Greater Norwich Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	
Site details	
Site Code	**FOU 2**
Address/Grid Ref.	Old Railway Yard, Station Road / 602765,324267
Area	1.06 hectares
Current land use	Brownfield
Proposed land use	Employment
Sources of flood risk	
Location of site within catchment	The site is located in the south of the Foulsham Tributary catchment. A number of small watercourses flow into the main tributary which flows parallel to the northern boundary of the site. This unnamed tributary joins the River Wensum in the Wensum US Norwich catchment approximately 3km to the west of the site.
Existing drainage features	An unnamed watercourse lies to the north of the site, flowing from east to west. There is also a small drainage ditch which runs along the southern boundary of the site, flowing in a north westerly direction and joining the unnamed watercourse in approximately 200m.
Fluvial	**Proportion of site at risk:** **5% AEP – 5**% **1% AEP –** 9.80% **0.1% AEP –** 19.39% *As the model used is not externally reviewed, results do not align with designated flood zones and extents at risk during indicative events are instead quoted.* **Available data:** A strategic 2D model was built to inform the flood risk to this site. The model is strategic in nature and topography is informed by OS Mastermap. The model has not been externally reviewed and therefore has not informed the Environment Agency flood zones. Therefore, both SFRA flood mapping and the Environment Agency flood zones (whichever are greater) will need to be used for future development planning. The developer should look at the fluvial risk to the site in further detail for a site-specific FRA. Figures quoted are from the SFRA flood mapping. **Flood characteristics:** The 2D modelling shows that fluvial risk at the site is associated with the watercourse to the north. For the 5% AEP flood event, flooding from the channel occurs in a small area in the north west corner of the site, up to depths of 0.2m. The extent is similar for the 1% AEP event, but the modelled flood hazard increases from 'Low- Caution' to 'Moderate- Dangerous for some'. For the 0.1% AEP event, the flooding extends further onto the site and depths increase slightly to 0.4m. The flood hazard also increases to 'Significant- Dangerous for most'. During the 1% AEP and 0.1% AEP flood events, water also covers Station Road and enters the eastern boundary of the site. Within the site boundary, depths are below 0.2m for both scenarios and the flood hazard remains at 'Low- Caution'.
Surface Water	**Proportion of site at risk (RoFfSW):** **30-year** – 1.37% Max depth <0.3m

	Max velocity <0.25m/s **1% AEP** – 6.28% Max depth 0.3-0.9m Max velocity >0.25m/s **0.1% AEP** – 28.26% Max depth 0.3-0.9m Max velocity >0.25m *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. 1% AEP includes the 30-year %)* **Description of surface water flow paths:** There are two flow paths around the site which are associated with the nearby watercourses. The most significant flow path is associated with the unnamed watercourse just outside the northern boundary of the site. This flooding originates east of Station Road and flows westwards past the site. The less extensive flow path is associated with the drain running along the southern boundary of the site. Water flows along Bintree Road from the fields to the east of Foxley Road, before spreading northwards and encroaching slightly on the southern boundary of the site as it enters the drainage ditch and continues flowing westwards. In the 30-year event, a small part of the site in the northwest corner experiences surface water flooding. Depths here are less than 0.3m and the hazard rating is 'Low- Caution'. To the north of the site, flooding occurs along the unnamed watercourse to depths above 0.9m in some parts of the channel. In the 1% AEP event, the northwest corner of the site floods to a slightly greater extent and higher depth of between 0.3m and 0.9m. The hazard rating increases to 'Moderate- Dangerous for some'. For this event, surface water flooding also extends along the drain on the southern boundary of the site but is confined to the channel with depths remaining below 0.3m. In the 0.1% AEP event, a larger extent of the northwest corner is affected although depths are similar to the 1% AEP event. The hazard rating increases to 'Significant- Dangerous for most' with a very small area in the most extreme category of 'Dangerous for all'. On the southern boundary of the site, surface water leaves the drainage channel and encroaches a small amount onto the site, reaching depths between 0.3m and 0.9m. There is an additional area of surface water flooding for the 0.1% AEP event which occurs at the eastern end of the site just off Station Road. Flood depths here are low at less than 0.15m. Although the hazard rating is 'Low- Caution' within the site boundary here, it increases substantially to 'Significant- Dangerous for most' just to the east on Station Road.
Reservoir	The site is not shown to be at risk of reservoir flooding from the available online maps.
Groundwater	The Environment Agency Areas Susceptible to Groundwater Flooding dataset, provided as 1km grid squares, shows the susceptibility of an area to groundwater flood emergence. The following comments can be made about groundwater flood risk: • The entire site has a >= 50% <75% susceptibility to groundwater flood emergence. This assessment does not negate the requirement that an appropriate assessment of the groundwater regime should be carried out at the site-specific FRA stage.
Flood history	There are no records of historic flooding from the Environment Agency within the recorded flood outlines dataset or historic flooding dataset. Norfolk County Council do not have any reports of flooding at the site, but they do hold records of three incidents in the local area. One was of external flooding reported in November 2019 to a property on Claypit Road approximately 400m upstream from the site. An incident reported in January 2018 involved knee-deep flooding on Foxley Road (approximately 450m south of the site). Finally, internal flooding was reported in September 2015 for a property on Station Road, approximately 400m north east of the site.
Flood risk management infrastructure	
Defences	This site is not protected by any formal flood defences.
Residual risk	There is no residual risk to the site from flood risk management structures.
Emergency planning	
Flood warning	The north west corner of the site is covered by the 'Rivers Tud and Wensum from Fakenham to Costessey including Wendling Beck' Flood Alert area.

Access and egress	The site is bounded by an access road to the north, Station Road to the east, and a private road to the south. In terms of fluvial flood risk, the entrance of the access road to the site is flooded during the 1% AEP event, up to depths of 0.1m. Depths here increase to 0.2m during the 0.1% AEP event. As depths remain relatively low, access and egress is unlikely to be significantly affected by fluvial flooding. There is also surface water flooding on Station Road near the entrance to the site access road for a 1% AEP event. However, depths are below 0.3m so are unlikely to significantly impact access and egress. During a 0.1% AEP event, the site access entrance is entirely covered by surface water flooding as well as much of the access road itself. Furthermore, depths on Station Road nearby the site are between 0.3m and 0.9m so could impact access and egress. Therefore, the site should be accessed from the private road to the south if possible, during significant surface water flooding events. Access and egress via the south of the site will not be impacted by fluvial flooding in future, even in the most extreme (+65%) climate change scenario.
Dry islands	The site is not located on a dry island.
Climate change	
Implications for the site	• The site is slightly sensitive to increased fluvial flows in the nearby watercourse resulting from climate change. • The eastern end of the site is in future Functional Flood Zone 3b. The 5% AEP plus Upper End (+65%) climate change scenario results in flooding of depths up to approximately 0.1m and a flood hazard rating of 'Low- Caution'. This presents a small increase in risk as during the present day 5% AEP flood event, flooding only occurs in the northwest corner of the site. In the northwest corner, the future Functional Flood Zone 3b covers a slightly larger extent than the present-day scenario. However, the hazard rating is 'Low- Caution' for both present day and future scenarios. • The eastern end of the site and northwest corner is in future Flood Zone 3a. The extents are slightly larger than for the present day 1% AEP flood event. Flood depths during the 1% AEP plus the Upper End (+65%) scenario are up to 0.2m at the eastern end and up to 0.4m in the northwest corner. The flood hazard in the northwest corner is 'Significant- Dangerous for most' making it one category higher than the present-day scenario. In the east of the site, the hazard remains in the same category as the present-day scenario at 'Low- Caution'. This scenario therefore presents an increase in risk primarily to the northwest corner. • A larger area of the eastern end of the site and northwest corner are in future Flood Zone 2. The 0.1% AEP plus the Upper End (+65%) climate change scenario results in depths of up to 0.6m in the northwest corner and 0.3m in the east of the site. In the northwest the hazard rating remains at 'Significant- Dangerous for most' but in the east of the site it increases from 'Low- Caution' in the present-day scenario to 'Moderate- Dangerous for some' in the future scenario. As this flood event covers the access road to the site, this may have implications for access and egress. • Climate change also needs to be considered for surface water events. At the site-specific stage, the 1% AEP event with a 40% allowance for climate change should be considered as part of surface water drainage strategies, or surface water modelling. **Proportions of the site in Future Flood Zones can be found in Table 6-2 of the Greater Norwich Level 2 SFRA Report**
Requirements for drainage control and impact mitigation	

Broad scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock – Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation, Portsdown Chalk Formation (undifferentiated) - Chalk.
	  ○ Superficial – Alluvium Deposits - Clay, Silt, Sand and Gravel.
	• Soils at the site consist of:
	  ○ Loamy and sandy soils with naturally high groundwater and a peaty surface.
	SuDS
	• Most source control techniques are likely to be suitable. Mapping suggests that permeable paving may have to use non-infiltrating systems given the possible risk both to and from groundwater.
	• Infiltration may be suitable. Mapping suggests a medium risk of groundwater flooding and underlying soils may be permeable. Further site investigation should be carried out to assess potential for drainage by infiltration. If infiltration is suitable it should be avoided in areas where the depth to the water table is <1m. As the site is located within a Source Protection Zone, infiltration techniques should only be used where there are suitable levels of treatment although it is possible that infiltration may not be permitted. Additionally, proposed SuDS should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints.
	• Detention may be feasible provided site slopes are <5% at the location of the detention feature. If the site has contamination or groundwater issues, a liner will be required.
	• Filtration is probably suitable provided site slopes are <5% and the depth to the water table is >1m. If the site has contamination or groundwater issues, a liner will be required.
	• All forms of conveyance are likely to be suitable. Where the slopes are >5% features should follow contours or utilise check dams to slow flows. If the site has contamination or groundwater issues, a liner will be required.
	• The site is not designated by the Environment Agency as previously being a landfill site.

Opportunities for wider sustainability benefits and integrated flood risk management	• As a small amount of the site is in the Functional Floodplain, this would need to be left undeveloped. Green infrastructure could be put in place here such as rain gardens and tree pits. The areas of surface water ponding should ideally be used for green infrastructure too. • This presents the opportunity to deliver environmental benefits, improving biodiversity and amenity while also reducing flood risk.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out. The Sequential Test will need to be passed before the Exception Test is applied. Employment development is classified as 'Less Vulnerable'. Whilst most of the site is not currently within a designated Flood Zone, strategic modelling indicates that the site is at risk of fluvial flooding. Any proposed development should be accompanied by a site-specific Flood Risk Assessment which investigates the fluvial flood risk to the site in further detail.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • At the planning application stage, a site-specific Flood Risk Assessment will be required as part of the site is located in Flood Zone 2 with a small area of this in Flood Zone 3. • All sources of flooding, particularly the risk of fluvial and surface water should be considered as part of a site-specific flood risk assessment. • The site-specific FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance, Norwich City Council's Local Plan policies, and the Norfolk County Council Lead Local Flood Authority's Statutory Consultee for Planning Guidance Document. • Consultation with the Local Authority, Local Lead Flood Authority and the Environment Agency should be undertaken at an early stage. • The development should be designed to ensure that mitigation measures are in place to ensure the development does not flood, or that ground level space is used for less vulnerable parts of the development.

Guidance for site design and making development safe:

- A resilient approach to urban design should be taken. Habitable floor levels must be above the 1% AEP flood level taking into account climate change (upper end scenario) with an allowance for freeboard- approximately 0.7m above ground level.
- A shelter in situ for an extreme fluvial event must be designed into the building and supported by a flood warning and evacuation plan. Suitable shelter for all occupants of any buildings must be above the 1000-year flood level taking into account climate change (upper end scenario)- approximately 0.9m above ground level.
- 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).
- Safe access and egress will need to be demonstrated in the 1 in 1000-year plus climate change fluvial and rainfall events, using the depth, velocity and hazard outputs. Ideally, the access route should be situated 300mm above the designed flood level and waterproofing techniques should be used where necessary. Raising of access routes must 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.
- Compensatory flood storage is required for any land raising and all proposed buildings whenever there is built development on land within the 1% +35% climate change flood extent.
- The risk from surface water flow routes should be quantified as part of a site-specific FRA, including a drainage strategy, to ensure that runoff from the development is not increased by development across any ephemeral surface water flow routes. A drainage strategy should help inform site layout and design to ensure there is no increase in runoff beyond current greenfield rates.
- Areas at risk from surface water flooding should ideally be integrated into green infrastructure, which presents wider opportunities to improve biodiversity and amenity as well as climate change adaptation. An integrated flood risk management and sustainable drainage scheme for the site is advised. It is essential that a detailed model of surface water flooding, using the existing drainage system, topographical and asset survey is constructed at the FRA stage. This will determine the risk from surface water flooding further and to ensure that overland flows do not overwhelm future sustainable drainage features.
- Brownfield sites should discharge surface water at the original pre-development (greenfield) runoff rate. If this is not possible, a significant reduction in the current rate of discharge should be achieved and agreed with the relevant drainage body (LLFA).
- Developers should refer to Norfolk County Council's 'Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document' and the Level 1 SFRA for information on SuDS for guidance on the information required by the LLFA from applicants to enable it to provide responses to planning applications.

Key messages

The flood risk element of the Exception Test is likely to be passed if:

- Development is steered away from areas of fluvial flood risk and surface water flow routes along the northern and southern boundaries, preserving these spaces as green infrastructure. If development is necessary in these areas, carefully considered and integrated flood resilient and sustainable drainage design is put forward, with habitable floor levels above the fluvial design flood event (1% AEP) taking into account climate change and a facility for all occupants to shelter above the extreme fluvial flood event (1000-year) taking into account climate change.
- 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).
- Space for surface water to be stored on the site is provided and rainwater harvesting should be considered. Developers should consider SuDS strategies to help to manage the impacts of climate change from surface water in a detailed site-specific FRA.
- Brownfield sites should discharge surface water at the original pre-development (greenfield) runoff rate. If this is not possible, a significant reduction in the current rate of discharge should be achieved and agreed with the relevant drainage body (LLFA, IDB or Anglian Water).

- Areas of functional floodplain should be safeguarded from future development but may be appropriate for green infrastructure and open space uses
- Safe access and egress routes must not be in the areas of high surface water risk or the 1% AEP fluvial design flood event (taking into account climate change). The site would therefore be best accessed from the private road to the south of the site if possible, away from flow paths associated with the watercourse to the north.
- A Flood Warning and Evacuation Plan should be prepared for the site.

Mapping Information

The key datasets used to make planning recommendations regarding this site were the strategic 2D modelling outputs and the 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 strategic 2D modelling completed as part of the Level 2 SFRA.
Climate change	Climate change was modelled as part of the Level 2 SFRA strategic 2D modelling.
Fluvial depth, velocity and hazard mapping	A strategic 2D model was built to inform the flood risk to this site. The model is strategic in nature and topography is informed by OS Mastermap. The model has not been externally reviewed and therefore has not informed the Environment Agency flood zones. Therefore, both SFRA flood mapping and the Environment Agency flood zones (whichever are greater) will need to be used for future development planning. The developer should look at the fluvial risk to the site in further detail for a site-specific FRA
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 1 in 1% AEP event (considered to be medium risk) is taken Environment Agency's Risk of Flooding from Surface Water.