Bassetlaw Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	
Site details	
Site Code	**EM008**
Address	High Marnham Power Station. Grid Reference: SK 80874 70941
Area	149.56ha
Current land use	Power Station and greenfield land
Proposed land use	Employment
Sources of flood risk	
Location of the site within the catchment	The site is located in the catchment of the tidal River Trent. The River Trent is an Environment Agency designated main river and flows in a northerly direction towards its confluence with the River Humber.
Existing drainage features	One watercourse is located in the east of the site, on the edge of the disused power station. The unnamed watercourse flows from south to north through the site, before being channelled east into the River Trent. Several small land drains associated with the power station works are also located around the site. The Old Trent is an ordinary watercourse that rises to the south of Holme Lane and flows north towards the River Trent. The confluence of the Old Trent and the River Trent is located 30m south of the site. The site is bounded to the east by the tidal River Trent. Several small unnamed land drains are also located around the site.
Fluvial	**The proportion of site at risk:** **FZ3b –** 12% **FZ3a –** 13% **FZ2 –** 14% **FZ1 –** 86% **Defended Scenario (X%AEP Fluvial Event with 50% AEP Tidal Event)** **5%-** 12% **1%-** 13% **0.1%-** 14% *The % Flood Zones quoted show the % 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, e.g. FZ2 includes the FZ3 %. FZ1 is the remaining area outside FZ2 (FZ2 + FZ1 = 100%).* **Available data:** Flood Zones are based on the Environment Agency's 2015 detailed 1D-2D Flood Modeller-Tuflow model. The undefended outputs of this model have been incorporated into the Flood Map for Planning. As the majority of the site lies behind an embankment, defended runs have been undertaken for the purposes of this assessment. These runs are based on the 5%, 1% and 0.1% AEP fluvial event combined with the 20% AEP tidal event. **Flood characteristics:** The majority of the site is in Flood Zone 1, significantly raised above the river. The eastern part (12%) of the site forms part of the functional floodplain and should not be used for built development (although could be used as open space).

	The extent of flooding on site does not change significantly between the 5%, 1% and 0.1% AEP event although depths increase significantly, from approximately 2.5m in the 5% AEp event to 3.6m in the 0.1% AEP event. In the 1% and 0.1% AEP events, flooding extends along the external northern boundary of the site and it appears that a structure along the existing boundary may be serving a flood defence prupose to the site in these scenarios. This should be investigated further as part of a site specific FRA to determien the impact of this structure on flood risk to the site. If it is found to be providing a significant defense to the site any proposal will need to include plans for the replacement and/or ongoing maintenance of this feature throughout the life of the development.
Tidal	**Available data:** Results are based on the Environment Agency's 2015 detailed 1D-2D Flood Modeller-Tuflow model. The undefended outputs of this model have been incorporated into the Flood Map for Planning. However as the majority of the site lies behind an embankment, defended runs have been undertaken for the purposes of this assessment. This assessment is based on the 0.5% and 0.1% AEP Tidal events with the 50% fluvial event. **Flood characteristics:** In the present day defended scenarios, the site is not at significant risk from tidal flooding. In the 0.1% AEP event, flooding is limited to the very eastern edge of the site, adjacent the river.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 3.3% Max depth 0.9-1.2m Max velocity 1-2m/s **1% AEP** – 6% Max depth 0.9-1.2m Max velocity 1-2m/s **0.1% AEP** – 18% Max depth 0.9-1.2m 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. 1% AEP extent includes the 3.3 % AEP extent)* **Description of surface water flow paths:** In the 3.3% AEP flood event, several surface water ponding areas are present around the site in topographic depressions. A large amount of surface water ponding is intercepted by the drainage channels located around the disused power station site and the site access roads. Flood depths are generlly shallow (less than 0.3m) with some areas between 0.3-0.6m. The surface water ponding areas on the site have 'caution' to 'dangerous for some'. In the 1% AEP scenario, the extent of surface water flooding is not significantly increased from the 3.3% AEP event. Surface water ponding remains confined to topographic depressions and drainage channels around the site. Flood depths are between 0.3-0.6m, with some areas up to 1.2m in depth. The surface water ponding areas on the site have 'caution' to 'dangerous for most'. In the 0.1% AEP flood event, several flow paths are located around the site. As in the other two events, the flow paths follow the course of drainage channels located around the site. Depths are primarily shallow, less than 0.3m. Velocities range between 0.25-2m/s and have a flood hazard rating of 'caution' to 'dangerous for most'. Extensive surface water ponding is present across the site, including a large area in the north-western part of the site. Flood depths are primarily between 0.3-0.6m, but some areas are deeper, over 1.2m. These areas have a flood hazard rating of 'caution' to 'dangerous for most'.
Reservoir	The site is not shown to be at risk of reservoir flooding from the available online maps.
Canals	The site is a significant distance from the Chesterfield Canal and would not be affected if the canal was to breach.
Groundwater	The Environment Agency Areas Susceptible to Groundwater Flooding dataset, provided as 1km grid squares, shows an area's susceptibility to groundwater flood emergence. The following comments can be made about groundwater flood risk: • The west and south of the site has a <25% susceptibility to groundwater flood emergence from superficial deposits. • The east of the site has a > = 75% susceptibility to groundwater flood emergence from superficial deposits.

	• The north of the site has a > = 25% 50% susceptibility to groundwater flood emergence from superficial deposits. This assessment does not negate the requirement that an appropriate groundwater regime assessment should be carried out at the site-specific FRA stage.
Sewers	The Level 1 SFRA indicates that three incidences of sewer flooding have occurred in the NG23 6 postcode area.
Flood history	The Environment Agency's historic flooding map shows that a significant part of the site has previously been flooded. NCC does not hold any records of flooding within 100m of the site.
Flood risk management infrastructure	
Defences	Flood defences are present upstream and downstream of the site. It appears that a structure along the boundary of the former power station restricted the extent of tidal and fluvial flooding. This wall has not been designated flood defence infrastructure by the Environment Agency. The effect of this structure should be further investigated as part of a site-specific FRA. If the structure is found to have a significant effect on flood risk to the site, any proposal will need to include plans for the replacement and/or ongoing maintenance of the structure.
Residual risk	The site is not protected by any formalised flood defences; therefore, an assessment of residual risk has not been carried out.
Emergency planning	
Flood warning	The site is in the Environment Agency's 'River Trent from Cromwell Weir to Gainsborough' flood warning area. The site is located in the Environment Agency's ' River Trent at High Marnham and Low Marnham' flood alert area.
Access and egress	Access and egress is not likely to be impacted by fluvial or tidal flooding, even in an extreme event, considering climate change. The existing access road is affected by surface water flooding in all flood events; it is recommended that future site access roads are designed to be away from areas of surface water flooding.
Climate change	
Implications for the site	• The site is not sensitive to increasing fluvial or tidal risk as a result of climate change. The upper end climate change scenario (+50%) was applied to the 1% AEP fluvial and 0.5% AEP tidal event for this assessment.In both scenarios, flooding remains limited to the area directly adajacent the river wih no significant increase in extent beyond the present day 0.1% AEP event on site. Flooding is more extensive in the lower surrounding areas in these scenarios however access and egress remains unaffected. • There is a significant increase in surface water flood extent between the 1% and 0.1% surface water events, indicating that surface water flood risk on site is highly sensitive 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- Mercia Mudstone Group- Mudstone, Penarth Group- Mudstone.
	  ○ Superficial- Alluvium- Clay, Silt, Sand and Gravel, Holme Pierrepont Sand and Gravel Member- Sand and Gravel.
	• Soils at the site consist of:
	  ○ Slightly acid loamy and clayey soils with impeded drainage.
	
	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 Mudstone and is likely to be poorly draining. Any proposed use of infiltration should be supported by infiltration testing. Off-site discharge, by the SuDS hierarchy, is required to discharge surface water runoff.

	• The site is not located within a Groundwater Source Protection Zone, and there are no restrictions over the use of infiltration techniques about groundwater quality. • 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 its impact on SuDS. The 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 site is within the Trent Valley Internal Drainage Board district who may have additional requirements regarding discharge rates (directly or indirectly) into their district. The IDB should be consulted during the detailed design of the site to establish the Board's requirements, and determine whether there will be a need to apply for surface water discharge or ordinary watercourse consents. Currently, should the site discharge into any open or culverted watercourse within the IDB this will require the Boards formal consent. Consent shall not be required where sites discharge into soakaways or directly into an EA Main River (the River Trent) however the Lead Local Flood Authority should be consulted. Developers should consult the IDB's **website** for further guidance. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates surface water flow paths during the 3, 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 receiving watercourse or asset's condition and capacity 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 more comprehensive 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 consider the impacts of future climate change over the projected lifetime of the development.
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 facilities are classified as 'less vulnerable'. As a result, the Exception Test is not required for the site.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • A site-specific Flood Risk Assessment will be required at the planning application stage as the development is more than 1ha in size and is in Flood Zones 2 and 3. • All flooding sources, particularly the risk of fluvial flooding and surface water, should be considered part of a site-specific flood risk assessment. The effect of the boubndary structure on flood risk to the site should also be quantified. If found to be acting as a food defence to the site, proposals should include plans for the replacement and/or ongoing maintenance of the structure for the life of the development. • The site-specific FRA should be carried out according to the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance, Bassetlaw Council's Local Plan policies, and the Nottinghamshire County Council Lead Local Flood Authority's Statutory Consultee for Planning Guidance Document. • The development should be designed using a sequential approach. Development should be steered away from fluvial flood risk areas, and surface water flow routes, preserving these spaces as green infrastructure. Development must be in line with Table 3: flood risk vulnerability and flood zone compatibility of the NPPG. • The development should be designed to ensure that mitigation measures are in place to ensure that ground-level space is used for less vulnerable parts of the development. **Guidance for site design and making development safe:**

- As a significant new development, any proposal should be accompanied by an overall Surface Water Management Masterplan and Strategy (SWMMS) which should cover:
    - How the cumulative effects of potential peak rates and volumes of water from development sites would impact on peak flows, duration of flooding and timing of flood peaks on receiving watercourses. This should be used to develop and implement appropriate drainage sub catchments and specific runoff rate and volume requirements for each phase of the development.
    - The risk of flooding from all sources, including for rainfall events greater than the design standard of the surface water drainage system should be taken into account to ensure there is no flood risk to new properties and that exceedance flows in extreme events are safely routed around those properties.
    - The consideration of how SuDS, natural flood management techniques, green infrastructure and green-blue corridors can be designed into the development master plan to facilitate drainage flood risk management and ensure wider benefits such as biodiversity, amenity, water quality and recreation are realised. This should be integrated with a restoration plan for watercourses and drains on site.
    - Based on the above, a Drainage Phasing Plan should be developed, based on the SuDS train method (considering firstly how water can be infiltrated/stored at a plot level, then conveyed through the site and any regional storage needs at a settlement level).
    - The provision of drainage during the building phase shall be based on the Drainage Phasing Plan to ensure adequate drainage is provided and implemented throughout the development life.
- The LLFA, Environment Agency and IDB should be consulted during the development of the Surface Water Management Masterplan and Strategy
- Compensatory flood storage is required for any land raising and all proposed buildings whenever built development on land within the 1% + climate change flood extent.
- Through an FRA, the developer will need to show that 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, the operation of any mitigation measures can be safeguarded and maintained effectively through the development's lifetime. (Para 048 Flood Risk and Coastal Change PPG)
- Safe access and egress will need to be demonstrated in the 1% AEP event, considering climate change (upper-end scenario), using depth, velocity and hazard outputs. The raising of access routes must not impact surface water flow routes. Consideration should be given to the siting of access points concerning areas of surface water flood risk.
- Built development should not be located within the at risk area adjacent the river.
- As part of the site-specific FRA, surface water flooding risk should be quantified, including a detailed surface water flooding model and the existing drainage system using topographical and asset survey data. To further determine the site's risk and ensure that runoff from the development is not increased by development across any surface water flow routes, a drainage strategy should help inform site layout and design to ensure no increase in runoff beyond current rates. Surface water mitigation measures should be designed for the 1% plus climate change event. The modelling should also determine the risk from surface water flooding further and to ensure that overland flows do not overwhelm future sustainable drainage features.
- Plans to address both fluvial and surface water flooding should integrate green infrastructure, which presents wider opportunities to improve biodiversity and amenity and climate change adaptation. An integrated flood risk management and sustainable drainage scheme for the site is advised.
- 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). Development on greenfield land should discharge at rates no greater than the existing greenfield rates for the 100% and the 1% rainfall events.
- Developers should refer to Nottinghamshire County Council's 'Nottinghamshire County Council's Guidance Note on the Validation Requirements for Planning Applications and the Level 1 SFRA for information on SuDS guidance on the information required by the LLFA from applicants to enable it to respond to planning applications.

Key messages

The site is predominantly located within Flood Zone 1, with a small area located in Flood Zones 2 and 3; employment facilities are classified as 'less vulnerable' therefore the Exception Test is not required. There is a significant risk of fluvial/tidal and surface water

flooding that must be considered further to ensure the development can be made safe from flooding and not increase flood risk elsewhere.

The development is likely to be able to proceed if:

- Development is located outside of areas at risk of flooding.
- A site-specific FRA, including a detailed water flood model and the existing drainage system using topographical and asset survey, is undertaken to further determine the risk from surface water to the site and ensure surface water flows do not overwhelm any planned SuDS features.
- If flood mitigation measures are implemented, they are tested to ensure that they will not displace water elsewhere (for example, if the 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. Given the degree of surface water flood risk and the location of the surface water flow path crossing the site, the development's density may need to be lowered to make space for water. Surface water mitigation measures should be designed for the 1% plus climate change event.
- 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 discharge rate should be achieved and agreed upon with the relevant drainage body (LLFA and Trent Valley IDB).
- New developments should adopt exemplar source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff. This should include allowance for climate change.

Mapping Information

The key datasets used to make planning recommendations regarding this site were the Environment Agency's Flood Map for Planning, flood modelling of the River Trent 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 are based on the Environment Agency's 2015 detailed 1D-2D Flood Modeller-Tuflow model. The undefended outputs of this model have been incorporated into the Flood Map for Planning. As the majority of the site lies behind an embankment, defended runs have been undertaken for the purposes of this assessment. These runs are based on the 5%, 1% and 0.1% AEP fluvial event combined with the 20% AEP tidal event.
Climate change	Results are based on the Environment Agency's 2015 detailed 1D-2D Flood Modeller-Tuflow model. The undefended outputs of this model have been incorporated into the Flood Map for Planning. However as the majority of the site lies behind an embankment, defended runs have been undertaken for the purposes of this assessment. This assessment is based on the 0.5% and 0.1% AEP Tidal events with the 50% fluvial event.
Fluvial depth, velocity and hazard mapping	The upper end climate change scenario (+50%) was applied to the 1% AEP fluvial and 0.5% AEP tidal events from 2015 detailed Flood Modeller-Tuflow models for this assessment. As More Vulnerable (residential) development is planned for this area this is an appropriate scenario in line with the current Environment Agency guidance on climate change allowances.
Surface Water	Outputs are taken from the defended runs of the Environment agency's 2015 detailed 1D-2D Flood Modeller-Tuflow model.
Surface water depth, velocity and hazard mapping	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.