses, leisure centre (if needed), town centre uses and open space.
Flood Risk Vulnerability	Local Mixed– 'Essential infrastructure', 'More Vulnerable', 'Less Vulnerable and 'water compatible development.'
Sources of flood risk	
Location of the site within the catchment	This large 80ha site is located in Beckton, with the south-eastern boundary of the site adjacent to the River Thames. The site is boarded by the Beckton Sewage Treatment works to the north, and the A1020 Royal Docks Road and Docklands Light Railway (DLR) line to the west. The south of the site is adjacent to Gallions Reach, Magellan Boulevard and Atlantis Avenue to the south. The site currently includes the Beckton DLR Depot, and DLR line between Gallions Reach and Beckton. The site is located within the Roding, Beam and Ingrebourne Catchment. The catchment is 516km^2 and extends from the rural areas of Uttlesford, Brentwood, Epping Forest and Forest towards urbanised north-east London. This site lies adjacent to the River Thames, and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations vary between -3.51mAOD and 10.54mAOD. Site elevations are lowest to the west of the site, where the DLR transitions from overground to underground below the A1020 Royal Docks Road. Additionally, site elevations are lower in the centre of the site (under 3.20mAOD) corresponding with the location of the former Beckton Gas Works. The rest of the site is relatively flat, with site elevations generally above 4.5mAOD.
Existing drainage features	The River Thames is adjacent to the south-eastern site boundary. There is a 0.8ha attenuation pond located in the south-eastern corner of the site serving Gallions Reach. There are no other drainage ditches within the site, however, the topographically low-lying areas mentioned above could act as a drainage ditch for some of the site.
Critical Drainage Area	The site is not located within a critical drainage area (CDA).

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 94%** **FZ2 – 98%** **FZ1 – 2%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent are some isolated regions of partially raised ground in the centre of the site surrounding Armada Way and the Gallions Reach Shopping Centre. This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.8% Max depth – 0.6-0.9m Max velocity – 0.25-0.50m/s **1% AEP** – 5.4% Max depth – >1.2m Max velocity – 0.50-1.00m/s **0.1% AEP** – 18.2% Max depth – >1.2m Max velocity – 1.00-2.00m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g., 100-year includes the 30-year %).* *The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment.* **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP surface water event, flooding only covers 1.8% of the site. Flooding mainly occurs as isolated surface water ponding at the

	topographically low parts within the site, notably surrounding Gallions Reach and the former Beckton Gas Works. Flood depths within the site are generally between 0.0-0.6mFlood water velocity within the site varies from 0 to 0.25m/s, to a maximum of 0.5m/s. The resulting flood hazard varies from 'Very to Low' to 'danger for some' across the majority of the site, although hazard is rated as 'danger for most' at the approach to the DLR line underpass to the west of the site. During the 1% AEP surface water flooding event, flooding covers a larger portion of the site (5.4% of the site). This is still largely confined to Gallions Reach and the former Beckton Gas Works. Maximum flood depths and velocities within the site generally reach up to 0.6-0.9m and 0.5-1.0m/s, although these extend to over 1.20m at the approach to the DLR line underpass. Flood hazard during this event is similar to the 3.3% AEP event, with a slightly larger portion of the site classed as 'danger for most.' During the 0.1% AEP surface water flooding event, flooding covers approximately 18.2% of the site. Flooding now extends across the site as larger surface water pools within Gallions Reach, the former Beckton Gas Works, DLR Beckton Depot and Armada Way. Flood depths and velocities within the site are still generally confined to a upper limit of 0.6-0.9m and 0.5-1.0m/s. Maximum flood depths and velocities are still greatest at the approach to the DLR line underpass, where these extend to over 1.2m and 1.0-2.0m/s. Resulting flood hazard within the site is still between 'very low' and 'danger for most,' with the approach to the DLR line underpass rated as 'danger for all.'
Reservoir	The entire site is shown to be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. According to the Environment Agency's 'risk of flooding from reservoirs' datasets, the site is not at risk during the dry day reservoir flood. During the wet day scenario, flood risk is posed to the centre of the site surrounding the former Beckton Gas Works and Gallions Reach from the following reservoirs: Banbury, King George V, Lockwood, William Girling and Wraysbury. All these reservoirs are managed and operated by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with two recorded incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Recorded Flood Outlines map, there are no recorded incidents of flooding within the site. The London Borough of Newham's flood incident database includes two records of flooding within the site. The most recent of these flood records occurred in May 2018 within the Gallions Reach Retail Park, where the

	roadway and pavement flooding. No further details about this flood event were recorded. Additionally, another flood incident was recorded as the junction between the A1020 Royal Docks Road and Armada Way, where flooding to a depth of 600mm was recorded.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 30.7%** **0.1% AEP tidal present day event proportion of site at risk – 39.9%** **0.5% AEP tidal 2115 epoch event proportion of site at risk – 66.9%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 75.3%** During the 0.5% AEP tidal present day flood event, approximately 30.7% of the site is at risk. Flooding occurs across a large portion of the Gallions Reach Retail Park, as well as adjacent to the River Thames to the east of Armada Way. Flood depths within the site are generally below 1.0m, although extend to 1.9m to the north-east of the site, east of Armada Way. Flood velocities extend to 2.5m/s within the site, which are greatest adjacent to the River Thames. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification is classed between 'very low' and 'danger for most' surrounding Gallions Reach, with flood hazard adjacent to the River Thames generally classed as either 'danger for most' or 'danger for all.' During the 0.1% AEP tidal present day flood event, a larger portion of the site (39.9%) is at risk of tidal breach. There is more extensive flooding onto Atlantis Avenue and within Gallions Reach Retail Park. During this event, flood depths now extend to 2.2m adjacent to the Gemini Business Park. Flood velocities are still greatest adjacent to the River Thames, where they extend up to 4.52m/s. Resulting flood hazard classifications within the site are still similar to the 0.5% AEP tidal present day ratings. The site is also located within the 2115 epoch 0.5% AEP and 0.1% AEP event Thames tidal downriver breach extents which are described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located across two Environment Agency flood alert areas. The entire site is located within an Environment Agency flood alert area (063WAT233N) which covers the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham. The east of

	the site adjacent to the River Thames is also located within an additional Environment Agency flood alert area (063WAT23East) covering the River Thames riverside from Dartford Creek and The Mardyke to the Thames Barrier. The site is also located across two Environment Agency flood warning areas. The west of the site (west of the Beckton Gas Works and Hornet Way) is located within an Environment Agency flood warning area (063FWT23RDockB) covering the River Thames at Beckton including Canning Town, Custom House, and Beckton. The rest of the site is located within an Environment Agency flood warning area (063FWT23RDockA) surrounding the Tidal Thames from Beckton Sewage Works to the River Lee.
Access and egress	Access and egress to the site is possible via the A1020 Royal Docks Road, which is parallel to the western site boundary. This road can be accessed using the Armada Way/ A1020 Royal Docks junction, and the Atlantic Avenue/ A1020 Royal Docks junction. From here, the site can be exited by travelling north or south along the A1020 Royal Docks Road, or travelling south then west via the A1020 Royal Albert Way. Vehicular safe access and egress is not impacted during the modelled present day Thames breach events, but it impacted during the modelled 2115 epoch Thames breach events. During the 2115 epoch tidal Thames flood event, safe access and egress from the site would be extremely challenging, as there are patches of flooding on the A1020 Royal Docks Road. Flood depths on the A1020 Royal Docks Road extend to 0.6m when travelling north onto the A1020 Royal Docks Road, and up to 0.63m when travelling south instead. Associated flood hazard is classed as 'danger for most' on these roads. During the 0.1% AEP 2115 epoch Thames tidal event, there is flooding along the entirety of the A1020 Royal Docks Road. Flood depths along this road extend to a maximum of 1.2m, with associated hazard ratings on the road rated as 'danger for most' or 'danger for all.' Alternatively, during the 1% AEP plus 40% allowance for climate change surface water flood event, there is isolated surface water flooding on the A1020 Royal Docks Road. Flood depths along this road extend to approximately 0.35m, with associated flood hazard largely rated as either 'very low' or 'danger for some.' Therefore, vehicular access and egress will still likely be possible. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: Roding, Beam and Ingrebourne.** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** During the 0.5% AEP 2115 epoch tidal breach event, a larger proportion of the site (66.9%) is at risk compared to the 0.5% AEP present day event.

	Flooding now encroaches the centre of the site, including the Former Beckton Gas Works, Beckton DLR Depot and Atlantis Avenue. Flooding within the site is generally below 2.0m, although flood depths extend to 2.7m adjacent to the Gemini Business Park. The hazard rating for the majority of the site is rated as 'danger for most,' with land adjacent to the River Thames and isolated regions within the Gallions Reach Retail Park classed as 'danger for all.' Finally, during the 0.1% AEP 2115 epoch Thames tidal breach event, 75.3% of the site is at risk of tidal breach. There is more extensive flooding within the former Beckton Gas Works and to the south of Atlantis Avenue during this event. Flood depths extend to 2.9m during this event, located within the same part of the site as the 0.5% AEP 2115 Thames tidal breach. Most of the site is classed as 'danger for most' during this event, with isolated regions within the Gallions Reach Retail Park and former Beckton Gas Works classed as 'danger for all.' The site is therefore very sensitive to increases in flooding caused by tidal breaches due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event, the flood extent with in site increases, with more extensive flooding within the former Beckton Gas Works and within the Gallions Reach Retail Park. However, the flood extent is not as extensive as the 0.1% AEP present day event. Flood depths during this event are generally below 0.9m, with hazard rated between 'very low' and 'danger for some' within the site. Flood depths and hazard ratings within the site are still greatest at the DLR line approach to the underpass, where flood depths extend to 2.7m and hazard is rated as 'danger for most.' Therefore, the site is only reasonably sensitive to changes in surface water flood patterns and magnitudes due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    ○ Bedrock – There are four different types of bedrock located within the site. The north-west corner of the site is London Clay Formation (clay, silt and sand), which is a sedimentary bedrock. Bedrock at the centre of the site, surrounding the former Beckton Gas Works and Beckton DLR Depot, is Lambeth Group (clay, silt and sand), and the bedrock surrounding Armada Way is Thanet Formation (Sand). These are both sedimentary bedrocks. The bedrock at the south-eastern corner of the site is chalk (Lewes Nodular, Seaford Chalk and Newhaven Chalk).
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:

	◦ Loamy and clayey soils of coastal flats with naturally high groundwater. **SuDS** • The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. • BGS data indicates that the underlying geology within the site which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a Nitrate Vulnerable Zone. • The site is located across three different aquifer designations – principal to the south-east of the site, secondary A in the centre of the site, and unproductive in the north-west of the site. The entire site is located within a secondary (undifferentiated) superficial aquifer designation zones. • The site has an area within its boundary designated by the Environment Agency as being a historic landfill site. A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water results mapping indicates the presence of surface water flow flooding within the site during the 3.3% AEP, 1% AEP and 0.1% AEP surface water flood. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.

	• Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies essential transport infrastructure as 'essential infrastructure.' Residential development, and non-residential uses for educational establishments are classed as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2 the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, in a critical drainage area (CDA), is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.

	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe :** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that

	flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to: • raise them as much as possible • consider moving vulnerable uses to upper floors • include extra flood resistance and resilience measures. • Other examples of flood resistance and resilience measures include: • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an

	appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan. • If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Silvertown ICM Surface Water Model and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Tidal extents, depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.

JBA consulting	**London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables**
Site details	
Site Code	**Stratford Waterfront South N8.SA6**
Address	Land to the south of the ArcelorMittal Orbit, north of Sidings Street and east of City Mill River E20 2 and E15 2.
Area	5.85ha
Current land use	Vacant land. Part of the site under construction.
Proposed land use	Education, residential, employment, retail and open space.
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable and Water Compatible Development.
Sources of flood risk	
Location of the site within the catchment	The site is located within Stratford and borders Sidings Street to the south, and City Mill River to the west. Thornton Street runs along the site's northern boundary whilst Montfichet Road borders the east. The Waterworks River flows through the centre of the site for 125m, across the north and south boundaries. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies approximately 15m east of the City Mill River which flows from the River Lee approximately 440m north of the site before once more converging with the River Lee 650m south of the site. The Waterworks River, which flows through the site, flows from the River Lee approximately 590m north of the site before eventually converging with the River Lee again 1.5km south of the site. The site is also situated approximately 3.6km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. The lowest elevations are found in the centre of the site within the Waterworks River, land around the banks of the river is at around 4.31m AOD. The southern boundary to the east of the Waterworks River and north-eastern tip of the site also have low elevations of approximately 4.53m AOD. The land either side of the Waterworks River within the site is relatively flat with higher elevations. To the west, elevations range from 9.03m AOD to 10.34m AOD. To the east, elevations range from 6.58m AOD to 8.15m AOD, with a low spot to the east of the Waterworks River where land dips to 4.33m AOD.
Existing drainage features	Land along the western boundary of the site slopes down towards the City Mill River which is situated 15m east of the site. The Waterworks River flows through the site from the River Lee approximately 590m north of the site before eventually converging with the River Lee again 1.5km south of the site. The southern boundary to the east of the Waterworks River and north-eastern tip of the site are of lower elevations than other areas, which may help to drain water out of the site. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges.
Critical Drainage Area	The site is not located within a CDA.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 29%** **FZ2 – 30%** **FZ1 – 70%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended model outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0.26%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the northern half of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. There is also a small area along the western bank of the Waterworks River that is within this extent. The rest of the site is not within this extent. This means that half of the site is shown to benefit from defences (although may still be at some risk). Although the Waterworks River runs through the site, according to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% AEP modelled events as the flood water remains in bank. During the 0.1% AEP event, there is a small area flooded along one bank of the Waterworks River within 45m of the southern boundary. Flood depths here reach 0.1m with velocities remaining at 0m/s. The resulting hazard is 'Very Low'.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% Max depth – 0m Max velocity – 0m/s **1% AEP** – 0.4% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **0.1% AEP** – 2.9% Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events only. The 1% AEP event surface water covers 0.4% of the site. However, this extent is channelled by the Waterworks River due to the land being lower-lying, and does not encroach any land within the site. The 0.1% AEP event surface water covers 2.9% of the site. In this event there is some ponding along one side of the Waterworks River bank at the end of a towpath. There is also some ponding along the southern boundary of the site within a car park as well as a very small area of ponding along the western boundary, extending from the water that is channelled by the City Mill River. Flood depths vary from <0.15 to 0.6m. Most of the flood depths are 0.15 to 0.6m, with a small area of 0.6 to 0.9m located within the car park in the south of the site. Flood water flows at around 0 to 0.25m/s across most of the site, with a small area along the western boundary where it flows up to 0.5 – 1.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where water is deeper, there are areas of 'Danger for Most'.
Reservoir	The Dry Day reservoir flood events encroach the site along the flow path of the Waterworks River, the southern boundary north of this watercourse and the north-eastern tip of the site. The King George V and William Girling reservoir Dry Day flood events are the most extensive as these are the only two which encroach the north-eastern tip of the site, in addition to the other previously mentioned areas. The other reservoirs that pose a risk during the Dry Day flood event include: West Warwick, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Lockwood, High Maynard and Banbury. All these reservoirs are managed by Thames Water Limited and are deemed high-risk. The same areas are affected during the Wet Day reservoir flood event albeit the extents being slightly larger. There is also flooding along the entire length of the outskirts of the western boundary, with a small area in the south-western corner being encroached. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Stoke Newington (East), Stoke Newington (West), Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick, William Girling and Wraysbury. These reservoirs are all managed by Thames Water Limited, except Stoke Newington (West) which is managed by Hackney Council. These reservoirs are all deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.

Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 33 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has no record of flooding within the site. The nearest recorded flood outline is located approximately 35m west of the site. This occurred in 1947 due to the channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest incident occurred approximately 160m south-east of the site along Biggerstaff Road in September 2021.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are formal flood defences situated within the site. These include flood walls along both banks of the Waterworks River which flows through the centre of the site. The separate Olympic Park Wall is located adjacent to the Waterworks River flood wall to the east. These flood walls have design standards of protection which range from 0 to 1000 years. The eastern bank of the City Mill River adjacent to the site's western boundary has natural high ground as a formal defence which has a design standard of protection of 1000 years. There is also natural high ground which spans from the north-eastern tip of the site across to the southern boundary where it crosses Montfichet Road. The design standard of protection for this defence is 5 years.
Residual risk	The Environment Agency's Thames Estuary Downriver and Upriver Breach models were assessed for tidal flooding within this site. However, neither of these models encroach the site, therefore posing no residual risk to this area. The nearest area affected by the 2100 epoch 0.5% AEP Thames tidal upriver event is 155m to the west of the site along Marshgate Lane.
Emergency planning	
Flood warning	The eastern half of the site including the Waterworks River is located in Environment Agency Flood Alert Areas. It is located within the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The majority of the eastern half of the site, excluding some areas of the south-east, is located within the 063WAT233N Flood Alert Area. This is in the London Boroughs of Barking and Dagenham, Bexley, Greenwich, Havering, Newham and Tower Hamlets as well as Thurrock in Essex. The eastern half of the site including the Waterworks River is located in the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest. The majority of the eastern half of the site,

	excluding some areas of the south-east, is located within the 063FWT23RDockC Flood Warning Area. This covers the London Boroughs of Newham and Tower Hamlets.
Access and egress	Access and egress to the site is currently via a number of routes. Pool Street provides access to the site in the north of the site as well as to the south on to Montfichet Road. In the north-eastern corner of the site, access is gained via a road leading on to Carpenters Road. In the south-western corner, there is access to a car park along Sidings Street. The Newham Draft Local Plan (2022) has not provided any proposed new vehicle or pedestrian access routes, therefore it is not clear whether there will be suitable vehicular access along Thornton Street to the north of the site, although pedestrian access and egress is possible along this road. Safe access and egress is shown to be unaffected during all modelled Upriver and Downriver tidal breach assessments. The only exception to this is during the 2100 epoch 0.5% AEP upriver breach event. Despite there being no flooding within the site during this event, there is some ponding along Marshgate Lane, leading into Sidings Street to the south-west of the site. This may affect access to the car park in the south-west of the site. Flood depths here are up to around 1.33m. The resulting flood hazard varies from 'Very Low' to 'Danger for Most' where flood depths are deepest. This means that in the extreme 2100 epoch breach event, vehicular access and egress may not be possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC modelled fluvial event. During the 3.3% AEP surface water event, access and egress is possible on all mentioned routes into the site, excluding the north-eastern corner of the site leading on to Carpenters Road. Here, there is a small area of ponding. Flood depths reach 0.3 to 0.6m, with flood water flowing up to 0.25 – 0.5m/s. The resulting hazard is 'Very Low' to 'Danger for Some'. During the 1% AEP event, there is further surface water flooding along the affected roads mentioned during the 3.3% AEP event. The depths of this flooding are 0.3 to 0.6m. Flood water velocities vary between 0 to 0.5m/s. The resulting hazard is 'Very Low' to 'Danger for Some'. Therefore, access and egress is still possible to the site. During the 0.1% AEP event, flooding affects a larger stretch of Carpenters Road, forming a flow path which then ponds to the south-east of the site. There is also some ponding along Marshgate Lane to the west, which becomes Sidings Street to the south of the site. This may affect access to the car park in the south-west of the site. Flood depths vary from <0.15m to small areas of up to 1.2m along some of Marshgate Lane. Flood waters reach up to 1.0 to 2.0m/s. The resulting flood hazard along 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. along Marshgate Lane and Carpenters Road. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects the same access routes as those mentioned during the 0.1% AEP event because these extents are very similar in size. The flood hazard along Carpenters Road and Marshgate Lane 'Very Low' to 'Danger for Most'. Therefore, vehicular will not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during these surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.

Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding during the 3.3% AEP +17% climate change (Central allowance) as this extent does not enter the site. Compared to the present day 1% and 0.5% AEP events where there is no flooding within the site, there are small areas of flooding along the bank of the Waterworks River to the south of Iron Bridge during these events with the Central allowance for climate change. Maximum flood depths during the 1% AEP +17% climate change event and the 0.5% AEP +17% climate change event reach 0.03m and 0.06m, respectively. There is a significant increase in fluvial flooding during the 1% AEP +17%. **Tidal Breaches:** The Thames Upriver and Downriver breach extents for the Present Day epoch and 2100 epoch for the 0.5% and 0.1% AEP events do not encroach the site. However, it is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases from the 1% AEP event. The flood extent is similar to the 0.1% AEP event. There is a small area of ponding within the car park in the south-west of the site as well as a very small area of flooding along the site's western boundary from the City Mill River. Flood depths also increase from 0m (1% AEP event) to around 0.60m in the 1% plus 40% climate change event. This shows that the site is relatively sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation	
Broad-scale assessment of possible SuDS	**Geology & Soils** ● Geology at the site consists of: ○ Bedrock – Bedrock geology in the site is the Lambeth Group (clay, silt and sand). This is sedimentary bedrock. ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water. ● Soils at the site consist of: ○ Loamy and clayey soils of coastal flats with naturally high groundwater.

	SuDS • The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. • BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is located within Groundwater Source Protection Zones 2 and 3. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints. • The site is also located within a Nitrate Vulnerable Zone. • The entirety of the site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones. • The site is not located within an historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths beginning to form in areas surrounding the site as well as along the Waterwork River through the site during the 0.1% AEP event, connecting areas of ponding that were present in the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	

Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential and educational development as 'More Vulnerable' and employment and retail development as 'Less Vulnerable'. Open space is water compatible development. As there are several flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as access and egress routes for the proposed development site are at tidal flood risk from the 2100 epoch for the 0.5% AEP breach event of the River Thames (upriver), and is shown to be at surface water flood risk in the 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development within 20m of a flood defence will require specific planning permissions. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the Waterworks River. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.

- Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat (where applicable).

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
    - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
- The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
- The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the

	requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zones 2 and 3. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'Highly Vulnerable' development is not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Central climate change fluvial and surface water events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning and the Environment Agency's Risk of Flooding from Surface Water map. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee to indicate the impact on flood risk.
Fluvial & Tidal breach extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables

Site details

Site Code	**Plaistow North, N9.SA1**
Address	Plaistow Road, E13 0
Area	1.85ha
Current land use	Vacant site that was a former car showroom and servicing facility, as well as Plaistow Station railway tracks (brownfield)
Proposed land use	Residential, town centre uses, childcare facility and open space.
Flood Risk Vulnerability	Mixed - 'More Vulnerable,' 'Less Vulnerable' and 'Water Compatible' development.

Sources of flood risk

Location of the site within the catchment	The site is located south of Plaistow Road (A112) and north of Plaistow railway station. Corporation Street runs parallel with the site's western boundary from the western to the northern tips. The south-western corner of the site extends across the railway line to land west of Whitelegg Road. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies 780m east of Channelsea which flows into Bow Creek approximately 1.4km south-west of the site. The Bow Creek then becomes the River Lea which converges with the River Thames approximately 2.7km south of the site. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is in a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found in the south-west where there is a railway cutting. Ground levels here are as low as 0.7m AOD. The highest elevations are situated along the northern boundary where ground levels reach around 6.0m AOD. This corresponds with a section of the A112 which is raised in contrast to adjacent land to the north. Land between these two areas is relatively flat with elevations ranging from approximately 2.1m AOD to 3.5m AOD. This corresponds with a concreted area consisting of several industrial units.
Existing drainage features	The site lies 780m east of Channelsea which flows into Bow Creek approximately 1.4km south-west of the site. The Bow Creek then becomes the River Lea, which converges with the River Thames approximately 2.7km south of the site. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are points of lower elevation in the south-west of the site which corresponds to a railway cutting.
Critical Drainage Area	The Critical Drainage Area 'Group4_040' extends across a large section of the site from the south-west to the north-east.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 20%** **FZ2 – 30%** **FZ1 – 70%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** Some of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent include the south-western tip and the majority of the east of the site. There are also small areas within the west which are located in dry islands. The areas of the site within this extent are shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site and surrounding areas are unaffected by fluvial flooding during the 3.3%, 1%, 0.5% and 0.1% AEP modelled events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.1% Max depth – 0.3 – 0.6m Max velocity – <0.25m/s **1% AEP** – 2.0% Max depth – 0.3 – 0.6m

	Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 17.6% Max depth – >1.2m Max velocity – 0.5 – 1.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP surface water event, flooding only covers 0.1% of the site. This increases to 2% during the 1% AEP surface water event. Flooding is mainly concentrated in the south-west consisting of a small flow path along the railway cutting as well as a small area of ponding in the east. Flood depths reach 0.3 to 0.6m in both of these areas. Most flood water velocity within the site is <0.25m/s with water flowing between 0.5 to 1.0m/s in the south-west. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' with a small area in the south-west reaching 'Danger for Most' in areas where flooding is deepest. The 0.1% AEP surface water event covers 17.6% of the site. In this event the aforementioned area of ponding in the east increases in size and the flow path along the railway cutting in the south-west extends in length. There is also a flow path along the western boundary as well as a small area of ponding located at the eastern tip of the site. Flood depths vary from <0.15m to a small area in the south-west which reaches >1.2m. Most of the flood depths are <0.15 to 0.3m across most of the site. Most flood velocities flow at <0.25 to 0.5m/s, with small areas mainly in the south-west and north reaching 0.5 to 1.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where flood water is deeper in the south-west, there are areas of 'Danger for Most'.
Reservoir	The Dry Day reservoir flood events vary in extents, ranging from only covering the south-west of the site, to covering the whole excluding the northern section. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood and William Girling. The latter of which is the largest extent. These reservoirs are all managed by Thames Water Limited and are deemed as high-risk. The entirety of the site is flooded during the Wet Day reservoir extent, with a small area on the outskirts of the northern boundary being located in a dry island. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick, William Girling and Wraysbury. These reservoirs are all managed by Thames Water Limited and are all deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to be at moderate risk of groundwater flooding, and any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. This means there will be a significant possibility that incidence of groundwater flooding could lead to damage to property at, or near, this location. Further consideration of the local level of risk and mitigation is recommended.

Sewers	The site is located within a postcode area with 431 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets have no records of flooding within or surrounding the site. Newham Borough Council's flood records show no records of flooding within the site. The nearest incident occurred 90m north of the site along Maud Road. This took place in July 2021, however the source of this flooding is not known.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within or surrounding the site. The nearest formal flood defences are situated along both banks of the Channelsea River approximately 760m west of the site. These consist of flood walls, engineered high ground and embankments. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal Present Day event proportion of site at risk – 0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 11.6%** The site is unaffected by flooding during the Present Day 0.5% AEP Thames Tidal Breach event. During the 2100 epoch 0.5% AEP Thames Tidal Breach event, the south-west of the site is affected. This excludes the south-western tip to the south of the railway cutting. Flood depths reach around 1.6m with velocities remaining at 0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most' where flood depths are deeper. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The majority of the west of the site, excluding the south-western tip, is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The same area in the site is located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in

	the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	According to the Newham Draft Local Plan (2022), vehicular access and egress to the site will be via two routes in the north which lead on to Plaistow Road (A112). Pedestrian access and egress will be via Plaistow Road in the north. This route extends through the site to the south-west where it forks to form two access routes to the Greenway footpath, one north of the railway cutting and the other to the south from Whitelegg Road. Safe access and egress along most of these routes is possible during the Present Day and 2100 epoch 0.5% AEP Thames Tidal Breach events. This excludes pedestrian access in the south-west of the site as this is affected during the 2100 epoch 0.5% AEP event. Flood depths are up to 1.6m adjacent to the railway cutting. The resulting flood hazard varies from 'Very Low' to 'Danger for Most' where flood depths are deepest. This means that in the extreme 2100 epoch breach event, vehicular access and egress via these routes may not be possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. Access and egress is possible via all routes during the 3.3% and 1% AEP surface water flood events. During the 0.1% AEP surface water flood event, all routes are affected, excluding one of the two vehicular routes to the north leading on to Plaistow Road. The routes in the south-west are affected by the flow path which extends from the railway cutting whilst the route in the north is affected by a flow path which extends from Plaistow Road. It should be noted that although the second route in the north is unaffected, vehicles may be unable to travel to and from the site via Plaistow Road to the north-west of the site due to the aforementioned flow path. Flood depths reach 0.6 to 0.9m, with flood water flowing up to 0.5 to 1m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some', with the south-west of the site reaching 'Danger for Most' where flood depths are deepest. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects the same access routes as those mentioned during the 0.1% AEP event because these extents are very similar in size. Similar to the 0.1% AEP surface water flood event, the flood hazard is 'Very Low' to 'Danger for Most'. Therefore, vehicular access will not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change surface water event, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	There are areas within the western half and along the western boundary of the site which is located within dry islands in the Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset. There is also a dry island along the outskirts of the northern boundary during the Wet Day reservoir flood event.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding.

	Fluvial Flooding (River Lee): According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The Thames Upriver 2100 epoch 0.5% AEP event is the only breach event to encroach the site in the south-west. This excludes the south-western tip to the south of the railway cutting. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since 11.6% of the site is at risk during this breach event, the site is considered to be at medium risk in the aforementioned breach scenario and slightly sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further along the railway cutting in the south-west and the ponding in the east also increases. The flow path along Plaistow Road extends in length and connects to a newly formed flow path along the site's western boundary. Flood depths also increase from around 0 to 0.6m (1% AEP event) to around 1.1m in the 1% AEP plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology in the site is the London Clay Formation (clay, silt and sand). This is sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Kempton Park Gravel Member (sand and gravel) which is a sedimentary superficial deposit.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater.
	
	SuDS
	• The site is considered to have moderate susceptibility to groundwater flooding. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and gravel which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge

	in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is not located within a Nitrate Vulnerable Zone. • The entire site is also located within the Secondary A aquifer designation (superficial drift) zone. • The site is not located in an historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential uses for nurseries as 'More Vulnerable' development. Open space is classed as 'water compatible' development. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage.

- At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2100 epoch for the 0.5% AEP breach event of the River Thames (upriver), and is shown to be at surface water flood risk in the 1% AEP plus 40% CC and 0.1% AEP events.
- As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way.
- Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.
- All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.
- Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
- All Major development and any new development falling within a Critical Drainage Area must reduce surface water run-off to greenfield run-off rates through the application of Sustainable Urban Drainage Systems and other design considerations.
- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.

	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 and Flood Zone 3, as well as being at pluvial flood risk in the 1% AEP +40% CC and the 0.1% AEP events and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More Vulnerable development should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.

- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Central climate change surface water and fluvial events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial & Tidal breach extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

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Site details	
Site Code	**Canning Town East 1, LMUA16**
Address	Land to the south of Abbey Road, on both sides of Canning Road, E15 2 – E15 3.
Area	1.2ha
Current land use	Industrial/retail uses.
Proposed land use	Local Mixed Use
Flood Risk Vulnerability	Mixed - 'More Vulnerable' and 'Less Vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located south of Abbey Road and north of the pedestrian footpath Greenway. The site is dissected in two with Canning Road running from north to south, separating the two sections of site. The Jubilee line and Docklands Light Railway (DLR) is situated to the east of the site whilst the Channelsea River borders the west of the site. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies approximately 770m north-east of where the Channelsea River converges with Bow Creek. The latter converges with the River Lee approximately 410m south of the previously mentioned point. The site is located approximately 2.8km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that the majority of topography remains relatively flat. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Most elevations across both sections of the site range from around 3.8m AOD to 5.6m AOD. The lowest ground levels are around 3.2m AOD which are found along the eastern boundary of the eastern section of the site. This corresponds with the land sloping down at this point towards the railway cutting. The highest elevations reach 7.9m AOD in the south-eastern corner of the western section of the site. This corresponds with the location of building units which border Canning Road as well as this being the top of a slight hill.
Existing drainage features	The site's western boundary borders the Channelsea River which converges with Bow Creek approximately 770m south-west of the site. The site is located approximately 2.8km north of the River Thames. The section of the Channelsea River which borders the west of the site, as well as the vegetation which borders the south and east of the site may act as drainage ditches.
Critical Drainage Area	The Critical Drainage Area 'Group4_031' encroaches the eastern boundary but does not extend further into the site.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 11%** **FZ1 – 89%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is not located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The only area within this extent is the western third of the part of the site that is situated to the west of Canning Road. Although this section of the site is shown to benefit from defences, it may still be at some risk. According to the River Lee (2014) hydraulic model, despite being in close proximity to fluvial flood events, the site is unaffected by fluvial flooding during the 3.3%, 1%, 0.5% and 0.1% AEP modelled events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 2.5% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 6.9% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **0.1% AEP** – 23.5%

	Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event surface water flooding only covers 2.5% of the site. An area of ponding occurs in the centre part of the site that is to the east of Canning Road. There is also some ponding along Abbey Road which encroaches the northern boundary of the site. Maximum flood depths are 0.3 to 0.6m. Most flood water velocity within the site is <0.25m/s with a small area in the previously mentioned central-east ponding reaching 0.25 – 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. The 1% AEP event surface water covers 6.9% of the site. The two aforementioned areas of ponding increase in size with the central-east area reaching the southern boundary of the site. There is also some ponding on the road off to the east of Canning Road, leading to the industrial estate, which enters the north of the site but does not extend further into the site. Flood depths reach 0.3 to 0.6m, whilst water velocities are mainly <0.25m/s, with small areas across the site reaching 0.25 to 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. The 0.1% AEP event surface water covers 23.5% of the site. In this event, the previously separated areas of ponding in the east join to form a flow path which extends from north to south of the section of site to the east of Canning Road. Flooding also occurs along the northern, eastern and southern perimeter of the building unit within the section of site to the west of Canning Road. Flood depths vary from 0.15 to 0.6m with small areas along the northern boundary and central-eastern sections reaching 0.6 to 0.9m. Water velocities are mainly <0.25m/s but reach up to 0.5 – 1.0m/s in the northern of the site on both sides of Canning Road. The resulting flood hazard across the site varies from 'Very Low' to 'Danger for Some'. Where flood water is deepest, there are areas of 'Danger for Most'.
Reservoir	The Dry Day reservoir flood events encroach the western and eastern boundaries, however they do not extend further into the site. This risk is posed by the following reservoirs: William Girling, King George V and Banbury. The Lockwood and High Maynard Dry Day reservoir extents lie adjacent to the outskirts of the site's western and eastern boundaries but do not enter the site. It should be noted that the site and its surrounding area is located within a dry island due to this area being bounded by watercourses and railway cuttings, both of which are incorporated into reservoir extents. All these reservoirs are managed by Thames Water Limited and are deemed as high-risk. The entirety of the site is affected by reservoir flooding during the Wet Day scenario. The William Girling reservoir produces the largest extent. The other reservoirs which pose a risk are: Wraysbury, Queen Elizabeth II, Banbury, King George V and Lockwood. Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick and High Maynard reservoir extents only encroach the western and eastern boundaries and do not extend further into the site. These reservoirs are all managed by Thames Water Limited and are deemed as high-risk.

	Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 109 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within the site. This occurred in the western third of the section of site to the west of Canning Road in 1947. This was due to the channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest record of an incident is situated approximately 70m south-east of the site along Manor Road. This occurred in July 2021 and was caused by heavy rain which resulted in the sewer system being unable to cope.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are formal flood defences along the western boundary of the site which borders the Channelsea River. These defences consist of flood walls which have a design standard of protection of 1000 years. The Environment Agency AIMS dataset also shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 1.0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 96.9%** The western boundary of the site is the only area affected during the Present Day 0.5% AEP Thames Tidal Breach event. This extent does not encroach further into the site. The majority of the site affected during the 2100 epoch 0.5% AEP Thames Tidal Breach event which is described in the climate change section below. Flood depths reach 0.9m with velocities of up to around 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for All'. For further details, please refer to the Climate Change section of this site table.

	Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The western half of the site to the west of Canning Road is located within two Environment Agency Flood Alert Areas. These are: the 063WAT233N Flood Alert Area located in the London Boroughs of Havering, Barking and Dagenham, and Newham, and the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. A similar area of the site is covered by the Environment Agency 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest.
Access and egress	Access and egress to the site is currently via two roads in the north. The first is a slip road off Abbey Road which leads into the western section of the site. The second is a road off Canning Road leading to the industrial estate which branches off into the eastern section of the site via two entrances along the northern boundary. Safe access and egress along both roads is unaffected during the Present Day 0.5% AEP Thames Tidal Breach event. However, both access and egress routes are affected during the 2100 epoch 0.5% AEP Thames Tidal Breach event. Flood depths are up to 1.4m along Abbey Road. The resulting flood hazard varies from 'Very Low' to 'Danger for Most'. Where flood depths are deepest along Abbey Road to the north of the site, the flood hazard is 'Danger for All'. This means that in the extreme 2100 epoch breach event, vehicular access and egress is not possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the 3.3% AEP surface water event access and egress is only affected via Abbey Road to the west of this access point where there is an area of ponding. Flood depths reach 0.15 to 0.3m with flood water velocities reaching 0.25 to 0.5m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. During the 1% AEP surface water event, ponding increases along Abbey Road. There is also ponding along the access road off Canning Road in the east. Flood depths reach 0.3 to 0.6m. Flood water velocities are mainly <0.25m/s with a small area along Abbey Road reaching 0.5 to 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some', therefore vehicular access and egress may not be possible. During the 0.1% AEP event, flooding along both previously mentioned roads increases, with flooding in the east forming a flow path which extends through the site to the southern boundary. Flood depths are mainly 0.15 to 0.6m with a small area along Abbey Road reaching 0.6 to 0.9m. Flood water velocities are mainly <0.25m/s, however there are small areas along both roads which reach 0.5 to 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' along both roads. Where flood waters are deepest along Abbey Road, the flood hazard reaches 'Danger for Most', therefore vehicular access may not be possible.

	During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects the same access routes as those mentioned during the 0.1% AEP event because these extents are very similar in size. The flood hazard along both roads is 'Very Low' to 'Danger for Some'. Where flood waters are deepest along Abbey Road, the flood hazard reaches 'Danger for Most', therefore, vehicular access will not be possible here. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall event with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site and surrounding area is located within a dry island during the Dry Day reservoir flood event as well as in the Environment Agency's Flood Map for Planning Flood Zones 2 and 3.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The Thames Upriver Present Day epoch and 2100 epoch 0.5% AEP event are the only breach events to encroach the site. Whilst the present day extent remains along the western boundary, the 2100 epoch extent increases significantly, affecting the majority of the site. This excludes small areas along the southern boundary as well as land adjacent to both sides of Canning Road. Flood depths reach 0.9m with velocities of up to around 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for All', the latter of which is mainly situated along the western boundary of the site where it is adjacent to the Channelsea River. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a large percentage of the site is at risk during the 2100 epoch 0.5% AEP breach event, the site is considered to be at high risk in the aforementioned breach scenario, and is therefore sensitive to increases in tidal breach flooding due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The areas of ponding during the 1% AEP event increase in size with the previously separated areas of ponding in the east join to form a flow path

	which extends from north to south of the section of site to the east of Canning Road. Flooding also occurs along the northern, eastern and southern perimeter of the building unit within the section of site to the west of Canning Road. Flood water velocities also increase from a maximum of 0.25 to 0.5m/s (1% AEP event) to a maximum of around 0.7m/s in the 1% AEP plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology across the site is the London Clay Formation (clay, silt and sand). This is sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is located within a Nitrate Vulnerable Zone.
	• The entire site is also located within the Secondary (undifferentiated) aquifer designation (superficial drift) zone.
	• The site is not located within an historic landfill.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event, connecting areas of ponding that were present in the 1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 2, and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day epoch and 2100 epoch for the 0.5% AEP breach events of the River Thames (upriver), and is shown to be at surface water flood risk in the 3.3%, 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to

	determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.
	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
	• All Major development and any new development falling within a Critical Drainage Area must reduce surface water run-off to greenfield run-off rates through the application of Sustainable Urban Drainage Systems and other design considerations.
	• The Canal and River Trust should be consulted as part of this development as this site is within 150m of the Channelsea River.
	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
	
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    ◦ raise them as much as possible
	    ◦ consider moving vulnerable uses to upper floors
	    ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level

	• by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at risk of flooding in Flood Zone 2, as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Development is steered away from areas that are at significant risk of flooding during the 1% AEP plus 40% climate change surface water event.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. It is for this reason, as well as the site being at significant risk of flooding during the Wet Day reservoir flood event, that this site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.

Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from the Environment Agency's RoFSW dataset, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Chobham Farm North, N14.SA1**
Address	Land to the north of Liberty Bridge Road, around Aire Liquide. E15
Area	1.35ha
Current land use	Residential and employment.
Proposed land use	Residential and employment
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable.
Sources of flood risk	
Location of the site within the catchment	The site is located in central Temple Mills, immediately north of Liberty Bridge Road. The site is bordered by Leyton Road to the east and the Lee Valley railway line on the west. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment. The site is located around 900m east of the River Lee and 4.8km north of its confluence with the River Thames.
Topography	Environment Agency 1m resolution LiDAR across the site shows the north eastern part of the site to be at a significantly higher elevation than the west of the site. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. Maximum elevations are located at the southern border at around 10.8mAOD. Areas of lowest elevation are located along the western border of the site, at approximately 2.1mAOD.
Existing drainage features	There are no existing drainage features within the borders of the site. The site lies approximately 900m east of the River Lee and 4.8km north of the confluence between the River Lee and the River Thames.
Critical Drainage Area	The site is not located within a Critical Drainage Area; however, it should be noted that the site lies immediately east of Group4_051 Critical Drainage Area.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 0%** **FZ1 – 100%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%**

	0.5% AEP fluvial event – 0% **0.1% AEP fluvial event – 24.2%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportions of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. During the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). As such, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The entirety of the site is outside of the Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The site remains unaffected by the River Lee extent in the 3.3% and 1% AEP events. In the 0.1% AEP event the western part of the site is inundated, due to its lower topography, to a maximum depth, velocity, and hazard of 0.21m, 0.11m/s, and 'Danger for Some'.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 1.8% Max depth – 0.15m - 0.3m Max velocity – 0m/s – 0.25m/s **0.1% AEP** – 23.8% Max depth – >1.2m Max velocity - >2m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is unaffected from surface water flooding in the 3.3% AEP event. During the 1% AEP event, the areas of the site at the lowest elevation: to the west along the border of the high ground, are at risk of surface water flooding to maximum depth, velocity, and hazard of 0.15m – 0.3m, 0m/s – 0.25m/s, and 'Very Low Hazard/Caution'. The 0.1% AEP extent inundated most of the western side of the site due to its lower elevation. Surface water enters the site along the south western border, originating from the large surface water flow path along the Lee Valley Railway. The maximum depth, velocity, and hazard within the site

	are located at the south west corner where the surface water flow path enters the site, reaching >1.2m, >2m/s, and 'Danger for All'.
Reservoir	According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Dry Day scenario. The following reservoirs are shown to inundate the either part of, or the whole site: King George V and William Girling, both of which are managed by Thames Water Ltd and are considered high risk. According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Wet Day scenario. The following reservoirs are shown to inundate the whole site: Banbury, High Maynard, King George V, Lockwood, Walthamstow No.4, Walthamstow No.5, Warwick East, and William Girling. These reservoirs are all owned by Thames Water Ltd and are considered high risk. As all reservoirs in this area are deemed as high-risk, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The majority of the site is shown to have negligible risk of groundwater flooding, meaning any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. However, the far north eastern border is shown to have Low risk of groundwater flooding, meaning any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence.
Sewers	The site is located within postcode area E15 1, with 337 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's Historic Flood Map and Recorded Flood Outline show no records of flooding within the site. These data layers do show of a historical flood incident in March 1947 which extends 13m from the northern tip of the site boundary. Newham Borough Council's flood records show 1 record of flooding within the site at Aire Liquide. In addition, there is 1 record of flooding 80m south of the site on Leyton Road.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Lee. The area is protected by secondary tidal defences along the River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 design years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee.

Emergency planning	
Flood warning	A small portion of the south of the site is located in both an Environment Agency Alert Warning Area, and an Environment Agency Flood Warning Area. Flood Alert Area: 062WAF53LowerLee (Lower River Lee from Hoddesdon to Canning Town) Flood Warning Area: 062FWF53Hackney (Lower River Lee at Hackney and Walthamstow)
Access and egress	Access and egress to the site is currently via three routes. This includes a small access road off Temple Mills Lane along the northern border, Leyton Road along the eastern border, and Liberty Bridge Road along the southern border. No access routes are affected during the Fluvial River Lee 3.3% AEP event. Temple Mills Lane is partially inundated in the 1% and 0.1% AEP event around the Lee Valley Railway Line. The maximum depth, velocity, and hazard for the 1% and 0.1% AEP events are 0.15m and 0.48m, 0.12m/s and 0.19m/s, and 'Danger for Some' and 'Danger for Most'. In the 1% AEP plus 17% Climate Change event, the same locations on Temple Mills Lane are flooded, to a maximum depth, velocity, and hazard of 0.28m, 0.16m/s, and 'Danger for Some'. This suggests this location is susceptible to climate change in the fluvial events. Similarly, in the 0.5% AEP plus 17% Climate Change event Temple Mills Lane is inundated to a maximum depth, velocity, and hazard of 0.29m, 0.2m/s and 'Danger for Some'. During the 3.3% and 1% AEP surface water events, all access routes suffer from minor surface water ponding; however, these are not severe enough to impact access and egress. In the 0.1% AEP event Temple Mills Lane is severely impacted by surface water immediately north west of the site at the Lee Valley Railway Line. The maximum depth, velocity, and hazard here are >1.2m, >2m/s, and 'Danger for All'. As such, access and egress to the site during this event will be severely impacted. It important to note for these datasets, that the site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the site topography and structures such as underpasses and bridges. As such, surface water flow paths shown at highways or railways where there is a bridge, such as that on Temple Mills Lane, may not be fully representative.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding – River Lee** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1%, and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end

	allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% Climate Change, the patterns of flooding are very similar; however, surface water ponding extends further, and associated depths increase. The surface water flow path entering the site from the south west from the Lee Valley Railway reaches a maximum depth, velocity, and hazard of 4.36m, 4.53m/s, and 'Danger to All'. This change in extent and depth shows that this site is extremely sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology of the site is the London Clay Group (clay, silt, sand, and gravel).
	    ○ Superficial – The superficial geology of the site is undifferentiated River Terrace deposits (sand and gravel)
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	
	• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand, gravel, and clay which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is located within both Groundwater Protection Zones 2 and 3.
	• The site is located within the LEE Nitrate Vulnerable Zone.
	• The site is located within the Secondary (undifferentiated) superficial aquifer designation zone.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.

	• Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces, and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean and improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. The Exception Test is only required for 'More Vulnerable' development within Flood Zone 3. As the majority of the site lies within Flood Zone 1, the Exception Test is not required; however, it is recommended owing to the surface water risk in the 1% AEP plus central climate change allowance event.
Requirements and guidance for site-specific Flood Risk Assessment	Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as

	possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.
	• All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.
	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
	• Development within 20m of a main river or flood defence will require specific planning permissions.
	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
	
	Guidance for site design and making development safe:
	
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level

	- by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. - The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. - The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. - London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at minor fluvial risk from the River Lee as well as being at pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee to indicate the impact on flood risk.
Fluvial extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	
Address	ExCeL Centre, Western Gateway, Custom House, E16 1.
Area	3.5ha
Current land use	Mixed use – open space, day nursery, employment and a hotel
Proposed land use	Mixed use
Flood Risk Vulnerability	Mixed – more vulnerable, less vulnerable and water compatible
Sources of flood risk	
Location of the site within the catchment	The site is located within Custom House, adjacent to the Royal Victoria Dock (as part of the Royal Group of Docks). The site is located east of the existing ExCeL centre. The site is bounded to the north by Seagull Lane and Western Gateway. The north-west of the site encompasses this road. The Novotel London ExCeL and Galleria House flat complex are located to the east of the site. The southern boundary of the site is confined by the Royal Victoria Dock. The northernmost part of the site is adjacent to the Custom House for ExCeL DLR Station and underground (Elizabeth Line) station. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Thames and Royal Docks. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies slightly. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The elevation of the site varies between 3.41 and 7.20mAOD. Site elevations are lowest at the West Ramp leading towards the entrance to the Exhibition Centre. The elevations across the rest of the site are relatively consistent, and are generally above 5.5mAOD. The greatest elevations within the site are located at a small area of raised ground/grass to the east of the site, adjacent to the paved area leading towards the ExCeL Marina.
Existing drainage features	The site is bounded to the south by the Royal Victoria Dock, which as part of the Royal Group of Docks within the London Borough of Newham. There is also a smaller dock within the centre of the site, adjacent to the W Warehouse building. The site is approximately 940m north of the River Thames. There are no drainage ditches within or in the vicinity of the site.
Critical Drainage Area	This site is not located within a Critical Drainage Area.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the*

	area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This means that the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** - 3.5% Max depth - 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s **1% AEP –** 4.9% Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s **0.1% AEP –** 15.2% Max depth – 0.6 – 0.9m Max velocity – 1.0 – 2.0m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 2.6% Max depth – 0.6 – 0.9m Max velocity –0 – 0.25m/s **1% AEP** – 4.6% Max depth – 0.9 – 1.2m Max velocity – 0.25 – 0.5m/s **0.1% AEP** – 15.2% Max depth – >1.2m Max velocity – 0.25 – 0.5m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The entire site is covered by the Environment Agency's Risk of Flooding from Surface Water mapping. The Silvertown ICM surface water model was also available to assess surface water flood risk to the site.* *Where the ICM modelling is available, this modelling is more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset.*

	Description of surface water flow paths: The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding extends across 2.6% of the site according to the Silvertown ICM model. This flooding is predominantly isolated surface water ponding in topographic depressions within the site. Maximum flood depths (0.6 to 0.9m) and velocities (up to 0.25m/s) during this event are situated at the lowest lying area of the site, on West Ramp near the ExCeL Exhibition Centre bus stop. Associated flood hazard at this section of the site is rated as 'danger for most.' During the 1% AEP event, according to the Silvertown ICM model, surface water flooding extends across 4.6% of the site. Surface water flooding patterns are similar to the 3.3% AEP event just with a slightly more widespread extent and an additional area of ponding at the south of Royal Victoria Square. Maximum flood depths and velocities increase to 0.9 – 1.2m and 0.25 – 0.5m/s respectively. Hazard is still rated as 'very low', 'danger for some' or 'danger for most' across the site during this event. During the 0.1% AEP event, according to the Silvertown ICM model, surface water flooding extends across 15.2% of the site. Surface water pooling is now significantly more extensive across the site, notably along Western Gateway at the western corner of the site and the region between the Royal Victoria Square seating and the paving leading down towards the marina/dock. The ponding along Western Gateway has a hazard rating of 'danger for most,' and the hazard rating of the ponding near the ExCeL Exhibition Centre bus stop remains 'danger for most'. Maximum depths and velocities are now between up to >1.2m, and between 0.25 and 0.5m/s. These maximum depths are located on West Ramp, near the bus stop.
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the very northern border of the site (along Seagull Lane) is at risk of flooding during the 'dry day' flood. This risk is posed by the William Girling Reservoir, which is managed by Thames Water. During the 'wet day' scenario, the site is at risk from 10 reservoirs. Almost the entire eastern border of the site – except very south-east corner – is at risk of flooding from the Banbury, King George V, Lockwood, Queen Elizabeth II, William Girling and Wraysbury Reservoirs. The northern border of the site, along Seagull Lane, is at risk of flooding from the High Maynard, Walthamstow No.4 and No.5 and Warwick East Reservoirs. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	According to the Thames Water Hydraulic Sewer Flood Risk Register, there are 32 incidents of flooding in the E16 1 postcode area. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.

Flood history	According to the Environment Agency's historic flooding and recorded flood outlines database, there are no incidents of flooding within the site. As per the London Borough of Newham's flood incident database, there are no recorded incidents of flooding within, and in 50m of the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver and Downriver Breach Assessment models were used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 0%** **0.1% AEP tidal present day event proportion of site at risk – 0%** **0.5% AEP tidal 2115 epoch event proportion of site at risk – 0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 1%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 0%** The Upriver and Downriver Breach modelling shows that the site is not at risk during the present day or 2115/2100 epoch breach events. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. The site is located in Environment Agency Flood Alert Area 063WAT233N for flooding from the Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham. Additionally, the site is located in Flood Warning Area 063FWT23RDockA for the Tidal Thames between Beckton Sewage Works to the River Lee.
Access and egress	Vehicular access and egress to the site is currently via two routes. The site can be exited to the west using Western Gateway and travelling west towards Silvertown Way, or also via Western Gateway and travelling north before turning left and travelling west along Seagull Lane or, turning right and travelling east along Sandstone Lane. The site can be exited to the north and west as a pedestrian using a footpath along Western Gateway. The Custom House for ExCel DLR and underground station can be reached by travelling north out of the site. Pedestrians can also exit the site to the east and west along a footpath adjacent to the southern site boundary and Royal Group of Docks. During the 0.5% AEP 2115 Thames downriver tidal breach, pedestrian access and egress via the footpaths adjacent to the Royal Docks may be impeded. There is flooding on parts of the path which is rated as 'danger for most' with flood depths up to 1.0m, so pedestrian access would likely be impossible. Seagull Lane and Silvertown Way are predicted to flood during the 0.5% AEP 2100 epoch Thames tidal breach event. Flood depths along Seagull Lane are predicted to reach up to 0.35m with velocities of up to 0.3m/s. The resulting hazard rating of this flooding is up to 'danger for most' meaning vehicular

	access and egress, as well as pedestrian access and egress to the north and west is likely to be affected. Sandstone Lane is not predicted to flood during the breach event. The hazard rating of the flooding along Seagull Lane at the junction to Sandstone Lane is 'very low hazard'. Therefore, vehicular and pedestrian access and egress travelling north along Western Gateway before turning right onto Sandstone Lane is likely to be unaffected. It may also be possible for pedestrians to exit the site by walking through the ExCel centre to the east. Access and egress have also been assessed against the Silvertown ICM modelling as this covers all access and egress routes to/from the site. During the 1% AEP plus 40% climate change surface water flood, access and egress from the site if travelling west along Western Gateway, could be affected by surface water flooding. Flood depths on the road during this event extend to 0.44m, with associated flood hazard rated up to 'danger for some'. Remaining access and egress routes via Seagull Lane, Sandstone Lane and along the footpaths adjacent to the Royal Docks are not affected by surface water flooding during this event. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** A small proportion (around 1%) of the site is flooded during the 0.5% AEP 2100 epoch Thames (upriver) tidal breach compared to the 0.5% AEP present day tidal breach (0%). This flooding is to the northernmost part of the site, on Seagull Lane. Flood depths and velocities, within the site, during this event are up to 0.13m with zero velocity (0m/s). However, these extend up to 0.58m and up to 0.32m/s along Seagull Lane. Hazard during this event, within the site 'very low,' although this extends to 'danger for most' where the deepest and fastest flooding is located along Seagull Lane. Access and egress via Seagull Lane may be impeded during this event. During the 2115 epoch 0.1% AEP Thames (downriver) tidal breach event, the site is not predicted to flood. However, flooding to the footpaths adjacent to the Royal Docks extends to depths of up to 1.1m. Velocities extend to 0.52m/s, with associated hazard rated as 'danger for most.' Therefore, pedestrian access and egress via the footpaths adjacent to the docks is likely to be impeded during this event. The site itself, is therefore relatively insensitive to increases in flooding caused by tidal breaches due to climate change. However, access and egress is likely to be impacted by these changes. **Surface Water:**

	The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. The sensitivity of the site to surface water flooding was assessed using the ICM Silvertown model. During the 1% AEP plus 40% climate change event, the flood extent within the site slightly increases, notably at the Royal Victoria Square, and between the seating and paving leading down towards the marina/dock. Flood extent at the western side of the site, along Western Gateway also increases. Flood depths during this event are generally below 0.44m, although these extend to 0.95m at the east of the site, near the ExCeL Exhibition Centre bus stop, the lowest lying part of the site. Flood hazard during this event is generally rated between 'very low' and 'danger for some,' although flooding at the bus stop is rated as 'danger for most.' The site is therefore relatively sensitive to increases in surface water flooding caused due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology across the site is London Clay Formation (clay, silt and sand), which is a sedimentary bedrock.
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is clay, silt and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone.
	• The entire site is located within an 'unproductive' bedrock aquifer designation zone and within a secondary (undifferentiated) superficial aquifer designation zone.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.

	• The Silvertown ICM mapping indicates the presence of surface water flow flooding within the site during the 0.1% AEP surface water flood. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies educational and hotel uses as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. Open space is classed as 'Water Compatible Development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is within Flood Zone 3 of the FMfP and is shown to be at surface water flood risk in the 3.3%, 1% and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all

	development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor’s Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council’s Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115/2100 epoch 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF’s policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site. • Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help

	inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g., raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2. There is also some pluvial flood risk in the 0.1% AEP event. Access and egress is highly likely to be impeded if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Silvertown ICM Surface Water Model and the Environment Agency's Thames Estuary Downriver and Upriver Breach Assessment models. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model as well as the 2100 epoch results from the Environment Agency's Thames Tidal Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.
Tidal breach extents, depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model and the 2100 epoch results from the Environment Agency's Thames Tidal Upriver Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**LMUA1**
Address	A1011 and surrounding land, Silvertown, Newham E16 1
Area	3.37ha
Current land use	Mixed use- Road, commercial, brownfield land.
Proposed land use	Local mixed-use area– Residential and employment
Flood Risk Vulnerability	Mixed use – More vulnerable and Less vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located within the Canning Town South and Royal Docks area of Newham, extending from Tidal Basin Road and Scarab Road in the north, to west of West Silvertown station to the south. The A1020 passes through the site, and the A1011 is an overpass over the site. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lea and the River Thames and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The site area is predominantly comprised of a road with slip roads at varying levels as well as brownfield land in the north east. The lowest elevations are found to the south-east site corner at around 1.3mAOD, and the northern most tip of the site where the lowest lying land is around 0.6mAOD. The rest of the site lies higher at around 1.2 to 2.8mAOD with high points in the centre of the site and along the eastern boundary in the south of the site.
Existing drainage features	The western corner of the site is located 195m west from the lower section of the River Lee, and approximately 250m south-west from the River Thames. The confluence of the two rivers is located 290m west of the site. are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*

	Available data: Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This means that the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 3% Max depth – 0.6-0.9m Max velocity – 0.25-0.5m/s **0.1% AEP** – 18% Max depth – 0.9-1.2m Max velocity – 1-2m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 0% **1% AEP** –0.3% Max depth – 0.18m Max velocity – 0.04m/s **0.1% AEP** – 0.73% Max depth – 0.19m Max velocity – 0.05m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The Silvertown surface water model was used in the assessment of surface water flooding.* *Where ICM modelling is available, this modelling is more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset.* **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events, but the flooding is only minor. In the 3.3% AEP event the site remains flood free. In the 1% AEP event a small area of surface water ponding is present in the centre of the site, covering 0.3% of the site. Ponding occurs at the junction to the east of Dock Road and North Woolwich Road.

	In the 0.1% AEP event surface water covers 0.73% of the site. In this event, the extent of flood water in the 1% AEP event marginally increases. Flood depths are shallow and are below 0.2m. Flood water flows around the site are at around 0.0 to 0.05m/s across the area of ponding. The resulting flood hazard is 'Very Low'.
Reservoir	The site is shown to be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the majority of the site from the following reservoirs; Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, smaller areas of the north of the site are at risk of flooding from Banbury reservoir. Most of the site, apart from smaller isolated areas are at risk of flooding from the William Girling reservoir. This reservoir is managed and operated by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The entire site is classed as having a negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within two postcode areas with 32 and 94 incidences of sewer flooding each, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets has one record of flooding within and surrounding the site. This occurred in 1947 and 1953 due to channel capacity exceeded and overtopping of defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. There is no further information regarding these flood records.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The site is located in the extents of the Environment Agency's Thames Estuary Downriver and Upriver Breach Assessment model. The Upriver extent showed the greatest risk to the site and this has been used within this assessment of tidal flooding below.

	0.5% AEP tidal present day event proportion of site at risk – 62.8% **0.5% AEP tidal 2100 epoch event proportion of site at risk – 69.5%** The site is almost completely flooded in the Present Day 0.5% AEP Thames Tidal Breach event, apart from the central area of the site, flood depths across the site vary from 0 to 1.9m. Flooding is deepest where there are topographic lows in the site, in the north and north western areas. The velocity of flood waters varies from 0.02-1.23m/s, and is highest where water is channelled into existing roads. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Low' to 'Danger for Most' where flood depths are deepest. The site is also predominantly located within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 063WAT233N Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham flood alert area and the 062WAF53LowerLee Lower River Lee from Hoddesdon to Canning Town flood alert area. The northern part of the site located within the 062WAF53LowerLee, lower River Lee from West Ham and Canning Town flood warning area. The entire site lies within the 063FWT23RDockA, Tidal Thames at Greater London, Greenwich, Newham, Tower Hamlets flood warning area.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, access is gained via Dock Road, Tidal Basin Road, Kamal Chunchie Way. In the centre of the site, pedestrian access is available from Dock Road. To the south and south east of the site, access is possible via Hanover Avenue, North Woolwich Road, and Brittania Road. It is also possible to access the site via theA1020 which runs though the site off the A1011. Safe access and egress from the majority of the access routes is shown to be affected during all modelled tidal breach events in the present day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. Flood depths for the present day epoch are up to 2.7m along Tidal Basin Road, A1011, Dock Road and North Woolwich Road. The resulting flood hazard varies from 'Danger to most' to 'Danger for all' where flood depths are deepest. The pedestrian access route between Dock Road, Britannia Gate and Hanover Avenue remain flood free. In the 2100 epoch, flood depths increase slightly along the access roads, and therefore the flood hazard rating increases to 'Danger for Most' to 'Danger for All'. This means that in this extreme breach event, vehicular access and egress is not possible to the site. During the 3.3% AEP surface water event access and egress is possible on all the routes into the site. In the 1% AEP event, part of North Woolwich Road is predicted to flood. The depths of this flooding are up to 0.2m. Flood water is slow moving at 0 to 0.25m/s. The resulting flood hazard is 'Very Low' to

	'Danger for Some'. It is likely that vehicular access and egress may be possible during this event. During the 0.1% AEP event, flooding affects North Woolwich Road. Flood depths vary from <0.3m to small areas of up to 0.6m. The resulting flood hazard is Very Low' to 'Danger for Some', so vehicular access and egress may still be possible. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects all access and egress routes, the extent is similar to that of the 0.1% AEP event. The flood hazard along this road is 'Very Low' to 'Danger for Some'. Therefore, vehicular access and egress should be possible. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The 2100 epoch 0.5% AEP event shows a larger extent of flooding with deeper flood waters, with a very slight increase in flood extent versus the 2005 epoch 0.5% AEP event (62.8% versus 69.5%). Flood depths marginally increase from a maximum of 1.92m to 2.16m. Flood velocities increase from a maximum of 1.24m/s to 2.79m/s. change. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during both breach extents, the site is considered to be at high risk in both breach scenarios. The site is sensitive to the impact of climate change on the predicted flood depths and velocities. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent is similar to that in the 0.1% AEP event. Flood water ponds in the topographic depressions across the site. Flood depths remain shallow between the 1% AEP event to the 1% plus 40% climate change event and are predominantly between 0-0.3m with some areas predicted to flood between 0.3-0.6m. This shows that the site is somewhat sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    o Bedrock – Bedrock geology of the site is the Thames Group Formation (clay, silt, sand and gravel).
	    o Superficial – The superficial geology of the site is Alluvium (clay, silt and sand)
	• Soils at the site consist of:
	    o Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site has areas within its boundary designated by the Environment Agency as being historic landfill site. This area is the Western Entrance Lock historic landfill site A thorough ground investigation will be required as part of a detailed site-specific FRA, to determine potential mitigation for contamination and the impact this may have on SuDS. As such, proposed SuDS should be discussed with the relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.
	• Proposed attenuation features such as basins, ponds and tanks should be located outside of Flood Zones 2 and 3 to avoid the potential risks to the hydraulic capacity or structural integrity of these features. Surface water outfalls that discharge into the River Lea and River Thames may be susceptible to surcharging/tide locking due to water levels in the River Lea and River Thames. The impacts of tide locking/flood flows will need to be considered in terms of the attenuation storage requirements of the site and placement of the outfalls.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development, and non-residential uses for educational establishments as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-

	off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.

	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 1% AEP plus 40% climate change and 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood warning and evacuation plan is put in place for the site.

	• If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
Mapping Information	
The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Aldersbrook, LMUA2**
Address	Land north of Romford Road, east of the North Circular Road and south of the Great Eastern Main Line. The site borders the northern boundary of the London Borough of Newham.
Area	2.76ha
Current land use	Local Mixed Use Area
Proposed land use	Local Mixed Use – Residential and employment
Flood Risk Vulnerability	Mixed – 'More Vulnerable' and 'Less Vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located along the north-eastern boundary of the London Borough of Newham and borders Romford Road to the south and the North Circular Road to the east. The Great Eastern Main Line runs to the north of the site whilst Daines Close and Aldersbrook Lane are situated to the west of the site. The site is located within the Roding, Beam and Ingrebourne Management Catchment. The catchment is 516km^2 and is densely populated, especially within the south of the catchment. Aldersbrook dissects the site from west to east. This watercourse then converges with the River Roding approximately 100m east of the site. The site is located 5.5km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography across most of the site varies. The area surrounding the site is within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, and this may have an impact on some of the flood risk datasets used in this assessment. The lowest elevations are located along the course of Aldersbrook which dissects the site from west to east. Elevations here are as low as 3.79mAOD within the banks of the watercourse. To the south of Aldersbrook, elevations range from 4.66 to 7.24mAOD. The north of the site has higher and more uniform elevations that range between 7.48 to 8.31mAOD. There are two areas along the northern and western boundaries which have the highest elevations of up to 9.66mAOD.
Existing drainage features	Aldersbrook dissects the site from west to east. This watercourse then converges with the River Roding approximately 100m east of the site. The site is located 5.5km north of the River Thames, which also marks the location of the confluence of the River Roding and the River Thames. The area surrounding these watercourses and the site is urbanised and therefore highly constrained with development built up to the river edges. Due to the low topography channelling water into Aldersbrook, this could act as a drainage ditch for the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 96%**

FZ1 – 4%

The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).

Defended model outputs:
3.3% AEP fluvial event – 0%
1% AEP fluvial event – 0%
0.5% AEP fluvial event – 0%
0.1% AEP fluvial event – 32.2%

Modelled results show the percentage of site at risk from a given AEP flood event.

Available data:
The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario.

Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures.

Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames.

Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in.

The Environment Agency's 1D-2D ESTRY-TUFLOW detailed hydraulic model for the Shonks Mill Lower Roding has been used within this assessment of fluvial flooding.

Flood characteristics:

Some of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. These areas include the north of the site as well as small, isolated locations to the south of Aldersbrook. The rest of the site, including the north-western corner, is not within this extent. This means that only some of the site is shown to benefit from defences (although may still be at some risk).

According to the Shonks Mill Lower Roding (2018) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% AEP modelled events.

During the 0.1% AEP modelled fluvial event, the majority of the south of the site is flooded. This excludes the south-eastern corner of the site. Outside of the banks of the Aldersbrook, flood depths reach 1.3m in the south-west of the site with water flowing at a maximum of 1.5m/s on land adjacent to Lugg Approach. The resulting flood hazard is 'Very Low' to 'Danger for Most', with a small area along a section of the Aldersbrook being 'Danger for All' which corresponds with the deepest water being situated here.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.1% Max depth – 0.9 – 1.2m Max velocity – 0 – 0.25m/s **1% AEP** – 2.2% Max depth – 0.9 – 1.2m Max velocity – 0 – 0.25m/s **0.1% AEP** – 8.6% Max depth – >1.2m Max velocity – 0.25 – 0.5m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 0.5% Max depth – 0.6m Max velocity – 0.1m/s **1% AEP** – 1.3% Max depth – 0.9m Max velocity – 0.2m/s **0.1% AEP** – 6.8% Max depth – 1.9m Max velocity – 0.3m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The Little Ilford ICM surface water model was used in the assessment of surface water flooding.* *Where ICM modelling is available, this modelling is a more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset. The depth, velocity and hazard information used is from the ICM surface water model.* **Description of surface water flow paths:** The site is minimally affected during the 3.3% AEP modelled surface water flood event, with only 0.5% of the site flooded. The area affected is a section of the Aldersbrook in the west of the site. This surface water extends further along the Aldersbrook during the 1% AEP modelled surface water extent, covering 1.3% of the site. This water has been channelled into the banks of the Aldersbrook due to lower-lying topography in contrast to the surrounding area. During the 0.1% AEP modelled surface water event, 6.8% of the site is flooded. Surface water is channelled into the majority of the Aldersbrook within the site, excluding a small section of the watercourse to the east of Lugg Approach. There are also small areas of ponding in the north of the site, adjacent to the railway line. Flood depths reach 1.7m along some of the vegetated areas surrounding the banks of the Aldersbrook. Maximum velocities reach 0.2m/s in this area. The resulting flood hazard is 'Very Low' to 'Danger for Most', the latter being located along, and surrounding, the Aldersbrook where flood depths are deepest and water velocities are fastest.
Reservoir	The path of the Aldersbrook, which dissects the site from west to east, is the only area within the site that is at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. This risk is posed by several reservoirs which include: Perch Pond (Wanstead Park), Ornamental Road (Wanstead Park), Heronry Pond (Wanstead Park), Berners Hall Farm and Valentines Park Lake. The three Wanstead Park reservoirs are managed by the City of London Corporation, Berners Hall Farm is managed by Essex Farms,

	and Valentines Park Lake is managed by the London Borough of Redbridge. All these reservoirs are deemed as high-risk. The southern half of the site is at risk of Wet Day reservoir flooding. This risk is posed by the following reservoirs: Valentines Park Lake, Perch Pond (Wanstead Park), Ornamental Water (Wanstead Park), Heronry Pond (Wanstead Park), Eagle Pond, Chigwell Raw Water, Berners Hall Farm, Basin Lake (Wanstead) and King George V. All these reservoirs are deemed as high-risk. The additional reservoirs not within the Dry Day reservoir event are managed by Wanstead Golf Association Ltd (Basin Lake), Northumbrian Water Ltd (Chigwell Raw Water), the City of London Corporation (Eagle Pond) and King George V (Thames Water Ltd). These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The majority of the site is shown to have low risk of groundwater flooding, and any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property. The strip of land corresponding to the location of the Aldersbrook as well as the south-west of the site is at moderate risk of groundwater flooding. Any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. There will be a significant possibility that incidence of groundwater flooding could lead to damage to property. Further consideration of the local level of risk and mitigation is recommended. There are small areas in the north-eastern, north-western and south-eastern corners of the site that are shown to have negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 226 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within the northern two-thirds of the site. This occurred in 1974 due to the channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest record of a flooding incident was at Manor Service Station, Romford Road, approximately 290m south-west of the site. This occurred in August 2021.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are formal flood defences within the site. There are flood walls situated along the right bank of the Aldersbrook which extends across the entire length of the site. These flood walls have a design standard of protection of 20 years. The other flood defences within and surrounding the site are areas of natural high ground

	which are situated along both banks of the Aldersbrook. The design standard of protection for these defences is 20 years. The area is also protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Roding. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Roding. The site is not at risk from an overtopping or breach of defences along the River Thames during the Present Day epoch and 2115 epoch 0.5% or 0.1% AEP Thames Downriver breach events. The nearest area affected by the 2115 epoch 0.1% AEP downriver breach event is situated approximately 1.4km south of the site at the Former East Ham Gasworks site.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062WAF54LwRoding Flood Alert Area in the London Boroughs of Barking and Dagenham, Newham and Redbridge as well as the county of Essex. The site is located within the 062FWF54Redbridge Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Barking and Dagenham, Newham and Redbridge as well as Essex.
Access and egress	Access and egress to the site is currently via routes to the south of the site. These include Lugg Approach as well as two minor access routes to employment buildings in the south of the site. All these routes lead on to Romford Road. Safe access and egress is possible via all previously mentioned routes during all modelled tidal breach events in the present day epoch and the 2115 epoch 0.5% and 0.1% AEP Thames Tidal Downriver breach events. Safe access and egress is possible via all routes during the 3.3%, 1%, 1% +26% CC and 0.5% AEP modelled fluvial events. During the 0.1% AEP modelled fluvial event, flooding extends on to the section of Romford Road directly south of the site, affecting all access routes. Flood depths reach approximately 0.4m along the access route to the employment building in the south-western corner of the site. Maximum water velocities reach 1.6m/s along Romford Road. The resulting flood hazard is 'Very Low' to 'Danger for Most', the latter being located where flood depths are deepest in the south-western corner of the site. Therefore, vehicular access and egress may be affected during this modelled fluvial event. Safe access and egress is possible via all routes during the 3.3% AEP modelled surface water event. During the 1% AEP surface water event, ponding occurs along Romford Road to the south of the site. Flood depths here reach 0.2m with maximum velocities of 0.2m/s. The resulting flood hazard is 'Very Low', so access and egress is possible. During the 0.1% AEP modelled surface water event, this ponding extends further along Romford Road, forming a flow path. Flood depths reach 0.3m with maximum velocities of 0.8m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. The 1% AEP +40% CC surface water event covers a very similar area to the 0.1% AEP event with similar flood depths and water velocities. The resulting flood hazard is also 'Very Low' to 'Danger for Some'. Vehicular access and egress is likely to remain possible in these events. Arrangements for safe access and egress will need to be demonstrated for the 1% AEP plus an allowance for climate change rainfall event, using the depth, velocity, and hazard outputs. Given the risk to the site during the surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.

Dry Islands	The northern half of the site is within a dry island during both the Dry Day and Wet Day reservoir flood events. There are also small areas in the centre and south-east of the site which are within dry islands according to the EA's Flood Map for Planning Flood Zone 2.
Climate change	
Implications for the site	**Management Catchment: Roding, Beam and Ingrebourne** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** As the site's highest vulnerability classification is 'More Vulnerable', the central climate change allowance should be used as the design event. The site is not affected by fluvial flooding during the 3.3%, 3.3% +26% CC, 1%, 1% +26% CC or the 0.5% AEP modelled flood events. During the 0.5% AEP +26% CC, flooding increases significantly from the 0.5% AEP event. The south-west of the site is affected by flooding. Flood depths reach 2.8m with maximum velocities of 1.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most' with a small area along the Aldersbrook in the west of the site being 'Danger for All'. This shows that the site is sensitive to increases in fluvial flooding due to climate change. **Tidal Breaches:** The Thames Downriver 2115 epoch 0.1% AEP event does not encroach the site or surrounding access routes. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since the site is not at risk during this breach event, the site is considered to be at low risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Little Ilford ICM surface water model to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event, the flood extent increases from the 1% AEP event. The flood extent is similar to the 0.1% AEP event. Surface water is channelled into the majority of the Aldersbrook within the site, excluding a small section of the watercourse to the east of Lugg Approach. There are also small areas of ponding in the north of the site, adjacent to the railway line. Flood depths also increase from around 0.9m (1% AEP event) to around 1.5m in the 1% AEP plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the majority of the site is the Lambeth Group (clay, silt and sand). There is a small section in the south-western corner of the site which is London Clay Formation (clay, silt and sand).
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and gravel).
	• Soils at the site consist of:
	  ○ Loamy and clayey floodplain soils with naturally high groundwater.
	
	SuDS
	• Part of the site is considered to have low to moderate susceptibility to groundwater flooding. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and gravel which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone.
	• The site is located within the Secondary A bedrock aquifer designation zone. The site is also located within the Secondary A superficial aquifer designation zone.
	• The site is not located within an historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Little Ilford surface water ICM model indicates the presence of surface water flow paths beginning to form in areas surrounding the site during the 0.1% AEP modelled event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development.

	• Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies the residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 2, classified as 'More Vulnerable' and has some surface water flood risk, the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is shown to be at fluvial flood risk during the 0.1% AEP event and is at surface water flood risk in the 1% AEP plus 40% CC and 0.1% AEP modelled events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development within 20m of a flood defence will require specific planning permissions. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by

	the TE2100 Plan to improve flood risk management in the vicinity of the river.
	
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 1% AEP surface water event with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    ◦ raise them as much as possible
	    ◦ consider moving vulnerable uses to upper floors
	    ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	    ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request

	information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2, as well as being at pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 1% AEP surface water event, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus the upper end climate change allowance for peak rainfall intensity for the 2070s epoch surface water event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Little Ilford ICM surface water model (2015) and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have been applied to the Little Ilford ICM surface water model.
Fluvial and tidal breach depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/Mott MacDonald's Shonks Mill Lower Roding 2018 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Little Ilford ICM surface water model has been used to define areas at risk from surface water flooding. This model was re-run by JBA Consulting in 2023.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from the Little Ilford ICM model, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**LMUA4**
Address	East Ham Industrial Estate, Mahindra Way, Newham, E6 5
Area	1.71ha
Current land use	Residential
Proposed land use	Local Mixed Use Area – Residential and employment
Flood Risk Vulnerability	Mixed – 'More Vulnerable' and 'Less Vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located in the Beckton area of Newham. The site is bound by Newham Way to the north, Viking Gardens to the east, and the Beckton District Park to the south and west. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that the site is predominantly flat with some localised variations in site topography. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found around the northern, eastern and southern boundaries of the site at around 1.5 to 1.9mAOD, and the lowest lying land is around 0.83mAOD at a pond in the south eastern area of the site. The rest of the site lies higher at around 2.1 to 2.6mAOD.
Existing drainage features	The western corner of the site is located 2.9km east from the lower section of the River Lee, and approximately 2km north from the River Thames. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 80%** **FZ1 – 20%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario.

	Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entirety of the site is located within the Reduction in Risk of Flooding from Rivers and Sea due to Defences extent; meaning the full site is shown as benefitting from defences (although still may be at some risk). The nearest modelled defended fluvial flood extent is the River Lea, which is located approximately 2.7km south-west of the site. The site remains unaffected during the 3.3%, 1%, and 0.1% AEP events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0.2% Max depth – 0.15-0.3m Max velocity – 0.25-0.5m/s **0.1% AEP** – 3.8% Max depth – 0.15-0.3m Max velocity - 0.5-1m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events, but the flooding is only minor. In the 3.3% AEP event the site remains flood free. In the 0.1% AEP event surface water covers 3.8% of the site. In this event flood water predominantly propagates around the site boundary from neighbouring roads and topographic depressions and slightly encroach into the site. A small area of surface water ponding is present within the centre of the site. Flood depths vary from 0.15 to 0.3m with smaller areas of 0.30 to 0.90m. Flood water flows around the site are at around 0.0 to 0.25m/s across most of the site, with smaller areas where it flows around 0.5 to 1m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'.
Reservoir	The majority of the site is shown to be at risk of Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the whole site from the following reservoirs; Banbury, High Maynard, King George V, Queen Elizabeth II, Lockwood, Waltham Forest No 4, Waltham Forest No 5, Warwick East

	Reservoir, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, the site is at risk of flooding from the King George V reservoir. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The entire site is classed as having a negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location. Further consideration of the local level of groundwater flood risk and mitigation is recommended.
Sewers	The site is located within a postcode area with 11 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets have no records of flooding within and surrounding the site. Newham Borough Council's flood records show one record of flooding within the site, occurring in 2021. There is no further information regarding these flood records.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years. The site is also protected by the presence of natural high ground 13m east of the site which protects the site in a 20% AEP event.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 7.5%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 40%** Aside from an isolated area along the northern and eastern boundary of the site, almost the entire site is flood free by the River Thames in the Present Day 0.5% AEP scenario. The maximum depth, velocity, and hazard within the site reaches approximately 0.67m, 0.82m/s, and a maximum flood hazard rating of 'Danger for Most' respectively. The extent of flooding increases with flooding predicted around all boundaries of the site and in an area in the middle of the site in the 2100

	epoch event. Flood depths are predominantly shallow and are less than 0.3m. The maximum depth, velocity, and hazard within the site reaches approximately 0.67m, 0.77m/s, and a maximum flood hazard rating of 'Danger for Most' respectively. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 063FWT23RDockB, Tidal Thames at Beckton flood alert area. The site is mostly located within the 063FWT23RDockB, Tidal Thames at Beckton to the River Lee flood warning area. The north-eastern part of the site lies within the 063FWT23RDockC, Tidal Thames at Mill Meads and East Plaistow flood warning area.
Access and egress	Access and egress to the site is currently via two routes, from Mahindra Way to the east and Newham Way to the north. In the Present Day 0.5% AEP tidal upriver breach event, safe access and egress may not possible via Newham Way and may be restricted from Mahindra Way. This is also the case for the 0.5% AEP 2100 epoch breach event. Maximum depth, velocity, and hazard for the 0.5% AEP 2100 epoch breach event along Newham Way is 1.55m, 1.16m/s, and 'Danger for all' and 0.85m, 0.60m/s, and 'Danger for most'. As such, access and egress to the site during breach events will be severely impacted. During the 3.3%, 1%, and 0.1% surface water events, all access routes are inundated by surface water. In the 0.1% AEP event, the maximum depth, velocity, and hazard for Newham Way, and Mahindra Way reaches 0.6-0.9m, 1-2m/s, and 'Danger for most'; and 0.6-0.9m, 0.25-0.5m/s, and 'Danger for most' respectively. In the 1% AEP plus 40% climate change, the risk to access routes increases. Safe access and egress via Newham Road is not possible for the northern part of the road. Maximum depth, velocity, and hazard towards the southern end of the road reaches 0.72m, 1.25m/s, and 'Danger for Most'. Although affected by surface water flooding, safe access and egress may be demonstrated via Mahindra Way during the 1% AEP plus 40% climate change scenario. The maximum depth, velocity, and hazard for Mahindra Way are 0.54m, 0.50m/s, and 'danger for most'. It important to note for the surface water datasets, that the site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the site topography and structures such as underpasses. As such, surface water flow paths shown at highways or railways where there is an underpass, such as those on Newham Way, have been excluded from the calculation of maximum depth, velocity, and hazard. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.

Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both tidal and surface water flooding **Tidal Breaches:** **0.5% AEP Thames tidal upriver breach 2100 epoch (proportion of site at risk): 40%** The extent of flooding increases as a result of climate change with flooding predicted around all boundaries of the site and in an area in the middle of the site. Flood depths are predominantly shallow and are less than 0.3m. The maximum depth, velocity, and hazard within the site reaches approximately 0.67m, 0.77m/s, and a maximum flood hazard rating of 'Danger for Most' respectively. Since a large percentage of the site is at risk during the 2100 epoch 0.5% AEP breach event, the site is considered to be at high risk in the aforementioned breach scenario and sensitive to climate change **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent is similar to that in the 0.1% AEP event. The flooding extends further around the boundary of the site. Flood depths remain shallow between the 1% AEP event to the 1% plus 40% climate change event and are between 0-0.3m. This shows that the site is somewhat sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology across the site is the Thames Group comprised of clay, silt sand and gravel.
	  ○ Superficial – The superficial geology of the site is River Terrace Deposits (Undifferentiated) comprised of sand and gravel.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.

	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and gravel which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The entirety of the site is located within a Nitrate Vulnerable Zone. • The entire site is located within a Secondary (undifferentiated) superficial, aquifer designation zones. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test.

	The Exception Test is only required for 'More Vulnerable' development within Flood Zone 3. As the site lies within Flood Zone 2, the Exception Test is not required; however, it is recommended due to the significant residual risk identified previously.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 0.5% AEP Thames tidal breach extents **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).

	• Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 2115 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at Least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at Least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at Least 600mm above the estimated flood level.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.

Key messages	

The site is shown to be at significant risk of flooding in Flood Zone 2 as well as being at pluvial flood risk in the 0.1% AEP event. The site is also shown to be at significant flood risk if the Thames were to breach its banks or defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water event, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal extents, depth, velocity and hazard mapping	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**LMUA6**
Address	Ashburton Terrace, Newham, E13 0
Area	1.71ha
Current land use	Commercial
Proposed land use	Local Mixed Use Area – residential and employment
Flood Risk Vulnerability	Mixed – 'More vulnerable' and 'Less vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located within the Upton area of Newham. The site is bound by the London, Tilbury and Southend Railway in the north, Grasmere Road to the east, High Street in the south and Plaistow Road in the west. Ashburton Terrace road runs through the middle of the site running north east to south west. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR shows that topography across the site varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, which may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found to the north western site corner at around 3.3mAOD. The rest of the site lies higher at around 4.6 to 5.1mAOD. There is a high point in the southwest of the site at 6.2mAOD.
Existing drainage features	The western corner of the site is located 1.6km west from the River Lea, and approximately 3.7km north from the River Thames, which also marks the location of the confluence of the two rivers. There are no drainage ditches within the site.
Critical Drainage Area	The site is located within the Group 4 40 CDA. Ponding has previously occurred on the tracks at the underpass low point. Runoff from surrounding high ground is funnelled to this location.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 0%** **FZ1 – 100%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:**

	Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. **Flood characteristics:** The entire site is located in Flood Zone 1 of the Flood Map for Planning and therefore has a very low risk of fluvial and tidal flooding.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 5% Max depth – 0.15-0.3m Max velocity – 0.5-1m/s **0.1% AEP** – 12% Max depth – 0.3-0.6m Max velocity – 1-2m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events. In the 3.3% AEP event the site remains flood free. In the 1% AEP event surface water covers 5% of the site. Surface water flooding occurs along Ashburton Terrace and flows in a north westerly direction towards the railway along the northern border. Flood depths vary from 0 to 0.3m, deepest in the lower-lying parts of the flow path. The majority of the water flows at 0 to 0.5m/s, but varies from 0 to 1.0m/s. The fastest flowing water is located at intervals along the flow path. The resulting flood hazard is predominantly 'Very Low' with very small areas of 'Danger for Some' where flooding is deepest. In the 0.1% AEP event surface water covers 12% of the site. In this event the extent of the flow path in the 1% AEP event increases, with flood water on the site is still confined to the flow path along Ashburton Terrace. Flood depths vary from 0.5 to 2m, with smaller areas of 0.3 to 0.6m. Flood water flows at around 0.25 to 0.5m/s across most of the site, with smaller areas where it flows around 0.25 to 0.5m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where flood velocities are higher and water is deeper, there are areas of 'Danger for Most'.
Reservoir	The majority of the site is shown to be at risk of Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the whole site from the following reservoirs; Banbury, King George V, Queen Elizabeth II, Lockwood, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, the site is not at risk of flooding. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have moderate risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a significant possibility that incidence of groundwater flooding could lead to

	damage to property. Further consideration of the local level of risk and mitigation is recommended.
Sewers	The site is located within a postcode area with 0 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of [Thames Water's Drainage and Wastewater Management Plan](). The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets have no records of flooding within and surrounding the site. Newham Borough Council's flood records show one record of flooding within the site, occurring in 2021. There is no further information regarding these flood records.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is not protected by formal flood defences.
Residual risk	The site is not at residual risk of flooding from a breach of defences along the River Lee or River Thames
Emergency planning	
Flood warning	The site is not within an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Access and egress to the site is currently via a number of routes. The first is from Plaistow Road and High Street and the second from Ashburton Terrace. Access along Ashburton Terrace (and connecting High Street) will be restricted by a surface water in the 1% AEP plus 40% Climate Change event. This road is predicted to flood to depths of between 0-0.6m in the 1% AEP event and velocities are predicted to be 0.18-2.4m/s. This results in a hazard rating of very low to danger for some. In the 0.1% AEP event, flood depths are between 0.15-0.6m and flood velocities between 0.25-1m/s. This results in a flood hazard of very low to danger for most. Plaistow Road is predicted to be flood free during all events with flooding by the railway line likely to be on the railway and not on the Plaistow Road bridge crossing the railway line.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial** The site is not at risk of fluvial flooding.

	Tidal Breaches: The site is not at risk of flooding from a breach of defences from the River Thames. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent is similar to that in the 0.1% AEP event. The flooding extends further into Ashburton Terrace. Flood depths also increase from around 0 to 0.3m (1% AEP event) to around 0.3 to 0.6m in the 1% plus 40% climate change event. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt, sand and gravel).
	  ○ Superficial – The superficial geology of the site is River Terrace Deposits (Undifferentiated) (sand and gravel) which is produced as the dissected remnants of earlier abandoned floodplains.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater
	
	SuDS
	• The site is considered to have a medium susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
	• BGS data indicates that the underlying geology is London Clay Formation and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge in accordance with the SuDS hierarchy is required to discharge surface water runoff.
	• The site is not located within a Groundwater Source Protection Zone.
	• The site is located in a Secondary A Aquifer designation zone
	• The site is not located within a historic landfill site.
	• The site is not located within a nitrate vulnerability zone.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.

	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% and 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies the residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. It is recommended that the Exception test is applied should this site be brought forward, owing to the significant surface water flood risk identified as a flow path that bisects the site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the

	London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.
	• All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Careful consideration will also need to be given to the significant surface water flood risk on site.
	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 1% AEP surface water event with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level

	- by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at risk of surface water flooding in the 1% AEP event plus 40% CC and the 0.1% AEP event. Development of the site may be able to proceed if:

- A carefully considered and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 1% AEP surface water event, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal extents, depth, velocity and hazard mapping	The site is not within a mapped extent for fluvial or breach extent.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.

Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Canning Road West, LMUA9**
Address	Canning Road/Abbey Road, E15 3
Area	0.54 ha
Current land use	Industrial, residential, food and drink
Proposed land use	Local Mixed-Use Area (LMUA) – Mainly industrial, employment, residential
Flood Risk Vulnerability	Mixed – 'Less Vulnerable' to 'More Vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located within the West Ham neighbourhood. It is bordered to the north by the Greenway, to the east by Canning Road, to the south by a carpark and to the west by the Channelsea River. This river is one of the Bow Back rivers that flow into Bow Creek/the River Lea. The site is located approximately 2.4km north of the River Thames. The site is located in the London Management Catchment. The catchment is 1487km² and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site is in a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. LiDAR shows that the land in the northern half of the site lies at a higher elevation to that in the south. Elevations also slope down towards the Channelsea River. In the northern half of the site, elevations lie between 4.91m AOD, at the river's edge, and 9.21m AOD at the Channelsea House carpark. In the southern half of the site, elevations lie between 4.21m, at the river's edge, and 7.27m AOD at the GTEC carpark.
Existing drainage features	The Channelsea River forms the western site boundary. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. Currently, there is a concrete car park built up to the river edge. The site is approximately 2.4km north of the River Thames. There are no major topographic depressions in the site that could act as drainage ditches.
Critical Drainage Area	The site is not located within a critical drainage area (CDA).
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 4%** **FZ2 – 14%** **FZ1 – 82%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For*

	example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The entire proportion of the site within Flood Zones 2 and 3 is covered by the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The Environment Agency's Flood Map for Planning shows 4% of the site to be within Flood Zone 3 and 14% of the site to be within Flood Zone 2. The Flood Zones cover the western site boundary, which extends along the banks of the Channelsea River. The Reduction in Risk of Flooding from Rivers and Sea due to Defences covers the portion of the site within Flood Zone 2 and 3. This means the site benefits from defences (although it may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0% **0.1% AEP** – 0.2% Max depth – 0.3 – 0.6m Max velocity – 0.0 – 0.25m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment.

	Description of surface water flow paths: During the 3.3% and 1% AEP event there is no flooding to the site. During the 0.1% AEP event surface water ponding in the woodland between the Greenway and the northern site boundary. This flooding encroaches onto 0.2% of the site, within the carpark of Channelsea House, to depths between 0.3 and 0.6m and velocities of up to 0.25m/s. The resulting hazard rating of this flooding is 'Danger for Some'.
Reservoir	The western boundary of the site is at risk Dry Day reservoir flooding from the following reservoirs: Banbury, High Maynard, King George V, Lockwood, Warwick East and William Girling. These reservoirs are managed by Thames Water Limited. Approximately 55% of the site is at risk of Wet Day reservoir flooding from the following reservoirs: Banbury, King George V, Lockwood and William Girling. High Maynard, Queen Elizabeth II, Walthamstow No. 4, Walthamstow No. 5, Warwick East, West Warwick and Wraysbury reservoir also risk of Wet Day reservoir flooding to western boundary of the site. These reservoirs are all deemed high-risk and are all managed by Thames Water Limited. Despite the risk being residual, in the very unlikely event that the reservoir fails, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 4 historic incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets show one flood incident within the site. This only covers the land directly adjacent to the western site boundary. This flood incident occurred in March 1947 and was recorded as main river flooding due to channel capacity being exceeded and there being no raised defences. Newham Borough Council's flood records show one incident of flooding within the site. The incident occurred in 2021. No further information was provided.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years. The Environment Agency's AIMS dataset shows there are formal flood defences along the western boundary of the site which borders the Channelsea River. These consist of flood walls. The design standard of protection of these defences is 1000 years.

Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 13.5%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 72.1%** During the present day 0.5% AEP tidal breach event, approximately 13.5% of the site is inundated. This flooding affects the north-western corner of the site as well as the northern boundary, covering parts of Channelsea House and the associated car park. This flooding is to depths of between 0.02 and 3.31m and velocities of up to 0.45m/s. The associated hazard rating of this flooding is 'Danger for All'. The site is 72.1% inundated during the 2100 epoch 0.5% AEP tidal breach event which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within two Environment Agency Flood Warning Areas: 062FWF53Stratfd- the Lower River Lee at Stratford (The Lower River Lee at Stratford including Mill Meads) and 063FWT23RDockC- the Tidal Thames at Mill Meads and East Plaistow (River Thames at Mill Meads and East Plaistow including Star Lane, Plaistow, Mill Meads and south Stratford Marshes).
Access and egress	Access and egress to the site is currently Canning Road. Vehicular access to Canning Road is via Abbey Road. There is additional pedestrian access to the site via the Greenway. Abbey Road DLR station is located approximately 0.5km north of the site. During the present day 0.5% AEP tidal breach event, Canning Road is not flooded. Therefore vehicular and pedestrian access and egress to the site is still possible. Abbey Road is flooded to the west of the site. Vehicles and pedestrians can still travel east along Abbey Road. During the 2100 epoch 0.5% AEP tidal breach event, much of the site and the surrounding land is inundated. Flooding at the junction of Canning Road and Abbey Road is up to 0.76m deep with a velocity of up to 0.79m/s. The resulting flood hazard rating at the junction of Canning Road and Abbey Road is 'Danger for Most'. This is likely to impeded access and egress. The Greenway extends east from the site and is above the adjacent railway line and road. Therefore, pedestrian access and egress to the site during the 2100 epoch 0.5% AEP tidal breach event may be possible. Flooding does not extend beyond Upper Road, approximately 1.1km east of the site, which is accessible via the Greenway. During the 1% AEP +40% climate change surface water event there is flooding along Abbey Road. This flooding is to depths of up to between 0.3 and 0.6m. On Rick Roberts Way, west of the site, there is flooding of depths up to >1.2m and velocities of up to between 1.0 and 2.0m/s. The hazard rating of flooding on Rick Roberts Way is up to 'Danger for Most', likely impeding access and egress in this direction. Travelling east along Abbey Road, Mitre Road and (travelling north) on Manor Road the hazard rating of

	flooding is largely 'Very Low Hazard' and 'Danger for Some'. Vehicular and pedestrian access and egress may be possible via this route. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	During the 2100 epoch 0.5% AEP Thames tidal breach event, the eastern side of the site (along with land on the other side of Canning Road) form a dry island. The surrounding land is inundated with water of depths of up to 4.2m.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Fluvial:** According to the River Lee defended hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change during the Central climate change allowance. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The flood extent in the 0.5% AEP breach event during the 2100 epoch is much larger than the present day extent. Flooding inundates 72.1% of the site rather compared 13.5%. In the 2100 epoch event flood depths within the site increase by up to 0.87m when compared to the present day event. The velocity of flooding within the site during the 2100 epoch event increases to up to 1.29m/s and the resulting hazard rating of flooding increases to 'Danger for Most' at the north-western corner of the site. This shows that the site is sensitive to climate change. **Surface Water:** The proportion of the site at risk of flooding during the 1% AEP plus 40% climate change event is slightly smaller than that in the 0.1% AEP event. The depth, velocity and hazard of flooding during the 1% AEP plus 40% cc event is the same as during the 0.1% AEP event. Ponding of depths of up to 0.6m, velocities of up to 0.25m/s and with a hazard rating of up to 'Danger for Some' is found along the northern site boundary. The site is relatively insensitive to pluvial climate change flooding. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	
Broad-scale assessment of possible SuDS	**Geology & Soils** • Geology at the site consists of:

	- Bedrock - Bedrock geology of the site is the London Clay Group (clay, silt, sand and gravel). This is sedimentary bedrock. - Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water. - Soils at the site consist of: - Loamy and clayey soils of coastal flats with naturally high groundwater **SuDS** - The site is considered to have a very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. - BGS data indicates that the underlying geology is a mixture of clay, silt, sand and gravel which is likely to be with a highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. - The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. - The site is located within a Nitrate Vulnerable Zone. - The entire site is located within an unproductive bedrock aquifer zone and a Secondary (undifferentiated) superficial deposit aquifer zone - The site is not located within a historic landfill site. - Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. - The site is not located within a historic landfill site. - Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduced site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. - If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the owner.
Opportunities for wider sustainability benefits and integrated flood risk management	- Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. - Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. - Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.

	• Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development, and non-residential uses for educational establishments as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. If residential land use is included in the development proposal for this Local Mixed Use Area site, the Exception Test will be required due to the site's location within Flood Zone 3. As the site is partly within Flood Zones 2 and 3, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames. • Development within 20m of a main river or flood defence will require specific planning permissions. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific Flood Risk Assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the tidal flood risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.

	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers
	
	Guidance for site design and making development safe:
	
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal breach extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event with an appropriate allowance for climate change, using the depth, velocity and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • Raise them as much as possible
	    • Consider moving vulnerable uses to upper floors
	    • Include extra flood resistance and resilience measures.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan

	Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report

Key messages

The site is shown to be at risk of flooding in Flood Zone 3 and at significant flood risk if the Thames were to breach its banks or defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from areas identified to be at risk of flooding from rivers and sea (in Flood Zone 3) within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed in Flood Zone 3 is shown to pass the Exception Test.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal breach event, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development does not increase the risk of surface water flooding on the site and to third-party land.
- A site-specific Surface Water Drainage Strategy and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 0.5% AEP tidal, plus an allowance for climate change, breach event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan due to the widespread flooding on the site during the tidal breach event.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have been applied to the Environment Agency's River Lee 2D Flood Mapping model to indicate the impact on fluvial flood risk. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water mapping to indicate the impact on surface water flood risk.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. Fluvial - This has been assessed using the present day and climate change results from the Environment Agency's River Lee 2D model (2015).
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Beeby Road, LMUA14**
Address	Land to the east of Beeby Road, immediately south of Newham Way, E16 1
Area	0.87ha
Current land use	Mixed land use including industrial units.
Proposed land use	Local Mixed Use Area - Residential, industrial and employment, community, health, town centre uses, and open space.
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable.
Sources of flood risk	
Location of the site within the catchment	The site is located in the east of Canning Town, and is bordered by Newham Way to the north, Freemasons Road to the east, and Beeby Road to the west. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that most of the topography is relatively consistent. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. Despite the majority of the site being relatively flat, the lowest elevations are located to the east of the site at around 1.81mAOD. The areas of highest elevation are to the north west of the site bordering Beeby Road, up to 2.33mAOD.
Existing drainage features	There are no existing drainage features within the borders of the site. The site lies approximately 1.16km east of the River Lea and 1.44km north-east of the confluence between the River Lea and the River Thames.
Critical Drainage Area	The site is not located within a Critical Drainage Area.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 1%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportions of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been

	reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. During the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). As such, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entirety of the site is located within the Reduction in Risk of Flooding from Rivers and Sea due to Defences extent; meaning the full site is shown as benefitting from defences (although still may be at some risk). The nearest modelled defended fluvial flood extent is the River Lea, which is located approximately 1.16km south-west of the site. The site remains unaffected during the 3.3%, 1%, and 0.1% AEP events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0% **0.1% AEP** – 2.7% Max depth – 0.15m – 0.30m Max velocity - 0m/s – 0.25m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is unaffected by surface water in the 3.3% and 1% AEP events. The 0.1% AEP extent covers 2.7% of the south-east of the site, entering from a surface water flow path along Freemasons Road. The flooding mainly affects the small unnamed access road in the south of the site to a maximum depth, velocity, and hazard of 0.3m, 0.25m/s, and 'Very Low Hazard/Caution'.
Reservoir	According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Dry Day scenario. The following reservoirs are shown to inundate the either part of, or the whole site: King George V and William Girling, both of which are managed by Thames Water Ltd and are considered high risk. According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Wet Day scenario. The following reservoirs are shown to inundate the whole site: Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling, and Wraysbury. These reservoirs are all owned by Thames Water Ltd and are considered high risk. As all reservoirs in this area are deemed as high-risk, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than

	1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could Lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site lies within two postcode areas: E16 1 and E16 3, with 32 and 206 incidences of sewer flooding respectively, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's Historic Flood Map and Recorded Flood Outline show no records of flooding within or immediately surrounding the site. Newham Borough Council's flood records show no records of flooding within or immediately surrounding the site. The closest incident was on Russel Road, around 180m south of the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lea. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 design years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal Present Day event proportion of site at risk – 89%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 99.7%** Aside from some isolated areas towards the north and west of the site, almost the entire site is inundated by the River Thames in the Present Day 0.5% AEP scenarios. The maximum depth, velocity, and hazard within the site reaches approximately 0.42m, 0.82m/s, and 'Danger for Most' respectively. This only increases with the 2100 epoch event, with almost the complete site inundated in this scenario. Maximum depth, velocity, and hazard are detailed in the Climate Change section of this Site Table. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences is unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	

Flood warning	The entire site is located in both an Environment Agency Alert Warning Area, and an Environment Agency Flood Warning Area. Flood Alert Area: 063WAT233N (Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham) Flood Warning Area: 063FWT23RDockB (River Thames at Beckton including Canning Town, Custom House, and Beckton)
Access and egress	Access and egress to the site is currently via a number of routes. Along the eastern border, access is gained via Freemasons Road and a small unnamed access route that runs along the southern border of the site. To the west, access is gained via Beeby Road which follows the western border of the site. Access to both Freemasons Road and Beeby Road is gained from Newham Way along the northern border. Freemasons Road can also be accessed via Victoria Dock Road to the south. In the Present Day 0.5% AEP tidal upriver breach event, safe access and egress may not possible via Freemasons Road, Beeby Road, or Newham Way. This is also the case for the 0.5% AEP 2100 epoch breach event. Maximum depth, velocity, and hazard for the 0.5% AEP 2100 epoch breach event along Freemasons Road, Beeby Road, and Newham Way are 0.55m, 0.74m/s, and 'Danger for Most'; 0.67m, 0.53m/s, and 'Danger for Most'; and 0.65m, 1.06m/s, and 'Danger for Most' respectively. As such, access and egress to the site during breach events will be severely impacted. During the 3.3%, 1%, and 0.1% surface water events, all access routes are minorly inundated by surface water; however, safe access and egress may be demonstrated to the site via both Beeby Road and Freemasons Road via Newham Way to the north. In the 0.1% AEP event, the maximum depth, velocity, and hazard for Freemasons Road, Beeby Road, and Newham Way reaches 0.15-0.3m, 0.25-0.5m/s, and 'Danger for Some'; 0-0.15m, 0.25-0.5m/s, and 'Very low Hazard/Caution', and 0.15-0.3m, 0.25-0.5m/s, and 'Danger for Some' respectively. In the 1% AEP plus 40% climate change, the risk to access routes increases. Safe access and egress via Beeby Road may only be demonstrated for the northern part of the road. Maximum depth, velocity, and hazard towards the southern end of the road reaches 0.36m, 0.39m/s, and 'Danger for Most'. Although affected by surface water flooding, safe access and egress may be demonstrated via Freemasons Road via Newham Way during the 1% AEP plus 40% climate change scenario. The maximum depth, velocity, and hazard for Freemasons Road and Newham Way are 0.24m, 0.29m/s, and 'Very Low Hazard/Caution'; and 0.24m, 0.21m/s, 'Danger for Some'. It important to note for the surface water datasets, that the site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the site topography and structures such as underpasses. As such, surface water flow paths shown at highways or railways where there is an underpass, such as those on Newham Way, have been excluded from the calculation of maximum depth, velocity, and hazard. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment**

	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The site is almost completely inundated in the Thames River Present Day epoch as detailed previously. This is the same for the 2100 epoch, with more extreme depth, velocity, and hazards. The maximum depth, velocity, and hazard for the 0.5% AEP 2100 epoch is 0.69m, 0.83m/s, and 'Danger for Most'. Since a large percentage of the site is at risk during the 2100 epoch 0.5% AEP breach event, the site is considered to be at high risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. Unlike the 1% AEP scenario, the 1% AEP plus 40% climate change event minorly affects in the south-eastern corner of the site. The surface water flow path enters from Freemasons Road, mainly inundating the small unnamed access road. The maximum depth, velocity, and hazard of this surface water is 0.2m, 0.24m/s, and 'Danger for Some'. This change in extent and depth shows that this site is sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology of the site is the London Clay Group (clay, silt, sand, and gravel).
	    ○ Superficial – The superficial geology of the site is undifferentiated River Terrace deposits (sand and gravel)
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand, gravel, and clay which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone
	• The site is not located within a Nitrate Vulnerable Zone
	• The site is located within the Secondary (undifferentiated) superficial aquifer designation zone.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the

	LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces, and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean and improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. The Exception Test is only required for 'More Vulnerable' development within Flood Zone 3. As the majority of the site lies within Flood Zone 2, the Exception Test is not required; however, it is recommended due to the significant residual risk identified previously.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage.

	• At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development within 20m of a main river or flood defence will require specific planning permissions. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an

	appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  • raise them as much as possible
	  • consider moving vulnerable uses to upper floors
	  • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  • using flood resistant materials that have low permeability to at Least 600mm above the estimated flood level
	  • making sure any doors, windows or other openings are flood resistant to at Least 600mm above the estimated flood level
	  • by raising all sensitive electrical equipment, wiring and sockets to at Least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 as well as being at pluvial flood risk in the 0.1% AEP event. The site is also shown to be at significant flood risk if the Thames were to breach its banks or defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased

risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water event, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal extents, depth, velocity and hazard mapping	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity, and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Glory House, Tabernacle Avenue. LMUA18**
Address	Land to the north east and south-west of Tabernacle Avenue, including Glory House on Barking Road, E13 8.
Area	0.35ha
Current land use	Mixed land use
Proposed land use	Local Mixed Use Area - Residential, industrial and employment, community, health, town centre uses, and open space.
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable.
Sources of flood risk	
Location of the site within the catchment	The site is located in the north east of Canning Town, and is split in two, with Tabernacle Avenue running through the centre. For the purpose of this site table, the two parts of the site will be referred to as the northern and southern sub-sites. The site is bound by Chargeable Lane to the north east and properties along Barking Road to the south east. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site's western boundary borders the River Lee. The southern and eastern boundaries border the Bow Back Creek and City Mill River, respectively, both of which converge with the River Lee in the site's site-western corner. The site is also situated approximately 3.2km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that most of the topography is relatively consistent. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. Despite the majority of the site being relatively flat, the lowest elevations are located to the centre of the site along Tabernacle Avenue, at around 0.69mAOD. The areas of highest elevation are on the eastern border of the north eastern part of the site, up to 1.38mAOD.
Existing drainage features	There are no existing drainage features within the borders of the site. The site lies approximately 1.1km east of the River Lea and 1.69km north-east of the confluence between the River Lea and the River Thames.
Critical Drainage Area	The site is not located within a Critical Drainage Area.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For*

	example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entirety of the site is located within the Reduction in Risk of Flooding from Rivers and Sea due to Defences extent; meaning the full site is shown as benefitting from defences (although still may be at some risk). The nearest modelled defended fluvial flood extent is the River Lea, which is located approximately 1.1km south-west of the site. The site remains unaffected during the 3.3%, 1%, and 0.1% AEP events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 6.7% Max depth – 0.3m - 0.6m Max velocity – 0m/s – 0.25m/s **1% AEP** – 22.7% Max depth – 0.6m – 0.9m Max velocity – 0.25m/s – 0.5m/s **0.1% AEP** – 30.8% Max depth – 0.6m – 0.9m Max velocity – 0.5m/s – 1m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The 3.3% AEP extent only inundates the southern sub-site, flowing south west off Tabernacle Avenue that runs along the north eastern border. The maximum depth and velocity are quoted above, and the maximum hazard is 'Danger to Some'. Similarly, in the 1% AEP event, the surface water flow path originating on Tabernacle Avenue inundates the southern sub-site to a maximum depth, velocity, and hazard of 0.3m - 0.6m, 0.25m/s - 0.5m/s, and 'Danger for Most'. This flow path also inundates the south west of the northern sub-site

	to a maximum depth, velocity, and hazard of 0.3m - 0.6m, 0m/s - 0.25m/s, and 'Danger for Some'. In this event, surface water flow paths originating on Chargeable Lane along the north west border also inundate the northern sub-site. This is to a maximum depth, velocity, and hazard of 0.15m - 0.3m, 0m/s - 0.25m/s, and 'Danger for Some'. The flow paths described for the 1% AEP extent are amplified in the 0.1% AEP event, with the Tabernacle Avenue flow path in the southern sub-site reaching a maximum depth, velocity, and hazard of 0.6m - 0.9m, 0.25m/s - 0.5m/s, and 'Danger for Most'. The Tabernacle Avenue surface water flow path that inundates the south of the northern sub site reaches a maximum depth, velocity, and hazard of 0.6m - 0.9m, 0.25m/s - 0.5m/s, and 'Danger for Most'. Finally, the surface water extent originating from Chargeable Lane in the north of the northern sub-site reaches a maximum depth, velocity, and hazard of 0.3m - 0.6m, 0.5m/s - 1m/s, and 'Danger for Most'.
Reservoir	According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Dry Day scenario. The following reservoirs are shown to inundate the either part of, or the whole site: King George V and William Girling, both of which are managed by Thames Water Ltd and are considered high risk. According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Wet Day scenario. The following reservoirs are shown to inundate the whole site: Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling, and Wraysbury. These reservoirs are all owned by Thames Water Ltd and are considered high risk. As all reservoirs in this area are deemed as high-risk, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could Lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site lies within postcode area E13 8, which has 293 incidences of historical sewer flooding according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's Historic Flood Map and Recorded Flood Outline show no records of flooding within or immediately surrounding the site. Newham Borough Council's flood records show no records of flooding within or immediately surrounding the site. The closest incident was around 30m south of the site the other side of Barking Road.
Flood risk management infrastructure	

Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lea. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 design years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day event proportion of site at risk – 100%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 100%** The entire site is inundated by the River Thames in the Present Day 0.5% AEP scenarios. The maximum depth, velocity, and hazard within the site reaches approximately 1.44m, 0.52m/s, and 'Danger for Most' in the southern sub-site. In the northern sub-site, the maximum depth, velocity, and hazard is 1.36m, 0.49m/s, and 'Danger for Most'. This only increases with the 2100 epoch event, with almost the complete site inundated in this scenario. Maximum depth, velocity, and hazard are detailed in the Climate Change section of this Site Table. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences is unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The entire site is located in both an Environment Agency Alert Warning Area, and an Environment Agency Flood Warning Area. Flood Alert Area: 063WAT233N (Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham) Flood Warning Area: 063FWT23RDockC (River Thames at Mill Meads and East Plaistow including Star Lane, Plaistow, Mill Meads, and south Stratford Marshes)
Access and egress	The northern sub-site can be accessed from Barking Road to the south east; however, as the southern sub-site is located behind properties lining Barking Road, the only existing access is via Tabernacle Avenue, a small access road off Barking Road which bisects the site. In the Present Day 0.5% AEP tidal upriver breach event, safe access and egress may not be possible via Barking Road as the maximum depth, velocity, and hazard is 1.2m, 0.04m/s, and 'Danger for Most'. This only increases with the 0.5% AEP 2100 epoch breach event, where the maximum depth, velocity, and hazard is 1.47m, 1.2m/s, and 'Danger for Some'. As such, access and egress to the site during breach events will be severely impacted. In the 3.3% AEP surface water event, safe access and egress may be able to be demonstrated via Barking Road. When accessing from the north, the maximum depth, velocity, and hazard are 0m - 0.15m, 0m/s - 0.25m/s, and 'Very Low Hazard/Caution'. However, this is not the case for Tabernacle Avenue, which is inundated to a maximum depth, velocity, and hazard of 0.3m - 0.6m, 0.25m/s - 0.5m/s, and 'Danger for Some' in the 3.3% AEP scenario. As such, access and egress may only be demonstrated for the

	northern sub-site and not for the southern sub-site. In addition, safe access and egress may also be demonstrated for the northern sub-site in the 1% AEP event. The maximum depth, velocity, and hazard are 0.15m - 0.3m, 0.25m/s - 0.5m/s, and 'Danger for Some'. In the 0.1% AEP scenario, the maximum depth, velocity, and hazard on Barking Road reaches 0.3 - 0.6m, 1m/s - 2m/s, and 'Danger for Most', meaning access and egress to the site will be severely impacted. In the 1% AEP plus 40% climate change, the risk to access routes increases. The maximum depth, velocity, and hazard on Barking Road reach 0.49m, 1.16m/s, and 'Danger for All'. In addition, the maximum depth, velocity, and hazard of 0.84m, 0.98m/s, and 'Danger for All'. As such, access and egress to the site via both routes will be severely impacted. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The site is almost completely inundated in the Thames River Present Day epoch as detailed previously. This is the same for the 2100 epoch, with more extreme depth, velocity, and hazards. The maximum depth, velocity, and hazard for the 0.5% AEP 2100 epoch is 0.69m, 0.83m/s, and 'Danger for Most'. Since a large percentage of the site is at risk during the 2100 epoch 0.5% AEP breach event, the site is considered to be at high risk in the aforementioned breach scenario. Due to the increase in depths, velocity and hazard in the breach scenario, the site is also sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. The 1% AEP plus 40% climate change event, the surface water flow path originating on Tabernacle Avenue inundates the southern sub-site to a maximum depth, velocity, and hazard of 0.74m, 0.52m/s, and 'Danger for All'. Maximum depth, velocity, and hazard in the northern sub-site is 0.52m, and 0.4m/s, and 'Danger for All'. Although there is a significant increase in hazard, the extent of flooding in the southern sub-site is very similar to the 1% AEP extent. As such, the southern sub-site is not considered overly sensitive to climate change. However, there are areas in the northern sub-site whose change in depth and extent are quite significant, suggesting it is extremely sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.

Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the London Clay Group (clay, silt, sand, and gravel).
	  ○ Superficial – The superficial geology of the site is undifferentiated River Terrace deposits (sand and gravel)
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand, gravel, and clay which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone
	• The site is not located within a Nitrate Vulnerable Zone
	• The site is located within the Secondary (undifferentiated) superficial aquifer designation zone.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces, and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and

	their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean and improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. The Exception Test is required for this site, as the development includes 'More Vulnerable' development within Flood Zone 3. It is also highly recommended due to the significant residual risk identified previously.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development within 20m of a main river or flood defence will require specific planning permissions. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance;

	London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
	
	Guidance for site design and making development safe:
	
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at Least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at Least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at Least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The

	developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 and 3 as well as being at pluvial flood risk in the 3.3%, 1%, and 0.1% AEP event. The site is also shown to be at significant flood risk if the Thames were to breach its banks or defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water event, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan. If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal extents, depth, velocity, and hazard mapping	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.

Surface water depth, velocity, and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency’s RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Bidder Street, LMUA12**
Address	Bidder Street and Stephenson Street, Canning Town and Custom House Regeneration Area and Mayer Parry Wharf site, E16 4
Area	3.7ha
Current land use	Predominantly industrial uses
Proposed land use	Local mixed-use area (LMUA). Industrial, employment and residential.
Flood Risk Vulnerability	Mixed – 'Less Vulnerable' to 'More Vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located within the Custom House and Canning Town neighbourhood. It is bordered to the south west by the River Lea/Bow Creek and is located approximately 840m north of the River Thames. The site is located on Bidder Street and extends to Stephenson Street to the east, the River Lea to the west, Ives Road and the edge of the Mayer Parry Wharf site to the north, Crown Wharf and the end of Bidder Street to the south. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site is in a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. LiDAR shows that the site west of Bidder Street is at a higher elevation than the east. At the western half, elevations vary from approximately 1.67 to 5.14m.AOD At the eastern half, elevations vary from approximately 1.21 to 2.81m AOD, other than in the very southern point of the site where LiDAR elevations are up to 5.9m AOD.
Existing drainage features	The River Lea/Bow Creek forms part of the south-western border of the site. The site is approximately 840m north of the River Thames. There are no major topographic depressions within the site that could act as drainage ditches.
Critical Drainage Area	The site is not located within a critical drainage area (CDA).
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 93%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*

<table>
<tr><td></td><td>Defended outputs:
3.3% AEP fluvial event – 0%
1% AEP fluvial event – 0%
0.5% AEP fluvial event – 0%
0.1% AEP fluvial event – 0%

Modelled results show the percentage of site at risk from a given AEP flood event.

Available data:
Proportion of the sites at flood risk are determined from the Environment Agency’s Flood Map for Planning Flood Zones. This represents the undefended scenario.

Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures.

Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event).

Therefore, the EA’s Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in.

The entire site is shown to be within the EA’s Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent.

The Environment Agency’s 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding.

Flood characteristics:
The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. Although the site is shown to benefit from defences, it may still be at some risk.

According to the River Lee (2014) hydraulic model, despite being in close proximity to fluvial flood events, the site is unaffected by fluvial flooding during the defended 3.3%, 1%, 0.5% and 0.1% AEP modelled events.</td></tr>
<tr><td>Surface Water</td><td>Proportion of site at risk (RoFfSW):
3.3% AEP – 1.9%
Max depth – 0.3 – 0.6m
Max velocity – 0.25 – 0.5m/s
1% AEP – 3.9%
Max depth – 0.3 – 0.6m
Max velocity – 0.5 – 1.0m/s
0.1% AEP – 11%
Max depth – 0.3 – 0.6m
Max velocity – 1.0 – 2.0m/s

The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).

The Environment Agency’s Risk of Flooding from Surface Water mapping was used in this assessment.</td></tr>
</table>

	Description of surface water flow paths: During the 3.3% AEP and 1% AEP surface water events, there is flooding mainly along the roads within the site. During the 3.3% AEP event, there is surface water ponding along Wharf Street and Bidder Street. This flooding is to depths of up to between 0.3 to 0.6m. This flooding has a velocity of up to between 0.25 to 0.5m/s, resulting in a hazard rating of up to 'Danger for Some'. During the 1% AEP event, ponding along Wharf Street and Bidder Street expands and joins together forming a flow small flow path. There is also a small area of ponding in the carpark of the Mayer Parry Wharf site. The flooding during this event is also to depths of up to between 0.3 and 0.6m. The velocity of this flooding is up to between 0.5 and 1.0m/s, the resulting hazard rating of this flooding is up to 'Danger for Some'. During the 0.1% AEP event, the flooding extends to the entirety of Bidder Street within the site boundary and all of Wharf Street. There is also some ponding along Ives Road and the area of ponding within the Mayer Parry Wharf site carpark also increases in size. The depth of flooding during this event increases to up to between 0.6 and 0.9m. Velocities of flooding are up to between 1.0 and 2.0m/s, the resulting hazard rating of this flooding is up to 'Danger for Most'.
Reservoir	Bidder Street, Wharf Street and Ives Road are at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. This risk is posed by the Banbury, High Maynard and Lockwood reservoirs. The entire eastern half of the site is at risk of Dry Day reservoir flooding from the King George V and William Girling reservoirs. All five of these reservoirs are managed by Thames Water Limited and are deemed as high-risk. The entirety of the site, excluding small, isolated areas across the sites, are at risk of Wet Day reservoir flooding from the following reservoirs: Wraysbury, William Girling, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Queen Elizabeth II, King George V, and Banbury. These reservoirs are all deemed as high-risk and are all managed by Thames Water Limited. High Maynard Reservoir and Lockwood Reservoir also pose Wet Day reservoir flood risk to the eastern half of the site. Both of these reservoirs are also deemed as high-risk and are managed by Thames Water Ltd. Despite the risk being residual, in the very unlikely event that the reservoir fails, it is predicted that there is a risk to life. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 25 historic incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.

Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets both cover the site. Main river flooding impacted the entire site in Spring 1947. The cause of this flooding was the exceedance of channel capacity and there being no raised defences. Sea/tidal flooding impacted the southern part of the site (up to just north of Wharf Street) in 1953. The cause of this flooding was the overtopping of defences. Newham Borough Council's flood records show no record of flooding within the site. The nearest flooding incident (approximately 230m east of the site) was at a shop on Barking Road in 2021. No further information was provided about the incident.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lea. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 85.3%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 89.4%** During the 0.5% AEP tidal breach event, approximately 85.3% of the site is inundated. Flood depths vary from 0.01 to 3.3m with the deepest flood depths found along the roads within the site and in a small area of the Mayer Parry Wharf site. The velocity of flood water is up to 2.5m/s and the resulting flood hazard rating is up to 'Danger for All' along Wharf Street and ranging between 'Very Low Hazard' and 'Danger for Most' on the rest of the site. The site is approximately 89.4% inundated during the 2100 epoch 0.5% AEP tidal breach event which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within the Environment Agency Flood Warning Area – 063FWT23RDockC- Tidal Thames at Mill Meads to East Plaistow (River Thames at Mill Meads and East Plaistow including Star Lane, Plaistow, Mill Meads and south Stratford Marshes) as well as Flood Warning Area – 062FWB53TidalLee- Lower Lee from West Ham and Canning Town (The Lower River Lee from West Ham to Canning Town).
Access and egress	Access and egress to the site is currently via Stephenson Street (B164) linking to Ives Road, Wharf Street and Bidder Street, within the site. Stephenson Street is accessible from the north via Manor Road (A1011) and

	from the south via Barking Road (A124) which also links to Canning Town underground, DLR and bus station via Silvertown Way. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the present day 0.5% AEP tidal breach event, flood depths on Stephenson Street are up to 1.3m and velocities of up to 1.96m/s. This high velocity is concentrated at the junction of Wharf Street. The resulting hazard rating along Stephenson Road is largely 'Danger for Most' with a smaller area of flood hazard rating 'Danger for All' on Wharf Street (within the site) meaning vehicular and pedestrian access and egress is likely to be impeded. During the 2100 epoch 0.5% AEP tidal breach event, the proportion of the site inundated is 89.4%. On Stephenson Street flood depths are up to 1.47m and velocities of flooding are up to 2.1m/s. The resulting flood hazard rating is up to 'Danger for All' on parts of the road meaning vehicular and pedestrian access and egress is likely to be impeded. During the 1% AEP +40% climate change surface water flood event, there is flooding to much of Stephenson Street, Bidder Street and Ives Road. All of Wharf Street is inundated with water. The southern end of Bidder Street and Stephenson Street, where there is access onto Barking Road is not in the modelled flood extent during this event. Therefore, pedestrian access and egress from land either side of Muskell Industrial Place may be possible via these routes. Flooding on the remainder of Stephenson Street is up to between 0.6 and 0.9m with velocities of flooding up to between 1.0 and 2.0m/s. The resulting hazard rating of surface water flooding on Stephenson Road during this event is largely 'Danger for Most' meaning vehicular and pedestrian access and egress is likely to be impeded.
Dry Islands	During the present day 0.5% AEP tidal breach event there are several dry islands within the Mayer Parry Wharf part of the site. These are areas where there is no predicted flooding. These parts of the site are 'dry islands' as flood depths on the surrounding land extend between 0.01 and 3.3m, with associated flood hazard rated as up to 'Danger for All'
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Fluvial:** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%) **Tidal Breaches:** During the 2100 epoch, the proportion of the site inundated during the 0.5% AEP tidal breach event is 89.4%. The flood extent during the 2100 epoch is only 4.2% greater than the present day. However, flood depths increase by up to 0.5m within the site and the velocity of flooding increases to around 2.1m/s in some areas, indicating that the site is relatively sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP

	upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario for development with a lifetime beyond 2100. In the 1% AEP plus 40% climate change event, the surface water flood extent within the site increases significantly compared to the 1% AEP event. Ponding along Wharf Street and the southern end of Bidder Street expands along the north of Bidder Street. A flow path also forms along Stephenson Street (which provides access and egress to the site). The ponding within the Mayer Parry Wharf carpark also slightly increases in size. The depth and velocity of flooding also increases with the amount of deeper and faster moving water increasing within the site. Flood hazard rating within the site increases to 'Danger for Most'. This indicates the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the sites is London Group (Clay, Silt, Sand and Gravel). This is a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the sites is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is clay, silt, sand and gravel which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is located within a Nitrate Vulnerable Zone.
	• The entire site is located within an unproductive bedrock aquifer zone and a Secondary (undifferentiated) superficial deposit aquifer zone
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.

	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development, and non-residential uses for educational establishments as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. Open space is classed as 'water compatible development.' As the site is within Flood Zone 2 and 3, and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 3.3% AEP, 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • Development within 20m of a main river or flood defence will require specific planning permissions. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way.

	- Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. - All sources of flooding should be considered as part of a site-specific Flood Risk Assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the tidal flood risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. - Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. - Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. **Guidance for site design and making development safe:** - London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. - The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). - Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures. - The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. - Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity and hazard outputs. - Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. - Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:

	• Raise them as much as possible • Consider moving vulnerable uses to upper floors • Include extra flood resistance and resilience measures. • The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 3 as well as being at surface water flood risk during the 3.3% AEP, 1% AEP and 0.1% AEP events. The site is also shown to be at significant flood risk if the Thames were to breach its banks or defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'More Vulnerable' development proposed in Flood Zone 3 is shown to pass the Exception Test.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal breach event, as well as the 1% AEP surface water event, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development does not increase the risk of surface water flooding on the site and to third-party land.
- A site-specific Surface Water Drainage Strategy and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus higher central climate change surface water event, as well as the 0.5% AEP tidal, plus an allowance for climate change, breach event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan due to the widespread flooding on the site during the tidal breach event.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.

Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have been applied to the Environment Agency's River Lee 2D Flood Mapping model to indicate the impact on fluvial flood risk. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial and tidal extents, depth, velocity and hazard mapping	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. Fluvial - This has been assessed using the present day and climate change results from the Environment Agency's River Lee 2D model (2015).
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Abbey Mills, N7.SA1**
Address	Land between Mill Meads and Canning Town, between Bromley-by-Bow Station and West Ham Station, Three Mills, E15 3
Area	7.01ha
Current land use	Temporary community facility and vacant land.
Proposed land use	Residential, community facilities and open space.
Flood Risk Vulnerability	Mixed - 'More Vulnerable,' 'Less Vulnerable' and 'Water Compatible Development.'
Sources of flood risk	
Location of the site within the catchment	The site is located between Bromley-by-Bow Station and West Ham Station, located to the north of the District. The Hammersmith & City and District lines run parallel to Crows Road. The Channelsea River flows adjacent to the sites western boundary. Canning Road enters the site from the north. The south-eastern corner of the site extends across Manor Road (A1011) and on to land off Alan Hocken Way. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is situated within a very urbanised part of the catchment. The Channelsea River converges with the River Lee (also known as Bow Creek) adjacent to the site's south-western corner. The River Lee then flows into the River Thames approximately 2.5km south of the site.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography slightly varies. It is sloping from the north to south-southeast. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found to the south along the site at around 2.0mAOD. The highest elevations are found to the north along the site at around 6.4mAOD. The rest of the site elevation ranges between 3.0 and 5.0mAOD.
Existing drainage features	There are two watercourses in close proximity of the site. The Channelsea River (main river) runs along the sites northern boundary, and the Abbey Creek (main river) is situated on the other side of Channelsea Island. The latter only spans the length of this island, flowing back into the Channelsea River. The Channelsea River converges with Bow Creek adjacent to the sites south-western corner. This watercourse then flows into the River Lee approximately 400m south of the site. The River Lee then flows into the River Thames approximately 2.5km south of the site. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are areas of vegetation along the site's southern and eastern boundaries, as well as part of the northern boundary which may act as drainage ditches.
Critical Drainage Area	There are two areas within the east of the site, along Manor Road and north of West Ham Station. The Critical Drainage Area (CDA) 'Group 4_031' is located at the east of the site, along Manor Road and stretches from the north to the south. The CDA 'Group 4_040' is located at the very east of the site to the north of West Ham Station and is stretching from west to east.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 8%** **FZ2 – 12%** **FZ1 – 88%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended model outputs:** **3.3% AEP fluvial event – 0.1%** **1% AEP fluvial event – 0.1%** **0.5% AEP fluvial event – 0.2%** **0.1% AEP fluvial event – 0.2%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is not located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area that are within this extent include the eastern boundary and the western boundary that is adjacent to the Channelsea River, the majority of the section in the south-east which extends across Manor Road, and sections of the south-west of the site. These aforementioned areas are shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, a negligible portion of the site (up to a maximum of 0.2% of the total site boundary during the 0.1% AEP event) is impacted fluvial flooding during the 3.3%, 1%, 0.5% and 0.1% AEP defended modelled events. This flooding occurs on the north-western fringes of the site, parallel to the Channelsea River.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.2% Max depth – 0.6 – 0.9m Max velocity – 0.25 – 0.5m/s **1% AEP** – 3.0% Max depth – >1.2m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 7.5% Max depth – >1.2m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding only covers 1.2% of the site. This flooding then increases to 3.0% during the 1% AEP event. A surface water flow path forms along Crows Road in the south of the site as well as there being some ponding along Manor Road in the south-east. Ponding also occurs at the end of Canning Road in the north and close to the northern boundary. Maximum flood depths are >1.2m along part of Crows Road. Most flood water velocity within the site is <0.25m/s with small areas near the aforementioned road reaching a maximum of 0.5 – 1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most', the latter being situated along Crows Road and on land near the northern boundary where water is deepest. The 0.1% AEP surface water event covers 7.5% of the site. In this event the aforementioned areas of ponding further extend from the 1% AEP outlines within the centre and north of the site. The latter connects to the flow path to the east of the site along the railway cutting. The flow path along Crows Road in the south extends in length, and ponding in the south-eastern corner also increases, encroaching the land off Alan Hocken Way. Flood depths vary greatly from <0.15m to >1.2m. Most of the flood depths are 0.3 to 0.9m with smaller areas of 0.9 – >1.2m along the southern boundary. Most flood water flows at 0 – 0.5m/s across the site, with smaller areas predominantly in the south where velocities reach 0.5 – 1.0m/s. There is a small area along Manor Road were velocities reach 1.0 – 2.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for All', the latter of which is situated in a small area in the south of the site along Crows Road where water is deepest and fastest flowing.
Reservoir	The Dry Day reservoir flood events encroach the western, southern and eastern boundaries of the site, as well as the majority of the south-eastern corner which extends across Manor Road. These extents remain along or very close to the site's boundaries. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood, Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir West Warwick, and William Girling. The William Girling reservoir Dry Day event has the largest extent, covering all aforementioned areas. These reservoirs are all managed by Thames Water Limited and are deemed as high-risk. During the Wet Day reservoir event, the majority of the site is affected with the exception of an area along the northern boundary. This unaffected area is within a dry island. The reservoir with the largest extent is William Girling. The other reservoirs which pose a risk include: Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick

	East Reservoir, West Warwick, and Wraysbury. These reservoirs are all managed by Thames Water Limited and are all deemed as high-risk. Despite the risk being residual, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The majority of the site is shown to have negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There is a small area in the south-eastern corner of the site which is shown to be at moderate risk of groundwater flooding, and any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. There will be a significant possibility that incidence of groundwater flooding could lead to damage to property. Further consideration of the local level of risk and mitigation is recommended.
Sewers	The site is located within a postcode area with 193 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has one record of flooding within the site. This extent remains along the western boundary of the site only. This occurred in 1947 due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no incidents of flooding within the site. The nearest incident occurred approximately 50m north-west of the site at Channelsea House in June 2021. The cause of this flood incident is unknown.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years. The Environment Agency's AIMS dataset shows there are formal flood defences along the western boundary of the site which borders the Channelsea River. These consist of flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee, Channelsea River, and the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 9.9%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 76.5%** The eastern boundary, south-eastern corner and part of the south-west of the site is affected during the Present Day 0.5% AEP Thames Tidal Breach event. Flood depths reach around 3.1m with velocities of up to 2.0m/s. The resulting flood

	hazard is 'Danger for Some' to 'Danger for All', the latter situated in the south of the site along Crows Road. The majority of the site is affected during the 2100 epoch 0.5% AEP Thames Tidal Breach event, excluding some areas in the north and east of the site. Further information regarding this extent is detailed in the climate change section below. Flood defence structures along the Thames and Lee are designed to protect to a 0.1% AEP flood event. The current condition of the defences is unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The eastern boundary, west and south-west of the site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located in the 063WAT233N Flood Alert Area for the flooding from the Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham. The site is also located in the 062WAF53LowerLee Flood Alert Area for flooding from the Lower River Lee from Hoddesdon to Canning Town. Additionally, the site is located across two different EA Flood Warning Areas. The site is surrounded with the 063FWT23RDockC for the Tidal Thames at Mill Meads and East Plaistow and at the north the 062WAF53LowerLee for the Lower River Lee at Stratford warning areas.
Access and egress	Access and egress to the site is currently via Canning Road to the north. According to the Newham Draft Local Plan (2022), there will be an additional vehicular and pedestrian access route via Crows Road to the south. There are several other pedestrian access and egress routes including in the south-western corner, two areas along the southern boundary and two areas along the western boundary. One of these routes leads across to Channelsea Island and it should be noted the Plan does not state whether there is, or will be, an access route from this island to the mainland west of the site. Safe access and egress via routes along the western and southern boundaries as well as along Crows Road in the south-east of the site during the Present Day 0.5% AEP Thames Tidal breach event. Flood depths reach around 0.3m in the south along Crows Road with velocities here reaching 2.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for All', the latter being located along Crows Road where flood depths are deepest, and water is fastest flowing. All access and egress routes are affected during the 2100 epoch 0.5% AEP Thames Tidal breach event. Flood depths reach around 3.1m along Crows Road with water velocities reaching 2.6m/s here. The resulting flood hazard is 'Very Low' to 'Danger for All'. The latter is located along the majority of Crows Road in the south where flood water is deepest and fastest flowing, as well as the south-western corner and areas along the western boundary. Safe access and egress are possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the 3.3% AEP surface water event, access and egress is possible on all mentioned routes into the site. The only exception to this is access via Crows Road along the southern boundary which is affected by an area of ponding along this section of road. There is also an area further along Crows Road where a flow path forms. Flood depths reach 0.6 to 0.9m, with flood water flowing at <0.25m/s. The resulting hazard is 'Very Low' to 'Danger for Most', the latter located in the south of the site along Crows Road. During the 1% AEP event, there is further surface water flooding along the affected roads mentioned during the 3.3% AEP event. There is also some ponding along

	Rick Roberts Way which encroaches the access point to the proposed pedestrian route located between the two existing points of access. The depths of this flooding are 0.15 to 0.9m. Flood water velocities vary between 0 to 1.0m/s. The resulting hazard is 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. along Rick Roberts Way. During the 0.1% AEP event, flooding affects a larger stretch of Rick Roberts Way and Abbey Lane. Flood depths vary from <0.15m to small areas of up to 1.2m along some of Rick Roberts Way and Abbey Lane. Flood waters reach up to 1.0 to 2.0m/s. The resulting flood hazard along Rick Roberts Way is 'Very Low' to 'Danger for Most'. Along Abbey Lane, the flood hazard is also 'Very Low' to 'Danger for Most'. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. along Rick Roberts Way and Abbey Lane. Access to the north-west of the site via Stratford High Street remains accessible during all AEP surface events. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects the same access routes as those mentioned during the 0.1% AEP event because these extents are very similar in size. The flood hazard along Rick Roberts Way and Abbey Lane is 'Very Low' to 'Danger for Most'. Therefore, vehicular access will not be possible where flood waters are deepest and fast flowing. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	A section of the north of the site is located within a dry island during the Wet Day reservoir flood event.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Fluvial (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change during the Central climate change allowance. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The site significantly affected by the 0.5% AEP Thames tidal upriver breach 2100 epoch event (76.51% flooded). Flood depths across the site varies from 0.25m up to over 3.00m. The deepest parts of the site occurs along the south and the west corner of the site. The flood water velocities vary between 0.20m/s to >2.00m/s. The resulting flood hazard is from 'Very low' to 'Danger for all'. The latter occurs at the west corner of the site and along the south site boundary and along the Channelsea River. During the 0.5% AEP Thames tidal breach Present Day event the flood is not significant as during the 0.5% AEP 2100 epoch event, which makes the site sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance

	for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. During the 1% AEP plus 40% climate change event the flood extends increases from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. the flooding extends along the south site boundary and on the east along Manor Road. The occurring flood depths during the 1% AEP plus 40% climate change event are up to 1.00m deep with depths of >2.50m along the south boundary. The velocity of flood water is up to 2.0m/s. The resulting flood hazard is 'Danger for some' to 'Danger for most. Along the south boundary where the deep and fast flowing waters occur, the flood hazard occurs to be 'Danger for all'. Considering that the 1% AEP plus 40% climate change event for surface water flooding is higher than the 1% AEP present day event, it makes the site sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is mainly formed of London Clay Formation (Clay, silt, and sand). The west of the site is located within the Lambeth Group (clay, silt, and sand) bedrock geology.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water. The east corner of the site is located within the Kempton Park Gravel Member (sand and gravel).
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The majority of the site is considered to have medium to low vulnerability to groundwater flooding. The west of the site have a medium to high vulnerability to groundwater flooding.
	• GeoSmart Groundwater Flood Risk Map indicates a moderate susceptibility of groundwater flooding to the east corner of the site which is resulting from the underlying geology of the site which consist of sand and gravel. The majority of the site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying bedrock geology at the majority of the site is a mixture of clay, silt and sand which is likely to be with highly variable permeability. The underlying superficial geology of the majority of the site consist of silt, clay, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is located within a Nitrate Vulnerable Zone.
	• The west of the site is located within the Secondary A bedrock aquifer designation map. The remaining of the site is within the Unproductive bedrock aquifer designation area. The west corner of the site is located within the Secondary A superficial aquifer designation map and the majority of the site

	is located in the Secondary (undifferentiated) superficial aquifer designation area. • The site is not located within a historic landfill. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable.' Non-residential uses (which are not health services, education and nursery establishments) are classed as 'Less Vulnerable' development. fOpen space is classed as 'water compatible development.' As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zones 2 and 3, and at significant risk of surface water flooding in the design event with several surface water flow paths, the Exception test is required for this site.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, Canal and Rivers Trust and the Environment Agency should be undertaken at an early stage. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lee and Channelsea River. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 epoch 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. • Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the

	development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Development of the site should make sure that the Three Mills Conservation Area and the listing buildings in close proximity of the site are conserved and enhanced. • Furthermore the layout of the site should protect the Site of Importance for Nature Conservation and provide and increase access to the nature and the surrounding watercourses. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to: o raise them as much as possible o consider moving vulnerable uses to upper floors o include extra flood resistance and resilience measures. • Other examples of flood resistance and resilience measures include: ○ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level ○ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level ○ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the [Thames Water website.]
Key messages	
The site is shown to be at risk of flooding during surface water flooding mainly during the 0.1% AEP and 1% AEP pus 40% AEP events. The majority of the site is within Flood Zone 1 and the east and west areas	

are affected by flooding (Flood Zone 3 and Flood Zone 2). Additionally, the site is risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water, and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- As this development (including redevelopment of existing buildings and sites) is adjacent to a main river (River Thames), a buffer strip of 8m is required from the toe of any Main River and 16m from tidal defence structures, taking into account the requirements set by the Flood Risk Activities: Environmental Permits guidance (and any subsequent updates). Where flood defences are present, these distances should be taken from the toe of the defence.

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map, the River Lee (2014) hydraulic model and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The EA's RoFSW surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Canning Town East 2, N5.SA1**
Address	Canning Town East, land either side of Newham Way, E16 4 to E16 1.
Area	9.95ha
Current land use	Mixed Use
Proposed land use	Residential, community uses and open space
Flood Risk Vulnerability	More Vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located within in centre of Canning Town extending from Mona Street in the north, to Vincent Street to the south. The A13 overpass runs through the middle of the site running east-west. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lea and is close to the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found to the south-east site corner at around 0.7mAOD, and the northern most tip of the site where the lowest lying land is around 0.4mAOD. The rest of the site lies higher at around 1.2 to 1.8mAOD. There is a high point near the existing Christian Centre of 2.7mAOD. Land is also higher on the northern site boundary with elevations of around 2.1 to 2.9mAOD.
Existing drainage features	The western corner of the site is located 290m east from the lower section of the River Lee, and approximately 880m north from the River Thames, which also marks the location of the confluence of the two rivers. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.

Fluvial	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the northern-most tip of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, despite being in close proximity to fluvial flood events, the site is unaffected by fluvial flooding during the 3.3%, 1%, 0.5% and 0.1% AEP modelled events.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 2.2% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 7.2% Max depth – 0.9 – 1.2m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 32.0% Max depth – >1.2m Max velocity – 1 - 2m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment as the area is not covered by ICM surface water modelling. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event surface water flooding only covers 2.2% of the site. Flooding mainly occurs where it ponds in some roads across the site, such as along Mona Street to the north, and McDowell Close in the south of the site. Maximum flood depths are 0.3 to 0.6m. Flood water velocity within the site varies from 0 to 0.25 to maximum of 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' in areas where ponding is deepest. In the 1% AEP event surface water covers 7.2% of the site. The flooding extends further around the 3.3% AEP outlines along the roads, such as from Mona Street and down to Aviary Close. It also extends further into the low-lying areas in the south-eastern corner of the site, and particularly along Vincent Street and further into the site. Surface water flooding also extends down into the walkways that run under the A13 overpass. Flood depths vary from 0 to 0.6m, deepest in the lower-lying parts of the site and along the walkway at above 0.9m. The majority of the water flows at 0 to 0.25m/s, but varies from 0 to 1.0m/s. The fastest flowing water is along McDowall Close. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. There are very small areas of 'Danger to Most' where flooding is deepest along McDowall Close, Mona Street and along the walkway connecting Bothwell Close to north of the A13. In the 0.1% AEP event surface water covers 32% of the site. In this event multiple flow paths form, connecting flood water across most of the streets in the south-eastern part of the site. There is ponding of surface water along Vincent Street to Tant Avenue, and along Copper and Burke Street. In the northern part of the site north of the A13, flooding affects most of Mona Street, Aviary Close and surrounds. There is also more flooding along the A13. Flood depths vary from 0.15 to over 1.2m. Most of the flood depths are 0.15 to 0.6m, with smaller areas of 0.6 to 0.9m particularly along McDowell Close, Lawrence Street and Mona Street. The deepest flooding occurs along the walk ways where flood depths are over 1.2m. Flood water flows at around 0 to 0.25m/s across most of the site, with smaller areas where it flows around 0.5 to 2m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some'. Where flood velocities are higher and water is deeper, there are areas of 'Danger for Most'. Along the walk way off Lawrence Street is the only area of 'Danger for All'.
Reservoir	The entire site is shown to be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the whole site from the following

	reservoirs; Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, smaller areas of the north of the site are at risk of flooding from Banbury reservoir. Most of the site, apart from smaller isolated areas are at risk of flooding from King George V and William Girling reservoirs. All these reservoirs are managed and operated by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 145 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets has one record of flooding within and surrounding the site. This occurred in 1953 due to channel capacity exceeded and overtopping of defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show two records of flooding within the site, both occurring in 2021. There is no further information regarding these flood records.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day event proportion of site at risk – 99.0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 99.7%** The site is almost completely flooded in the Present Day 0.5% AEP Thames Tidal Breach event. Flood depths across the site vary from 0.2 to 1.9m. Flooding is deepest where there are topographic lows in the site, at the south-eastern corner, and the northern tip of the site. Velocity of flood waters varies from 0.1-1.2m/s, and is highest where water is channelled into existing streets and roads. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Danger for Some' to 'Danger for Most' and even areas of 'Danger for All' where flood depths are deepest.

	The site is also located wholly within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 063WAT233N, Tidal Thames in the Boroughs of Havering, Barking and Dagenham and Newham flood alert area. The site is mostly located within the 063FWT23RDockA, Tidal Thames from Beckton Sewage Works to the River Lee flood warning area. The north-eastern part of the site lies within the 063FWT23RDockC, Tidal Thames at Mill Meads and East Plaistow flood warning area.
Access and egress	Access and egress to the site is currently via a number of routes. To the north, access is gained via Beckton Road, Barking Road and Mona Street. To the south of the site (south of the A13), access is possible via Forty Acre Lane, Rathbone Street, Vincent Street and Rogers Road. It is also possible to access the site from the south via smaller roads off Silvertown Way to the west, and Fords Park Road to the east. Safe access and egress is shown to be affected during all modelled tidal breach events in the present day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. Flood depths for the present day epoch are up to 2.1m along all access roads mentioned above. The resulting flood hazard varies from 'Danger to Some' to 'Danger for Most' where flood depths are deepest. In the 2100 epoch, flood depths increase slightly along the access roads, and therefore the flood hazard rating increases to 'Danger for Most' to 'Danger for All'. This means that in this extreme breach event, vehicular access and egress is not possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the 3.3% AEP surface water event access and egress is possible on all mentioned routes into the site. During the 1% AEP event, there is some surface water flooding along the roads mentioned above. The depths of this flooding are 0.15 to 0.6m. Flood water is slow moving at 0 to 0.25m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. It is likely that vehicular access and egress may be possible during this event. During the 0.1% AEP event, flooding affects Barking Road, Beckton Road and Mona Street. Flood depths vary from <0.15m to small areas of up to 0.9m. The resulting flood hazard along Barking Road is most 'Very Low' to 'Danger for Some'. Along Mona street the flood hazard is up to 'Danger for Most'. Towards the south of the site, most of Forty Acre Land, Rathbone Street and Vincent Street are affecting by flooding in the 0.1% AEP event. Flood depths along Rathbone Street vary from 0.15 to 0.9m Flood waters reach up to 0.5 to 1.0m/s.. The flood hazard category in these areas is 'Very Low' to 'Danger for Some' along most roads, and up to 'Danger for Most' along parts of Vincent Street. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. along Vincent Street.

	During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects all access and egress routes, the extent is similar to that of the 0.1% AEP event. The flood hazard along this road is 'Very Low' to 'Danger for Some'. Therefore, vehicular access and egress should be possible. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The 2100 epoch 0.5% AEP event shows slightly deeper flood waters, with a very slight increase in flood extent versus the 2005 epoch 0.5% AEP event (99.7% versus 99.0%), almost covering the high point of the site. Flood depths remain similar to the present day scenario of up to 1.9m. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during both breach extents, the site is considered to be at high risk in both breach scenarios. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the north of the site, and also in the south-eastern part of the site, accumulating on the roads and streets and other impermeable surfaces. Flood depths also increase from around 0.3 to 0.6m (1% AEP event) to around 0.5 to 1.3m in the 1% plus 40% climate change event. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology across the majority of the site (north and west) is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock. Bedrock geology in the south-east of the site is Lambeth Group (clay, silt and sand), which is also a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The entirety of the site is located within a Nitrate Vulnerable Zone.
	• The entire site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface

	water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames, and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site.

	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.

	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water and fluvial events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial, and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal breach and fluvial extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023.

	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

JBA consulting	**London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables**
Site details	
Site Code	**Canning Town Holiday Inn, N5.SA3**
Address	Canning Town Holiday Inn, land on the east side of Silvertown Way and Caxton Street North (A1011), south of Brunel Street and west of Shirley Street, E16 1.
Area	0.66ha
Current land use	Mixed Use
Proposed land use	Residential, employment, town centre use, community facilities (if needed) and open space.
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable and Water Compatible Development.
Sources of flood risk	
Location of the site within the catchment	The site is located south of Canning Town, east of the A1011 (Silvertown Way), Brunel Street runs parallel to the northern site boundary, and Shirley Street to the east and south.. The western site boundary is approximately 250m from the River Lee. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lee and is close to the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography is relatively flat. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations range between 1.7 and 2.4mAOD. Topography is lower in the north-west of the site, and higher along most of the eastern site boundary and further into the site. The site has a slight slope in between the entrances of the site from Shirley Street towards Brunel Street.
Existing drainage features	The site is located approximately 250m east from the lower section of the River Lee, and approximately 600m north from the River Thames, which also marks the location of the confluence of the two rivers. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*

	Defended outputs: **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the northern-most tip of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, despite being in close proximity to fluvial flood events, the site is unaffected by fluvial flooding during the defended 3.3%, 1%, 0.5% and 0.1% AEP modelled events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0.3% Max depth – 0.3m Max velocity – 0.5m/s **0.1% AEP** – 11.6% Max depth – 0.9m Max velocity – 2.0m/s The site is affected by surface water flooding in the 1% and 0.1% AEP events. During the 3.3% AEP event the site is not directly affected, although on the northwest of the site on Brunel Street, there is surface water flooding present. During the 1% AEP event surface water only enters the north of the site slightly off Brunel Street. The 1% AEP event surface water covers 0.3% of the site on the north-west, off of Brunel Street. The 0.1% AEP event surface water covers 11.6% of the site. In this event the Surface water flooding along Brunel Street and Caxton St North connect to form a flow path which crosses the site boundary and extends into the centre the site covering the low-lying areas. Flood depths vary greatly from 0.15m to 0.60m. Most of the flood depths are 0.15 to 0.30m, with some locations of 0.30m to 0.60m within the site in the lowest lying areas near Brunel Street. Flood water flows at around 0 to 0.5m/s across most of the

	site, most likely where the slight slope occurs from the south-east to the north-west, with smaller areas where it flows around 0.25 to 0.5m/s to the north of the site. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Some' where flooding is deepest.
Reservoir	The entire site is shown to be at risk of Dry Day and Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the whole site from the following reservoirs; Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, smaller areas of the east along the site are at risk of flooding from King George V and William Girling reservoirs. All these reservoirs are managed and operated by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area (E16 1) with 32 incidences of sewer flooding, with five incidences nearby the site on Hallsville Road, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets has one record of flooding at the southern edge of the site. This occurred in 1953 due to channel capacity exceeded and overtopping of defences. It is unknown how many properties were affected by this flooding and if it has directly impacted the site. Flood incidents were not recorded for the site, but three incidents were recorded near site at Canning Town Bus Station, Rogers Road and Lawrence Street during summer 2021.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 100%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 100%**

	The site is completely flooded in the Present Day 0.5% AEP Thames Tidal Breach event. Flood depths across the site vary from 0.10 to 1.0m, with depths on Brunel Street the varying between 1.00m to 1.50m. Flooding is deepest where there are topographic lows in the site, at the centre of the site. Velocity of flood waters varies from 0.0 up to 2.0m/s and is higher at most of the site and on Brunel Street, and the highest is on Shirley Road with up to 2.1m/s velocity. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Danger for Some' to 'Danger for Most' and even areas of 'Danger for All' where flood depths are deepest. The site is also located wholly within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 063WAT233N, Tidal Thames in the Boroughs of Havering, Barking and Dagenham and Newham flood alert area. The site is mostly located within the 063FWT23RDockA, Tidal Thames from Beckton Sewage Works to the River Lee flood warning area. The north-eastern part of the site lies within the 063FWT23RdockC, Tidal Thames at Mill Meads and East Plaistow flood warning area.
Access and egress	Access and egress to the site is currently via Brunel Street to the north (off Silvertown Way) and Shirley Street to the south of the site. Safe access and egress are shown to be affected during all modelled tidal breach events in the present day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. Flood depths for the present day epoch are of up to 1.20m depths along both access roads mentioned above. The resulting flood hazard varies from 'Danger for Most' to 'Danger for All' where flood depths are deepest. In the 2100 epoch, flood depths increase slightly along the access roads, and therefore the flood hazard rating increases to 'Danger for Most' to 'Danger for All'. This means that in this extreme breach event, vehicular access and egress is not possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. During the 1% AEP surface water flooding event, there is some surface water flooding along Silvertown Way and Brunel Street. The depths of this flooding are 0 to 0.60m. Flood water is slow moving at 0 to 0.25m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. It is likely that vehicular access and egress may be possible during this event. Shirley Street is not affected by surface water flooding in this event. During the 3.3% AEP surface water event access and egress is may be impacted on Silvertown Way and Brunel Street. The depths of this flooding

	are 0.15 to 0.6m, deepest at the access point to the site. Flood water is slow moving at 0 to 0.20m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. Access and egress remains possible to the south of the site from Shirley Street. During the 0.1% AEP event, flooding affects the northern roads (Brunel Street)Flood depths vary from 0.15m to up to 0.90m. The resulting flood hazard along Brunel Street the flood hazard is up to 'Danger for Most'. Flood velocity on Brunel Street between 0 to 2.0m/s. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. Brunel Street and Caxton St North. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects all access and egress routes, the extent is similar to that of the 0.1% AEP event. The flood hazard along Brunel Street is between 'Very Low Risk' to 'Danger for Most'. Therefore, vehicular access and egress may be possible along Shirley Road and not Brunel Street. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** The 2100 epoch 0.5% AEP event shows slightly deeper flood waters than the present day epoch by up to 0.2m in the topographic lows. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during both breach extents, the site is considered to be at high risk in both breach scenarios. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the centre of the site. Flood depths remain similar to the 1% AEP even, up to

	0.35m. This shows that the site is relatively sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill or is not a nitrate vulnerable zone.
	• The entire site is located within a Secondary (undifferentiated) superficial deposit aquifer designation zone.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development.

	• Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are multiple different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice

	Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.
	
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal and fluvial or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan.The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered

	from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'Highly Vulnerable' development is not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial, and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan. If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal and fluvial depth, velocity and hazard mapping	This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.

Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Canning Town Riverside N5.SA5**
Address	Canning Town Riverside, land on the east side of River Lee, north of Newham Way (A13), west of Bidder Street, Crown and Mayer Parry Wharf, E16 4.
Area	3.78ha
Current land use	Mixed Use
Proposed land use	Residential, employment and open space (including walkway along the edge of River Lee).
Flood Risk Vulnerability	Mixed – 'More Vulnerable' and 'Less Vulnerable'
Sources of flood risk	
Location of the site within the catchment	The site is located west of Canning Town, north to the A13 (Newham Way) and the underground line. Bidder Street runs along the eastern site boundary. The western boundary of the site runs parallel to the River Lee. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lee and is close to the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies and sloping from the south-west to the north-east. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found to the east along the site at around 0.3mAOD. The highest elevations are found to the west along the site at around 5.5mAOD. The rest of the site elevation ranges between 2.0 and 4.0mAOD.
Existing drainage features	The site is located within close proximity of the River Lee, approximately 20m east and 120m north from the River Lee, and approximately 880m north from the River Thames, which also marks the location of the confluence of the two rivers. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 77%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%**

	0.5% AEP fluvial event – 0% **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames and Lee are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. This site is parallel to the River Lee. However, the River Lee remains in bank adjacent to the site for all modelled defended flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the northern-most tip of the site. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, despite being in close proximity to fluvial flood events, the site is unaffected by fluvial flooding during the defended 3.3%, 1%, 0.5% and 0.1% AEP modelled events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0.4% Max depth – 0.30-0.60m Max velocity – 0.25-0.50m/s **0.1% AEP** – 2.8% Max depth – 0.30-0.60m Max velocity – 0.50-1.00m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in the 1% and 0.1% AEP events, although the extents are small. During the 3.3% AEP event the site is not directly affected, although on the east of the site on Bidder Street there is surface water flooding present.

	The 1% AEP event surface water covers 0.4% of the site on north-east, off of Bidder Street. The 0.1% AEP event surface water covers 2.8% of the site. In this event the surface water flooding along Bidder Street and Wharf Street connects to form a flow path which crosses the site boundary and is ponding on the north-east of the site. Flood depths vary greatly from 0.15 to 0.60m. Most of the flood depths are 0.15 to 0.30m, with smaller areas of 0.60m situated along Bidder Street and Wharf Street next to the site and Wharfside Road within the site. Flood water flows at around 0 to 0.2m/s across most of the site, with smaller areas where it flows around 0.5 to 1.0m/s. The resulting flood hazard across most of the site is 'Very Low' to 'Danger for Most' where flooding is deepest.
Reservoir	The entire site is shown to be at risk of the Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. During the Wet Day scenario, flood risk is posed to the whole site from the following reservoirs; Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling and Wraysbury reservoirs, all are managed and operated by Thames Water. During the Dry Day scenario, smaller areas of the east along the site are at risk of flooding from King George V and William Girling reservoirs. All these reservoirs are managed and operated by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area (E16 4) with 113 incidences of sewer flooding, with one incidences within a very close proximity to the site on Bider Street, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outline datasets has two records of flooding within and surrounding the site. This occurred in 1947 and 1953 due to channel capacity exceeded and overtopping of defences. It is unknown how many properties were affected by this flooding and if it has directly impacted the site. Flood incidents were not recorded for the site, but three incidents were recorded near site at Canning Town Bus Station, Meydan Barking Road and Oak Cresent junction, Malmesbury Road and Star Lane during summer 2021.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal

	flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 78.8%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 82.6%** The majority of the site is flooded in the Present Day 0.5% AEP Thames Tidal Breach event. Flood depths across the site vary from 0.10 to >2.50m, with depth of 0.10-0.50m at the majority of the site. Flood depths of 1.00 to 1.50m occurs in the north-west corner of the site, on the south-western area and along Bidder Street. There are over 2.00m flood water present in the south-west corner of the site and the north-west, where the topography is low-lying. The maximum velocity occurring on site is >2.0m/s, with areas varying between 0.2 and 2.0m/s. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Danger for Some' to 'Danger for Most' and even areas of 'Danger for All' where flood depths are deepest. The site is also located largely within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in an Environment Agency Flood Warning and Flood Alert Area. It is located within the 062FWB53TidalLee, Lower River Lee from West Ham to Canning Town from warning area and the 063FWT23RDockC, Tidal Thames at Mill Meads and Plaistow flood warning area. The site is also part of the 062WAF53LowerLee, The Lower River Lee from Hoddesdon to Canning Town flood alert area and the 063WAT233N Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham flood alert area.
Access and egress	Access and egress to the site is currently via Bidder Street off of Ives Road and Wharf Street. Safe access and egress are shown to be affected during all modelled tidal breach events in the present-day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. Flood depths for the present-day epoch are of up to 1.50m depths along Bidder Street. The resulting flood hazard varies from 'Danger for Most' to 'Danger for All' where flood depths are deepest. Therefore, access and egress to the site is not possible. In the 2100 epoch, flood depths increase slightly along the access roads, and therefore the flood hazard rating increases to 'Danger for Most' to 'Danger for

	All'. This means that in this extreme breach event, vehicular access and egress is not possible to the site. During the surface water 1% AEP the flood depths vary from 0.15 to 0.60m, with the deepest located along the eastern area of the site and along Bidder Street and Wharf Street near to the east of the site. The water flows at 0 to 0.5m/s on the site and up to 1.0m/s along Bidder Street and Wharf Street. The resulting flood hazard varies from 'Very Low' to 'Danger for Some. The affected areas are Bidder Street and Wharf Street. During the surface water 0.1% AEP event, the surface water flooding affects most of the roads east to the site, such as Bidder Street, Ives Road and Wharf Street. Flood depths vary between <0.15 to 0.60m within the site and along the surrounding streets. Flood velocity on Bidder Street is between 0 to 1.0m/s. Where flood waters are deepest and fast flowing, vehicular access will not be possible, i.e. Wharf Street and the north of Bidder Street along the site. Safe access and egress is not impacted by River Lee flooding. Although the site is adjacent to the River Lee, the River Lee remains in bank adjacent to the site for all modelled defended flood events (including with the central climate change allowance applied for the 3.3%, 1% and 0.5% AEP events) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. During the surface water 1% AEP plus 40% allowance for climate change event, flooding effects all access and egress routes, the extent is similar to that of the 0.1% AEP event. The flood hazard along Brunel Street is between 'Very Low Risk' to 'Danger for Most'. Therefore, vehicular access and egress may be possible along Ives Road and Wharfside Road to exit to Stephenson Street (B164). Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Fluvial Flooding (River Lee):** As the development includes 'residential development' the central climate change allowance should be assessed. According to the River Lee hydraulic model, the site is not at an increased risk of fluvial flooding during the 3.3% AEP +17% climate change (higher central allowance), 1% AEP + 17% climate change and 0.5% AEP + 17% climate change as these extents remain in bank and do not enter the site. **Tidal Breaches:** The 2100 epoch 0.5% AEP event shows slightly deeper flood waters than the present day epoch by up to 0.2m in the topographic lows. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during

	both breach extents, the site is considered to be at high risk in both breach scenarios. The site is also sensitive to climate change in the breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas in the centre of the site. Flood depths remain similar to the 1% AEP event on the nearby roads. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock.
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is located within a Nitrate Vulnerable Zone.
	• The site is not located within a historic landfill site.
	• The entire site is located within a Secondary (undifferentiated) superficial deposit aquifer designation zone and an Unproductive bedrock deposit aquifer designation zone.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event.

	Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2 the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, the Canals and Rivers Trust and the Environment Agency should be undertaken at an early stage. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lee. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to

include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.

- All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site.
- Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal and fluvial or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.

	- Other examples of flood resistance and resilience measures include:
	  - using flood resistant materials that have low permeability to at Leest 600mm above the estimated flood level
	  - making sure any doors, windows or other openings are flood resistant to at Leest 600mm above the estimated flood level
	  - by raising all sensitive electrical equipment, wiring and sockets to at Leest 600mm above the estimated flood level.
	- The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	- The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, pLeese refer to Section 8 of the Level 1 SFRA report.London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More Vulnerable development should be steered away from Flood Zone 3. More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water and fluvial events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and fluvial, and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information	
The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning, the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal breach and fluvial extents, depth, velocity and hazard mapping	Fluvial - This has been assessed using the EA/CH2M Hill's ISIS-TUFLOW River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal breach – This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N3.SA3**
Address	Thames Road and North Woolwich Road, Royal Victoria, E16 2
Area	12.88 ha
Current land use	Local Mixed Use – Residential (currently under construction), waste management, hotels, community uses, industrial and employment uses.
Proposed land use	Residential, employment, community facilities, education, main town centre uses as part of local centre and open space
Flood Risk Vulnerability	Mixed – 'More vulnerable,' 'Less Vulnerable' and 'Open Space.'
Sources of flood risk	
Location of the site within the catchment	The site is located within the centre of Silvertown, with the River Thames bordering the south of the site. The site is bounded by the Elizabeth Line to the north-east, the A112 Connaught Bridge to the north and north-west of the site, and Thames Road/ Wards Wharf Approach to the west. The east of the site is adjacent to Factory Road and some industrial buildings. The Docklands Light Railway (DLR) line dissects the site from west to north-east between the A1020 Connaught Bridge/ North Woolwich Road roundabout, and A112 Connaught Road. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies adjacent to the River Thames and 130m south of the Royal Docks (Royal Victoria Dock and Royal Albert Dock). The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations vary between -3.4 and 7.6mAOD. Site elevations are generally highest to the south of the site, adjacent to the River Thames, and to the north of the site boarding the A112 Connaught Road. Site elevations are lowest in the centre of the site. According to LiDAR, there is a topographic low point to the west of the site where site elevations are generally under 1.0mAOD. This topographic low point corresponds with the recently constructed Pontoon Reach residential development, so is unlikely to be representative of actual site topography.
Existing drainage features	The river Thames borders the south of the site. There are no ordinary watercourses within, or in the vicinity of, the site.
Critical Drainage Area	An area within the north-west of the site, adjacent to the A1020 Connaught Bridge, and stretching towards Thames Road, is located within Critical Drainage Area (CDA) 'Group 4_036' located in the Woolwich industrial estate, Woolwich. Additionally, the north-east of the site boarders Critical Drainage Area 'Group 4_053' which includes Wythes Road and Drew Road, North Woolwich.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This indicates that the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.2% Max depth – 0.15-0.30m Max velocity – 0.25-0.50m/s **1% AEP** – 4.7% Max depth – 0.3-0.6m Max velocity – 0.5-1.0m/s **0.1% AEP** – 18.3% Max depth – 0.9-1.2m Max velocity – 1.0-2.0m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 3.1% Max depth – 0.95m Max velocity – 0.53m/s **1% AEP** – 6.0% Max depth – 1.11m Max velocity – 0.60m/s **0.1% AEP** – 30.8% Max depth – 1.61m Max velocity – 1.19m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g., 100-year includes the 30-year %).*

	The Silvertown ICM surface water model was used in the assessment of surface water flooding. This model extent covers the entire site. *Where ICM modelling is available, this modelling is more detailed assessment of surface water flood risk and should take precedence over the RoFfSW dataset.* **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding extends across 3.1% of the site. This flooding is generally isolated surface water ponding in topographic depressions within St Mark's Industrial Estate and the Thames Road Industrial Estate, notably along Thames Road. Flood depths across the site are largely under 0.1m, with velocities under 0.53m/s and associated flood hazard classed as 'very low' or 'danger for some.' The main exception to this pattern is an underpass beneath Connaught Bridge to the north-west of the site, where flood depths extend to 0.95m, velocities to 0.23m/s and flood hazard is classed as 'danger for most.' During the 1.0% AEP event, surface water flooding covers 6.0% of the site. Flooding is still generally confined to the topographic low points mentioned above, although these flood extents have now expanded. Flood depths during this event are generally under 0.72m, although flood depths to the north-west of the site under Connaught Bridge now extend to 1.11m. Flood velocities during this event extend to 0.60m/s, with the fastest flood velocities located along Thames Road. Similar to the 3.3% AEP event, flood hazard is still classed as 'very low' or 'danger for some.' However, flooding surrounding the underpass beneath Connaught Bridge and at a surface water pool to the south of the site has a flood hazard classed as 'danger for most.' During the 0.1% AEP event, surface water flooding now extends across 30.8% of the site. Flooding is now significantly more widespread across the site, with extensive flooding between North Woolwich Road and the DLR line within the Saint Mark's Industrial Site. Whilst flood depths within the site are generally under 0.77m, there is a floodwater pool to the south of the site within the Thames Industrial Site where flood depths extend to 1.61m. Flood velocities now extend up to 1.19m/s, with the fastest floodwaters travelling westwards down North Woolwich Road, and southwards down Thames Road. Flood hazards are classed as 'danger for most' along Thames Road and in the centre of the site surrounding North Woolwich Road and Oriental Road, with flood hazard across the rest of the site classified as 'very low' or 'danger for some.'
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the centre of the site between the DLR and Thames Road industrial estate is inundated by the William Girling reservoir during the 'dry day' reservoir flood. Additionally, a small portion to the north-east of the site adjacent to the DLR line is inundated by the King George V reservoir. All of these reservoirs are owned by Thames Water. During the 'wet day' scenario, almost the entire site except the southern portion adjacent to the River Thames is inundated by the following reservoirs: Banbury, King George V, Lockwood and William Girling. Additionally, the centre of the site between the DLR and Thames Road Industrial Estate can be inundated by the following reservoirs: High Maynard, Walthamstow No.4, Walthamstow No.5 and Warwick East. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.

Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The entire site is classed as having a negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site is located within a postcode area with 94 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Flood Incident Database and the LBN Council's Flood Incident database, there have been no recorded incidents of flooding within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. Tidal flooding at the site was assessed using the Environment Agency's Thames Estuary Upriver Breach Assessment model and the Environment Agency's Thames Estuary Downriver Breach Assessment. As both tidal breach assessment datasets are available, the breach assessment with the conservative model outputs for the site should take precedence in this assessment of residual risk. As such, the Environment Agency's Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 82.1%** **0.5% AEP tidal 2115 epoch event proportion of site at risk – 92.7%** During the 0.5% AEP present day tidal breach event, flooding extends across 82.1% of the site. Floodwater inundates the majority of the site, with the exception of some regions on raised ground to the north, west and south of the site. Flood depths within the site are deepest in the centre of the site, where depths are generally between 0.5-1.8m. However, flood depths to the north-east of the site parallel to the DLR line extend to 4.7m. The velocity of floodwaters varies between 0.1-2.5m/s, and is highest where water is channelled into existing streets and roads, notably within the Thames Road Industrial Estate, where the highest velocities are found. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Very Low' to 'Danger for Most' and even areas of 'Danger for All' where flood depths are deepest.

	The site is also located wholly within the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within two Environment Agency flood alert areas. The entire site is located within Environment Agency flood alert area (063WAT233N) which extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham. The southern quarter of the site is also located within Environment Agency flood alert area (063WAT23East) which stretches across the River Thames riverside from Dartford Creek and The Mardyke to the Thames Barrier. The entire site is located within Environment Agency flood warning area (063FWT23RDockA) which extends between the Tidal Thames from Beckton Sewage Works to the River Lee flood warning area.
Access and egress	Access and egress to the site is currently via a number of routes. North Woolwich Road dissects the site from west to east. The majority of the site can be exited to the east by travelling east on North Woolwich Road, which leads onto Factory Road and, eventually, the A112 Albert Road. The site can also be exited to the west onto the A1020 North Woolwich Road/ Connaught Bridge roundabout. From this roundabout, the site can be exited to the west via North Woolwich Road, or north via Connaught Bridge. The hotel located within the site adjacent to the northern site boundary can also exited to the north via Connaught Road, and then either to north/south on the A1020 Connaught Bridge, or east onto the A112 Connaught Road. Careful consideration of safe access and egress will be needed for this site. Safe access and egress is shown to be affected during all modelled tidal breach events in the present day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. During the 0.5% AEP 2115 epoch Thames tidal breach, the majority of the site is inundated as described below. The hazard rating on all the access roads to the site is classed as 'danger for all': Albert Road, Connaught Bridge, Connaught Road, Factory Road and North Woolwich Road. Vehicular access to the site using these roads would be extremely challenging. Additionally, the surface water 1% AEP plus 40% allowance for climate change flood event impacts access and egress routes from the site. Surface water flooding on Albert Road, Connaught Bridge, Factory Road and North Woolwich Road is classed as 'danger for most' with flood depths of over 0.5m in some areas. However, site exit from the hotel to the north of the site is still possible during this event, as flood hazard on Connaught Bridge north of the Connaught Bridge/ Connaught Road roundabout is classed as either 'very low' or 'danger for some.' Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an

	allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** During the 0.5% AEP 2100 tidal Thames defence breach, a greater proportion of the site (92.7%) of the site is inundated by floodwater. Only very small isolated patches to the north and south of the site remain 'flood free' during this event. Similar to the 0.5% present day event, flood depths are greatest in the centre of the site. However, these depths in the centre of the site are now generally above 1.50m, now extending up to 5.79m parallel to the DLR line. Site velocities are generally greater than 0.5m/s, although those associated with the flow paths in streets and roads within the Thames Road industrial estate now reach up to 3.8m/s. The majority of the site now has a hazard rating of 'danger for all,' with some of the site classed as 'danger for some.' Flood depths and velocities for the 0.1% AEP 2115 epoch event are deeper and faster, with a greater proportion of the site assessed to have a hazard rating of 'danger for all.' **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. Flooding now extends further into the low-lying areas in the centre of the site, stretching between North Woolwich Way and the DLR line. Additionally, there is also a new surface water flow path extending down Thames Road towards the River Thames. Flood depths and velocities also increase from a maximum of 1.11m and 0.60m/s during the 1% AEP event, to a new maximum of 1.47m and 1.26m/s during the 1% AEP plus 40% event. These greatest depths are concentrated within isolated topographic pools to the south of the site within the Thames industrial estate, and greatest velocities along the surface water flow path on Thames Road. This indicates the site is extremely sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology to the north and west of the site is Lambeth Group (Clay, Silt and Sand). This is a sedimentary bedrock. Alternatively, bedrock geology to the south and east of the site is Thanet formation (Sand), which is also a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is clay, silt and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone.
	• The entire site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of

	surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development, and non-residential uses for educational establishments as 'More Vulnerable' development. Employment and industrial uses are classed as 'Less Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames, is in a Critical Drainage Area and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.

	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.
	
	Guidance for site design and making development safe:
	
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at least 600mm above the estimated flood level

	- making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. - The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. - The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 1% AEP plus 40% climate change and 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood warning and evacuation plan is put in place for the site.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Silvertown ICM Surface Water Model and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Silvertown ICM Surface Water Model (2015) and to indicate the impact on pluvial flood risk.
Tidal extents, depth, velocity and hazard mapping	This has been assessed using the present day and 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and Environment Agency's Risk of Flooding from Surface Water (RoFFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Silvertown ICM Surface Water model (2015) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Custom House Phase 1 and Phase 2, N5.SA6 and N5.SA7**
Address	Custom House Area Redevelopment Project, Freemasons Road and Coolfin North development site, Custom House, E16 1 to E16 3
Area	4.29 and 8.01ha
Current land use	Residential, green space, educational, GP surgery
Proposed land use	Residential, community uses (including health centre), education, town centre uses and open space
Flood Risk Vulnerability	Mixed – 'More vulnerable' and 'Less Vulnerable'
Sources of flood risk	
Location of the site within the catchment	These sites are located within the Custom House and Canning Town neighbourhood, approximately 300m north of the Royal Docks (Royal Victoria and Royal Albert Docks) and 1.1km north of the River Thames. Custom House Phase 1 and 2 are located on either side of Freemasons Road. Custom House Phase 1 is smaller, and extends from Victoria Dock Road to the south, to Throckmorton road in the east, and to Vandome Close in the north. Custom House Phase 2 is larger, and extends from Freemasons Road, to Coffin Road/Boreham Avenue in the south, to Radland Road in the west and extending over Hallsville Primary School. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the sites show that topography varies. The sites area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. At the Phase 1 site, elevations are relatively flat and vary from 0.97mAOD to 1.64mAOD. At the Phase 2 site, elevations vary from 1.28mAOD to 2.44mAOD. The site is relatively flat with the higher elevations found to the west.
Existing drainage features	There are no main rivers or mapped ordinary watercourses within, or in the vicinity of, the site. There are also no major topographic depressions within the site that could act as drainage ditches.
Critical Drainage Area	Neither site is located within a critical drainage area (CDA).
Fluvial and tidal	**The proportion of Phase 1 site at risk FMFP:** **FZ3 – 99%** **FZ2 – 100%** **FZ1 – 0%** **The proportion of Phase 2 site at risk FMFP:** **FZ3 – 89%** **FZ2 – 100%** **FZ1 – 0%**

	The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entirety Custom House Phase 1 and Custom House Phase 2 sites are located within a Reduction in risk of Flooding from River and Sea due to Defences area. his means that both sites are shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **Phase 1 site:** **3.3% AEP** – 2.7% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 8.5% Max depth – 0.6 – 0.9m Max velocity – 1.0 – 2.0m/s **0.1% AEP** – 40% Max depth – 0.9 – 1.2m Max velocity – 1.0 – 2.0m/s **Phase 2 site:** **3.3% AEP** – 0.6% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 2.9% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **0.1% AEP** – 14.1% Max depth – 0.6 – 0.9m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment.

	Description of surface water flow paths: During the 3.3% AEP and 1% AEP surface water events, there is flooding mainly along the roads within the sites. At the Phase 1 site, during the 3.3% AEP event, there is flooding along Ethel Road, Leslie Road and Tallis Road to depths of up to between 0.3 and 0.6m. This flooding has a velocity of up to 0.25 to 0.5m/s, resulting in a hazard rating of up to 'Danger for Some'. During the 1% AEP event, there is additional ponding along Leslie Road and Ethel Road, as well as the carpark on Ethel Road. There is also ponding along Freemasons Road. During this event, there are flood depths of up to between 0.6 and 0.9m. Water has a velocity of up to between 1.0 and 2.0m/s. The resulting hazard rating of this flooding is up to 'Danger for Most'. During the 0.1% AEP event, a large amount of the site is impacted by surface water flooding. The aforementioned areas of flooding now develop into flow paths and join along Freemasons Road and Ethel Road to cover a large amount of the site. Depths reach up to 0.9 to 1.2m. Velocities reach up to 1.0 to 2.0m/s. The resulting hazard rating of this flooding is 'Danger for Most'. At the Phase 2 site, during the 3.3% AEP event, there is a small amount of ponding on Butchers Road and Hooper Road to depths of up to between 0.3 and 0.6m. This flooding has a velocity of up to 0.25 to 0.5m/s, resulting in a hazard rating of up to 'Danger for Some'. During the 1% AEP event, there is additional ponding along Butchers Road and Hooper Road and carpark. There is also surface water flooding along Chaseway Lodge, Goldwing Close, Mandela Road and Kerry Close. Maximum flood depths remain between 0.3 and 0.6m. The maximum velocity of this water remains between 0.25 and 0.5m/s. The resulting hazard rating of this flooding remains 'Danger for Some'. During the 0.1% AEP event, there is further surface water flooding along all of the roads within the site, where some join to form flow paths such as along Adamson Road and Mandela Road. There are also some areas of ponding at Hallsville Primary School. During this event, maximum flood depths are between 0.6 and 0.9m. Maximum flood velocities are between 1.0 and 2.0m/s. The maximum hazard rating of this flooding is 'Danger for Most'.
Reservoir	**Phase 1 and Phase 2 sites:** The entirety of the sites, excluding small, isolated areas across the sites, are at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. This risk is posed by the William Girling and King George V reservoirs, both of which are managed by Thames Water Limited and are deemed as high-risk. The entirety of the sites, excluding small, isolated areas across the sites, are at risk of Wet Day reservoir flooding from the following reservoirs: Wraysbury, William Girling, Warwick East Reservoir, Walthamstow No.4, Walthamstow No.5, Queen Elizabeth II, Lockwood, King George V, High Maynard and Banbury. These reservoirs are all deemed as high-risk and are all managed by Thames Water Limited. Despite the risk being residual, in the very unlikely event that the reservoir fails, it is predicted that there is a risk to life. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole of both sites is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.

Sewers	The Phase 1 site is located within a postcode area with 8 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The Phase 2 site is located within two postcode areas. The eastern half of the site is within an area with 8 incidences of sewer flooding and the western half in an area with 7, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets have two records of flooding within and surrounding the sites. This covers the majority of both sites excluding part of the northern boundary of the Phase 2 site. Both flood incidents occurred in January 1953. One incident was due to sea levels overtopping defences. The other was due to channel capacity being exceeded and there being no raised defences. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show one record of flooding within the Phase 1 site. This occurred in July 2021 along Freemasons Road. No further information was provided about the incident.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the sites are protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The sites are at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **Phase 1 site:** **0.5% AEP tidal present day event proportion of site at risk – 100%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 100%** **Phase 2 site:** **0.5% AEP tidal present day event proportion of site at risk – 98.8%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 99.9%** **Phase 1 site:** During the present day 0.5% AEP tidal breach event, 100% of the site is inundated. Flood depths vary between 0.11m and 1.54m with the deepest flood depths concentrated at the centre of the site, along Leslie Road. The velocity of flood water is up to 1.6m/s and the resulting flood hazard rating across the site is 'Danger for Most' with a smaller area of 'Danger for Some' and 'Very Low Hazard' at Freemasons Road Midwifery Centre. The site is also 100% inundated during the 2100 epoch 0.5% AEP tidal breach event which is described in the climate change section below.

	Phase 2 site: During the present day 0.5% AEP tidal breach event, approximately 98.8% of the site is inundated. Flood depths vary between 0.01 and 1.34m. The deepest flood depths are concentrated and the bottom of Butchers Road and along the driveway and in the yard of Hallsville Primary School. The velocity of flood water is up to 1.0m/s and the resulting flood hazard rating across the site is ranges 'Very Low Hazard' at Hallsville Primary School to 'Danger for Most' across the majority of the site. The site is also 99.9% inundated during the 2100 epoch 0.5% AEP tidal breach event which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The Phase 1 and Phase 2 sites are located within Environment Agency Flood Warning Area - Tidal Thames at Beckton (River Thames at Beckton including Canning Town, Custom House and Beckton). The Phase 2 site is also located within another EA Flood Warning Area – Tidal Thames from Beckton Sewage Works to the River Lee (River Thames from Beckton Sewage Works to the River Lee including Beckton Gas Works, London City Airport, the ExCel Centre, areas around the King George V, Royal Albert and Royal London Victoria Docks and Canning Town.
Access and egress	**Phase 1 site:** Access and egress to the site is currently via Freemasons Road. During the present day 0.5% AEP tidal breach event, flood depths on Freemasons Road are up to >1m within the site. Velocities of flooding on the road are up to 1.2m/s. The flood hazard rating on Freemason's Road is 'Danger for Most' and vehicular and pedestrian access and egress to the site is likely to be impeded. During the 2100 epoch 0.5% AEP tidal breach event, flooding on Freemasons Road is up to depths of 1.4m and velocities of up to 1.3m/s. The flood hazard rating on Freemasons Road is 'Danger for Most' and vehicular and pedestrian access and egress to the site will be impeded. Proposed pedestrian and vehicular access and egress routes via Throckmorton Road, Vandome Close, Victoria Dock Road, Murray Square and Coolfin Road are also within the present day and 2100 epoch tidal breach flood extent. The flooding along these roads has a hazard rating of 'Danger for Most', meaning access and egress is likely to be impeded. During the 1% AEP plus 40% climate change surface water event, there is flooding along all of the roads within the site boundary. On Freemasons Road there is flooding of depths up to between 0.6 and 0.9m. The velocity of this flooding is up to between 1.0 and 2.0m/s. The resulting hazard rating of this flooding is up to 'Danger for Most'. Therefore, access and egress will be impeded. Proposed vehicular access and egress via Vandome Close may be possible as flooding on this road has a hazard rating of 'Danger for Some'. Vandome Road leads onto Freemasons Road, travelling north along Freemasons Road avoids the most hazardous flooding during this event. Pedestrian access and egress via Throckmorton Road will not be possible due to the flooding with hazard rating 'Danger for Most' on Shipman Road. **Phase 2 site:**

	Access and egress to the site is currently via multiple routes. There is access via Butchers Road and Mandela Road. During the present day 0.5% AEP tidal breach event, flood depths on Butchers Road are up to 1.26m. Velocities are up to 1.0m/s and the resulting flood hazard rating on the road is 'Danger for Most' On Mandela Road, flood depths are up to 1.1m. Flood water has a velocity of up to 0.95m/s and the hazard rating on the road is up to 'Danger for Most'. Vehicular access and egress will be impeded during this event. During the 2100 epoch 0.5% AEP breach event, the flood hazard rating remains 'Danger for Most' on both roads with deeper flood depths, pedestrian and vehicular access is likely to be impeded during this event. Vehicular access and egress will be impeded during this event. During the 1% AEP plus 40% climate change surface water event, there is flooding along Butchers Road and Mandela Road. On Butchers Road, flood depths are up to 0.3 to 0.6m and velocities are up to between 0.5 and 1.0m/s. The resulting hazard rating of this flooding is between 'Very Low Hazard' and 'Danger for Some'. Therefore pedestrian and vehicular access and egress may be possible via Butchers Road. On Mandela Road, flood depths are up to 0.3 to 0.6m and velocities are up to between 0.5 and 1.0m/s. The resulting flood hazard rating is between 'Very Low Hazard' and 'Danger for Most', although the areas on the road classified as 'Danger for Most' are very small. Therefore, pedestrian and vehicular access may be possible via Mandela Road.
Dry Islands	**Phase 1 site:** There are no dry islands at this site. **Phase 2 site:** During both the present day and 2100 epoch 0.5% AEP tidal breach events there is a small dry island at the northeastern corner of the Hallsville Primary School yard.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Tidal Breaches:** **Phase 1 site:** During the 2100 epoch 0.5% AEP tidal breach, again, 100% of the site is inundated. Flood depths vary between 0.30m and 1.65m. Once again, the greatest depths are along Leslie Road. The velocity of flood water during this event is up to 1.72m/s and the resulting hazard rating across the majority of the site is 'Danger for Most'. There is an area of hazard rating 'Danger for All' along Leslie Road and an area of hazard rating 'Danger for Some' at Freemasons Road Midwifery Centre. Flood depths are deeper than the present day scenario, and therefore the site is sensitive to climate change. **Phase 2 site:** 0.5% AEP Thames tidal upriver breach 2100 epoch (proportion of site at risk): 99.9% During the 2100 epoch 0.5% AEP tidal breach, 99.9% of the site is inundated. Flood depths are up to 1.5m. Again, the deepest flood depths are at the driveway to Hallsville Primary School. The velocity of flooding during this event is up to 1.0m/s at the bottom of Butchers Road and the resulting hazard rating across the majority of the site is 'Danger for Most'. There is an area of hazard rating 'Danger for Some' and 'Very Low Hazard' on the grounds of

	Hallsville Primary School. Flood depths are deeper than the present day scenario, and therefore the site is sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. **Phase 1 site:** In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is the same as 0.1% AEP event as described in the surface water risk section. Flood depths within the site are similar to the 1% AEP event, with a maximum flood depth of 0.8m, and the flood hazard remains the same at 'danger for most' across the areas of flooding including Leslie Road. This indicates the site is sensitive to increases in pluvial flooding due to climate change. **Phase 2 site:** In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is the same as 0.1% AEP event as described in the surface water risk section. Flood depths within the site are similar to the 1% AEP event, with a maximum flood depth of 0.6m, and the flood hazard remains the same at 'danger for most'. This indicates the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	
	• Geology at the site consists of:
	    o Bedrock – Bedrock geology of the sites is Lambeth Group (Clay, Silt and Sand). This is a sedimentary bedrock.
	    o Superficial – The superficial geology of the sites is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	    o Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	
	• The sites are considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is clay, silt and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone.

	• The entire site is not located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development, and non-residential uses for educational establishments and health services as 'More Vulnerable' development. Employment uses are classed as 'Less Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the sites are within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN.

	- Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. - At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames, is in a Critical Drainage Area and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. - As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. - Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. - All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on sites. - Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. - Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. - Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. **Guidance for site design and making development safe:** - The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). - Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. - The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. - Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. - Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate

	allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this sites.
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors
	  ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 1% AEP plus 40% climate change and 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.

- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood warning and evacuation plan is put in place for the site.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	Tidal breach - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Custom House Phase 3, N7.SA8**
Address	Land between Butchers Road and Freemasons Road south of Russell Road E16 1 and E16 3.
Area	1.13ha
Current land use	Residential and open space
Proposed land use	Residential and open space
Flood Risk Vulnerability	Mixed – More Vulnerable and Water Compatible Development
Sources of flood risk	
Location of the site within the catchment	The site is located in the south east of Canning Town, and is bordered by Russel Road to the north, Freemasons Road to the east, Chevron Close and Maplin Road to the south, and Butcher's Road to the west. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site's western boundary borders the River Lee. The southern and eastern boundaries border the Bow Back Creek and City Mill River, respectively, both of which converge with the River Lee in the site's site-western corner. The site is also situated approximately 3.2km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that most of the topography is relatively consistent. The site is situated within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in this assessment. Despite the majority of the site being relatively flat, the lowest elevations are located to the east of the site at around 1.44mAOD. The areas of highest elevation are to the north west of the site bordering Butcher's Road, up to 2.1mAOD.
Existing drainage features	There are no existing drainage features within the borders of the site. The site lies approximately 920m east of the River Lea and 1.1km north-east of the confluence between the River Lea and the River Thames.
Critical Drainage Area	The site is not located within a Critical Drainage Area.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 56%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*

	Available data: Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entirety of the site is located within the Reduction in Risk of Flooding from Rivers and Sea due to Defences extent; meaning the full site is shown as benefitting from defences (although still may be at some risk). The nearest modelled defended fluvial flood extent is the River Lea, which is located approximately 920m west of the site. The site remains unaffected during the 3.3%, 1%, and 0.1% AEP events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% **1% AEP** – 0.3% Max depth – 0.15m – 0.3m Max velocity – 0.25m/s – 0.5m/s **0.1% AEP** – 5.2% Max depth – 0.3m – 0.6m Max velocity – 0.5m/s – 1m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is unaffected by surface water flooding in the 3.3% AEP event. In the 1% AEP event, surface water flow paths along Maplin Road along the sites southern border begin to extend into the site, to a maximum depth, velocity, and hazard of 0.15 – 0.3m, 0.25m/s – 0.5m/s, and 'Very Low Hazard/Caution'. In the 0.1% AEP, the surface water flow paths mentioned above extend further into the south of the site, and reach a maximum depth, velocity, and hazard of 0.3m – 0.6m, 0.5m/s – 1m/s, and 'Danger for Some'. In addition, surface water flow paths originating from Freemasons Road extend onto Burrard Road which lies in the east of the site. The maximum depth, velocity, and hazard of the Burrard Road flow path is 0.3m – 0.6m, 0.5m/s – 1m/s, and 'Danger for Some'. Finally, there is an isolated area of surface water ponding in the north west of the site between residential properties. The maximum depth, velocity, and hazard of this ponding in the 0.1% AEP event is 0.15m – 0.3m, 0.25m/s – 0.5m/s, and 'Very low Hazard/Caution'.
Reservoir	According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Dry Day scenario. The following reservoirs are shown to inundate the

	either part of, or the whole site: King George V and William Girling, both of which are managed by Thames Water Ltd and are considered high risk. According to the Environment Agency's (EA) risk of flooding due to reservoirs dataset, the entirety of the site is at risk of reservoir flooding in the Wet Day scenario. The following reservoirs are shown to inundate the whole site: Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5, Warwick East, William Girling, and Wraysbury. These reservoirs are all owned by Thames Water Ltd and are considered high risk. As all reservoirs in this area are deemed as high-risk, in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could Lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site lies within two postcode areas: E16 1 and E16 3, with 32 and 206 incidences of sewer flooding respectively, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's Historic Flood Map and Recorded Flood Outline show no records of flooding within the site. Approximately 10m south of the site, south of Maplin Road, both the Historic Flood Map and Recorded Flood Outline detail a large flood incident in January 1953 at the confluence of the River Thames and River Lea due to overtopped defences. Newham Borough Council's flood records show no records of flooding within the site. Immediately north of the site on Russell Road and east of the site on Gadwell Close there is one record each of historical flooding from 2018 and 2021 respectively.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 design years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day event proportion of site at risk – 100%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 100%**

	The entire site is inundated by the River Thames in the Present Day 0.5% AEP scenarios. The maximum depth, velocity, and hazard within the site reaches approximately 0.74m, 0.88m/s, and 'Danger for Most'. This only increases with the 2100 epoch event. Maximum depth, velocity, and hazard are detailed in the Climate Change section of this Site Table. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences is unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The entire site is located in both an Environment Agency Alert Warning Area, and an Environment Agency Flood Warning Area. Flood Alert Area: 063WAT233N (Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham) The site lies within two Flood Warning Areas: 063FWT23RDockA (Tidal Thames from Beckton Sewage Works to the River Lea) and 063FWT23RDockB (River Thames at Beckton including Canning Town, Custom House, and Beckton)
Access and egress	There are numerous ways in which this site can be accessed: Russell Road and Hands Walk to the north, Freemasons Road and Burrard Road to the east, Maplin Road and Chevron Close to the south, and Butchers Road to the west. Russell Road, Hands Walk, Burrard Road, Maplin Road, and Chevron Close are all accessed via either Freemasons Road or Butchers Road; therefore, this section will focus on these two access routes. In the Present Day 0.5% AEP tidal upriver breach event, safe access and egress may not be possible via any route due to complete inundation of the site. The maximum depth, velocity, and hazard on Freemasons Road and Butchers Road, are 0.73m, 0.8m/s, and 'Danger for Some', and 0.44m, 0.6m/s, and 'Danger for Some' respectively. In the 0.5% AEP tidal upriver breach 2100 event the entire site is once again inundated by flood waters. The maximum depth, velocity, and hazard on Freemasons Road and Butchers Road, are 0.99m, 0.85m/s, and 'Danger for Some', and 0.61m, 0.88m/s, and 'Danger for Some' respectively. In the 3.3% AEP event, safe access and egress may be demonstrated via all access routes. Butcher's Road suffers minor surface water flooding to the north of the site to a maximum depth, velocity, and hazard of 0.15m – 0.3m, 0m/s – 0.25m/s, and 'Very Low Hazard/Caution'. Freemasons Road in unaffected by surface water in this event. In the 1% AEP event, surface water flooding on Butcher's Road increases to a maximum depth, velocity, and hazard of 0.3m – 0.6m, 0.25m/s – 0.5m/s, and 'Danger for Some', meaning access and egress may be impacted. Access and egress from Freemasons Road may be possible despite minor surface water flooding. The maximum depth, velocity, and hazard here are 0.15m – 0.3m, 0.25m/s – 0.5m/s, and 'Danger for Some'. In the 0.1% AEP event, access and egress from both Butcher's Road and Freemason's Road may be impeded due to surface water flooding. The maximum depth, velocity, and hazard on Freemasons Road reach 0.3m – 0.6m, 0.5m/s – 1m/s, and 'Danger for Most'. In addition, the maximum depth, velocity, and hazard of Butcher's Road reaches 0.3m – 0.6m, 0.25m/s – 0.5m/s, and 'Danger for Some'.

	In the 1% AEP plus 40% climate change, the risk to access routes increases. The maximum depth, velocity, and hazard on Freemasons Road reach 0.37m, 0.87m/s, and 'Danger for Most'. In addition, the maximum depth, velocity, and hazard of Butcher's Road reaches 0.42m, 0.4m/s, and 'Danger for Most'. As such, access and egress to the site via both routes will be severely impacted. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The site is completely inundated in the Thames River Present Day epoch as detailed previously. This is the same for the 2100 epoch, with more extreme depth, velocity, and hazards. The maximum depth, velocity, and hazard for the 0.5% AEP 2100 epoch is 0.98m, 0.85m/s, and 'Danger for Most'. Since a large percentage of the site is at risk during the 2100 epoch 0.5% AEP breach event, the site is considered to be at high risk in the aforementioned breach scenario and sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. Similar to the Present Day event, surface water flow paths in the 1% plus 40% climate change event originating on Maplin Court and Chevron Close bordering the south of the site extend into the site boundary and have a maximum depth, velocity, and hazard of 0.32m, 0.38m/s, and 'Danger for Most'. The flow path along Burrard Road in the east of the site experiences flooding of a maximum depth, velocity, and hazard of 0.32m, 0.56m/s, 'Danger for Most'. The north of the site also experiences minor surface water ponding to a maximum depth, velocity, and hazard of 0.19m, 0.06m/s, 'Very Low Hazard/Caution'. Due to the significant increase in extent and depth between the Present Day and 40% Climate Change event, this site is considered extremely susceptible to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	
Broad-scale assessment of possible SuDS	**Geology & Soils** • Geology at the site consists of: ○ Bedrock – Bedrock geology of the site is the London Clay Group (clay, silt, sand, and gravel).

	◦ Superficial – The superficial geology of the site is undifferentiated River Terrace deposits (sand and gravel) • Soils at the site consist of: ◦ Loamy and clayey soils of coastal flats with naturally high groundwater. **SuDS** • The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. • BGS data indicates that the underlying geology is a mixture of clay, silt, sand, gravel, and clay which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone • The site is not located within a Nitrate Vulnerable Zone • The site is located within the Secondary (undifferentiated) superficial aquifer designation zone. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity, and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces, and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean and improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to

	facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable'. Open space is classed as 'water compatible development.' The Exception Test is required for 'More Vulnerable' development within Flood Zone 3. It is also highly recommended due to the significant residual risk identified previously.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the Present Day and 2100 epochs for the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Development within 20m of a main river or flood defence will require specific planning permissions. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.

	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at Least 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at Least 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at Least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 2 and 3 as well as being at minor - moderate pluvial flood risk in the 3.3%, 1%, and 0.1% AEP events. The site is also shown to be at significant flood risk if the River Thames were to breach its banks or defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water event, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan. If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Fluvial and tidal extents, depth, velocity and hazard mapping	Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment **Detailed Site Summary Tables**
Site details	
Site Code	**N11.SA2**
Address	Land at Ferndale Street, Beckton, E6 6
Area	1.01 ha
Current land use	Vacant land and greenspace
Proposed land use	Residential and open space
Flood Risk Vulnerability	More vulnerable and water compatible development.
Sources of flood risk	
Location of the site within the catchment	The site is located within Cyprus to the south-east of Newham. The site is bounded by Ferndale Street to the east, the Cyprus Allotments to the north and Heather Close to the west. The site is located within the Roding, Beam and Ingrebourne Catchment. The catchment is 516km^2 and extends from the rural areas of Uttlesford, Brentwood, Epping Forest and Forest towards urbanised north-east London. This site lies approximately 800m north-west of the River Thames, and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site indicates that topography varies. The site is within a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The elevation of the site ranges between 1.10mAOD and 4.81mAOD. The site generally gently slopes downwards towards the north-west There is an area of raised ground in the centre of the site and running parallel to Ferndale Street, and some isolated topographic depressions to the west.
Existing drainage features	There are no main rivers or mapped ordinary watercourses within, or in the vicinity of, the site. The site is situated 800m north-west of the Thames. There are no drainage ditches within the site, however, the topographically low-lying areas mentioned above could act as a drainage ditch for some of the site.
Critical Drainage Area	The site is not located within a Critical Drainage Area (CDA).
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:**

	Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This indicates that the site is shown to benefit from defences up to and including the 0.1% AEP event (and into the future).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0% Max depth – 0.0m Max velocity – 0.0m/s **1% AEP** – 0.4% Max depth – 0.3-0.6m Max velocity – 0.25-0.50m/s **0.1% AEP** – 4.8% Max depth – 0.60-0.90m Max velocity – 0.50-1.00m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water (RoFSW) mapping was used in this assessment. **Description of surface water flow paths:** RoFSW mapping indicates that no flooding should occur in the site during the 3.3% AEP surface water flood event. During the 1.0% AEP event, surface water flooding only occurs within 0.4% of the site. This flooding is confined to an isolated topographic depression to the north-east of the site. During the 0.1% AEP event, surface water flooding occurs across a greater proportion of the site (4.8%) than the 1% AEP event. Water is predicted to pool within four topographic depressions, located to the centre, south and east of the site. The maximum predicted flood depth during this event is 0.6-0.9m, with maximum velocity between 0.5 to 1.0m/s. Flood hazard during this event ranges from 'very low – caution' to 'danger for some,' with the highest hazard ratings corresponding to the locations where the floodwater is deepest.
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the western half of the site is at risk during the 'dry day' reservoir flood. This risk is posed by the King George V and William Girling Reservoirs, which are both managed by Thames Water.

	During the 'wet day' scenario, the entire site is at risk from the following reservoirs: Banbury, King George V, Lockwood, Queen Elizabeth II and William Girling. Additionally, the western half of the site is at risk from the following reservoirs: Walthamstow 4, Walthamstow 5 and Warwick East. All of these reservoirs are owned by Thames Water. All of the reservoirs listed are deemed as 'high risk,' so, in the very unlikely event that the reservoir fails, it is predicted that there would be a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is classed as having a negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 92 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Recorded Flood Outlines Database and the LBN Council's Flood Incident database, there have been no recorded incidents of flooding within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences (tidal flood walls) along the Thames frontage. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk form an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding and described below. **0.5% AEP tidal present day event proportion of site at risk** – 0% **0.5% AEP tidal 2115 epoch event proportion of site at risk** – 21.5% **0.1% AEP tidal present day epoch event proportion of site at risk – 0%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 0%** The site is not at risk during the 0.5% AEP tidal present day flood event. During the 0.5% AEP tidal 2115 epoch event, 21.5% of the site is inundated. This flooding is concentrated within an area of lower ground to the west of the site. Flood depths within the site reach a maximum of 0.67m, concentrated in the topographic depressions within the site, with a maximum velocity of 0.23m/s. Flood hazard during this event at the site is generally rated as either 'very low hazard' or 'danger for some,' although hazard is rated 'danger for most' to the west of the site where the deepest flood depths are located. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences is unknown, but a breach of defences is very unlikely.

	The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within an Environment Agency flood warning area (063FWT23RDockB) – extends around River Thames at Beckton including Canning Town, Custom House, and Beckton. The site is located within the Environment Agency flood alert area (063WAT233N) – extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham.
Access and egress	Safe access and egress to the site is currently via a number of routes. To the east access is gained via Ferndale Street. Safe access and egress for the site was assessed against the Thames tidal downriver 2115 epoch 0.5% AEP breach model outputs. When assessing against the Thames tidal downriver 2115 epoch 0.5% AEP model outputs, access and egress for the site is possible as the northern end of Ferndale road up to the A117 is not within the breach extent. Occupants should exist the site to the east onto Ferndale Street, and then travel north onto the A117 Woolwich Manor Way as neither of these sites are predicted to flood during the design flood event. During the surface water 1% AEP plus 40% allowance for climate change event, site access and egress is still possible to the north via Ferndale Street and the A117 Woolwich Manor Way. There is either limited (where hazard is rated as 'very low – hazard') or no flooding on these roads during this event.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: Roding, Beam and Ingrebourne Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** 0.5% AEP Thames tidal downriver breach 2115 epoch (proportion of site at risk): 21.5% 0.1% AEP Thames tidal downriver breach 2115 epoch (proportion of site at risk): 43.1% Whilst the site does not flood during the 0.5% AEP present day Thames tidal upriver breach, approximately 21.53% of the site floods during the 0.5% AEP 2115 Thames tidal downriver breach. This flooding is concentrated to the west of the site. Flood depths within the site reach a maximum of 0.67m, concentrated in the topographic depressions within the site, with a maximum velocity of 0.23m/s. Flood hazard during this event at the site is generally rated as either 'very low hazard' or 'danger for some,' although hazard is rated 'danger for most' to the west of the site where the deepest flood depths are located. Since the whole site is at risk during the 0.5% AEP 2115 tidal Thames breach, the site is considered to be sensitive to breach due to climate change. **Surface Water:**

	The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. During the 1% AEP plus 40% climate change event, flood extents across the site have increased slightly (3.26% of the total site floods) relative to the 1% AEP surface water flood, where just 0.4% of the site floods. During the 1% AEP plus 40% climate change event, there is isolated surface water ponding across the site. For this event, maximum flood depths extend to 0.70m, with maximum velocities up to 0.68m/s. Hazard is generally classed as 'very low' or 'danger for some,' although a small portion to the south-east of the site is classed as 'danger for most.' This suggests that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	
Broad-scale assessment of possible SuDS	**Geology & Soils** • Geology at the site consists of: • Bedrock – Bedrock geology of the site is Lambeth Group (Clay, Silt and Sand). This is a sedimentary bedrock. • Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water. • Soils at the site consist of: • Loamy and clayey soils of coastal flats with naturally high groundwater. **SuDS** • The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding. • BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial deposits, aquifer designation zones. • The site is not located within a historic landfill site or a nitrate vulnerable zone. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as attenuation basins, green roofs, permeable surfaces and rain gardens must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and open space as 'water compatible development'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham Council, Thames Water, London City Airport and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, and is within Flood Zone 3. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the

Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site.

- Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies.
- The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 0.5% AEP Thames tidal breach extents.

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 2115 0.5% AEP Thames tidal downriver flood extents, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flooding should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:

	- using flood resistant materials that have low permeability to at least 600mm above the estimated flood level - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3, as well as at high risk if the Thames were to breach its bank and defences were to fail during the 0.5% AEP 2115 epoch event. There is also some pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and open space as 'water compatible development'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water event, including an allowance for climate change, is needed. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.

If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from

Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal extents depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N11.SA1 East Beckton Town Centre**
Address	Tollgate Road, Beckton, London E6 5
Area	8.40 ha
Current land use	Mixed use development – town centre uses including retail, a supermarket, an extensive car park, and community facilities including a health centre, a faith facility, a library, a community centre and a gymnastics centre.
Proposed land use	Residential, health centre, leisure uses, town centre uses, community facilities and open space.
Flood Risk Vulnerability	Mixed - More vulnerable to less vulnerable
Sources of flood risk	
Location of the site within the catchment	The site is located in central Beckton. It is bounded by Tollgate Road to the north and Beckton Corridor, a key pedestrian footpath, to the south. The east of the site is bounded by, and partially includes the A117 Woolwich Manor Way. The site is located within the Roding, Beam and Ingrebourne Catchment. The catchment is 516km^2 and extends from the rural areas of Uttlesford, Brentwood, Epping Forest and Forest towards urbanised north-east London. This site lies approximately 1.5km north-west of the River Thames, and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The site is reasonably flat, with elevations varying between-1.24mAOD and 3.23mAOD. Site elevations are generally higher (above 1.0mAOD) to the north and west of the site. The lowest lying land is found to the north-east of the site, corresponding with the footpath between Tollgate Road and under the A117 Woolwich Manor Way, where elevations are between -1.24mAOD and 0.09mAOD.
Existing drainage features	There are no main rivers or mapped ordinary watercourses within, or in the vicinity of, the site. There are also no major topographic depressions within the site that could act as drainage ditches.
Critical Drainage Area	The site is not located within a critical drainage area (CDA).
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 80%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For*

	example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** Almost the entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The area not within this extent is the most south western tip of the site, which has a total area of just 220m^2. This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 4.2% Max depth – >1.2m Max velocity – >2.0m/s **1% AEP** – 12.9% Max depth – >1.2m Max velocity – >2.0m/s **0.1% AEP** – 42.4% Max depth – >1.2m Max velocity - >2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding only covers 4.2% of the site. This flooding is generally isolated surface water ponding in topographic depressions or within car park of the Mary Rose Mall, where flood depths are largely under 0.3m, velocity under 0.25m/s and hazard rated as either 'very low hazard' or 'danger for some.' However, during this event, there is more extensive flooding surrounding the roundabout and underpass between Tollgate Road and the A117 Woolwich Manor Way. Flood depths here extend over 1.2m, with max velocities over 2.0m/s and flood hazard rated as 'danger for all.' During the 1.0% AEP event, surface water flooding covers 12.9% of the site. Flooding around the Mary Rose Mall and its car parks is more

	widespread, now extending to Frobisher Road. Flood depths and velocities in this area of the site are still reasonably similar to the 3.3% AEP event, although a greater proportion of the site is classed as 'danger for some.' Flood extents and magnitudes surrounding Tollgate Road and the A117 Woolwich Manor Way are still reasonably similar to the 3.3% AEP event. During the 0.1% AEP event, surface water flooding covers 42.4% of the site. In this event, the entire Mary Rose Mall is surrounded by flood water, and a flow path forms, connecting floodwater between the Tollgate Road/ A117 Woolwich Manor Way roundabout to the car park of the Mary Rose Mall. Flood depths surrounding the Mary Rose Mall now extend up to 0.9m/s, with velocities reaching up to 2.0m/s, and hazard generally classed as 'danger for most.' Flood extents and magnitudes surrounding Tollgate Road and the A117 Woolwich Manor Way still remain reasonably similar to the 3.3% AEP event.
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the majority of the site is inundated during the 'dry day' reservoir flood. This risk is posed by the King George V and William Girling Reservoirs, which are both managed by Thames Water. During the 'wet day' scenario, the entire site is at risk from the following reservoirs: Banbury, King George V, Lockwood, Queen Elizabeth II, Walthamstow 4, Walthamstow 5, Warwick East, William Girling and Wraysbury. All of these reservoirs are owned by Thames Water. All of the reservoirs listed are deemed as 'high risk,' so, in the very unlikely event that the reservoir fails, it is predicted that there would be a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is classed as having a negligible risk of groundwater flooding, where any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 167 recorded incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Flood Incident Database and the LBN Council's Flood Incident database, there have been no recorded incidents of flooding within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding.

	0.5% AEP tidal present day event proportion of site at risk – 0.0% **0.5% AEP tidal 2115 epoch event proportion of site at risk – 75.4%** **0.1% AEP tidal present day epoch event proportion of site at risk – 0%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 0%** The site does not flood during the 0.5% AEP present day tidal breach flood event. During the 0.5% AEP tidal 2115 epoch flood event, flooding extends across 75.42% of the site, with floodwater surrounding the Mary Rose Mall, Kingsford Way, Mitchell Walk, Tollgate Road and the A177 Woolwich Manor Way. The surface water flow path between the Tollgate Road/ A177 Woolwich Manor roundabout and Mary Rose Mall car park is also present. Flood depths beneath the Tollgate Road/ A177 Woolwich Manor Way underpass extend to 3.12mAOD, with velocities up to 1.19m/s and hazard classed as 'danger for all' during this event. Across the rest of the site, flood hazard is generally rated as 'danger for most,' with flood depths extending up to 1.19mAOD. Velocities are generally under 0.5m/s, although those associated with the surface water flow path increase to up to 1.70m/s. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within Environment Agency flood warning area (063FWT23RDockB) which extends around River Thames at Beckton including Canning Town, Custom House and Beckton. Additionally, the site is within Environment Agency flood alert area (063WAT233N) which extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham.
Access and egress	Access and egress to the site is currently possible via a number of routes. Tollgate Road is located within, and adjacent to, the northern site boundary. The site can be exited from the north by travelling west onto Tollgate Road, or to the east, where you can reach the A117/ Tollgate Road roundabout. From the roundabout, the site can be exited to the east via Winsor Terrace, or either north or south via the A117 Woolwich Manor Road. To the south of the site, there is no vehicular access present, although pedestrians can exit the site to the south-west using the Beckton Corridor footpath. Careful consideration of safe access and egress will be needed for this site. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. During the 0.5% AEP 2115 epoch Thames tidal breach, the vast majority of the site is inundated as described above. To the north, the site can be exited to the north-west, by travelling west on Tollgate Road, where there is limited (classed as 'very low') or no flooding. However, site exit to the north-east via access routes stemming from the A117/ Tollgate Road roundabout would be challenging as associated flood hazard along these roads are rated as 'danger for most.'

	To the south, the site can be exited using the Beckton Corridor pedestrian footpath in a south-westerly direction. As it is a footpath, this exit route is only available for pedestrians and vehicular access would not be possible. There is no flooding along most of the footpath, with some flooding in isolated patches, which are rated as 'very low' hazard with flood depths under 0.1m. Additionally, the surface water 1% AEP plus 40% allowance for climate change flood event impacts access and egress routes from the site. To the north, the site can still be exited to the west via Tollgate Road, which generally remains flood free. However, site exit to the north-east via access routes stemming from the A117/ Tollgate Road roundabout would be challenging as associated flood hazard this roundabout is rated as 'danger for most.' To the south, the site can be exited using the Beckton Corridor pedestrian footpath, which remains flood free during this event.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: Roding, Beam and Ingrebourne Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** 0.5% AEP Thames tidal downriver breach 2115 epoch (proportion of site at risk): 75.4% 0.1% AEP Thames tidal downriver breach 2115 epoch (proportion of site at risk): 86.9% Whilst the site does not flood during the 0.5% AEP present day Thames tidal down river breach, it does in the 2115 (into the future) epoch. Approximately 75.4% of the site floods during the 0.5% AEP 2115 Thames tidal downriver breach. This flooding is concentrated to the centre and east of the site, notably around the Mary Rose Mall and car park, and roundabout connecting Tollgate Road and the A117 Woolwich Manor Way. Flood depths beneath the Tollgate Road/ A177 Woolwich Manor Way underpass extend to 3.1mAOD, with velocities up to 1.2m/s and hazard classed as 'danger for all' during this event. Across the rest of the site, flood hazard is generally rated as 'danger for most,' with flood depths extending up to 1.2mAOD. Velocities are generally under 0.5m/s, although those associated with the surface water flow path increase to up to 1.7m/s. Flood depths and hazard for the 0.1% AEP 2115 epoch event are deeper and the extent is further into the site. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during both breach extents and not in the 2005 epoch, the site is considered to be at high risk in both breach scenarios and sensitive to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario.

	In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is not as severe as the 0.1% AEP event, although the flow path between the Tollgate Road/ A117 Woolwich Manor Way roundabout and Mary Rose Mall car park is present. Flood depths in the 1% AEP plus 40% climate change event now extend up to 0.8m, with velocities up to 2.9m/s. The flood hazard during this is event is now classed as 'danger for most' across the majority of the site, rather than 'danger for some' as the site is classed during the present day 1% AEP event. This suggests surface water flooding at the site is extremely sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  o Bedrock – Bedrock geology of the site is London Clay formation (Clay, Silt and Sand). This is a sedimentary bedrock.
	  o Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  o Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, and sand which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site or nitrate vulnerable zone.
	• The entire site is located within unproductive bedrock, and Secondary (undifferentiated) superficial deposits aquifer designation zones.
	• Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS

	techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential institutions including health centres as 'More Vulnerable' development. Leisure and non-residential institutions (excluding health centres, nursery and educational establishments) are classed as 'Less Vulnerable' development. Open space is classed as water compatible development. As there are multiple flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.

	• All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site, as the site is at risk of flooding during the 0.5% AEP 2115 epoch Thames Tidal breach. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 2115 0.5% AEP Thames tidal breach event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding

	is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to: ◦ raise them as much as possible ◦ consider moving vulnerable uses to upper floors ◦ include extra flood resistance and resilience measures. • Other examples of flood resistance and resilience measures include: ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • The scale of development in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'More vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP 2115 Thames tidal breach, and 1% AEP and surface water events, including an allowance for climate change, is needed. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Careful consideration of safe access and egress is necessary for this site. Safe access and egress should be demonstrated in the 1% AEP plus Higher Central climate change surface water and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.

	• If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
Mapping Information	
The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal depth, velocity and hazard mapping	This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Former East Ham Gasworks, N13.SA3**
Address	Former East Ham Sports Ground east of Leigh Road and west of the North Circular Road.
Area	10.3ha
Current land use	Former gasholders and associated infrastructure and open space currently inaccessible to the public.
Proposed land use	Residential development, open space and community facility. Development should retain the gas governor on site.
Flood Risk Vulnerability	Mixed - Less Vulnerable, More Vulnerable and Essential Infrastructure (section of the site containing the gas governor).
Sources of flood risk	
Location of the site within the catchment	The site is located within East Ham and borders Leigh Road to the west, and the North Circular Road to the east. Stevenage Road and the Fenchurch Street and Shoeburyness railway line runs along the northern boundary, whilst Watson Avenue borders the south of the site. The site is located within the Roding, Beam and Ingrebourne Management Catchment. The catchment is 516km^2 and is densely populated, especially within the south of the catchment. The site lies approximately 110m west of the River Roding, which flows south into the River Thames. The site is also situated 123m west of Loxford Water where this watercourse converges with the River Roding. The site is located 3.9km north of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography across most of the site is relatively flat, excluding the area where the gasworks cylinder is located. The area surrounding the site is within a densely populated, developed urban area and LiDAR data is unlikely to be representative of the actual site topography, and this may have an impact on some of the flood risk datasets used in this assessment. The majority of elevations at the site are between 2.0 to 3.0m AOD. There are areas of slightly higher elevations along the site's eastern and western boundaries that reach approximately 4.71m AOD. The highest elevations are located in the southern half of the site where the road leading from Southend Road to the gasworks cylinder and the gasworks cylinder itself are situated. Here, elevations are between 3.73 to 11.85m AOD.
Existing drainage features	The site lies approximately 110m west of the River Roding which flows into the River Thames. The site is also situated 123m west of Loxford Water where this watercourse converges with the River Roding. The site is located 3.9km north of the River Thames, which also marks the location of the confluence of the River Roding and the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 93%** **FZ2 – 100%** **FZ1 – 0%**

	The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Defended model outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 86.6%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ESTRY-TUFLOW detailed hydraulic model for the Shonks Mill Lower Roding has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The areas not within this extent include the south of the site, the eastern boundary and a small area in the north-west. This means that the majority of the site is shown to benefit from defences (although may still be at some risk). According to the Shonks Mill Lower Roding (2018) hydraulic model, the site is unaffected by fluvial flooding during the 3.3%, 1% and 0.5% AEP modelled events. During the 0.1% AEP modelled fluvial event, the majority of the site is flooded. This excludes the area in the south of the site where the gasworks cylinder is located which extends to a small section along the western boundary. Flood depths reach 1.0m in the centre of the site with water flowing at a maximum of 1.64m/s in the north-east of the site. The resulting flood hazard is 'Very Low' to 'Danger for Most'. The latter covers the majority of the northern half of the site as well as most of the south (which follows areas where water is deepest and fastest flowing), excluding the south-west from Watson Avenue to Southend Road.

Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 39.4% Max depth – 0.3 – 0.6m Max velocity – 0.25 - 0.5m/s **1% AEP** – 49.7% Max depth – 0.3 – 0.6m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 66.1% Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 0% **1% AEP** – 1.5% Max depth – 0.2m Max velocity – 0.1m/s **0.1% AEP** – 40% Max depth – 0.4m Max velocity – 0.8m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *Little Ilford ICM surface water model was also used in the assessment of surface water flooding.* *Where ICM modelling is available (including depth, velocity and hazard grids), this modelling is a more detailed assessment of surface water flood risk, and should take precedence over the RoFfSW dataset.* **Description of surface water flow paths:** According to the Little Ilford ICM surface water model, the site is unaffected by surface water flooding during the 3.3% AEP modelled event. During the 1% AEP modelled surface water event, there are two small areas of ponding within the centre and south of the site. Flood depths reach 0.2m with maximum velocities of 0.1m/s. The resulting flood hazard is 'Very Low'. During the 0.1% AEP modelled surface water event, a large area of ponding forms within the north as well as a slightly smaller area ponding forming in the south-east of the site. There are several smaller areas of ponding in the west and north of the site. Flood depths reach 0.4m with maximum velocities of 0.8m/s. The resulting flood hazard is 'Very Low' to 'Danger for Some'. The latter covers a variety of areas within the site including a large area in the north as well as the south-eastern corner where flood depths are deepest.
Reservoir	The northern half of the site is at risk of Dry Day reservoir flooding according to the Environment Agency's reservoir flood mapping. This risk is posed by the Berners Hall Farm reservoir which is managed by Essex Farms and is deemed as high-risk. There are small areas along the northern half of the site's boundaries which are unaffected by Dry Day reservoir flooding as well as small dry islands which are concentrated in the north-east of the site. The majority of the site is at risk of Wet Day reservoir flooding with the exception of the area within the south of the site where the gas cylinder is located due to it being located on high-ground. This risk is posed by the following reservoirs: Valentines Park Lake, Ornamental Water (Wanstead Park), Heronry Pond (Wanstead Park), Chigwell Raw Water, Berners Hall Farm, Basin Lake (Wanstead) and Banbury. These reservoirs are all deemed as high-risk. Ornamental Water and Heronry Pond and managed by the City of

	London Corporation whilst Valentines Park Lake is managed by the London Borough of Redbridge. Chigwell Raw Water's undertaker is Northumbrian Water Limited and Berners Hall Farm's is Essex Farms. Basin Lake is managed by Wanstead Golf Association Limited whilst Banbury is managed by Thames Water Limited. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The majority of the site is shown to have low risk of groundwater flooding, and any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property. There is a strip of land along the entire stretch of the eastern boundary that is at moderate risk of groundwater flooding. Any groundwater flooding incidence has a chance of greater than 1% annual probability of occurrence. There will be a significant possibility that incidence of groundwater flooding could lead to damage to property. Further consideration of the local level of risk and mitigation is recommended. The area within the south of site where the gasworks cylinder is located is shown to have negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within postcode areas with 753 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has three records of flooding within the northern half of the site. These occurred in 2000 due to local drainage/surface water flooding. It is unknown how many properties were affected by this flooding. Newham Borough Council's flood records show no records of flooding within the site. The nearest record of a flooding incident was on the North Circular Road 25m east of the site. This occurred in May 2018.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within the site. The nearest formal flood defences are situated along both banks of the River Roding approximately 140m east of the site. There are also defences which extend from the banks of the River Roding to further up the floodplain which are 50m east of the site. These defences consist of flood walls and embankments. The design standard of protection of these defences ranges from 5 to 1000 years. The area is also protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Roding. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Roding and River Thames.

	The Environment Agency's Thames Estuary Downriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal 2005 epoch event proportion of site at risk – 0%** **0.1% AEP tidal 2005 epoch event proportion of site at risk – 0%** **0.5% AEP tidal 2115 epoch event proportion of site at risk – 0%** **0.1% AEP tidal 2115 epoch event proportion of site at risk – 44.7%** The site is not at residual risk from an overtopping or breach of defences of the Thames in the 0.5% and 0.1% AEP 2005 epoch events, or the 0.5% AEP 2115 epoch event. There are several areas within the site which are flooded in the 2115 epoch 0.1% AEP event Thames Downriver Tidal Breach event. These areas include the south-east of the site, the north-west and land surrounding the south, east and north of the gasworks cylinder. Flood depths across these areas of the site vary from approximately 0.01 to 0.49m. Flooding is deepest within the south of the site. Velocity of flood waters is between 0.01 to 0.34m/s. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. The resulting flood hazard classification varies from 'Very Low' to 'Danger for Some' where flooding is deepest to the south of the site. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in Environment Agency Flood Warning and Flood Alert Areas. It is located within the 062WAF54LwRoding Flood Alert Area in the London Boroughs of Barking and Dagenham, Newham and Redbridge as well as the county of Essex. The site is also located within the 063WAT233N Flood Alert Area in the London Boroughs of Barking and Dagenham, Greenwich, Havering, Newham, Tower Hamlets and Bexley as well as Thurrock in Essex. The site is located within the 062FWF54Barking Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Barking and Dagenham, Newham and Redbridge. The site is also located within the 063FWT23Roding Flood Warning Area. This is situated within the London Boroughs of Barking and Dagenham, Greenwich and Newham.
Access and egress	Access and egress to the site will be via two routes. According to the Newham Draft Local Plan (2022), proposed vehicular access will be via Southend Road to the west of the site and Watson Avenue in the south-western corner of the site. Safe access and egress is possible via the two previously mentioned routes during all modelled tidal breach events in the present day epoch and the 2115 epoch 0.5% and 0.1% AEP Thames Tidal Downriver breach events. Safe access and egress is possible via both routes during the 3.3%, 1%, 1% +36% CC and 0.5% AEP modelled fluvial events. However, access via both routes is affected during the 0.1% AEP modelled fluvial event. Flood depths reach approximately 0.55m in the south-west of the site with maximum water velocities reaching 0.19m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most' meaning vehicular access via these routes may be affected. According to the Little Ilford surface water ICM model, access and egress is unaffected during all modelled surface water events which includes the 3.3%, 1%, 1% +40% CC and 0.1% AEP events. During the 0.1% AEP modelled

	surface water event, a large area of ponding is located within the north of the site which may affect access via Southend Road. Flood depths closest to this road reach 0.2m with maximum velocities of 0.1m/s. The resulting flood hazard is 'Very Low'. This extent is similar during the 1% AEP +40% CC modelled surface water event. Flood depths closest to the access road in the site reach 0.3m with maximum velocities of 0.1m/s. The resulting flood hazard is 'Very Low'. Therefore, vehicular access and egress is possible during both these surface water flood events.
Dry Islands	There are small dry islands during the Dry Day reservoir flood event in the north-east of the site. The gasworks cylinder is also located on a dry island during the Wet Day reservoir flood event and in the Environment Agency's Flood Map for Planning Flood Zone 3.
Climate change	
Implications for the site	**Management Catchment: Roding, Beam and Ingrebourne Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial:** As the site's highest vulnerability classification is 'Essential Infrastructure', the higher central climate change allowance should be used as the design event. The site is not affected by fluvial flooding during the 3.3%, 3.3% +36%CC, 1%, 1% +36%CC or the 0.5% AEP modelled flood events. During the 0.5% AEP +36%CC, flooding increases significantly from the 0.5% AEP event. The majority of the site is affected by flooding, excluding the access point in the west of the site via Southend Road as well as the gasworks cylinder. Flood depths reach 0.7m with maximum velocities of 1.4m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. This shows that the site is sensitive to increases in fluvial flooding due to climate change. **Tidal Breaches:** The Thames Downriver 2115 epoch 0.1% AEP event is the only breach event to encroach the site in several areas. These areas include the south-east of the site, the north-west and land surrounding the south, east and north of the gasworks cylinder. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a substantial percentage of the site is at risk during one breach event, the site is considered to be at high risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Little Ilford ICM surface water model to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event, the flood extent increases significantly from the 1% AEP event. The flood extent is similar to the 0.1% AEP event. The areas of ponding in the north and south-eastern corner of the site increase in extent with additional smaller areas of ponding occurring in the south, north and west of the site. Flood depths also increase from around 0.2m (1% AEP event) to around 0.4m in the 1% AEP plus 40% climate change event. This shows that the site is very sensitive to increases in pluvial flooding due to climate change.

<table>
<tr><td></td><td>Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.</td></tr>
<tr><td colspan="2">Requirements for drainage control and impact mitigation</td></tr>
<tr><td>Broad-scale assessment of possible SuDS</td><td>
Geology & Soils

Geology at the site consists of:

Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand).
Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and gravel).

Soils at the site consist of:

The majority of the site is loamy and clayey floodplain soils with naturally high groundwater. The remaining strip of land in the west of the site is loamy soils with naturally high groundwater.

SuDS

Part of the site is considered to have low to moderate susceptibility to groundwater flooding. Detention and attenuation features should be designed to prevent groundwater ingress from impacting hydraulic capacity and structural integrity. Additional site investigation work may be required to support the detailed design of the drainage system. This may include groundwater monitoring to demonstrate that a sufficient unsaturated zone has been provided above the highest occurring groundwater level. Below ground development such as basements are not appropriate at this site.
BGS data indicates that the underlying geology is a mixture of clay, silt, sand and gravel which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
The site is located within a Groundwater Source Protection Zone. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints.
The site is not located within a Nitrate Vulnerable Zone.
There is no data for the bedrock aquifer designation zones at the site. However, the entirety of the site is located within the Secondary A superficial aquifer designation zone.
The site is not located within an historic landfill site.
Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
The Little Ilford surface water ICM model indicates the presence of surface water flow paths beginning to form in areas surrounding the site during the 0.1% AEP modelled event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

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Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies the gas governor as 'Essential Infrastructure', residential development as 'More Vulnerable' and community facilities as 'Less Vulnerable'. As there are three different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, classified as 'Essential Infrastructure' and 'More Vulnerable' and has some surface water flood risk, the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is at tidal flood risk from the 2115 epoch for the 0.1% AEP breach event of the River Thames, is shown to be at fluvial flood risk during the 0.1% AEP event and is at surface water flood risk in the 1% AEP, 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way.

	• Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits.
	• All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.
	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
	• Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
	• Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.
	
	Guidance for site design and making development safe:
	• The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
	• Should built development be proposed within the 0.1% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. According to Thames Water, surface water is expected to be discharged to the watercourses.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Arrangements for safe access and egress will need to be demonstrated for the 0.1% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	  ◦ raise them as much as possible
	  ◦ consider moving vulnerable uses to upper floors

	- include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	  - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	  - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	  - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.
	• London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in Flood Zone 3 and Flood Zone 2, as well as being at pluvial flood risk in the 1% and 0.1% AEP events and also being at risk if the Thames were to breach its bank and defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- 'Highly Vulnerable' and further 'Essential Infrastructure' development is not permitted in Flood Zone 3. Any development in this category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.1% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change fluvial and surface water events, as well as the 0.1% AEP tidal event plus an allowance for climate change. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.

	• If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
Mapping Information	
The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Little Ilford ICM surface water model (2015) and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.	
Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model. The latest climate change allowances (updated May 2022) have been applied to the Little Ilford ICM surface water model.
Fluvial and tidal extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/Mott MacDonald's Shonks Mill Lower Roding 2018 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the 2115 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Little Ilford ICM surface water model has been used to define areas at risk from surface water flooding. This model was re-run by JBA Consulting in 2023.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from the Little Ilford ICM model, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables

Site details

Site Code	**Greater Carpenter's District, N8.SA3**
Address	Land south of Stratford Station and north of Warton Road and Stratford High Street, E15 1 to E15 2.
Area	10.83ha
Current land use	Residential, industrial and employment, community facilities, education, retail and open space.
Proposed land use	Residential, employment, community facilities, education, open space and main town centre uses.
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable and Water Compatible

Sources of flood risk

Location of the site within the catchment	The site is located south of Stratford Station and north of Warton Road and Stratford High Street, the latter of which is also adjacent to the east of the site. Several railway lines, including the DLR and the Elizabeth Line, run along the site's western boundary. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is situated within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography remains at similar levels throughout the site. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found within the northern half of the site along roads including Rosher Close, Kennard Road Gibbins Road. There is also lower lying land towards the western corner of the site on land between Rowse Close and Carpenters Road. Elevations range between 2.9 to 3.5m AOD. The highest elevations (up to 8.0m AOD) are situated along the site's western boundary. This may correspond to the raised railway line which runs parallel to the site or a section of vegetation which may slope up towards the railway bridge.
Existing drainage features	The site lies approximately 55m north-east of the Waterworks River. This river stems from the River Lee 760m north-west of the site and then converges with the Three Mills Wall River approximately 315m south of the site. The site is also approximately 3.6km north of the River Thames. The area surrounding these watercourses is urbanised and therefore highly constrained with development built up to the river edges. Outside the site, there is an area of low lying vegetation adjacent to the northern tip which corresponds to the Channelsea River and could be used as a drainage ditch for some of the site. This is then culverted between Stratford High Street and Lett Road 40m east of the site. There is also the Tommy Lee Sewer East Culvert which runs parallel to the railway line along the site's western boundary.
Critical Drainage Area	The Critical Drainage Area 'Group4_050' encroaches a small part of the north-east of the site.

Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 98%** **FZ2 – 98%** **FZ1 – 2%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. The Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee has been used within this assessment of fluvial flooding. **Flood characteristics:** The majority of the site's western boundary as well as some of the north tip and south are located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The extent within the south encroaches furthest into the site, extending across most of Wilmer Lea Close. These are the only areas within the site that are shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, the site is unaffected by fluvial flooding during defended the 3.3%, 1%, 0.5% and 0.1% AEP modelled events. The nearest modelled fluvial flood extent is located along the railway line approximately 20m east of the site during the 0.1% AEP modelled fluvial event. Flood depths here reach around 0.8m with maximum velocities of 0.9m/s. The resulting hazard is 'Very Low' to 'Danger for Most'.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.3% Max depth – 0.3 – 0.6m

	Max velocity – 0.25 – 0.5m/s **1% AEP** – 4.8% Max depth – 0.3 – 0.6m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 38.0% Max depth – 0.6 – 0.9m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all modelled AEP events. In the 3.3% AEP event, surface water flooding only covers 1.3% of the site. Flooding occurs where it ponds in some roads across the site, such as along Gibbins Road, Jupp Road West and Wilmer Lea Close. The entire length of an offshoot of the cul-de-sac Rosher Close is encroached during this event whilst a section of car parking bays along Biggerstaff Road is also encroached. Maximum flood depths are 0.3-0.6m. The majority of flood water velocities within the site are < 0.25m/s with small areas that reach a maximum of 0.25-0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' in areas where ponding is deepest. The 1% AEP event surface water flood extent covers 4.8% of the site. The flooding extends slightly further than in the 3.3% AEP event along the roads, such as Rosher Close, Jupp Road West and Biggerstaff Road. There are also more areas of ponding within the site including along Hutchins Close and Kennard Road. The majority of flooded areas have depths of between 0.15 - 0.3m. The majority of flood water velocities within the site are < 0.25m/s with small areas that reach a maximum of 0.5-1.0m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some'. There are small areas along Rosher Close and Gibbins Road that are 'Danger for Most'. The 0.1% AEP event surface water covers 38% of the site. In this event the aforementioned areas of ponding in the northern half of the site significantly increase, connecting to each other to form an extensive area of ponding along all roads north of Carpenters Road. A flow path feeding into this ponding also flows along Carpenters Road and south along the Friendship Way footpath along the site's southern boundary. There is also a large area of ponding within the south-west of the site, bordered by Carpenters Road, Biggerstaff Road and the railway line. Flood depths vary from <0.15 -0.9m. Most of the flood depths are 0.15 to 0.6m with small areas of 0.6 to 0.9m located within the previously mentioned extensive areas of ponding. Flood water velocities are <0.25m/s across most of the site, with smaller areas where velocities are up to up to 0.5 – 2.0m/s. The resulting flood hazard across the site is 'Very Low' to 'Danger for Most'.
Reservoir	The Dry Day reservoir flood events for the William Girling and King George V reservoirs encroach the entirety of the site. The Lockwood, High Maynard and Banbury reservoirs encroach most of the site, excluding small areas along Jupp Road West and land east of Jupp Road. These reservoirs are all managed by Thames Water Limited and are deemed high-risk. The entirety of the site is within the Wet Day reservoir flood events. This risk is posed by several reservoirs including Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Stoke Newington (East), Stoke Newington (West), Walthamstow No.4, Walthamstow No.5, Warwick East Reservoir, West Warwick, William Girling and Wraysbury. These reservoirs are all managed by

	Thames Water Limited, except Stoke Newington (West) which is managed by Hackney Council. These reservoirs are all deemed as high-risk. In the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within postcode areas with 370 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded flood outlines datasets has no records of flooding within the site. The nearest outline is situated approximately 10m from the section of the southern boundary along Warton Road. This occurred in January 2021 and the cause was unknown. It is also unknown how many properties were affected by this flooding. Newham Borough Council's flood records show one record of flooding within the south of the site along Biggerstaff Road in September 2021.
Flood risk management infrastructure	
Defences	The Environment Agency's AIMS dataset shows there are no formal flood defences within the vicinity of the site. Natural High Ground runs parallel to the railway line from the western tip of the site to the Building Crafts College along Gibbins Road. The standard of protection provided is 5 years. The Environment Agency AIMS dataset also shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding and is described below. **0.5% AEP tidal present day epoch event proportion of site at risk – 0%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 93.48%** The site is unaffected by flooding during the Present Day 0.5% AEP Thames Tidal Upriver Breach event. This breach assessment model considers the impact of a breach occurring during a tidal event, between the Thames Barrier (along the southern boundary of Newham) and the upriver tidal limit at Teddington Weir (located approximately 24.8km upriver of Newham). The majority of the site is affected by flooding during the 2100 epoch 0.5% AEP event Thames tidal upriver breach extent. This excludes small sections of Jupp Road West and land east of Jupp Road as well as some of the northern tip of the site. Flood depths across the site are <1.5m. Water flows at a maximum velocity of 1.3m/s with a resulting hazard between 'Very Low' to 'Danger for Most'.

	Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is believed to be very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located in Environment Agency Flood Warning and Flood Alert Areas. It is located within the 063WAT233N Tidal Thames in the London Boroughs of Havering, Barking and Dagenham, and Newham Flood Alert Area. It is also located in the 062WAF53 Lower Lee in the London Boroughs of Enfield, Hackney, Haringey, Newham, Tower Hamlets and Waltham Forest as well as the counties of Hertfordshire and Essex Flood Alert Area. The site is also located within the 062FWF53Stratfd Lower River Lee at Stratford Flood Warning Area. This Flood Warning Area is situated in the London Boroughs of Hackney, Newham, Tower Hamlets and Waltham Forest. The site is also located within the 063FWT23RDockC Flood Warning Area. This is situated within Mill Meads and East Plaistow.
Access and egress	Access and egress to the site is currently via a number of routes. There are several vehicular access routes along the eastern boundary connecting to Stratford High Street including Lett Road, Ward Road, Park Lane and Carpenters Road. To the south, vehicular access is gained via Biggerstaff Road and the pedestrian footpath Friendship Way. To the west, vehicular access is possible via Carpenters Road under the railway bridge. According to the Newham Draft Local Plan (2022), there is a proposed pedestrian access route from Gibbins Road across the northern tip of the site towards Stratford station. Safe access and egress is only possible via Lett Road in the east of the site during the 2100 epoch 0.5% AEP upriver breach scenario. Although flooding does not occur on this road, flooding is encroached on the connecting Jupp Road West 50m from Lett Road. All other access routes during this event are affected by flooding. During the 2100 epoch 0.5% AEP event, flood depths are up to 1.50m on land off Carpenters Road. The resulting flood hazard varies from 'Very Low' to 'Danger for Most', the latter being situated predominantly in the western corner and northern half of the site where flood depths are deepest. This means that in the extreme 2100 epoch breach event, vehicular access and egress may not be possible to the site. Safe access and egress is possible via all routes during all present day modelled AEP fluvial flood events. This is also the case during the 1% AEP +17% CC fluvial event. In the 3.3% and 1% AEP surface water events, access and egress is unlikely to be affected. During the 0.1% AEP and 1% AEP +40% surface water event, all pedestrian and vehicular access routes are affected by flooding. The exception to this is Lett Road and Carpenters Road in the east of the site, although the latter is affected by some flooding further into the site. The depth of flooding along the affected routes varies from <0.15 to 0.6m. Flood water is fastest along Ward Road on to Stratford High Street at 1.0 to 2.0m/s. The resulting flood hazard is 'Very Low' to 'Danger for Most'. Vehicular access is likely to be significantly impacted during these events. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP plus an allowance for climate change rainfall and fluvial events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the breach and surface water scenarios, consultation with

	RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located within a dry island. However, there is small, isolated area within the south of the site where there is a dry island in Flood Zones 2 and 3. This is situated at James Riley Point on the corner of Carpenters Road and Jupp Road West.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** According to the River Lee hydraulic modelling, the site is not at an increased risk of fluvial flooding due to the impact of climate change. This is because the site is unaffected during the 3.3%, 1% and 0.5% AEP modelled fluvial flood events plus the Central allowance for climate change (17%). **Tidal Breaches:** As the Thames Upriver Present Day epoch 0.5% AEP event does not impact the site, it is significantly more at risk of flooding during the Thames Upriver 2100 epoch 0.5% AEP event which affects the majority of the site. This excludes a section of Jupp Road West and land east of Jupp Road as well as some of the northern tip of the site. It is noted that LiDAR for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since a large percentage of the site is at risk during this breach event, the site is considered to be at high risk in the aforementioned breach scenario. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. In this event the areas of ponding in the 1% AEP event in the northern half of the site significantly increase, connecting to each other to form an extensive area of ponding along all roads north of Carpenters Road. A flow path feeding into this ponding also flows along Carpenters Road and south along the Friendship Way footpath along the site's southern boundary. There is also a large area of ponding within the south-west of the site, bordered by Carpenters Road, Biggerstaff Road and the railway line. Flood depths vary from approximately 0.45 to 0.73m which is an increase from the majority of flood depths being 0.15 to 0.30m in the 1% AEP event. Flood water flows at between approximately 0.04 to 0.51m/s. The resulting flood hazard across the site is 'Very Low' to 'Danger for Most'. This shows that the site is sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology within the site is the Lambeth Group (clay, silt and sand). This is sedimentary bedrock.
	  ○ Superficial - The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is located within Groundwater Source Protection Zone 3. Infiltration techniques may not be suitable and should only be used following the granting of any required environmental permits from the Environment Agency for Zones 2, 3 and 4 although it is possible that infiltration may not be permitted. Proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible opportunities and constraints.
	• The site is also located within a Nitrate Vulnerable Zone.
	• The entirety of the site is located within Secondary A bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones.
	• The site is not located within an historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths within and surrounding the site during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be

	funded and should be supported by an appropriately detailed maintenance and operation manual. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and non-residential institutions including educational establishment as 'More Vulnerable' development. Employment and non-residential institutions (excluding health centres, education and nursery establishments) are classed as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are multiple different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2 and classified as 'More Vulnerable', the Exception Test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on the requirements and guidance for FRAs and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is within Flood Zone 3 and is shown to be at surface water flood risk in the 1% AEP plus 40% CC and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDS guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the risk to the site posed by the River Thames (Tidal, Fluvial and Breach scenarios) using the latest available modelling will be required to

determine the risk to the site. Careful consideration will also need to be given to the surface water flood risk on site.
- Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan.
- Development within 20m of a main river or flood defence will require specific planning permissions.
- The Canal and River Trust should be consulted as part of this development as this site is within 150m of the Waterworks River.
- All major development and any new development falling within a Critical Drainage Area must reduce surface water run-off to greenfield run-off rates through the application of Sustainable Urban Drainage Systems and other design considerations.
- Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers.
- Development plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river.

Guidance for site design and making development safe:

- The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).
- Should built development be proposed within the 0.5% AEP tidal breach extent or 1% AEP surface water flood extent, careful consideration will need to be given to flood resistance and resilience measures.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
- Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and surface water events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs.
- Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
- Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements (whichever is higher of 300mm above the average ground level of the site, adjacent road level to the building or estimated river or sea design flood level), developers will need to:
    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.
- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level

	- making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. - The scale of development is likely to require upgrades to the wastewater network. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing and infrastructure phasing plan. - The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. - London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be almost entirely within Flood Zone 3 as well as being at pluvial flood risk in the 0.1% AEP event and also being at risk if the Thames defences were to fail. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. 'More Vulnerable' development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal event, as well as the 1% AEP fluvial and surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDS maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Central climate change surface water and fluvial events, as well as the 0.5% AEP tidal plus an allowance for climate change event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee to indicate the impact on flood risk.

Fluvial & Tidal Breach extents, depth, velocity and hazard mapping	Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023. Tidal - This has been assessed using the present day and 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N11.SA3**
Address	Land at Royal Road, E16 3
Area	1.62 ha
Current land use	Greenfield – Fenced greenspace
Proposed land use	Education (Special Educational Needs), residential and open space
Flood Risk Vulnerability	Mixed - More vulnerable, Less Vulnerable and Water Compatible development.
Sources of flood risk	
Location of the site within the catchment	The site is located within the Beckton neighbourhood approximately 300m north of the Royal Docks (Royal Victoria and Royal Albert Docks), and 1.1km north of the River Thames. The site is bounded by Royal Road to the north, Leyes Road to the east and the Leyes Road Allotment Site to the south. A pedestrian footpath, which extends between Royal Road and the Jake Russell Walk footpath, is adjacent to the western site boundary. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. Site elevations vary between 0.89 and 4.11mAOD, with site topography gently sloping downwards to the west with a gradient of under 0.5%. There are three areas of rounded raised ground within the site – each located to the north-west, south-west and south of the site – where the maximum site elevation (4.11mAOD) is located.
Existing drainage features	There are no main rivers or mapped ordinary watercourses within, or in the vicinity of, the site. There are also no major topographic depressions within the site that could act as drainage ditches.
Critical Drainage Area	The site is not located within a critical drainage area (CDA).
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 7%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).*

	Available data: Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The entire site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This indicates that the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.0% **1% AEP** – 0.0% **0.1% AEP** – 2.3% Max depth – 0.15-0.30m Max velocity – 0.25-0.50m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment.* **Description of surface water flow paths:** The site is not affected by surface water flooding during the 3.3% AEP and 1.0% AEP events. In the 0.1% AEP event, surface water flooding covers 2.3% of the site. This flooding is concentrated at the western and north-western fringes of the site – where the lowest site elevations are found – as an overspill of floodwater pooling on Royal Road and Baxter Road. Maximum flood depths within the site during this event are between 0.15 to 0.30m, and maximum velocity extends to between 0.25 to 0.50m/s. The resulting flood hazard is rated as 'Very Low.'
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, entire site is inundated by the William Girling Reservoir during the 'dry day' flood. The majority of the site, except some isolated patches to the north-east of the site, is also flooded by the King George V reservoir. Both of these reservoirs are managed by Thames Water. During the 'wet day' scenario, the entire site is at risk from the following reservoirs: Banbury, High Maynard, King George V, Lockwood, Queen Elizabeth II, Walthamstow No.4, Walthamstow No.5,

	Warwick East, William Girling and Wraysbury. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5) is provided as 5m resolution grid squares. The entire site is classed as having a negligible risk of groundwater flooding, which indicates that there is a less than 1% annual probability of occurrence of groundwater flooding. There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.
Sewers	The site is located within a postcode area with 206 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Flood Incident Database and the London Borough of Newham Council's Flood Incident database, there have been no recorded incidents of flooding within the site.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lea. These include tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 98.8%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 100%** During the 0.5% AEP tidal present day breach, almost the entire site is inundated, with the exception of a small area of raised ground to the north-east of the site. Flood depths and velocities are greatest to the west of the site, reaching a maximum of 0.64m and 1.17m/s. Associated flood hazard is classed as either 'danger for most' or 'danger for some' to the west of the site, although the east of the site is classed as 'very low' hazard. Additionally, during the 0.5% AEP tidal 2100 epoch breach event, the entire site is inundated by floodwater, as described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely.

	The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	
Flood warning	The site is located within Environment Agency flood warning area (063FWT23RDockA) – extends around River Thames from the Beckton Sewage works to the River Lea. Additionally the Environment Agency flood alert area (063WAT233N) extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham.
Access and egress	Access and egress to the site is currently possible via a number of routes. Leyes Road/ Royal Road is adjacent to the northern/ north-eastern boundary of the site, so the site can be exited using vehicles to the north by travelling north onto Baxter Road. There are no other vehicular access and egress routes from the site. However, the site can be exited as a pedestrian using a footpath adjacent to the western site boundary, which extends between Royal Road and the Jake Russel Walk footpath. There is also a footpath located to the south-east of the site, stretching between Leyes Road and Jake Russel Walk footpath. Careful consideration of safe access and egress for the site will be needed, especially considering the proposed usage (Special Educational Needs school) of the site. Safe access and egress is shown to be affected during all modelled tidal breach events in the present day epoch and the 2100 epoch. The flood extent is vast, with significant depths and velocities that will significantly impact access and egress to and from the site. During the 2100 epoch 0.5% AEP Thames tidal upriver breach, flood hazard along Royal Road, Leyes Road, the Baxter Road footpath and Leyes Road footpath are each classed as 'danger for most.' Flood depths during this event extend up to 0.9m, and velocities up to 0.7m/s. Therefore, during this extreme breach event, vehicular access and egress is not possible to the site. During the surface water 1% AEP plus 40% allowance for climate change event, safe access and egress from the site would also be challenging. Flood hazard along Royal Road/ Leyes Road is generally classed as 'danger for some,' although some areas – notably the corner of the road stretching between Royal Road and Leyes Road – are classed as 'danger for most.' Flood depths in this corner generally extend to a maximum of 0.5m, with associated velocities up to 0.6m/s. During this event, there is flooding along the Baxter Road and Leyes Road footpaths, although flood hazard along these footpaths is classed as 'very low,' so the site can probably be exited via these routes. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	The site is not located on a dry island.

Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding **Tidal Breaches:** During the 2100 epoch 0.5% AEP event, flooding now extends across the entire site relative to the 2005 0.5% AEP event (100% versus 99.8%). Flood depth and velocities increase from a maximum of 0.64m and 1.17m/s during the 2005 epoch event to 0.98m and 1.13m/s during the 2100 epoch event. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk. Since nearly the whole site is at risk during both breach extents, the site is considered to be at high risk in both breach scenarios. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. The site does not flood during the 1% AEP surface water event. However, during the 1% AEP plus 40% climate change event, flooding now starts to encroach into a very small portion of the north-western and western of the site. However, the depths (0.19m maximum) and velocities (0.45m/s maximum) of this floodwater is still reasonably low, with associated flood hazard classed as 'very low.' This suggests that the site itself is not particularly sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	    ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock.
	    ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	    ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.

	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site. • The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • The entirety of the site is located within a Nitrate Vulnerable Zone. • The majority of the site is designated as an 'unproductive' aquifer, although south-east of site is classified as an unproductive bedrock. The entire site is classed as a secondary (undifferentiated) superficial deposits aquifer designation zones. • The site is not located within a historic landfill site. • Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as attenuation basins, green roofs, permeable surfaces and rain gardens must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development and 'non-residential uses for educational establishments' as 'More Vulnerable' and open space as 'water compatible development'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2 and the proposed development is 'More Vulnerable', the Exception test is required for this site.

Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • Consultation with the London Borough of Newham, Thames Water, London City Airport and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha and is at tidal flood risk from the 0.5% AEP breach event of the River Thames. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • The site should be designed using a sequential approach, locating the 'more vulnerable' development outside of the areas of the site within Flood Zone 3.

	• Should built development be proposed within the 2115 0.5% AEP Thames tidal downriver flood extents, careful consideration will need to be given to flood resistance and resilience measures.
	• The risk from surface water flooding should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates.
	• Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water.
	• Careful consideration of safe access and egress is needed for this site. Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. A
	• Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. Given the proposed usage of part of the site (special educational needs educational facility) it is recommended that a flood warning and evacuation plan should be prepared for this site.
	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    ◦ raise them as much as possible
	    ◦ consider moving vulnerable uses to upper floors
	    ◦ include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    ◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
	    ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
	    ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan

	Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity. • On the information available to date Thames Water do not envisage infrastructure concerns regarding water supply network infrastructure in relation to this development/s. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to advise of the developments phasing. Please contact Thames Water Development Planning for further details.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zones 2 and 3, as well as at high risk if the Thames were to breach its bank and defences were to fail during the 0.5% AEP 2115 epoch event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and open space as 'water compatible development'. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water event, including an allowance for climate change, is needed. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- The site should be designed using a sequential approach, locating the 'more vulnerable' development outside of the areas of the site within Flood Zone 3.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 0.5% AEP tidal plus an allowance for climate change events. Given the proposed usage of part of the site (special educational needs educational facility) it is recommended that a flood warning and evacuation plan should be prepared for this site.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model.

	The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal extents depth, velocity and hazard mapping	This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**N5.SA4**
Address	Limmo Site, Lower Lee Crossing, Canning Town, E16 1
Area	6.36ha
Current land use	Mixed Use
Proposed land use	Local Mixed Use – Residential, re-configuration of existing transport infrastructure and open space.
Flood Risk Vulnerability	Mixed – Essential Infrastructure, More Vulnerable and Water Compatible.
Sources of flood risk	
Location of the site within the catchment	Located within the Canning Town neighbourhood, the site boundary includes the Limmo Peninsula and Canning Town underground station (serving the Docklands Light Railway (DLR) and Jubilee Line). The western site boundary is adjacent to the River Lee (Bow Creek), which reaches it confluence with the River Thames approximately 300m south of the site. The site is bounded by the A13 Newham Way to the north and A1020 Lower Lee Crossing to the south. The eastern site boundary borders the A1101 Silvertown Way and DLR/ Elizabeth Line railway. The site is located in the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site lies near the River Lee and is close to the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The elevation of the site varies between -5.32 and 15.16mAOD. Site elevations are lowest to the north of the site within the Canning Town Train Station, where the minimum site elevations (-5.32mAOD) are located. Site elevations are generally higher (>5.2mAOD) in the southern half of the site. The maximum site elevations (15.16mAOD) are located in the south-western corner of the site, corresponding with the Limmo Penninsula Ventilation Shaft for the Elizabeth Line.
Existing drainage features	The western boundary of the site is adjacent to the Bow Creek (as part of the River Lee). There are no drainage ditches within, or adjacent to, the vicinity of the site.
Critical Drainage Area	The site is not located within a Critical Drainage Area (CDA).
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 41%** **FZ2 – 55%** **FZ1 – 45%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values*

	quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Defended outputs:** **3.3% AEP fluvial event – 0%** **1% AEP fluvial event – 0%** **0.5% AEP fluvial event – 0%** **0.1% AEP fluvial event – 0%** *Modelled results show the percentage of site at risk from a given AEP flood event.* **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. This site is parallel to the River Lee. However, the River Lee remains in bank adjacent to the site for all modelled flood events (up to the 0.1% AEP event) when using the Environment Agency's 1D-2D ISIS-TUFLOW detailed hydraulic model for the River Lee/Shonks Mill Lower Roding. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. The part of the site not within this extent is a portion of raised ground located to the south of the site. This indicates that the site is shown to benefit from defences (although may still be at some risk). According to the River Lee (2014) hydraulic model, despite being in close proximity to fluvial flood events, the site is unaffected by fluvial flooding during the defended 3.3%, 1%, 0.5% and 0.1% AEP modelled events.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 0.5% Max depth – >1.20m Max velocity – >2.0m/s **1% AEP** – 1.9% Max depth – >1.20m Max velocity – >2.0m/s **0.1% AEP** – 12.1% Max depth – >1.20m Max velocity - >2.0m/s

	The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %). The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. During the 3.3% AEP event, surface water flooding only covers 0.5% of the site. Flooding occurs within the site as two isolated surface water pools, located within the Canning Town underground station and adjacent to the Canning Town Bus Station. At the surface water pool to the west of the site within the Canning Town underground station, where the lowest site elevations are located, flood depths are greater than 1.2m, velocities above 2.0m/s. Hazard for this pooling location is rated as either 'danger for all' or 'danger for some.' During the 1% AEP event, surface water flooding within the site slightly expands to 1.9% of the total site area. Flooding now covers the DLR line to the north of the site, and occurs as an isolated surface water pond to the south-west of the site. Maximum flood depths of >1.2m, velocities of >2.0m/s and a hazard of 'danger for all' is located to the north-west of the site within the Canning Town trains station. Flooding across the rest of the site is shallower with depths of 0.3-0.6m maximum, with a slower velocity of 0.25-0.50m/s maximum. Associated flood hazard is rated as either 'very low' or 'danger for some.' During the 0.1% AEP event, surface water flooding now covers 12.1% of the site. There is now extensive flooding to the north of the site within, and surrounding, the Canning Town underground station and bus station. Maximum flood depths in this part of the site extend above 1.2m, with velocities greater than 2.0m/s and hazard rated as 'danger for most' or 'danger for all.' In the southern half of the site, there are some isolated patches of surface water ponding, with flood depths between 0.0-0.6m and velocities between 0.0-1.0m/s. The hazard rating for these surface water pools are rated as either 'very low' or 'danger for some.'
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, the north-west of the site, notably surrounding the Canning Town station, are at risk of flooding during the 'dry day' flood. This risk is posed by the Banbury, High Maynard, King George V, Lockwood and William Girling Reservoirs, which are all managed by Thames Water. During the 'wet day' scenario, the site is at risk from 10 reservoirs. The northern half, alongside the western and eastern fringes of the site, are at risk from the following reservoirs: Banbury, King George V, Lockwood, Queen Elizabeth II, Walthamstow No4., Walthamstow No5., William Girling and Wraysbury. Additionally, the northern half of the site is at risk from the High Maynard and Warwick East reservoirs. All of these reservoirs are owned by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located across the E16 1 postcode area. According to the Thames Water Hydraulic Sewer Flood Risk Register, there are 32 incidents of flooding in the E16 1 postcode.

	The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's recorded flood outlines database, there are two records of flooding at the site, occurring in March 1947 and 1953. The north and south-western corner of the site flooded during the March 1947 flood event, where the channel capacity of the River Lee exceeded (prior to raised defences being installed). Additionally, the north and south-eastern corner of the site flooded during the January 1953 floods. This was also caused by the River Lee and Thames Tidal flooded exceeding their channel capacity, also prior to raised defences being installed. Additionally, there is one recorded incident of flooding within the site as per the London Borough of Newham's flood incident database. This occurred on the 25th July 2021 within the Canning Town Station, with the recorded cause being heavy rainfall which could not drain into the sewer system effectively.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage and River Lee. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Lee and River Thames. The Environment Agency's Thames Estuary Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 28.9%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 37.5%** During the 0.5% AEP tidal present day flood event, approximately 28.9% of the site is inundated. This flooding is concentrated to the north of the site, surrounding the Canning Town station and bus station. This flood event is associated with extreme flood depths and velocities. Flood depths extend to a maximum of 3.14m surrounding the Canning Town station, with velocities up to 4.76m/s. Associated flood hazard is classed as 'danger for all.' The site also floods during the 0.5% AEP tidal 2100 epoch, as described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.

Emergency planning	
Flood warning	The site within Environment Agency Flood Warning and Flood Alert Areas. The site is located across three Environment Agency Flood Alert Area. The south-west of the site is located in Flood Alert Area 063WAT23Central for River Thames riverside from the Thames Barrier to Putney Bridge. The north and west of the site is located in Flood Alert Area 063WAT233N for flooding from the Tidal Thames in the boroughs of Havering, Barking and Dagenham, and Newham. Finally, the north and western border of the site is located within Flood Alert Area 062WAF53LowerLee covering the Lower River Lee from Hoddesdon to Canning Town. The site is located across two different Environment Agency Flood Warning Areas. The north and western border of the site is located in Flood Alert Area 063FWT23RDockA for the Tidal Thames between Beckton Sewage Works to the River Lee. Additionally, the west of the site is located within Flood Alert Area 062FWB53TidalLee covering the lower River Lee from West Ham to Canning Town.
Access and egress	There are currently no access and egress routes into the site. However, it is assumed that planned site access will be via the A1020 Lower Lee Crossing (travelling west or east), Heartwell Avenue/ onto Peto Street North/ onto Victoria Dock Road or the A1101 Silvertown Way (travelling north of south). Safe access and egress is shown to be affected during all modelled Thames tidal breach events in the present day and 2100 epoch. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may actually be at risk, impacting safe access and egress routes into and from the site. During the 0.5% AEP 2100 Thames tidal breach, flood depths on Heartwell Avenue and the A1101 Silvertown Way extend to 1.1m, with associated flood hazard rated as 'danger for all.' Alternatively, flood depths on the A1020 Lower Lee extend to 2.95m when travelling west (with hazard rated as 'danger for all'), and up to 1.62m when travelling east (with hazard rated as 'danger for all'). Therefore, vehicular access and egress to and from the site using these roads would be extremely challenging. Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site is unaffected by flooding in this event, therefore safe access and egress is possible in this event. During the 1% AEP plus 40% allowance for climate change surface water flood event, there is flooding on all access and egress routes to from the site. Flooding is most extensive on the A1020 Lower Lee, with flood depths extending to 0.51m when travelling west (rated as 'danger for most'), and depths extending to 0.89m when travelling east (rated as 'danger for most'). Additionally, access/ egress when travelling south on the A1011 Silvertown Way is unlikely to be possible as flood hazard is rated as 'danger for most,' with depths up to 0.52m. However, access via Heartwell Avenue or travelling north on the A1011 Silvertown Way may be possible. Flood depths on Heartwell Avenue extend to a maximum of 0.35m, with associated flood hazard rated as 'danger for some.' Additionally, flood depths when travelling north on the A1011 Silvertown Way/ A124 Barking Road are below 0.31m, with associated hazard also rated as 'danger for some.' Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal breach event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard

	outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site.
Dry Islands	During the 0.5% present day tidal Thames breach, there is no predicted flooding in the southern half of the site. This part of the site is a 'dry island' as flood depths on the surrounding A1020 Lower Lee Crossing, Heartwell Avenue and A1011 Silvertown Way extend up to 2.95m, with associated flood hazard rated up to 'danger for all.'
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Fluvial Flooding (River Lee):** Since the site has 'Essential Infrastructure' the higher central allowance is the design event for this site. The 0.5% AEP event plus 17% climate change allowance is used as a more conservative proxy for the site. The site is unaffected by flooding in this event. **Tidal Breach:** A greater portion of the site (37.5%) of the site is flooded during the 0.5% AEP 2100 epoch Thames tidal breach compared to the 0.5% AEP present day tidal breach (28.9%). Floodwater now encroaches southwards into the centre of the site during this event. Maximum flood depths and velocities during this event now extend to 3.32m and 5.83m/s. Flood hazard is mainly classed as 'danger for all,' with flooding at the centre of the site classed as 'danger for most.' The site is therefore very sensitive to increases in flooding caused by tidal breaches due to climate change. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends further into the low-lying areas to the north of the site surrounding the Canning Town station and bus station. Flood depths also increase to 6.91m in the north-west of Canning Town station, where the lowest site elevations are located. This shows that the site is very sensitive to increases in pluvial flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology across the site is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	SuDS
	• The site is considered to have a negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a Nitrate Vulnerable Zone (NVZ). However, the north-west of the site is adjacent to the Lee NVZ.
	• The entire site is located within unproductive bedrock, and Secondary (undifferentiated) superficial, aquifer designation zones.
	• The site is not located within a historic landfill site.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
	• The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space.
	• If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.

Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will cLeen improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies.

	• Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies 'essential transport infrastructure' as essential infrastructure. Additionally, residential development is classed as 'More Vulnerable' development. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, London City Airport, Thames Water, and the Environment Agency should be undertaken at an early stage. • The Canal and River Trust should be consulted as part of this development as this site is within 150m of the River Lee. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 0.1% AEP event. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site.

	• Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas impacted by the 2115 epoch 0.5% AEP Thames tidal breach extents. **Guidance for site design and making development safe :** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The development should be designed using a sequential approach. The most vulnerable development should be steered away from areas of surface water flood risk and affected by the tidal Thames breach within the site. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. A flood warning and evacuation plan will likely be needed for this site. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

	• Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
	• Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g., raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:
	    • raise them as much as possible
	    • consider moving vulnerable uses to upper floors
	    • include extra flood resistance and resilience measures.
	• Other examples of flood resistance and resilience measures include:
	    • using flood resistant materials that have low permeability to at Leest 600mm above the estimated flood level
	    • making sure any doors, windows or other openings are flood resistant to at Leest 600mm above the estimated flood level
	    • by raising all sensitive electrical equipment, wiring and sockets to at Leest 600mm above the estimated flood level.
	• The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.
	• The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, pLeese refer to Section 8 of the Level 1 SFRA report.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP surface water events, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and the 1% AEP surface water plus an allowance for climate change rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during breach scenarios, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map and River Lee model to indicate the impact on flood risk.
Fluvial and tidal breach extents, depth, velocity and hazard mapping	This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model. Fluvial – This has been assessed using the EA/CH2M Hill's River Lee 2014 hydraulic model which was re-run by JBA Consulting in 2023.
Surface Water	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Lyle Park West, N3.SA2**
Address	Lyle Park West, land at Knights Road and Bradfield Road, E16 2
Area	7.80ha
Current land use	Local Mixed Use - Residential, industrial and employment uses.
Proposed land use	Residential, employment, community facilities (if needed) and open space.
Flood Risk Vulnerability	Mixed - More Vulnerable, Less Vulnerable and water compatible development.
Sources of flood risk	
Location of the site within the catchment	The site is located at West Silvertown, at the south of the A1020 and north of the River Thames. The north-west corner of the site is bordered by West Silvertown rail station and North Woolwich Road. The east side of the site runs alongside Knights Road. Bradfield Road runs from north-east to the south-west through the site. Lyle Park is located in the north-west of the site. The site is located within the London Management Catchment. The catchment is 1487km^2 and is very densely populated. The site is close to the River Thames and is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies slightly. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The topography of the site varies between 1.50 to 3mAOD, with a number of localised areas within the east side of the site where the topography varies between 5 to 9mAOD. This might be a result of the ongoing site works and the satellite picked up the aggregate piles heights.
Existing drainage features	The northern bank of the River Thames runs parallel to the southern site boundary. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 100%** **FZ2 – 100%** **FZ1 – 0%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%).* **Available data:**

	The proportion of the site at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, therefore there is no functional floodplain/Flood Zone 3b for the tidal Thames. Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The majority of the site is located within a Reduction in Risk of Flooding from Rivers and Sea due to Defences area. This means that the majority of the site is shown to benefit from defences (although may still be at some risk).
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 1.1% Max depth – 0.15-0.30m Max velocity – 0.00-0.25m/s **1% AEP** – 5.2% Max depth – 0.30-0.60m Max velocity – 0.25-0.50m/s **0.1% AEP** – 25.7% Max depth – 0.60-0.90m Max velocity – 0.50-1.00m/s **Proportion of site at risk (ICM model):** **3.3% AEP** – 5.9% Max depth – 0.50-1.00m Max velocity – 0.50-1.00m/s **1% AEP** – 13.7% Max depth – 0.50-1.00m Max velocity – 1.00-2.00m/s **0.1% AEP** – 40.8% Max depth – 1.00-1.50m Max velocity – 1.00-2.00m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* *The Silvertown ICM surface water model was used in the assessment of surface water flooding.* *Where ICM modelling is available, this modelling is more detailed assessment of surface water flood risk and should take precedence over the RoFfSW dataset.* **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events.

	In the 3.3% AEP surface water flooding only covers 5.9% of the site. Flooding mainly occurs on Bradfield Road within the site and at the south area of the site where probably the ground is excavated. Maximum flood depths are 0.50 to 1.00m. Flood water velocity within the site varies from 0.50 to 1.00m/s. The resulting flood hazard is 'Very Low' within the site during the 3.3% AEP. In the 1% AEP the surface water covers 13.9% of the site. The flooding extends further around the 3.3% AEP along Bradfield Road and extends down between the buildings in the centre of the site. Flood water also occurs on Knights Road and off west of Knights Road at the north-west area of the site. Furthermore, surface water flood extends at the southern area of the site. The depths if the surface water varies between 0.50 to 1.00m. The velocity of flood water varies between 1.00 to 2.00m/s. the resulting flood hazard varies from 'Very Low' to 'Danger for Some'. In the 0.1% AEP the surface water covers 40.8% of the site. The surface water flood extends from Bradfield Road to cover most of the northern areas of the site around the buildings and on Knights Road. There are some areas on the southern part of the site where the flood water appears during the 0.1% AEP epoch. The depths of flood water varies between 1.00 -1.50m throughout the site. The velocity of surface water varies between 1.00-2.00m/s. The flood hazard is from 'Very Low' to 'Danger for Most'.
Reservoir	According to the Environment Agency's 'Risk of Flooding from Reservoirs' mapping, 59.6% of the site is at risk of flooding during the 'dry day' reservoir flood. This risk is posed by the William Girling Reservoir, which is managed by Thames Water. During the 'wet day' scenario 89.5% of the site is at risk of flooding from the following reservoirs: Banbury, Lockwood, King George V., Walthamstow No.4, Walthamstow No.5, Warwick East and William Girling Reservoirs. On the southern part, along the River Thames a very minor area is further affected by Queen Elizabeth II. and Wraysbury Reservoirs. These reservoirs are managed by Thames Water. These reservoirs are deemed as high-risk, and in the very unlikely event that the reservoirs fail, it is predicted that there is a risk to life.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have negligible risk of groundwater flooding in this area, and any groundwater flooding incidence has a chance of less than 1% annual probability of occurrence.
Sewers	The site is located within a postcode area with 94 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of [Thames Water's Drainage and Wastewater Management Plan]. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	According to the Environment Agency's Recorded Flood Outlines dataset, there has been one recorded incident of flooding within the site. This occurred in March 1947, and occurred due to the overtopping of the River Thames defences which were in place at the time. This flooding was concentrated to the north of the site surrounding the A1020, Knights Road and Bradfield Road northern areas of the site. It is unknown how many properties were affected by this flooding. Please note that since this flood

	event occurred, there have been several changes to site topography and upgrades to flood defences surrounding the River Thames. According to the London Borough of Newham's historic flood incident database, there have been two flood incidents recorded within the E16 2 area but have been no recorded flooding incidents within the site itself.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	The site is at residual risk from an overtopping or breach of defences along the River Thames. Tidal flooding at the site was assessed using the Environment Agency's Thames Estuary Upriver Breach Assessment model and the Environment Agency's Thames Estuary Downriver Breach Assessment. As both tidal breach assessment datasets are available, the breach assessment with the conservative model outputs for the site should take precedence in this assessment of residual risk. As such, the Environment Agency's Upriver Breach Assessment model was used within this assessment of tidal flooding. **0.5% AEP tidal present day event proportion of site at risk – 75.7%** **0.5% AEP tidal 2100 epoch event proportion of site at risk – 91.6%** The majority of the site is projected to be flooded during the present day 0.5% Thames Tidal Upriver Breach event (75.7% flooded). Flood depths across the site extend to a maximum of 2.10m, with flood depths highest between Knights Road and Bradfield Road on the northern area of the site. Highest flood depths are present at the south-east corner of the site with approximately 2.10m depth. Floodwater velocities are a maximum of 2.00m/s at the north-west corner of the site. Some rapid flood water velocity occurs at the south-east corner of the site. The resulting flood hazard varies between 'Very low' to 'Danger for all'. The north and south-east corner of the site is resulting in 'Danger for all'. Between Knights Road and Broadfield Road, the flood hazard is 'Danger for most' to 'Danger for all'. The site is almost entirely flooded during the 0.5% AEP 2100 epoch event (91.58% flooded), which is described in the climate change section below. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event. The current condition of the defences are unknown, but a breach of defences is very unlikely. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed. The residual risk to the site posed by failure of flood defences, including overtopping and breach must be considered in a site-specific Flood Risk Assessment. Maintenance arrangements (including funding mechanisms) for the defences will need to be demonstrated for the lifetime of development, this will need to include how the existing defences can be improved and fixed.
Emergency planning	

Flood warning	The site is located within Environment Agency flood warning area (063FWT23RDockA) which extends around River Thames from the Beckton Sewage works to the River Lea. The entire site is located within Environment Agency flood alert area in 063WAT233N, which extends surrounding the River Thames including areas in the boroughs of Havering, Barking and Dagenham, and Newham. Additionally, some of the southern area of the site is located in flood alert area 063WAT23Central at the Tidal Thames riverside from the Thames Barrier to Putney Bridge.
Access and egress	Access and egress to the site is currently via the A1020 road towards the west. The site can be exited along Bradfield Road and Knights Road. Careful consideration of safe access and egress will be needed for this site. Safe access and egress are shown to be affected during all modelled tidal breach events in the present day epoch and the 2100 epoch. The site during the 0.5% AEP 2100 epoch event is heavily affected by flood water, with significant depts and velocities of flood water which impacts access and egress to and from the site. The resulting flood hazard are 'Danger for most' and 'Danger for All' at all roads. It is noted that Lidar for the site does not appear to accurately represent the topography, and it is likely that some areas identified as being at higher elevation and outside the flooded area may be at risk, impacting safe access and egress routes into and from the site. During the 0.5% AEP present day Thames Tidal Upriver Breach event, both of the roads within the site are affected by deep (<2.00m) and fast flowing (<2.00m/s) flood waters. The flood hazard is 'Danger for Most' and 'Danger for all' along the roads which would be extremely challenging for vehicular access. The south corner of the site is affected by deep (>2.00m) flood water with high velocities (>1.00m/s) Additionally, during the surface water flood risk during the 1% AEP plus 40% Climate Change event most of the surrounding roads are affected by surface water flooding. Flood water depths vary between 0.10m up to 1.00m depths along Knights Road, Bradfield Road and A1020. Flood water velocities occur from 0.20m/s up to 2.00m/s along Bradfield Road and the A1020. Surface water flood hazard varies from 'Very low' to 'Danger for most'. Therefore, access and egress will be impaired during this event.
Dry Islands	The site is not located within a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment** Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The site is significantly flooded during the 0.5% AEP 2100 Thames Tidal Upriver Breach event (91.58% flooded). Flood depths across the site varies between 1.00m to 2.50m between Knights Road and Bradfield Road. Flood depths at the south corner of the site is about 3.00m deep. Flood water velocities are almost 3.00m/s. The resulting flood hazard on site varies between 'Very low' to 'Danger for all'. At the south of the site the hazard is lower and the majority of the site is in high danger. Additionally, the south corner of the site has deeper flood water during the 0.5% AEP 2100 epoch event (<2.89m depth) compared to the 0.5% AEP present day event (<2.10m depth), which makes the site sensitive to climate change. **Surface Water:**

	The latest climate change allowances have also been applied to the Silvertown ICM surface water model to indicate the impact of climate change on pluvial flood risk. The 1% AEP plus 40% climate change allowance corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. According to the Silvertown ICM surface water model, the site is has depth of >1.00m flood water present during the 1% AEP plus 40% climate change event. The velocity of the flood water varies between 0.20m/s up to 2.00m/s. The resulting flood hazard at the site during the 1% AEP plus 40% climate change surface water flood event is from 'Very low' to 'Danger for most'. During the 1% AEP event (without the climate change allowance) the site has slightly less affected areas by flood water. Occurring flood depths during this period are between 0.10m to 1.00m with the deepest flood waters at the south corner of the site. During the 1% AEP event, the flood water velocities are between 0.20m/s to 2.00m/s. The flood water velocity at the south corner of the site is up to 0.20m/s. The resulting flood hazard within the site is 'Very low' to 'Danger for most' during the 1% AEP event. As the surface water flooding increases during the 1% AEP plus 40% climate change allowance epoch, this makes the site sensitive to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is defined as Lambeth Group – Sand, silt and clay. These deposits are sedimentary which is variable in permeability.
	  ○ Superficial – The superficial geology of the site is Alluvium (clay, silt, sand and peat) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy and clayey soils of coastal flats with naturally high groundwater.
	
	SuDS
	• The site is considered to have very low to negligible susceptibility to groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may still be susceptible to groundwater flooding.
	• BGS data indicates that the underlying geology is a mixture of clay, silt and sand which is likely to be with variable permeability.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill or is not a nitrate vulnerable zone.
	• The entire site is located within a Secondary (undifferentiated) superficial deposit aquifer designation zone.
	• The north-west of the site is located within an Unproductive bedrock geology aquifer designation zone. The south-east of the site is located within a Secondary A bedrock geology aquifer designation zone.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to greenfield runoff rates as reasonably practical in consultation with the

	LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 0.1% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable' and employment development as 'Less Vulnerable'. Open space is classed as 'water compatible development.' As there are different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is within Flood Zone 3 and Flood Zone 2, and high risk of surface water flooding, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultation with the London Borough of Newham, Thames Water, and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the proposed development site is greater than 1ha, is at tidal flood risk from the 0.5% AEP breach event of the River Thames and is shown to be at surface water flood risk in the 1% AEP and 0.1% AEP events. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in

	London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. In particular, an assessment of the Thames Tidal breach model will be required to determine the fluvial risk to the site. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. • Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan, including the production of Riverside Strategies by Local Authorities as laid out by the TE2100 Plan to improve flood risk management in the vicinity of the river. The site is within the TE2100 Royal Docks policy unit. In this area the P4 policy applies. • Application of permission for development proposals is required at the site as it is located within 20m of a main river and flood defence. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within the 0.5% AEP tidal and fluvial or 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Arrangements for safe access and egress will need to be demonstrated for the 0.5% AEP tidal event and rainfall events with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. This is particularly important given the risk of breach at the site. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor

levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to:

    - raise them as much as possible
    - consider moving vulnerable uses to upper floors
    - include extra flood resistance and resilience measures.

- Other examples of flood resistance and resilience measures include:
    - using flood resistant materials that have low permeability to at least 600mm above the estimated flood level
    - making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level
    - by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level.

- The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website.

- The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report.

- The design and development of the site should be in accordance with the Local Plan Policy BFN2.

- London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding, the site is in Flood Zone 3 and Flood Zone 2, as well as at high risk if the Thames were to breach its bank and defences were to fail. There is also significant pluvial flood risk in the 0.1% AEP event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.

- Any development in the 'More Vulnerable' category should be steered away from Flood Zone 3. More vulnerable development proposed within Flood Zone 3 will require the Exception Test to be passed.

- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 0.5% AEP tidal, and 1% AEP and surface water, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.

- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water, and 0.5% AEP tidal plus an allowance for climate change events. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed. This site will need a specific Flood Warning and Evacuation Plan.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- As this development (including redevelopment of existing buildings and sites) is adjacent to a main river (River Thames), a buffer strip of 8m is required from the toe of any Main River and 16m from tidal defence structures, taking into account the requirements set by the Flood Risk Activities: Environmental Permits guidance (and any subsequent updates). Where flood defences are present, these distances should be taken from the toe of the defence.

Mapping Information

The key datasets used to make planning recommendations for this site were the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Upriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver Breach Assessment model. The latest climate change allowances (updated May 2022) have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on pluvial flood risk.
Tidal breach extents, depth, velocity and hazard mapping	This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Upriver 2017 Breach Assessment model.
Surface Water	The Silvertown ICM Surface Water model (2015) and the Environment Agency's Risk of Flooding from Surface Water (RoFSW) map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The EA's RoFSW surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) and the Silvertown ICM Surface Water model (2015) maps have been used to define areas at risk from surface water flooding.

	London Borough of Newham Council Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables
Site details	
Site Code	**Newham Sixth Form College**
Address	Prince Regent Lane, E13 8
Area	1.66ha
Current land use	Educational
Proposed land use	Residential and open space
Flood Risk Vulnerability	More vulnerable and water compatible development
Sources of flood risk	
Location of the site within the catchment	The site is located within the south of Plaistow. It comprises the southern half of the Newham Sixth Form College campus and is bordered by Prince Regent Lane to the east. To the north, the site is bordered by the remaining Newham Sixth Form College campus. To the south, the site is bordered by the rear gardens of the houses on Jenkins Road. To the west, the site is bordered by the grounds of Kaizen Primary School. The site is located in the London Management Catchment. The catchment area is 1487km² and is very densely populated. The site lies approximately 2.6km east of the River Lea and 2.1km north-east of the River Thames. The site is located within a very urbanised part of the catchment.
Topography	Environment Agency 1m resolution LiDAR across the site shows that topography varies. The site area is a densely developed urban area and LiDAR data is unlikely to be representative of the actual site topography, this may have an impact on some of the flood risk datasets used in the assessment. The lowest elevations are found in the south-west site corner at around 1.6mAOD. There are further areas of low elevation within the south of the site, ranging from around 1.7mAOD to 1.8mAOD. The highest ground elevations on site (excluding the existing sixth form building) are around 2.5mAOD, west of the buildings, within the carpark. The rest of the site lies at around 2.1 to 2.2mAOD.
Existing drainage features	The site lies approximately 2.6km east of the River Roding and 2.1km north-east of the River Thames, which also marks the confluence of the two rivers. There are no drainage ditches within the site.
Critical Drainage Area	The site is not located within a CDA.
Fluvial and tidal	**The proportion of site at risk FMFP:** **FZ3 – 0%** **FZ2 – 0%** **FZ1 – 100%** *The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. This is because the values quoted are the area covered by each Flood Zone/extent within the site boundary. For*

	example: Flood Zone 2 includes Flood Zone 3. Flood Zone 1 is the remaining area outside Flood Zone 2 (FZ2+ FZ1 = 100%). **Available data:** Proportion of the sites at flood risk are determined from the Environment Agency's Flood Map for Planning Flood Zones. This represents the undefended scenario. Therefore, the defended scenario outputs have been reported as a more accurate representation of the flood risk in Newham due to the presence of flood defence structures. Flood defence structures along the Thames are designed to protect to a 0.1% AEP flood event, during the defended scenario there is no out of bank flooding from the Thames (including and up to the 0.1% AEP event). Therefore, the EA's Reduction in Risk of Flooding from Rivers and Sea due to Defences dataset extent has been used to assess the area of the site located within this extent. The dataset shows the area where there is a reduction in risk of flooding from rivers and sea due to flood defences, taking into account the condition they are in. **Flood characteristics:** The site is within Flood Zone 1. The edge of Flood Zone 2 is located approximately 40m south of the site.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 4.0% Max depth – 0.3 – 0.6m Max velocity – 0.25 – 0.5m/s **1% AEP** – 16.0% Max depth – 0.6 – 0.9m Max velocity – 0.5 – 1.0m/s **0.1% AEP** – 45.3% Max depth – 0.9 – 1.2m Max velocity – 1.0 – 2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %).* The Environment Agency's Risk of Flooding from Surface Water mapping was used in this assessment. **Description of surface water flow paths:** The site is affected by surface water flooding in all AEP events. In the 3.3% AEP event, surface water flooding only covers 4.0% of the site. Flooding ponds in areas of lower elevation across the site, in the south-western corner and at the eastern side of the site. Maximum flood depths are 0.3 to 0.6m. Flood water velocity within the site is predominantly 0.00 to 0.25m/s with a very small area of flooding with velocity of 0.25 to 0.5m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Some' in areas where ponding is deepest. In the 1% AEP event, surface water covers 16.0% of the site. The flooding extends further around the 3.3% AEP outlines, and further east into other low-lying areas of the site, covering more of the existing carpark. There is also flooding along Prince Regent Lane from Glen Road to the Newham Leisure Centre carpark entrance. Flood depths on site vary from 0.15 to 0.9m. The deepest depths are at the centre of the ponding and shallowest depths at the edges. Depths along Prince Regent Lane range between 0.00 and 0.9m with the greatest depths at the southern end of the road, adjacent

	to Prince Regent Lane Playing Fields. On site, the majority of water flows at 0.00-0.25m/s, but varies from 0.00 to 1.00m/s. The resulting flood hazard varies from 'Very Low' to 'Danger for Most' where flooding is deepest, within the area of ponding at the south-west corner of the site. In the 0.1% AEP event surface water flooding covers 45.3% of the site. In this event multiple flow paths form, connecting flood water across most of the streets in the vicinity of the site. There is a surface water flow travelling south-west from Newham University Hospital along Glen Road and south down Prince Regent Lane (which forms the eastern border of the site). Ponding of surface between the playing fields of Kaizen Primary School and Prince Regent Lane covers the southern half of the site. Another flow path flowing south from the footpath around the northern sixth form campus enters the site and joins the ponding at the southern half of the site. Flood depths vary from 0.15 to 1.2m. Within the site, most of flood depths are between 0.3 and 0.6m. The deepest flooding occurs at the lowest-lying part of the site, the south-west corner. Flood water flows at around 0.00 to 0.25m/s across most of the site. The flow path coming from the northern sixth form campus flows at a speed of 0.5 to 2.00m/s. At the western site boundary, the flow path entering the site from the primary school playing fields flows at up to 0.5 to 2.00m/s. The resulting flood hazard ranges between 'Very Low' at the edges of ponding, and 'Danger for Most' at the centre of ponding.
Reservoir	The entire site is shown to be at risk of Wet Day reservoir flooding according to the Environment Agency's reservoir flood mapping. The reservoirs which would flood the site are: Banbury Reservoir, High Maynard Reservoir, King George V Reservoir, Lockwood Reservoir, Queen Elizabeth II Reservoir, Walthamstow No. 4 and Walthamstow No. 5 Reservoirs, Warwick East Reservoir, William Girling Reservoir and Wraysbury Reservoir. These reservoirs are all managed and operated by Thames Water Limited This flooding is deemed as high-risk, and in the very unlikely event that a reservoir fails, it is predicted that there is a risk to life. The site is not shown to be at risk of Dry Day reservoir flooding.
Groundwater	The GeoSmart Groundwater Flood Risk Map (GW5), is provided as 5m resolution grid squares. The whole site is shown to have a moderate risk of groundwater flooding in this area, and any groundwater flooding incidence has a greater than 1% annual probability of occurrence. This means there will be a significant possibility that incidence of groundwater flooding could lead to damage to property at, or near, this location. Further consideration of the local level of risk and mitigation is recommended.
Sewers	The site is located within a postcode area with 293 incidences of sewer flooding, according to the Thames Water Hydraulic Sewer Flood Risk Register. The site is located within the Beckton sewer catchment. Newham was identified as a high risk catchment as part of Thames Water's Drainage and Wastewater Management Plan. The strategic plan for this risk zone identifies a series of solutions and targets which include, for example, network improvements, and property level protection measures to prevent buildings from flooding. It is recommended that developers seek advice from Thames Water during early development stages so that they ensure that development aims to help achieve these targets.
Flood history	The Environment Agency's historic flooding and recorded do not show any records of flooding to the site or within the surrounding area.

	Newham Borough Council's flood records do not show record of flooding within the site. There are four records of flooding along Prince Regent Lane dating from 2011 to 2021.
Flood risk management infrastructure	
Defences	The Environment Agency AIMS dataset shows that the site is protected by formal flood defences along the River Thames and the River Lee. The area is protected by the Thames Barrier and secondary tidal defences along the Thames frontage. These include tidal embankments and tidal flood walls. The design standard of protection of these defences is 1000 years.
Residual risk	There is no residual risk to the site from breach of defences as the site is outside of the Thames modelled breach extent and is located north of the extent. The reservoir risk to the site was described above.
Emergency planning	
Flood warning	The site is not located in an Environment Agency Flood Warning or Flood Alert Area.
Access and egress	Proposed pedestrian and vehicle access and egress to the site to the north and south, is via Prince Regent Lane. During the tidal breach events in the 2100 epoch, much of the land south of the site will be flooded. The tidal breach flood extents reach to approximately 38m south of the site. This will have a significant impact on access and egress to the site from (and towards) the south. The land north of the site remains unaffected. During the surface water 0.1% AEP event, there is flooding to the southern half of the site. This flooding has a hazard rating of up to "danger for most". The northern part of the site is not impacted by flooding. Therefore, Prince Regent Lane can be accessed from the northern half of the site. There is also flooding along Prince Regent Lane, from the entrance to Newham Leisure Centre to the junction with Barking Road. The flood hazard on the road is largely "very low/caution" with smaller areas of "danger for some" and "danger for most", notably at the northern end of the road, before the junction to Barking Road. Vehicles can access Barking Road alternatively via Wanlip Road and Cumberland Road, where flood hazard is "very low/caution". Pedestrians can alternatively access Barking Road via St Andrew's Road or access the Greenway via Prince Regent Lane. Therefore, access and egress to the site should be possible. During the 1% AEP plus 40% allowance for climate change event (design flood event), flooding is very similar. Flood hazard within the site and along Prince Regent Lane ranges between "very low/caution" and "danger for most". Flood hazard on St Andrews Road increases from "very low/caution" to "danger for some". However, flood depths along the road will reach 0.3m, which may be passable for adults. Pedestrians can also access Barking Road via the Greenway. Arrangements for safe access and egress will need to be demonstrated for the 1% AEP surface water flood event with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. Given the considerable risk to the site during the surface water 1% AEP plus 40% allowance for climate change event, consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site.
Dry Islands	The site is not located on a dry island.
Climate change	
Implications for the site	**Management Catchment: London Management Catchment**

	Increased storm intensities due to climate change may increase the extent, depth, velocity, hazard, and frequency of both fluvial and surface water flooding. **Tidal Breaches:** The site remains outside of the modelled Thames tidal breach extents. **Surface Water:** The latest climate change allowances have also been applied to the Risk of Flooding from Surface Water map to indicate the impact on surface water flood risk. The 1% AEP plus 40% climate change corresponds to the 1% AEP upper end allowance for peak rainfall intensity for the 2070s epoch and is therefore the 'design event' scenario. In the 1% AEP plus 40% climate change event the flood extent increases and significantly from the 1% AEP event. The flood extent is very similar to the 0.1% AEP event. The flooding extends into the lower lying parts of the site, mainly in the southern half of the site. The extent of flooding along Prince Regent Lane also increases significantly from the 1% AEP event. Flood depths also increase from around 0.15 to 0.6m (1% AEP event) to around 0.25 to 0.75m in the 1% plus 40% climate change event. This shows that the site is sensitive to increases in surface water flooding due to climate change. Development proposals at the site must address the potential changes associated with climate change and be designed to be safe for the intended lifetime. The provisions for safe access and egress must also address the potential increase in severity and frequency of flooding.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Bedrock geology of the site is the London Clay Formation (clay, silt and sand). This is a sedimentary bedrock.
	  ○ Superficial – The superficial geology of the site is Taplow Gravel Member (sand and gravel) which is a sedimentary superficial deposit formed of unconsolidated detrital material deposited by a body of running water.
	• Soils at the site consist of:
	  ○ Loamy soils with naturally high groundwater.
	
	SuDS
	• The whole site is shown to have a moderate risk of groundwater flooding, this should be confirmed through additional site investigation work. Below ground development such as basements may be susceptible to groundwater flooding. Surface water flooding and failure of drainage systems will be exacerbated when groundwater levels are high.
	• BGS data indicates that the underlying geology is a mixture of clay, silt, sand and peat which is likely to be with highly variable permeability. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality.
	• The site is not located within a historic landfill site.
	• The bedrock beneath the site is classified as an unproductive aquifer zone, the superficial geology is a secondary aquifer zone.
	• Surface water discharge rates should not exceed pre-development discharge rates for the site and should be designed to be as close to

	greenfield runoff rates as reasonably practical in consultation with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 1% AEP plus 40% climate change allowance event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development and consider using areas as public open space. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the Sequential Test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. The NPPF classifies residential development as 'More Vulnerable'. Open space is classed as water compatible development. As there are two different flood risk vulnerability classifications for this site, the most vulnerable type is the one taken into consideration for the Exception Test. As the site is at high risk of surface water flooding in the design event with several surface water flow paths, the Exception test is required for this site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** Section 2 of the Level 2 SFRA and Sections 7 and 8 of the Level 1 SFRA have more guidance on this section and any relevant policies and information applicable to development within LBN. • Consultations with the London Borough of Newham, Thames Water and the Environment Agency should be undertaken at an early stage. • At the planning application stage, a site-specific Flood Risk Assessment (FRA) will be required as the site is greater than 1ha and affected by surface water flooding. • As part of the London Plan policy SI12 on Flood Risk Management, flood risk should be recognised as an important consideration as part of all development proposals, and it sets out the strategic approach in

	London to manage flood risk. This includes the expectation that flood risk from all sources is managed in a cost-effective way. • Development plans should use the Mayor's Regional Flood Risk Appraisal and their SFRA, as well as the Local Flood Risk Management Strategies to identify cumulative flood risk issues. As part of the London Plan policy SI13 and LBN SuDs guidance, all development proposals are required to include a Surface Water Drainage Strategy along with their FRA. This aims to achieve greenfield run-off rates and ensure surface water run-off is managed as close to source as possible. It should also promote an integrated approach to water management. Drainage should be designed and implemented in ways that promote multiple benefits. • All sources of flooding should be considered as part of a site-specific flood risk assessment and ensure that this flood risk is minimised and mitigated. Residual flood risk must be addressed. Careful consideration will also need to be given to the significant surface water flood risk on site. • Developers should consult with Thames Water to ensure that the development aims to help achieve the targets of the Drainage and Wastewater Management Plan. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; London Borough of Newham Council's Local Plan Policies and Sustainable Drainage Design and Evaluation Guide for developers. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG). • Should built development be proposed within 1% AEP surface water flood extents, careful consideration will need to be given to flood resistance and resilience measures. • The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, so runoff magnitudes from the development are not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure runoff rates are as close as possible to greenfield rates. • Planning permission is required to surface more than 5 square metres of a front garden using a material that cannot absorb water. • Arrangements for safe access and egress will need to be demonstrated for the 1% AEP surface water event, with an appropriate allowance for climate change, using the depth, velocity, and hazard outputs. • Provisions for safe access and egress should not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk. • Consultation with RMAs early on should be implemented to ensure an appropriate flood evacuation plan is put in place for the site. • Flood resilience and resistance measures should be implemented where appropriate during the construction phase, e.g. raising of floor levels. These measures should be assessed to make sure that flooding is not increased elsewhere. If the floor levels cannot be raised to meet the minimum requirements, developers will need to: o raise them as much as possible o consider moving vulnerable uses to upper floors o include extra flood resistance and resilience measures. • Other examples of flood resistance and resilience measures include:

	◦ using flood resistant materials that have low permeability to at least 600mm above the estimated flood level ◦ making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level ◦ by raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level. • The scale of development/s in this catchment is likely to require upgrades of the water supply network infrastructure. It is recommended that the Developer and the Local Planning Authority liaise with Thames Water at the earliest opportunity to agree a housing phasing plan. Failure to liaise with Thames Water will increase the risk of planning conditions being sought at the application stage to control the phasing of development in order to ensure that any necessary infrastructure upgrades are delivered ahead of the occupation of development. The housing phasing plan should determine what phasing may be required to ensure development does not outpace delivery of essential network upgrades to accommodate future development/s in this catchment. The developer can request information on network infrastructure by visiting the Thames Water website. • The design and layout of the site should take account of risk of flooding from all sources and meet the requirements of Local Plan Policy CE7. Sustainable drainage should be considered from the outset and meet the requirements of Local Plan Policy CE8. For more information on these policies, please refer to Section 8 of the Level 1 SFRA report. • London City Airport can provide comment on planning applications or development proposals within 13km of the airport which include landscaping schemes that may attract birds to the site. Early consultation with London City Airport is recommended for any site which incorporates SuDS, open water and landscaping which will impact local biodiversity.

Key messages

The site is shown to be at significant risk of flooding in the surface water 1% AEP plus 40% climate change allowance event. The development may be able to proceed if:

- A carefully considered and integrated flood resilient and sustainable drainage design is put forward, with development to be steered away from the areas identified to be at risk of surface water flooding within the site.
- A site-specific Flood Risk Assessment that demonstrates that site users will be safe in the 1% AEP surface water event, including an allowance for climate change. This will need to show that the site is not at an increased risk of flooding in the future and that development of the site does not increase the risk of surface water flooding on the site and to neighbouring properties.
- A site-specific Surface Water Drainage Strategy, and SuDs maintenance and management plan is submitted along with the FRA.
- Safe access and egress can be demonstrated in the 1% AEP plus Higher Central climate change surface water event. If this is not possible, an appropriate Flood Warning and Evacuation Plan is needed.
- If flood mitigation measures are implemented then they are tested to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning, the Environment Agency's Risk of Flooding from Surface Water map and the Environment Agency's Thames Estuary Downriver Breach Assessment model. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping. Modelled tidal breach flood extents have been taken from the Environment Agency's Thames Estuary Downriver Breach Assessment model.

Climate change	The latest climate change allowances (updated May 2022) have been applied to the Risk of Flooding from Surface Water map to indicate the impact on surface water flood risk. Tidal climate change has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Downriver Breach Assessment model.
Tidal & fluvial depth, velocity and hazard mapping	This has been assessed using the 2100 epoch results from the Environment Agency's Thames Estuary Downriver 2018 Breach Assessment model.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, velocity, and hazard mapping for the 3.3%, 1% and 0.1% AEP events (considered to be high, medium, and low risk) have been taken from Environment Agency's RoFSW, which have been uplifted for climate change.