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Sunderland Flood Risk Policy

Level 2 Strategic Flood Risk Assessment – Site Screening

Final Report

August 2018

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City of Sunderland Council

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Revision history

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June 2018	Draft Report	Gary Baker
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Contract

This report describes work commissioned by Gary Baker, on behalf of Sunderland City Council. Josh Rutherford and Howard Keeble of JBA Consulting carried out this work.

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Purpose

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Contents

1 Introduction

1.1 Local plan potential development site screening

To inform the Sequential Approach to the allocation of development through Sunderland City Council's upcoming Local Plan, JBA completed the Level 1 SFRA in 2017 and updated in 2018. Subsequently, one site was chosen as a potential Development Site where further, more detailed, site specific assessment was required to confirm the potential suitability of proposed development with respect to flood risk.

It is noted that there are no specific development or redevelopment options for the Port of Sunderland site at this time.

This report provides a summary table which incorporates the following:

- Screening Flood Risk Assessment;
- Outline drainage strategy;
- Level 2 site screening assessment.

The following assessment table describes the likely tidal, fluvial, groundwater, canal, reservoir and surface water (both offsite impacts and runoff generated by development) flood risks. In addition, flood risk mitigation options including requirements for further assessment are provided.

2 Site Appraisal Table

2.1 The Port of Sunderland

Designation Area	The Port of Sunderland
Site area (ha)	91.60
Developable area (ha)	67.10 (excluding the actual dock area)
Existing use	Port related developments and activities under Unitary Development Plan Policy SA2. In addition, adopted Policy SA6A.2 supports the redevelopment of land surplus to Port requirements within the wider area of the Port for employment generating uses.
Existing flood risk vulnerability classification	Water-compatible development.
Proposed use	Port related uses (Use Classes B1, B2 and B8). (Note - no specific development opportunities have been specified for this site. Flood risk to any proposed dock related facility will need to be appraised in detail as part of any site specific assessment. The FRA will need to include further consideration of detailed requirements for tidal and wave inundation modelling).
Proposed development flood risk vulnerability classification	Less Vulnerable. Essential Infrastructure. Water Compatible. (Mixed use – differing types of development will be subject to differing levels of testing – sequential and exception.)
Proposed development impermeable area (ha)	85% of total area (Assumed impermeable area) 57.00

Figure 1: EA Flood Map for Planning flood outlines (current day)

Designation Area	The Port of Sunderland

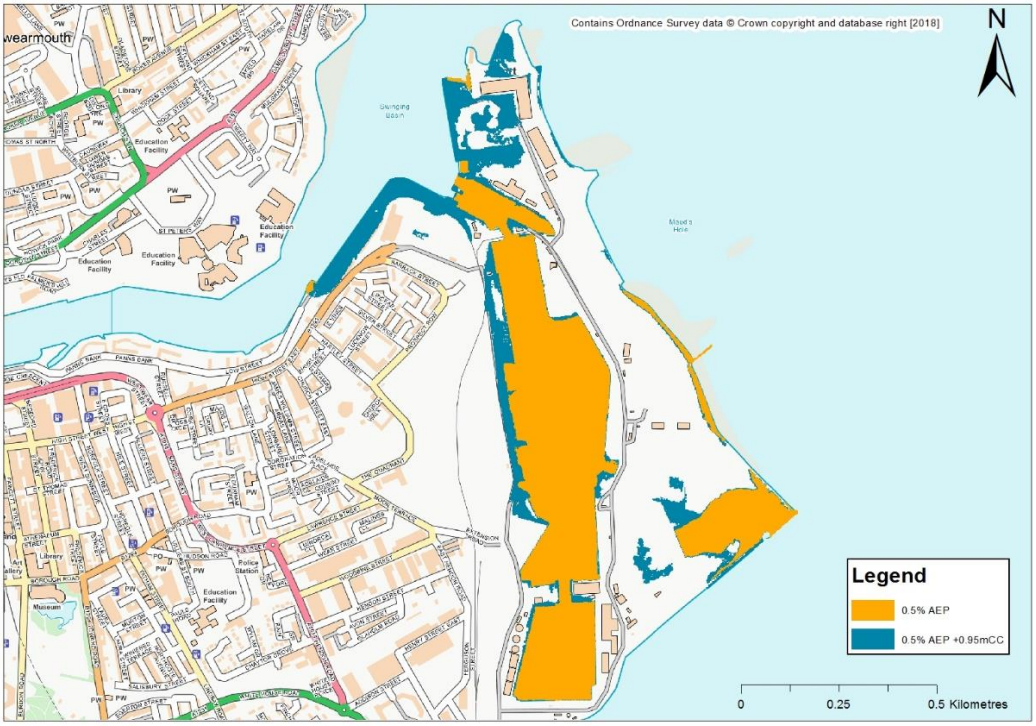

Figure 2: Extrapolated flood outlines for 0.5% AEP pre and post climate change (based on still water level and no defences).

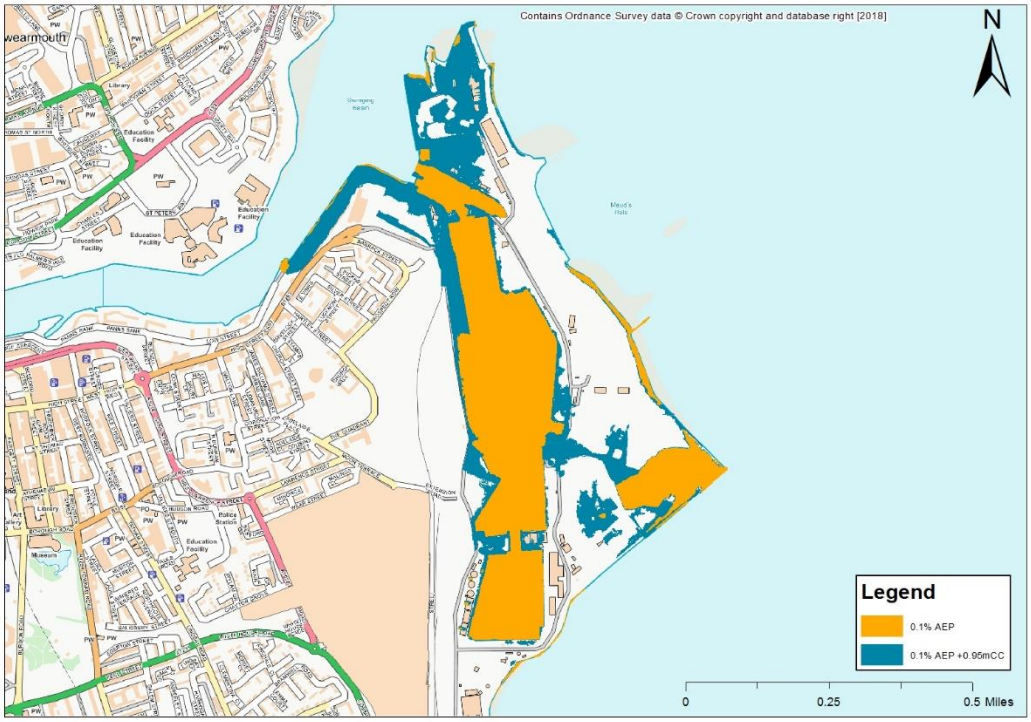

Figure 3: Extrapolated flood outlines for 0.1% AEP pre and post climate changed (based on still water level and no defences).

Designation Area	The Port of Sunderland

Figure 4: Surface water flood outlines (current day)

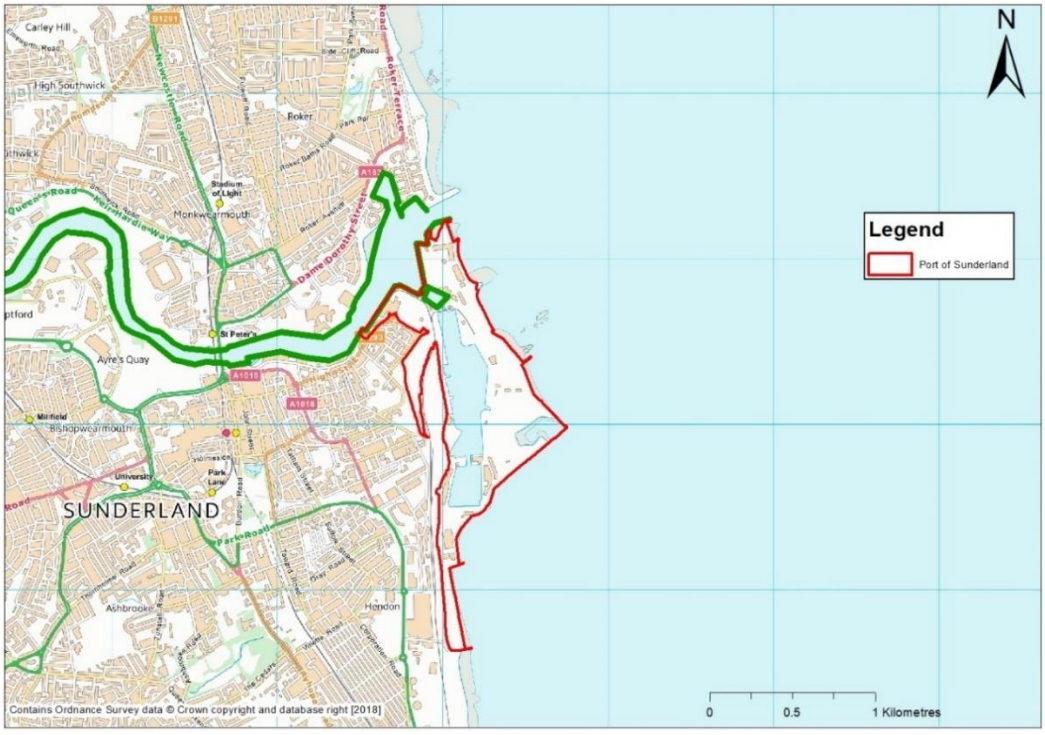

Figure 5: Flood defences (green) along the Wear Estuary

Designation Area	The Port of Sunderland

Available information: Review of EA published flood map (Figure 1)

In accordance with Figure 1; the majority of the site, approximately 54% of the developable area, is located within high risk Flood Zone 3. This outline represents an undefended scenario in terms of coastal defences and is based on the assumption that all defences fail. In this instance, the Wear Estuary is currently defended on both banks and these defences tend to mitigate and reduce flood risk to the dock (Figure 5). The extent of flooding appears to exceed both the 0.5% (including climate change) and the 0.1% (including climate change) still water tidal flood levels (Figures 2 and 3).

The EA have confirmed that extrapolated outlines do not reflect this mapped extent of flooding. The extent of flooding in this instance is likely to be based on a historic flooding event, however, no details or information have been provided for use in this assessment. As the published EA mapping, Figure 1 currently forms the primary mapping for evaluating flood risk at the port.

As the flood outline is not based on detailed modelling, hazard mapping is not available. Indicative depths of flooding are, therefore, based on flood extents and LiDAR levels. It should be noted that this approach produces wide ranging depths of maximum flooding and the variation in flood depth appears significant.

Depending on the type of proposed development and the associated vulnerability, a site-specific Flood Risk Assessment (FRA) will be required. The FRA may need to consider the impacts of wave, surge and overtopping in order to define accurate flood levels. The policy allocates the site for port related uses within Use Classes B1, B2 and B8. This is consistent with existing Policy SA2 of the adopted Sunderland Unitary Development Plan.

A comparison of LiDAR levels with flood extents indicates that the flood outline for both the 0.5% and 0.1% AEP events is approximately 5.21m AOD to 8.5m AOD (Figure 6). There is no substantive difference between the extents of flooding predicted for the 1% and 0.1% AEP events. It is also noted that some areas of land within the site are not indicated to be within the flood extent. This includes areas of land at with ground levels of 5.05m AOD.

No hazard mapping or climate change flood extents is available at this location.

Figure 6: Comparison of flood extents and LiDAR levels.

Designation Area	The Port of Sunderland

Extrapolated flood outlines based on still water tidal (including climate change) levels (Figures 2 and 3).

To enhance available information flood maps, additional maps have been prepared, based on extrapolation of tidal levels. The extrapolated flood outlines (Figures 2 and 3) are based on model tidal flood levels from the available 1-dimensional model (there is no 2-dimensional link to represent the floodplain and surrounding urbanised areas (EA model update 2017).

Flood outlines, based on the 0.5% AEP and 0.1% AEP tidal levels, have been generated based on LiDAR levels to generate a corresponding flood outline. This approach assumes flood water is free to bypass any defences, lock gates or embankments (ie a no defence scenario). Climate change has also been taken into consideration based on increasing design flood levels by 0.95m above the design tidal flood level.

Based on these flood outlines and assuming a 0.1% AEP event then 68% of the developable site will be available for development. In this instance, appropriate zoning of the development to avoid areas susceptible to flooding should ideally be considered (warehousing and industrial processes for example). Water compatible, and essential infrastructure relating to dock activities may still need to be located within the flood extent as defined by the 0.1% AEP outline (Figure 3).

As flood extents are based on still design water levels, depth and velocity mapping is not available.

JBA were provided with the 2016 Fatfield model. The EA have confirmed that the model was not developed for the port area, but the design tidal levels are suitable for the basis of extrapolating flood levels. Information from the provided model report, stated that the effects of climate change to the tidal limits was modelled by an increase in sea level by 0.95mAOD, as per the latest EA climate change guidance. Any FRA will need to take climate change levels into account at that time.

Tidal design event	Design level (m)	Design level + CC (m)
0.5% AEP (1 in 200yr)	3.94	4.89
0.1% AEP (1 in 1000yr)	4.23	5.18

Variation between the published mapping and the extrapolated flood extents

The EA Flood Zone Map has 0.1% AEP event levels ranging from 5.21m AOD to 8.5m AOD. This is a significant variation in design level. Without EA modelling this outline is understood to be based on historic accounts of flooding, however, the variation in flood level indicates a significant level of uncertainty in this instance.

Based on extrapolated flood levels the 0.1% AEP event including climate change is 5.18m AOD. This is significantly lower than the 1% AEP level assumed in the EA Flood Zone Map. Whilst the impact of wave action is likely to result in higher depths of flooding, standing water to depths of 8.5m AOD will not occur owing to the surrounding topography and lower lying areas of the port.

Designation Area	The Port of Sunderland

Observations and Recommendations

- The allocation is for port related uses, within Use Classes B1, B2 & B8, currently identified as less vulnerable (including water-compatible and essential infrastructure) development (in accordance with Table D.2 PPS25). This is an operational port site. The designation area is operational for potentially hazardous uses. Note - no specific development opportunities have been specified for this site. Flood risk to any proposed dock related facility will need to be appraised in detail as part of any site-specific assessment.
- Based on the published EA flood map (Figure 1), approximately 42% of the developable site area is located in Flood Zones 1 and 2 and is therefore, considered suitable for redevelopment. However, Flood Zones 1 to the east of the dock is likely to be surrounded by floodwater. This will prevent access during flood events and effectively results in 25% of the site, located on the western boundary, (17 ha) remaining for development (within low risk areas).
- Based on flood model levels (Figures 4 and 5), including climate change then the docks will be partially susceptible to climate induced inundation and 32% of the developable site will be at flood risk. Whilst this won't prevent development a detailed FRA will be required for proposed development within these areas. On the basis that flood risk is tidal, compensatory flood storage would not be required. Approximately 68% of the site is predicted to be located within Flood Zone 1) for the 0.1% AEP scenario. Development should, therefore, be prioritised where possible for within this lower risk area.
- No hazard mapping can be generated from the 1 dimensional model.
- Further land raising or raised infrastructure may be considered as part of longer term essential infrastructure planning as this approach will not increase tidal risk elsewhere. This will need to be considered further and confirmed as part of a site specific Flood Risk Assessment.
- Surface water flooding appears localised and so should not impact significantly on the development potential across the majority of the site. Surface water will tend to drain to the dock facilities.
- From the extrapolated mapping, the current access route to the site from the north is restricted for 0.5% AEP. The adjacent railway line may preclude a different access point to the southern side of the site, however if this could be achieved, safe access / egress can be maintained for the 0.5% AEP. The eastern side of the dock is connected to the western side south of the dock emergency access remains achievable even during the 0.1% AEP event.
- The Council is aware that once Climate Change is taken account of the existing site road is at risk of inundation. Future redevelopment will need to take safe access and egress into consideration including links to the proposed access road from site KEA1 to the port, and COMAH facilities (Figures 7 & 8). With depths of inundation to between approximately 5.21m AOD to 8.5m AOD a minimum road level cannot be defined at this stage.

Designation Area	The Port of Sunderland

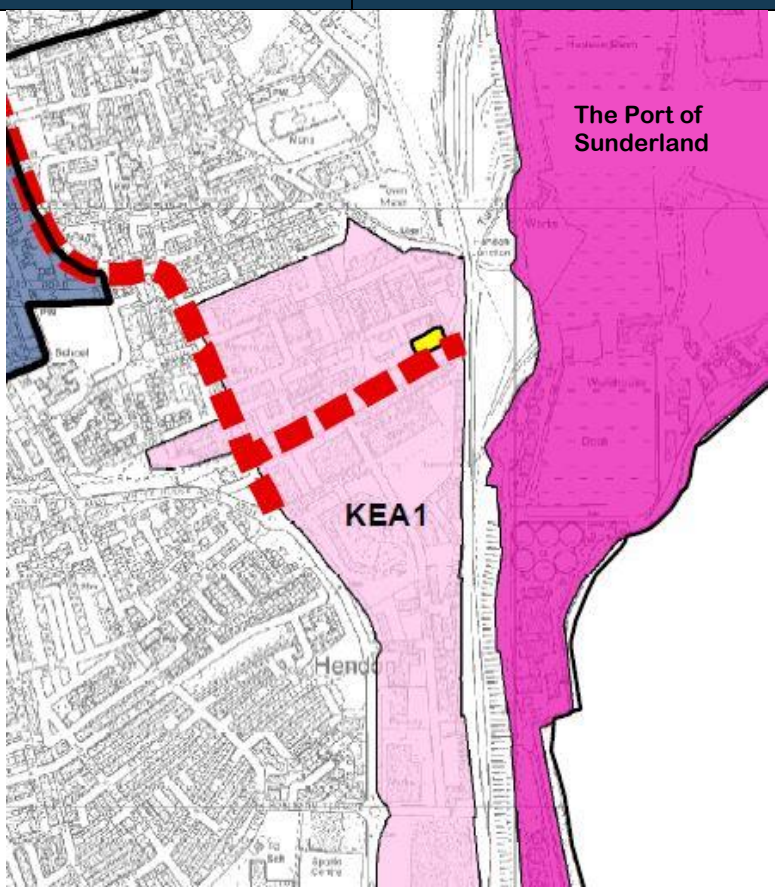

Figure 7: Proposed new access route to the port facility.

Figure 8: Indicative COMAH area

Designation Area	The Port of Sunderland		
Flood Source: Tidal (Based on extrapolated levels)			
Flood Zones (%) EA publish flood outline	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
	4.3	53.5	0.00
Flood Zones (%) EA model	Flood Zone 1		Flood Zones 2 and 3
	68		32
Climate change	Climate change impacts have been assessed by updating the existing model by increasing the peak tidal level by 0.95m (EA model report).		
Historic flooding	The Designation Area is not contained within the Environment Agency Historic flood outline.		
Defended	Available mapping and information indicates that the area is currently defended by flood defences to the north-western edge of the site. This is described as 'high ground around quays' to protect against overtopping from the tidal entry point. The Wear Estuary is currently defended on both banks. Following consultation with the LLFA; there are some historic raised defences along the shoreline which is assumed to offer some level of coastal protection. However, no available mapping or models are available to confirm the extents to which the site is protected. No standard of protection has been defined. The beneficial impacts of any existing or planned defence measures at the port site will need to be confirmed as part of the FRA.		
Flood Warning Area	The Designation Area is not contained within the Environment Agency Flood Warning Area outline.		
Flood risk	The site is situated adjacent to the coastline and as such has raised pockets of land on the edges closest to the sea. This reduces risk from tidal inundation during high tides. The rest of the site is relatively level and the main source of flood risk is posed by the sea. There are defences along the Wear Estuary which protect the site from the north.		
Mitigation options & site suitability	• The site will be afforded an additional level of flood protection in the form of the raised defences. The Standard of Protection provided by the crest level of these defences has not been confirmed by this assessment. The site may, therefore, be reconsidered on this basis; subject to confirmation of residual risks and overtopping assessment as part of a detailed Flood Risk Assessment. The Environment Agency will need to be consulted as to site specific flood risks at that time. • Provision for climate change should be made in the FRA ensuring the site will remain safe in the future, assuming current risk can be mitigated. • The FRA should also focus on the risk associated with the interactions between surface water and tidal flooding.		

Designation Area	The Port of Sunderland		
	• Access (including emergency access) across the site will need to take account of future flood levels. This will need to be determined based on site specific proposals and operational requirements.		
Flood Source: Groundwater			
Flood risk: groundwater	No groundwater mapping available however due to the type of the site and its proximity to the sea, no groundwater flooding is anticipated at this site.		
Flood Source: Infrastructure Failure – Reservoirs			
Flood risk: reservoir	Site is not within reservoir flood extents.		
Flood Source: Infrastructure Failure – Canals			
Flood risk: canal	There are no nearby canals to the Designation Area, therefore, no risk is recognised at the site.		
Flood Source: Surface Water			
Surface Water Flood Risk to Proposed Development Site			
Existing development: risk of flooding from surface water (%)	High Risk (3.33% AEP outline)	Medium Risk (1% AEP outline)	Low Risk (0.1% AEP outline)
	12.76	0.64	0.18
Surface water flooding depths (Note surface water is likely to be constrained to low spots on the site only. Discharge to the dock will limit actual depths of flooding)	Max: 0.30-0.60m Average: 0.15-0.30m	Max: 0.30-0.60m Average: 0.15-0.30m	Max: >1.20m Average: 0.30-0.60m
Climate change - EA model.	The current day 0.1% AEP outline provides an indication of the likely increase in depth and extent of the more frequent events as a consequence of climate change impacts. Operations, machinery or uses susceptible to flooding should ideally be located outside of these area.		
Surface water: flood risk to development site	There are localised areas of surface water flood risk throughout the site. The 'high risk' (3.33% AEP) areas are largely contained within the waters of the dockland area. For the 'low risk' (0.1% AEP) event there are some overland surface water flow paths from outside of the site boundary, however these appear to be draining towards the dock. These overland flow routes should be considered for the development layout plan and seek to avoid intersecting these paths to prevent surface water flooding at the development level. Access / egress around the site does not appear to be constricted by surface water flood risk however, this must be considered at an FRA level to ensure that the development plan for the site can achieve safe evacuation from the site during flood events.		

Designation Area	The Port of Sunderland
Surface water: mitigation options & site suitability	• As the site is in close proximity to the sea, free discharge may be permittable to sea. However, levels must be checked during detailed design to ensure that outfalls do not become tide-locked and surcharge flows onto the site. • SuDS options at the site are likely to be unsuitable due to the previous land use and therefore, any attenuation options to be considered are likely to be sub-surface measures. • Surface water flooding appears localised and so should not impact significantly on the development potential across the majority of the site. However, localised development areas will need to consider surface water based on location. Apart from localised areas the development area is not generally subject to a surface water flood risk. However, a site specific detailed surface water assessment and drainage strategy will be required as part of any FRA. The FRA will need to mitigate climate change impacts across the lifetime of the development. • The FRA should also assess the potential for offsite surface water impacts on the proposed development. This will need to include consideration of inflows from adjacent sites.

Indicative Surface Water Flood Risk from Proposed Development (for Designation Area in its Entirety)

Proposed development limiting runoff rate: Greenfield - FEH Statistical				QBar: 82.9l/s	
Design flood event (incl climate change)	Critical storm duration (capt) (Hrs)	Inflow volume (m^3)	Outflow volume (m^3)	Attenuation required (m^3)	Time to empty (assuming no infiltration) Hrs
3.33% AEP Rainfall+20%	42	52498	8774	43724	208.7
3.33% AEP Rainfall+40%	42	61248	8774	52473	250.5
1% AEP Rainfall+20%	42	70604	8774	61830 ($18106m^3$ of exceedance storage)	295.1
1% AEP Rainfall+40%	42	82372	8774	73597 ($21124m^3$ of exceedance storage)	351.3

Designation Area	The Port of Sunderland
Critical storm duration	A 40 hour storm duration has been considered to ensure that attenuation volumes overestimate the likely requirements. Surface water attenuation, if required, will need to then be prorated depending on development proposals
Climate change	Application of the central (20%) and upper band (40%) potential change anticipated for climate change in the table above shows the estimated attenuation volumes for the 3.33% and 1% AEP rainfall events.

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