

# Bedford & Milton Keynes Waterway

## Bell Farm Site Alignment Options Appraisal

Prepared for  
**Bedford Borough Council**

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# Introduction

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## Study Scope

This study looks into options for a waterway alignment in the Bell Farm area near Kempston in Bedford Borough. The waterway section would be part of the Bedford & Milton Keynes Waterway, connecting the River Great Ouse with the Grand Union Canal (see Scheme Background below).

Bell Farm is situated to the south-west of the A428/A421 junction (see the study area in Figure 2). Within the Local Development Framework (LDF), Bell Farm has been allocated for development for employment purposes. This was in response to a submission seeking to provide a mix of opportunities including offices, studios, light industry, distribution warehouses and hotels<sup>1</sup>.

The LDF also shows the route of the Bedford & Milton Keynes Waterway passing through this employment area.

The specific LDF policy is as follows:

*Policy AD12 Land at Bell Farm, Kempston*

*Land at Bell Farm will be developed for a mix of classes B1 (a)(b) & (c), and B8 uses. Key principles of development include:*

- i. *Approx 18 hectares employment site.*
- ii. *Contribution to the delivery of the objectives of the Forest of Marston Vale – particularly enhancing Bedford's Green Gateway.*
- iii. *Deliver a section of the Bedford to Milton Keynes Waterway Park incorporating canal, cycle and pedestrian paths (possibly Sustrans Route 51) through the site.*
- iv. *A strategic/integrated approach to surface water management.*
- v. *Enhance/strengthen important gap between Bell Farm and Wootton.*
- vi. *Design to reflect site topography.*
- vii. *Provision of a high quality landmark/ gateway building at A421 junction.*
- viii. *Pre-determination archaeological evaluation.*
- ix. *Improvements to transportation networks, including*
  - a. *Pedestrian and cycle access to facilities west of Kempston and Wootton.*
  - b. *Direct left in/left out access to Bedford Western Bypass.*
  - c. *Junction design to facilitate dualling of Bedford Western Bypass in the future.*
- x. *The development of the site to be guided by a Master Plan to be agreed by the local planning authority. The Master Plan should be for the whole of the site and be submitted to support the planning application.*

*Supporting text:*

*Bell Farm lies adjacent to the Bedford Western Bypass and has excellent links to the strategic road network. Its development provides the opportunity to deliver a stretch of the Bedford to Milton Keynes Waterway Park along with high quality waterside business units. The site slopes, rising south to north which should be a major consideration in the design of the site. Particular attention should be paid to the impact of additional traffic movements on the Ridge Road/bypass junction and the A421/Cemetery Road junction. Pre-determination archaeological evaluation work is required due to potentially significant archaeological remains on this site.*

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<sup>1</sup> Bell Farm, Bedfordshire: Masterplan (Woods Hardwick)

Bedford's Green Gateway, which forms part of the Forest of Marston Vale, lies to the south-west of the employment site. Owned and maintained by the Marston Vale Trust, this land consists of relatively new woodland, planted on farmland between 2001 and 2007 to provide a green corridor between the expanding communities of Bedford/Kempston and Wootton, and to 'green' the southern approach to Bedford/Kempston<sup>2</sup>.

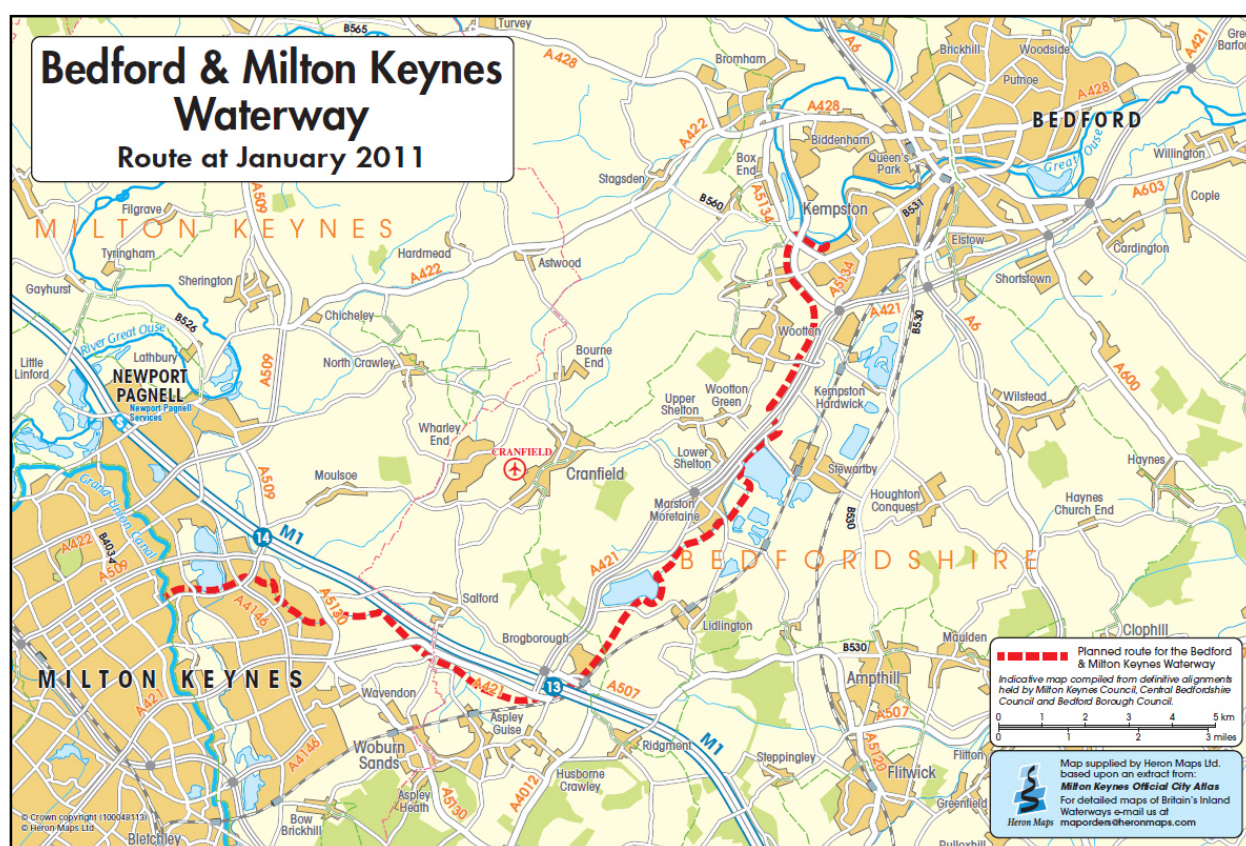
This study has been commissioned to assess potential alignment options for the waterway, both within the employment site and within the land owned by the Marston Vale Trust.

## Scheme Background

The Bedford & Milton Keynes Waterway is a proposed new 26 kilometre canal, to connect the River Great Ouse at Kempston in Bedford Borough with the Grand Union Canal at Newlands in Milton Keynes, located within a series of green corridors<sup>3</sup>. These corridors, or waterway parks, are aimed at providing a link between local communities, but will provide a more unique and attractive environment in what has been recognised as an important growth corridor in the local development plan. The canal will also provide a new habitat for wildlife, as well as a new channel for drainage and water supply.

FIGURE 1

**Bedford & Milton Keynes Waterway – Route Overview (B&MKW Consortium)**



<sup>2</sup> Forest of Marston Vale website (<http://marstonvale.org/wootton/> - Accessed 03-Sep-2013)

<sup>3</sup> Bedford & Milton Keynes Waterway – A-Z Project Delivery Plan, November 2012 (B&MKW Consortium)





# Site Information

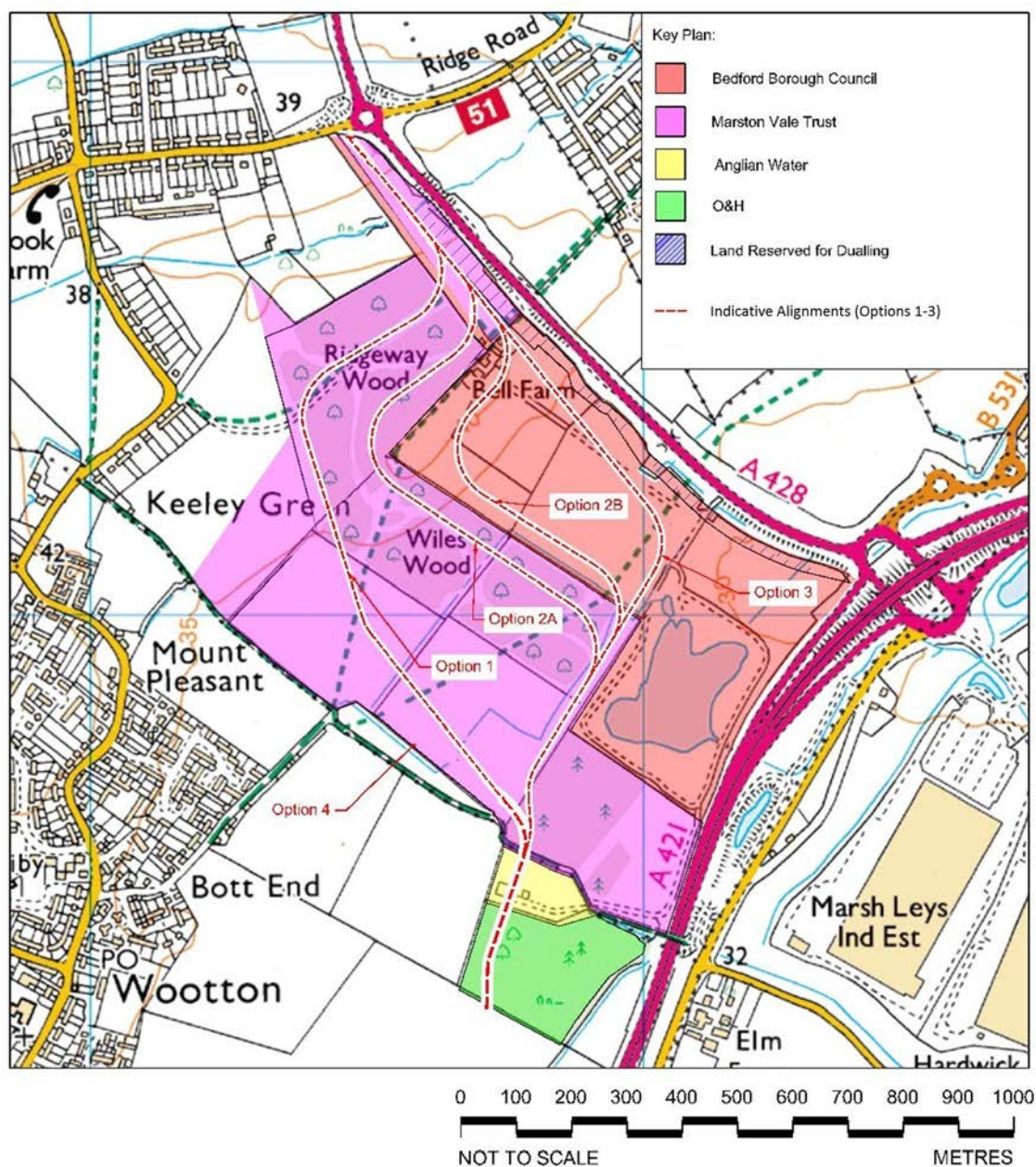
## Landowner Details

The footprints of the proposed waterway alignments considered in this report appear to affect four landowners. To the south of the study area, the alignments pass through woodland (Homeless Wood) owned by O&H Group, before crossing a disused wastewater treatment works (Anglian Water – subject to ownership confirmation).. The majority of the land is owned by Marston Vale Trust, and the north eastern part of the section is owned by Bedford Borough Council. Further discussion regarding the landowners affected by the alignment of the waterway is outlined in the Alignment Appraisal section of this report.

Landowner boundaries can be seen on Figure 2 below, with a more detailed plan showing the four proposed alignments in Appendix B (drawing 476075-HG-01-00-DR-C-001).

FIGURE 2

**Landowner Plan – Bell Farm study area (showing indicative proposed waterway alignments)**





## Topographical Information

To the south of the study area, the topography remains fairly flat at circa 32m Above Ordnance Datum (AOD). The land rises in the centre of the study area, steeply at points, to a peak of circa 40mAOD around the Bell Farm agricultural buildings and farm house.

To the north of the study area, the land drops into a small valley where it crosses Wood End Brook (circa 34mAOD), before rising to meet Ridge Road (road level at circa 38mAOD), which the waterway must pass beneath.

## Constraints or Other Infrastructure

### Tie-In Levels

The waterway is to tie in to specific levels at either end of the study area as below:

To the south of the study area, the waterway enters a housing development (Persimmon), where the ground level has been agreed at 33.0mAOD (water level 32.5mAOD).

To the north of the study area, the waterway must pass under Ridge Road, with a road level of circa 38.25mAOD. With an allowance of 2m below existing finish level (for road construction and slab/beam) to soffit level of the underpass and 3m clearance to water level, giving a tie in pond level of 33.25mAOD. The underpass structure itself is outside of the study area so its design features are therefore not discussed here.

### Internal Drainage Board (IDB)

An arterial watercourse (B15) passes north-easterly across the study area, which is under statutory control of the Bedford Group of Internal Drainage Boards<sup>4</sup>. The proposed waterway alignment will be required to cross this watercourse at some stage.

On the eastern side of the study area, the IDB's Woburn Road Wetlands storage reservoir and a section of existing floodplain for the site is located<sup>5</sup>. Further discussion with IDB is required to assess the possibility of realigning a section of the drain B15 along the toe of the waterway footprint, which is discussed further in the Alignment Appraisal section of this report.

### A428 Dualling

The site is bounded on its north-easterly edge by the western bypass of Bedford, the single carriageway A428. To account for the potential future demand on this route, a strip of land has been reserved for widening of the A428 to dual-carriageway status. This is of particular significance to the proposed waterway alignment at the north of the site area, where the narrow strip of land alongside the Bell Farm access track has to accommodate both the waterway and A428 dualling requirements. The corridor reserved for dualling is shown on all the alignment plans included in Appendices A and B.

### Public Rights of Way

Within the study area, three public footpaths provide a link between Wootton and Kempston, with one bridleway heading across the A421 to the south-east. Where the proposed alignment intersect the public footpaths, provisions would be made for a suitable crossing, which will be described in the appraisal of each option. Where Public Right of Way references are provided, please refer to the Rights of Way<sup>6</sup> map in Appendix D.

### Marston Vale Forest

A range of constraints relating to the creation of woodland by the Marston Vale Trust are relevant to alignment sections on the Trust's land including already planted woodland/tree cover, recreational

<sup>4</sup> Bedford Group of Internal Drainage Boards ([www.idbs.org.uk/board-area-map/](http://www.idbs.org.uk/board-area-map/), accessed: 24-Sep-13)

<sup>5</sup> Bedfordshire & River Ivel IDB – Developments West of Bedford Strategic Flood Facility, Master Plan (Hannah Reed, Dwg no. 98145/200 Rev.N)

<sup>6</sup> Rights of Way in Bell Farm Area (1:5000 @ A3) – Bedford Borough Council (26/07/2013)

access networks, forest tracks and the potential breach of some tree planting contracts/agreements/relationships.

## Services

Overhead power lines cross the site towards the south east of Wiles Wood (heading north-east). These may require raising or burying as part of the proposed works.

Other services are to be confirmed.

# Typical Details

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For the purpose of this feasibility study, typical details provided in the brief technical guide<sup>7</sup> from B&MK Consortium have been used, a copy of which is included in Appendix D. These are:

## Typical Cross Sections & Dimensional Data

### Open Aspect Waterway

<b>Top width:</b>	<b>32</b>	metres (NOTE: not including outer bank slopes to existing ground level)
Bed width:	9	metres
Pond width:	21	metres
Water depth:	1.5	metres
Freeboard:	0.5	metres
Bank slope:	1:3	gradient
Maintenance width:	9	metres (one side)
Verge width:	2	metres (opposite side)

### Vertical Hard Sided Waterway

<b>Top width:</b>	<b>20</b>	metres (NOTE: not including outer bank slopes to existing ground level)
Bed/Pond width:	9	metres
Water depth:	1.5	metres
Freeboard:	0.5	metres
Maintenance width:	9	metres (one side)
Verge width:	2	metres (opposite side)

### One Boat Width Underpass

<b>Top width:</b>	<b>9</b>	<b>metres (including towpath and verges)</b>
Bed/Pond width:	6	metres
Water depth:	1.5	metres
Freeboard:	0.5	metres
Towpath width:	3	metres (one side)
Head clearance:	2.5	metres (towpath)
	3	metres (waterway)

### Other Key Dimensional Data

Lock width:	5	metres
Lock length:	24	metres
Min bend radius:	100	metres
Max towpath slope:	1:16	gradient (maximum gradient for accessibility)

(Top widths mentioned here do not represent the proposed waterway footprint widths. The land take and earthworks calculations will therefore include bank slopes beyond top width to include total footprint widths.)

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<sup>7</sup> A Brief Guide to Space, Design and Other Technical Issues in Providing for the Bedford Milton Keynes Waterway – B&MK Consortium

# Alignment Appraisal - Engineering

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## Alignment Options

Initially three alignment options were considered; one alignment to the west, mainly on Marston Vale Trust land called Option 1; one alignment to the east, mainly on Bedford Borough Council land known as option 3; and one alignment along the boundary between the two landownerships called Option 2. Later on, Option 2 was subsequently changed to two alignments, one to the west of the boundary on Marston Vale Trust land (Option 2A) and the other to the east on Bedford Borough Council land (Option 2B).

### Southern Section (all alignments)

To the south of the study area, all four options follow the same alignment for the first 300 metres, with the waterway following the north-westerly boundary line of both Homeless Wood and the disused wastewater treatment works. A footbridge would also be provided at the end of this section, as bridleway KER23A crosses the waterway here.

### Northern Section (all alignments)

To the north of the study area, all four options converge on the narrow strip of land between the Bell Farm access track and the A428. Here, to reduce the footprint, the waterway is of a vertical hard sided cross section. The locks descend into the valley to allow passage under Ridge Road, however the final lock has been located north of Wood End Brook, to allow sufficient clearance for the watercourse to be culverted beneath the upstream end of the lock. Providing a culvert for the watercourse under the waterway negates the need to use an expensive, and often maintenance heavy, siphon system.

The following sections describe the individual sections for each alignment option.

### Option 1

From the south end, as Option 1 passes onto Marston Vale Trust land, it immediately turns north-west, passing across open grassland (land to remain largely unplanted<sup>8</sup>). In order to raise the waterway to cross the IDB watercourse (B15), the first navigation lock would be located here, with a water level change of 3.5 metres.

Although this would raise the waterway above the surrounding ground, this would provide a more attractive vista for users of the waterway, including walkers along the towpath. A footbridge at the lock structure would also address the public footpath (KERA3A) crossing the waterway in this section of land.

The waterway passes through Wiles Wood (planted 2006) as the land ascends, before entering Ridgeway Wood (planted 2004/5). As the gradient increases, a second lock of 3.5 metres is positioned, raising the waterway pond level to a height of 39.5mAOD. Again, a footbridge would be provided at the lock, which would also allow the public footpath (KER33A) to cross, although some realignment of the public right of way would be required, following the towpath for 150 metres or so before the lock.

The waterway would turn north-east, following the 40mAOD contour, where it would meet another public footpath (KERA4A), which would follow the towpath, before again turning north-west, crossing into Bedford Borough Council land and over the Bell Farm access track, where an access bridge may need to be provided. The public footpath would also cross at this point, forming KERA4D. A vehicular access bridge is likely to be required (location to be agreed at detailed design stage) to cross over the waterway for any maintenance work in the area.

The main structures required for the alignment Option 1 are shown in Table 1 below. The associated plan and the waterway cross sections are given on 100-Series drawings in Appendix B.

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<sup>8</sup> Bedford's Green Gateway – Marston Vale Trust (29 June 2012)

Table 1 - Main Structures for Option 1

Length (m)	Locks	Underpasses	Drainage Culverts	Footbridges	Vehicle Bridges
1890	4	1	3	3	1

## Option 2A

Entering Van Diemen's land (Marston Vale Trust), the Option 2A alignment shifts around 50m to the left, to avoid the IDB reservoir. The first lock (3.5m head difference) would be required to raise the waterway above the IDB watercourse, just before the waterway turns through 90 degrees, to follow the boundary of the Marston Vale Trust land. At this change in direction, the footprint of the waterway would be located within the floodplain of the IDB reservoir. With the proposed remodelling of the reservoir at a future date, this may be acceptable, however if the floodplain needs to be retained then the waterway would have to cut across Wiles Wood.

The land rises steeply from the centre of the Marston Vale Trust land. In this option a second lock,(3.5m head difference) would be located in this area, with a pond level of 39.5mAOD. The land flattens out at the peak, where the waterway would turn 90 degrees to the north-east. A further 90 degree turn would be required to bring the proposed alignment back into Bedford Borough Council land leading towards north-west. At this point the proposed waterway would cross the Bell Farm Access, where an access bridge would be required.

Under this option a section of the waterway close to the first lock would be aligned on the existing IDB drain B15. Further discussion with IDB would be required to assess options of realigning the drain (along the toe of the waterway) in this length.

Four foot bridges would be required for the existing rights of ways (for KER23A, KERA3A, KER33A and KERA4A). In addition a vehicular access bridge may be required (location to be agreed at detailed design stage) to cross over the waterway for any maintenance work in the area.

The main structures for the alignment Option 2A are shown in Table 2 below. The engineering plans and the waterway cross sections are given in Appendix B (200-series drawings).

Table 2 - Main Structures for Option 2A

Length (m)	Locks	Underpasses	Drainage Culverts	Footbridges	Vehicle Bridges
2010	4	1	3	4	1

## Option 2B

Option 2B would be same alignment as 2A up to the start of the first lock. The first lock on the Option 2B alignment would be required approximately 100m further northeast (2.0m head difference) to pass over the IDB watercourse (B15). Again, this would pass through the floodplain, so may require adjustment of the alignment around this area if the floodplain is to be retained in future. Following the lock, the waterway would turn through 90 degrees into the Bedford Borough Council land (employment site), where the waterway would follow the ownership boundary with Marston Vale Trust as the land rises. Two further locks would be required to address the steep gradient which occurs at approximately the centre of the alignment, the first of which would be 2.0m head difference and the second would be 2.5m head difference.

At the peak, the waterway would turn through 90 degrees to the north-east. The alignment would pass through the existing farm buildings and farmhouse, however it is envisaged that these would no longer be occupied by the time the waterway would be constructed. A second 90 degree turn would bring the proposed alignment to head north-west, where the open aspect waterway would be replaced with a vertical sided channel.

As in the case of option 2A, further discussion with IDB is required to assess options of realigning the drain (along the toe of the waterway) in the section where the waterway is aligned with existing IDB drain B15.

Three foot bridges would be required for the existing rights of ways (for KER23A, KERA3A, a combined footbridge for KER33A and KERA4A). In addition, a vehicular access bridge may be required (location to be agreed at detailed design stage) to cross over the waterway for any maintenance work in the area. A vehicular access bridge may be required to cross over the waterway for any maintenance work in the area.

Table 3 below shows the main structures for the alignment Option 2B. The engineering plans and the waterway cross sections are given in Appendix B (300-series drawings).

*Table 3 - Main Structures for Option 2B*

Length (m)	Locks	Underpasses	Drainage Culverts	Footbridges	Vehicle Bridges
1940	5	1	2	3	1

### Option 3

Option 3 follows the same alignment as the two previous options for the first section, with the first lock be located 50m further northeast of where it is situated in Option 2B (2.5m head difference), where it would cross the IDB watercourse. The waterway would then continue deeper into Bedford Borough Council land (employment site), before sweeping through a 120 degree bend, to head north-west through the employment site.

Similar to Options 2A and 2B, further discussion with IDB will be required to assess options of realigning the drain.

Three foot bridges would be required for the existing rights of ways (for KER23A, KERA3A and for KER20A) under this option. In addition, depending on the final arrangements for the employment site, it is likely that a number of vehicular crossings would be needed within this section of waterway.

Table 4 below shows the main structures for the alignment Option 3. The engineering plans and the waterway cross sections are given in Appendix B (400-series drawings).

*Table 4 - Main Structures for Option 3*

Length (m)	Locks	Underpasses	Drainage culverts	Footbridges	Vehicle Bridges
1880	4	1	2	2	1-2

## Alignment Appraisal – Landscape & Visual

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The information in this section is a summary of the key points identified from the landscape and visual impact assessment technical memorandum, prepared by CH2M HILL landscape architect, Peter Martin. The full technical memorandum can be found in Appendix E.

### Baseline

The study area is located within the North Marston Vale Landscape Character Area. Historically this has been a mix of farm land, settlements, mineral extraction, brick works and landfill. More recently new roads have been built and housing developments are being constructed, which are currently visually intrusive and where mitigation planting will take time to mature.

Much of the area currently has an open character as trees have only recently been planted with older hedgerows dividing the area. In time this will become woodland with open rides and clearings with glimpsed views out to the surrounding landscape.

A mature oak tree is a dominant feature at the top of the ridge. Currently there are views across the landscape from the ridge although in future much of this will be screened by the development of Bell Farm and the Forest of Marston Vale tree planting when it matures.



*View from the ridge, across the Forest of Marston Vale tree planting to the landscape beyond*

The Bell Farm employment site is currently an open area mostly of tall ruderal vegetation with horse paddocks close to the farm buildings. Adjacent to the A421 is a large pond and flood storage area.



## Landscape and Visual Impacts of the Alternative Options

### Option 1

The construction of the waterway would require the removal of a number of sections of existing mature hedgerow and areas of recently planted native trees and shrubs. Over time, as the Forest develops the impact of this loss would be negligible. There will also be opportunities for new wetland habitat creation along the waterway, with the possibility of new ponds providing a water source.



*Option 1 route through recent tree and shrub planting*

Over time the visual impacts will be negligible except for those using paths immediately in the vicinity of the waterway as the surrounding trees will block any more distant views. The waterway would provide an attractive destination and give the forest a central focus for users of the Forest. This option would also create a vista from the ridge through the tree planting to the surrounding landscape.

This option is located some distance from the Bell Farm employment site. It would therefore have little immediate benefit to workers and visitors.

Moving the alignment towards the housing in Wootton would potentially create a barrier for residents to the Forest and also remove the waterway even further from the Bell Farm employment site. However the route of National Cycle Network 51 passes through the Bell Farm employment site and then on to link with housing in Wootton. There is therefore the potential to link this infrastructure with the towpath of the waterway and walkways through the Forest.

### Option 2A

Newly planted trees would have to be removed, gaps created in existing hedges and some hedge along the farm access road would probably have to be removed. There is potential that the excavation works would have an adverse impact on the existing mature hedge and trees along the boundary to the Forest.



*Option 2a route with the boundary hedge between the Forest and Bell Farm on the right*

During construction the impacts would be less severe than for Option 1 because most of the route is towards the edge of the Forest and screened by the existing hedge. The visual impact and effect on circulation would therefore be much less severe.

For users of the Forest during the operation of the waterway there would be limited impact on the existing circulation pattern, while providing the benefits a new visual feature and destination. A vista out to the surrounding landscape would be created from the locks up to the ridge. The locks would also provide a crossing point to the Bell Farm employment site, although at least one more would be required to the south.

For workers and visitors to Bell Farm this option provides visual interest and an easily accessible recreational facility on the edge of the development.

## **Option 2B**

As it would be located within the employment area, Option 2b would have an impact on the layout of the development. This would be limited to along the western edge but the section of the waterway running along the ridge would mean that road bridges and bridges to buildings would be required. The bridges would necessitate raising roads or dropping the waterway thereby taking up additional space.



*The hedge lined access road to Bell Farm*

There would be opportunities for wetland habitat creation although this is likely to be more limited than for Options 1 and 2a as this could have an impact on the land take within the new development. There is potential that the construction works would have an adverse impact on the existing mature hedge and trees along part of the boundary to the Forest.

For users of the Forest during the operation of the waterway there would be limited impact on the existing circulation pattern, while providing the benefits a new feature and destination just outside of the Forest boundary. The locks would provide a crossing point to the Bell Farm employment site.

For workers and visitors to Bell Farm this option provides visual interest and an easily accessible recreational facility on the edge of the development similar to those for Option 2a.

Users of the waterway would have similar benefits to those of Option 2a although part of the route lies entirely within the employment site and therefore have views of new buildings rather than the natural environment of the Forest.

### Option 3

This alignment would have a significant impact on the layout of the Bell Farm employment site, effectively splitting it in two. A number of road bridges would be required over the waterway, with additional bridges required to allow access to buildings. The bridges would necessitate raising roads or dropping the waterway thereby taking up additional space.



*The Bell farm employment site, looking up the hill towards the farm buildings*

There is potential for the waterway to form part of a central linear park through the development, though this would severely constrain development options. In addition the size and shape of the employment land would result in a narrow waterway corridor, much of which would be straight sided and of limited visual interest.

There would be less benefit for users of the Forest than for the other options, with only the southern part of the route providing a visual feature within the Forest.

Users of the canal would be likely to be present to enjoy their surroundings and would be more likely to enjoy a route through the Forest of Marston Vale than a new development.

# Land Take & Cost Estimates

## Cut & Fill Estimations

The four alignments have been optimised to minimise the amount of material leaving site. The waterway has been designed with the aim of using excavated material from proposed works for building of the proposed waterway embankment, with the assumption that the excavated material will be suitable for building embankments. This assumption will be checked at further design development stages involving geo-environmental and geotechnical investigations.

It is also assumed that any surplus material would be used within the site boundary for creating landscape features and for raising any local lower areas. Lock structures have been positioned to ensure net cut is achieved, to avoid any material being imported in. The following table identifies cut & fill estimations for the four alignment options discussed previously.

*Table 5 - Cut & Fill Volume Estimates for each option*

Alignment Option	Cut (excavation)	Fill	Net (Cut / Fill)
Option 1	64,834 m <sup>3</sup>	59,157 m <sup>3</sup>	5,677 m <sup>3</sup> (Cut)
Option 2A	90,282 m <sup>3</sup>	85,071 m <sup>3</sup>	5,212 m <sup>3</sup> (Cut)
Option 2B	68,109 m <sup>3</sup>	61,599 m <sup>3</sup>	6,509 m <sup>3</sup> (Cut)
Option 3	71,333 m <sup>3</sup>	67,919 m <sup>3</sup>	3,413 m <sup>3</sup> (Cut)

<sup>a</sup> Table Notes

## Land Take Comparison

The following table identifies the total footprint area (2D Area) for the four alignment options, along with individual footprints for the land owned by Bedford Borough Council and Marston Vale Trust.

*Table 6 – Waterway Footprint Area Comparison for each option*

Alignment Option	Total Footprint	Bedford Borough Council	Marston Vale Trust	Others
Option 1	75,905 m <sup>2</sup>	3,069 m <sup>2</sup>	62,368 m <sup>2</sup>	10,468 m <sup>2</sup>
Option 2A	85,582 m <sup>2</sup>	8,644 m <sup>2</sup>	66,470 m <sup>2</sup>	10,468 m <sup>2</sup>
Option 2B	78,100 m <sup>2</sup>	37,416 m <sup>2</sup>	30,216 m <sup>2</sup>	10,468 m <sup>2</sup>
Option 3	76,415 m <sup>2</sup>	37,051 m <sup>2</sup>	28,896 m <sup>2</sup>	10,468 m <sup>2</sup>

<sup>a</sup> Table Notes

## Estimated Construction Costs

A high level construction cost comparison of all four route options has been undertaken. At this stage it is based on unit rates from other similar projects with some allowances and consideration for the specific requirements of the Bell Farm area.

Table 7 below gives the estimated construction costs for each of the options.

*Table 7- High Level Construction Cost Comparison*

Main Elements/ Structures	Unit Rate (£k)	Option 1		Option 2A		Option 2B		Option 3	
		Quantity	Cost (£k)	Quantity	Cost (£k)	Quantity	Cost (£k)	Quantity	Cost (£k)
Waterway, (linear length in m)	2	1,890	3,780	2,010	4,020	1,940	3,880	1,880	3,760
Lock Structures	1,000	4	4,000	4	4,000	5	5,000	4	4,000
Underpasses	1,000	1	1,000	1	1,000	1	1,000	1	1,000
Foot Bridges	500	4	2,000	4	2,000	3	1,500	3	1,500
Vehicle Brigdes	1,000	1	1,000	1	1,000	1	1,000	2	2,000
Drainage Culverts	200	3	600	3	600	2	400	2	400
Services diversion (allowance)			1,000		1,000		1,000		1,000
Balancing pond/ pumping for water resources(allowance only)			2,000		2,000		2,000		2,000
<b>Totals</b>			<b>13,380</b>		<b>13,620</b>		<b>13,780</b>		<b>13,660</b>

The estimates assume that the excavated material from site will be suitable and will be used within the site on proposed waterway embankments, landscape features and for raising any local lower areas.



# Conclusion & Further Recommendations

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## Conclusions

This study concludes that from the landscape and visual impacts perspective, Option 2A is the preferred option. This route would provide a new feature for the Forest of Marston Vale; cause little impact on existing circulation features; provide access for workers and visitors of the Bell Farm employment site; have no impact on the layout of the employment site and benefit users of the waterway by providing an attractive setting (especially if the existing hedge is retained), while providing access to facilities.

From the overall land take perspective, Option 1 involves a relatively small area in comparison to the other three options, however the difference in land take for all options is less than one hectare. From a high level construction cost estimate perspective, the study shows that the four options considered would require similar levels of spend and so the construction cost consideration does not indicate a clear preference at this stage, though impact on the employment site would count against Options 2B and 3.

Option 2A is therefore recommended as the preferred option for the consideration of the Council and other key stakeholders subject to any specific issues affecting the precise alignment on Marston Vale Trust's land.

## Further Recommendations

### Alternative Routes

One of the key restrictions for the waterway alignments within the study area, is that of the narrow strip of land to the north, between the Bell Farm access track and the A428. Even without considering the land reserved for dualling, the waterway and associated embankments would struggle to be accommodated within this area.

An alternative solution would be to relocate the waterway alignment to the west of the Bell Farm access track, through another party's land (ownership to be determined). This would also provide an improved approach for passing underneath Ridge Road and would also limit the conflict in levels which would be experienced with the existing pedestrian underpass of the bypass to the north of Ridge Road.

### Land Drainage / Water Resources.

Due to the varied topography through the study area, water resource for supplying this section of waterway is a key consideration for further study. With a head difference of up to 7 metres to the centre of the study area from either end, it is clear that a pumped water supply would be required. A potential option would be to source water from the IDB reservoir (Woburn Road Wetlands), however this would need an agreement in place with the IDB. Supply could be based on a closed loop system, with an equivalent amount of water returning to the reservoir, either from the Bell Farm site, or further upstream from the Berry Farm site.

Other potential water sources include the IDB arterial watercourses which intersect the waterway through the study area, and Wood End Brook to the north of the site.

A further more detailed study on water resourcing is required, with a more holistic approach being considered, in association with other reaches of the waterway.

### Others

Further consideration in due course of following aspects is recommended:

1. Studies of the ecology and archaeology of the area
2. Assessment of the geology and ground conditions
3. Detailed consultation with all stakeholders (Marston Vale Trust, Environment Agency, Bedford Group of Internal Drainage Boards, other landowners, other owners of utility infrastructure potentially affected)

# UPDATE: Option 4 - Marston Vale Trust Preferred Alignment

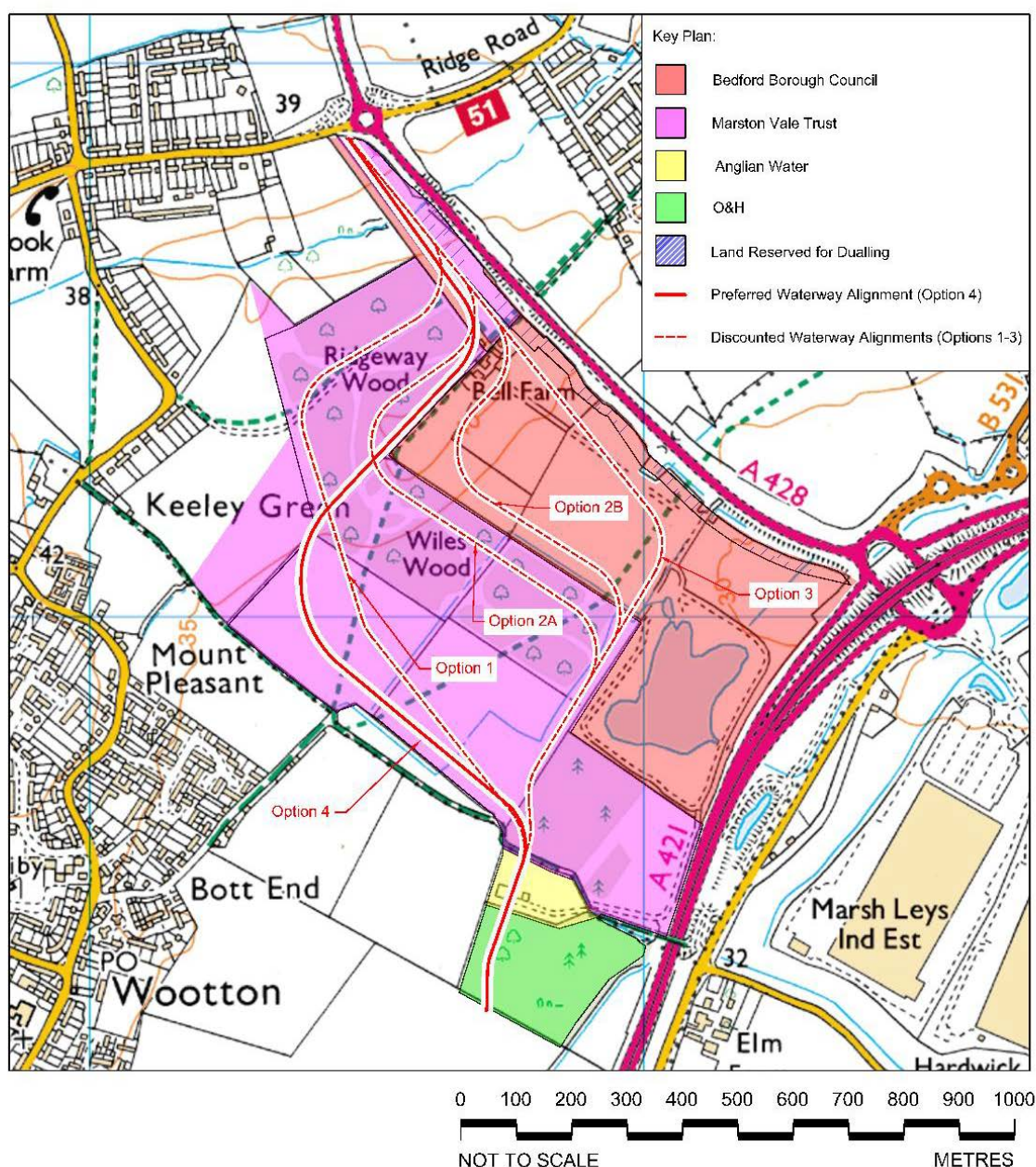
## Introduction

Following consultation of the Draft of this document with Marston Vale Trust, a further alignment was considered (Option 4) to take into account sensitive planting areas within the newly planted woodland, as well as important historical features, such as areas of ridge and furrow.

This is now the preferred option and supersedes Option 2A to that effect.

The general alignment for Option 4 is shown on the plan below, along with the other options that have now been discounted. More detailed plans can be found in Appendix A (600 series drawings).

FIGURE 3  
Waterway Alignment Plan





## Option 4 Description

The alignment of option 4 within the southern reach of the study area follows the same alignment as the previous options, following the north-westerly boundary of both Homeless Wood and the disused wastewater treatment works.

Passing onto Marston Vale Trust land, the waterway turns through 80 degrees to follow the south-western field boundary to minimise the impact on the ridge and furrow land at this point. Initially, the first lock was to be located within the first 500m (Water Level Change: 3.50m) to raise the waterway, allowing the IDB drain to be culverted beneath.

After subsequent consultation, this lock has been moved further south into the Green Lane to Homeless Wood Section, within land owned by Persimmon Homes. The first 520m of the Bell Farm study area is also included in the Green Lane to Homeless Wood section of the B&MK Waterway study. The calculations involving land take, cut / fill and the overall project costing for the first 520m of previously Bell Farm study area now form part of that section of the B&MK. As a result of this overlap, the chainage for Bell Farm area drawings has been adjusted so that chainage: 0 represents the start of Bedford Borough Council boundary at Green Lane, which in effect adds 2820m to all Bell Farm area drawings in comparison to previous arrangement mentioned in the preceding sections of this report.

The remaining proposed waterway alignment under this option would be as follows: After the first 520m, as the waterway heads out of the ridge and furrow land, it would turn gradually through 90 degrees, heading in a north-easterly direction along the boundary of Wiles Wood and Ridgeway Wood. The first lock would be located after the bend (Water Level Change: 3.25m) as the waterway climbs to the highest point within the study area.

Approaching the Bell Farm access track, the waterway would then turn through 90 degrees to follow the existing Bell Farm access track in a north-westerly direction. The waterway footprint (including all embankments) would be located up against the western boundary of the access track would be merged with the proposed maintenance strip and towpath on the western bank of the waterway. The next lock (Water Level Change: 2.50m) will be located immediately after the bend where the waterway would change from an open aspect to a vertical sided channel. The final lock (Water Level Change: 3.50m) would be required after Wood End Brook to allow the brook to be culverted beneath the lock. The waterway would then continue through an underpass at the end of the section at Ridge Road. The existing road surface level at the crossing point is around 38.25mAOD. With an allowance of 2m for road construction and slab/beam to soffit level of the underpass and 3m clearance to water level, the proposed waterway pond level at this point will be 33.25mAOD.

Three foot bridges would be required for the existing rights of ways (for KER23A, KERA3A and for KER20A) under this option. It is also assumed that a vehicle bridge would be required to allow the Marston Vale Trust to access land to the east of the waterway.

Table 8 below shows the main structures for the Option 4 alignment. The engineering plans and the waterway cross sections are given in Appendix A (600-series drawings).

*Table 8 - Main Structures for Option 4*

Length (m)	Locks	Underpasses	Drainage culverts	Footbridges	Vehicle Bridges
1433	3	1	3	3	1

Table 9 shows the estimations for the cut (excavation) and fill volumes for Option 4. The net volume is based on the assumption that the cut or excavated material from site will be suitable and will be used within the site for building proposed waterway embankments.

*Table 9 - Cut & Fill Volume Estimates for Option 4*

Alignment Option	Cut (excavation)	Fill	Net (Cut / Fill)
Option 4	58,199 m <sup>3</sup>	49,289 m <sup>3</sup>	8,910 m <sup>3</sup> (Cut)

<sup>a</sup> Table Notes

Table 10 identifies the total footprint area (2D Area) for the four alignment options, along with individual footprints for the land owned by Bedford Borough Council and Marston Vale Trust

*Table 10 – Waterway Footprint Area for Option 4*

Alignment Option	Total Footprint	Bedford Borough Council	Marston Vale Trust
Option 4	56,682 m <sup>2</sup>	3,316 m <sup>2</sup>	53,366 m <sup>2</sup>

<sup>a</sup> Table Notes

Table 11 shows the revised cost estimates for this preferred option. The detailed cost estimates for this option is given in Appendix F.

Similar to previous options, the estimates assume that the excavated material (cut) from site will be suitable and will be used within the site on proposed waterway embankments, landscape features and for raising any local lower areas. This assumption will be checked at further design development stages involving geo-environmental and geotechnical investigations.

*Table 11 – High Level Cost Estimate Option 4*

Waterway Components	Unit	Quantity	Total Cost (£)
Open aspect waterway	m	1,100	911,988
Vertical sided waterway	m	340	1,403,282
Earthworks	Total	-	903,450
Locks (3 no)	Total	-	2,307,853
Footbridges (allowance only for 3no footbridges)	Total	-	1,500,000
Vehicle Bridges (allowance only for a road bridge)	Total	-	1,000,000
Underpasses (allowance)	Total	-	1,000,000
Services Diversion (allowance)	Total	-	500,000
Balancing Pond/ Pumping for Water Resources	Total	-	2,000,000
<b>Contingency/ Optimism bias</b>			<b>3,457,972</b>
<b>Grand Total</b>			<b>14,984,545</b>