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Independent Flood Review

Milton Keynes – 27th May 2018 Flood Event

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FINAL

Quality information

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Revision History

Revision	Revision date	Details	Authorised	Name	Position
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1 Non-technical Summary

1.1.1 An Independent Flood Review (IFR) has been completed by AECOM on behalf of Milton Keynes Council (MKC) in relation to the flooding experienced in Milton Keynes (MK) on 27th May 2018. Whilst there is no statutory requirement to commission an IFR, the MKC Cabinet considered it appropriate given the scale of impacts of the flooding, and gave the instruction to "*investigate the aspects of public concern raised and make recommendations as necessary*".

Flooding Impacts

1.1.2 The flooding during 27th May 2018 is estimated to have affected 1,000 properties across MK, of which half were internally flooded. Of these, 42 properties were evacuated, leaving their occupants displaced and requiring varying levels of welfare support.

1.1.3 Several local roads were flooded and closed, leading to travel disruption for residents and visitors of MK. Utilities, such as gas, communications and water were largely unaffected; however, the electricity supply was turned off for 48 hours in many houses for safety purposes. The total economic damages associated with this flood event are estimated at £7m.

Sources and Causes

1.1.4 The flooding occurred due to an intense rainfall event which led to the exceedance of local drainage systems. The volume and intensity of rainfall varied across MK which explains why particular communities were affected more than others. In some locations the drainage systems are reported to have needed maintenance. It is however important to note that even if the systems were in optimum condition, they would still have been unable to manage such a significant rainfall event.

1.1.5 Some of the affected locations have flooded previously. Members of the public have voiced frustrations that problems remain and feel that little action has been taken despite repeatedly reporting. Going forward, organisations have a role to improve communications with members of the public and jointly coordinate resolution of problems.

Emergency response and recovery

1.1.6 Numerous organisations responded to the flood event to provide support to affected communities. The ethic and care of staff across organisations should be commended for going above the 'call of duty'. Without doing so, support to affected communities outside of normal working hours would have been significantly reduced.

1.1.7 There is a Multi-Agency Flood Plan (MAFP) for MK, which sets out how organisations should work together during a 'major incident' so a coordinated and informed response can be delivered. Despite the scale of the flooding, the MAFP was not implemented and in hindsight, most organisations have explained they believe it should have been. During the early stages of the emergency response, organisations worked in isolation in the understanding they could manage the impacts. However, with better communications between them, the scale of flooding would have been better understood, likely leading to a 'major incident' being declared and a multi-agency response coordinated.

1.1.8 Coordination was greatly improved during the recovery phase, particularly from 29th May when staff returned to work. MKC organised mass street cleansing, gully emptying and free bulk collection of flood damaged items in affected areas. Temporary accommodation was arranged and welfare needs identified. The Environment Agency, Anglian Water Services and flood risk consultants provided further support by mobilising staff to affected areas to investigate the impacts, liaise with communities, and identify where intervention was needed. A great example where colleagues across organisations can collaborate to meet mutual goals.

1.1.9 To further support MK residents, a 'Hardship Grant' was made available by MKC to support with immediate welfare needs and a short suspension of Council Tax was implemented for homes affected by flooding. For MKC housing tenants, rent was also waived for two months with a commitment made to reimburse temporary accommodation costs.

Assets Management and Flood and Drainage Projects

1.1.10 The ownership of MK flood and drainage related assets rests with various organisations and landowners, which in places is known but not all. During the flood event it is understood that strategic assets performed primarily as expected.

1.1.11 Organisations have plans to investigate and deliver thirteen flood and drainage projects across MK. Collaboration between all partners will support effective delivery. MKC is also assessing those areas affected during the 27th May 2018 flooding to investigate whether large scale flood and drainage projects are needed.

Policy Review

1.1.12 A review of local policy relating to surface water management and flood risk in MK has found that many good principles are set out. Further enhancements could be made, and these should be reflected in future policy reviews.

1.1.13 The Local Flood Risk Management Strategy for MK has numerous actions which are supplemented by the Surface Water Management Plan. Evidence of progress against these actions is limited, which is likely due to the available Lead Local Flood Authority (LLFA) resource. To effectively deliver its statutory duties and wider role of a LLFA, MKC ought to seek experienced resource to lead and drive these activities.

2 Introduction

2.1 Flooding Incident – 27th May 2018

2.1.1 Several areas within the Borough of Milton Keynes experienced significant rainfall during the evening of Sunday 27th May 2018.

2.1.2 The resulting local flooding from surface water and ordinary watercourses throughout South-Central and the rural North of Milton Keynes caused significant impacts in local communities affecting residential and commercial properties, as well as critical infrastructure.

2.1.3 Milton Keynes Council (MKC) has reported hundreds of properties flooded internally and identified critical infrastructure to have been affected including the Milton Keynes University NHS Foundation Trust and Centre: MK Shopping Centre.

2.1.4 MKC determined that it was necessary to complete an independent review into the flood event that occurred in Milton Keynes on Sunday 27th May 2018.

Figure 2-1: Flood Impacts during 27th May 2018

2.2 Independent Flood Review

Terms of Reference

2.2.1 The terms of reference for this Independent Flood Review (IFR) are to "investigate the aspects of public concern raised and make recommendations as necessary, which will include, but not be limited to:

- An assessment of the Council's inspection and maintenance process of their flood related assets including any structural defects identified before, during and after the flooding and any planned repairs following the incident.
- An appraisal of any completed and/or planned flood and drainage projects in the Borough.
- An evaluation of the existing planning guidance to identify any actions which could reduce the impact of surface water flash flooding in major new housing developments.
- A review of the emergency response procedures (including the provision of sandbags) to learn what worked well and where improvements could be made, if any, to ensure that the Council can respond more efficiently and effectively to future events. This should include an overview of how all Agencies, Risk

Management Agencies (RMAs) and Communities (Town and Parish Councils and Residents Associations) currently work together. Recommendations to enhance resilience to future events should be considered.

- An analysis of the economic costs incurred by the community, businesses and Council as a result of the flooding."

2.2.2 The terms of reference also required AECOM to engage with all relevant stakeholders as appropriate to provide their input regarding the flooding event.

Agreed Objectives

2.2.3 It has been agreed by AECOM and MKC that the purpose of the IFR is to build upon and complement existing learning. The IFR aims to report on the following matters:

- The response of MKC, Risk Management Authorities (RMAs) and local communities during and after the flood;
- A review of the Flood Investigation Reports (FIRs) prepared by MKC following the flooding on 28th May, prepared in accordance with their duties under the Flood and Water Management Act (F&WMA);
- The effectiveness of emergency plans and preparedness to manage flood risk in Milton Keynes prior to the flood event;
- The effectiveness of existing flood assets and alleviation schemes; and whether additions or improvements could be made;
- The effectiveness and use of existing local policies relating to flood risk and surface water drainage systems;
- Provision of high-level economic damages associated with the flood event in May 2018.

2.2.4 It has been agreed, as part of the stakeholder engagement process, to consult with the public, representatives from MKC, and external partners including RMAs (such as Environment Agency and Anglian Water) and affected organisations and businesses such as the Milton Keynes University NHS Foundation Trust and The Centre: MK.

2.2.5 Summary recommendations have been identified within each Section with detailed actions provided in Appendix A.

2.2.6 As part of this IFR, various stakeholder engagement activities have been undertaken with MKC, its partner organisations along with residents and businesses. The full details are provided in Appendix B.

3 Review of Flood Investigation Reports (FIR)

3.1 Flood and Water Management Act requirements

3.1.1 MKC, as the Lead Local Flood Authority (LLFA) for the Borough of Milton Keynes, has a duty to conduct formal flooding investigations, as specified under Section 19 of the Flood and Water management Act 2010[1] (F&WMA).

3.1.2 Section 19 of the F&WMA states:

19 Local authorities: investigations

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—

(a) which risk management authorities have relevant flood risk management functions, and

(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must—

(a) publish the results of its investigation, and

(b) notify any relevant risk management authorities.

Source: https://www.legislation.gov.uk/ukpga/2010/29/section/19

3.1.3 Two Flood Investigation Reports (FIRs) have been published by MKC following the flooding event that occurred on Sunday 27th May 2018. These covered two distinct areas as follows:

- Stoke Goldington Flood Investigation Report[2].
- South Central Milton Keynes Section 19 Flood Investigation Report[3].

3.1.4 A third FIR covering the area of Newport Pagnell has been drafted. It is currently waiting for approval by the Council and is yet to be published.

3.1.5 All three FIRs have been reviewed as part of this IFR.

3.2 Milton Keynes Council

3.2.1 As described above, MKC has a statutory duty to investigate flooding in its area to the extent that it considers *necessary or appropriate*. Therefore, pre-determined criteria to determine what is "necessary or appropriate" in the context of MK should be outlined.

[1] https://www.legislation.gov.uk/ukpga/2010/29/contents
[2] F&WMA Section 19 Report, South central Milton keynes May 2018, Milton Keynes Borough Council https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/emergency-planning/flood-and-water-management-drainage?chapter=7
[3] F&WMA Section 19 Report, Stoke Goldington Flood investigation Report. https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/emergency-planning/flood-and-water-management-drainage?chapter=7

3.2.2 A Flood Investigation Policy Draft[4] was prepared by MKC and published in October 2018, pending full Council Approval. The Policy includes the Flood Investigation Protocol, which establishes the process for the investigating officer to follow in order to determine whether an investigation should be carried out and the subsequent actions to undertake.

3.2.3 The Flood Investigation Policy Draft sets out thresholds for the need of carrying formal flood investigation under Section 19 of the F&WMA as follows:

3.2.4 "A formal investigation will generally be carried out if one or more of the following occurs:

- Flooding has affected critical infrastructure for a period in excess of three hours from the onset of flooding;
- Internal flooding of a building has been experienced on more than one occasion in the last five years;
- Internal flooding of five buildings in close proximity has been experienced during one single flood incident."[5]

3.2.5 Section 19 of the F&WMA explains that on becoming aware of a flood which meets certain pre-determined criteria, the LLFA must undertake a formal flood investigation. The FIR should identify which RMAs have relevant flood risk management functions and whether these authorities have exercised, or are proposing to exercise their respective functions in response to the flood.

3.2.6 The MKC Flood Investigation Policy Draft also mentions a non-exhaustive list of authorities having flood risk management functions in Milton Keynes. This proposed list of RMAs includes: Milton Keynes Council (including the Highways Department), Anglian Water, and Environment Agency, the Internal Drainage Board and the Parks Trust and landowners.

3.2.7 The MKC Flood Investigation Policy Draft specifies that flood investigations aim to describe the flood incident, determine contributing factors and provide recommendations for each relevant body or persons.

3.3 Flood Investigation Reports

Overview

3.3.1 Due to the available resources in the LLFA team and the extent of flooding which occurred on 27th May 2018, MKC made the decision to obtain support from consultancies to fulfil its statutory duty (described in Section 3.2) to undertake flood investigations.

3.3.2 AECOM was commissioned by MKC to carry out formal investigations into the flood incident at Newport Pagnell and Stoke Goldington.

3.3.3 WSP was commissioned by MKC for the flood investigation covering the South-central Milton Keynes area.

3.3.4 The three FIRs identify and explain the likely cause(s) of flooding in each of these study areas. A summary of this information is provided in Section 4.

[4] F&WMA Section 19 Report, Flood event: May 2018, Appendix A, Milton Keynes Draft S19 Policy, October 2018
[5] Flood Investigation Protocol Draft, Milton Keynes Council, 2018.

3.4 Compliance with the Section 19 requirements

RMA respective rights and responsibilities

3.4.1 The formal FIRs identify the different RMAs, communities and individuals having relevant flood risk management roles and responsibilities, as required under Section 19 of the F&WMA 2010.

3.4.2 Within the Borough of Milton Keynes, the following RMAs have been identified: the Lead Local Flood Authority (Milton Keynes Council), the Environment Agency, Anglian Water Services (AWS), Highway Authority (MKC and Highways Agency), the Bedford Group of Drainage Boards (BGDB), Milton Keynes Parks Trust (MKPT), Landowners and Developers, Communities and residents.

3.4.3 A summary of the RMAs rights and responsibilities identified in the three FIRs is provided in Appendix E.

3.4.4 From the review of the three FIRs, it is observed that different methodologies have been used for identifying the relevant RMAs. The investigation covering South Central Milton Keynes identifies and reports all RMAs having rights and responsibilities in flood risk management in the Borough of Milton Keynes, and includes Newport Pagnell and Stoke Goldington. More detailed investigations for Newport Pagnell and Stoke Goldington report on RMAs having rights and responsibilities relevant to the specific flooding event of May 2018.

Assessment of RMAs exercise of rights and responsibilities

3.4.5 The FIRs outline whether those authorities, communities or individuals have or are planning to exercise their powers or responsibilities in response to the different incidents that occurred during the flooding event of May 2018.

3.4.6 In Stoke Goldington, it was noted during the flood investigation that MKC have undertaken a number of capital maintenance drainage works since 2007, including clearing ditches, construction of flood defences and cleaning gullies. A chronological record of these works was provided to inform the flood investigation carried out in this area.

3.4.7 In Newport Pagnell, the flood investigation reports that MKC Highways and AWS have undertaken investigations on Westbury Lane and on Wolverton Road following the flood event. This identified a manhole where concrete had been fly-tipped into the sewer resulting in a dam effect which was causing siltation to build-up behind and flows to back up in the system. AWS have since undertaken a program to clear more than 30 tonnes of silt and concrete from the system.

3.4.8 MKC Highways and AWS both identified several maintenance activities requires on the highway drainage network within Wolverton Road and Westbury Lane. These are understood to be ongoing or planned. In addition, AWS is understood to have completed planned maintenance in Beanhill.

FIR Recommendations

3.4.9 The FIRs provide recommendations for each of those authorities, communities and individuals. These have been combined and summarised in Section 3.5 below.

3.4.10 Most of the recommendations within the FIRs are general and relate to strategic long-term flood risk management which applies to whole Borough of Milton Keynes.

3.4.11 A specific recommendation was made for Newport Pagnell area; that the Highways authorities and AW complete identified reactive maintenance activities within Wolverton Road and Westbury Lane. At the time of writing this IFR, some of these have been complete with others programme for later in 2019.

Publications and Notifications

3.4.12 The FIRs covering the South Central area of Milton Keynes and Stoke Goldington have been published, in October 2018 and November 2018 respectively, on the MKC website[6] under a dedicated section, which is easily accessible.

3.4.13 The FIR covering the Newport Pagnell area is yet to be finalised or published. Whilst there is no set timeframe for the publication of a flood investigation findings, it has been over a year since the flood event and it is not apparent why this FIR has yet to be finalised.

3.4.14 Consultations with AWS and MKC Highways were undertaken during the flood investigations to understand how their respective drainage assets performed during the flooding event and to identify any areas of concerns. Discussions and consultations helped to inform the flood investigations on the actions that these RMAs have exercised or were planning to exercise relative to their legal flood risk management functions.

3.4.15 While consultations with some of the identified RMAs were undertaken during the investigation process, it remains unclear whether all relevant RMAs were notified of the publication of the FIRs. The notification process is a legislative requirement when undertaking Section 19 Investigations.

3.5 Recommendations

Recommendations	Detailed Recommendation Reference
MKC's flood investigation policy and protocol should be published, included with the LFRMS and compliance should be monitored annually.	R.3.1 R.3.2 R.3.3
Consistent approaches should be used to report on investigations of incidents induced by the same event	R.3.4
FIRs should be published within 6 months of a flooding event, all partners notified of the publication and their roles and duties identified in the context of the specific flood event.	R.3.5 R.3.6

[6] https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/emergency-planning/flood-and-water-management-drainage?chapter=7

4 Summary of flooding event

4.1 Introduction

4.1.1 The findings of the FIRs have been summarised along with the outputs of the stakeholder engagement activities to provide an overview of the flood event. The IFR has not sought to revisit or confirm if the findings of the FIRs are complete or correct but where gaps have been identified or additional information has been gathered as a product of the IFR, this has been incorporated.

4.1.2 This section aims to identify the impacts to various receptors and the likely causes of flooding whilst putting these in context of the intense and discrete nature of the rainfall event. A review of the affected areas in relation to the Environment Agency's 'Risk of Flooding from Surface Water' (RoFSW) mapping has also been completed. In addition, a combined summary from the site inspections completed by the FIR and IFR teams has been included.

4.2 Impacts and likely causes of flooding

4.2.1 It has been identified that the surface water drainage systems in the three study areas were unable to collect and convey surface water and land drainage effectively during the 2018 flood event. The overwhelming of the drainage network resulted in significant excess surface water flowing overland towards low points in the local topography.

4.2.2 Identifying the total number of properties affected by flooding is challenging due to the quality of the data available. Sources of this data include the residents' and businesses' surveys (Appendix C and Appendix D) and data provided by MKC emergency planning team collected during the event. These datasets have been merged, duplicates removed, and differences corroborated.

4.2.3 This IFR estimates that flooding affected 1,000 residential and non-residential properties across MK. From available data, it is estimated that 490 residential and 17 non-residential properties flooded internally. Several properties were also reported to have experienced flooding within their curtilage; including gardens, driveways, and garages.

4.2.4 The data from the surveys is the most recent, comprehensive and considered of good quality. Analysis of the 351 responses identifies that 57% of residents and 35% of businesses report they were affected by the flooding. Figure 4-1 below identify the proportion of residential properties which experienced internal or external flooding. Figure 4-2 identifies the proportion or flood affected properties which are privately owned, housing association or rented.

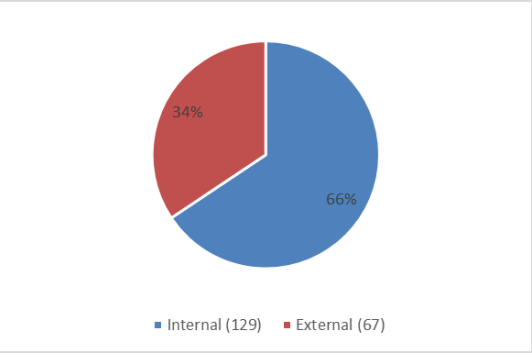

Figure 4-1: 'Type of Flooding' for residential properties

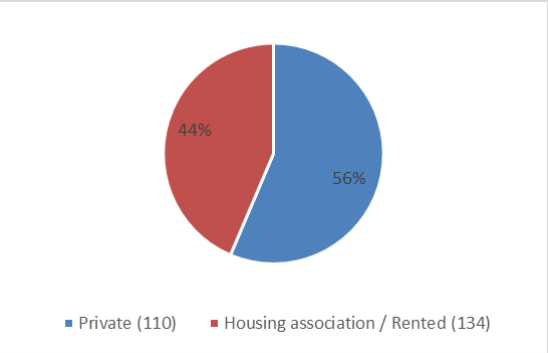

Figure 4-2: Ownership of flooded residential properties

4.2.5 The responses also identify that 42 properties were evacuated with many families being out of their home for several months. Two properties are still unoccupied at the time of receiving these responses (April 2019).

4.2.6 Analysis also demonstrated that only 22% of all respondents consider themselves 'aware of a risk of flooding' and that 48% of the respondents whose properties were affected by the 27th May 2018 flooding event, had been affected by previous floods. Of those who have been flooded previously, 70% state they have reported this to MKC, a housing association or Buckinghamshire Fire and Rescue Service (BFRS).

4.2.7 The surveys also asked if the property owners had undertaken any works to help manage flooding in the future. A total of 36 property owners have reported to have undertaken a degree of works ranging from installing flood barriers to purchasing sandbags.

4.2.8 Some members of the public have expressed their dissatisfaction with the service received from MKC during and after the event. Whilst MKC does need to take note of this and the report sets out recommendations to improve on communications and other areas, it will always be challenging to meet the needs of all members of the public in an emergency. The good work undertaken in response has also been well noted.

4.2.9 Critical infrastructure including four schools, the MKUH, and other health care and community premises are also reported to have experienced internal flooding. It is understood that education and general health care provision were not impacted by the flooding.

4.2.10 It is understood MKUH suffered flooding primarily from the roof although in combination with surface water runoff from adjacent hard paved areas. MKUH decided to redirect ambulances due to the presence of flood water in the resuscitation area which may have led to a delay in patients receiving emergency treatment.

4.2.11 The Centre: MK has reported as part of the IFR that flooding emanated from "Anglian Water drains which run beneath the building" following manhole lids being lifted due to hydraulic pressure. The depth of flooding is understood to have been minimal however some retail units did lose stock.

4.2.12 The flooding that occurred across MK was primarily caused by heavy rain which fell over a short period of time leading to the capacity of drainage systems being exceeded. Further details of the rainfall are provided below.

Rainfall analysis

4.2.13 Radar data and records from local rainfall gauges were analysed as part of the FIRs, to calculate the probability of occurrence of the rainfall event on 27th May.

4.2.14 Rainfall intensities recorded using tipping bucket rain gauges at different locations tend to be more accurate than radar, which is often susceptible to interference. Radar data however provides a good spatial coverage of rainfall intensity, whereas rain gauges only provide details of intensity at that location.

4.2.15 The FIR for South Central MK explains that the two months prior to the flood event in May 2018, had experienced on average 74% more rainfall when compared to average monthly rainfall figures for the Midlands. The local waterbodies are therefore likely to have had elevated water levels at the time of the flood event.

4.2.16 The radar data (Figure 4-3) showed the varying nature of the rainfall which resulted in several locally significant flooding incidents.

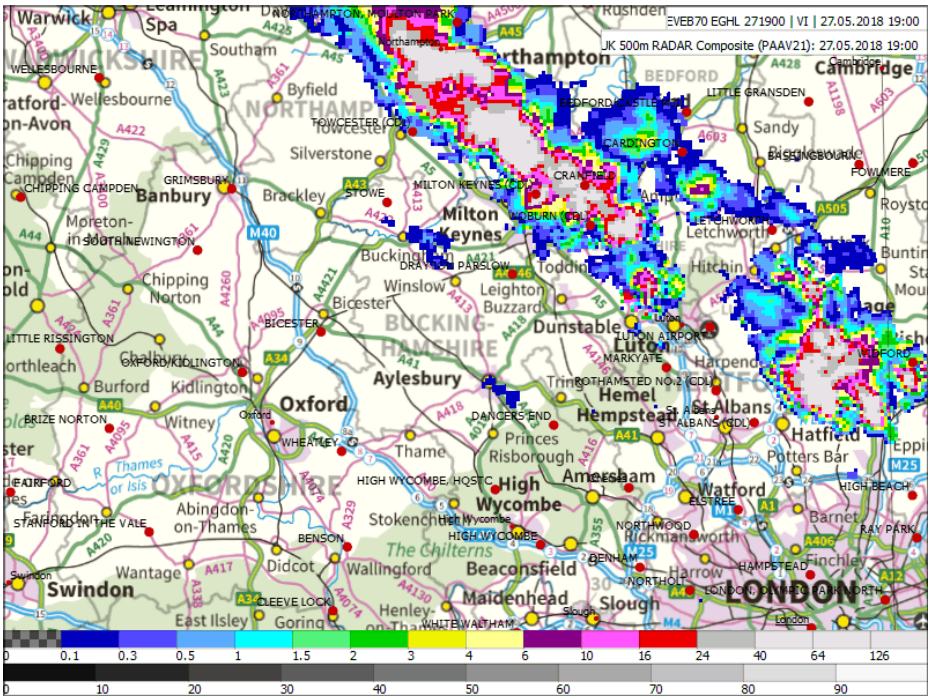

Figure 4-3: Rainfall radar from the Met office

4.2.17 According to the relevant FIR[7], the rainfall across South Central Milton Keynes had Annual Exceedance Probabilities (AEPs) in excess of 1% (1 in 100 year), with some discrete areas affected by rainfall in excess of 0.5% (1 in 200 year) AEP.

4.2.18 The rainfall seemingly varied significantly across the Borough. In Stoke Goldington, the short duration rainfall appears to have been extreme with an estimated AEP of 0.12% (1 in 819 year return period[8]), which occurred in 90 minutes.

4.2.19 A rain gauge in proximity to Willen Lakes accumulated 64 mm of rain during the event with the peak intensity recorded as 115 mm/hour (Figure 4-4).

[7] F&WMA Section 19 Report, Stoke Goldington Flood investigation Report. https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/emergency-planning/flood-and-water-management-drainage?chapter=7

[8] Data supplied to MKC from Meniscus

4.2.20 For Newport Pagnell, rainfall gauges were located outside the corridor of the main affected areas, and as such may not have received the full rainfall that occurred in the area. It has been assessed by the relevant FIR[9] that data recorded at Olney and Shenley were not representative of the rainfall intensity that occurred in Newport Pagnell.

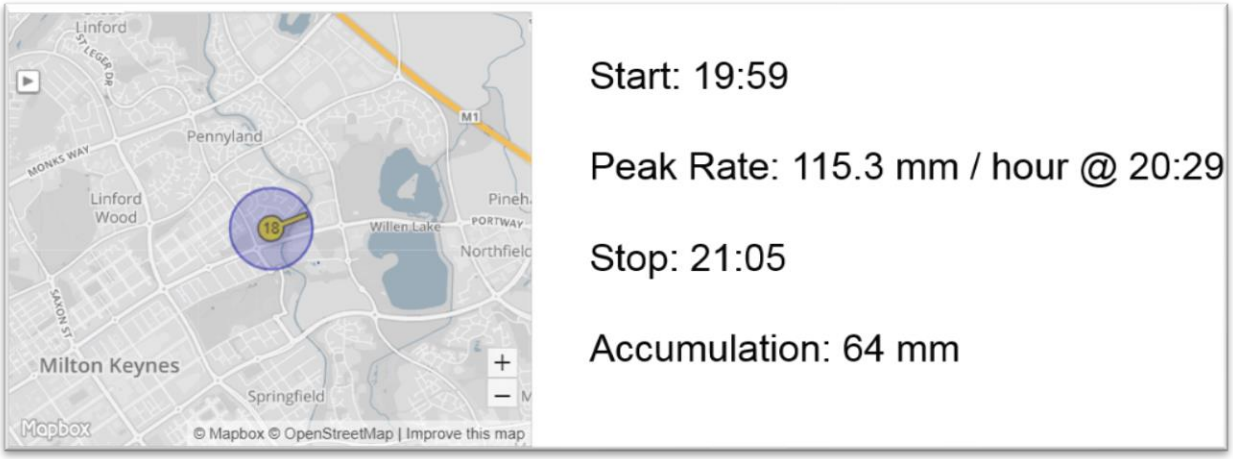

Figure 4-4: Data from rain gauge 'IMILTON36' supplied by the Met Office[10]

4.2.21 Rainfall events such as those identified are considered 'significant' by practitioners across the industry. Managing the intensity and volumes of water associated with such events is challenging. Infrastructure is usually not designed to do so therefore flooding is likely to occur.

Surface water flood risk maps

4.2.22 The Environment Agency's 'Risk of Flooding from Surface Water' (RoFSW) mapping identifies areas within MK which are at risk of surface water flooding. When compared against the areas affected by flooding during the event in May 2018, it is considered to provide a reasonable representation of the associated flood extents.

4.2.23 In Stoke Goldington, a large proportion of the village is identified at high risk of surface water flooding, equivalent to greater than 3.33% AEP (1 in 30 year), with additional areas also at medium risk (equivalent to between 1% and 3.33% chance of flooding each year). The RoFSW mapping (Appendix G) can also help to identify the general alignment of watercourses.

4.2.24 Newport Pagnell, bordered to the north and east by the River Great Ouse, has two defined areas of properties affected by flooding (Wolverton Road and Westbury Lane). Both locations are within areas identified at high risk of surface water flooding, equivalent to greater than a 3.33% chance of flooding each year, based on the Environment Agency RoFSW mapping (Appendix G).

4.2.25 In South and Central Milton Keynes, the Environment Agency RoFSW mapping (Appendix G) indicates that within the areas identified as having experienced flooding, surface water flow routes are predicted, and therefore surface water flooding could be expected.

[9] F&WMA Section 19 Report, Newport Pagnell. Currently unpublished.
[10] Data provided by the MET Office to MKC following the flood event.

Site inspections

4.2.26 Site inspections were undertaken as part of the flood investigations and detailed within FIRs. In addition, a site inspection was completed by the IFR team in attendance with MKC LLFA and Highway Department teams. Examples of the key issues discussed and noted during the site visit are described below, supported by site photographs.

4.2.27 During the site visit a number of existing flood mitigation measures were observed across MK. For the sake of brevity, these will be discussed within the relevant sections later in this Report.

South Central MK

4.2.28 In South Central Milton Keynes, areas were visited during the flood investigation and indicators of flooding were observed, particularly in Coffee Hall, Oldbrook, Milton Keynes Hospital, and Winterhill. Indicators include burst pipes, siltation, rack marks, wicking on brickwork, and household items with signs of water damage.

4.2.29 Housing in the areas of Netherfield, Beanhill, Oldbrook and Tinkers Bridge generally sit below the local road level therefore driveways or access paths slope towards the properties, allowing rainwater to do the same (Figure 4-5). Further exacerbating the risk of flooding is the low property thresholds in these locations, typically observed between 50 – 150 mm (Figure 4-6). This provides very little protection during intense rainfall events and occasions when the capacity of the drainage systems is exceeded.

4.2.30 Drainage systems in many of the areas were not particularly apparent. For example in Coffee Hall, it is understood that filter drains were originally installed in the gardens of residential properties to collect surface water from the individual gardens and runoff from the adjacent carriageways. It is likely given the age of the development, that these filter drains are at the end of their useful life and would benefit from being renewed. It is also fair to assume that many of these features have been lost over time due to paving and general alterations of gardens (Figure 4-7). Both of these factors mean surface water is unlikely to be collected effectively.

4.2.31 Housing estates were observed to have large areas of impermeable surfacing particularly along local access roads and parking areas. A typical arrangement is shown in Figure 4-8. Areas of impermeable surfaces like this do not manage surface water at source thereby increasing the rate and volume of runoff to the surrounding drainage networks

4.2.32 For one property in Oldbrook, the guttering was observed to be heavily vegetated and showing signs of having little routine maintenance (Figure 4-9). This would prevent roof water from being collected efficiently and discharged into the property's drainage system. Whilst this would not usually cause significant flooding, a proficient roof drainage system can only help manage water more effectively within the curtilage of the property.

Figure 4-5: Typical sloping access to property

Figure 4-6: Typical low threshold of properties

Figure 4-7: Example of paved gardens

Figure 4-8: Typical impermeable area

Figure 4-9: Vegetated guttering

Newport Pagnell

4.2.33 In Newport Pagnell, the site inspections were carried out in the two most affected areas: Wolverton Road and Westbury Lane. In both areas, reports were made regarding a number of internal flooding incidents.

4.2.34 On Wolverton Road, gullies were observed in poor condition (vegetated or blocked) at the time of the inspection. Following later investigatory works, AWS has a manhole next to the car park on Marsh End Road where concrete had been fly-tipped into the sewer, resulting in a dam effect which was causing siltation build-up behind and flows to back up in the system. AWS has since undertaken a week program to clear in excess of 30 tonnes of silt and concrete from the system between Caldecotte Street and the roundabout at the junction of Marsh End Road and Wolverton Road.

4.2.35 The surface water sewers in Little Linford Lane and the west part of Wolverton Road are 300mm diameter pipes, according to the Anglian Water public sewer records. At the junction of these two roads the two surface water sewers converge into a 375mm diameter pipe which then, travelling east, increases further in size to 600mm to accommodate pipe connections from areas surrounding Wolverton Road. At the junction of Lakes Lane where the 600mm sewer splits into two 300mm sewers towards Marsh End Road, it was identified that one of the 300mm pipes had been damaged over time by previous road works and had partially collapsed. Remodel works in the area were completed in August 2019 by Anglian Water.

4.2.36 On Westbury Lane, properties were reported to have experienced surface water flooding, foul water flooding, and in some cases, a combination of both. As part of the FIR, an analysis of the foul and surface water network around Westbury Lane was conducted. A number of connections into the foul network in this area and the presence of a combined system in some part of the upper catchment were found. It was therefore assessed that excessive surface water runoff was likely to have contributed to the surcharging of several of the foul manholes.

4.2.37 The IFR team visited Newport Pagnell and observed the area predominantly around Wolverton Road. Property threshold levels are generally 225 mm above the external ground (Figure 4-10) although some are lower on certain properties. The carriageway is fairly typical in design with a chamber from north to south and gullies in the lowest areas. A concrete channel is present between the rear of the public footpath and private driveways (Figure 4-11). In places this looked unmaintained with siltation and vegetation present. Cleansing and weed spraying of footways is undertaken by MKC's street cleansing team. It is understood that budget restrictions have reduced the frequency of such activities which has led to increased siltation and debris in drainage features.

Figure 4-10: Example of typical threshold levels

Figure 4-11: Concrete channel at the rear of public footpath

Stoke Goldington

4.2.38 As a part of the flood investigation covering Stoke Goldington area, a site visit was undertaken on 27th June 2018. Stoke Goldington presents a different flood mechanism due to its rural nature. The village sits in a valley at the confluence of two ordinary watercourses and is reported to suffer flooding from capacity exceedance of these along with overland flow from the surrounding land. Figure 4-12 shows the topography of the agricultural land and Figure 4-13 indicates how water would run towards properties of Stoke Goldington.

4.2.39 Nearer to the village, one of the ordinary watercourses was observed within channel and providing a land drainage function for this upper reach of the catchment. This then enters a culvert which appeared to flow beneath the properties immediately downstream (Figure 4-13).

4.2.40 Within Town End Crescent, several properties reported incidents of flooding. The FIR states that a ditch located immediately north of Town Crescent was in a mixed condition at the time of inspection. Upstream sections appeared to be in good condition and were assumed to be built after a previous flood event that occurred in 2007, while downstream sections are described as being noticeably older.

4.2.41 The area which experienced the some of the worst flooding is Orchard Way, with some properties reporting internal depths of water of approximatively one metre. There may be inaccuracies in the flood depths reported by residents due to the length of time since event and the mental stress of flooding. It is thought properties were affected by flow paths from multiple directions on Orchard Way.

4.2.42 The FIR states that flow paths ran past properties on the adjacent Dag Lane. It was however reported that the culvert in this area was quickly overwhelmed. Visual inspection of the flood storage area located upstream of Dag Lane were undertaken to inform the flood investigation and revealed that it was heavily vegetated. The vegetation in Dag Lane ditch is maintained every autumn as part of a routine maintenance schedule.

4.2.43 Properties located on High Street, Mount Pleasant, and Malting Close, were also reported as affected by the flooding event.

Figure 4-12: Higher surrounding land of Stoke Goldington

Figure 4-13: Evidence of flow path in field to the south of the Church

Figure 4-14: Ordinary watercourse entering culvert upstream of Stoke Goldington

4.3 Recommendations

Recommendations	Detailed Recommendation Reference
MKC should be responsible for investigations to determine: • **Measures to manage the risk of flooding to properties which sit below the road and surrounding land.** • **Why properties are still unoccupied and understand what support would be beneficial to the residents.** • **Why survey respondents are unhappy with the service received during and after the event and how this can be improved.**	R.4.1 R.4.6 R.4.8
Partner organisations should collaborate to improve community awareness of flood risk, ensuring reports of flooding are shared so all are aware of the appropriate actions to take. This will help property owners to manage flood risk to their property and the local area by: • **Inspecting and maintaining drainage systems within the curtilage of their properties (including guttering, downpipes and any other above or below ground features).** • **Replace impermeable surfaces with permeable alternatives to promote better surface water management at source.** • **Creating/joining a flood action group.** • **Installing property level flood resilience measures.**	R.4.2 R.4.7 R.4.9
MKC and landowners should investigate measures to better manage surface water runoff from higher ground and flow within the associated ordinary watercourses specifically in Stoke Goldington.	R.4.3
MKUH should investigate the flooding which emanates from the roof and identify what remedial works are required to resolve it.	R.4.4
AWS should investigate the flooding issue at Centre:MK in detail.	R.4.5

5 Response to the flood event

5.1 Multi Agency Flood Plan (MAFP)

5.1.1 MKC is part of the Thames Valley Local Resilience Forum (TVLRF) which brings together Category 1 and 2 responders[11] within the local police area for the purposes of cooperation in fulfilling their duties under the Civil Contingencies Act[12].

5.1.2 MKC Emergency Planning Department has developed a Multi-Agency Flood Plan (MAFP) for the Milton Keynes area which was published in February 2013. The purpose of a MAFP is to explain how Category 1 and 2 responders will coordinate a response to flooding. As part of this IFR, the MAFP has been reviewed at a high level to assess whether there is a robust process in place to respond to flooding incidents and whether this plan is regularly tested.

5.1.3 Through liaison with key stakeholders and a review of the flood impacts, it has been assessed whether the MAFP was successful in managing the emergency response to the flood event 27th May 2018.

Key findings

5.1.4 The MAFP clearly sets out the different sources of flooding applicable to the MK area and the various organisations' responsibilities. There is generally more focus on fluvial flooding to reflect the known risk and history of flooding from this source. It is also not unusual for other sources to have a lesser focus given the plan was produced six years ago when there was less intelligence available on these sources.

5.1.5 Appendices B and C of the MAFP provide useful information on numerous 'at risk' locations across MK. Most notably these include specific fluvial flood maps, the number of properties at risk, vulnerable people/infrastructure, and location of flood defences. The 'at risk' locations within the MAFP do not tally with the areas affected during the May 2018 flood event. The MAFP should be updated to include surface water flood risk to provide a more realistic overview of the 'at risk' locations.

5.1.6 The information in Appendices B and C of the MAFP would be generally useful to practitioners and duty officers in delivering the MAFP and making key decisions. From the interviews of internal and external staff, this information was not mentioned to have been referred to during the incident, nor its existence made aware to the interviewers.

5.1.7 The MAFP explains that the plan can be activated by any of the emergency services or MKC and the criteria for activation are identified as:

- requires resources or services not normally / immediately available to the emergency service or Council;
- threatens the health and safety of residential properties;
- threatens critical infrastructure, such as power and water supplies, communications or roads; or
- leads to significant media interest.

[11] https://www.gov.uk/guidance/preparation-and-planning-for-emergencies-responsibilities-of-responder-agencies-and-others
[12] http://www.legislation.gov.uk/ukpga/2004/36/contents

5.1.8 The MAFP has devised a progressive series of flood levels (low to severe risk) to aid the preparation and response to incidents[13] (Figure 5-1). This provides decision makers a useful tool with actions to take should associated triggers be met.

5.1.9 The activation of the MAFP is reliant upon decision makers having sufficient intelligence related to the current impacts of the flood event and weather/flood warnings and forecasts. Effective sharing and collation of this intelligence is vital to inform the activation decision. It is clear that key decision makers from MKC did not have this intelligence during the flood event of May 2018 until recovery was underway, as an amber weather alert was not received for the Milton Keynes region.

5.1.10 The sharing and collation of intelligence can only be achieved with effective communication between partner organisations and internal MKC departments. It is recognised that blue light services often receive the majority of 'emergency calls' although MKC will also receive many calls related to flooding of highways and public realm. Within the MAFP, there are communication routes identified upon activation, such as the Multi-Agency Silver Control Suite and MKC's Emergency Operations Centre (EOC). Prior to activation there is less clarity or direction on the routes of communications except where the 'Flood Desk' is set up. TVLRF are introducing two prior potential notification stages, which can be used where information is unclear, using a revision of the Emergency Response arrangements document and acknowledging the general reluctance for calling a major incident.

5.1.11 For incidents occurring out of hours, intelligence from outside of MKC is coordinated through its 'Alarm Centre' and passed to the relevant officers to decide the best course of action. This requires MKC staff to be trained in identifying and managing emergency events along with the administration of the MAFP. The 'Alarm Centre' could also become a bottle neck for dissemination of information, particularly when dealing with a high volume of calls.

5.1.12 Throughout the MAFP there are references to the support from an Emergency Planning officer (EPO) to deliver various key tasks such as the creating the 'Flood Desk' during the early stages of a flood event to provide a central coordination hub. It is understood that EPOs are not 'on call' therefore may not be readily available outside of normal working hours nor able to fulfil tasks described within the plan.

[13] Annex 2 – Flood Activation Table, Milton Keynes Council MAFP

ANNEX 2 - FLOOD ACTIVATION TABLE				
FLOOD RISK	**POSSIBLE IMPACTS**	**ENVIRONMENT AGENCY FLOOD WARNINGS**	**OTHER WARNINGS**	**ACTIVITY**
Level 0 Low flood risk	No flooding occurring	No Flood Alerts No Flood Warnings	No Met Office severe weather warnings No Met Office flash warnings of Heavy Rain	Normal activities
Level 1 Flood risk to roads, fields and low lying areas	Bank-full rivers Flooding of fields & recreational land (risk to caravan parks & camp sites) Surface water flooding Localised flooding from heavy storms	Flood Alert issued	Met Office severe weather warning of Heavy Rain issued Met Office flash warning of Heavy Rain issued Public report road flooding	**Organisations alerted** Possible Standby notification to organisations Road closures and diversions may be implemented by MKC Highways, TVP or BF&RS.
Level 2 Flood risk to property	Flooding of cellars and basements Flooding of homes and businesses Flooding of major roads Significant flood plain inundation High risk to caravan parks & camp sites	Flood Warning issued	Met Office severe weather warning of Heavy Rain issued Met Office flash warning of Heavy Rain issued Public report homes and businesses flooding or at imminent risk of flooding	**Organisations on Standby**. MKC consider opening Flood Desk/EOC **Plan activated if co-ordination of response is required.** Virtual Joint Silver Control may be implemented to monitor developments or escalated to attendance at TVP Silver Control. Sandbags issued and BFRS may undertake pumping operations.
Level 3 Severe flood risk	Large numbers of homes and businesses expected to flood. Large numbers of people likely to be affected Possible risk to life Adverse impact on local infrastructure likely (transport, communications, health, utilities) Possible impact on responding organisations Flood defences could fail	Severe Flood Warning issued	Flood wardens, emergency services and public report large scale property flooding	**Plan activated** Joint Silver Control in operation. Consider Gold Control activation request. MKC operating Emergency Team from EOC Evacuation considered/initiated (by TVP) Temporary shelter opened for evacuees
Recovery	Flood water recedes	Warnings no longer in force issued	Flood water recedes	**Stand Down of organisations** Evacuees begin to return home Clean up process begins Organisations debrief

Figure 5-1: Flood Activation Table from MKC MAFP

5.2 Severe Weather Plan

5.2.1 At the time of the flood event on 27th May 2018, MKC did not have an adopted Severe Weather Plan. It is understood that MKC's Emergency Planning team have prepared a draft plan however this needs to be finalised prior to being formally adopted.

5.2.2 Having a severe weather plan is not a mandatory requirement but once in place, should provide RMAs and partner organisations in MK with a further tool to identify and manage future flood events. This would supplement the MAFP and other emergency plans.

5.3 Emergency response to the flood event

5.3.1 The IFR builds upon the work already completed as part of the FIRs and post flood event debriefs to outline the response by MKC, partner organisations, and local communities.

5.3.2 To facilitate this part of the IFR several engagement activities have been undertaken as described in Appendix B. These include:

- Interviews with key MKC officers from various departments;
- Interviews with contacts from external partner organisations; and,
- Questionnaire responses from residents and business owners in flood affected areas.

5.3.3 From engaging with this wide group of people an understanding of how the event unfolded and the interventions taken has been established. It should be noted that nine months have passed since the flooding occurred in May 2018 and supporting the preparation of this IFR in February 2019. Recollections of the event are limited for some and are not always consistent. This is to be expected given the lapsed time and the varying experiences of the event depending on the interaction with the flooding during and after. A timeline of the event has been established below based on available information.

5pm 27th May
- MET Office amber weather warning issued

7pm 27th May
- BFRS and MKC Highways receive reports of flooding
- BFRS dealing with 40+ calls and requested support from neighbouring fire service

9:30pm 27th May
- TVP call MKC emergency planning department for info
- DEPRO made aware of flood through MKC EPO
- MKC EPO contacts Highways department and Alarm Centre for info who confirm inundated with calls.

10pm 27th May
- Rest centre opened

10:30pm 27th May
- MKC EPOs and LLFA officers travel to MKC Alarm Centre
- BFRS advised MKC that 70 properties evacuated and power is off in Coffee Hall
- Additional Highway Officers and Highways resource mobilised.

11pm 27th May
- EPO requests EOC set-up
- BFRS report approx. 80 more properties across MK also affected and power off.

11:30pm-00:30am 27th May
- MKUH declares internal emergency - not accepting ambulances due to A&E flooding
- DEPRO travelled to MKC offices, Incident Director contacted and major incident discussed
- MKC sent Hghways tankers to MKUH to remobilise

1am 28th May
- Evacuees left the rest centre, Councillours and nurse team checking in on vulnerable people
- Numerous roads closed across MK
- Police and BFRS report they're operating within normal demand
- MKC check with MKUH for impacts

28th May
- MKC staff in affected areas helping residents and identifying recovery needs
- MKC Corporate Leadership team planning recovery phase
- AWS start to attend affected areas

29th May (am)
- MKC Incident Director called an emergency meeting and recovery Director named
- Sub-groups tasked with managing key recovery elements
- Customer services team briefed and action plan in place
- EA staff attend affected areas

29th May (pm)
- Three gully emptiers and highway operatives mobililsed across the network.
- MKC operating bulk waste collection
- Aditional four Highways duty officers
- Twice daily meetings convened with RMAs.

30th May
- Hot debrief by MKC
- Road sweeping undertaken across MK
- Member of the Waste team visiting areas to support waste removal
- Primary recovery phase ended 1st July with ongoing support until December 2018

Acronyms Table

AWS	Anglian Water Services
BFRS	Buckinghamshire Fire and Rescue Service
DEPRO	Duty Emergency Planning Response Officer
EOC	Emergency Operations Centre
LLFA	Lead Local Flood Authority
MKC	Milton Keynes Council
MKUH	Milton Keynes University NHS Foundation Trust
RMA	Risk Management Authorities
TVP	Thames Valley Policy

Communications and Intelligence

5.3.4 During the interviews it was explained that the Duty Emergency Planning Response Officer (DEPRO) who was 'on-call' during Sunday 27th May, was first made aware of flooding within MK from an off duty MKC officer. Whilst this highlights the great work ethic and care of the MKC off duty officer, it does raise the question if the DEPRO should have been aware through a more formalised route.

5.3.5 With all developing situations the key is to establish the extent of the problem by collating as much relevant intelligence as possible, and this flood event was no different. Intelligence is key to help the DEPRO and Incident Director to establish the need within the Borough, inform their decisions, and identify actions. From the officer event logs and reports made available to support this IFR, intelligence around the extent and impacts of the flooding was lacking.

5.3.6 Intelligence should be actively shared between partner organisations as as the combination of the sources is likely to provide a fuller and wider picture of an event. This was further hampered by the intense and relatively short nature of the rainfall (Section 4.2) within many discrete locations across MK. During the early stages of the event on 27th May this did not appear to happen, and responding organisations were undertaking their roles autonomously.

5.3.7 Whist there is a communications process described within the MAFP, it would appear that many of the staff from relevant organisations were unaware of this process and individual operation/emergency plans were followed. It should be noted that there was little warning due to the fast onset of flooding, which resulted in no request for assistance from Emergency Services. The Environment Agency was not aware of the flood event until Monday 28th May and it is understood this was through senior management and Government ministers.

5.3.8 From the completed interviews it is reported that key RMA contact phone numbers (outside of MKC) were out of date at the time of the flood event. This inhibited the communication between partner organisations resulting in some having to call the general MKC enquiry numbers to speak with relevant officers, which was already inundated.

5.3.9 MKC Highway Department and BFRS were both receiving and attending a growing number of reports from the public related to flooding. During the early stages of the event it would appear both organisations considered themselves able to independently respond effectively to these reports, therefore did not consider any wider implications. The combining of this intelligence would have allowed both organisations an opportunity to be aware of wider flooding impacts and to consider if a coordinated response was required or could have been beneficial.

5.3.10 The higher than usual reports of flooding could have been a trigger for RMA staff to consider if the potential for a significant event should be raised to senior managers or DEPRO, as appropriate. An informed decision and relevant actions could then be considered.

5.3.11 It is understood the BFRS received data protection advice not to share the exact details of properties which reported flooding with partner organisations, as this included personally identifiable information and concerns with the restrictions associated with GDPR[14]. It is understood that redacted information at a street level was provided to MKC within 24 hours of a written request being received approximately one week after the rainfall event.

[14] General Data Protection Regulations (2018)

5.3.12 BFRS explained that had the request for the details been made during the emergency incident response they would have been provided; however, with the request being made during the recovery phase the BFRS considered the sharing of such information not to be for emergency purposes therefore protected under GDPR.

5.3.13 MKC staff considers that the decision to not share information inhibited the efficiency and effectiveness of the recovery response which MKC could provide.

5.3.14 Throughout this IFR it is apparent that MKC and BFRS currently have different organisational positions on GDPR. This will require some further work to resolve, however, both organisations are proactively working together to ensure a good working relationship and to make sure that recovery is as smooth as possible for communities. In order to find a clearer ground going forward, further advice could be sought together from the Home Office as to whether the relevant legislation needs to be refined or how best to interpret it in emergency situations.

5.3.15 The calls received by MKC out of hours are managed by the Alarm Centre which is understood to be staffed by two operators which is sufficient for normal conditions. During the early stages of the flood event the Alarm Centre is reported to have been inundated with calls with the operators working determinedly to manage and record the enquiries as best as possible.

5.3.16 MKC's Incident Director decided to open a temporary rest centre in Coffee Hall following advice from the Emergency Planning team. Attempting to contact the rest centre is reported to have been difficult due to incorrect contact details and the call being made late on the Sunday of a Bank Holiday weekend, when people may have been asleep or otherwise engaged.

5.3.17 MKC attempted to contact the owners of temporary accommodation to house those who needed to evacuate their homes. Challenges were realised as some owners were uncontactable or their accommodation was already used with pre-booked guests.

5.3.18 From the interviews and questionnaire responses from partner organisations, the general feedback supports the need for improved communications and better intelligence sharing, particularly during the response stage. MKC's Communication team reports that in the later 'recovery' stage it received some positive feedback through social media. Whilst some positive feedback may have been received, this IFR finds that communications between partners and the public could have been improved across the board.

5.3.19 MKC have a number of weather stations across the Borough which are primarily used by the Highway department to inform winter operational decisions. These weather stations include rainfall monitoring however it is understood these did not record significant rainfall during the event. This further supports the localised nature of the rainfall and the difficulty to identify locations that could be affected.

Operations

5.3.20 The intense and relatively short nature of the rainfall (Section 4.2) within many discrete locations across MK, presented challenges to partner organisations when identifying and organising the necessary response. Resources had to be programmed and prioritised when mobilised to attend the widespread enquiries received.

5.3.21 MKC Highways department distributed approximately 500 filled sandbags and 1,500 empty sandbags with nine tonnes of sand to affected areas to help protect residential and business premises. This was provided free of charge and further stock was made available at short notice should requests have been received.

5.3.22 The filling and laying of sandbags are labour intensive tasks, and needs to be completed correctly to be effective. As part of the IFR, some residents have reported they were unable to complete the tasks as they are elderly, infirm or otherwise unable. This has left some people feeling unsupported by MKC.

5.3.23 Both the waste impact and the resource intensive nature of supply, filling, laying and distribution of sandbags is difficult for councils to provide. During the recovery phase, sandbags and other flood damaged waste was bulk collected by MKC and disposed of free of charge. This was arranged efficiently by the Waste department.

5.3.24 MKC Highways department actively responded to and prioritised widely distributed enquires received from members of the public. Numerous road closures were put in place and high-speed traffic management mobilised to locations which required it. Additional gully emptiers were also mobilised along with four additional duty officers during the recovery phase. Drainage inspections and maintenance works were carried out across MK through a prioritised programme.

5.3.25 The opening of the EOC at approximately 11pm on 27th May enabled specialist from various disciplines (including LLFA, Social Care, Legal, Finance Housing, Communications and Waste) to provide advice and develop the Recovery Sub-groups to manage relevant flood related tasks. E.g. Housing Team to identify needs of evacuated residents. The work ethic and willingness of MKC staff should be celebrated. Many officers volunteered and provided support out of hours for the benefit of MK residents.

5.3.26 During this IFR it has been reported that rooms within the Civic Offices identified as locations for the EOC, are not dedicated for this purpose during normal hours. These are known to be used for sensitive meetings with members of the public, senior management or councillors which are considered inappropriate for interrupting therefore having the potential to inhibit the emergency response coordination.

5.3.27 Detailed decision and incident logs were prepared by MKC officers during the incident. These provide a clear series of events and decisions understood and taken by officers during the flood event and subsequent days within the localised areas across MK. The logs are in paper format and hand-written which provided a convenient method for recording such information but are vulnerable to being lost and possibly difficult to read.

5.3.28 Situation reports were also completed by MKC officers during the days immediately following the rainfall event. These provide a clear overview of the situation and provide details on current issues and decisions which have or need to be taken. In addition, the reports also include an impact assessment of MKC's ability to deliver key service areas which enables identification of potential issues and prioritisation of resolutions. From the reports made available for the IFR all services were assessed as 'amber' or better, meaning services were impacted but managing within the current resources.

5.3.29 It has been recognised by MKC during the event debrief that Shelter plans, staff training and rotation, and available equipment should be reviewed for appropriateness.

5.3.30 During the recovery phase, MKC provided further support to it housing tenants by identifying and undertaking repair works to properties. This included initially drying out the property followed by repairs to flooring, kitchens, plastering and decorating. In some cases, small drainage maintenance or improvements were completed with the curtilage of the properties.

5.3.31 MKUH suffered internal flooding during the evening of 27th May which is reported to be primarily from the roof although in combination with surface water runoff from adjacent hard paved areas. This resulted in the emergency department's resuscitation area becoming flooded and preventing the safe use of electrical equipment. MKUH implemented its own emergency plan to manage this situation and subsequently patients traveling via. ambulances were redirected to another hospital. Referring to the MAFP, this could be considered a trigger for implementation as MKUH was requiring mutual aid; however there appears to have been little communication outside of the organisation except TVP asking MKC if it was aware of the situation some hours later. MKC Highways also responded, sending Gully tankers to enable the hospital to return to normal operations.

5.3.32 MKUH appears to have a good internal emergency planning process including frequent meetings with the Emergency Preparedness and Resilience Group. The plans are updated and tested regularly including table top simulation annually and live exercising every three years. This is similar for Centre: MK which appears to have internal processes that are regularly tested. The lead emergency planning contact at Centre: MK is clearly committed to effectively delivering emergency planning on behalf of the organisation and has explained they would be pleased to work closer with other partners.

5.3.33 The Buckingham and River Ouzel IDB has explained its assets and known flood hotspots were inspected upon receiving the MET office weather warning. This proactive approach enabled the IDB to confirm its assets were functional prior to the expected rainfall but also identified where urgent works where necessary should that have been the case.

5.3.34 Organisations have reported that there was a general lack of awareness of "who should be doing what" during the event in May 2018. This is likely due to the range of awareness of emergency plans relevant to MK (Figure 5-2). Many practitioners who believe they have a 'rudimentary' understanding appeared to find some questions challenging to answer during interviews and not all were sure where to locate plans. A person who is ill-trained or inexperienced but confident in their own ability or feels responsible to make decisions, can be perilous in stressful and challenging situations.

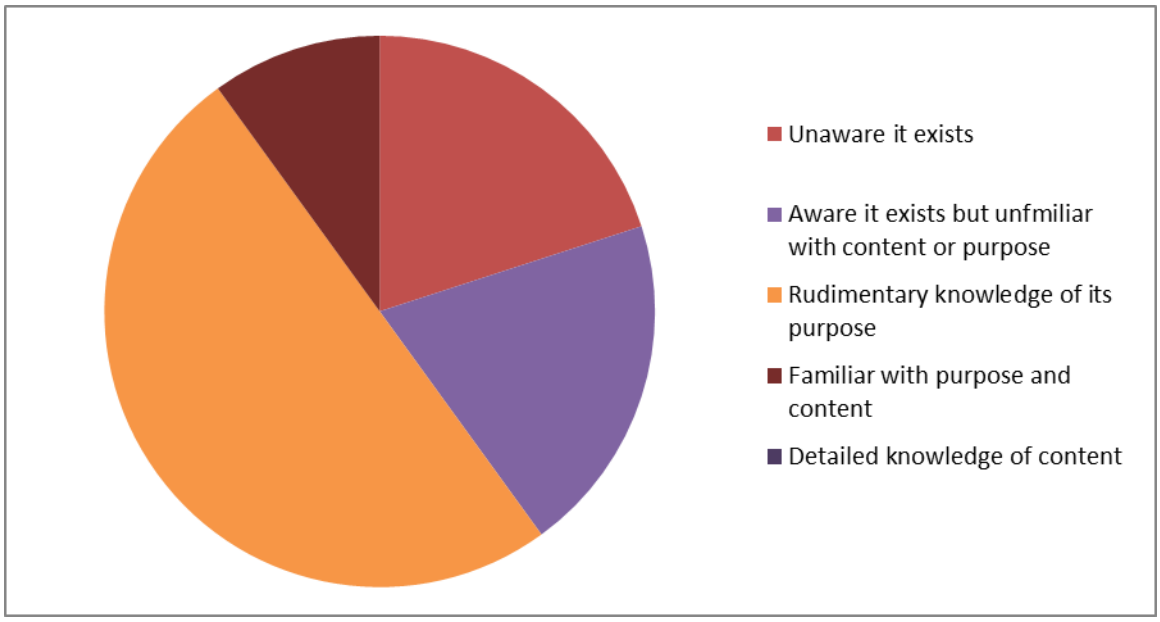

Figure 5-2: Responses to the survey question "How familiar are you with emergency plans/procedures?"

5.3.35 Retail centres, such as centre:MK and Winterhill, have a responsibility to ensure members of the public are safe whilst using their facilities. These two retail centres are known to have been flooded during the event in May 2018 and understood to have managed the impacts.

5.3.36 From the interviews, it was identified that centre:MK has an onsite emergency plan for dealing with a range of situations, including flooding. Following evacuation of the centre, it is reported that staff worked tirelessly and through the night to minimise the flood damages and ensure retails units were reopened on Monday 28th May. It is understood that centre:MK has completed its own debrief and identified internal improvement which it is progressing.

Resource

5.3.37 MKC has decided that the first response to incidents will be provided by selected members of the Senior Management team, many of whom have responsibilities in such situations already. These fulfil the role of DEPRO on a seven day rota basis and are responsible for an incident until handed over to an Incident Director, technical specialist, or it is decided no further action is required. It has been established that some DEPROs and Incident Directors live a few hours outside of MK which means they are detached from an event and would require longer to attend a site or EOC.

5.3.38 MKC Emergency Planning Department have a list of 'mandatory training' including table top exercise which DEPROs, Incident Directors and Senior Managers are expected to attend. From interviews with individuals fulfilling these roles, it is clear that only some training has been completed, but it is unclear how regularly this is revisited. It is understood this has been particularly challenging due to recent turnover of senior managers.

5.3.39 Other organisations have varying levels of training provided to their staff, but this is usually specific to its own requirements. Blue light services have staff trained in Joint Emergency Services Interoperability Principles (JESIP) and major incident response, however it is unclear how aware they are of MKC's specific plans.

5.3.40 It has been reported that systems and software to help manage an emergency event could be improved to support MKC's response. For example, the needs of residents and businesses were recorded in a comprehensive spreadsheet created by the Emergency Planning team and used by others receiving the calls. Whilst this provides one place for information to be recorded and managed, its application is limited in this situation. More intuitive systems/software exist that enable efficient sharing, interaction between other systems, and allow multiple users simultaneously.

5.3.41 The MKC Alarm Centre (out of hours), Call Centre (in hours) and Housing department are all reported to have needed to hand write notes from callers due to the inundation of enquiries and accessibility of the computer recording system. Hand written notes are vulnerable to being missed or lost, possibly leading to someone not receiving the support they require. In context of MKC's 'Customer Service Standards' this could inhibit it from ensuring "*accurate information is recorded on our (MKC) telephone system to enable customers calling out of hours to report emergencies*".

5.3.42 It is widely recognised that all organisations plan resources around the usual demand of services. Responses to severe flood events, particularly those which occur quickly with limited warning like the one in May 2018, are challenging to mobilise and resource. It is reported by those who organised responses during the flood event, that the lack of warning slowed the mobilisation of additional resources as MKC was not in the amber warning zone. Despite this >30 MKC staff provided support during the 28th May, from various departments, with many working long hours. The goodwill of these staff enable support to be provided to >100 callers and tens of people rehoused. In addition, vulnerable people were identified and appropriate assistance provided.

5.3.43 During the interviews, BFRS explained that the flood event did not require resources above those available for 'business as usual' despite requesting support from neighbouring services through pre-existing cross border agreements. As such, the BFRS did not deem this a major incident. However this could be considered to meet one of the triggers for the MAFP:

- "*requires resources or services not normally / immediately available to the emergency service or Council*".

5.3.44 From the findings of this IFR, it is clear that BFRS operational staff provided great support to members of the public locating and managing its resources effectively to do so. From responses to questions asked of the BFRS, it is also clear that staff are proud of the service they provide and the admiration received from members of the public. It is important that this does not impede staff to identify where wider support would be beneficial or inhibit staff to request it in a timely manner.

5.3.45 The Environment Agency had no involvement in the incident response. Once the Environment Agency was aware of the event and had established communications with MKC, it was able to provide staff resource to support the recovery phase. This included staff to collect information from members of the public and observe flood affected areas. The Environment Agency also provided operational resource for MK Highways to assist in the recovery phase by clearing, gullies, screens and outfalls.

5.3.46 To further support MK residents, a 'Hardship Grant' of £200 was made available by MKC to support with immediate welfare needs and a short suspension of Council Tax was implemented for homes affected by flooding. For MKC housing tenants, rent was also waived for two months with a commitment made to reimburse temporary accommodation costs.

5.4 Multi-agency debrief report

Overview

5.4.1 Following the recovery stage of the flood event, a multi-agency debrief was undertaken on 14 August 2018 to review the response to the incident. The debrief was coordinated by the TVLRF and attended by officers from BFRS, the Environment Agency, the Met Office, MKC, MK Clinical Commissioning Group (CCG), MKUH, MKPT and TVP.

5.4.2 Whilst no formal multi-agency response structure was established and the MAFP was not implemented, the undertaking of a debrief in these circumstances is good practice and demonstrates the TVLRF's commitment to reflecting on an incident to identify good practice and areas for improvement.

Highlights of the debrief report

5.4.3 The debrief report[15] identifies escalating weather warnings were issued by the Met Office on 26th and 27th May. The former was a 'yellow' warning of low likelihood and medium impacts which spanned the majority of the UK from North Wales to the English Channel (Figure 5-3). The coverage of the weather warning would have provided little confidence in the location of where impacts are likely to be realised. This accompanied with the low likelihood of the rainfall occurring, would have led to little action being taken.

5.4.4 An amber warning was issued by the Met Office around 5pm on 27th May. The extent of the warning area was much more defined although did not cover Milton Keynes (Figure 5-4) therefore pre-emptive actions would not have been taken. This identified a potential rainfall intensity of 30mm/hour in urbanised areas, with up to 80mm predicted over three hours. Upon receiving this weather warning the debrief report does not identify any actions being taken by Category 1 and 2 responders. This is likely due to the coverage not extending to the Milton Keynes area and the timing of this amended warning level not being picked up by responders immediately.

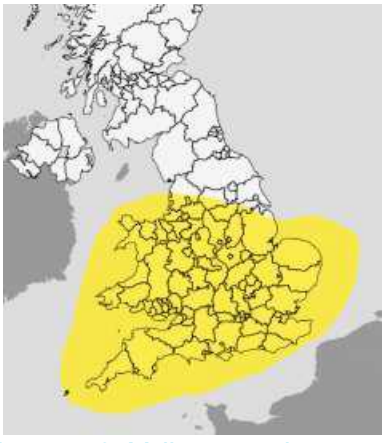

Figure 5-3: Yellow warning extent

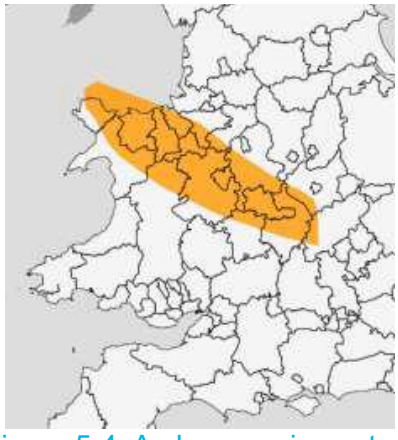

Figure 5-4: Amber warning extent

Source: TVLRF Draft de-brief report

[15] 27th May 2018 Post Event Report, Thames Valley Local Resilience Forum (Aug 2018)

5.4.5 The debrief report explains the “BFRS rescued 22 individuals from homes affected by flooding and supported in pumping out flood water from a number of properties”. In addition, support was requested from neighbouring Fire and Rescue services and an Operational Support Room was ‘stood up’ to coordinate the response as per Thames Valley standard operating procedures. It is not clear from the debrief report if the BFRS was liaising with other Category 1 and 2 responders at this time and whether declaring a major incident and activating the MAFP had been considered by any of these.

5.4.6 It is explained that MKUH experienced flooding within the hospital and declared a “major incident”. Considering no formal multi-agency response command and control was established, it is more likely that an internal incident was declared by MKUH.

5.4.7 The debrief report explains the MKC call centre was inundated with calls from residents affected by flooding. This is an indication that flooding in Milton Keynes was severe and not isolated. It is not clear from the debrief report if this intelligence was provided to senior management within MKC during the flood event.

5.4.8 No formal multi-agency command and control was established although it is reported that communications between Category 1 responders did occur via telephone and engagement on the ground. The debrief goes on to explain “*Individual agencies established their own response structures and emergency control centres to coordinate the response, however, at no stage was a multi-agency response structure considered*”. It is unclear from the debrief report why a multi-agency response structure was not considered by any organisation. The rapid onset and subsequent subsidence of the spate conditions may have been a factor.

5.4.9 The debrief report identifies a number of actions for the TVLRF members to take forward. The draft debrief report was only made available in late January 2019 and has not yet been finalised, therefore TVLRF members have not had the opportunity to progress the actions unless this has been done independently. Many of these actions will be reflected within the recommendations of this IFR report and adapted or supplemented where appropriate following the detailed work of the IFR.

5.5 Recommendations

Recommendations	Detailed Recommendation Reference
The MAFP should be updated to reflect the recommendations of this IFR report, the Multi-agency debrief report and individual organisations own debrief reports or lessons learnt findings.	R.5.1
The TVLRF should: • **Establish the hierarchy of emergency plans relevant to Milton Keynes and communicate this to all RMAs and partner organisations.** • **Collectively identify what incident management and communications systems are being used, and what improvements could be made** • **Ensure contact numbers for all partners are up to date**	R.5.2 R.5.7 R.5.1
RMAs and Emergency Services should: • **Ensure duty officers responding to flood incidents in the early stages are trained on the content and use of the MAFP, Severe Weather Plan, Communications Strategy and to identify a deterioration in conditions which may require additional resources or a coordinated response.** • **Reflect on informing members of the public of their reports of flooding and progression for a resolution.** • **Consider if a more proactive approach to 'amber' or worse weather warnings is appropriate.** • **Review their own communication processes and update to reflect this IFR.**	R.5.5 R.5.9 R.5.12 R.5.14
MKC should: • **Review its resource availability to respond to emergency events, particularly out of hours** • **Develop an EOC manual, which considers limiting the use of rooms identified for EOC to ensure they are available when required and staff feel empowered to do so.** • **Undertake an emergency flood exercise to test updated plans and provide training to all partner organisations.** • **Formally adopt the draft Severe Weather Plan.** • **Review contact details for rest centres and temporary accommodation**	R.5.3 R.5.4 R.5.6 R.5.8 R.5.10

6 Economic Costs

6.1 Economic costs Summary

6.1.1 The best estimate of the total economic damages caused by the 27th May 2018 flooding event is **£7,086k** with a range of £2,905k to £12,420k.

6.1.2 The greatest proportion of quantified damages was felt by residential property holders, with 66.6% of total damages occurring in this sector (best estimate of £4,716k incurred by up to 490 properties).

6.1.3 A breakdown of the damage estimates by impact category is provided in the table below. The ranges shown in the table below take into account the uncertainty associated with the data used to estimate the damages and assumptions that had to be adopted to fill data gaps.

6.1.4 Impacts on roads, utilities, public health and education were not estimated due to the lack of available data but were discussed qualitatively in the previous section.

Table 6-1: Damage estimates by impact categories

Categories	Damage estimates			
	Best estimate	Percentage of total	Lower estimate	Upper estimate
Residential Properties	£4,716k	66.6%	£1,749k	£8,018k
Non-Residential Properties	£1,320k	18.6%	£623k	£2,536k
Temporary accommodation	£529k	7.5%	£233k	£966k
Vehicles	£64k	0.9%	£49k	£121k
Intangible health impacts	£119k	1.7%	£105k	£137k
Local authority, emergency services and recovery	£337k	4.8%	£134k	£594k
Total economic costs	**£7,086k**		**£2,905k**	**£12,420k**

6.1.5 The assessment of uncertainty used to inform the range is based largely on the availability and quality of the data on flood depth, damages, and the number and type of assets affected. It was assumed that there has been no permanent loss of residential/non-residential property as a result of flooding.

6.1.6 In this study, flood depth information was available for only 25% of the total (residential and non-residential) properties reported as having experienced internal flooding. Assumptions were made on unknown flood depths and the results show that the total economic costs are sensitive to a small change in flood depth (+/- 0.1m) with a wide range around the best estimate. In order to obtain more confidence in the total economic costs, more detailed information on flood depths for a higher proportion of properties is therefore necessary.

6.1.7 This economic study concludes that improving the gathering of primary data on flood depth and damages could help to reduce uncertainty in the estimation of economic costs for future events, as well as supporting the appraisal of different options to reduce flood risk. A detailed methodology and damage estimates are provided in Appendix H.

7 Asset Management and Maintenance

7.1 Overview

7.1.1 Across MK there are numerous assets which affect the management of water to varying degrees. These include large balancing lakes, flood defences, sewer systems, highway drainage and land drainage. The responsibility of these rests with various organisations and landowners.

7.1.2 From the stakeholder engagement activities (described in Appendix B), residents and officers have reported that it is not always clear which organisation is responsible for certain assets. This can be frustrating for a resident who is reporting a problem and can be left feeling passed between organisations with little progression being made. Similarly, officers can feel frustrated when ownership or responsibility of assets is unknown as progress of resolution is often inhibited.

7.1.3 From the data provided in support of this IFR, an overview of the assets which provide a flood risk function have been identified. Due to the little impact of Environment Agency, BGDB and MKPT related assets, details of these have been provided in Appendix I rather than the main report.

7.2 MKC Highways Department

7.2.1 MKC Highways has established a regime for undertaking safety inspections across the highway network. The purpose of the planned inspections is to identify the location of dangerous defects and arrange for the necessary repairs to be undertaken as a priority. These inspections include the visual assessment of defective highway drainage (such as gullies and outfalls) and the presence of flood water. MKC has developed a Code of Practice for the inspections which provides a prioritisation matrix to categorise observed drainage defects and flooding. The frequency in which roads have a planned inspection is dependent on the category of the road and a risk based approach is set out in the Code of Practice.

7.2.2 In addition to planned inspections, MKC will investigate drainage and flooding problems related to the highway when reports are received. The usual approach is for a highway inspector to attend the location reported, visually assess the problem and investigate if and what solution may be required. In some instances the inspector may be able to resolve the problem, decide no further action is required, or arrange for further investigation or works to be undertaken.

7.2.3 MKC have established a three year gully emptying regime (Appendix J). It would appear that gullies have planned maintenance once during a three year period. Additional emptying would be completed upon receipt of an enquiry related to a gully or flooding in the locality. Due to the increasing expansion of the city, this may increase to a four year regime without increasing the vehicle gully cleaning capability from one to two or more vehicles.

7.2.4 MKC's general approach to resolving a reported highway drainage problem is set out in Figure 7-1. If a problem requires further investigation or works (moving down the list), more planning, funding and permissions are required before these can be progressed. As such, these problem locations are added to a programme of works so the required resources can be assigned. This follows general practice replicated across England.

7.2.5 Annual budgets are finite, and therefore locations requiring further investigation and works are prioritised by MKC and the programme may span a number of years. This can be frustrating for members of the public who report drainage problems but do not see immediate responses. This can lead to them feeling ignored or unimportant, as reflected in survey responses received.

7.2.6 Following the flood event in May 2018, the approach outlined in Figure 7-1 below has been followed by MKC to address reported highway drainage problems.

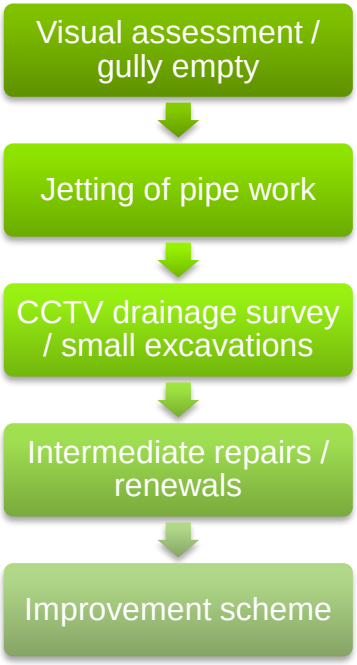

Figure 7-1: MKC's approach to a highway drainage problem

7.2.7 Responses to questionnaires issued as part of this IFR have highlighted locations where the same drainage defects have been reported to MKC on numerous occasions. It would therefore seem that an update on the progress of a resolution has not been provided to the members of the public. This has been improved by recording information, and talking to members of the public face-to-face and via telephone to report and process priority works, using the drainage matrix introduced by the council

7.2.8 Highway drainage has historically been designed to manage high return events generally up to 50% AEP (1 in 2 years), not significant rainfall events such as that experienced on 27th May 2018. It is therefore important to note that, even if the highway drainage system had been fully functional at the time of the event, the capacity would likely have been exceeded and flooding occurred.

7.2.9 MKC Highway department has found it challenging to provide some of the information requested as part of this IFR. This is largely due to:

- reliance on key individuals with the local knowledge of drainage assets and issues; and
- availability and functionality of existing recording systems and process.

7.2.10 MKC Highways previously delivered the LLFA function and as such led a flood alleviation scheme at Stoke Goldington. This incorporates an attenuation pond and a series of earth bunds. Limited information has been made available to this IFR therefore the standard of protection this provides has not been established.

7.2.11 MKC Highways is currently working with Kaarbontech to record silt level data and asset condition across three programs for high, medium and low frequency. In the future, this will be used to highlight the priority individual or groups of gullies within villages or estates for cleansing before storms, using intelligence that the gullies have increased silt levels.

7.2.12 MKC Highways is continuing improvements to asset management by improving GIS mapping of flood risk areas in the emergency planning program. Cross-party collaboration has improved by incorporating AWA assets within Kaarbontech to show the locations of pipes, manhole covers and flow directions.

7.2.13 MKC Highways has asset data captured on a number of systems including proprietary systems and MS excel. The asset database is being improved to show ownership and condition of assets by photographing and recording locations. The addition of a specific flood management module will also be explored that will allow all drainage/flood assets to be both captured and managed. This system will also allow flooding incidents to be managed at an asset level. The system will allow remote system access for all MKC officers.

7.3 MKC LLFA

7.3.1 MKC LLFA does not own nor have primary responsibility for the maintenance of assets. It does however have a duty to establish and maintain an asset register as prescribed under the F&WMA:

21 Lead local authorities: duty to maintain a register

(1) A lead local flood authority must establish and maintain—

(a) a register of structures or features which, in the opinion of the authority, are likely to have a significant effect on a flood risk in its area, and

(b) a record of information about each of those structures or features, including information about ownership and state of repair.

Figure 7-2: Extract of Section 21 of F&WMA 2010

7.3.2 MKC has not formally published a register of structures or assets which are likely to have a significant effect on flooding. It is understood that MKC, until recently, only had one member of staff in the LLFA team, and therefore progress in relation to F&WMA duties had been constrained.

7.3.3 An asset register has since been developed to include a long list of assets and structures which provide a flood risk or drainage function within MK. It is understood this is in spreadsheet format and collates information from MKC Highways Department, the Environment Agency, Anglian Water Services, BGDB and MKPT Trust. This has not been reviewed as part of the IFR.

7.4 Anglian Water Services

7.4.1 AWS is responsible for maintaining public sewers in its ownership including a number of the balancing lakes (Figure 7-4) within MK. The purpose of these balancing lakes is to attenuate an incoming flood peak to a flow level that can be accepted by the downstream receiving system. It may also delay the timing of a flood peak so that its volume is discharged over a longer time interval.

7.4.2 The lakes are listed below and a map identifying their location is included in Figure 7-4.

- Ashlands Lakes (Ashland/Simpson balancing reservoir)
- Blue Bridge Balancing Lake
- Caldecotte Lake
- Furzton Lake
- Lodge Lake
- Teardrop Lakes
- Walton Lake
- Willen Lake
- Wolverton Mill Balancing lake

Figure 7-3: Teardrop balancing lakes

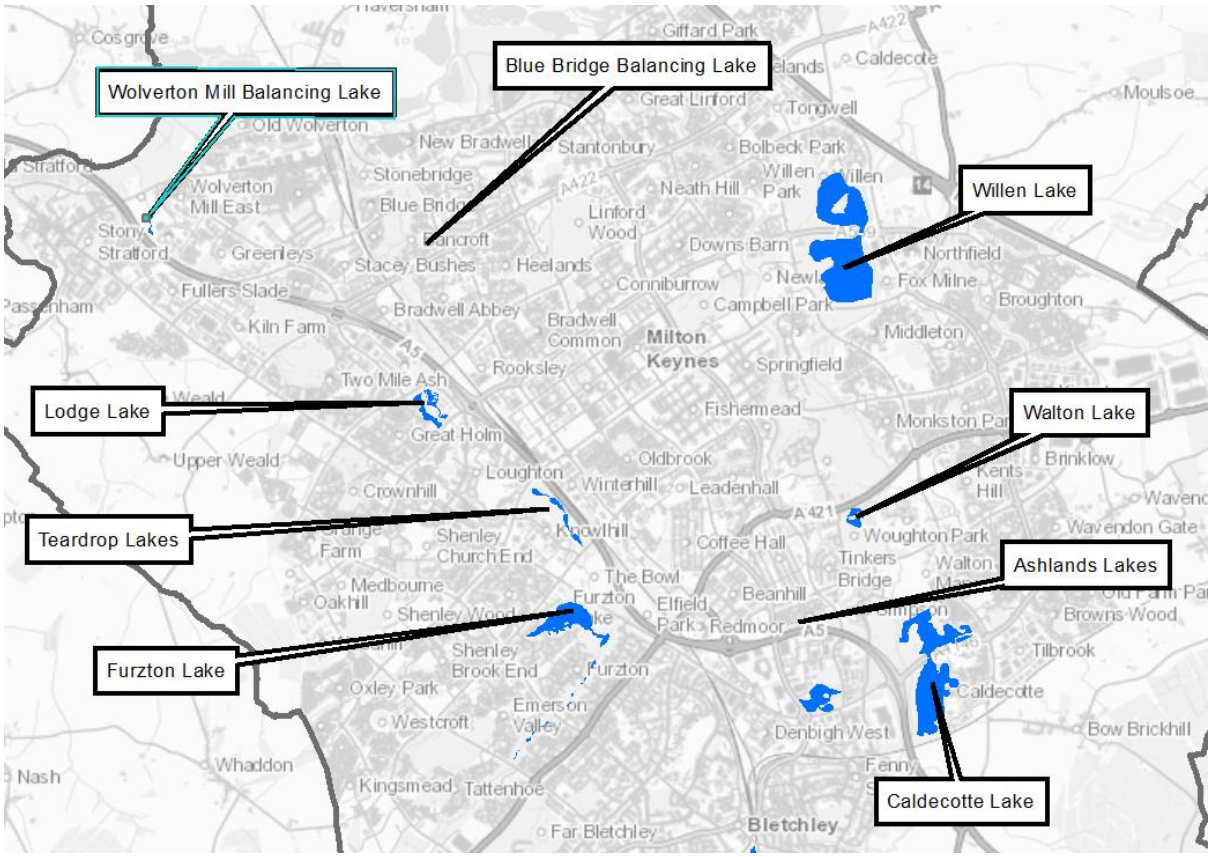

Figure 7-4: Location of balancing lakes across MKC

7.4.3 AWS visually inspect the balancing lakes and associated structures on a six monthly basis. Where works are required these are programmed using a risk-based approach and considering the availability of funding. AWS will collaborate with MKC and other partners to consider the capacity and performance of significant assets (including all lakes) now and with future growth and climate change. It is understood the lakes functioned well and provided flood storage during the event in May 2018 although some report the lakes filled quickly. The AWS network outfall becomes surcharged when water levels rise in Tear Drop lakes, which caused flooding in Grace Avenue, Winterhill and Leadenhall.

7.4.4 From the stakeholder engagement activities (described in Appendix B) it is reported that the capacity of the sewer network was exceeded across MK during the flood event. This included a number of reported manhole covers being 'lifted' out of the frame due to the hydraulic pressure and exposing deep chambers. In addition, highway drainage systems that connect to the adopted sewers were unable to discharge due to surcharging.

7.4.5 Adopted sewers in relatively new areas like Milton Keynes have been designed to a national design standard to manage high return period events generally up to 3.33% AEP (1 in 30 years), not significant rainfall events such as that experienced on 27th May 2018. It is therefore important to note that, even if the sewer network had been fully functional at the time of the event, the capacity would likely have been exceeded and flooding occurred.

7.4.6 Following the flood event, it has been reported that AWS have undertaken drainage CCTV surveys and completed immediate works where these identified a need. Locations include:

- Beanhill – general area drainage inspection;
- Fishermead – Penryn Avenue and Talland Avenue drainage inspection;

- Coffee Hall – general area drainage inspection and removal of restrictions to the foul sewer;
- Winter Hill Business Park – investigation of flooding;
- MKUH – drainage inspection and mapping of assets; and,
- Newport Pagnell – Wolverton Road – mass concrete blockage removed from adopted sewer system. Further works to remediate a partially collapsed pipe completed in August 2019.

7.4.7 Once remedial works are completed, AWS has committed to carrying out inspections by means of CCTV on an annual basis on the surface water system in Wolverton Road, Marsh End Road and Westbury Lane. These will assist in identifying if any further works are required in future.

7.4.8 Due to the extent of the adopted sewer network, AWS predominantly undertake inspections and maintenance reactively, upon reports of a problem. It is understood that AWS has identified hotspots within MK that are known to suffer flooding more frequently which could be related to the capacity of the sewer system. The location of these hotspots has not been made available as part of the IFR however it is understood that planned inspection and maintenance is undertaken every 6 months up to 5 years using a risk based approach.

7.5 Recommendations

Recommendation	Detailed Recommendation Reference
MKC should consider updating these maintenance programs: • **Highway drainage renewal and improvement works - determine whether a business case can be developed to increase available funding.** • **Gully emptying - increase attendance in 'at risk' areas.**	R.7.1 R.7.2
All partner organisations should review their protocol for inspecting flood assets upon receipt of a weather or flood warning, and managing situations where asset ownership is unknown or reported problems may require more complex/time-consuming resolutions. This should include ongoing communication with members of the public and councillors as appropriate.	R.7.3
Improvements should be made to the asset register, to define 'significant effect on flood risk' and identify which assets and structures meet this criterion.	R.7.5
MKC must collaborate and communicate more with partner organisations including AWS, Anglian Regional LLFA, the Environment Agency and landowners. This will aid in establishing a better understanding of flood risk and drainage assets, flood defences, promoting maintenance programmes and sharing intelligence on flooding hotspots and capacity issues.	R.7.4 R.7.6
MKC should reflect on how they communicate with the public, informing them of progress related to reported problems and meeting standards in relation to received queries.	R.7.7

8 Flood and Drainage Projects

8.1 Overview

8.1.1 As part of this IFR, information has been collated from partner organisations regarding future plans for flood and drainage projects. This may include formal flood and drainage projects delivered through national and regional capital funding, capital programmes for each organisation, or revenue funded drainage improvements.

8.1.2 The availability of funding for each organisation is limited, therefore delivery of schemes can be challenging and must be programmed following consideration of prioritisation factors. Organisations operating within MK share the same challenges as others nationally.

8.1.3 Partnership funding aims to overcome delivery barriers with organisations combining available resources, including funding, to deliver schemes with mutual benefits. This can enable schemes to be delivered that were previously stalled, and promotes the holistic alleviation of flooding.

8.2 Planned Flood and Drainage Projects

8.2.1 Formal flood and drainage projects have several stages from conception through to delivery. These stages are necessary to understand the flooding problem, the economic business case to justify the scheme, and the feasibility of it being delivered. This also promotes funding being spent in the right places for the right schemes.

8.2.2 The planned flood and drainage projects reported as part of this IFR are identified in Table 8-1. Where applicable, the approximate location of these are identified in Appendix G.

8.2.3 The schemes listed may relate to a specific flooding area or problem which it seeks to resolve. Alternatively, it could include a study of wider areas to improve the understanding of the risk from flooding and identify potential specific schemes. A short description, indicative deliver timescale and lead organisation are identified.

Table 8-1: Planned Flood and Drainage Projects within Milton Keynes

IFR Ref	Scheme	Description	Indicative timescale	Lead organisation
1	Milton Keynes Flood and Water Strategy	This Strategy will enable MKC (in conjunction with all partners) to plan out the water infrastructure needs that it has for the future growth. This work will resemble an updated WCS and SFRA.	Business case 2020 Work commence 2021	MKC Futures Team
2	MKC Flood Projects (Initial Assessments then Capital schemes)	To review the areas that flooded in 2018 and check if a viable project exists for each. This will involve working out more clearly if potential deliverable schemes exist and the benefits and costs of those. All areas identified during the section 19 investigations will be assessed.	Business case 2020 following Initial Assessment work late 2019. Works commence 2023	MKC LLFA EA, local landowners and local developers
3	Water Eaton Bank Erosion Protection and Stabilisation Works	"Velocity of the water in Water Eaton Brook in Milton Keynes causes natural erosion. In recent years the existing anti-erosion measurers (Gabion Boxes, Railway sleepers and wooden piling) have come to the end of their life and are in need of replacement. The project seeks to reduce bank erosion, strengthen the banks, and restore channel capacity.	Business case 2018 Work commence 2019	MKC LLFA
4	Asset Performance and Capacity Assessment - Balancing Lakes	This review will provide an update to the 2000 Milton Keynes Drainage Strategy, assessing the capacity and capabilities of the existing MK drainage network (focusing primarily on the balancing lakes) and providing an assessment of the impact of future growth. It will also recommend a preferred maintenance regime for the balancing lakes and any potential works needed to ensure the wider system can cope with the existing and planned future development of Milton Keynes.	Business case 2020 Works commence 2020	MKC LLFA, MKC Futures Team, AWS, Parks Trust and other partners
5	Stoke Goldington - Old Farm Park Track	Install three reinforced concrete bunds with grasscrete and extend one flood defence in to field	Works commence 2019/20	MKC Highways
6	Tyringham - Wood House Farm	Replace new carrier system due to roots entering system and ditch recut by head wall	Works commence 2019/20	MKC Highways
7	Church Farm Crescent - Great Linford	Install new drainage system and kerb line	Works commence 2019/20	MKC Highways
8	Theydon Ave - Woburn Sands	Install new kerb line and change camber of footway	Works commence 2019/20	MKC Highways
9	New Row, Lavendon Village	Ongoing plans to design flood defences for village	Works commence 2019/20	MKC Highways
10	North Crawley Road - Newport Pagnell	Basic highway drainage/flood mitigation improvements	Works commence 2019/20	MKC Highways
11	Haversham Village - Near Grey Hound Public House	Replace damaged surface water pipe	Works commences 2020/21	MKC Highways
12	Loughton - The Old Plough Public House	Full system renewal	Works commence 2020/21	MKC Highways
13	Ravenstone Mill Sluice	Health and Safety improvement works	Works commence 2019/20	Environment Agency

8.3 IFR Findings

8.3.1 There are currently thirteen schemes identified within MK which are programmed for delivery in the short to medium term. Two schemes, IFR Ref 2 and 5 (Table 8-1), directly relate to the areas flooded during the event in May 2018.

8.3.2 IFR Scheme Ref 2 (Table 8-1) includes initial assessments of the flood affected areas. This will identify the specific problems in these areas, possible measures to manage the risk of flooding, and estimate the economic benefits that could be achieved through a scheme being delivered. It is understood that MKC LLFA has commenced this work in August 2019, further demonstrating MKC's commitment to reducing the risk of flooding.

8.3.3 MK benefits from more public realm than is usually found across other areas of the UK, largely due to the recent urban design in the 1950s. This presents a great opportunity to include blue-green infrastructure and multi-beneficial features to manage the risk from flooding.

Figure 8-1: Green space adjacent to highway and properties in Netherfield

Figure 8-2: Public Realm in Coffee Hall

Figure 8-3: Playing field in Newport Pagnell

8.3.4 From discussions with MKC Highways it is clear that some of its proposed schemes have not been designed to a particular standard of protection, including IFR Scheme Ref 5. There is therefore little supporting information to establish if the proposed works will deliver the desired outcome or perhaps worsen the situation elsewhere. For renewal of drainage systems this presents less of a problem as direct replacement would assume the previous system was sufficiently designed. It does however highlight that opportunities may have been missed to deliver a high standard of protection. This is not applicable for all schemes and a considered approach depending on the scale of the project is appropriate.

8.3.5 The aspiration to undertake a Strategic Flood and Water Strategy, IFR Scheme Ref 1 (Table 8-1), is a positive addition to MKC's medium term plan. This will support MK Futures Strategy, in collaboration with partners. Once delivered this will provide a current assessment of the risk of flooding across MK and identify where policy and other measures are necessary to manage this. This will also inform any regeneration plans MKC has and what strategic planning opportunities exist to better manage the risk to existing developments.

8.3.6 IFR Scheme Ref 3 (Table 8-1) will help partner organisations to meet Section 7.5 Recommendations of this IFR. Improving intelligence around the drainage systems and balancing lakes across MK will inform future flood and drainage projects and required resources.

8.3.7 It is important to note that the flood event in May 2018 was following significant rainfall (as described in Section 4.2). Delivering flood and drainage projects which manage flooding associated with such rainfall is challenging and funding is usually targeted at managing more frequent events.

8.3.8 It is understood that MKC Landscape Services is currently refreshing its tree plan, focussing on the delivery of the urban forest and how this supports the growth of the area. MKC will look to remove or replace trees when they have reached the end of their life or outgrown their location and are no longer sustainable. MKC explain it is aware that past species choices may no longer suit the location and have already tested alternate species and planting design e.g. in Coffee Hall on Rochfords.

8.3.9 It is understood that the landowner of the retail outlet at Winterhill is progressing their own detailed investigation into the flooding problem at this location. This may lead to a flood and drainage project but at the time of preparing this IFR, it is unknown. MKC LLFA is understood to have attended an initial meeting in relation to the investigation.

8.4 Recommendations

Recommendation	Detailed Recommendation Reference
MKC Highways should reflect upon its current programme of flood and drainage projects and identify those which don't have a formal design and hydraulic calculations to support them.	R.8.1
All organisations proposing to deliver flood and drainage projects should consider the incorporation of sustainable and multi-beneficial solutions.	R.8.2
As a priority, MKC LLFA should consider IFR Scheme Ref 2 and 3 (Table 9-1), in collaboration with AWS where necessary.	R.8.3 R.8.4
Partner organisations and neighbouring local authorities should work to share information between themselves and communities. This should communicate flooding and drainage issues, and identify opportunities for flood and drainage projects.	R.8.5 R.8.6R.8.7
MKC LLFA should maintain contact with the landowners of Winterhill to keep abreast of its investigation.	R.8.7

9 Review of Local Policy

9.1 Overview

9.1.1 MKC local policy relating to surface water flood risk and the application of Sustainable Drainage Systems (SuDS) has been reviewed against national policy, industry good practice and the specific needs of Milton Keynes (inclusive of specific flood event characteristics) as identified through wider delivery of this IFR. Subsequently, opportunities for enhancement of local policy have been identified.

9.1.2 It is envisaged that these recommendations (alongside other actions defined by this IFR) will contribute to the strengthening of local planning policy, thereby reducing flood risk to new development and surrounding communities.

9.1.3 Table 9-1 lists the relevant national policy and good practice documents of relevance, as well as the local policy and guidance documents that have been reviewed within this section of the IFR.

Table 9-1: Policy and good practice documents

National Policy and Good Practice	MKC Policy and Guidance
• National Planning Policy Framework (MHCLG 2019) • Planning Practice Guidance (MHCLG 2018) • Surface Water Management – An Action Plan (Defra, 2018) [16] • National Infrastructure Assessment (National Infrastructure Commission, 2018)[17] • Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (Environment Agency, 2016) • Non-statutory technical standards for sustainable drainage systems (Defra, 2015) • National Strategy for Flood and Coastal Erosion Risk Management (FCERM) (Environment Agency, 2011) • The SuDS Manual (C753) (CIRIA, 2015) • CIRIA Research Project RP993: Demonstrating the multiple benefits of SuDS – A business case (Phase 2) • Planning for SuDS – Making it happen (C687), (CIRIA, 2010) • A review of the application and effectiveness of planning policy for Sustainable Drainage Systems (SuDS)'[18]	• Milton Keynes Local Flood Risk Management Strategy (LFRMS) (2016) and Summary Document (2016)[19] • Milton Keynes Level 1 Strategic Flood Risk Assessment Update (2015) • Milton Keynes Surface Water Management Plan (2016) • Plan:MK (March 2019) • Milton Keynes Surface Water Drainage Guidance for developers (July 2019)[20] • Milton Keynes Drainage Strategy Supplementary Planning Guidance (2004)[21].

[16] Defra (2018). Surface Water Management Action Plan. Available online at: https://www.gov.uk/government/publications/surface-water-management-action-plan
[17] National Infrastructure Commission (2018). National Infrastructure Assessment. Available online at: https://www.nic.org.uk/publications/national-infrastructure-assessment-2018/
[18] Ministry of Housing, Communities and Local Government (2018). A review of the application and effectiveness of planning policy for Sustainable Drainage Systems (SuDS). Available online at: https://www.gov.uk/government/publications/a-review-of-the-application-and-effectiveness-of-planning-policy-for-sustainable-drainage-systems
[19] Milton Keynes Council (2016). Surface Water Management Plan. Available online at: https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/emergency-planning/flood-and-water-management-drainage?chapter=5
[20] Milton Keynes Council (2016). Surface Water Drainage, Local Guidance for Planning Applications. Available online at: https://www.milton-keynes.gov.uk/assets/attach/27866/MK%20Guidance%20for%20developers%20(May%202016).pdf
[21] Milton Keynes Council (2004). Milton Keynes Drainage Strategy, Available online at: https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/milton-keynes-drainage-strategy

9.2 Findings

9.2.1 A review of local policy is particularly pertinent considering the outcomes of a survey undertaken as part of the LFRMS[22], which identified that approximately two thirds of respondents considered that future priorities should be; changes to flood management policy for new development and increased maintenance of watercourses and road drains. This is subsequently reinforced by Measure 3.1 of the LFRMS which requires MKC to review planning policy and guidance in relation to flood risk.

9.2.2 Across the industry, approaches to flood risk management are becoming increasingly comprehensive and robust, particularly in relation to new development and associated flood risk management requirements. Plan:MK requires all sources of flood risk to be considered (as per the SFRA). Similarly, the need for new development proposals to include full details of the means of achieving future management, maintenance and adoption of SuDS is also stipulated. These are positive examples of Milton Keynes' commitment to managing and reducing surface water flood risk for future developments.

9.2.3 The NPPF has recently been updated in 2019 and the Draft National FCERM Strategy has recently been publicised for consultation. The updates to these key documents have taken place since the production of the local policy documents therefore some gaps are expected to be identified.

9.2.4 The updated NPPF (2019) which states that "Major development should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should…where possible, provide multifunctional benefits". Similarly, the NPPF states that development should "consider the opportunities presented by existing or planned investment in infrastructure, the area's economic potential and the scope for net environmental gains". MKC's local planning policy promotes the multiple benefits that sustainable flood risk management measures can offer. Similarly within the Local Plan, MKC considers placemaking principles. This is a positive step as these are fundamental yet an often overlooked component of flood risk management within the planning system.

9.2.5 Specifically relating to pre-application advice, the revised NPPF places renewed focus on pre-application engagement, stating that 'early engagement has significant potential to improve the efficiency and effectiveness of the planning application system for all parties. Good quality pre-application discussion enables better coordination between public and private resources and improved outcomes for the community'. This service is provided by MKC although it may struggle to resource the requests and promotion of uptake could be stronger.

9.2.6 Similarly, the Non-technical Standards for SuDS highly recommend that pre-application discussions take place before submitting applications. This is supported by local policy, particularly the Surface Water Drainage Guidance for Developers document, which details the requirements and standards that MKC will seek from all new developments in relation to the management of surface water drainage. It states: *"The LPA will need to be satisfied that: Through the use of planning conditions or planning obligations there are clear arrangements in place for ongoing maintenance over the lifetime of the development, including clearly identifying who will be responsible for maintaining the sustainable drainage systems and that funding for maintenance is fair for householders and premises occupiers".*

[22] Milton Keynes Council (2016). Local Flood Risk Management Strategy. Available online at: https://www.milton-keynes.gov.uk/environmental-health-and-trading-standards/emergency-planning/flood-and-water-management-drainage?chapter=4

9.2.7 National Infrastructure Commission explains that Government should ensure that all communities are resilient so that they are able to cope with, and recover from, flooding. In addition, the NPPF states that “plans should positively seek opportunities to meet the development needs of their area, and be sufficiently flexible to adapt to rapid change” and “policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts”. Whilst ‘Resilience’ is referred to across the MKC policy documents, the most current understanding and national guidance is not.

9.2.8 It is understood that MKC have regeneration plans for the area. This presents an opportunity to ensure future buildings and infrastructure are located in areas at least risk and resilient to flooding, and the design does not increase the risk elsewhere. Existing design issues could also be addressed; such as siting buildings below surrounding land therefore within surface water and exceedance flowpaths.

9.2.9 Whilst the SFRA and Surface Water Drainage guidance act as primary sources of information, this review has identified that the key flood risk and development ‘Principles’ defined within Section 4.3 of the LFRMS could be strengthened by MKC and further integrated into wider policy documents.

9.2.10 Through review of local policy and guidance, it appears that MKC’s approach broadly complies with national guidance related to flood risk. Primarily this is demonstrated by the SFRA and ‘*Surface Water Drainage Guidance for Developers’* which provide a detailed framework for all sources of flood risk to be considered as per the planning system. A review of the relevant actions of the LFRMS and SWMP has been undertaken and it is recognised that these are broad and therefore inherently difficult to measure and achieve. From this IFR, specific actions have been identified from these documents which are considered a priority for an update of progress (Appendix K).

9.2.11 Generally, the local management of flood risk could be demonstrated as a more holistic area of work and one which affords greater opportunities for multiple, wider benefits which meet MKC’s and partner organisations’ strategic objectives, beyond those of flood risk.

9.2.12 MKC as the LLFA have statutory duties under the F&WMA and leads the delivery of the LFRMS, along with the recommendations of the SWMP and other relevant studies. MKC LLFA however, only currently employs one full time equivalent despite recruitment campaigns but now has a service level agreement with a partner LLFA to provide support until December 2020. MKC would benefit from having experienced resources for the medium-long term to manage surface water effectively and deliver the various duties and actions.

9.3 Recommendations

Recommendations	Detailed Recommendation Reference
Partner organisations should collaborate to publish joint plans to manage surface water flood risk and clearly define roles and responsibilities within local policy.	R.9.1 R.9.2
Local policy should be updated to include: • **Clarity when referring to updated 'national policy and guidance' and signposting key local policy documents;** • **Reflect recent changes in terminology;** • **Delivery of blue green infrastructure, natural flood management, and delivery of wider benefits.**	R.9.3 R.9.5 R.9.6
MKC must improve use of the SWMP outputs to facilitate an increasingly stringent and holistic approach to flood risk management in new development.	R.9.8
MKC must incorporate long-term sustainability and Water Sensitive Urban design into its regeneration plans.	R.9.4
MKC should progress the suggested quick document updates as per Table 9-2.	R.9.7
It is recommended that MKC increase the number of LLFA staff including an experienced practitioner to coordinate, manage and lead the team.	R.9.9

Table 9-2: Summary of suggested 'quick' updates to existing documents

Document	Suggested updates
LFRMS	• Guidance to be signposted within the Supporting Plans and Documents Section (1.5); • Objective 4 with the LFRMS, 'Make best use of resources for maximum protection from flooding' could be enhanced to include reference to multiple benefits and to subsequently place greater emphasis on this consideration within the planning system. • Include within Measure 1.3: 'Ensure drainage infrastructure for new development is future proofed for its design life'. The benefits to the developer (i.e. cost-savings, reduced risk of delays) should be clearly outlined to enhance uptake.
SFRA	• Guidance to be signposted within the Legislative and Planning Policy Context Section (2); • Guidance to be signposted within the Guidance for the Application of SuDS Section (8), specifically in relation to how SuDS can be used to deliver surface water management and multiple benefits.
Surface Water Drainage Guidance for Developers	• It is identified that 'Opportunities for the surface water management system to deliver multiple benefits' should be established/considered at the pre-application stage. It is recommended that this is strengthened, with signposting of the SuDS Manual guidance.

10 Disclaimer

This report has been prepared at the request of Milton Keynes Council. It is intended to provide context and information and should not be used for any other purpose.

The findings of the report are based on a subjective assessment of the information available by those undertaking the Independent Flood Review and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event.

Any recommended actions outlined in this Independent Flood Review will be for the relevant responsible body or persons to assess in terms of resource implications, priority and cost/benefit analysis of the proposal. Moving forward, these may be included in the Action Plan linked to the Local Flood Risk Management Strategy or in the relevant risk management authority's future work programme as appropriate.

The opinions, conclusions and any recommendations in this report are based on assumptions made by AECOM when preparing this report, including reliance on information provided by others.

AECOM and Milton Keynes Council expressly disclaim responsibility for any error in, or omissions from, this report arising from or in connection with any of the assumptions being incorrect.

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The implications for producing the Independent Flood Review and any consequences of blight have been considered. The process of gaining insurance for a property and/or purchasing/selling a property and any flooding issues identified are considered a separate and legally binding process placed upon property owners and this is independent of and does not relate to the Council highlighting flooding to properties at a street level.

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11 Acronyms

AEP	Annual Exceedance Probability
AWS	Anglian Water Services
BFRS	Buckinghamshire Fire and Rescue Service
BGDB	Bedford Group of Drainage Boards
CDC	Critical Drainage Catchments
DEPRO	Duty Emergency Planning Response Officer
EOC	Emergency Operations Centre
F&WMA	Flood and Water Management Act 2010
FIR	Flood Investigation Report
IDB	Internal Drainage Board
LLFA	Lead Local Flood Authority
MAFP	Multi Agency Flood Plan
MCM	Multi Coloured Manual
MKC	Milton Keynes Council
MK CCG	Milton Keynes Clinical Commissioning Group
MKPT	Milton Keynes Parks Trust
MKUH	Milton Keynes University NHS Foundation Trust
RMA	Risk Management Authorities
RoFSW	Risk of Flooding from Surface Water
SoP	Standard of Protection
TCG	Tactical Coordination Group
TVLRF	Thames Valley Local Resilience Forum
TVP	Thames Valley Policy