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FLOOD RISK ASSESSMENT



LAND AT CAR PARK OF FORMER RIVERSIDE PUB, SUMMERSEAT

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Project Quality Assurance Information Sheet

FLOOD RISK ASSESSMENT

Car Park of Former Riverside Pub, Summerseat

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TABLE OF CONTENTS

1. INTRODUCTION

- 1.1 Appointment
- 1.2 Background
- 1.3 Objective and Scope of Work
- 1.4 National Planning Policy Framework
- 1.5 Sequential & Exception Test
- 1.6 Climate Change
- 1.7 Sustainable Drainage Systems
- 1.8 Limitations
- 1.9 Local Planning Policy

2. SITE LOCATION & DESCRIPTION

- 2.1 Site Location
- 2.2 Existing Site Layout
- 2.3 Surrounding Land Use
- 2.4 Proposed Site Layout

3. HISTORICAL FLOODING

- 3.1 Internet Search
- 3.2 Bury, Rochdale, Oldham Strategic Flood Risk Assessment Volume III – Level 2 SFRA (November 2009)

4. SOURCES OF FLOOD RISK

- 4.1 Environment Agency Flood Map
- 4.2 Fluvial: River Irwell
- 4.3 Reservoir Flooding
- 4.4 Pluvial: Surface Water Flooding
- 4.5 Groundwater
- 4.6 Blockage Infrastructure Failure: Bridges and Culverts

5. QUANTITATIVE FLOOD RISK ASSESSMENT

- 5.1 Fluvial Flooding: River Irwell
- 5.2 Environment Agency Flood Data
- 5.3 Overtopping – 1 in 100 year flood level
- 5.4 Overtopping – 1 in 100 year plus climate change flood level
- 5.5 Overtopping – 1 in 1000 year flood level
- 5.6 Conclusion

6. SURFACE WATER DRAINAGE

- 6.1 Surface Water Runoff Hierarchy
- 6.2 Infiltration
- 6.3 Watercourse
- 6.4 Surface Water Design Criteria
- 6.5 Sustainable Drainage Systems (SUDS)
- 6.6 SUDS – Design Considerations
- 6.7 Maintenance

- 6.8 Outfall Locations
- 6.9 Discharge Rates

7. MITIGATION MEASURES

- 7.1 Finished Development Levels
- 7.2 Access and Egress
- 7.3 Compensatory Flood Storage
- 7.4 Easements

8. CONCLUSIONS AND RECOMMENDATIONS

APPENDICES

APPENDIX A	LIDAR Topographic Survey
APPENDIX B	Proposed Plans
APPENDIX C	BGS Borehole Log
APPENDIX D	Greenfield Runoff Rates
APPENDIX E	Photographs

1. INTRODUCTION

1.1 Appointment

- 1.1.1 BEK Enviro Limited (BEK) has been commissioned by Ground and Project Consultants Ltd to prepare a Flood Risk Assessment for residential units at land adjacent to Riverside pub, Summerseat (hereafter referred to as 'the site') to assess potential risks associated with flood risk to the development for residential use.

1.2 Background

- 1.2.1 A site specific flood risk assessment provides and appraisal of flood risk both within the application site and any potential impact that the development will have on flood risk elsewhere and provide recommendations for mitigation measures which may be included within the design of the development to reduce the overall risk of flooding.
- 1.2.2 An initial assessment indicates that the primary source of flood risk to the development is from fluvial flooding from the River Irwell.

1.3 Objective and Scope of Work

- 1.3.1 The objective of this report is to evaluate the issues in regard to flood risk at the application site i.e. development of a number of residential units on land that was formerly the car park of Riverside pub, Summerseat.
- 1.3.2 To achieve the objective BEK will undertake the following:
- Suitability of the proposed development in accordance with current planning policy
 - Identify the risk to both the development and people from all forms of flooding
 - Review the relevant background information for the site, including:
 - National Planning Policy Framework
 - Planning Practice Guidance
 - Building Regulations Approved Document H
 - Environment Agency Flood Mapping
 - Bury, Rochdale and Oldham Strategic Flood Risk Assessment Volume III – Level 2 SFRA (November 2009)
 - BGS – Historic Borehole Logs
 - Cranfield University Soils Vues Viewer
 - Recommendation of appropriate measures to mitigate against flooding both within the proposed development, and neighbouring land and property.

1.4 National Planning Policy Framework

- 1.4.1 The requirements for undertaking site specific flood risk assessments are generally as set out in the Planning Practice Guide – Flood Risk & Coastal Change.
- 1.4.2 Site specific flood risk assessment should always be proportionate to the degree of flood risk and make use of information already available. A flood risk assessment should also be appropriate to the scale, nature and location of the development.

1.5 Sequential & Exception Test

- 1.5.1 The objective of the Sequential Test is to steer new development to areas of the lowest probability of flooding, this takes into account the flood zones and the flood risk vulnerability classification of developments.
- 1.5.2 The Environment Agency flood map indicates that the proposed development site is within Flood Zone 2. Flood Zone 2 is defined as land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding in any one year.
- 1.5.3 Proposals for the application site involve residential development with car parking and landscaped areas.
- 1.5.4 The proposed residential dwellings are located within Flood Zone 2. In accordance with Table 2 'Flood Risk Vulnerability Classification' of the Technical Guidance to the National Planning Policy Framework, residential site are defined as 'more vulnerable' development.

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	x	Exception Test Required	✓
	Zone 3b	Exception Test Required	✓	x	x	x

Table 1: Flood Risk Vulnerability and Flood Zone Compatibility

- 1.5.5 'More Vulnerable' developments within flood zone 2 are considered appropriate development. However the Local Authority may request the undertaking of a Sequential Test.

1.6 Climate Change

- 1.6.1 The National Planning Policy (NPPF) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. Table 2 shows anticipated changes in extreme rainfall intensity in small and urban catchments.

- 1.6.2 For flood risk assessments, both central and upper end allowances should be assessed to understand the range of the impact. Residential development is usually designed with a lifetime approximating 100 years; and therefore 20% and 40% must be applied to peak rainfall intensities (see table 2).

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

Table 2: Peak rainfall intensity allowance in small and urban catchments

- 1.6.3 For peak river flow allowances the Environment Agency guidance recommends a number of allowances based on the vulnerability of the site and the river basin it is located within. The River Irwell is located within the North West river basin with the allowances shown within Table 3 below.

Allowance Category	Total potential change anticipated for 2015 to 2039	Total potential change anticipated for 2040 to 2069	Total potential change anticipated for 2070 to 2115
Upper End	20%	35%	70%
Higher Central	20%	30%	35%
Central	15%	25%	30%

Table 3: Peak river flow allowances by river basin district

- 1.6.4 When applying peak river flow allowances for flood risk assessments the flood zone and appropriate flood risk vulnerability classification should be consulted to decide which allowances applies to the development.

- 1.6.5 The proposed residential development will be located within Flood Zone 2 therefore 'more vulnerable' development within Flood Zone 2 should use the central and higher central allowances. As such 30% and 35% should be applied to peak river flow to assess the range of impact for this maximum impact on the development.

1.7 Sustainable Drainage Systems (SUDS)

- 1.7.1 The key planning objectives in the NPPF are to appraise, manage and where possible, reduce flood risk.
- 1.7.2 Since April 2015 the Lead Local Flood Authority i.e. Bury Council, is the statutory consultee for surface water flood risk in relation to planning applications. They are now the appropriate body to assess applicants/developers surface water drainage proposals and the Local Planning Authority should consult the Lead Local Flood Authority as necessary during determination of applications.
- 1.7.3 Sustainable Urban Drainage Systems (SUDS) are designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges, thereby providing a suitable way of achieving some of these objectives.
- 1.7.4 Furthermore, the NPPF and Building Regulations Approved Document H encourages developers to use SUDS wherever possible. The Flood and Water Management Act 2010 also reinforces the requirements for SUDS to be implemented where practicable.
- 1.7.5 The proposals are for the development of over 10 residential units which is classified as 'major' development. The inclusion of SUDS within the detailed drainage design is mandatory for major developments.
- 1.7.6 Part H of the Building Regulations requires that surface water should be discharged from new development in accordance with the following hierarchy in order of preference:
- Infiltration to the ground via soakaway
 - To a watercourse
 - To a public surface water sewer
 - To a public combined sewer

1.8 Limitations

- 1.8.1 The conclusions and recommendations presented in this report are the result of our professional interpretation of the information currently available. BEK reserves the right to amend the conclusions and recommendations if further information becomes available.

- 1.8.2 However, it should be noted that much of the information has been derived from reports written by others and BEK takes no responsibility for the accuracy of that information. Notwithstanding the above, the reports reviewed have all been written by professional environmental consultants with a duty of care to provide relevant and accurate information.

1.9 Local Planning Policy

- 1.9.1 The following policy relating to flood risk and drainage have been taken from the Adopted Bury Unitary Development Plan:

Policy EN5 – Flood Protection and Defence

The Council will seek to control development in a manner consistent with flood protection and the maintenance of flood defence systems.

Justification

Circular 30/92 "Development and Flood Risk" acknowledges that the risk of inland flooding will become an increasingly important issue given the expected rises in sea level, increases in storm severity and changes in weather patterns arising from predicted global climate changes. As such, the Government is looking to local authorities to guide development away from areas that may be affected by flooding, and to restrict development that would itself increase the risk of flooding or would interfere with the ability of the Environment Agency (EA) or other bodies to carry out flood control work and maintenance.

Under Section 105(2) of the Water Resources Act 1991, the NRA, now incorporated into the EA, is conducting a survey of areas of potential flood risk. The Council will have regard to published information, and will operate this policy in consultation with the EA.

Policy EN5/1 - New Development and Flood Risk

The Council will not permit new development, including the raising of land and the intensification of development, where such development would be at risk from flooding, would be likely to increase the risk of flooding elsewhere, or would adversely affect river flood defences. When assessing proposals against this policy, the following criteria will apply:

- the impact on the floodplain;
- the increase in surface water run-off as a result of the proposal;
- the impact on fluvial flood defences;
- the incorporation of mitigating works.

Justification

Circular 30/92 "Development and Flood Risk" states that where flood defence considerations arise, they should always be taken into account by local planning authorities in preparing development plans and in determining planning applications. This policy follows this advice, the aim being to ensure that new development or the intensification of existing development is not at risk from flooding and does not increase the risk of flooding elsewhere.

Within the floodplain, new development may be liable to flooding and may also increase the risk of flooding elsewhere by reducing the storage capacity of the floodplain and impeding flood flows. New developments may also result in a substantial increase in surface water run-off because of impermeable surfaces such as roofs and paving. This may result in an increased risk of flooding downstream and a reduction in infiltration to groundwater. A breach in river flood defences could lead to flooding and as such the Council will need to assess the impact of developments on the stability and continuity of any river flood defences.

When assessing proposals against this policy, the Council will consult the Environment Agency before determining the application. Where the principle of development is accepted, the Council may require the developer to undertake works to mitigate the impact of any development.

- 1.9.2 In addition the Bury Council website states the following in relation to Sustainable Drainage Systems:

'A revised Validation Checklist for major developments is currently being developed and will specify what the Council will expect to see at each stage of the planning process, in terms of surface water'

As the Validation Checklist is not currently available, a section of SUDS and sustainable drainage for the proposed development has been included within Section 6.5 of this report.

2. SITE LOCATION & DESCRIPTION

2.1 Site Location

2.1.1 The site is located to the north of Summerseat some 4.3 km north of Rochdale town centre. The site is located immediately east of Kay Street. A watercourse known as the River Irwell flows from the east to the west adjacent to the northern boundary of the site.

2.1.2 The National Grid Reference for the centre of the site is 379380, 415070.

2.1.3 The site occupies an irregular shaped plot of land comprising tarmac hardstanding and grassed areas. It is understood the site was the car park of the former Riverside Pub which has since been demolished following flooding in December 2015. The site is currently vacant.

2.2 Existing Site Layout

2.2.1 The existing site is currently vacant and comprised of tarmac which was formerly the car park of the Riverside pub. The site is accessed from the west from Kay Street which leads onto the former car park.

2.2.2 The site is generally flat and comprised of the former car park with a steep drop towards the River Irwell along the northern boundary of the site. A selection of photographs of the site is included within Appendix E of this report.

2.3 Surrounding Land Use

2.3.1 The site is located in an area dominated by commercial/residential land use.

2.4 Proposed Site Layout

2.4.1 The proposed development plans are for the development of a number of residential dwellings within a single building. The building will be located towards the north of the site with car parking located towards the south and west of the site.

2.4.2 A copy of the latest option site plan is included within Appendix B of this report.

3. HISTORIC FLOODING

3.1 Internet Search

- 3.1.1 An internet search of flooding within the Summerseat area resulted in a number of articles relating to the December 2015 flood event. This is considered the most relevant historic flood event for the Summerseat area.
- 3.1.2 The December 2015 flood event resulted in large scale flooding of many areas in the north-west of England. The Riverside pub was destroyed by the December 2015 flooding.
- 3.1.3 An article on the Manchester Evening News website titled 'Waterside pub collapse: Astonishing drone footage shows devastation' dated 26th December 2015 contains a video of the flood event. A still from the video below shows that the pub was destroyed by the floods and the development to the north of the River Irwell experienced flooding however the proposed development site (car park area) is shown to be free from flooding.



Figure 1: Drone footage of December 2015 flood event

- 3.1.4 Figure 2 overleaf shows the aftermath of the flood event taken from a Youtube video titled 'Waterside, Summerseat Collapse 4K' with the proposed car park area shown to be unaffected.



Figure 2: Drone footage of December 2015 flood event

- 3.2 Bury, Rochdale and Oldham Strategic Flood Risk Assessment Volume III – Level 2 SFRA (November 2009)
- 3.2.1 The Bury, Rochdale and Oldham Strategic Flood Risk Assessment Volume III – Level 2 SFRA does not include any specific historical flood events in the Summerseat area. However as it was published pre-2015 it will not include any information regarding the December 2015 flood event.

4. SOURCES OF FLOOD RISK

4.1 Environment Agency Flood Map

- 4.1.1 The Environment Agency Flood Map shown within the Figure below confirms that the proposed development site is located wholly within Flood Zone 2.

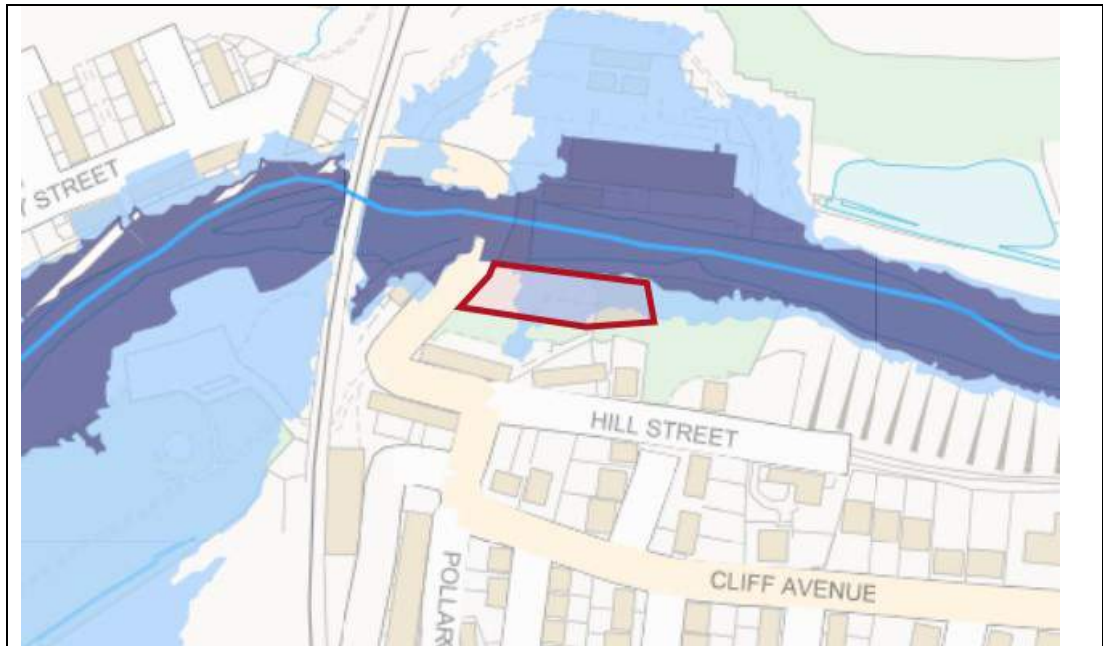


Figure 1: Environment Agency Flood Map

Key



- 4.1.2 Flood Zone 2 is the medium flood risk area and is assessed as having between a 1 in 100 and 1 in 1000 annual probability of river or sea flooding.

4.2 Fluvial: River Irwell

- 4.2.1 The River Irwell flows along the northern boundary of the site from the east to the west adjacent to the site. As the development site is located within Flood Zone 2 the risk of fluvial flooding from this source is considered to be medium and will be assessed in more detail in section 5 of this report.

4.3 Reservoir Flooding

4.3.1 The Environment Agency flooding from Reservoirs map identifies that the proposed development is within the extent of flooding following a breach of a reservoir.

4.3.2 It is noted that reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs are regularly inspected by reservoir panel engineers and the EA ensures that reservoirs are regularly inspected and essential safety work is undertaken as appropriate. As such the risk of flooding from this source is considered to be low.

4.4 Pluvial: Surface Water Flooding

4.4.1 The Environment Agency Surface Water Flood Map indicates that the site is at low risk of surface water flooding.

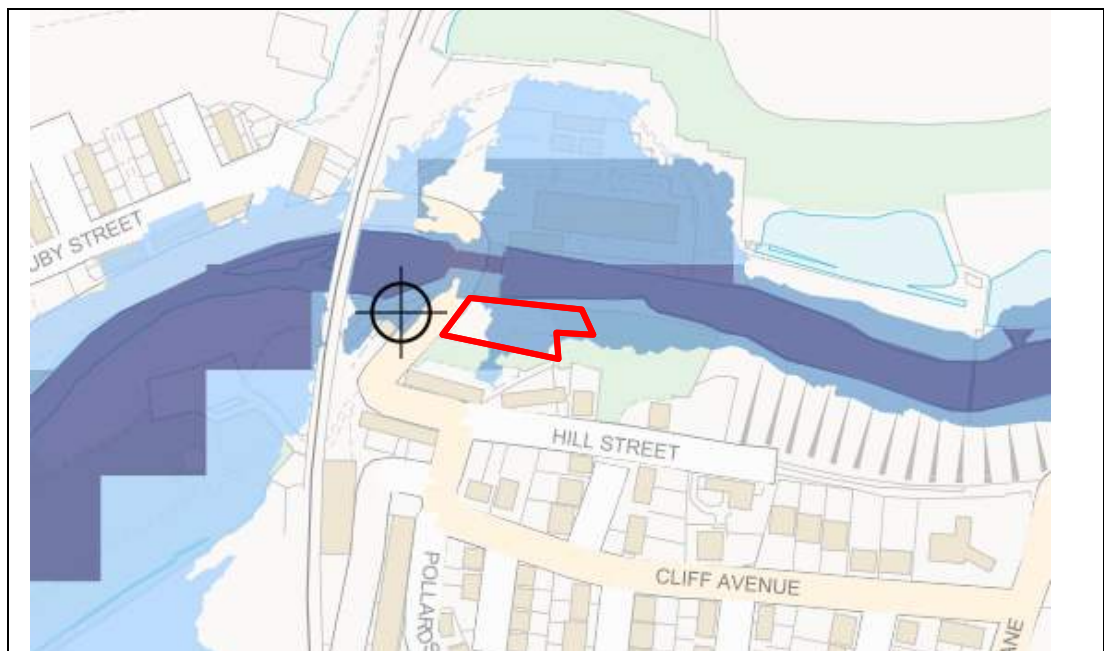


Figure 2: *Environment Agency Flood Risk from Surface Water Map*

Key

	High
	Medium
	Low
	Very Low

4.4.2 The Environment Agency Surface Water Flood Map indicates that the majority of the site is at medium risk of surface water flooding.

4.4.3 However the low risk surface water flood depths indicate that the site would largely remain dry with a depth of below 300 mm.

- 4.4.4 As part of the development it is considered likely that the finished floor levels will be raised above the general ground level by 300 mm in accordance with Environment Agency Standing Advice for residential developments within Flood Zone 2 which will mitigate the risk from surface water flooding at the site.

4.5 Groundwater

- 4.5.1 Groundwater flooding is caused by the emergence of water originating from beneath the ground. The water may emerge from either point or diffuse locations. The occurrence of groundwater is usually very local.
- 4.5.2 The Bury Local Flood Risk Management Strategy (April 2018) Document Section 2.9 states 'Local understanding of groundwater flooding is limited and often groundwater is not identified as a distinct event.'
- 4.5.3 As such it is not considered that groundwater flooding is a significant issue within the Bury area.

4.6 Blockage Infrastructure Failure: Bridges and Culverts

- 4.6.1 During flood conditions there is the potential for debris to enter the open channel sections of watercourses, and be washed downstream. An accumulation of debris at bridges and culverted sections of any watercourse may lead to blockages within structures located along the channel, causing flood water to backup.
- 4.6.2 Similarly should the existing bridges spanning a river fail, the capacity of the enclosed section of watercourse is likely to be greatly reduced, which again is likely to cause flood water to backup within the channel upstream from the existing bridge section.
- 4.6.3 As such, in regard to the River Irwell it is considered likely that the extent of flooding within the local vicinity of the affected structure will be exacerbated in the event of severe blockage or structural collapse.
- 4.6.4 The former Riverside Pub originally sat over the River Irwell until the December 2015 flood event when it was destroyed by the flood. Since then the pub has been demolished. The Kay Street bridge is located immediately downstream of the site.
- 4.6.5 Due to the distance of the bridge from the development site it is considered that blockage of the Kay Street bridge would result in significant increases of flood levels adjacent to the development site.
- 4.6.6 The Kay Street Bridge over the River Irwell is comprised of two arches as shown within the figure below:



Figure 3: *Kay Street Bridge viewed from proposed site*



Figure 4: *Kay Street Bridge during 2015 flood event*

- 4.6.7 As shown in Figure 3 the soffit level of the arches of the bridge is elevated a significant distance above the watercourse with Figure 4 showing that the flood level during the December 2015 flood event is lower than the soffit level of the bridge. As such it is considered that there is a freeboard even during the extreme events which would reduce the risk of blockage Kay Street bridge.

- 4.6.8 Furthermore, the River Irwell is designated as 'Main River' and therefore the Environment Agency are responsible for managing flood risk along the watercourse and it is considered likely that there is a routine maintenance schedule in place to ensure the watercourse remains free from obstruction.
- 4.6.9 As such the risk of infrastructure failure of the bridge over the watercourse in the vicinity of the site is considered to be low to medium.

5. QUANTITATIVE FLOOD RISK ASSESSMENT

5.1 Fluvial Flooding: River Irwell

5.1.1 The source of the River Irwell is located approximately 14 km north-east of the site at Irwell Springs and generally flows in a southerly direction where it merges with the River Roch some 8 km south of the site.

5.2 Environment Agency Flood Data

5.2.1 The modelled flood data has been provided by the Environment Agency for a range of scenarios taken from the Draft Mid Irwell 2017 Study. The EA data provide levels for the undefended and defended scenarios however only climate change allowances have been provided for the defended scenario therefore these levels have been used to assess the risk of flooding to the development site.

5.2.2 It is considered that flooding to the development site would be caused by overtopping of the open channel sections of the River Irwell. The nearest node to the site is known as IRWE06_01112 (Node 4) located adjacent to the site.

	Return Period			
	100 year	100 year plus 30% CC	100 year plus 35% CC	1000 year
River Level (mAOD)	107.45	108.19	108.31	108.47

Table 4: Flood Level Data for the River Irwell (IRWE06_01112)

5.3 Overtopping – 1 in 100 year flood level

5.3.1 The nearest node to the site is labelled as IRWE06_01112 and therefore the 1 in 100 year flood level for site is 107.45 mAOD.

5.3.2 The topographic survey of the site taken from LIDAR data indicates that the site would not experience flooding during this event with the lowest level on site shown to be 108.33 mAOD which is 0.88 m above the 1 in 100 year flood level.

5.4 Overtopping – 1 in 100 year plus climate change flood level

5.4.1 In February 2016 the Environment Agency provided new guidelines for projected climate change allowances for use in flood risk assessments.

5.4.2 For 'more vulnerable' developments such as the development site within Flood Zone 2 within the Humber Basin District, the central, higher central allowances should be applied to peak river flows.

- 5.4.3 Therefore 30% and 35% should be applied to the 1 in 100 year flows to assess the potential impacts of climate change.
- 5.4.4 The Environment Agency data provided includes an allowance for climate change which for the 30% and 35% climate change allowances.
- 5.4.5 The 1 in 100 year plus 30% climate change flood level for the site is 108.19 mAOD which is 0.14 m below the lowest level on site of 108.33 mAOD.
- 5.4.6 During the modelled 1 in 100 year plus 35% climate change flood event the flood level is 108.31m AOD which is 0.02 m below the lowest level on site of 108.33 mAOD.
- 5.5 Overtopping – 1 in 1000 year flood level**
- 5.5.1 The 1 in 1000 year flood level for the site is 108.47 mAOD.
- 5.5.2 The LIDAR topographical survey of the site shows that the lowest level on site is 108.33 mAOD which is 0.14 m below the extreme modelled 1 in 1000 year flood level.
- 5.6 Conclusion**
- 5.6.1 It is concluded that the site would not experience flooding during the 1 in 100 year flood event, the 1 in 100 year plus 30% climate change event and the 1 in 100 year plus 35% climate change flood event.
- 5.6.2 The extreme 1 in 1000 year flood event would flood the lowest part of the site to a maximum depth of 0.14 m.
- 5.6.3 As such it is considered that the majority of the site is located within Flood Zone 1 with a small area adjacent to the River Irwell within the extents of Flood Zone 2.

6. SURFACE WATER DRAINAGE

6.0.1 The purpose of this section is to provide information on how the site can discharge surface water created as a result of the development without increasing flood risk at both the site and downstream of the site.

6.1 Surface Water Drainage Hierarchy

6.1.1 The hierarchy for disposal of surface water from new developments is outlined within the Buildings Regulations Approved Document H and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public surface water sewer
- Discharge to public combined sewer

6.2 Infiltration

6.2.1 Site investigation information is not currently available. Therefore in order to assess the potential for infiltration methods to dispose of surface water from the site, a desk top investigation of the general ground conditions within the local vicinity of the site has been undertaken.

6.2.2 A review of historical borehole logs from the British Geological Society website shows the presence of a Borehole in the vicinity of the site. The details of the borehole identify the ground conditions in the area to be clayey, silty, gravel. A copy of the Borehole Log is included within Appendix C of this report.

6.2.3 Information from the National Soil Resource Institute details the development area as being situated on loamy and clayey floodplain soils with naturally high groundwater.

6.2.4 Due to the underlying soils it is considered that disposal of surface water from the proposed development via infiltration are unlikely to be feasible due to the high groundwater.

6.2.5 However percolation testing should be undertaken to BRE 365 (2018) to provide evidence that soakaways are viable or otherwise and to provide an infiltration rate for the site.

6.3 Watercourse

6.3.1 If, following percolation testing, it is determined that soakaways are unviable at the site then discharge to watercourse should be investigated. The River Irwell runs

adjacent to the north of the site and therefore surface water should discharge into this watercourse if infiltration is not viable.

6.4 Surface Water Drainage Design Criteria

6.4.1 The proposed detailed drainage design for the site will be completed at a later stage however the following criteria for designing surface water drainage systems for new development have been extracted from the Joint DEFRA/EA R&D Technical Report 'Preliminary Rainfall Runoff Management for Developments' (SC030219) published in October 2013.

1. Discharge Rate

The Environment Agency normally require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year event) the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event based on the calculation of QBAR or QMED and the use of FSSR growth curves.

Exceptions only apply where it is not practical to achieve this due to either constraints on the size of the hydraulic control unit, or excessive storage volumes. The purpose of this is to retain a natural flow regime in the receiving watercourse and not increase peak rates of flow for events of an annual probability greater than 1%. Three annual probabilities are used to define discharge compliance limits though the critical criteria are for the lowest and highest frequency events; 100% (1 year), 3.33% (30 year) and 1% (100 year).

2. 1 in 1 year Design Event

The 1 in 1 year event is the highest probability event to be specifically considered to ensure that flows to the watercourse are tightly controlled for frequent events to provide good morphological conditions.

3. 1 in 30 year Design Event

The 1 in 30 year event is of importance because of its linkage with the level of service requirement of Sewers for Adoption 6th Edition, which requires that surface water sewers should be capable of carrying the 1 in 30 year flows generated by a development within the system without causing flooding to any part of the site.

4. 1 in 100 year Design Event

The 1 in 100 year event has been selected since it represents the boundary between high and medium risks of fluvial flooding defined by the National Planning Policy Framework (2012) and also recognises that it is not practicable to fully limit flows for

the most extreme events. Also Sewers for Adoption 6th Edition recognises that, during extreme wet weather, the capacity of surface water sewers may be inadequate.

Sewers for Adoption 6th Edition requires that the site layout should be such that internal property flooding does not result, by demonstrating safe above ground flow paths.

The return period for this analysis is not specified, but it is recommended that 1% annual probability event (i.e. an event with a return period of 100 years) is used.

5. Flood Flows

Runoff up to the 1 in 100 year return period should preferably be managed within the site at designated temporary storage locations unless it can be shown to have no material impact by leaving the site in terms of nuisance or damage, or increase river flow during periods of fluvial flooding. Analysis for overland flood flows within the site will need to use appropriate duration events which may be different to critical events for designing surface water control storage structures.

6. Surface Water Runoff Volume

Theoretically the surface water runoff volume from a site should be limited to the greenfield runoff volume for all event frequencies.

However this is technically extremely difficult to achieve and therefore compliance to two criteria on runoff volume is required.

- a. Interception: Where possible, infiltration or other techniques are to be used to try and achieve zero discharge to receiving waters for rainfall depths up to 5 mm.
- b. Additional Runoff Due to Development: The difference in runoff volume pre- and post-development for the 100 year 6 hour event, (the additional runoff generated) should be disposed of by way of infiltration, or if this is not feasible due to soil type, discharged from the site at flow rates below 2 l/s/ha, unless Point 8 (see below) is applicable to the development.

7. Climate Change

In accordance with Table 2 of Flood Risk Assessment: climate change allowances issued in February 2016 by the Environment Agency, a 20% increase to rainfall intensities should be applied for development with a lifetime up to 2115 for the central allowances; and 40% for the upper allowances.

Residential development is generally expected to have a design life of 100 years; and as such an additional 20% and 40% must be applied within the drainage design for the

proposed development situated at former car park of Riverside pub, Kay Street, Summerseat.

8. Minimum Limit of Discharge Rate

A practicable minimum limit of discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level.

This limit is set to a minimum of 5 l/s, using an appropriate vortex or other flow control device.

Where sedimentation could be an issue, the minimum size of orifice for controlling flow from an attenuation device should normally be 150 mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 6th Edition.

9. Urban Creep

Urban creep is now an acknowledged issue which results in an increase in runoff from an estate over time. An allowance should be made by factoring the impermeability percentage by 1.1 (10% increase) unless a more precautionary requirement is specified by the local planning authority.

6.5 Sustainable Drainage Systems (SUDS)

- 6.5.1 In accordance with the Flood and Water Management Act 2010; there is a requirement to incorporate sustainable drainage systems i.e. SUDS into new development.
- 6.5.2 The main objective for the inclusion of SUDS is treatment and control of runoff as near to the source as possible, protecting downstream habitats and enhancing the amenity value of the site and surrounding area.
- 6.5.3 Undertaking an assessment using the assessment criteria provided within CIRIA C697 'The SUDS Manual' and its companion document CIRIA C522 'SUDS Design Manual for England and Wales' revealed that a number of different methods would be suitable for inclusion within the proposed drainage strategy for the development.
- 6.5.4 Reviewing various SUDS methods which may be included within a detailed drainage strategy for the development; it is advised that all methods are considered suitable however space constraints within the development may make some SUDS unviable.
- 6.5.5 A summary of the evaluation process is tabulated in the table below.

SUDS Group	Type	Comment
Retention	Pond	May be used to attenuate surface water runoff prior to discharge into receiving watercourse. Outflows regulated using a Hydrobrake or orifice plate flow control. Able to provide amenity value; however there may be local issues relating to safety.
	Sub-surface Storage	Large diameter pipes/culverts, concrete storage tank; shallow geocellular storage crate systems; can be used to attenuate surface water runoff, and also to reduce the potential land required for open surface attenuation structures such as ponds and basins.
Wetland	Shallow Wetland	Extended detention wetlands are mainly utilised where significant pollution removal would be required; and as such other types of wetland are more suited to residential development sites. A wetland is considered the most appropriate solution for attenuation at surface level, in areas where there are high groundwater levels; and the base of the structure intersect groundwater to provide a permanent body of water.
	Extended Detention Wetland	
	Pond	
	Pocket Wetland	
	Submerged Gravel	
	Wetland Channel	
Infiltration	Infiltration Trench	It is considered that infiltration could potentially be viable at this stage of the study however this would need to be confirmed via a ground investigation and percolation testing.
	Infiltration Basin	
	Soakaway	
Filtration	Surface sand filter	Sand filters are not commonly used within the UK; and although suitable for use within a residential setting are more widely used for development which may require high pollutant removal. Bioretention systems (rain gardens) are aimed at managing and treating runoff from frequent rainfall events; can be incorporated into landscape features; and connected to a drainage system in the event that disposal via infiltration is not feasible. Filter strips and trenches are commonly used adjacent to large impermeable areas such as roads and car parks to provide significant volumes for attenuation purposes.
	Sub-surface sand filter	
	Bioretention	
	Filter Trenches	
Detention	Detention Basin	In its basic form, a detention basin is used to manage water quantity while having a limited effectiveness in protecting water quality, unless it includes a permanent pool feature. Designed

		normally to remain dry unless required to attenuate surface water runoff, such features may provide usable space for leisure activities during dry weather; and be operational only during periods when attenuation of surface water is required.
Swales	Conveyance Swale	Swales are linear vegetated conveyance structures, which are designed to promote low flow velocities in order to provide pollutant removal; and can replace conventional gullies and drainage pipes, when located adjacent to roads. It is noted that the land take required for swales is relatively high and therefore would be unlikely to be viable for the site.
	Enhanced Dry Swale	
	Enhanced Wet Swale	
Source Control	Green Roof	Provides interception storage for first flush of rainfall; and can act to offset any increase in surface water runoff volume generated as a result of the development
	Rainwater Harvesting	
	Permeable Paving	Due to the underlying ground conditions, infiltration is not considered viable for the development however permeable paving may be used for attenuation purposes prior to discharge into the receiving watercourse, or sewer; and is ideally placed within shared driveway area, or car park area.

Table 5: Initial SUDS Appraisal

- 6.5.6 Large diameter pipes, or box culvert arrangements, should be sited within estate roads, or public open spaces, to maintain access for inspection and/or maintenance.
- 6.5.7 Tank systems for attenuation purposes should be sited within public open space or under car park areas. Permeable paving may be utilised within the development within private or shared driveways within residential areas to provide infiltration to ground if ground conditions allow, or for treatment and attenuation of flow.
- 6.5.8 Bioretention areas or rain gardens could be placed within the landscaped areas; and may be used as source control elements i.e. within individual plots. Propriety systems such as Hydro-Biocell or other similar products may be installed in areas where space is a premium, and utilises the natural catchment action of vegetation and the infiltration capacity of specially engineered soils.
- 6.5.9 If it is deemed that infiltration at the development site is viable then infiltration methods such as infiltration trenches, infiltration basins or soakaways should be used to dissipate surface water into the ground. Soakaways are required to be located at least 5 m from any buildings and at least 10 m apart.

6.6 SUDS – Design Considerations

- 6.6.1 It is good engineering practice to design drainage systems in accordance with Sewers for Adoption 6th Edition; Building Regulations Approved Document H and other statutory requirements, as appropriate.
- 6.6.2 During the 1 in 1 year event, flow must be retained within the pipes and manholes of the drainage system. Surcharging, but no surface water flooding is permitted during the 1 in 30 year rainfall event, and some surface flooding is allowed during the 1 in 100 year plus climate change event, however it is noted that levels within the site should be designed to prevent flood water migrating beyond the development boundary or uncontrolled into the River Irwell, in order to prevent an increase in flood risk to others.

6.7 Maintenance

- 6.7.1 For drainage elements such as open attenuation structures, or ponds, the Developer will maintain overall responsibility for inspection and maintenance, and as such it is recommended that a contract to undertake such works on a regular basis with a suitably qualified professional is set up and begins upon completion of the project.
- 6.7.2 During the detailed design stage a Maintenance Plan should be developed using guidance from CIRIA RP992 The SUDS Manual.

6.8 Outfall Locations

- 6.8.1 The hierarchy of surface water disposal states that surface water should be discharged into watercourse as discharge via infiltration is unlikely to be viable. The nearest watercourse is the River Irwell which is located immediately north of the site.
- 6.8.2 As such the outfall from the site will be located in the north of the site into the River Irwell.

6.9 Discharge Rates

- 6.9.1 The existing site is comprised of a hardstanding tarmac area and grassed areas.
- 6.9.2 Greenfield runoff rate limits are required to meet normal best criteria in line with the Environment Agency Guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 Rev. E (2012) and the CIRIA SUDS Manual (2007).
- 6.9.3 Utilising the HR Wallingford Greenfield Runoff Estimation for Sites website greenfield runoff rates have been calculated for the 1 in 1 year, 1 in 30 year and 1 in 100 year return periods, and a summary of the results is tabulated below.

- 6.9.4 Flows in excess of this must be attenuated within the boundary of the development prior to disposal.

Return Period	Q_{bar}	Peak Flow Rate Site
1 in 1 year	3.29	2.86
1 in 30 year		5.59
1 in 100 year		6.84

Table 6: Existing Surface Water Runoff (0.27 Hectares)

7. MITIGATION MEASURES

7.1 Finished Development Levels

7.1.1 The Environment Agency Flood Map indicates that the site is located within Flood Zone 2.

7.1.2 Environment Agency and National Planning Policy Framework guidelines indicate that finished ground floor levels should be set at a minimum of whichever is the higher of:

- 300 mm above the general ground level of the site
- 600 mm above the estimated river flood level

7.1.3 The 1 in 100 year plus 35% climate change flood level is 108.31 mAOD therefore 600 mm above this level is 108.91 mAOD. The general ground level of the site using LIDAR data is approximately 108.95 mAOD therefore 300 mm above this level is 109.25 mAOD.

7.1.4 As such it is proposed that finished ground floor levels of the building are set at 109.25 mAOD. It is noted that this level is 0.94 m above the 1 in 100 year plus 35% climate change flood level and 0.48 m above the 1 in 100 year plus 70% climate change flood level.

7.2 Access and Egress

7.2.1 In accordance with the requirements set out within the National Planning Policy Framework, it is essential to ensure that the route into and out of the application site will not present a danger to people during a flood event.

7.2.2 The Environment Agency flood map shows that the access route into and out of the site is located within Flood Zone 1 and therefore would remain dry during the 1 in 100 year plus climate change flood event and the extreme 1 in 1000 year event.

7.3 Compensatory Flood Storage

7.3.1 A comparison of modelled flood levels and the LIDAR topographical survey indicates that the site would not experience flooding the design 1 in 100 year plus climate change flood event. Therefore no compensatory flood storage is required.

7.4 Easements

7.4.1 The River Irwell is classified as 'Main River' therefore an 8 m easement will be required either side of the river where no development can take place. At this stage of the development it is unclear if the proposed building is located within 8 m of the watercourse.

8. CONCLUSIONS & RECOMMENDATIONS

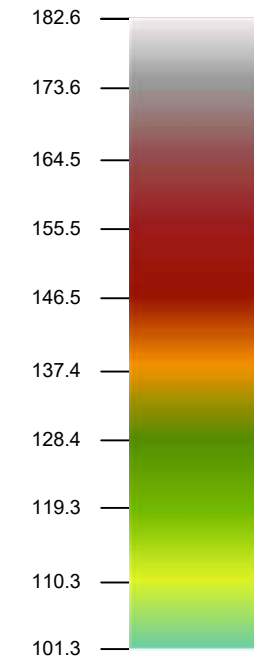
- 8.1 The proposed development at the former car park of the Riverside Pub, Kay Street, Summerseat is for residential development and associated car parking and landscaped areas.
- 8.2 The site is shown to be located within Flood Zone 2 of the Environment Agency Flood map.
- 8.3 The primary sources of flood risk to the site are identified to be from the River Irwell which flows adjacent to the north of the site in an easterly to westerly direction.
- 8.4 Modelled flood data from the Environment Agency indicates that the River Irwell would not be overtopped during the 1 in 100 year flood event, the 1 in 100 year plus 30% and 35% climate change flood events at the site. However the site would experience flooding during the extreme 1 in 1000 year flood event.
- 8.5 In accordance with Environment Agency standing advice, it is proposed that finished floor levels are set 300 mm above general ground levels which are greater than 600 mm above the 1 in 100 year plus 35% climate change flood level. Therefore finished floor levels should be set no lower than 109.25 mAOD.
- 8.6 Secondary sources such as artificial water sources, infrastructure blockage and groundwater flooding have been investigated and are deemed to present a low risk of flooding to the site.
- 8.7 It is considered that infiltration at the site is unlikely to be viable due to the high groundwater table and potentially clayey soils at the site therefore following the hierarchy of surface water disposal, it is recommended that surface water is discharged into the River Irwell utilising existing outfalls wherever possible.
- 8.8 Greenfield runoff rates have been determined to be 2.86, 5.59 and 6.84 l/s for the 1 in 1 year, 1 in 30 year and 1 in 100 year return periods respectively.
- 8.9 It is proposed that foul from the development will be discharged into a United Utilities foul or combined sewer close to the site following consultation with United Utilities. This should be confirmed at the detailed design stage.
- 8.10 It is considered that the proposed development is at low/medium risk from all sources of flooding and that surface water as a result of development will have to be managed in accordance with current practices and guidance so as not to increase the risk of flooding at the site or downstream of the site.

APPENDIX A

LIDAR Topographic Survey



LEGEND



REV	DESCRIPTION	DATE	BY



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CLIENT.	GROUND & PROJECTS CONSULTANTS LTD
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JOB TITLE.	LAND ADJACENT TO RIVERSIDE PUB, SUMMERSEAT
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DRAWING TITLE.	LIDAR TOPOGRAPHY
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SCALE © A3. N'TS	DRAWN BY. D.E.	APPROVED BY. M.B.	DATE. 14/08/18
DRAWING No. 18439-1			REV. -

APPENDIX B

Proposed Plans



NOTES		
• This drawing is copyright. No unauthorised copying of drawing without the express permission of the architect.		
• Do not scale from prints. Use figure dimensions only.		
• Contractors to check all dimensions on site prior to commencement of works.		
• All works to be carried out in accordance with current statutory Health and Safety Regulations.		
• This drawing is to be read in conjunction with all relevant consultants' and / or specialists' drawings / documents and any discrepancies or variations are to be notified to the architect before affected work commences.		
REV.	AMENDMENTS	DATE

PROPOSED SITE PLAN 1:200

Project	RESIDENTIAL DEVELOPMENT
Drawing	WATERSIDE SUMMERSEAT PROPOSED SITE PLAN
Client	KINGSLEY PROPERTIES LTD
Dwn. By	MMcD
Scale	1:200
Dwg. No.	18-518-14
Dwg. Size	A1
Date	DECEMBER 2018

JOHN HOLT ARCHITECTS LTD.

APPENDIX C

BGS Borehole Log

Norwest Holst Soil Engineering Ltd.

Borehole No.

3

British Geological Survey

British Geological Survey

British Geological Survey

Contract No. F6199

BOREHOLE LOG

Location Summerseat

Sheet 1 of 1

Client Metropolitan Borough of Bury

Chainage

Method of Boring Percussion

Ground Level 106.35 m.A.O.D.

Diameter of Borehole 150mm

Date 29.10.84

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/R.Q.D.%	Daily Progress
MADE GROUND: sandstone setts		0.20	106.15				
Medium dense, becoming dense with depth brown, clayey silty, fine to coarse sandy sub-rounded to sub-angular GRAVEL					1.50	22	
					2.50	29	
		3.50	102.85	150mm to 4.20m			
Medium to coarse sandy, fine to coarse GRAVEL, cobbles and boulders.		4.20	102.15		4.00	50 for 25mm*	29/10
END OF BOREHOLE							

Type of Sample

- ☒ S.P.T. ☒ Undisturbed
☒ C.P.T. ☒ Vane
☒ Jar ☒ Water
☒ Bulk ☒ Piezometer

Remarks (Observations of Ground Water etc.)

*seating blows only
 Medium water strike at 3.50m (casing at 3.40m)
 Final level 3.20m
 Chiselling boulder 3.80m - 4.20m (1½ hours)

Water levels are subject to seasonal or tidal variations and should not be taken as constant

APPENDIX D

Greenfield Runoff Rates

Calculated by: David Emmott

Site name: Waterside Pub

Site location: Summerseat

Site coordinates

Latitude: 53.63180° N

Longitude: 2.3128° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference: 6415987

Date: 2018-08-09T12:34:08

Methodology

IH124

Site characteristics

Total site area (ha) 0.27

Methodology

Qbar estimation method Calculate from SPR and SAAR

SPR estimation method Calculate from SOIL type

	Default	Edited
SOIL type	5	5
HOST class	---	---
SPR/SPRHOST	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm)	1236	1236
Hydrological region	10	10
Growth curve factor: 1 year	0.87	0.87
Growth curve factor: 30 year	1.7	1.7
Growth curve factor: 100 year	2.08	2.08

Notes:

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is $SPR/SPRHOST \leq 0.3$?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	3.29	3.29
1 in 1 year (l/s)	2.86	2.86
1 in 30 years (l/s)	5.59	5.59
1 in 100 years (l/s)	6.84	6.84

APPENDIX E

Photographs



River Irwell looking upstream with development site on right of picture

Photograph 1



Proposed site looking across the River Irwell from west of site

Photograph 2



Proposed development site looking east from west of site

Photograph 3



View downstream of Kay Street Bridge from north-east of development site

Photograph 4



Development site looking north-west from south-east

Photograph 5



Development site looking north-east from south-west

Photograph 6



Development site
looking from
opposite bank

Photograph 7



Development site
looking from
opposite bank

Photograph 8



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