

A38 Derby Junctions

TR010022

Volume 6

**6.3 Environmental Statement
Appendices**

**Appendix 13.2B: Markeaton Flood Risk
Assessment**

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

April 2019

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms
and Procedure) Regulations 2009**

A38 Derby Junctions
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6.3 Environmental Statement Appendices
Appendix 13.2B: Markeaton Flood Risk Assessment

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A38 Derby Junctions

Markeaton Junction Flood Risk Assessment

Report Number: HE514503-ACM-EWE-Z2_ZZ_ZZ_ZZ-RP-HF-0001 P04 S4
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EXECUTIVE SUMMARY

Scheme Details

AECOM has been commissioned by Highways England to provide design services regarding the development of the A38 Derby Junctions Scheme (referred to herein as “the Scheme”). This Scheme concerns three junctions on the A38 in Derby as follows:

- A38/ A5111 Kingsway junction
- A38/ A52 Markeaton junction
- A38/ A61 Little Eaton junction

In flood risk terms, the Scheme at Markeaton junction would increase impermeable surfacing and potential surface water runoff.

This Flood Risk Assessment (FRA) comprises one of a number of documents supporting the environmental assessment of the Scheme as reported in the Environmental Statement. A separate Road Drainage Strategy (Report Number HE514503-ACM-HDG-A38_SW_PR_ZZ-RP-CD-0002, Highways England 2019) has been produced. The Road Drainage Strategy report considers the management of surface water runoff from the Scheme.

Flood Risk Assessment

An FRA has been undertaken in accordance with the National Policy Statement for National Networks (NPSNN) and the 2019 National Planning Policy Framework (NPPF) and taking into account guidance provided in the Design Manual for Roads and Bridges (DMRB). According to the NPSNN and NPPF, applications for development proposals of 1 hectare (ha) or greater located in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by a FRA. This FRA has therefore been undertaken to determine:

- The risks of flooding to the Scheme.
- The risks of flooding that could result from the Scheme.
- Appropriate flood risk mitigation measures.

The main aim of this FRA is to demonstrate that flood risks can be suitably managed associated with Scheme design. It should be noted that hydraulic modelling was not required as part of this FRA.

Outcome of the Flood Risk Assessment

This FRA has established that there would be low overall risk of flooding to the Scheme at the proposed Markeaton junction. However, surface water flood risk from Markeaton junction to adjacent areas would increase as a result of highway expansion without appropriate mitigation. A road drainage strategy has been developed in parallel with this FRA as a separate report which demonstrates that surface water risks can be managed appropriately.

Incorporation of the mitigation measures as detailed herein indicate that flood risks associated with the Scheme at Markeaton junction can be appropriately managed. Should the Scheme gain development consent, further consultation will be undertaken during the Scheme detailed design with the Environment Agency (EA), Derby City Council (DCiC), Severn Trent Water (STW) and other statutory agencies as applicable.

1 INTRODUCTION

1.1 Commission

1.1.1 AECOM has been commissioned by Highways England to provide design services regarding the development of the A38 Derby Junctions Scheme (referred to herein as “the Scheme”). This Scheme concerns three junctions on the A38 in Derby as follows:

- A38/ A5111 Kingsway junction
- A38/ A52 Markeaton junction
- A38/ A61 Little Eaton junction

1.1.2 AECOM has been requested by Highways England to carry out a FRA for the Scheme at Markeaton junction. This FRA has been prepared in accordance with the National Policy Statement for National Networks (NPSNN¹) and the National Planning Policy Framework (NPPF²), its associated Planning Practice Guidance (PPG³) and the Design Manual for Roads and Bridges (DMRB⁴).

1.1.3 The Road Drainage Strategy (Report Number HE514503-ACM-HDG-A38_SW_PR_ZZ-RP-CD-0002, Highways England 2019) is contained in Appendix 13.4 of the Environmental Statement (ES) (ES Volume 3). It has been developed alongside this report, with the flood risk and drainage assessment informing each other.

1.2 Scheme Background

1.2.1 The existing Markeaton junction is currently an at-grade, four-armed roundabout located along the A38 at Derby, providing a connection between the A38 and the A52 Ashbourne Road.

1.2.2 This FRA is based on the best flood risk information provided available. The Environment Agency (EA) Flood Map for Planning (Rivers and Sea)⁵ shows that the Scheme site at Markeaton junction is located within Flood Zone 1 of Main Rivers with the exception of Markeaton Brook which is in Flood Zones 2 and 3⁶.

1.2.3 Lead Local Flood Authorities (LLFAs)⁷, in this case Derby City Council (DCiC), have lead responsibility for managing the risk of flooding from ordinary watercourses, as well as surface water and groundwater.

1.3 The Scheme

1.3.1 The Scheme entails the provision of grade-separation at Markeaton junction. The proposed Markeaton junction would comprise an enlarged two-bridge roundabout at existing ground level with the A38 passing beneath in an underpass to the south-east of the existing roundabout with slip roads connecting the A38 to the new roundabout. Retaining walls would be constructed between the A38 and the slip roads to reduce the footprint of the junction. The northbound merge slip road would be approximately

¹ Available online:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

² Available online: <http://planningguidance.planningportal.gov.uk/blog/policy/>

³ Available online: <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

⁴ Available online: <http://www.standardsforhighways.co.uk/ha/standards/dmr/index.htm>

⁵ Available online: <http://www.environment-agency.gov.uk/homeandleisure/floods/38329.aspx>

⁶ Available online: See <http://apps.environment-agency.gov.uk/wiyby/151293.aspx>

⁷ Available online: See <https://www.gov.uk/government/publications/ordinary-watercourse-regulation-advice-note>

on the line of the existing northbound carriageway adjacent to Markeaton Park.

1.3.2 In addition to grade-separation of the existing A38/ A52 Markeaton junction, additional lanes are proposed in both directions between the Markeaton and Kedleston Road junctions and through Markeaton junction. The existing footbridge to the north of the junction would be demolished and replaced in the same location (with a longer span to allow for the additional lanes on the new A38). The existing access from the A38 onto Enfield Road would be closed.

1.3.3 The Scheme layout is shown in Appendix A.

1.4 Planning Process

1.4.1 The Scheme is a Nationally Significant Infrastructure Project (NSIP) and thus a Development Consent Order (DCO) application is to be made to the Planning Inspectorate (The Inspectorate). The DCO application will be accompanied by an Environmental Impact Assessment (EIA) as reported within an Environmental Statement.

1.4.2 Given the above, the Scheme is subject to consideration by The Inspectorate, rather than being subject to planning control by the Local Planning Authority (LPA). Highways England is the promoter and the Applicant for the Scheme, and would also be responsible for the Scheme maintenance (with the exception of those parts of the Scheme that would be the responsibility of third parties such as the local authority and landowners).

1.5 Aims and Objectives

1.5.1 This report comprises an FRA of the proposed Markeaton junction. The assessment has involved assessing flood risks to the Scheme site, advising on the potential constraints to the Scheme, assessing the potential impacts of the Scheme on flood risks in the wider area and providing outline mitigation measures and a road drainage strategy. To complete this study the following objectives have been met:

- Review the development plans with respect to flood information in national and local policy documents, strategic flood risk documents and relevant previous and local studies that cover the area of the Scheme.
- Assess potential sources of flood risk including rivers, surface water, drainage infrastructure, groundwater and artificial sources.
- Identify requirements for surface water runoff attenuation from the site and the implications for storm water attenuation/ storage.
- Propose suitable flood mitigation measures (where applicable) in line with the recommendations of current best practice.
- Produce a report that summarises flood risk at the site and surface water considerations appropriate for the Scheme, in accordance with the NPSNN, NPPF, PPG and DMRB.

2 SITE AND SURROUNDING AREA

2.1 Site Location

- 2.1.1 The existing Markeaton junction is located approximately 1.5km to the west of Derby, Derbyshire at Ordnance Survey National Grid Reference 433440, 336970. It forms the intersection of the A38 from the north and south and the A52 from the east and west. The Scheme location is shown in Figure 2-1.

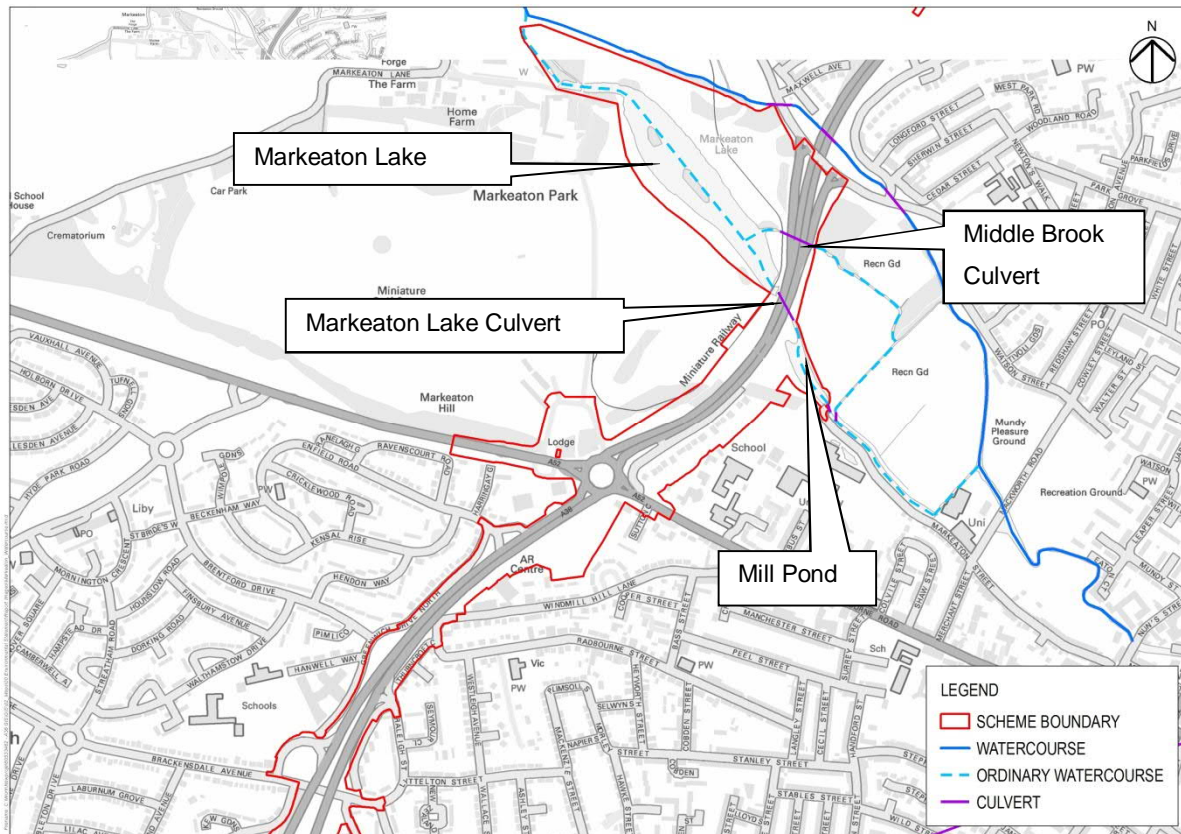


Figure 2-1: Site location map and water features

© Reproduced from Ordnance Survey digital map data © Crown copyright 2018. All rights reserved.

2.2 Existing Junction

- 2.2.1 Immediately to the north of the existing junction site is Markeaton Park which contains playing fields, a golf course and Markeaton Lake. Residential properties are located immediately to the east, west and south, which include the properties along Queensway and the A52. Immediately to the west of the junction is a petrol filling station and fast food restaurant.

2.3 Topographic Setting

- 2.3.1 The topographic survey for Markeaton junction shows that the junction is at a level of approximately 65m AOD (above ordnance datum). The land and connecting roads to the north and east fall away from Markeaton junction with the A38 to the north falling to a level of approximately 57.2m AOD in the area where it crosses Markeaton Lake. Roads from the south and west both slope gently down to the junction.

2.4 Local Water Features

- 2.4.1 Markeaton Brook flows from north-west to south-east, flowing beneath the A38 approximately 650m to the north-east of Markeaton junction. The brook then flows east where it eventually discharges into Mill Fleam. Markeaton Brook is the largest of the Derby Brook watercourses and has a total catchment of approximately 50km².
- 2.4.2 Mackworth Brook flows from the north-west and joins Markeaton Brook shortly upstream of the culvert beneath the A38.
- 2.4.3 Both Markeaton Brook and Mackworth Brook are connected to a significant watercourse diversion, the Northern Relief Culvert, upstream of Markeaton Lake. The culvert serves as flood relief for the area downstream of Markeaton Lake by diverting peak flows directly to the River Derwent.
- 2.4.4 Markeaton Lake is located approximately 450m to the north of the junction. The Markeaton Lake culvert and the Middle Brook culvert convey flows beneath the A38 before they join Markeaton Brook further downstream.
- 2.4.5 Figure 2-1 shows the water resources within the vicinity of Markeaton Junction.

2.5 Geology and Hydrogeology

- 2.5.1 Ground conditions comprise topsoil, overlying Made Ground, both underlain by rocks of the Mercia Mudstone Group and the Tarporley Siltstone Formation (Siltstone, Mudstone and Sandstone) (as stated in the A38 Derby Junctions Ground Investigation Report (Report Number HE514503-ACM-VGT-A38_SW_PR_ZZ-PR-GE-0003_P02_24, 2018)).
- 2.5.2 The Made Ground comprises embankment fill and previous road construction material up to a depth of 3.2m. Mercia Mudstone Group material comprises a weathered profile, typically becoming less weathered with depth. The material is typically described as red and grey stiff to hard, sometimes soft. The less weathered material, typically found at greater depths is described as a very weak mudstone. The material includes laminations and bands of grey siltstone and sandstone.
- 2.5.3 To the north-east of the junction, alluvium underlain by River Terrace Deposits is indicated. The alluvium is indicated to be up to 4.1m thick and is typically very soft to firm silty clay or sandy silty clay. The River Terrace Deposits are typically fine to coarse, sand and/or gravel with a thickness of up to 4.1m.
- 2.5.4 According to the DEFRA Magic mapping⁸, the bedrock is classified as a Secondary A aquifer; permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers. The superficial River Terrace Deposits are mapped as Secondary B aquifer;

⁸ Available at: <https://magic.defra.gov.uk/MagicMap.aspx>. Last Accessed November 2018.

lower permeability layers which store and yield limited amounts of groundwater due to localised features.

- 2.5.5 Groundwater used for drinking water is protected by the EA. The EA classifies zones around potable groundwater abstraction points as Source Protection Zones (SPZs). These are designed to limit potential pollution activities and have implications for how surface water is managed, e.g. by infiltration. According to the EA, the site at Markeaton junction is not located within an SPZ, with the closest zone located approximately 2.3km to the north of the junction.

3 REGULATORY POSITION

3.1 National Policy Statement for National Networks (NPSNN)

- 3.1.1 The primary basis for deciding whether or not to grant a Development Consent Order (DCO) is the National Policy Statement for National Networks (NPSNN) which, at Sections 4 and 5, sets out policies to guide how DCO applications will be decided and how the impacts of national networks infrastructure should be considered.
- 3.1.2 Flood risk paragraphs 5.90 – 5.115 state that the Secretary of State should be satisfied that flood risk will not be increased elsewhere and should only consider development appropriate in areas at risk of flooding where it can be demonstrated that: the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; development is appropriately flood resilient and resistant, including safe access and escape routes where required; that any residual risk can be safely managed, including by emergency planning; and that priority is given to the use of sustainable drainage systems (SuDs). Applications for projects should be accompanied by a flood risk assessment (FRA) to assess all risks of flooding and take climate change into account.
- 3.1.3 In preparing an FRA an applicant should:
- Consider the risk of all forms of flooding arising from the project (including in adjacent parts of the United Kingdom), in addition to the risk of flooding to the project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe throughout its lifetime.
 - Take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made.
 - Consider the vulnerability of those using the infrastructure including arrangements for safe access and exit.
 - Include the assessment of the remaining (known as ‘residual’) risk after risk reduction measures have been taken in to account and demonstrate that this is acceptable for the particular project.
 - Consider if there is a need to remain operational during a worst case flood event over the development’s lifetime.
 - Provide the evidence for the Secretary of State to apply the Sequential Test and Exception Test as appropriate.

3.2 National Planning Policy Framework (NPPF)

- 3.2.1 Section 14 of the NPPF (revised in February 2019) and the associated 2014 Planning Practice Guidance (PPG) provides the current guidance for planning with respect to flood risk and meeting the challenges associated climate change. The NPPF advocates a sequential approach for the planning process in order to steer development to areas with the lowest possible risk of flooding. It is important to note the revision to the 2012 NPPF in 2018 and 2019. This FRA has been completed in accordance line with the 2019 revision and the associated 2014 PPG.
- 3.2.2 As discussed in Section 1.2, the EA Flood Map confirms that most of the Scheme at Markeaton junction is located within Flood Zone 1. According to Table 2 within the

PPG, this means that it lies within the 'Essential Infrastructure' vulnerability classification. Table 3 within the PPG, which provides a matrix identifying which vulnerability classifications are appropriate within each flood zone, demonstrates that 'Essential Infrastructure' developments are permitted within Flood Zone 1.

- 3.2.3 The Scheme area near Markeaton Brook is within Flood Zone 2, with areas either side of the carriageway within Flood Zone 3. 'Essential Infrastructure' development is permitted within Flood Zone 2.

3.3 Design Manual for Roads and Bridges (DMRB)

- 3.3.1 Highways England and other highway authorities have a responsibility to keep trunk roads and local roads respectively free from flooding (relevant legislation includes the Highways Act 1980 and the Land Drainage Acts 1991 and 1994).
- 3.3.2 The DMRB primarily refers to the former PPS25 (Planning Policy Statement 25, now superseded by the NPPF) for FRA and flood mitigation guidance, and emphasises the need for consultation with the EA early in the design process.
- 3.3.3 The DMRB offers guidance on hydraulic design of highway drainage systems, and assessment, and guidance on mitigation techniques for roads (and embankments) that encroach into floodplains. The latter is not applicable in this case because the site is in Flood Zone 1.
- 3.3.4 More detailed discussion of highway surface water management and sustainable drainage is provided in Section 5.

3.4 Local Plan Review – Adopted Plan

- 3.4.1 The current adopted Local Plan for the study area is The Derby City Local Plan- Part 1 Core Strategy (2017)⁹ which sets out the long term strategy for promoting and managing development in the city up to 2028. The plan forms part of a statutory framework to be used in addition to the on-going policies from the City of Derby local Plan Review (2006)¹⁰.
- 3.4.2 In terms of flood protection the Local Plan, 'CP2 Responding to Climate Change' aims to protect important flood plain areas and provides guidance relating to development within these areas. The policy states:

'Except where satisfactory compensatory measures are provided to off-set any potential adverse effects for development on the water environment and associated lands, planning permission will not be granted for development which:

- a. Lies within undefended areas at risk of flooding;*
- b. Would create or exacerbate flooding elsewhere;*
- c. Results in the loss of natural floodplain;*
- d. Would impede access to a watercourse for maintenance or flood defence purposes;*
- e. Does not provide for the adequate management of surface run-off using sustainable drainage principles, unless it can be demonstrated that their use is inappropriate.'*

⁹ Available online: <http://www.derby.gov.uk/environment-and-planning/planning/planning-policy/>

¹⁰ Available online: <http://www.derby.gov.uk/environment-and-planning/planning/local-development-framework/>

3.4.3 The Scheme is an NSIP and therefore subject to a DCO. In order to obtain development consent, Highways England must demonstrate that flood risk has been adequately managed. Furthermore, planning consent will only be granted where compensating measures are proposed to mitigate potential flood problems.

3.4.4 The draft Core Strategy provides policy and guidance relating to flood risk and water management. It must be ensured that development is flood resilient and resistant and that flood risk is not increased to people or property within the surrounding area. Development must also be designed and laid out to incorporate sustainable drainage systems (SuDS) and ensure that runoff is directed to areas where it does not cause harm to others.

3.4.5 There are no development plans described in the Core Strategy that are in the vicinity of Markeaton junction.

3.5 Strategic Flood Risk Assessment(SFRA)

3.5.1 In October 2013 DCiC prepared a Level 1 Strategic Flood Risk Assessment (SFRA)¹¹ to assist the city in meeting the requirements of national policy. The SFRA provides general advice on flood risks and on the principles and application of sustainable drainage.

3.5.2 According to the SFRA numerous flood events from Markeaton Brook occurred in the 1930s. This led to construction of the Northern Relief Culvert in 1937 and since its introduction, the SFRA reports that fluvial flooding events have reduced.

3.5.3 Both the Markeaton and Mackworth Brooks have been modelled as traditionally they have posed a threat to the city because the watercourse capacities are restricted. The SFRA states that Markeaton Brook is prone to flooding as a result of:

- Insufficient capacity – the brook course is narrow and overgrown in many places. The capacity of the open sections is generally around 9-14 cumecs (as reported in the 2007 SFRA), however this is only a third of the required capacity should the flood diversion system at Markeaton Park fail. The capacity may have also reduced since 2007 due to siltation.
- Markeaton junction is not assessed within the SFRA, but this study notes that the junction does not lie within an area which is mapped as a potential problem area for the 1 in 100 year flood event from Markeaton Brook should defences fail. The SFRA describes how overflows at Markeaton Park into the Northern Relief Culvert should provide a high level of flood defence to the area now proposed for junction improvements, although this would be dependent on regular maintenance of assets.

3.6 Preliminary Flood Risk Assessment (PFRA)

3.6.1 In 2011 DCiC produced its Preliminary Flood Risk Assessment (PFRA)¹² which represented the first stage in recording and monitoring flooding in Derby. The high level assessment addresses flood risk from surface water groundwater, ordinary watercourses and canals. Main rivers and reservoirs were excluded from the scope as they were covered under a separate assessment.

¹¹ Available online:

https://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/policiesandguidance/planning/SFRA_1_Update_Explanation_V3.pdf

¹² Available online: <http://enjoyfreepdf.com/download/derby-city-council-preliminary-flood-risk-assessment/>

- 3.6.2 The PFRA does not include any details of historic flooding at, or within the vicinity of Markeaton junction.

3.7 Our City Our River

- 3.7.1 The Our City Our River Masterplan¹³ has been developed jointly by DCiC and the EA since 2012, and sets out a shared vision to reduce flood risk in Derby and transform the City's relationship with the River Derwent by helping to encourage economic regeneration in areas currently at risk of flooding.
- 3.7.2 Our City Our River describes flow control structures and pumping stations that may be required to prevent the River Derwent backing up Markeaton Brook culvert in the city centre area, but this would not affect Markeaton junction.

3.8 Consultation

- 3.8.1 AECOM has been consulting with DCiC, EA and STW regarding flooding and highway drainage design issues since 2015..

Derby City Council (DCiC)

- 3.8.2 DCiC is the LLFA responsible for managing the risk of flooding from surface water, groundwater and ordinary watercourses in the vicinity of the Scheme at Markeaton junction, and has been consulted regarding local flood risks, available data and the drainage design.
- 3.8.3 DCiC is also the Land Drainage Authority for Markeaton Brook and is responsible for issuing consents for any works requiring approval under the Land Drainage Act (1991).

Environment Agency (EA)

- 3.8.4 The EA has been consulted on the Markeaton junction improvement proposals. Given that Main Rivers are unlikely to be affected at Markeaton junction, the EA had no particular comments on fluvial flood risks for the proposals, but did emphasise that surface water runoff should be controlled to existing rates or less.

Severn Trent Water (STW)

- 3.8.5 Consultation has been undertaken with STW with regard to their assets in the vicinity of the Scheme at Markeaton junction. .

¹³ Available at:
<https://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/environmentandplanning/OurCityOurRiverMasterplan2013.pdf>

4 SOURCES OF FLOODING AND FLOOD RISK

4.1 Introduction

4.1.1 The NPPF (and the NPSNN for NSIPs) requires that all potential sources of flooding that could affect a development are considered within an FRA. This includes flooding from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems. Flooding from reservoirs, canals, lakes and other artificial sources must also be considered. There should be demonstration of how these should be managed so that the development remains safe throughout its lifetime, taking into account climate change.

4.2 Historic Flooding

4.2.1 Fluvial flooding occurred in Markeaton Brook catchment in the 1930s, and the Northern Relief Culvert was subsequently constructed to manage flood risk.

4.2.2 The Highways England Drainage Data Management System (HE DDMS) database was investigated for records of historic flooding at the Scheme site. One flood event is reported (ID 12470) in the vicinity of the Scheme at Markeaton junction, which occurred midway between the Kingsway and Markeaton junctions. Flooding was reported on the A38 southbound Palm Court roundabout slip road and onto the A38 south towards Markeaton junction in September 2013, and remedial action was taken (unblocking a gully).

4.3 Fluvial

4.3.1 Flooding from fluvial sources (rivers) can occur through inundation of floodplains from rivers and watercourses, or inundation of areas outside of the floodplain due to influence of bridges, embankments and other features that can restrict flow.

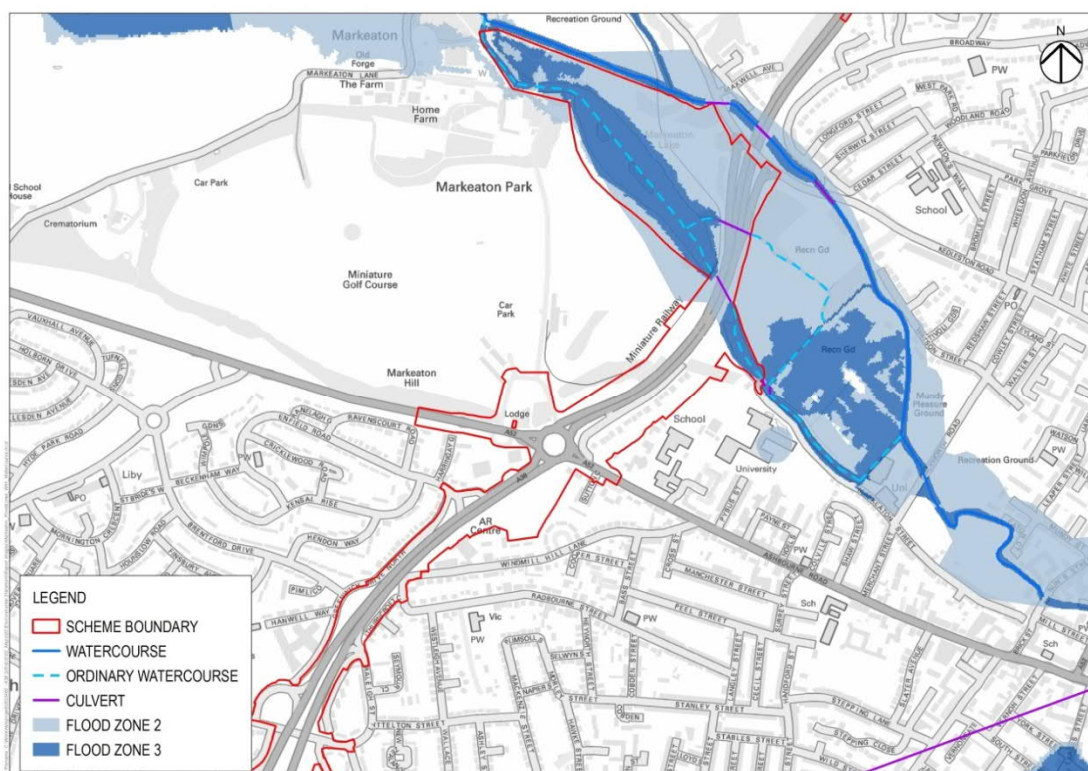


Figure 4-1: Fluvial flood map with Scheme extent
(areas not within Flood Zones 2 and 3 are within Flood Zone 1)

- 4.3.2 The fluvial flood maps (refer to Figure 4-1) show that Markeaton junction is largely at very low risk of flooding from Main Rivers. However, the northern parts of the Scheme are located in Flood Zone 2 due to the close proximity to Markeaton Brook (as identified in Figure 2-1).

4.4 Tidal

- 4.4.1 Tidal flood sources include the sea and estuaries. There are no tidal sources within close proximity of the junction, therefore, Markeaton junction is not considered to be at any risk from this source.

4.5 Groundwater

- 4.5.1 Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels. It tends to occur sporadically in both location and time, and because of the more gradual movement and drainage of water, and tends to last longer than fluvial, pluvial or sewer flooding.
- 4.5.2 As highlighted in the A38 Derby Junctions Ground Investigation Report (Report Number HE514503-ACM-VGT-A38_SW_PR_ZZ-PR-GE-0003_P02_24, 2018), Markeaton junction lies over bedrock geology of Mercia Mudstone Group and the Tarporley Siltstone Formation (Siltstone, Mudstone and Sandstone). The underlying geology is therefore permeable.
- 4.5.3 According to the Areas Susceptible to Groundwater Flooding Map within the PFRA, the majority of Markeaton junction lies within an area considered to have a risk of $\geq 50\%$ $< 75\%$, although DCiC has no records of groundwater flooding in the vicinity of the site.
- 4.5.4 The A38 Derby Junctions Ground Investigation Report indicates that groundwater was typically encountered at depths of around 2.5m to 3.5m in the vicinity of the junction and 9.0m to the south, possibly within semi-confining layers of the Mercia Mudstone Group. To the north-east of the junction, in the area of Markeaton Lake, shallow groundwater depths of 1.0m to 3.0m were encountered within the river terrace and alluvium deposits.
- 4.5.5 Overall, the risk of groundwater flooding is considered to be high.

4.6 Surface Water

- 4.6.1 Overland flow results from rainfall that fails to infiltrate the surface and travels over the ground surface; this is exacerbated where the permeability of the ground is low due to the type of soil and geology (e.g. clay soils) or urban development. Surface water flow is also promoted in areas of steep topography which can rapidly convey water that has failed to penetrate the surface.
- 4.6.2 EA long term flood risk maps (Figure 4-2)¹⁴ show that there are areas along the edge of the existing highway infrastructure at a 'high' risk of surface water flooding. These

¹⁴ Available at: <https://flood-map-for-planning.service.gov.uk/>. Last Accessed November 2018

areas fall within the Scheme boundary and will therefore need to be managed through the proposed road drainage strategy (see Section 5).

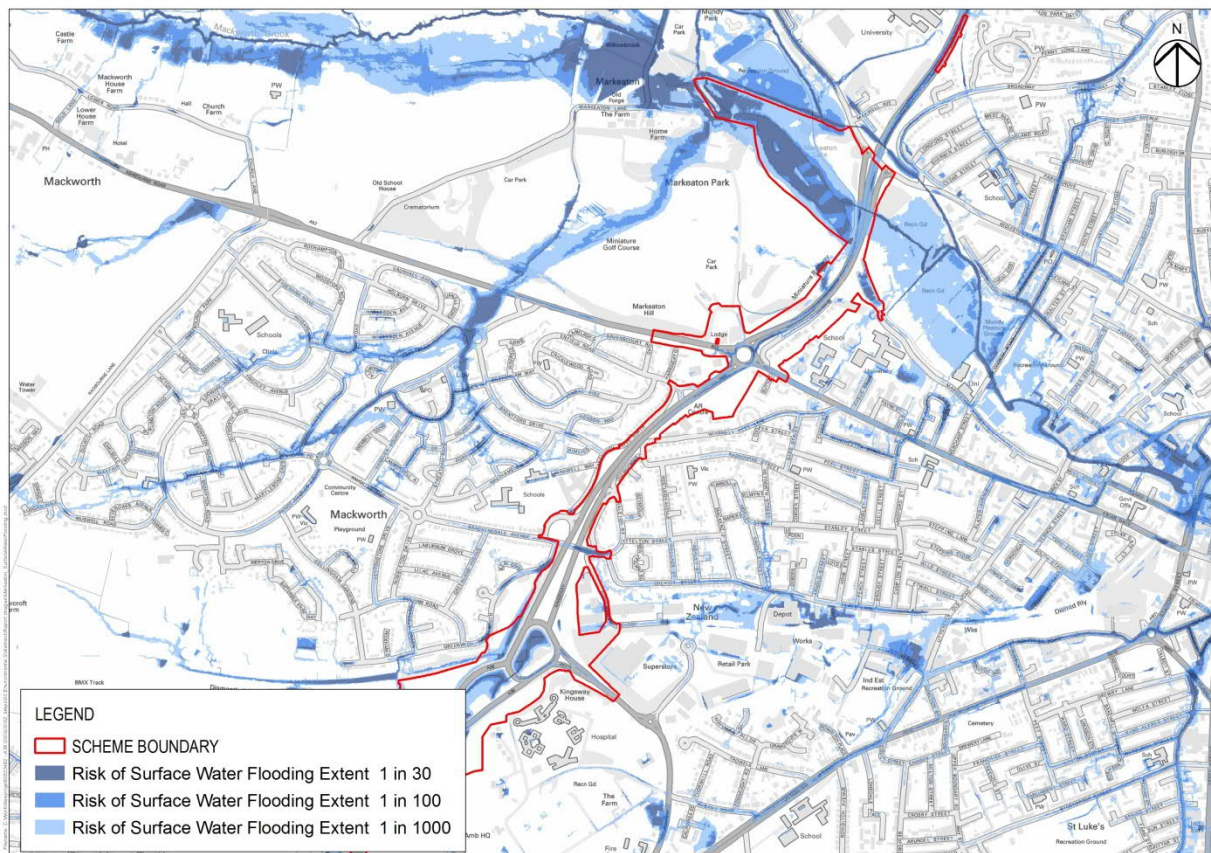


Figure 4-2: Environment Agency flood map for surface water

4.6.3 As the Scheme at Markeaton junction would increase the amount of impermeable surface, the amount of surface water runoff from the area would also increase.

4.6.4 Surface water flood risks to the Scheme at Markeaton junction are considered to be medium, but mitigation measures would be required to control surface water flood risks from the proposed junction. These issues are discussed in Section 5.

4.7 Sewers

4.7.1 Flooding can occur as a result of infrastructure failure e.g. blocked sewers or failed pumping stations. Sewer flooding can occur when the system surcharges due to the volume or intensity of rainfall exceeding the capacity of the sewer, or if the system becomes blocked by debris or sediment.

4.7.2 No sewer flooding records have been identified in the vicinity of the Scheme at Markeaton junction.

4.7.3 As described above, the Road Drainage Strategy (Report Number HE514503-ACM-HDG-A38_SW_PR_ZZ-RP-CD-0002, Highways England, 2019) states that the existing highway pavement and drainage collection systems would be replaced as part of the junction improvements, and detailed drainage design including sewers and a pumping station would take place during detailed design.

4.7.4 The current risk of sewer flooding at the Markeaton junction site is considered to be low.

4.8 Artificial Sources

- 4.8.1 Artificial sources include raised channels such as canals or storage features such as ponds and reservoirs. Markeaton Lake is located approximately 450m to the north of the junction and adjacent to the Scheme and presents a flood risk to the site. There are two weirs at the lake outlet and there is a low likelihood of both structures blocking at the same time. According to OS mapping, there are no other significant canals, ponds or storage features located in the proximity of the Scheme at Markeaton junction.
- 4.8.2 The EA Map of Flood Risk from Reservoirs¹⁵ indicates that Markeaton junction is not at risk of flooding from reservoirs.
- 4.8.3 The risk of flooding from artificial sources is considered to be low.

4.9 Climate Change

- 4.9.1 The United Kingdom Climate Impacts Programme is assessing implications of climate change in the UK. Climate change scenarios for the UK predict that winters will be wetter by up to 15% by the 2020s, summers will possibly be drier by up to 20% by the 2020s, snowfall amounts will decrease significantly, and extreme winter precipitation will become more frequent.
- 4.9.2 In February 2016 the EA released updated guidance on the climate change allowances to be used in Flood Risk Assessments. The Markeaton Brook is located within the Humber River Basin District and the total potential change in watercourse flows anticipated for the 2080s (2070 to 2115) is 50% for the upper end allowance.
- 4.9.3 The EA and DCiC have confirmed that 40% allowance for climate change is appropriate for assessing the Scheme site and this is incorporated into the drainage assessments described in Section 5.
- 4.9.4 It is not considered likely that climate change, as it is currently predicted, will have significant impacts on the flood risks described above, subject to the necessary allowances being made in the Scheme drainage design.

4.10 Summary

- 4.10.1 Key findings of the flood risk review are as follows:
- The risk of fluvial flooding to the proposed Markeaton junction is considered to be low.
 - There is no realistic risk of tidal flooding.
 - The risk of groundwater flooding is considered to be medium.
 - The risk of surface water flooding to the proposed Markeaton junction is low. However, the risk of increased surface water runoff from the Scheme arrangement to surrounding areas is considered to be high. The road drainage strategy has been developed to describe how attenuation would be used to control runoff from the Scheme to existing rates – refer to Section 5.
 - The risk of sewer flooding is considered to be low.
 - The risk of flooding from artificial sources is considered to be low.

¹⁵ Available at: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map> Last Accessed November 2018.

5 SURFACE WATER MITIGATION MEASURES

5.1.1 The Road Drainage Strategy (Report Number HE514503-ACM-HDG-A38_SW_PR_ZZ-RP-CD-0002, Highways England, 2019) is available as a separate report and should be read in parallel with this FRA. The Road Drainage Strategy report indicates that the highway drainage design at Markeaton junction comprises the following:

- Pumping station adjacent to the southbound diverge slip road to pump highway runoff from the mainline cutting.
- To provide groundwater exclusion and avoid post-construction groundwater pumping, a secant pile retaining wall is proposed along both sides of the main cutting, combined with a water excluding reinforced concrete base slab.
- Attenuation using the carrier pipework network.
- Narrow filter drains.
- Combined kerb drainage units.
- Use of underground tanks or cellular storage (allowance for two separate storage tanks under the area left vacant by building demolition at Queensway).
- Surface sedimentation pond.
- Trapped gully pots and road-side linear drains.
- Petrol interceptors at outfalls and connections to existing public sewers – includes a swale discharge into Mill Pond.
- By-pass separators.

5.2 Runoff collection and conveyance

5.2.1 Markeaton junction's preliminary drainage design consist of six catchments.

5.2.2 Runoff from the carriageway would be collected via a combination of road edge channels, gullies and combined kerb drainage units (where required). The proposed overbridges allow for bridge drainage/ combined kerb drainage units on the bridge deck.

5.2.3 The use of carrier pipes would ensure that spillages would be contained within the drainage system and would not infiltrate to ground close to source. Subsurface drainage would be provided via narrow filter drains throughout where necessary.

5.2.4 To provide groundwater exclusion from the new underpass and avoid post-construction groundwater pumping, a secant form of pile construction is proposed, combined with a water excluding reinforced concrete base slab. Due to potential high groundwater levels, the structural arrangement would be required to exclude groundwater, with the capacity to resist uplift pressures. Temporary pumping of groundwater would be required during construction. Permanent pumping of surface water would be required, as the underpass would be below the level of nearby watercourses.

5.2.5 The carriageway within the A38 mainline cut would be approximately 7.8m below existing ground level near chainage 2,850m (approximately 400m to the west of the nearest watercourse).

- 5.2.6 A pumping station would be required to convey surface water runoff from the majority of the new A38 mainline to the surface. The pumping station would be located beside the junction's southbound diverge slip road.
- 5.2.7 Further consultation is required to determine the electrical supply to the pumping station and would be carried out in the detail design stage. A risk-based approach at detailed design stage would be completed to fully understand the implications of the inclusion or exclusion of an electrical backup system or systems. Access to the pumping station would be from the adjacent slip road.

5.3 Attenuation and pollution control

- 5.3.1 A GRR of 4.6l/s/ha has been agreed with DCiC for use within the preliminary design calculations.

Catchment 6

- 5.3.2 The widening of the Markeaton Park entrance road would provide an increase in impermeable area. The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the existing pipe network/ upgraded pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. Drainage information regarding the existing network would be ascertained through a drainage survey during the detailed design stage.
- 5.3.3 Catchment 6 would discharge into the existing drainage network within Markeaton Park.

Catchment 7

- 5.3.4 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing connections to the existing Markeaton Lake culvert (subject to condition assessment) would be retained. No vegetative highway runoff treatment would be provided due to the site constraints, matching existing conditions. An open highway runoff attenuation and treatment feature was not feasible in this location as it would require land take from Markeaton Park.
- 5.3.5 A petrol interceptor would be located upstream of the connection to the culvert.

Catchments 8 and 9

- 5.3.6 The northbound and southbound slip roads of Kedleston Road junction would discharge to the existing culvert connecting Markeaton Lake with Middle Brook.
- 5.3.7 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing connections to the existing culvert (subject to condition assessment) would be retained. No vegetative highway runoff treatment would be provided due to the site constraints, matching existing conditions.

Catchment 10

- 5.3.8 Attenuation up to and including 100 year + 40% climate change storm event would be provided within the pipe network, lined attenuation tanks (underground) and a

lined vegetated treatment forebay (open water storage pond). The runoff from this catchment would outfall into Mill Pond.

- 5.3.9 Due to the size of attenuation required, it would not be possible to attenuate all highway runoff using open water features, especially as this area would be used for replacement public open space offered in exchange for public open space lost due to the Scheme. As such, a combination of buried attenuation and surface water features compatible with a public open space land use is proposed.
- 5.3.10 Markeaton junction's preliminary drainage design includes a vegetated lined open ditch to convey highway runoff water from the pumping station to the initial lined attenuation tank (buried). The flow would then conveyed via a vegetated lined open ditch from this tank to the lined open forebay pond which would provide further treatment of the runoff. The lined forebay (which would be planted) would consist of water to a depth of approximately 300mm and would be sized to hold the first flush generated from the catchment, equal to the first 10mm of rainfall across the road surface from a 10 year storm event (HA103/06). Another vegetated lined open ditch would convey the water from the forebay to a second buried attenuation tank. A further vegetated lined open ditch would convey the runoff from the second buried attenuation tank to the proposed discharge point into Mill Pond.
- 5.3.11 The first flush would be held back by the lined forebay and which would drain through to the second buried attenuation tank via a filter drain. The retention time of the lined forebay would be greater than 24 hours.
- 5.3.12 The preliminary design allowable discharge rates have been calculated using a GRR of 4.6l/s/ha for the new impermeable areas as agreed with DCiC and restricted to ensure betterment over the existing situation for the site.
- 5.3.13 Penstocks would be provided upstream of the attenuation tanks to allow cut off in the event of a spillage on the highway. The spillage would be contained within the carrier/ system and/ or lined ditches.

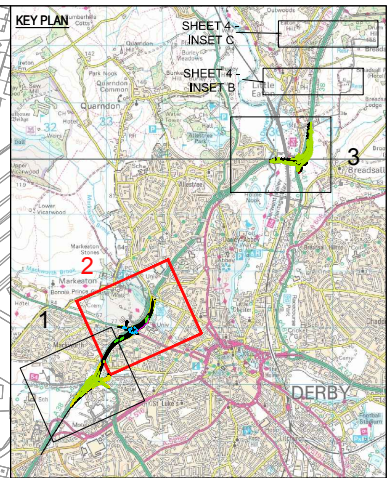
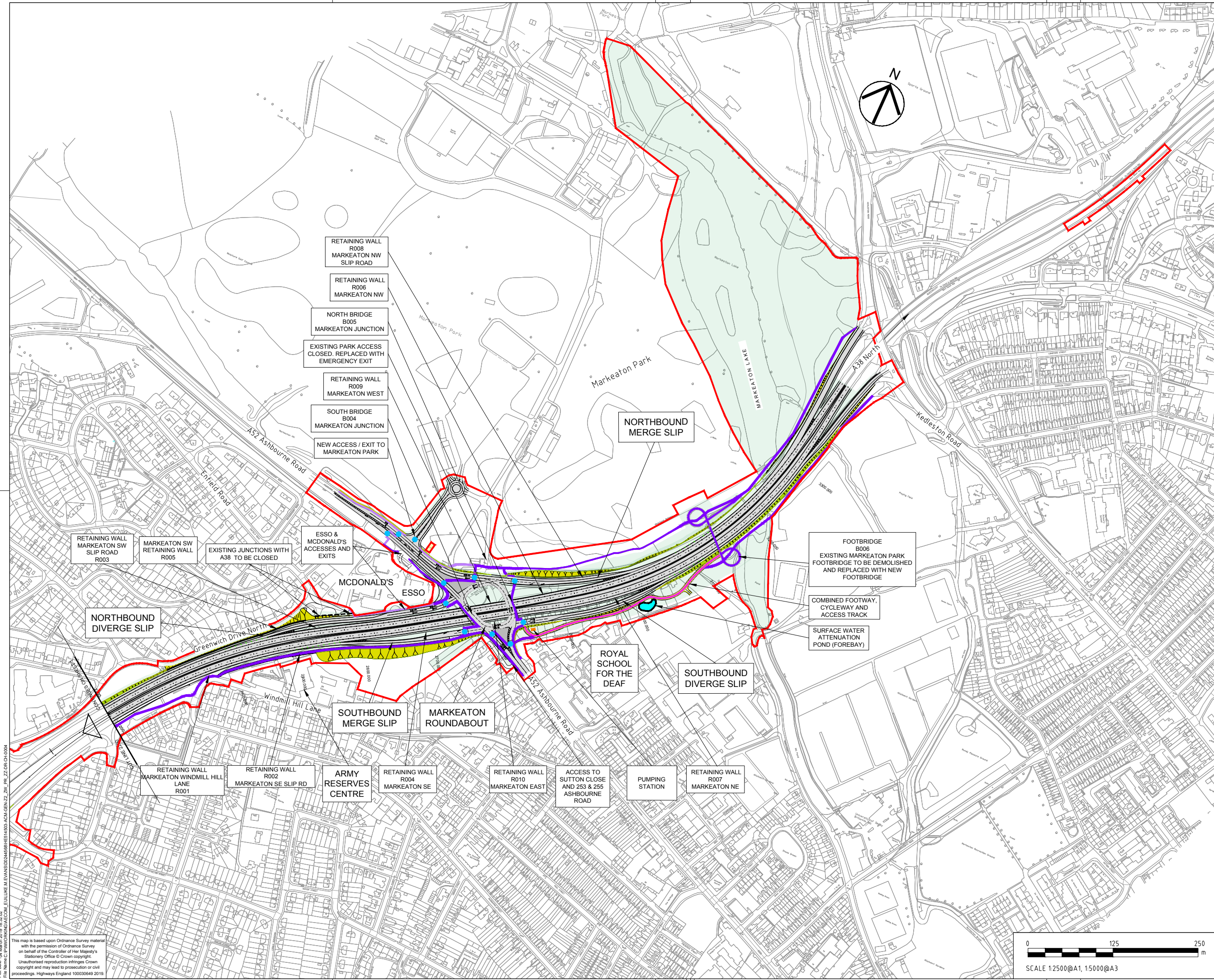
Catchment 11

- 5.3.14 South-east of the proposed A38 underpass, the A52 would drain via existing gullies into the DCiC highway drainage system on Ashbourne Road. There would be a reduction in the drained area with the Scheme and consequently a reduction in peak runoff flows.

6 CONCLUSIONS

- 6.1.1 The proposed Markeaton junction would increase the impermeable surfacing and potential surface water runoff.
- 6.1.2 This Flood Risk Assessment (FRA) has reviewed the Scheme proposals at Markeaton junction. Flood risks to, and resulting from, the Scheme were assessed as follows:
- The risk of fluvial flooding to the proposed Markeaton junction improvement is considered to be low.
 - There is no realistic risk of tidal flooding.
 - The risk of groundwater flooding is considered to be medium.
 - The risk of surface water flooding to Markeaton junction is low. However, the risk of increased surface water runoff from the Scheme arrangement to surrounding areas is considered to be high. The road drainage strategy has been developed to illustrate how runoff from the Scheme would be controlled to existing rates (this is summarised in Section 5).
 - The risk of sewer flooding is considered to be low.
 - The risk of flooding from artificial sources is considered to be low.
- 6.1.3 Surface water flood risks from the Scheme would be managed through the drainage design as detailed in the Road Drainage Strategy (Report Number HE514503-ACM-HDG-A38_SW_PR_ZZ-RP-CD-0002, Highways England, 2019).
- 6.1.4 Pumping station adjacent to the southbound diverge slip road to pump highway runoff from the mainline cutting, attenuation using the carrier pipework network, narrow filter drains; combined kerb drainage units, use of underground storage tanks or cellular storage (allowance for two separate storage tanks under the area left vacant by building demolition at Queensway), plus a surface sedimentation pond, trapped gully pots and road-side linear drains, petrol interceptors at outfalls and connections to existing public sewers, by-pass separators. The Road Drainage Strategy is available as a separate report and should be read in parallel with this FRA.
- 6.1.5 Incorporation of the mitigation measures as detailed herein indicate that flood risks associated with the Scheme at Markeaton junction can be appropriately managed.

Appendix A Scheme Design and Boundary



- NOTES
- PLEASE REFER TO 1:1000 SERIES DRAWINGS FOR:
- MAIN PEDESTRIAN/CYCLE ROUTES AND CROSSING POINTS
 - INDICATIVE ROAD MARKINGS
 - MAINTENANCE ACCESS AREAS
 - FENCING (INCLUDING ENVIRONMENTAL BARRIERS)
- KEY:
- The Design
 - Limits of Land to be acquired or used permanently or temporarily
 - Proposed Footway/Cycleway
 - Proposed Footway
 - Public Right of Way Diversion
 - Existing Right of Way to be stopped up
 - Area Not Included within the DCO Boundary
 - Proposed Controlled Crossing
 - Proposed Un-Controlled Crossing
 - Embankment
 - Cuttings
 - Access Track
 - Combined Access track & Footway/Cway
 - Environmental Mitigation
 - Highway to be stopped up
 - Proposed Culvert
 - Streams

First Issue	LE	GS	20/02/19	P01
First Issue	LE	GS	04/03/19	P02
Revision Details				
	By	Check	Date	Suffix
Purpose of issue				
FINAL				
Client				
Highways England				
Floor 5				
Two Colmore Square				
38 Colmore Circus				
Birmingham				
B4 6BN				
Development Consent Order Number				
TR010022				
Project Title				
A38				
DERBY JUNCTIONS				
Drawing Title				
GENERAL ARRANGEMENT				
REGULATION 5(2)(O)				
SHEET 2 OF 4				
Designed	Drawn	Checked	Approved	Date
LE		GS	GS	04/03/19
Internal Project No.		Suitability		
60533462		S3		
Scale @ A1		Zone		
1:2500		Whole Scheme		
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