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# Bedford and Milton Keynes Waterway Park

Phase 1 Flood Risk Management Opportunity Study

On behalf of **Bedford and Milton Keynes Waterway Trust**



Project Ref: 41799/4001 | Rev: 2 | Date: September 2019

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2	20/9/19	Executive Summary added	AH	RR	AH

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## Executive Summary

Peter Brett Associates (PBA), now part of Stantec, has completed a Phase 1 Flood Risk Management Opportunity Study for the Bedford and Milton Keynes Waterway Park on behalf of Bedford and Milton Keynes Waterway Park, exploring opportunities to incorporate wider water and flood risk management within the Waterway Park design and construction.

The Bedford and Milton Keynes Waterway Park route lies within the wider Cambridge – Milton Keynes – Oxford corridor growth arc. The National Infrastructure Commission has identified that there are opportunities to deliver one million new homes and jobs in the area by 2050, while respecting the natural environment.

The Waterway Park crosses a number of hydrological catchments, including the River Great Ouse, smaller catchments such as the Ouzel, Elstow Brook and Broughton Brook, and that of the Grand Union Canal.

The aim of the Phase 1 study was to identify the potential of the Waterway to manage and reduce flood risk as part of the strategic infrastructure to support planned growth in the local area, and as part of the Cambridge – Milton Keynes – Oxford Arc.

### Method

The study has been completed with consideration of how the Waterway Park contributes to a Catchment Based Approach. The provision of the new Waterway Park will provide new infrastructure within the Cambridge – Milton Keynes – Oxford corridor growth arc to allow the better management of water to support the local community and create a healthy water environment for people and wildlife, whilst creating a sustainable amenity which reduces flood risk to the local communities and benefits growth plans.

The approach that is being adopted for this Opportunity Study presents the first stage of a partnership approach which will engage business, civil society and local authorities. This collaborative working will allow a number of funding streams to be accessed and maximise benefits. The collaborative partnership in this instance will facilitate the distillation of local knowledge, and expertise from the Trust together with the support from the regulatory authorities.

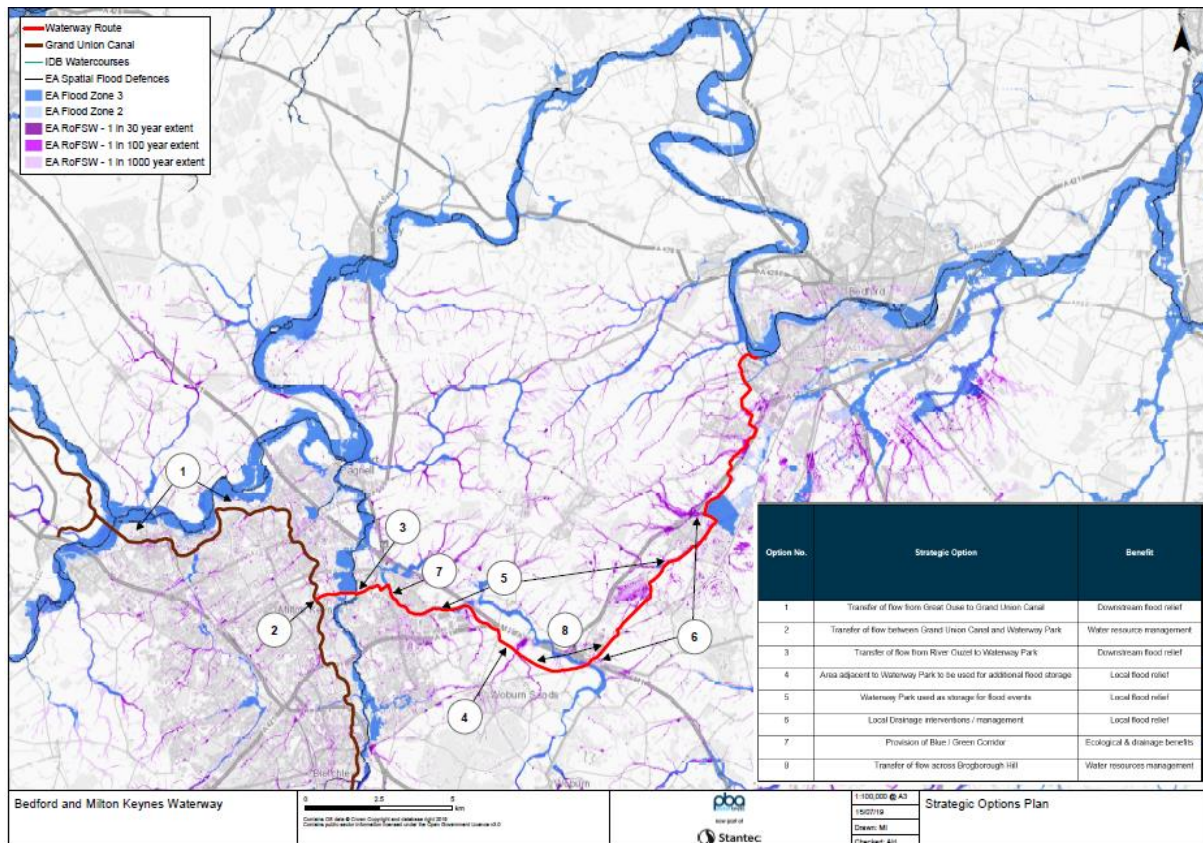
This Phase 1 study has been a high level review, based on a Stakeholder Workshop attended by Lead Local Flood Authorities, the Environment Agency, Bedford Group Internal Drainage Board and the Forest of Marston Vale; data collection and analysis, GIS mapping and an assessment of options at a Strategic and Local Scale. To date, no technical assessment of options has been conducted.

### Innovative Strategic Options

The Strategic Options identified consider how the Waterway Park as an entity could aid flood risk management on a broader catchment scale. These are indicated in the Figure below and can be summarised as follows:

- Transfer of flow from Great Ouse to Grand Union Canal
- Transfer of flow between Grand Union Canal and Waterway Park
- Transfer of flow from River Ouzel to Waterway Park
- Area adjacent to Waterway Park to be used for additional flood storage

- Waterway Park used as storage for flood events
- Local Drainage interventions / management
- Provision of Blue / Green Corridor
- Transfer of flow across Brogborough Hill.



Innovative flood management options could be delivered by the management of the transfer of flow between the various watercourses and the new Waterway Park. This will provide wider benefits including improvements to the local ecology, provision of a new amenity and creation of sustainable transport links.

There are opportunities to use the Waterway channel to convey water from one system to another. Further, the Grand Union Canal could be utilised to connect the Waterway to the River Great Ouse in the Newport Pagnell/Milton Keynes area, effectively creating a bypass channel, relieving flood risk to the communities along the River Great Ouse between here and Bedford where the Waterway connects to the River Great Ouse.

The Waterway Park also presents opportunities for blue / green infrastructure to be delivered through the heart of existing communities along its length.

The Waterway offers the ability to export / transfer water resource between catchments which may provide wider environment and ecology benefits as well as recharging catchments that are suffering from a water deficit.

The existing water bodies within some reaches of the Waterway Park have poor water quality and the Waterway may provide some potential in providing a water quality betterment, for example by provide spills from the Waterway into the existing water bodies to prevent drying out.

Providing the Waterway Park may also build a corridor for other infrastructure to be delivered, including gas mains and water mains within tow-paths.

The provision of the Waterway Park provides additional character to the area and provides tangible landscape and recreational benefits together with new sustainable transport links.

## Local Scale Options

In addition to the Strategic Options, there are a number of options which could provide local benefits. To assess the potential options the Waterway Park has been subdivided into Study Zones based on hydrological catchments and local administrative boundaries. These Local Options can be delivered by a variety of interventions along the Waterway route, but can be broadly summarised as follows:

- The provision of additional floodplain capacity by modifying local ground levels during the Waterway construction;
- The management of floodplain flow routes to reduce risk or defend local communities, e.g. by the construction of canal embankments;
- The Interception of watercourses / flows by the Waterway to manage the downstream flood risk;
- Provision of additional flow controls along the watercourses and on the Waterway to manage water levels at a local scale;
- The inclusion of a blue / green corridor along route of waterway to provide ecological enhancements to improved drainage management;
- The provision of additional capacity in the local catchments by creating an over widened waterway to reduce and store flood water.

## Conclusions

The Bedford and Milton Keynes Waterway offers a unique opportunity to deliver strategic and local scale flood management solutions to existing communities, whilst providing wider benefits to those existing residents and the new communities within the Cambridge-Milton Keynes-Oxford growth arc.

It is recommended further technical studies are progressed to investigate these opportunities further.

# 1 Introduction

## 1.1 Introduction

- 1.1.1 The Bedford and Milton Keynes Waterway Trust ('the Trust') are currently reviewing the approach and feasibility of delivering a new navigable waterway and park corridor to connect Bedford and Milton Keynes.
- 1.1.2 Peter Brett Associates (PBA), now part of Stantec, has been appointed by the Trust to undertake a Phase 1 Flood Risk Management Opportunity Study for the Bedford and Milton Keynes Waterway Park ('the Waterway'). This is to explore opportunities to incorporate wider water and flood risk management within the Waterway Park design and construction.

## 1.2 Context

- 1.2.1 The Bedford and Milton Keynes Waterway Park route lies within the wider Cambridge – Milton Keynes – Oxford corridor growth arc. The National Infrastructure Commission has identified that there are opportunities to deliver one million new homes and jobs in the area by 2050, while respecting the natural environment.
- 1.2.2 The Waterway Park crosses a number of hydrological catchments, including the River Great Ouse, smaller catchments such as the Ouzel, Elstow Brook and Broughton Brook, and that of the Grand Union Canal.
- 1.2.3 The growth arc's characteristics are such that parts of the catchment are at significant flood risk, whilst there is a paucity of water during drought periods. Both of these have detrimental effects to the community and environment.
- 1.2.4 The River Basin Management Plan (RBMP) for the Upper and Bedford Ouse catchment presents an overview of the drivers and challenges for this catchment. The priority river basin management issues to tackle in this catchment are the negative impacts on habitats and ecological diversity caused by:
  - i. the physical modification of watercourses
  - ii. invasive non-native plant and animal species (INNS)
  - iii. pollution (diffuse and point source)
- 1.2.5 The provision of a Waterway Park must consider its influence on the above and how it goes towards delivering the RBMP's objectives, aims and future goals.
- 1.2.6 Ultimately, as it progresses, the Waterway Park will be in accordance with national and local policy with regard to flood risk.

## 1.3 Scope

- 1.3.1 The aim of the Phase 1 study, as outlined in the brief provided by the Trust via the Environment Agency (EA), is to identify the potential of the Waterway to manage and reduce flood risk as part of the strategic infrastructure to support planned growth in the local area, and as part of the Cambridge – Milton Keynes – Oxford Arc.
- 1.3.2 The study has been completed with consideration of how the Waterway Park contributes to a Catchment Based Approach. The provision of the new Waterway Park will provide new infrastructure within the Cambridge – Milton Keynes – Oxford corridor



growth arc to allow the better management of water to support the local community and create a healthy water environment for people and wildlife, whilst creating a sustainable amenity which reduces flood risk to the local communities and benefits growth plans.

- 1.3.3 The brief further outlined the spatial scope to be considered as part of the Phase 1 Assessment study with flood risk to be considered both across the Waterway Park route and within sub-catchments that are influenced by it including the River Great Ouse, the Grand Union Canal and Broughton Brook. The Phase 1 Assessment study has also considered the Elstow Brook catchment.
- 1.3.4 The Phase 1 Assessment study has therefore been designed to comprise a screening exercise whereby the output will provide the framework for more targeted feasibility appraisal in Phase 2.
- 1.3.5 The Phase 1 Assessment study consists of identification of:
  - i. Areas where the Waterway Park route is likely to be constrained by existing flood risk issues, such that consideration of flood risk mitigation is required as part of the Waterway Park design); and,
  - ii. Areas of opportunity for flood risk management using the Waterway Park– which both incorporates using the Waterway Park to alleviate existing flood risk issues and to manage surface water run-off from development within planned growth areas.
- 1.3.6 It is noted that at this stage (Phase 1) of the Flood Risk Management Opportunity Study, no technical assessment of options has been conducted. Detailed / technical appraisal will take place during Phase 2 of the study for the sites which are selected to be carried forward from the 'long list' of options provided from this Phase 1 Assessment.
- 1.3.7 This Phase 1 Assessment has been produced based on stakeholder engagement and the, information available / provided at the time of writing. As the development of the Waterway Park is ongoing it is acknowledged that this information may be subject to change and require further review at a later date.
- 1.3.8 Engagement with stakeholders at this Phase 1 stage has been limited to local authorities, the Environment Agency, the Internal Drainage Board, Milton Keynes Parks Trust and the Forest of Marston Vale.

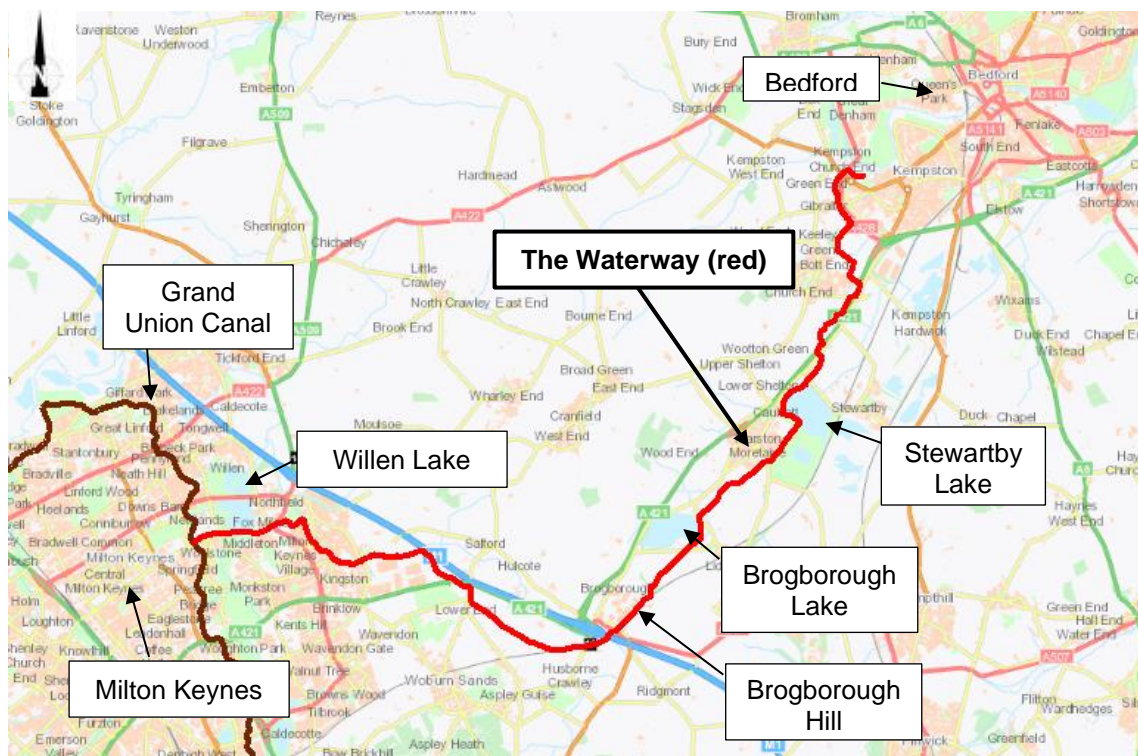
## 1.4 A Catchment Based Approach

- 1.4.1 A Catchment Based Approach (CaBA) embeds collaborative working at a river catchment scale, delivering a range of environmental, social and economic benefits and protecting our water environments for the benefit of all.
- 1.4.2 The approach that is being adopted for this Opportunity Study presents the first stage of a partnership approach which will engage business, civil society and local authorities. This will be supported by regulation but is delivered with this collaborative approach providing a range of environmental, societal and economic benefits.
- 1.4.3 This collaborative working this will allow a number of funding streams to be accessed and maximise benefits. The collaborative partnership in this instance will facilitate the distillation of local knowledge, and expertise from the Trust together with the support from the regulatory authorities.

## 2 Waterway Park Route and Study Area

- 2.1.1 The provision of the proposed Waterway Park will connect Milton Keynes in the west to Bedford in the east. The Waterway Park will manage the traversing of the levels through a sequence of locks, which will facilitate movement in both directions.
- 2.1.2 Brogborough Hill, in the vicinity of the M1 corridor, presents a requirement to raise the Waterway Park across this feature. A review of potential approaches to cross the hill is ongoing by the Trust but is currently identified as a boatlift.
- 2.1.3 Throughout its route the Waterway Park will incorporate the surrounding topography or require engineering to facilitate the structure in comparison to existing levels. An exercise has been completed to compare the Waterway Park level to the existing ground. This therefore informs the potential for watercourses to freely interact with the proposed Waterway.
- 2.1.4 The study area for the Phase 1 Assessment is provided in **Figure 2.1** below and will consider each of the 26 Waterway sections as set out in the 'B&MK Waterway Consortium Project Delivery Plan' within the context of planned growth within the Cambridge – Milton Keynes – Oxford Growth Arc.

Figure 2.1: Phase 1 Assessment Study Area

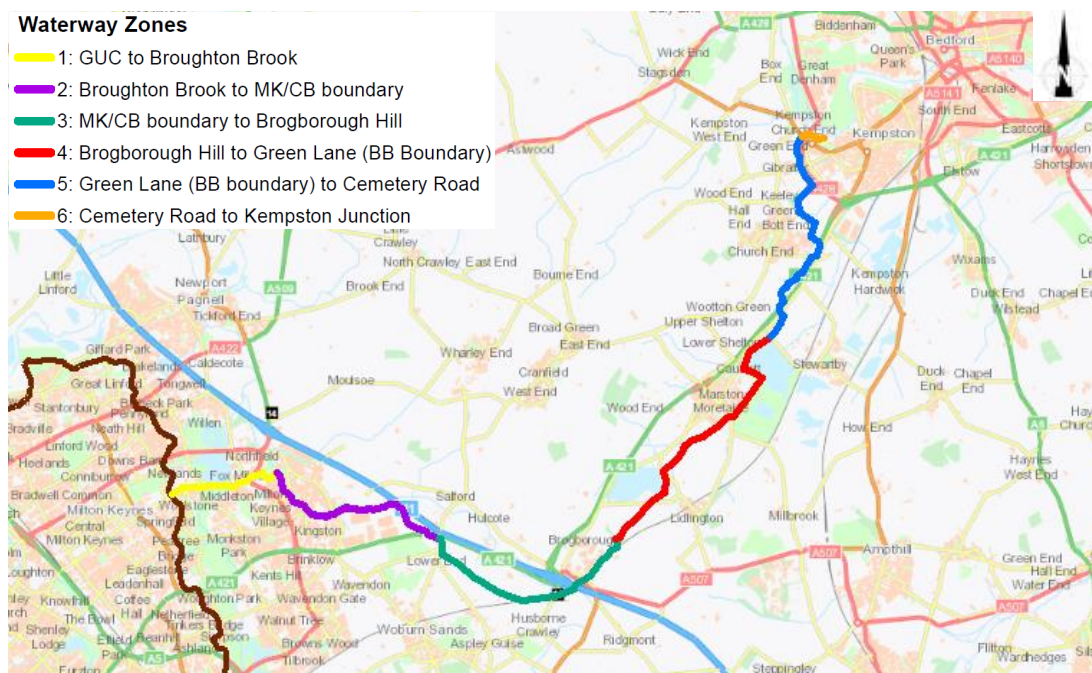


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- 2.1.5 The 26 Waterway sections as set out in the 'B&MK Waterway Consortium Project Delivery Plan' have been grouped into six separate Study Zones based on natural hydrological catchments and administrative boundaries, as follows:
- iii. Study Zone 1: From North of Childs Way / Grand Union Canal to Broughton Brook
  - iv. Study Zone 2: From Broughton Brook connection to Industrial Park and M1
  - v. Study Zone 3: From Glebe Farm to North of M1 Junction 13
  - vi. Study Zone 4: From Brogborough Hill to Green Lane / Bedford Borough Boundary
  - vii. Study Zone 5: From Green Lane / Bedford Borough Boundary to Cemetery Road
  - viii. Study Zone 6: Cemetery Road to Kempston Junction

2.1.6 The Study Zones are illustrated in **Figure 2.2** and described in greater depth below.

Figure 2.2: Phase 1 Assessment Waterway Study Zones



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## Study Zone 1

- 2.1.7 The proposed Waterway Park route originates at the Grand Union Canal in Milton Keynes.
- 2.1.8 The route passes east, south of Willen Lake, and over the River Ouzel via a 40m viaduct. It then passes under Tongwell Street via a 10m underpass and under Childs Way via a 50m underpass. The Waterway Park then continues through Atterbury toward the Broughton Brook.

## Study Zone 2

- 2.1.9 For the majority of Study Zone 2, the Waterway Park route follows the existing route of the Broughton Brook, it passes Milton Road, Countess Way and Newport Road as the route continues east past the industrial estate north of the A421.
- 2.1.10 The Waterway Park continues east north of the industrial estate where it then turns south away from the existing course of the Broughton Brook adjacent to the M1. The Waterway Park crosses the A421 north-east of Eagle Farm via a 20m underpass.
- 2.1.11 Study Zone 2 ends north of Eagle Farm.

## Study Zone 3

- 2.1.12 Study Zone 3 starts just before Cranfield Road, north-east of Eagle Farm.
- 2.1.13 The Waterway Park route passes under Cranfield Road via a bridge and continues east north of Glebe Farm and then south of Hayfield Farm as it continues toward Bedford Road.
- 2.1.14 The route beneath the Bedford Road (A507) via a 10m underpass. The Waterway crosses beneath the M1 in the vicinity of Junction 13. It is proposed that an existing underpass which was built as a 'cattle creep' will be used to convey the Waterway and no new structure will be required. The Waterway Park crosses the Ridgmont Bypass via a 20m underpass as the route turns north toward Ridgmont. The route continues north-east toward Brogborough Middle Farm which it passes to the west.
- 2.1.15 This study zone ends within Fox Covert.

## Study Zone 4

- 2.1.16 In Study Zone 4 the proposed Waterway Park route continues north-east toward Brogborough Lake where a boatlift is proposed to facilitate the ~23m level change.
- 2.1.17 The Waterway Park route continues north-east and follows the existing course of an unnamed watercourse / drain where it passes to the east of Marston Moretaine and continues toward Stewartby Lake.
- 2.1.18 The Waterway continues west and then north around the perimeter of Stewartby Lake by following the existing course of Elstow Brook. A smaller boatlift is proposed at Brogborough lake to change the proposed water level by approximately 5m.
- 2.1.19 Study Zone 4 ends at the northern point of Stewartby Lake in 'The Sycamores'.

## Study Zone 5

- 2.1.20 The proposed Waterway route turns north in Study Zone 5 through Belmont where it then passes back underneath the A421 via another underpass. The route then continues to traverse north through Berry Wood, east of Wootton, west of Homeless Wood and through Ridgeway Wood. The route is then proposed to pass underneath Ridge Road east of Gibraltar via an underpass and then continue north adjacent to The Branston Way (A428) toward Cemetery Road.
- 2.1.21 This Study Zone ends just prior to Cemetery Road.

## Study Zone 6

- 2.1.22 Study Zone 6 begins with the crossing of the route underneath Cemetery Road (B560) via a further underpass. The Waterway Park route then turns east and passes beneath the A428 before continuing east toward the River Great Ouse where the route ends.

## 3 Methodology

### 3.1 Overall Approach

3.1.1 The identification and development of potential flood risk management options for the Waterway Park for the Phase 1 Opportunity Study has been undertaken by the completion of the following activities:

- Stakeholder Workshop;
- Gap Analysis and Data collection
- Data Analysis and GIS Mapping
- Assessment of options at a Strategic and Local Scale

3.1.2 Strategic Options are considered in Section 4 and Local Scale Options are reflected on in Section 5.

3.1.3 Each of the above approaches are discussed below.

### 3.2 Stakeholder Workshop

3.2.1 A stakeholder workshop was held on 23<sup>rd</sup> November 2018 at the Forest Centre, Marston Moretaine, Bedford. This workshop was held prior to the collection of data and review of potential options for the Waterway Park.

3.2.2 The principal objectives of the workshop were as follows:

- a. Facilitate data collection;
- b. Identify and collate local/site-specific information and knowledge relating to:
  - i. flood risk issues, challenges and constraints (both now and in the future);
  - ii. the sources and mechanisms of flooding associated with existing flood risk issues;
  - iii. flood risk management opportunities provided by the proposed Waterway Park; and,
  - iv. wider water management and environmental enhancement opportunities provided by the proposed Waterway Park.
- c. Agree the study methodology.

3.2.3 The following organisations were represented at the workshop:

- Bedford and Milton Keynes Waterway Trust;
- Bedford Borough Council;
- Bedford Group of Drainage Boards;
- Central Bedfordshire Council;
- Environment Agency;

- Forest of Marston Vale Trust;
  - Milton Keynes Council; and,
  - Milton Keynes Parks Trust
- 3.2.4 A summary of the issues / themes raised by workshop attendees is presented below.
- 3.2.5 It was agreed that the screening study should be applied at a range of spatial scales (i.e. strategic and catchment scale through to individual water bodies and the local / site-scale).
- 3.2.6 The EA is keen to explore the opportunities for linking major systems / networks, associated water transfer and the benefits that may arise.
- 3.2.7 The potential for strategic green space associated with the Waterway Park corridor to serve a flood risk / water management function should be explored.
- 3.2.8 The form of the workshop was focussed around maps of each Study Zone, to provide an appropriate level of detail, and therefore both strategic scale and local scale themes have been presented for each of the Study Zones:

### **Study Zone 1: North of Childs Way / Grand Union Canal to Broughton Brook**

- Any interaction between the Waterway and Willen Lake (that serves a flood management function) may necessitate changes to Lake operational rules (but noted that this is a matter for later feasibility assessment);
- Consideration required of the impact of elevated water levels (along the Waterway Park / Broughton Brook corridor) upon surface water and sewer flood risk (but noted that this is a matter for later feasibility assessment);
- The Waterway Park potentially provides an opportunity for surface water storage that could ease pressure on Broughton Brook / River Ouzel;
- Consideration required of the potential impact upon flood risk where the Waterway Park crosses watercourses (but noted that this is a matter for later feasibility assessment);
- Consider opportunities for water management/transfer associated with linkage to the Grand Union Canal in Milton Keynes;
- It was noted that Campbell Park (north-side development) routes surface water flows into minor watercourse and ultimately Willen Lake – potential pressures / capacity issues;
- Consider issues / opportunities / constraints associated with possible development at the junction between the Waterway and the Grand Union Canal; and,
- It is considered that future development in the southern Milton Keynes area will add to pressure upon the River Ouzel system.

### **Study Zone 2: Broughton Brook connection to Industrial Park and M1**

- Consideration required of the impact of elevated water levels within the Waterway upon surface water and sewer flood risk (but noted that this is a matter for later feasibility assessment);

- Consider potential role of Waterway as a balancing reservoir to reduce pressures upon River Ouzel (principally where the Waterway subsumes Broughton Brook, so the Brook and Waterway are one and the same feature); and,
- It is considered that future development in the southern Milton Keynes area will add to pressure upon the River Ouzel system – consider potential role of additional capacity offered by the Waterway.

### **Study Zone 3: From Glebe Farm to North of M1 Junction 13**

- Explore the possibility of diverting ditches / drains receiving surface water from the clay ridge (watershed) to Brogborough Lake;
- Hayfield area / proposals (3,000 houses) and requirement to integrate Waterway Park appropriately highlighted;
- Explore potential relationship between the Eagle Farm development scheme and the Waterway Park;
- Consider opportunities associated with the Expressway and linking water management with cycle/walking routes; and,
- Requirement to consider the vertical alignment of the Waterway Park where it crosses the M1 Motorway as this is likely to influence the scope for flood risk / water management opportunities along this reach.

### **Study Zone 4: Brogborough Hill to Green Lane / Bedford Borough Boundary**

- Flow capacity constraints noted along the Cranfield Tributary system – explore opportunities for alleviation using the Waterway Park; and,
- Properties located within the floodplain at Marston Moretaine and potential for Waterway Park to alleviate (noted that this issue is addressed by the emerging Marston Valley proposals).

### **Study Zone 5: Green Lane / Bedford Borough Boundary to Cemetery Road**

- Historic issues managing surface water run-off at Stewartby landfill noted – explore opportunities for alleviation using the Waterway;
- Potential conflict between flood risk management and leisure uses at Stewartby Lake noted; and,
- Consider diversion of surface water flows within land drainage network to the west of Marston Moretaine into the Waterway.

### **Study Zone 6: Cemetery Road to Kempston Junction**

- Longstanding flood risk issues associated with Wood End Brook (Brook backing up due to high levels on River Ouse, surface water flooding between Kempston High Street and R Ouse) – explore opportunities for alleviation using the Waterway Park; and,
- Flooding on the River Ouse often extends over several days – explore opportunities for the Waterway to manage / control inflows to the River Ouse from tributary watercourses.



- 3.2.9 The information and data obtained at the workshop has been combined with the data obtained as part of the data collection process discussed below, and with review of the Local Authority Strategic Documents, to characterise the baseline environment of the Waterway Park route and wider area from a flood risk perspective. This has provided the foundation of the Phase 1 screening exercise.
- 3.2.10 It is noted that a number of the points from the workshop discussed above are the subject of subsequent pre-feasibility and feasibility work and have therefore not been explored further at this stage. The current scope is for a high level screening exercise to produce a 'long list' of options for Stakeholder review.

### 3.3 Data Collection

- 3.3.1 The Phase 1 Assessment makes use of data from a variety of sources, both open data and data sourced from key stakeholders.
- 3.3.2 The data has been used to map the proposed Waterway Park route against existing flood risk constraints and proposed development growth areas. The stakeholders consulted and the data obtained as part of this process are outlined below:
- Bedford and Milton Keynes Waterway Trust:
    - Waterway Park route and design parameters including vertical alignment.
  - Ordnance Survey (OS):
    - Base mapping open data; and,
    - LiDAR topographical data.
  - Environment Agency (EA):
    - EA Flood Map for Planning;
    - EA Risk of Flooding from Surface Water (RoFSW);
    - EA Flood Risk from Reservoirs Map;
    - Catchment Explorer Water Framework Directive (WFD) datasets;
    - Detailed River Network (DRN); and,
    - National Receptor Dataset (NRD).
  - Internal Drainage Boards (IDBs):
    - IDB District boundaries; and,
    - IDB watercourse routes.
  - Canal and River Trust (CRT):
    - Grand Union Canal centreline;
    - CRT 'planning buffer'; and,
    - Culvert locations.
  - Local Authorities – Milton Keynes Council (MKC), Central Bedfordshire Council (CBC) and Bedford Borough Council (BBC):
    - MKC Local Plan Allocations (SAP);
    - CBC Adopted Local Plan Allocations;
    - CBC Local Plan 2015 – 2035 Proposed Allocations;
    - BBC Local Plan 2013 Allocations; and,
    - BBC Local Plan 2030 Proposed Allocations

- 3.3.3 It is further noted that as part of the Phase 1 Assessment all Strategic / Policy documents from the Local Authorities listed above were reviewed and considered as part of the screening exercise.
- 3.3.4 The EA's NRD was requested but received late during the Phase 1 Study period. Due to the amount of data this has therefore not been included in the analysis of the options. It is noted that as the NRD information will influence the benefits / constraints for future options and affect the final decision it is recommended that this data be reviewed at the next stage.

### 3.4 Data Analysis and GIS Mapping

- 3.4.1 In order to assess the proposed Waterway Park against the flood risk constraints and Local Authority allocations as discussed above, the proposed Waterway route was spatially mapped against the constraints and allocations (provided as shapefiles) using ArcGIS (ESRI) software.
- 3.4.2 The proposed vertical alignment of the Waterway Park was also mapped against surrounding topography based on LiDAR data using proposed Waterway levels provided by the Trust on the 30<sup>th</sup> November 2018. This process has enabled identification of where the Waterway was raised, level or below-grade.
- 3.4.3 GIS plans produced as part of the Phase 1 Assessment are provided in **Appendix A**.

### 3.5 Waterway Park Options Assessment

- 3.5.1 Through the information received and interpreted it has been possible to formulate an initial options assessment for the Waterway, both on a strategic scale and at a more focused study zone. The overall approach to this phase is described below.
- 3.5.2 The following data sets and considerations have been used to advise the strategic and local options:
- Waterbodies – lakes, watercourses (identified from the EA DRN dataset and OS mapping);
  - Areas identified in the EA flood maps to be at risk of fluvial and / or surface water flooding;
  - Local Authority Allocations (as provided in shapefile format by the Local Authorities); and,
  - Proposed / existing infrastructure such as rail and road networks (identified from OS mapping).
- 3.5.3 The outputs of the strategic and local analysis are detailed further in **Sections 4 and 5** respectively.

## Strategic Options

3.5.4 The Waterway Park was first assessed on a strategic scale which consisted of desk-study review based on the workshop discussion, data obtained and GIS mapping to identify a number of potential options.

3.5.5 The Strategic Options have been advised by the following objectives:

**Objective 1: Identification of where the Waterway Park route is constrained by flood risk, such that flood risk mitigation must be embedded within the design;**

**Objective 2: Identification of where the Waterway Park provides opportunity to manage / alleviate extensive areas at risk of flooding;**

**Objective 3: Identification of where the Waterway Park may strategically support future development / infrastructure growth through serving a surface water / flood risk management function.**

3.5.6 The findings of this exercise are presented in Figure 4.1, Appendix A, and **Section 4**.

3.5.7 No technical evaluation of the strategic options has taken place at this stage but will be conducted during a later phase for those options that are taken into Phase 2. It is recognised that the Strategic Options then lead into and influence the Study Zone / Local options and are therefore in part interlinked.

## Study Zone Scale / Local Options

3.5.8 As described the Waterway Park has been grouped into the six separate Study Zones based on natural hydrological catchments and administrative boundaries, as detailed in Section 2.

3.5.9 For each Study Zone, a number of sites have been identified that are relevant to each of the Phase 1 three objectives based on discussion at the initial stakeholder workshop, review of Local Authority strategic documents and GIS mapping discussed above.

3.5.10 The sites identified through the process as described above were assessed against a series of key parameters in order to inform the potential options or recommendation for each objective.

3.5.11 Considerations and parameters used for this local scale assessment against each objective are as follows:

**Objective 1: Identification of where the Waterway Park route is constrained by flood risk, such that flood risk mitigation must be embedded within the design;**

- Whether the Waterway is on-line or off-line. i.e. where the Waterway subsumes an existing watercourse would constitute being on-line.
- Whether the Waterway Park lies within a local hotspot or area at risk of flooding and will require modification / mitigation to be included

**Objective 2: Identification of where the Waterway Park provides opportunity to manage / alleviate existing flood risk issues;**

- Location of the Waterway Park in relation to an identified local hotspot or area at risk of flooding;
- The Waterway level in relation to this identified area at risk of flooding; and,

- Presence of receptors within the area affected; includes whether the area affected is urban or rural and if there is a presence of any critical infrastructure such as the road or rail networks.

**Objective 3: Identification of where the Waterway Park may support future development / infrastructure growth through serving a surface water / flood risk management function.**

- Location of the Waterway Park in relation to the Local Authority Allocation / Growth Area;
- The Waterway level in relation to the Local Authority Allocation / Growth Area; and,
- Presence of existing / proposed infrastructure that may act as a constraint.

3.5.12 Following consideration of the above parameters the sites are presented in the form of the long lists of options. The List of Options is presented in tables for each of the six Study Zones. The results are presented in **Section 5 / Appendix B** of this report.

## 4 Strategic Level Options

### 4.1 Strategic Options

- 4.1.1 The Strategic Options identified consider how the Waterway Park as an entity could aid flood risk management on a broader catchment scale.
- 4.1.2 Through the workshop discussion, data obtained and GIS mapping the key strategic options / opportunities have been identified. The Waterway provides a physical link between the River Ouzel and Elstow Brook systems, via the Broughton Brook. The route currently traverses Brogborough Hill, this has been identified as via a boatlift, although other options are being reviewed. This physical link between various watercourses offers a number of opportunities:

#### Strategic Flood Risk Management:

- 4.1.3 It is understood from the stakeholder workshop that the River Ouzel and the River Great Ouse in particular are under pressure from a flood risk perspective.
- 4.1.4 There are be opportunities to use the Waterway channel to convey water from one system to another. Further, the Grand Union Canal could be utilised to connect the Waterway to the River Great Ouse in the Newport Pagnell/Milton Keynes area, effectively creating a bypass channel, relieving flood risk to the communities along the River Great Ouse between here and Bedford where the Waterway connects to the River Great Ouse.
- 4.1.5 It is considered that the Waterway Park offers the strategic opportunity to manage flood risk by transferring/distributing water across catchments. This will be more achievable between local catchments, but subject to managing the crossing of Brogborough Hill, there may be the potential to manage water levels to improve flood risk between the River Ouzel and Elstow Brook via the existing Broughton Brook channel. This may relieve flood risk pressures on the River Ouzel catchment.
- 4.1.6 Over widening of the Waterway throughout would provide additional flood storage and managed structures and controls could ensure that this is considered early in the design.
- 4.1.7 Flood storage could also be provided within the Waterway Park corridor, separate to the Waterway channel, which may be permanent wet features or dry areas except in times of flood.
- 4.1.8 The Waterway can relieve pressure on tributaries with known capacity issues, such as in the Cranfield area north of Brogborough Lake. Flows can be diverted to Brogborough Lake or Stewartby Lake via the Waterway to relieve capacity pressures. Note that Brogborough Lake is marginally upstream from the existing course(s) of the Cranfield area tributaries so a requirement for pumping would need to be considered in this case.
- 4.1.9 It is noted that the management of flood risk would require a more rapid response and active management to reduce water levels. In addition, the transfer of water could have detrimental flood risk issues in other locations that would need to be reviewed actively during flood events.
- 4.1.10 Local interventions and storage opportunities through the Waterway Park reach further support the management of flood risk.
- 4.1.11 The Waterway Park also presents opportunities for blue / green infrastructure to be delivered through the heart of existing communities.

A summary of the potential strategic options together with the benefits that may be realised are shown in Table 4.1 and Figure 4.1. This figure is also recreated in Appendix A:

Figure 4.1: Strategic Options Plan

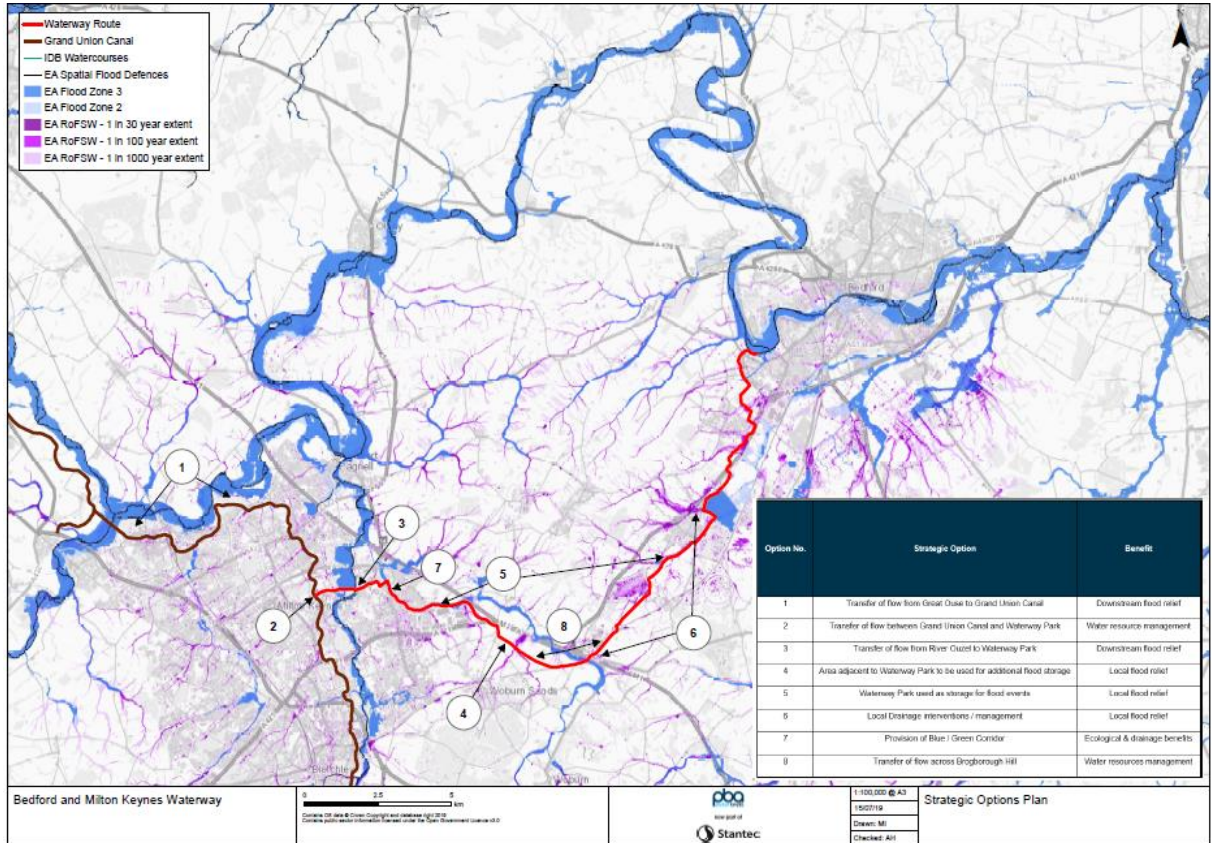


Table 4.1: Summary of Options, Constraints and Opportunities

Option No.	Strategic Option	Benefit
1	Transfer of flow from Great Ouse to Grand Union Canal	Downstream flood relief
2	Transfer of flow between Grand Union Canal and Waterway Park	Water resource management
3	Transfer of flow from River Ouzel to Waterway Park	Downstream flood relief
4	Area adjacent to Waterway Park to be used for additional flood storage	Local flood relief
5	Waterway Park used as storage for flood events	Local flood relief
6	Local Drainage interventions / management	Local flood relief
7	Provision of Blue / Green Corridor	Ecological & drainage benefits
8	Transfer of flow across Brogborough Hill	Water resources management

## 4.2 Additional Benefits

4.2.1 The options detailed in Section 4.1 could also provide wider benefits beyond flood risk, including but not limited to the following:

### Strategic Water Transfer

- 4.2.2 As described above the Waterway offers the ability to export / transfer water resource between catchments. This may provide wider environment and ecology benefits as well as recharging catchments that are suffering from a water deficit.
- 4.2.3 Due to the more measured approach of transferring water, i.e. establishing the need and coordinating a response, this may be more achievable than the more rapid response which would need to be undertaken during flood events.
- 4.2.4 Options could include the potential for storage within the various former clay pits and waterbodies in Marston Vale which could then provide a means of supporting the operational water demands of the Waterway in times of water deficit in the Elstow Brook catchment.
- 4.2.5 The linking of the 3 lakes (Willen, Brogborough, Stewartby) for water transfer. The Waterway can facilitate spills into the lakes in times of flood / high flows and / or to move water between the lakes in times of water deficit (i.e. for water supply and demand purposes). This could be achieved relatively easily with local transfers, but may

require more appropriate infrastructure or advanced planning if transferring flows across Brogborough Hill.

- 4.2.6 Again, the transfer of water will need to be reviewed with the potential increased flood risk in other parts of the catchment.

### Infrastructure and Wider Social Opportunities

- 4.2.7 Providing the Waterway Park may also build a corridor for other infrastructure to be delivered, including gas mains and water mains within tow-paths.
- 4.2.8 The infrastructure requirement for the new Waterway Park and the additional flood capacity will need to be assessed and subject to localised constraints.

### Ecological / WFD Improvements

- 4.2.9 Study Zones 2 & 3 of the Waterway Park are located within a Poor WFD Catchment (Cycle 2, 2016). The Waterway may provide some potential in providing a water quality betterment.
- 4.2.10 The Waterway can provide spills to minor waterbodies, including EA designated 'Main Rivers', Ordinary Watercourses and Internal Drainage Board (IDB) drains, along its course during low flow conditions to prevent drying out and maintain the existing ecological environment.
- 4.2.11 The provision of the Waterway Park provides additional character to the area and provides tangible landscape and recreational benefits together with new sustainable transport links.
- 4.2.12 The above Strategic options have been reviewed and lead into and influence the Study Zone / Local options, discussed in **Section 5**.



## 5 Study Zone / Local Options

- 5.1.1 The list of Study Zone / Local Options have been determined through a review of the local features, drivers and constraints within each study area. This has resulted in a number of opportunities to be identified for each area.
- 5.1.2 A summary of the Phase 1 Assessment at the Study Zone / Local Level are presented in Table 5.1 below considering potential options and which Study Zones these may be applicable to. More detailed tables for each of the six Study Zones can be found in **Appendix B**. Each set of tables is accompanied by the accompanying 'Constraints and Options Plan' for that Study Zone. This accompanying plan presents the location of each of the constraints and options discussed for that Study Zone; the plan is to be read in conjunction with the tables.
- 5.1.3 In addition to the identification of the potential intervention Table 5.1 includes an indicative funding band. This is a high level review based on a coarse assessment of likely number of discrete works required to facilitate the improvement (e.g. provision of large or small control structure, requirement for control measures). A summary of the assumptions is included in **Appendix C**.
- 5.1.4 The detailed tables in Appendix B & C include high level estimates of the costs to implement potential interventions along the Waterway Park route. These costs are based on the cost of intervention and are in addition to the physical delivery of the Waterway. It should be noted that the costing makes no consideration for the detail of delivering these interventions or elements such as land costs, project management/design, service diversions or feasibility. These bandings should therefore only be seen as a first pass and used for comparison purposes.
- 5.1.5 The bandings for each interventions are allocated High (H), Medium (M) and Low (L), and are assessed as follows:
- Low: <£300k
  - Medium: £300k to £1m
  - High: >£1m
- 5.1.6 In a similar vein the potential impact of delivering the stated improvement is summarised as High, Medium and Low. This assessment is subjective and has not been quantified within the analysis and should be reviewed during the next stage of assessment.
- 5.1.7 Finally, an overall score has been calculated based on the combination of costing and potential benefits, using the following matrix:

		Benefit		
		L	M	H
Cost	L	L	M	H
	M	L	M	H
	H	L	L	M

- 5.1.8 In addition to the above, each of the options will need to be assessed against any significant concerns which could prevent the delivery of the option, i.e. land ownership concerns, ecological constraints etc. It is recommended that this is reviewed at the next stage and with the wider Project Team.
- 5.1.9 Before proceeding to Phase 2, the List of Options tables for Objective 2 and Objective 3 have a free final column titled, 'Proceed to next stage?'. It is recommended that this be completed as a collaborative exercise within the Project Team, as a workshop or conference. This would then inform and provide focus to the next stage.

Table 5.1: Summary of Local Scale Options

Option	Applicable Study Zone (s)	Benefit	Indicative Cost per intervention
Provision of additional cut / fill during Waterway construction	2 & 5	Increased flood plain capacity	M-H
Construction of canal embankments within existing flow route	3 & 5	Opportunity to manage floodplain flow	M
Interception of drainage / flow routes	1, 2, 4 & 5	Facilitate watercourse discharge into Waterway – management of flows	L-M
Provision of flow controls along watercourse / Waterway interception	1, 3, 4, & 6	Transfer of flows / water to watercourses / waterway	M-H
Inclusion of blue / green corridor along route of canal	2 & 6	enhanced drainage / ecological benefit	L-M
Over widening of canal to provide additional capacity	2, 3, 4 & 6	Provision of additional capacity to manage flood events	L-H

## 6 Conclusions and Recommendations

- 6.1.1 This Phase 1 Flood Risk Management Opportunity Study has been prepared by PBA, now part of Stantec, on behalf of the Bedford and Milton Keynes Waterway Trust.
- 6.1.2 This Phase 1 report summarises the methodology of the Phase 1 'screening exercise' and provides a series of constraints and options for consideration for the Waterway Park as a whole and the strategic options that could be provide.
- 6.1.3 Innovative flood management options could be delivered by the management of the transfer of flow between the various watercourses and the new Waterway Park. This will provide further benefits outside of the immediate flood benefits including improvements to the local ecology, provision of a new amenity and create sustainable transport links.
- 6.1.4 Further local options exist and these are presented for each of the six study zones together with initial estimates of costs and benefits that may accrue from the interventions. Further work will be required to refine the options and quantify the interventions and provide a more robust assessment of costs and benefits.
- 6.1.5 No consideration of the wider constraints at this Opportunity Study Stage has been made.
- 6.1.6 It is recommended that the tables and options discussed within are reviewed by the Project Team in order to select options that are both potentially feasible and viable to carried forward for further detailed / technical assessment as part of Phase 2.
- 6.1.7 The Bedford and Milton Keynes Waterway offers a unique opportunity to deliver strategic and local scale flood management solutions to existing communities, whilst providing wider benefits to those existing residents and the new communities within the Cambridge-Milton Keynes-Oxford growth arc.

# Appendix A GIS Plans

# Appendix B List of Options Tables

Table B -5.1: Summary of Study Zone Options, Constraints and Opportunities

Study Zone / ID	Site Location / Feature	Potential Intervention	Indicative Cost Band	Indicative Benefit Band	Overall
<b>Study Zone 1</b>					
S1:2A	Connection/crossing of GUC	Water transfer opportunity - managed by control gates	M	H	H
S1:2B	Local watercourse management to reduce adjacent flood risk	Local Watercourse management to improve surface water/fluvial flooding through control / pumping	M	M	M
S1:2C	Connectivity between Willen Lake	Transfer of flows / Management of Waterway water levels to manage flood risk from Willen Lake. Widen Waterway to maximise storage	M	M	M
S1:2D	Use adjacent land to Willen Lake for flood mitigation	Transfer of water from Waterway to adjacent floodplain	H	M	L
S1:2E	Management of River Ouzel Flood Relief	Flows between river and Waterway – subject to topography	M	M	M
S1:3A	Milton Keynes SAP20: Drainage for local plan allocation	Management of Waterway water levels to provide capacity & accommodate flows	M	H	H
<b>Study Zone 2</b>					
S2:2A	Subsume Broughton Brook: Widen waterway / adjacent capacity improvements	Widen watercourse to accommodate Waterway requirement and additional capacity	M	H	H
S2:2B	Flood plain management upstream of Broughton Brook connection	Mobilise water levels in upstream Broughton Brook floodplain	H	H	M
S2:2C	Provision of Blue / Green Corridor	Opportunity to provide ecological enhancement – reduce flood risk through localised SUDs	L	H	H
S2:2D	Management of SW flows into Waterway	Provision of conveyance / storage within Waterway	M	H	H
S2:2E	Mobilisation of floodplain & creation of designated greenspace	Mobilisation of local area adjacent to Waterway to provide storage	M	M	M
S2:2F	IDB Drain 27	Provision of conveyance / storage within Waterway	L	M	M
S2:2G	IDB Drain 97	Provision of conveyance / storage within Waterway	L	M	M
<b>Study Zone 3</b>					
S3:2A	Waterway crossing IDB drainage route	Potential to mobilise floodplain storage upstream of the culvert crossing	M	M	M
S3:2B	Crossing of Ordinary Watercourse	Potential to mobilise floodplain storage upstream of the culvert crossing	M	H	H

S3:2C	Embanked waterway	Provision of storage area formed by Waterway embankment	M	M	M
S3:3A	Central Beds Development Allocation	Management of Waterway water levels to provide capacity & accommodate flows	M	H	H
<b>Study Zone 4</b>					
S4:2A	IDB Drain B35 and associated surface water/fluvial floodplain management:	Waterway offers ability to reconfigure flows to reduce this risk of flooding	L	M	M
S4:2B	Waterway subsumes existing Elstow Brook channel	Widen watercourse to accommodate Waterway requirement and additional capacity	M	M	M
<b>Study Zone / ID</b>	<b>Site Location / Feature</b>	<b>Potential Intervention</b>	<b>Indicative Cost Band</b>		
<b>Study Zone 4 Continued</b>					
S4:2C	Connectivity between Stewartby Lake and the Waterway.	Transfer of flows / Management of Waterway water levels to manage flood risk from Stewartby Lake. Widen Waterway to maximise storage	M	H	H
S4:3A	Central Bedfordshire Local Plan 2015-2035 Proposed Allocation: Marston Vale New Villages	Drainage from allocation to be managed through the Waterway.	L	L	L
S4:3B	Central Bedfordshire Adopted Local Plan Allocation: Land East of Bedford Road, Marston Mortaine	Drainage from allocation to be managed through the Waterway.	L	L	L
S4:3C	Bedford Borough Council Local Plan 2030 Residential Allocation: Stewartby Brickworks Development Site	Drainage from allocation to be managed through the Waterway.	L	L	L
<b>Study Zone 5</b>					
S5:2A	Mobilisation of floodplain adjacent to Waterway	Control structure and land management to facilitate floodplain storage	M	M	M
S5:2B	IDB Drain B42	Potential to mobilise floodplain storage upstream of the culvert crossing or transfer into Waterway	L	L	L
S5:2C	IDB Drain B16	Potential to mobilise floodplain storage upstream of the culvert crossing or transfer into Waterway	L	L	L
S5:2D	IDB Drain B16 (2)	Potential to mobilise floodplain storage upstream of the culvert crossing or transfer into Waterway	L	L	L
S5:2E	IDB Drain B15	Potential to mobilise floodplain storage upstream	L	L	L

		of the culvert crossing or transfer into Waterway			
S5:2F	Land drain crosses Waterway	Potential to mobilise floodplain storage upstream of the culvert crossing	M	L	L
S5:2G	SW Drainage west of A428	Potential to mobilise floodplain storage upstream of the culvert crossing or transfer into Waterway	M	L	L
<b>Study Zone 6</b>					
S6:2A	SW Drainage Route at Waterway crossing	Potential to convey water along existing drainage route, requirement to provide active water level management	M	M	M
S6:2B	Waterway interaction with River Great Ouse Floodplain	Provision of capacity within Waterway	H	L	L
S6:2C	Designated Greenspace / flood storage and wet woodland	Potential to mobilise floodplain and create ecological feature	M	M	M



# Appendix C High Level Costing Table