



## NPPF: Detailed Drainage Assessment

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Monarchs Quay, Liverpool – All development Phases

**YPG Developments**

SHF.1380.001.D.R.001.A

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### Monarchs Quay, Liverpool – All development Phases

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## Executive Summary

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A Detailed Drainage Assessment has been undertaken for a proposed development, located, within a 5.5 ha wider Site at Monarchs Quay. The assessment is in response to, and addresses Liverpool City Council (the Local Lead Flood Authority) comments on Application 1A and addresses potential comments on Application 1B with consideration of future Site development.

It has been calculated that the proposed development will not change the impermeable surfaces and therefore runoff will remain the same.

The hierarchy of discharge has been considered and discharge of surface water will be to the existing private sewer network with subsequent discharge to the public sewer network and Mersey Estuary.

A CCTV survey has demonstrated that the site currently discharges to separate foul and surface water public sewer networks within Kings Parade via an existing, private network. The surface water discharges to the Mersey Estuary via a Ø900mm outlet at Half Tide Wharf and via a Ø1200mm outlet by the Liverpool Echo Arena. The foul water would be carried to a pumping station located at the northern end of Kings Parade and Gower Street, which pumps all foul waste from the Kings waterfront to the main sewer in Chaloner Street. It must be noted that no foul water currently leaves the wider Site.

A managed drainage scheme is proposed to manage excess surface water runoff from the wider Site, which includes all phases of proposed development, and comprises below ground cellular storage to retain and manage existing flooding in 1:100yr +40% storms, whilst retaining the existing private sewer network.

United Utilities have agreed to the proposed connection locations and unrestricted discharge rates set by the LLFA.

It is proposed that foul flows will maintain the current connection to the public sewer network.

The Detailed Drainage Assessment should satisfy and address the LLFA comments for the Application 1A submission and envisage comments for the Application 1B submission.

## 1.0 Introduction

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### 1.1 Background

- 1.1.1 Enzygo Ltd was commissioned by YPG Developments to carry out a Detailed Drainage Assessment to address Lead Local Flood Authority (LLFA) comments in response to planning application 17F/2490 for the development of an office building within an area of land off Monarchs Quay, Liverpool (hereafter referred to as 'the Site').
- 1.1.2 The proposal is for office development comprising of a single building, with a footprint of approximately 0.19 ha with associated landscaping and hardstanding, within a 1.33 ha redline boundary. A copy of the proposed layouts are included in Appendix 1.
- 1.1.3 The development redline boundary is located within a 5.5 ha 'wider Site' (hereafter referred to as the 'wider Site'). The Application 1A proposal forms the first phase of development within the wider Site (Appendix 1b), in which further developments entitled Application 1B and Stage 2 are proposed.
- 1.1.4 The purpose of this Detailed Drainage Assessment is to fulfil the completion of a detailed drainage assessment, as detailed within Flood Risk Assessment (*SHF.1380.001.HY.R.002.A Monarchs Quay Application 1\_FINAL*) and address LLFA comments in response to planning application 17F/2490.
- 1.1.5 The LLFA comments relating to planning application 17F/2490, and to which this drainage assessment is directed, are included below:
1. *The site has no history of flooding and is subject to no notable flooding from the predicted 1:30yr & 1:200yr flooding models. There are no watercourses (culverted, open and historic) shown on our records that cross or are close to the site and the area is not susceptible to high ground water levels shown on the EA groundwater model.*
  2. *Insufficient drainage information has been provided with the application and detailed flood and drainage design drawings are required otherwise we would recommend refusal of the application as it does not meet the Non-Statutory Technical Standards for Sustainable Drainage: Practice Guide, which has been produced by DEFRA as a supporting document to NPPF on which the requirements for a planning application with regards to surface water drainage are detailed. This has previously been supplied to the drainage consultant Enzygo.*
  3. *The proposed surface water discharge of 185 l/s is not acceptable as the receiving United Utilities surface water sewer is only 150mm dia and will be far in excess of the pipe capacity.*
  4. *The gradient of the existing 150mm dia surface water sewer should be established and then the maximum surface water discharge can be derived which should take into account any existing connections to this sewer.*
  5. *It should be noted that if the existing outfall to the R. Mersey is subject to tidal locking then any hydraulic modelling will need to show that for up to the 1:30yr critical rainfall event surface water is retained within the system and that for the 1:100yr+30% climate change allowance, critical rainfall event there will be no flooding to any buildings and any excess volumes of water will be retained on site.*

- 1.1.6 A second planning application relating to the second phase of development within the wider Site, entitled 'Application 1B' has been submitted. Comments relating to surface water drainage for Application 1B have not yet been received. However, it is envisaged that comments will be the same as those described above. Therefore, this drainage assessment aims to address the received comments for Application 1A and also envisaged comments for 1B as part of a holistic approach to drainage within the wider Site.
- 1.1.7 This drainage assessment report should be read in conjunction with the submitted flood risk assessment '*SHF.1380.001.HY.R.002.A Monarchs Quay Application 1\_FINAL*' and '*SHF.1380.001.HY.R.003.A Monarchs Quay Application 1B\_FINAL*'.

## 2.0 Sources of Information

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### 2.1 Sources of Information

The following information was used in preparation of this Drainage Assessment:

- Detailed topographic survey.
- United utilities sewer asset plans.
- Drainage Plans provided by Kings Waterfront Estates
- CCTV survey
- Flood Risk Assessment; Climate Change Guidance

### 2.2 Consultation and Discussion with Regulators

- 2.2.1 Consultation and discussions were undertaken with United Utilities and Liverpool City Council, who are the lead Local Authority.
- 2.2.2 United Utilities is responsible for the disposal of wastewater within the area. Copies of asset plans are included in Appendix 2 and United Utilities correspondence is included as Appendix 3.
- 2.2.3 The Lead Local Flood Authority (LLFA); Liverpool City Council, are responsible for surface water and drainage, groundwater and ordinary watercourses. A copy of LLFA correspondence is included within Appendix 4.



## 3.0 Site Location and Description

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### 3.1 Location

3.1.1 The wider Site is located on land at Monarchs Quay off Queens Wharf, Liverpool, L3 4FP.

3.1.2 The wider Site is centred on National Grid Reference (NGR) 334367, 389182.

3.1.3 The wider Site is approximately 5.5 ha in area, within which are a number development plots that are proposed to be developed as part of a staged approach;

Application 1A:

- **Application 1A:** 4 Storey Contact/Office Centre. Proposed building footprint area is 0.19 ha.

Application 1B:

- **Application 1b: Plot 2:** 5 Storey Interpretation Centre /Office use with ground floor Cafe (Less Vulnerable Use). Proposed building footprint is 0.017 ha
- **Application 1b: Plot 3:** Ground Floor Retail and Multi Storey Car Park. (Less Vulnerable Use). Proposed building footprint is 0.24 ha
- **Application 1b: Plot 4:** Ground floor Commercial, Food Hub and 120 apartments (More Vulnerable Use). Proposed building footprint is 0.36 ha

Application 2:

- **Stage 2: Plot 5:** Ice Rink
- **Stage 2: Plot 6:** Leisure facility including bowling complex, restaurants, bars and eateries
- **Stage 2: Plot 7:** 250 Apartments
- **Stage 2: Plot 8:** 250 Bedroom Hotel

### 3.2 Existing Use

3.2.1 The wider Site is accessed via the Queens Wapping bridge, which falls within the Site Redline boundary and links the island to the A562 to the East of Wapping and Queens Dock. The Queens Wapping bridge is the primary access and egress route to the Site and wider Site. An existing metalled road infrastructure is located within, and bounding, the wider Site, namely; Queens Wharf, Keel Wharf, Monarchs Quay, Kings Parade and Half Tide Wharf. Approximately (~) 2 Ha of the Site is currently laid to tarmac in the form of car parking. The remaining ~3.5 Ha comprises the existing metalled road network, brownfield land and areas of various hardstanding.

3.2.2 **Application 1A:** The Site has a current land use of car parking, metalled road, paved hardstanding and grassed areas. The Application 1A Site is 1.33 ha in area, of which 0.15 ha comprises private roads and hardstanding under the ownership, and responsibility of, Kings Waterfront Estates and does not form part of the proposed development.

3.2.3 **Application 1B:** The Site has a current land use of car parking, metalled road, paved hardstanding and grassed areas. The application 1B Site is 1.57 ha in area, of which 0.15 ha comprises private roads and hardstanding under the ownership, and responsibility of, Kings Waterfront Estates and does not form part of the proposed development.

- 3.2.4 **Stage 2:** The Site has a current land use of car parking, metalled road, paved hardstanding and grassed areas.
- 3.2.5 For a fuller description of the Site and wider Site, please refer to Flood Risk Assessment 'SHF.1380.001.HY.R.002.A Monarchs Quay Application 1\_FINAL' and 'SHF.1380.001.HY.R.003.A Monarchs Quay Application 1B\_FINAL'

### 3.3 CCTV Survey

- 3.3.1 To facilitate detailed drainage design, a CCTV survey was undertaken, on the 6<sup>th</sup> and 7<sup>th</sup> of November 2017, for the existing foul and surface water drainage network within the wider Site. The CCTV survey aimed to provide additional information on top of that obtained from an initial tracing/connectivity survey.
- 3.3.2 The initial tracing/connectivity survey determined that a separate foul and surface water network within the wider Site, with subsequent connection to the Public sewer network and discharge to the River Mersey estuary.
- 3.3.3 The results of the CCTV survey are included as Appendix 5. At the time of writing, a formal issue of the CCTV report and plans had not been received. The CCTV report will be submitted as Appendix 5 once received.

### 3.4 Existing network description

- 3.4.1 The drainage network within the Site and wider Site, is private and is the responsibility of Kings Wharf Ltd. All private sewers within the Site and wider Site are located beneath the existing roads, which are un-adopted and the responsibility of Kings Waterfront Estates.
- 3.4.2 A tracing/connectivity survey (Drawing 008 within FRA SHF.1380.001.HY.R.002.A Monarchs Quay Application 1\_FINAL') wrongly determined that a diversion between manhole SW04 to SW10 was completed during the construction of the Exhibition Centre Liverpool. This diversion was planned and approved, but was not completed. Instead, the exhibition centre was constructed over the surface water network, between manholes SW04 and SW08, as shown on Drawing 1380.001.D.100 and Drawing 1380.001.D.101, and no diversion occurred.
- 3.4.3 The build over was confirmed by the CCTV survey and through consultation with Kings Waterfront Estates, who also supplied fragmented design plans for the sewer network (Appendix 6).
- 3.4.4 The existing drainage network, as shown within Drawing SHF 1380.001.D.100 to Drawing SHF 1380.001.D.102, was determined from the CCTV survey and supplemented by plans supplied by Kings Waterfront Estates and the tracing/connectivity survey.
- 3.4.5 The 5.5 ha wider Site is served by two separate surface water drainage networks, termed 'Arena' and 'Half Tide Wharf' within this report and shown within Drawing SHF 1380.001.D.100 to Drawing SHF 1380.001.D.102.

**Drainage Network 'Half Tide Wharf':** Drainage Area 'Half Tide Wharf' serves a 4.67 ha area which includes the central and southern area of the wider Site as well as areas outside the wider Site to the south, as shown within Drawing SHF 1380.001.D.100 . Drawing area 'Half Tide Wharf' largely comprises of two main runs within Half Tide Wharf and Monarchs Quay. A Ø300 sewer routes southerly within Monarchs Quay from the junction with Queens Wharf to the junction with Half Tide Wharf. The sewer collects surface water from the car parks located to the east and west of Monarchs Quay, which includes the development Plot for Application 1A. At the junction between Monarchs Quay and Half Tide Wharf (Manhole

SW09), the Monarchs Quay sewer joins a Ø300mm sewer within Half Tide Wharf, before continuing westwards, along Half Tide Wharf, as a Ø375mm sewer, increasing to Ø450mm. At the junction of Half Tide Wharf and Kings Parade, the private sewer enters a public Ø600mm surface water sewer, which routes southwards, along Kings Parade, before discharging to the Mersey Estuary via a flapped Ø900mm diameter outfall. With an invert of 4.2 mAOD.

**Drainage Network 'Arena':** Drainage Area 'Arena' serves a 11.75 ha area which includes the central and northern area of the wider Site, as well as areas outside the wider Site to the north, as shown within Drawing SHF 1380.001.D.101-102. The drainage area comprises of two main runs within Queens Wharf and Keel Wharf. A Ø300mm sewer routes westerly, along Queens Wharf before increasing to Ø525mm at the junction with a Ø525mm sewer within Keel Wharf. Following a further Ø225mm input from Monarchs Quay, the sewer increases to Ø600mm before passing under the Exhibition Centre Liverpool and joining a Ø750mm public surface water sewer within Kings Parade. The Ø750mm public surface water sewer routes northwards along Kings parade before discharging to the Mersey Estuary via a Ø1200mm flapped outfall, with an invert of 3.1 mAOD

- 3.4.6 The CCTV survey also included the United Utilities public sewers located on Kings Parade, which also includes the outfalls to the Mersey Estuary. The survey has shown that there are two sewers, of which one routes northwards and one routes southwards, with the 'break' adjacent to the southern corner of the Exhibition Centre.
- 3.4.7 During the CCTV survey, significant volumes of construction waste, in the form of concrete and rubble, was found within both surface water networks along with large quantities of sand and silt. Large quantities of sand and silt was also found within the 'Arena' section of the United Utilities public surface water sewer on Kings Parade.
- 3.4.8 The CCTV survey coincided with a period of high spring tides, which peaked at 4.9 mAOD, resulting in surcharging of both the Ø900mm and Ø1200mm flapped outfalls. During the survey, tidal ingress was noted through the Ø1200mm outfall for 'Arena', indicating failure of the flapped outfall and a source of noted quantities of sand and silt within the network.
- 3.4.9 No tidal ingress was noted through the Ø900mm outfall for 'Half Tide Wharf'.
- 3.4.10 Asset plans supplied by United Utilities (Appendix 2) shows the public surface water sewer, located on Kings Parade, to be Ø150mm. This was highlighted within the LLFA comments amid concerns that estimates of unattenuated, impermeable runoff volumes from the Site would be significantly greater than sewer capacity. The sewer size was queried with United utilities, who responded with:

*'In response to your query, I can confirm the size shown on our plan is the information we have on record. If you are developing the Site, can you please contact our developer services or arrange a CCTV survey to confirm the details you require'.*

- 3.4.11 The subsequent CCTV survey has confirmed that the United utilities public surface water sewer, into which the 'Half Tide Wharf' Site private network connects, is Ø600mm with a gradient of 1:450. The outfall, to which the public sewer discharges, has been confirmed as Ø900mm. As such, the supplied United Utilities asset plans are incorrect, and the public surface water sewer network does not present a constraint, with regards to sewer size, to discharges from the Site.

The CCTV survey also demonstrated that the public surface water sewer, located on Kings Parade, into which the 'Arena' drainage network connects is Ø750mm. United utilities assets plans show the southern extent of the public surface water sewer to be Ø600mm. The United utilities asset plans for this section are therefore considered to be incorrect.

- 3.4.12 Information regarding the United Utilities sewers, gained through the CCTV survey, including the apparent flapped outfall failure will be supplied to United Utilities, so they can update their records.

## 4.0 Site Drainage

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### 4.1 Surface Water Drainage

- 4.1.1 A surface water management strategy for the development is proposed to manage and reduce the flood risk posed by surface water runoff from the Site. The developer will be required to ensure that any scheme for surface water should build in sufficient capacity for the entire Site.
- 4.1.2 The surface water drainage arrangements for any development Site should be such that the volume and peak flow rates of surface water leaving a developed Site are no greater than the rates prior to the proposed development, unless specific off-Site arrangements are made and result in the same net effect.
- 4.1.3 An assessment of the surface water runoff rates was undertaken to determine the surface water options and attenuation requirements for the Site.

### 4.2 Existing Drainage System

- 4.2.1 The CCTV survey has confirmed that the wider Site has an existing separate surface water and foul drainage network that enters the public sewer network on Kings Parade before discharging at unrestricted rates to the River Mersey Estuary.
- 4.2.2 The proposed development areas are located as follows:
  - **Application 1A:** Located wholly within drainage area '*Half Tide Wharf*' with discharge to the Ø900mm Mersey outfall.
  - **Application 1B:** Plot 4 is located wholly within drainage area '*Half Tide Wharf*' with discharge to the Ø900mm Mersey outfall.
  - **Application 1B:** Plot 3 is located within drainage area '*Arena*' with discharge to the Ø1200mm Mersey outfall.
  - **Stage 2:** 'Other Hotel' is located wholly within drainage area '*Half Tide Wharf*' with discharge to the Ø900mm Mersey outfall.
  - **Stage 2:** 'Other Ice rink, leisure facility and Apartments' are located wholly within drainage area '*Arena*' with discharge to the Ø1200mm Mersey outfall.
- 4.2.3 As all phases of development will connect to the existing drainage networks, this drainage assessment considers all phases as part of a holistic approach. As such, the impact of all phases will be considered as part of an overall surface water management strategy.
- 4.2.4 Application 1B Plot 2 is proposed to discharge directly to the Queens Dock and will not connect to either the '*Arena*' or '*Half Tide Wharf*' drainage networks. The LLFA have stated that discharge to the Queens Dock can occur at unrestricted rates and consultation is ongoing with the Canal and Rivers Trust. As such, Application 1B Plot 2 will not be considered further within this drainage assessment.

### 4.3 Proposed Development

- 4.3.1 The wider Site, in which all proposed phases of development will be located, is currently 100% impermeable, consisting primarily of metalled roads, hardstanding and tarmacked car parks. Some grassed areas are located within the wider Site; however, it is highly likely that these are engineered areas with limited infiltration and storage potential. The proposed development

will not increase impermeable area. The existing and proposed impermeable areas are shown in Table 4.1.

**Table 4.1: Impermeable Area**

Area	Existing Buildings and Hardstanding	Proposed Buildings and Hardstanding	Difference
Area (ha)	5.5	5.5	0
Percentage of Total Site Area (%)	100	100	0

- 4.3.2 The proposed development will maintain the existing impermeable area and therefore maintain existing runoff volumes. As previously stated, this drainage assessment considers all phases of development as part of a holistic approach to the surface water drainage strategy.
- 4.3.3 Through correspondence the LLFA have acknowledged that the proposed development phases will not increase impermeable area. (Appendix 4).
- 4.3.4 Subsequent development phases, entitled 'Application 1B' and 'Stage 2: Others' will also connect to the existing surface water drainage network and will also be constrained by the existing network capacity. To ensure that the existing network has the capacity to accommodate all phases of development, and to ensure that subsequent development does not offer detriment, in terms of flood risk, the modelling exercise and drainage design considers all proposed development, which will connect to either the 'Arena' and 'Half Tide Wharf' drainage areas.

#### **4.4 Runoff Rates**

- 4.4.1 Through consultation with the LLFA (Appendix 4), unrestricted discharge rates to the River Mersey or Queens and Wapping dock would be permitted, however there would need to be a high degree of confidence that any flows for the 1:100yr event with allowance for 30% climate change would not cause any flooding to properties connected to the upstream drainage network which will be dependent on the detailed drainage design and details of the existing network being connected to.
- 4.4.2 A pre-development application was submitted to United Utilities (Appendix 3) regarding the discharge of surface and foul water to the sewer network located on Kings Parade, via the existing connections. United Utilities responded and stated that:
- 'In lieu of the above, UU would not be able to comment upon any proposed discharge rates as that would be a matter for the LLFA. I can state on behalf of UU that as it's obvious the said sewerage system was installed in readiness for the future development, we would have no objection in principle to the perceived wastewater flows ultimately communicating with the respective public sewerage systems'.*
- 4.4.3 Based on the above consultations, drainage design has been based upon un-restricted rates, from a regulatory point of view, to the United Utilities surface water sewers on Kings Parade and River Mersey estuary, hence maintaining the existing arrangement. However, discharge volumes will be restricted, through attenuation, to meet the existing network constraint determined during the existing network modelling exercise.

- 4.4.4 Existing runoff rates for both drainage networks have been calculated and are included within Appendix 7 and summarised within Table 4.2.

**Table 4.2: Existing Runoff Rates**

Annual Probability (Return Period, years)	Existing Runoff (l/s) 'Arena' drainage area	Existing Runoff (l/s) 'Half Tide Wharf' drainage area
100% (1)	633	350
3.33% (30)	1670	953
1% (100)	1963	1185
1% + Climate Change	2148	1425

#### 4.5 Surface Water Management Strategy

##### *i. Hierarchy of Discharge*

- 4.5.1 Flood Risk Assessments 'SHF.1380.001.HY.R.002.A Monarchs Quay Application 1\_FINAL' and 'SHF.1380.001.HY.R.003.A Monarchs Quay Application 1B\_FINAL' have considered the Hierarchy of Discharge and concluded that discharge will be to existing private sewer, with subsequent discharge to the Mersey Estuary, via the United utilities public sewer network, therefore maintaining the existing Site drainage.

##### *ii. Choice of SuDS Options*

- 4.5.2 Sustainable water management measures should be used to control the surface water runoff from the proposed development Site, thereby managing the flood risk to the Site and surrounding areas from surface water runoff. In the case of the wider Site, unrestricted discharge to the Mersey Estuary is permitted.
- 4.5.3 Current guidance promotes sustainable water management using SuDS. Options applicable to this Site are identified in Table 4.3.

**Table 4.3: SuDS Options**

Green roofs	Infiltration basins
Water butts	Detention basins
Permeable paving	Oversized pipes
Rainwater harvesting	Brown roofs
Filter strips	Swales
Wetland Areas	Cellular Storage

**Note:** SuDS appropriate to the development are highlighted green



- 4.5.4 SuDS options available to the proposed development phases within the wider Site are limited and constrained by the existing developed nature of the wider Site, presence of an existing drainage network, presence of made ground and possible subsurface contamination and development within pre-determined development plots.
- 4.5.5 Attenuation features will be designed to be located within each development plot with connection to the existing drainage network. As previously discussed, attenuation is not required to restrict discharge rates based on the discharge receptor, in this case the public sewer network and Mersey Estuary, but is required to ensure that the existing network is not detrimentally affected by proposed works.

*iii. SuDS Maintenance*

- 4.5.6 Above ground SuDS features are not considered feasible due to limited space within the individual development plots and constraints posed by the existing highway infrastructure. As such, subsurface cellular storage is proposed.
- 4.5.7 Maintenance of the SuDS features would be in line with the SUDS Manual (CIRIA C753, 2015), as detailed in Figure 4.1. The maintenance would be undertaken by a private maintenance company.

**Figure 4.1: Storage Tank Operation and Maintenance Requirements (Table 21.3 of the SUDS Manual)**

<b>TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks</b>			
	<b>Maintenance schedule</b>	<b>Required action</b>	<b>Typical frequency</b>
	Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
		Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
		For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
		Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
	Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
	Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
		Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

*iv. Drainage Design*

- 4.5.8 The existing surface water network will be retained, as per the CCTV survey, within both drainage areas. No changes to either drainage area are proposed.
- 4.5.9 As the existing drainage network discharges to the River Mersey Estuary, the LLFA requested that tidal locking was considered.
- 4.5.10 The most influential component of extreme tidal levels is the astronomical component, which determines the pattern of low and high tide, as well as spring and neap tides. The astronomical



tidal component is unrelated to weather systems which would generate extreme rainfall events, such as the 1 in 30 and 1 in 100-year events. As such, assessment of a concurrent extreme rainfall and tidal event is considered highly improbable and would result in over design.

- 4.5.11 Based upon joint probability and unrelated nature of extreme rainfall and tidal events, the drainage modelling exercise utilised a Mean High-Water Spring (MHWS) tidal level, with climate change to the year 2115 to account for sea level rise during the lifetime of all development phases. The modelled tidal levels are as follows, as taken from the National Tidal and Sea level facility.

**Mean High Water Spring Level (m) (years 2008 to 2026)<sup>1</sup>:** 9.39m

**Chart datum<sup>2</sup>:** -4.93m

**Mean High Water Spring Level (mAOD) = 9.39 + (-4.39) = 4.46 mAOD.**

**Sea level Rise:** Assuming a development lifetime of 100 years to the year 2115, as described within '*Flood Risk assessments: Climate change allowances*'<sup>3</sup>, sea level rise would be 0.99m.

**MHWS for the year 2115:** 4.46 mAOD + 0.99m = 5.45 mAOD.

- 4.5.12 Use of the Mersey Estuary MHWS tidal level as the downstream level within the drainage models was sent to the LLFA (Appendix 4), however, no response was received.
- 4.5.13 All drainage model runs have included a 3-hour surcharge level of 5.45 mAOD.

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<sup>1</sup> <http://www.ntsif.org/tgi/portinfo>

<sup>2</sup> <http://www.ntsif.org/tides/datum>

<sup>3</sup> Flood Risk assessments: Climate change allowances, Environment Agency, Flooding and Coastal change, 19th February 2016.

#### 4.6 Surface Water Management Calculations and Results

- 4.6.1 Two Windes models, based upon the topographic survey, CCTV survey, Kings Waterfront Estates plans and tracing survey were created for both existing surface water drainage networks (Appendix 7a and 7b). Model results showed that the existing surface water drainage system does flood in extreme storm events, and demonstrates that the drainage system installed was likely only designed for 1:30 year storm events. Ponding is shown to occur within the carpark areas diffuse discharge into the Mersey Estuary and Liverpool Docks using the existing road network as conveyance pathways. This is the case for both the 'Arena' and Half Tide Wharf' drainage networks. Flooding volumes and locations, for the existing scenario, are shown within Tables 4.4 and 4.6.
- 4.6.2 A proposed model was constructed, for Application 1A to demonstrate that, in isolation its construction will not be detrimental to the existing wider site network (Appendix 7c). Drainage design includes adding 259m<sup>3</sup> of attenuated storage to reduce peak flooding incidences around the proposed building to levels that would be containable within the development redline boundary and would improve existing flooding experienced within the existing road network. 100m<sup>3</sup> of attenuated storage was also included for the proposed Keel Wharf extension, which does not form part of the wider Site phased development, but will discharge to, and add catchment to, the existing Half Tide Wharf drainage network. The proposed drainage design and attenuation, for Application 1A, is shown within Drawing SHF 1380.001.D.110, with a summary of results presented within Table 4.4.

**Table 4.4: Half tide Wharf Drainage Area for Application 1A for the 1:100yr +30% Climate**

Change Event			
Pipe reference Existing/Proposed	Existing Site flooding volume (m3)	Proposed final site flooding volume (m3)	Comments
1.000/1.003	68.889	0	No longer floods
2.000	49.680	11.504	Reduction in existing flooding levels in Monarchs Quay and excess water will flow down the road and into the dock
2.001	123.871	60.045	
2.002	48.284	5.752	
2.003	9.595	0.111	
1.001/1.004	46.083	0.091	Reduction in existing flooding levels in Halftide Wharf and excess water will flow down the road and into the dock
1.002/1.005	36.228	24.512	
4.000/6.000	5.353	5.03	
5.000/7.000	0.092	0	No longer floods
Totals	615.965	107.045	83% reduction in onsite flooding

- 4.6.3 Proposed models, for Half Tide Wharf drainage area, were constructed, for Application 1A and Application 1B, to demonstrate that the cumulative impact of both development phases discharging to 'Half Tide Wharf' drainage area will not be detrimental to the existing wider site network (Appendix 7d). The proposed models include Application 1A and Application 1B Plot 3 discharging to the Arena drainage area. Drainage design includes adding 196m<sup>3</sup> of attenuated storage within Application 1B Plot 3 (Car park and shopping area) but due to lack of external space this will need to be located beneath the building floor slab and will need to

be accommodated into the structural design of the foundations. A Bypass Oil Separator was also added in line with PPG3 guidance due to the number of vehicle spaces exposed on the car park to mitigate against a risk of a fuel and oil spillages. The proposed combined drainage design and attenuation, for Application 1A and Application 1B Plot 3, is shown within Drawing SHF 1380.001.D.120 with a summary of results presented within Table 4.5.

**Table 4.5: Half tide Wharf Drainage Area for Application 1A and Application 1B Plot 3 for the 1:100yr +30% Climate Change Event**

Pipe reference Existing/Proposed	Existing Site flooding volume (m3)	Proposed final site flooding volume (m3)	Comments
1.000/1.003	68.889	0	No longer floods
2.000	49.680	0	No longer floods
2.001	123.871	4.372	Reduction in existing flooding levels in Monarchs Quay and excess water will stored in the road area
2.002	48.284	0.068	
2.003	9.595	0	No longer floods
1.001/1.004	46.083	0	No longer floods
1.002/1.005	36.228	0	No longer floods
1.003/1.006	0	15.947	New flooding in the road is due to the building discharge, reductions in flooding upstream still offer flooding in this road as a reduction
4.000/7.000	5.353	4.956	Reduction in existing Flooding in Kings Parade
5.000/8.000	0.092	0.450	Minor flooding due to changes in volume from the 1b Development but is still a reduction on flooding in Kings Parade
<b>Totals</b>	<b>615.965</b>	<b>25.793</b>	<b>96% reduction in onsite flooding</b>

- 4.6.4 A proposed model was constructed, for Application 1B Plot 4, to demonstrate the impact of the proposed development discharging to the 'Arena' drainage area will not be detrimental to the existing wider site network (Appendix 7e). Drainage design includes adding 432m<sup>3</sup> of attenuated storage to Application 1B Plot 4 (Residential development) to reduce peak flooding incidences around the building to levels that would be containable within the redline boundary and would improve existing flooding experienced within the existing road network. The proposed drainage design and attenuation, for Application 1B Plot 4, within the Arena drainage area, is shown within Drawing SHF 1380.001.D.121 with a summary of results presented within Table 4.6.

**Table 4.6: Arena Drainage Area for Application 1B Plot 4 for the 1:100yr +30% Climate Change Event**

Pipe reference Existing/Proposed	Existing Site flooding volume (m3)	Proposed site flooding volume (m3)	Comments
1.000	266.017	251.047	Reduction in existing flooding levels in Wharf Road and excess water will be channelled by the road to the dock as existing
1.001	36.069	36.341	
1.002	1.698	2.919	
1.003	163.242	107.780	
1.004	227.997	139.956	
3.000	0.234	0	No longer floods
4.000	57.375	0	No longer floods
1.005	11.952	0.685	Reduction in existing flooding levels in the road with excess water channelled by the road to the dock/estuary as existing
5.000	41.300	33.447	
6.000	56.321	54.146	Reduction in total Flooding in the Exhibition centre loading area
6.001	0	0.160	
7.000	28.901	27.170	
1.010	137.014	102.910	Reduction in existing flooding in Kings Parade
8.000	64.035	63.313	Reduction in existing flooding levels in the road with excess water channelled by the road to the dock/estuary as existing
9.000	119.468	118.525	
8.001	267.501	258.662	
8.002	1.481	0.866	
10.000	32.786	32.555	Reduction in existing flooding by the arena
8.004	45.263	40.512	Reduction in existing flooding levels in the road with excess water channelled by the road to the dock/estuary as existing
8.005	1.546	1.303	
1.011	0.132	0.203	Reduction in existing flooding in Kings Parade
11.001	23.622	17.236	Reduction in existing flooding by the arena
<b>Total</b>	<b>1343.954</b>	<b>1289.736</b>	<b>4% reduction in onsite flooding</b>

4.6.5 Proposed models were constructed for Phase 2 'Other' which incorporates all potential phases of development within the wider Site., in order to demonstrate that subsequent development of the Site will not be detrimentally affected by any of the new development and that existing flooding issues will not detrimentally affect the proposed developments (Appendix 7f and 7g) To achieve this, 1095m<sup>3</sup> of below ground attenuation has been added to the network, primarily within Phase 2 Plots 5 to 7, to reduce peak flooding incidences around the whole

site. Table 4.7 and 4.8 below indicate that proposed drainage systems for both networks would exacerbate existing flooding and will improve the wider Site drainage capability whilst achieving current legislative requirements for the new buildings. While some flooding still occurs in the extreme 1:100+30% storm, the flood water is greatly reduced from the existing scenario and is wholly contained within the confines of the completed network and the wider site boundary without compromising safety or property. The proposed drainage design and attenuation, for Phase 2 'Other', within the 'Arena' and 'Half Tide Wharf' drainage area, is shown within Drawings SHF 1380.001.D.130 to SHF 1380.001.D.132 with a summary of results presented within Tables 4.6 and 4.7.

**Table 4.7: All Phases of Development within Half Tide Wharf Drainage Area flooding 1:100yr +30%**

Pipe reference Existing/Proposed	Existing Site flooding volume (m3)	Proposed final site flooding volume (m3)	Comments
1.000/1.003	68.889	0	No longer floods
2.000	49.680	4.140	Remaining flooding will be contained in the road channel
2.001	123.871	0.049	
2.002	48.284	0	No longer floods
2.003	9.595	0	No longer floods
1.001/1.004	46.083	0	No longer floods
1.002/1.006	36.228	11.767	Remaining flooding will be contained in the road channel
1.003/1.007	0	0.218	
4.000/7.000	5.353	6.013	
5.000/8.000	0.092	1.171	
<b>Totals</b>	<b>615.965</b>	<b>23.358</b>	<b>96% reduction in onsite flooding</b>

**Table 4.8: All Phases of Development within Half Tide Wharf Drainage Area flooding 1:100yr +30%**

Pipe reference Existing/Proposed	Existing Site flooding volume (m3)	Proposed site flooding volume (m3)	Comments
1.000	266.017	2.465	Reduction in existing flooding levels in Wharf road
1.001	36.069	0	No longer floods
1.002	1.698	0	
1.003	163.242	0	
1.004	227.997	0	
3.000	0.234	0	
4.000	57.375	0	
1.005	11.952	0	
5.000	41.300	0	
1.008	0	24.289	This flooding is new but will be taken by the existing exhibition centre carpark drain which has been reduced by 28m3 and is designed to flood currently
6.000	56.321	37.982	Existing flooding in the Exhibition centre carpark reduced
6.001	0	0.070	
7.000	28.901	24.107	
1.010	137.014	31.070	Reduction in existing flooding levels in Kings Parade
8.000	64.035	7.314	Remaining flooding will be contained in the road channel
9.000	119.468	37.098	
11.000	0	0.060	Minimal flooding in a grassed area in the extreme event
10.002	0	0.377	
8.001	267.501	128.659	Reduction in existing flooding levels by the existing carpark, excess flood flow will be stored in the road or in Wharf Road
8.002	1.481	0	No longer floods
10.000/13.000	32.786	22.398	Reduction in existing flooding levels at the Arena
8.004	45.263	14.455	Remaining flooding will be contained in the road channel
8.005	1.546	0.092	
1.011	0.132	0	No longer floods
11.001/14.001	23.622	17.149	Reduction in existing flooding levels at the Arena
<b>Total</b>	<b>1343.954</b>	<b>347.578</b>	<b>74.1% reduction in flooding</b>

- 4.6.6 As previously stated, the LLFA permitted unrestricted discharge to the Mersey Estuary. The drainage models discussed above show that runoff rates in high probability storm events will likely see a reduction in peak runoff rates. Extreme events will likely see negligible differences in peak discharges due to exceedance of maximum pipe capacity. Variations in peak discharge rates are summarised within Table 4.9 below. However, during extreme events, the proposed design, and attenuation, will greatly reduce surface flooding that would otherwise have diffusely discharged into the Docks or Mersey Estuary, therefore providing more sustainable surface water drainage management.

**Table 4.9: Proposed Runoff Rates following Development and Mitigation**

Annual Probability (Return Period, years)	Proposed Runoff (l/s) 'Arena' drainage area	Existing Runoff (l/s) 'Arena' %	Proposed Runoff (l/s) 'Half Tide Wharf' drainage area	Existing Runoff (l/s) 'Half Tide Wharf' %
100% (1)	566.3	-10.5%	321.7	-8.0%
3.33% (30)	1605.4	-3.9%	939.4	-1.4%
1% (100)	1849.7	-5.8%	1185.1	0.0%
1% + Climate Change	2172.4	+1.1%	1475.1	+3.5%

#### 4.7 Foul Drainage

- 4.7.1 An existing foul network is located within the Site and wider Site, as shown within drawings 1380.001.D.101-102. United Utilities have confirmed that the adopted network in Kings Parade had been designed to accommodate for the development areas when the existing private network onsite was constructed (Appendix 3).
- 4.7.2 Drawing 1380.001.D.110 shows a proposed foul network for Application 1A, connecting to the existing manhole FW01, on the existing Ø150mm foul sewer within Half Tide Wharf.
- 4.7.3 Drawing 1380.001.D.120-121 shows a proposed foul network for Application 1B. Application 1B Plot 3 will connect to the existing manholes, FW07 and FW27, located in the roads around the building. Application 1B Plot 4 will discharge to a new manhole between existing manholes FW12-FW14. Both of these new developments are located on the existing Ø225mm foul sewer that passes under the Exhibition Centre Liverpool.
- 4.7.4 Drawing 1380.001.D.121 shows the proposed Application 1B Plot 2 development. The foul system for will be a combination gravity from floors 2-5 and a localised pumped system from floor 1. The foul will be discharged to the foul sewer in Chaloner Road.
- 4.7.5 Foul provision for Stage 2 development has not been included within the drainage design drawings, but the locations of the existing sewers within 10m of the proposed development plots will enable connection to the existing network via a suitable foul system
- 4.7.6 Following a pre-application enquiry with United Utilities (Appendix 3), It was stated that  
*'I can state on behalf of UU that as it's obvious the said sewerage system was installed in readiness for the future development, we would have no objection in principle to the perceived wastewater flows ultimately communicating with the respective public sewerage systems'.*  
 Based upon the United Utilities response, United Utilities have already accounted for wastewater flows from development of the wider Site to the Kings Parade foul sewer.

## 5.0 Summary and Conclusions

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### 5.1 Introduction

- 5.1.1 A Detailed Drainage Assessment has been undertaken for a phased development within a 5.5 ha wider Site on land off Monarchs Quay. The assessment is in response to, and addresses the LLFA's planning comments.

### 5.2 Site Drainage

#### *Surface Water*

- 5.2.1 It has been calculated that the proposed development will maintain the existing impermeable area and therefore maintain the existing runoff volumes.
- 5.2.2 A CCTV survey has demonstrated that the wider site currently, discharges via a private surface water sewer network located within the wider Site, to a United Utilities outfall network into the Mersey River.
- 5.2.3 An attenuated drainage scheme, that considers all phases of development, is proposed to manage excess runoff from the developments, comprising below ground attenuation to reduce existing onsite flooding events. This has resulted in significant improvements in surface water flooding across the wider site, when compared to existing, whilst ensuring that proposed buildings remain flood free and exceedance flows are contained within the Site boundary.

#### *Foul Water*

- 5.2.4 It is proposed that foul flows will discharge to the existing onsite private drainage network installed in preparation for these developments.
- 5.2.5 Through a pre-application response, United Utilities stated that foul flows can be discharged to the sewer located within Kings Parade.

### 5.3 Conclusion

- 5.3.1 This detailed drainage assessment has demonstrated that the proposed development has a viable receptor for discharge of surface water and foul flow and can be operated to achieve restricted discharge rates to public sewer, as stated by LLFA and United Utilities.
- 5.3.2 The Detailed Drainage Assessment should satisfy planning conditions issued for Phase 1a and the future anticipated conditions issued for Phase 1B and Phase 2.





## APPENDICES

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## Appendix 1 – Proposed Development Layout

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## Appendix 2 – United Utilities Asset Plans

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## Appendix 3 – United Utilities Correspondence

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## Appendix 4 – LLFA Correspondence

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## Appendix 5 – CCTV Survey

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**Document to be submitted separately once the formal CCTV report has been issued**

## **Appendix 6 – Kings Waterfront Estates Drainage Plans**

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## **Appendix 7a – Drainage Model Files - Existing 'Arena Area'**

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## **Appendix 7b – Drainage Model Files – Existing ‘Half Tide Wharf’ Area**

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## **Appendix 7c – Drainage Model Files – Application 1A ‘Half Tide Wharf’ Area**

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## **Appendix 7d – Drainage Model Files – Application 1B ‘Arena’ Area**

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## **Appendix 7e – Drainage Model Files – Application 1B ‘Half Tide Wharf’ Area**

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## **Appendix 7f – Drainage Model Files – Stage 2 ‘Arena’ Area**

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## **Appendix 7g – Drainage Model Files – Stage 2 ‘Half Tide Wharf’ Area**

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