



British Waterways

**Hatherton Canal
Restoration**

Feasibility Report

British Waterways

Hatherton Canal Restoration

Final Feasibility Report

September 2006

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Ove Arup & Partners Ltd

The Arup Campus, Blythe Gate, Blythe Valley Park, Solihull, West Midlands. B90 8AE
Tel +44 (0)121 213 3000 Fax +44 (0)121 213 3001
www.arup.com

Job number 115356-36

CONTENTS

	Page
EXECUTIVE SUMMARY	i
1 INTRODUCTION	1
2 STUDY METHODOLOGY	1
2.1 Tier 1 Scope	1
2.2 Tier 2 Scope	1
2.3 Items Excluded from the Clients Brief	2
2.4 Information Available for Study	2
3 SITE LOCATION AND CANAL ROUTING	2
3.1 Site Location	2
3.2 Canal Routing and Structures	3
3.3 Calf Heath to the Straight Mile	4
3.4 The Straight Mile	5
3.5 The M6 Crossing	6
3.6 Oak Lane Bridge	8
3.7 Saredon Mill Bridge	9
3.8 Cross Bridge	9
3.9 Cats Bridge	11
3.10 Meadow Lock	12
3.11 Bridge 8 (Roman Way Hotel)	12
3.12 Wedges Mills and Wolverhampton Road (A4601)	13
3.13 Wedges Mills to Severn Trent Water Lagoons	14
3.14 Severn Trent Water (STW) Lagoons	14
3.15 Severn Trent Water Lagoons to Walkmill Lane Bridge	16
3.16 Walkmill Lane Bridge	16
3.17 Walkmill Lane Bridge to the M6 Toll Crossing	16
3.18 M6 Toll to the Walsall to Rugeley Railway Line	17
3.19 Walsall to Rugeley Railway Line Crossing	17
3.20 Walsall - Rugeley Railway Line to the David Suchet Tunnel	17
3.21 David Suchet Tunnel – Culvert 155	20
3.22 Streetway Farm	20
3.23 Wash Brook – A5 Crossing.	21
3.24 A5 Crossing	22
3.25 A5 Crossing to Gains Lane	22
3.26 Gains Lane Crossing	23
3.27 Wyrley Lane Crossing	24

3.28	Landfill Access Road Bridge	25
3.29	Connection into Cannock Extension Canal	26
3.30	Moorings and Marinas	27
4	GEOTECHNICAL ISSUES	28
4.1	Introduction	28
4.2	Site History	28
4.3	Geology	30
4.4	Groundwater and Hydrology	30
4.5	Mining	31
4.6	Potentially Contaminated Ground	31
4.7	Engineering Considerations	32
4.8	Canal Lining Requirements	33
5	LOCK CONSTRUCTION	35
5.1	General arrangement	35
5.2	Construction Issues	35
5.3	Methods of Construction	36
5.4	Recommendations	38
6	MULTI-USE TOWPATHS	38
6.1	Towpath Standards.	38
6.2	Towpath and Access Considerations	39
6.3	Towpath Route	39
6.4	Obstructions	40
7	SERVICES INVESTIGATION	41
8	WATER SUPPLY STUDY	42
8.1	Overview of Existing Canal System	42
8.2	Main Surface Water Drainage	43
8.3	Groundwater Features	43
8.4	Existing Water Supplies	44
8.5	Water Requirements	44
8.6	Possible/Potential Water Supplies	46
8.7	Feasibility of Water Sources	46
8.8	Recommended Water Supply Strategy	49
9	Water Quality	50
9.1	Introduction	50
9.2	Potential Sources of Pollution	50
9.3	Water Quality of the Associated Water Courses	51
9.4	Implications of Proposed Scheme	51

9.5	Groundwater Quality	52
9.6	Water Quality Conclusions	52
10	FLOOD RISK ASSESSMENT	53
10.1	Consultation With Operating Authorities	53
10.2	Description Of Local Fluvial System	53
10.3	Identified Risks And Potential Mitigation Measures	55
10.4	Flood Risk Assessment	59
11	PLANNING CONTEXT	59
11.1	Planning Policy Review	59
11.2	National Policies	59
11.3	Regional Planning Policy	63
11.4	Local Policy	64
11.5	Other Planning Issues	67
11.6	Planning Approvals Required	68
11.7	Planning for Moorings and Marinas	68
12	Environmental considerations	68
12.1	Environmental Study Methodology	68
12.2	Tier One – Ecology and Bio-diversity	69
12.3	Landscape & Visual	76
12.4	Cultural and Built Heritage	79
12.5	Contamination & Waste Management	80
12.6	Sustainability	85
13	ECONOMIC IMPACT ASSESSMENT	87
13.1	Introduction and Scope	87
13.2	Context	87
13.3	Methodology	89
13.4	Calculation of the Economic Impact	91
13.5	Operational Employment Impacts	94
13.6	Construction Impact	95
13.7	Consultations	96
13.8	Wider Impact	96
13.9	Economic Impact Assessment Conclusions	97
14	COST ESTIMATE	98
14.1	Summary	98
14.2	General Exclusions	99
14.3	Risk/Contingency Allowance	99
15	CONCLUSIONS AND RECOMMENDATIONS	101

APPENDICES

Appendix A

Schedule of Service Crossings

Appendix B

Flood Plain Map

Appendix C

Schedule of Landfill Tax Materials

Appendix D

Breakdown of Cost Estimate

EXECUTIVE SUMMARY

Ove Arup and Partners Limited (Arup) were commissioned by British Waterways to undertake a Tiered feasibility Study, on behalf of the Lichfield and Hatherton Canals Restoration Trust (LHCRT) for the reinstatement of the Hatherton Canal.

It draws heavily upon Ordnance Survey maps and contoured plans, published records and a specific level of consultation with key authorities in order to formulate this report. In order to progress this project to the next stage in its development it will be necessary to undertake detailed topographical, geotechnical and hydrological surveys and studies that will be able to define the scheme proposals in more detail.

The canal is currently in water for only the first two miles from Calf Heath, though only a very short section up to the marina is currently navigable. Much of the remainder of the canal alignment has now been in-filled and lost to re-development. However, both the South Staffordshire Council and Cannock Chase District Council have identified a protection line through their administrative areas to allow the future reinstatement of the Hatherton Canal, though there are still some major obstacles to be overcome on the route i.e. the M6, the Rugeley to Walsall Railway Line and the A5 as well as certain ecological issues at the Cannock Extension Canal.

The study has been undertaken using an agreed two-tiered approach in order to maintain a program of deliverables that will enable BW and the LHCRT to take this scheme forward to the next stage of their proposal for the restored canal. In tier 1 we identified the essential engineering parameters, the water resource demands, potential water supplies and resource management aspects using historical results from the BW computer based model for boat movements and economic benefits. In the tier 2 work we have reviewed and commented on issues such as the environment, planning issues, heritage and landscape.

The study has identified that there are 5 specific locations along the currently defined route which will need closer investigation to fully identify the engineering required to enable the canal to pass these complex locations: -

Key Engineering Constraints Table	
1	The crossing of the Straight Mile and the M6 Motorway (chainages 0+600 and 0+800) that is likely to be affected by the Highways Agency's proposals for the widening of the M6 motorway or the development of a new M6 Expressway.
2	The length adjacent to the Severn Trent lagoons (Chainage 3+800 to 4+100) needs further investigation in terms of how the canal interacts with the STW outfall and how the Ridings Brook crosses the alignment.
3	The area between Walkmill Lane (Chainage 4+700) and the Walsall to Rugeley Railway (Chainage 5+500). The main issues in this length are the interaction between the canal and the Wyrley Brook, and the crossing of the two water courses beneath the M6 Toll motorway.
4	The area between the Walsall to Rugeley Railway (Chainage 5+500) and the eastern end of the David Suchet Tunnel where the Wash Brook passes back under the A5 (Chainage 6+200). Again the issue of how the canal interacts with the Wash Brook needs to be studied, as well as how the two water courses pass through the David Suchet Tunnel.
5	The crossing of the Wash Brook at chainage 6+640.

From desk studies and consultations with the Environment Agency it is considered that there are a number of potential sources of water supply that could help to feed the restored canal the most likely of these being the shallow aquifers near to the M6 Toll Road in the area of the Wyrley Estate.

However there are other potential sources all of which will need more detailed examination and testing in order that such applications may be made to the appropriate authorities to use these resources.

In addition to the engineering issues it is considered inevitable that there will be some short term impact to and loss of habitats and species along the route. The most critical of these impacts is that of the Floating Water Plantain in the Cannock Extension Canal. However, it is considered that the restored canal will also provide additional habitat and could also afford additional environmental improvements that should more than compensate for what may be lost in the shorter term.

As part of the study a cost benefit assessment has been undertaken to estimate the number of full time equivalent jobs the scheme is likely to generate. This study determined that the construction of the canal is likely to lead, after adjustments for leakage, deadweight and displacement effects, to the direct creation of 14 FTE jobs. Operational, indirect and induced effects will lead to the formation of a further 11 jobs. Adding construction jobs of 134, leads to a sum total employment creation from the scheme of approximately 159 FTE jobs.

The estimated cost of the scheme is £48.7 million, with an estimated risk contingency allowance of £3.5 million.

In conclusion, it is felt that there is a definable and feasible route for the restored Hatherton Canal between Calf Heath and the Cannock Extension Canal. However, this study has identified some engineering and environmental challenges that will need to be addressed during the future detailed design stage in order to enable the scheme to be realised.

1 INTRODUCTION

Ove Arup and Partners Limited (Arup) were commissioned by British Waterways to undertake a feasibility Study, on behalf of the Lichfield and Hatherton Canals Restoration Trust (LHCRT) for the reinstatement of the Hatherton Canal.

The LHCRT was formed in 1988 and is a registered charity and company and is a voluntary non-profit making body. The LHCRT vision statement is: -

'To restore the Lichfield Canal and the Hatherton Canal to reopen waterway links between Staffordshire and the West Midlands, for the benefit of the environment, amenity and prosperity of the people of the region and to enhance the nation's inland waterway system'

The Hatherton Canal was part opened in 1841 from Calf Heath on the Staffordshire and Worcestershire Canal to Churchbridge. It was then further extended in 1860 to join the Cannock Extension Canal, and was in use until abandoned in 1955. The length of the canal was approximately 4 miles.

The canal is currently in water for only the first two miles from Calf Heath, though only a very short section up to the marina is navigable. Much of the remainder of the canal alignment has now been in-filled and re-developed. However, both the South Staffordshire Council and Cannock Chase District Council have identified a protection line through their areas to allow the future reinstatement of the Hatherton Canal, though there are still some major obstacles to be overcome on the route i.e. the M6, the Rugeley to Walsall Railway Line and the A5.

This report aims to identify the key issues that need to be investigated and considered in greater detail, to enable the restoration of the canal to be progressed in an economical and sustainable manner.

2 STUDY METHODOLOGY

The study has been undertaken using a two-tiered approach, by doing this we have been able to maintain a program of deliverables that will enable BW and the LHCRT to take this scheme forward to the next stage of their proposal for the restored canal.

2.1 Tier 1 Scope

In Tier 1 we identified the essential engineering parameters, the water resource demands, potential water supplies and resource management aspects using historical results from the BW computer based model for boat movements and economic benefits.

- The Engineering Feasibility Works
- Water Supply
- Impact on the SSSI at the Cannock Extension canal
- Economic benefits estimation
- Cost Estimate

2.2 Tier 2 Scope

In the Tier 2 work we have reviewed and commented on available data for the other requirements of the brief but only to the extent that they support or influence the key requirements identified above and contribute to the costs estimation for the restored canal scheme. These are:

- Planning Context – Review of relevant planning policies and strategies

- Cultural and Built Heritage
- Landscaping
- Natural Environment, ecology and bio-diversity - Cannock Extension Canal SSSI will be part of the key study aspects and be dealt with in Tier 1 work above
- Contamination and Waste Management
- Sustainability
- Flood Risk Assessment – other than elements covered in Water Supply in Tier 1 above

2.3 Items Excluded from the Clients Brief

The following items of work were included within the clients brief, however following a review of the costs they have been omitted from the scope of work under this present study:

- Detailed Topographical Survey of the canal alignment.
- Geotechnical Site Investigation.
- Physical searches of all infrastructure services locations.
- Sampling of water quality, point source discharges or diffused pollution.

2.4 Information Available for Study

This report has been compiled using the best information available at the time of writing, which included the following information: -

- OS plans and levels – as provided by British Waterways.
- Supplementary spot level information as surveyed by Arup
- Utility Plans – as provided by Groundwise
- Geological Maps
- Envirocheck Report - as provided by Landmark Information Group
- Coal Authority Mining Report
- Information from the M6 toll site scheme – information used with the permission of Midland Expressway Limited.
- Observations made during a number of specialist site visits.
- Correspondence and meetings with interested third parties

3 SITE LOCATION AND CANAL ROUTING

3.1 Site Location

The site is a linear feature that stretches from Calf Heath (393461,308516) on the Staffordshire and Worcestershire Canal for 10.2km to where it joins the Cannock Extension Canal (401891,306029). The alignment passes through both South Staffordshire Council and Cannock Chase District Council jurisdictions.

The water level of the Cannock Extension Canal has been taken as 144.0m OD, and after traversing mounds of made ground associated with the Grove Colliery, the elevation of the proposed new line falls steadily across the eastern side of the Wash Brook Valley to about 127.4m OD at the valley bottom of the Wash Brook. The elevation of the canal along the

Wash Brook/Wyrley Brook valley continues to fall to the junction with the existing in-water section of the Hatherton canal at an elevation of 114.5m OD. From this point the gradient of the Wyrley Brook/Saredon Brook becomes generally slacker. The line of the existing canal falls another 10.5m in the final 4km, to 104m at its junction with the Staffordshire and Worcestershire Canal.

The proposed route of the canal follows the original alignment as far as is possible, however where the original alignment has been lost due to development since its closure, the route of the new canal line has been determined as necessary from the basic topographical and physical features en route and as shown in the clients brief..

3.2 Canal Routing and Structures

3.2.1 Horizontal Alignment

The route of the canal is shown on drawings C-36-001 to C-36-016. Generally, a width of 9m has been adopted for the canal and 3m for the towpath and associated vegetation strip, though both of these widths vary to accommodate "bottle-necks", bends and similar restricted areas. Where space permits the canal sides and cutting/embankment earthworks have been battered using a 1 in 2 slope which is considered to be appropriate for the ground conditions to be encountered. However the suitability of this side-slope will need assessing during the detailed design phase after the results of the geotechnical site investigations are available. In the event the steepness of the slope is not suitable then stabilisation techniques may have to be employed to minimise any further land take requirements. Where space is especially tight, vertical sides have been shown which will require a retaining structure.

The line of the canal must negotiate various existing features along its proposed route. Due to the length and limited manoeuvrability of canal boats the radii of canal bends must be carefully considered. Following discussions with British Waterways and the LHCRT it has been agreed that bends on canals should not have a radius of less than 40m, and that it would be beneficial to widen the canal at bends to aid navigation. The canal horizontal alignment has therefore been shown so as to ensure bends are not less than the specified 40m in radius.

3.2.2 Vertical Alignment

In designing the vertical alignment for the restored canal a minimum allowance of 1m has been adopted between the soffit of the bridges and the finished road level above. This allows for the depth of the structural slab, the thickness of road pavement and any variations in road level. This allowance will also provide sufficient depth to incorporate public utility services. The statutory undertaker's requirements should however be fully investigated at each location as large services may require a change in the proposed design at a particular site. Diversions of services could also have a significant effect on cost and programme.

3.2.3 New Structures

Numerous new structures are to be provided for the scheme. Although some standardisation of solutions is possible, each individual site's constraints must be considered in the scheme proposals. In particular, access and available construction/maintenance workspace needs to be carefully considered at the detailed design stage. Generally a standard 2.5m headroom will be provided at all structures to allow safe navigation beneath, with a draught of 1.5m in line with the rest of the canal network.

It is proposed that precast concrete culverts bridge units be used wherever possible. These would in general be larger than the most common precast concrete box culverts, but it is believed they will provide a feasible solution at bridges. They are a cost effective solution in

terms of initial capital and maintenance cost and better control of quality is possible. The culverts would generally have simple square ends, but at some constrained sites with heavily skewed crossings special skew-ended box units would be adopted.

Use of precast elements permits fast construction with disruption therefore minimised. They also permit staged construction, which may be necessary to suit traffic management arrangements. Cranes are required to lift the culverts into position and access and working space for a crane and delivery vehicles will be a key constraint in the detailed design phase.

Wingwalls would be constructed in insitu reinforced concrete. A featured finish is possible in less conspicuous locations, but brick cladding to give a more traditional look may be preferred.

Metal parapets provide adequate restraint for all of the structures proposed although more expensive solid parapets may be preferred from an aesthetic or safety viewpoint and again this can be reviewed at the detailed design phase.

We believe providing an aesthetic theme and consistency between the structures is important and careful selection of parapet type and facing materials would provide an attractive "signature" feature to the restoration project. However, this will be assessed on an individual basis depending on the bridge's intended purpose and its surrounding landscape.

Culverts can be founded on relatively weak soils but soft material would need to be removed and replaced with granular fill in these specific conditions.

3.3 Calf Heath to the Straight Mile

The entrance to the Hatherton Canal is at Hatherton Junction on the Staffordshire and Worcestershire Canal. This first section of canal is navigable including Calf Heath Bottom Lock although the towpath is not at present publicly accessible. The canal alignment then passes through Hatherton Marina and Boatyard to Calf Heath Top Lock. The lock has been modified in the past to facilitate the dry-docking of boats, by the removal of the southern wall and widening the lock to the south. The western headwall of the extended section of the dock is constructed from stop planks that allow boats to be dropped onto cradles and towed out of the dock to adjacent workshops.

The dry dock appears to be in reasonable condition, though some re-pointing works would be required to the walls and the lock gates would require refurbishment. However, as part of the proposed scheme it is likely to be necessary to remove this dry dock facility, so these works are unlikely to be required (see section 3.4 below).

Removing this lock would also remove the dry dock and it will be necessary to provide a replacement docking facility for the boatyard at an agreed location. Construction of a new dry dock is feasible and a sufficient area of unused land is available alongside, although a pumped drain-down system may be necessary to facilitate this. However, the present arrangement of driving cradles into the dry dock could not easily be replicated, and if this proved unsatisfactory to the owner then craning of boats may be an alternative option. The optimum method for re-establishment of the dry dock will need to be carefully considered during the next phase of work



The alignment follows the original line of the canal to where it crossed under the Straight Mile via the now demolished Dog Bridge. The canal is in water along this length, though in need of dredging and weed removal to enable navigation. However, it is proposed to lower the level of this section of canal by 1.3m in a cutting, which may require additional land to the north or retaining structures to maintain a normal width. There has been some encroachment onto the towpath by householders on this section, and this land will need to be reclaimed.

3.4 The Straight Mile

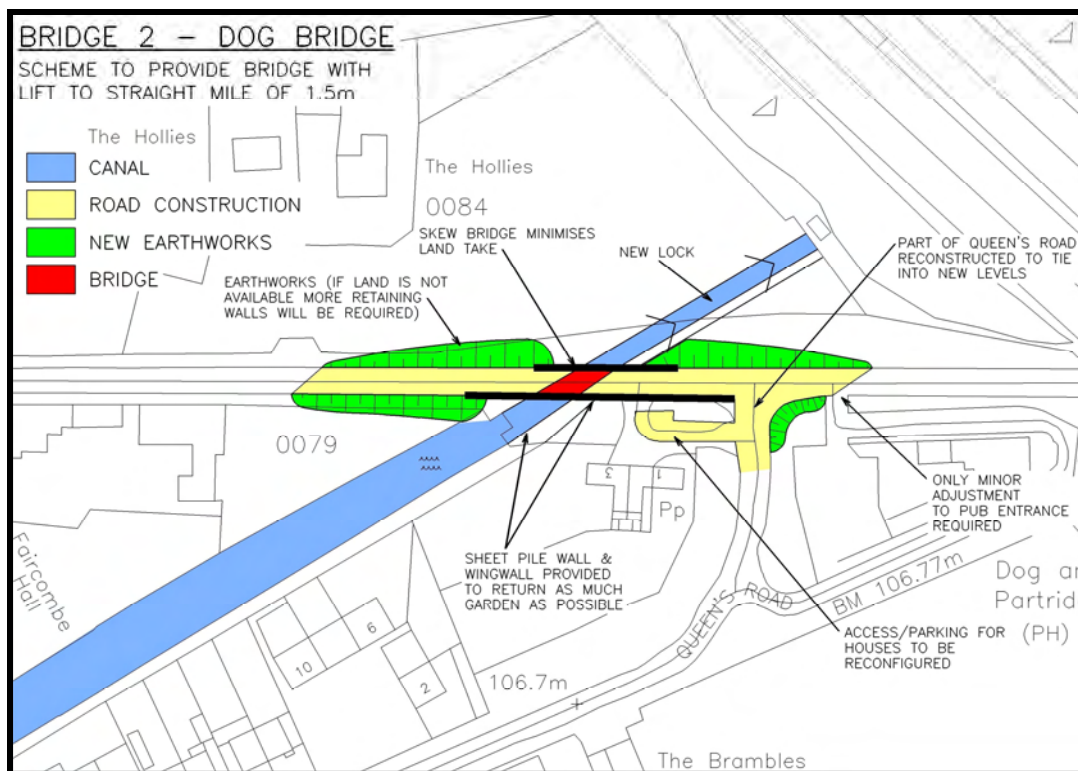
The Dog Bridge has been replaced by a series of pipe culverts, which cross under the Straight Mile and emerge the other side of the M6 motorway. In order to reopen the canal to navigation, a new bridge, which provides the necessary 2.5m clearance for boats to pass, will need to be constructed at this location. There are a number of formerly canal side properties very close to the site and the garden of the most westerly of these has spread on to the line of the canal.



The first option considered would maintain the water level of the canal close to that of the existing level and would require the road surface level of the Straight Mile to be raised by approximately 2.8m. However, this is not considered feasible because of the length and height of the approach embankments required, which would force considerable reconfiguring of the adjacent junctions and accesses as well as severe visual intrusion for the adjacent householders.

A lift bridge was also considered, but believed to be impractical as the Straight Mile road is heavily trafficked and the Highways Authority would object to this proposal. Lift Bridges are also considered undesirable due to issues which include: cost, reliability, safety and disruption to canal and road users.

The preferred option at this stage is to remove the dry dock (top lock) at the Hatherton Marina and maintain the water level of the canal until the Straight Mile has been passed.



The water level of the canal will then be returned to its existing level via a new lock 1.3 m deep before it passes under the M6 motorway. This means the Straight Mile needs to be raised only by 1.5m, and a feasible solution for maintaining the junctions and accesses can be achieved while minimising the visual intrusion. The solution is illustrated on the sketch above.

There is still a significant visual intrusion issue and negotiations with the local householders will be required. The length of the ramps is based on the assumption that a departure from the normal highway standards is granted to permit a 50kph design speed for this section of the Straight Mile.

A standard culvert solution could be adopted for the construction of this new bridge, however, due to the restricted space the culvert would have skew ends with extended wingwalls to retain the ramps.

During construction it is envisaged that traffic could be diverted via Queens Road. If this was not permitted an off line temporary diversion would be required which, despite the wide verges on the northern side of the Straight Mile, would probably require some temporary land acquisition.

3.5 The M6 Crossing

The M6 motorway is on a high embankment at the point where the canal is intended to cross beneath the motorway, between junctions 11 and 12. The canal has been culverted between the southern edge of the Straight Mile and the toe of the eastern embankment of the M6 motorway where the canal re-emerges in its original channel. The original Straight Mile road bridge has been removed and the canal, over a short length to the motorway, was culverted as part of the M6 motorway construction works. In order to re-open this part of the Hatherton Canal it will be necessary to reconstruct the Straight Mile Road Bridge and to form a tunnel under the motorway by the use of an appropriately sized jacked box construction. Work would commence with site clearance and the forming of a jacking pit in the existing edges of the motorway embankment to minimise the jacked length.

The jacking technique anticipated is a linear operation and so provided that the parcels of land on either side of the motorway are available then there should be sufficient workspace for this operation. Site accommodation may require the lease of some additional land temporarily.

The jacking operation would not require a closure of the M6 although a “real-time” monitoring regime and contingency plans would be required by the Highway Agency as Standard Practice. An investigation into the existing services and ground conditions will be required to develop this solution further and to ensure a robust design of the structure.

There are currently some proposals being considered by the Highways Agency and the Department for Transport for the widening of the M6 motorway in the vicinity of the proposed canal crossing. The Highways Agency has been consulted in order to determine what plans have been developed in relation to widening the M6, but they were not in a position at that time to comment on their proposals. They did however state that they were looking at a number of options which broadly range between:

- Parallel widening with the addition of a 4th lane in both directions on either side of the existing carriageways.
- A proposal for remodelling to provide for 4 lane dual carriageway, which may be carried out on one side or the other of the existing carriageways.
- A separate “Expressway” constructed along a parallel routeing corridor.

The HA were not at liberty at the time of our consultations to discuss in any detail the above options as these were to go before the Secretary of State for a decision and they felt there was little benefit to us to look at these options in the context of this present study. Besides, the HA’s proposals are very much in outline at this point in time.

The Secretary of State was to have made a decision in the summer of 2005, but recent enquiries with the HA show that this decision is as yet still awaited.

In our opinion there are a number of scenarios whereby some principles should be able to be established.

- If the Motorway has not been widened or indeed any of the parallel widening options or Expressway commenced before the Hatherton Canal is ready to commence on site or has been granted planning permission, then the establishment of a new tunnel crossing of the motorway as shown on drawing C-36-003 will be required, albeit with the recognition that any future M6 works will need to take into account the restored canal.
- If there are detailed proposals of the intended M6 widening/Expressway options available and planning permission has been granted in respect of the Hatherton Canal then the Highways Agency or PFI Contractor responsible for these works will be bound to make provision within their proposals for the canal crossing.
- In the event that the Hatherton canal has either not commenced or not been granted planning permission, and the M6 widening/Expressway proposals have reached a detailed design stage then, depending on the details of the scheme, it may involve the Trust in partial funding of the infrastructure necessary for the canal restoration to go ahead at sometime in the future.

The HA will need to progress their proposals to a point whereby they are able to usefully consult with the Trust on matters relating to the canal restoration proposals. Or in the event that the restoration moved ahead before the decision is taken by the HA on the future widening/Expressway options the trust will need to provide for the tunnelled-under crossing of the existing motorway as illustrated.

From the M6 the canal follows the original line of the canal through open fields to Oak Lane. The existing canal is in open water but requiring dredging and reinstatement of the towpath with appropriate bank protection.

3.6 Oak Lane Bridge

Oak Lane Bridge was originally a masonry arch bridge, which at some point was modified by the Highway Authority to incorporate a reinforced concrete slab deck in order to reduce the “hump” in Oak Lane. In general the bridge is in a satisfactory condition. There is some evidence of reinforcement corrosion in the deck, which, if it were to be retained, should be addressed to prevent further deterioration.

The result of the historic structural modification detailed above, is that there is currently insufficient clearance beneath the bridge to allow canal navigation. Two options to reinstate navigation beneath the bridge were considered: -



Option 1

The deck could be reconstructed 1.3m higher retaining the existing abutments. To achieve this the abutments would need to be modified and there is a risk that this may not be possible without extensive works being carried out. An assessment would be required to verify the adequacy of the abutments in the modified form. Alternatively the new deck could be supported on piles behind the existing abutments. Precast concrete planks would form a suitable deck for the new bridge. Metal parapets are appropriate for this location although more elaborate and therefore expensive solid parapets may be preferred from an aesthetic viewpoint. It may be more cost effective however to remove the existing structure entirely and replace it with a new precast culvert. A cost comparison should be carried out during a more detailed design stage to assess these options.

Approach ramps would need to be constructed on Oak Lane. We would envisage that departures from current highway standards would be permitted to allow the crest curve to be designed for a speed of 50kph, which means that the ramps would be approximately 50m long. The ramp to the south of the bridge would improve the existing alignment but would interfere with the access to the front of a nearby cottage. This could be resolved by provision of a retaining wall to maintain the flat hard standing in front of the cottage or preferably realignment of the road away from the cottage.

It may be possible to close Oak Lane during construction although the potential diversion route is quite long. If this was not permitted land would need to be leased and a temporary crossing of the canal constructed to allow a side road diversion.

Option 2

As Oak Lane is only lightly trafficked a lift bridge might be acceptable. This could utilise the existing abutments or the road level could be further lowered to remove the remaining

hump. However, any possible construction cost savings would have to be balanced against higher maintenance costs and inconvenience to canal and road users

A third option of lowering the canal alignment beneath the existing bridge structure was also considered but was discounted due to the engineering and environmental complexities.

Option 1 is the preferred option at this stage. The canal alignment then continues along the original line to Saredon Mill Bridge. The towpath on this section has been badly eroded and bank protection is required to permit its reinstatement to normal width.

3.7 Saredon Mill Bridge

Saredon Mill Bridge is a masonry arch and provides sufficient headroom for canal navigation under it. In recent years some work has been done to this bridge by LHCRT to repair the parapets. Arches are inherently robust structures, which continue to work adequately despite deterioration. This bridge exhibits some deterioration and neglect although the defects observed are not a serious concern. Provided that the bridge is not being modified and the usage (foot traffic only) is not being changed we do not believe an assessment is essential at this stage.

Some cracking was observed and we would recommend installing tell-tales, which can simply and cheaply confirm that differential movement is not occurring. If the cracking is stable repair work will not be essential.



We recommend that consideration should be given to carrying out further repair and refurbishment to address the following.

- Further re-pointing of the existing brickwork (particularly to make sure bricks will not fall on users once the canal is opened).
- Repair of cracks in the arch barrel
- Address water leakage through the barrel.

The alignment continues easterly through open fields to Cross Bridge.

3.8 Cross Bridge

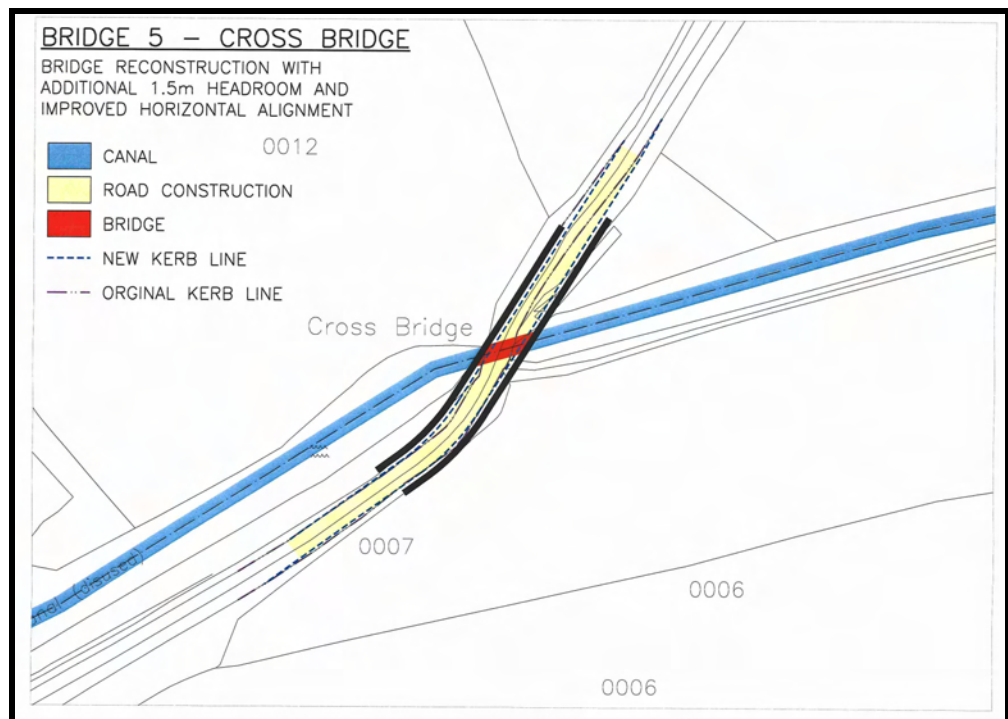
Similar to Oak Lane Bridge, Cross Bridge was a masonry arch bridge, which at some point was heavily modified to incorporate a reinforced concrete slab deck to reduce the vertical alignment of the road. In general the bridge is in a satisfactory condition. There is some evidence of reinforcement corrosion in the deck, which, if it were to be retained, should be addressed to prevent further deterioration.

At Cross Bridge the deck would need to be raised to achieve navigation clearance below. It is not considered feasible to lower the canal water level here due to the considerable length of canal at this level. It is more cost effective and environmentally preferable to maintain the canal water level and lift the road by 1.5m to reinstate the headroom beneath.



Cross Bridge is however on a poor horizontal alignment and a vertical crest curve. We believe that numerous road traffic accidents have occurred at the bridge in the past and there is evidence of several repairs to the structure. For this reason we would not expect to be permitted departures from highway standards, which further reduce the standard of the alignment. Introduction of traffic calming measures may be possible to mitigate these problems and further consultation with the local highway authority is required.

We recommend at this stage that it is assumed that this bridge would need to be rebuilt incorporating an improved horizontal alignment as shown below.



Again, precast concrete box culverts are proposed as the most appropriate construction method for the new bridge. This is in keeping with the proposals for new bridges throughout and the benefits of these are discussed in section 3.2.3. The extent of the wing walls depends on the land available to accommodate embankment slopes. We propose that these would be in reinforced concrete. A featured finish is recommended or brick cladding if a more traditional look is preferred. A similar finish should be adopted for all of the new structures thus introducing a Hatherton Canal theme to identify the restoration project.

Metal parapets are appropriate for this location although more expensive solid parapets may be preferred from an aesthetic viewpoint. Again adopting a consistent theme between the new structures is considered important.

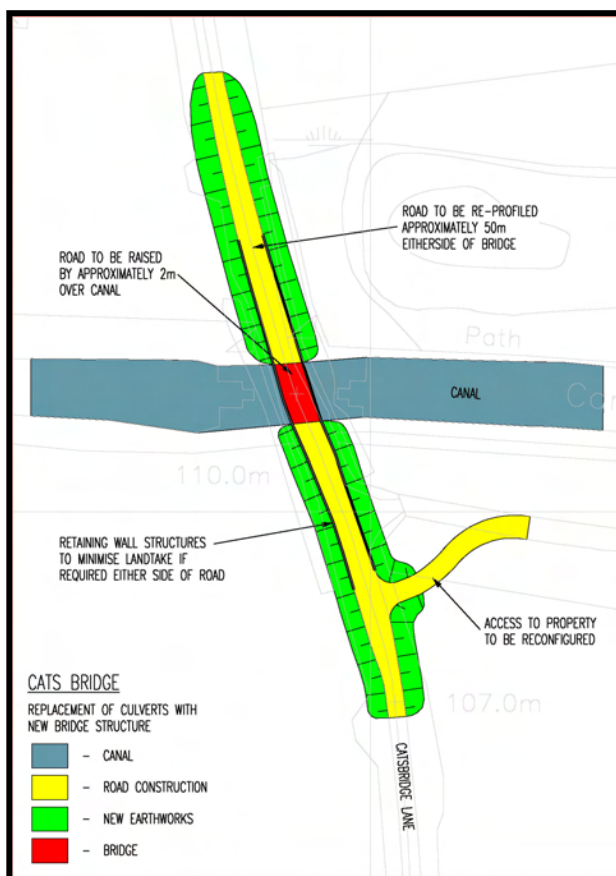
During reconstruction works we believe that it would be necessary to divert the road off line and provide a temporary bridge. This could be a simple structure comprising a series of pipe culverts with fill over the top. Temporary land acquisition is likely to be necessary. Alternatively, the new bridge could be built off line if this improves the final road alignment, thereby avoiding any temporary bridge works.

From Cross Bridge the canal continues eastwards along the original line to Cats Bridge. From a point about half way between these bridges, the canal channel to the east has been narrowed by tipping colliery spoil along both banks to counteract mining subsidence. The channel will need some re-widening with provision of bank protection and towpath reinstatement.

3.9 Cats Bridge

The canal crossing at Cats Bridge is currently by a series of small pipe culverts, the existing masonry arched bridge having been substantially removed. In order to reopen the canal a new bridge would need to be constructed and the road raised by approximately 2.1m. This is a quiet rural road and we would envisage a departure from HA standards will be granted to permit fairly steep approach embankments. Nevertheless these will extend for approximately 50m either side of the bridge. These embankments would interfere with several private accesses but with cooperation from the landowners these issues should be resolved fairly easily.

The structure would again be the standard box culvert with earth embankments or, if additional land width can not be acquired, reinforced concrete wingwalls parallel to the road could be constructed.



The road is a quiet rural lane and we would anticipate that permission to close the road for the duration of the construction would be possible. This means that construction could be carried out quickly and efficiently. The road could be used to provide the necessary working area and site accommodation.

From this point the canal channel narrows due to prolific reed growth, and continues eastwards to Meadow Lock. Bank protection will be required to reinstate a full channel and towpath width along this length



3.10 Meadow Lock

Meadow Lock was always a relatively shallow structure and appears to be of a standard brick construction, with large copingstones along the top edge of the lock. The lock is now in a poor state of repair with both lock gates removed. The upper sill is acting like a weir and the level of water upstream is reduced. The structural integrity of the lock is difficult to assess without a detailed survey being undertaken, however the brickwork that can be seen is generally in a poor state. It is reasonable to assume that the brickwork culverts for the lock are also in a poor condition and could even have collapsed. It is evident that it has suffered from mining subsidence in the past although this should now have stopped.

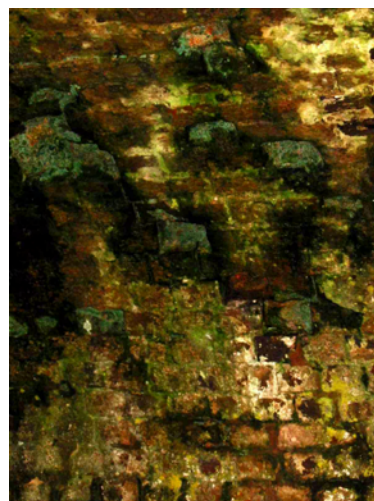
A detailed survey of the lock would be required to determine if it is structurally viable to restore. This study shall assume that the lock can be substantially rebuilt, as these structures were historically well built. The lock will be 1.7m deep.

The main water supply for the canal enters just below the lock via a weir from Saredon Brook.

The canal continues eastwards as a dry channel with a central watercourse at reduced level to just beyond Bridge 8 behind the Roman Way Hotel, thereafter it has been completely in-filled and the line lost.

3.11 Bridge 8 (Roman Way Hotel)

Bridge 8 behind the Roman Way Hotel is a masonry arch, which like Saredon Mill Bridge, has been subjected to some refurbishment work by the LHCRT in recent years, including the addition of a towpath access ramp. The bridge is in a reasonable condition and the extent of deterioration is not considered serious. Provided that the bridge is not being modified and the usage (footpath traffic only) is not being changed we do not believe an assessment is essential at this stage. We would recommend a closer examination of the structure and installation of tell-tales on some areas of cracking which were observed. If the cracking is stable, repair is not considered to be essential.



We recommend that consideration should be given to carrying out further repair and refurbishment to address the following.

- Further re-pointing of the existing brickwork (particularly to make sure bricks will not fall on users once the canal is opened).
- Repair of cracks in the arch barrel.
- Address water leakage through the barrel.

3.12 Wedges Mills and Wolverhampton Road (A4601)

Approximately 190m past Bridge 8 at the Roman Way Hotel, the canal has been infilled and warehouse units and a small car lot now occupy the line. Following discussions between the LHCRT and landowners of the warehouse units, a 12m strip has been provisionally reserved as part of the protected planned alignment for the line of the canal. The canal is envisaged to be circa 6m wide with a 2m towpath, depending on available width and adjacent foundations. The canal will be in the order of 5 to 6 metres below existing ground level at this section, and therefore, a vertical retaining wall will need to be provided to both the canal bank and the cutting walls to minimise the amount of width required for the overall width of the canal to pass this location. Some details of the buildings' foundations have been obtained and the effect of this cutting adjacent to them will need to be reviewed at a more detailed design stage.



The car lot that occupies the line of the canal will need to be purchased. After the alignment passes through the car lot the canal crosses beneath the Wolverhampton Road, A4601 and a large diameter water main pipe bridge. The main issue in constructing a new bridge at this location is maintaining access for road traffic during construction. The local retailers would need to be reassured to make certain that traffic disruption, which interferes with their business, is minimised. Fortunately the road is wide and we believe that traffic and

pedestrians could be diverted onto a temporary alignment on one side of the carriageway while the first phase of the bridge was constructed. The space appears to be marginally too narrow to permit construction to be carried out in two halves although a more detailed study is required to verify this. At this stage we assume that three phases would be required to construct the bridge. Temporary sheet piles would need to be installed parallel to the road prior to excavation.

The bridge itself would be of standard precast concrete culvert units with reinforced concrete wingwalls. No significant change in horizontal or vertical alignment of the road would be required.

3.13 Wedges Mills to Severn Trent Water Lagoons

The canal locks up through a 2.6m lock immediately after crossing the Wolverhampton Road and then passes through an area that is occupied by an office, warehouse and electricity sub station. It is believed that the canal could possibly negotiate the narrow gap adjacent to the Adini House office block if it is locally narrowed, but this will be dependant on the foundations of the building, which will need to be fully assessed at a later stage. Directly opposite the building an electrical sub station also exists and this structure will need relocating further away from the canal alignment.

Directly behind the office block there is a warehouse unit that will need to be at least partially demolished to allow the canal to pass, further room along this length could be achieved by re-engineering the slope of the embankment leading down from the industrial units (Halfords and Focus DIY) to the north of the alignment.



The canal continues eastwards along its original line to where it meets the Wyrley Brook, which was diverted into the canal in the past to make room for the now disused Severn Trent Water Treatment Lagoons (known as the 'Grass Plots') that are located to the south.

3.14 Severn Trent Water (STW) Lagoons

It is intended that the canal reclaims its original line where it runs parallel to the disused STW lagoons. As the Environment Agency have indicated that combined channels for the canal and the brook are not acceptable, it will be necessary to divert the Wyrley Brook to the south through the now disused STW lagoon site. From previous experience of Environment Agency requirements, the diverted channel will also require to have a meandering course with soft natural edges.

Currently along this length there are two pipe crossings, at Joveys lock, an outfall from the Cannock Sewage Treatment Works and at the eastern end of the lagoon site the Golly Brook outfalls into the Wyrley Brook.



STW have advised that the most eastern pipe crossing is redundant, so this could possibly be removed, though this would need to be agreed with STW. The other pipe crossing consists of a sludge transfer main from Cannock STW to Four Ashes STW. These will need modifying in an agreed manner to allow for navigation beneath.

The outfall from the Sewage Treatment Works will need to cross the canal possibly via a siphon, to allow direct discharge into the Wyrley Brook. This is because the Environment Agency has concerns that effluent discharges from this outfall would significantly reduce the water quality within the canal if discharged directly into it. It is anticipated that Severn Trent Water would echo these concerns as the Environment Agency would probably impose greater restrictions on their discharge consent if this was to happen.

The Environment Agency have advised that they do not support the concept of watercourses flowing through canals due to water quality issues during base flow conditions, this is discussed further in the water quality section of this report, refer to section 9.0. Therefore an alternative means will need to be considered to enable the Ridings Brook to cross the canal route, and this could be in the form of a carefully designed inverted siphon.

To enable easier under-crossing of the canal by the sewage treatment works outfall and the Ridings Brook, the canal should be maintained at as high a level as possible until these features have been passed. It is therefore proposed that the canal is raised via a lock 2.7m deep, located in a similar position to that of the former Joveys Lock.



Joveys Lock appears to be of a standard brick construction. The brickwork appears to be in a poor state of repair and as a minimum would require repointing and rebuilding. Again as with the previous existing lock, the gates have been removed. A detailed survey of the lock would be required to determine if it is at the correct level or structurally viable to be used as part of the restored canal.

3.15 Severn Trent Water Lagoons to Walkmill Lane Bridge

At the end of the STW lagoons the original canal line continues in an easterly direction to the first of the Bridgtown Locks, however beyond this the line is now heavily redeveloped and the restored canal must therefore follow a new alignment following the line of the Wyrley Brook. The available land at this location is restricted by an industrial estate to the north and the Walkmill Clay Pit SSSI to the south.

As the Wyrley Brook runs within an engineered channel in this section it is proposed to take the line of the brook for the canal and provide a new more natural alignment for the brook between the canal and the SSSI. Clearly, this encroachment into the SSSI will need to be fully assessed and further consultation with English Nature held at the next design stage to agree the details of this.

3.16 Walkmill Lane Bridge

The canal then passes beneath Walkmill Lane via a new culvert constructed alongside the existing culvert that will be retained and used solely for the brook. Walkmill Lane goes over the M6 Toll via a newly constructed bridge. The road was diverted and kept open during the construction of the M6 Toll. We therefore assume that closure of the road to construct the canal bridge would not be permitted. The level difference between the road and canal is quite large at this location and excavation from road level would be a difficult undertaking. We do not believe it would be possible without diverting the road and this would require a temporary bridge to be constructed over the M6 Toll. We therefore recommend that this structure would need to be a box jacked culvert as proposed for the M6 crossing and the same structural form and construction technique would be adopted.

Use of some land currently leased by Midland Expressway Limited (MEL) would be required during the construction operation.



3.17 Walkmill Lane Bridge to the M6 Toll Crossing

The alignment between Walkmill Lane Bridge and the culvert crossing of the M6 Toll is again through an engineered channel, constructed as part of the M6 Toll accommodation works. With the Environment Agency's requirement for separate channels for the canal and Wyrley Brook, a splitter wall will be required to be constructed down the length of this channel, including the M6 Toll Culvert 144. A detailed Hydraulic analysis will need to be carried out to prove the culvert is large enough for both water bodies to pass through at the required storm return event. If it is found that additional capacity is required to accommodate these a thrust bored flood relief culvert can be constructed parallel to the existing Culvert 144.

A number of surface water outfalls exist along this length and these could potentially be used as an additional water supply to the canal depending on their individual water qualities and consistency of flow rate.



3.18 M6 Toll to the Walsall to Rugeley Railway Line

Between the M6 Toll and the Walsall to Rugeley railway line the new canal will run parallel to the Wyrley Brook. To create sufficient space for this the slope of the existing embankment will need to be modified and steepened somewhat.



A new lock approximately 2.2m deep will be located immediately after the motorway crossing. By locating the lock here it should be possible to divert an existing surface water outfall, which runs under the M6 Toll, under the canal.

3.19 Walsall to Rugeley Railway Line Crossing

At the location of the proposed crossing the railway is on a high embankment. There is a 4 pipe culvert for the Washbrook, which was installed using jacking techniques as part of the M6 Toll accommodation works. We believe that the canal under crossing structure could be similarly jacked and would utilise the same construction technique as proposed for the M6 crossing.

The fact that the brook culverts were jacked successfully gives confidence that the ground conditions are satisfactory and that adequate workspace is available. Network Rail Technical Approval will be required, which is a reasonably lengthy process. Monitoring of the rail tracks would be required and contingency plans developed before this work would be permitted.

3.20 Walsall - Rugeley Railway Line to the David Suchet Tunnel

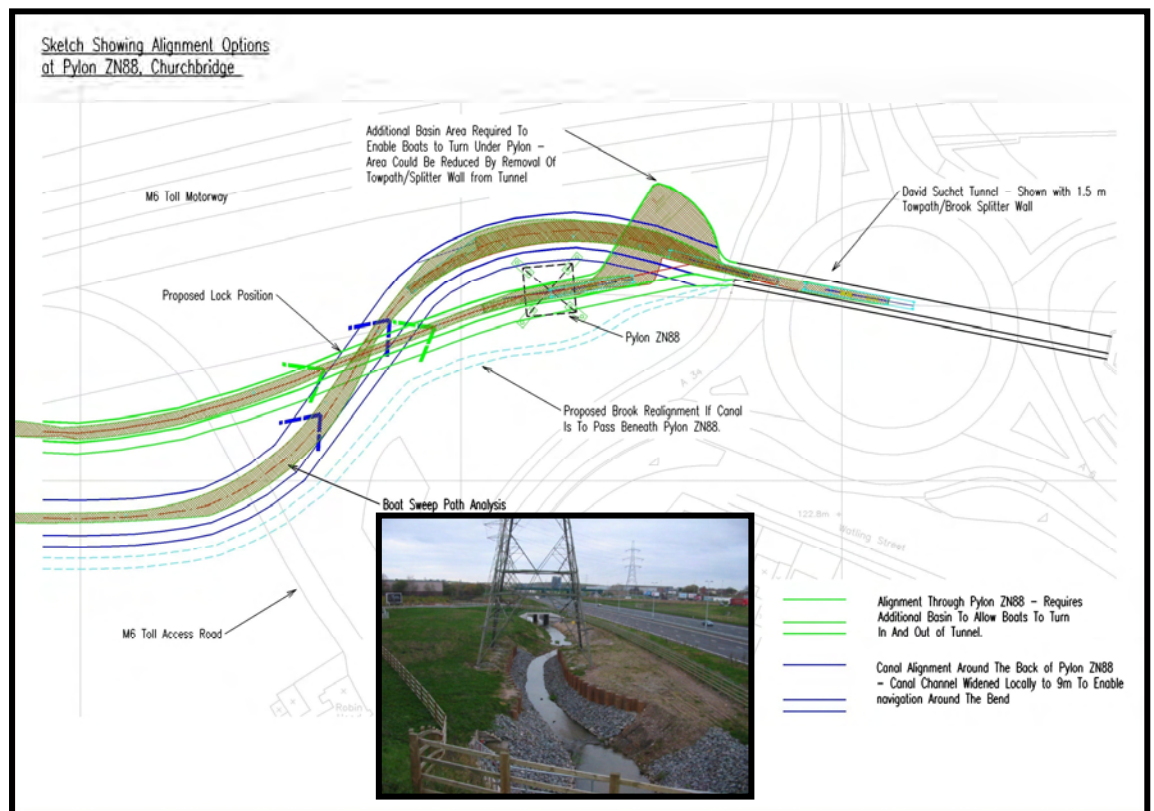
This section is very complex due to the number of obstructions that lie within it, and a definitive solution is difficult to determine without more detailed survey information. The constraints consist of:

- The David Suchet Tunnel.
- Two electricity pylons (ZN88 and ZN88A) beneath which a sheet piled channel for the Washbrook has been provided.

- Emergency Access road for the M6 Toll.

Two options have been considered. The first option (shown in green below) considered was to pass the canal beneath the pylon tower ZN88 using the pre-constructed piled channel. The section of canal between the two pylons would need to be deviated to enable a new culvert under the emergency access road to be constructed further away from the M6 Toll where adequate headroom could be provided without having to make the gradient of the emergency access road unacceptably steep for emergency services vehicles.

However, due to the proximity and poor alignment of pylon ZN88 to the entrance to the David Suchet tunnel, the radii of the canal would be very tight, making navigation extremely difficult, which is further exacerbated by the Environment Agency's wish for the canal and the brook to have separate channels. Navigation between the David Suchet tunnel and Pylon ZN88 can be made easier by the construction of a basin at the entrance of the tunnel. It can be seen below that to generate sufficient space for this manoeuvre to be completed, the basin will need to encroach into land currently within the M6 Toll motorway strip and purchase of this land will need to be negotiated with Midland Expressway Limited. The size of the basin shown could be reduced however if the full width of the tunnel could be utilised i.e. the towpath/splitter wall were removed from within the tunnel and the full width given over to the canal.



The second option (shown in blue) is to divert the canal around the pylon towards the M6 toll road, so as to increase the radii of the canal entering/leaving the tunnel. Navigation can be further aided by increasing the channel width along this section to 9.0m. This solution also requires the canal to be swung towards the M6 toll road and some land will be required from the existing motorway strip.

3.21 David Suchet Tunnel – Culvert 155

It is intended that both the canal and the Wash Brook would use the Suchet tunnel to pass under the roundabout complex at Churchbridge. The Environment Agency's requirement for fluvial and canal waters to be kept separate during normal flow conditions will mean that a splitter wall will be required within the tunnel to keep the two water courses separated. As with Culvert 144, detailed hydraulic analysis will need to be carried out to demonstrate that the culvert is hydraulically adequate for both the brook and the canal to pass through during flood events. In the event that additional capacity is required then a thrust bored flood relief culvert could be constructed parallel to the existing culvert/tunnel.

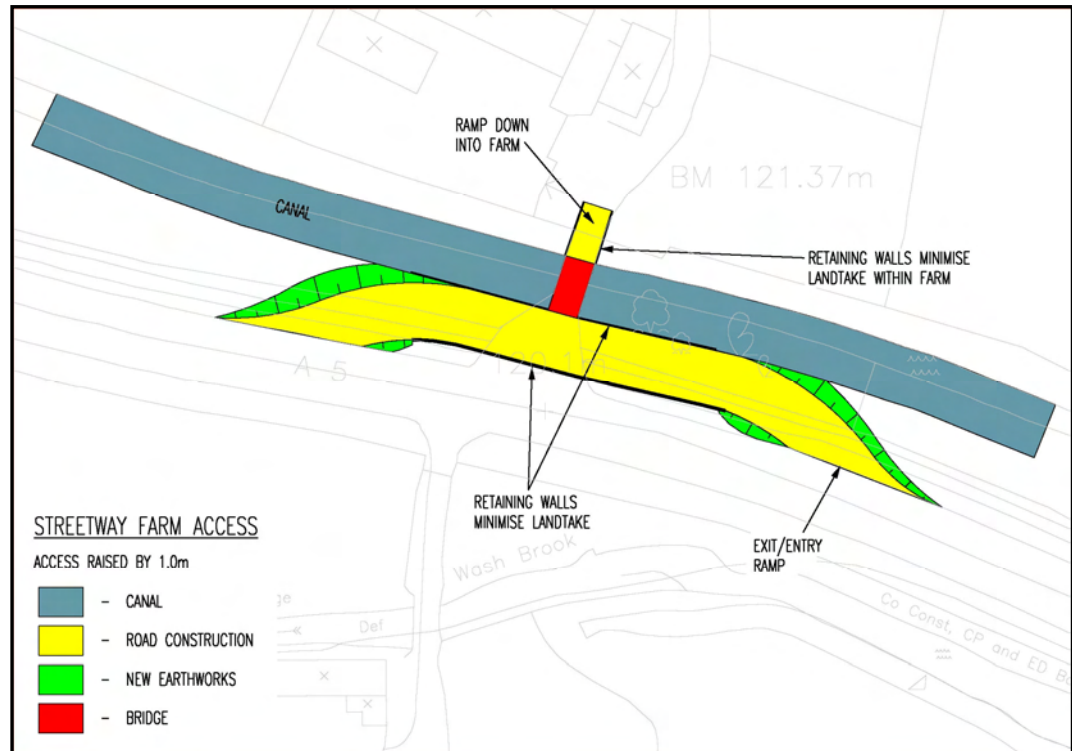


The canal then continues eastwards on the line of a flood relief channel, which runs parallel to the A5 passing Streetway Farm until it intersects the Wash Brook at its crossing with the A5.

3.22 Streetway Farm

The main access to Streetway Farm is directly off the A5 Trunk Road. The access bridge to the farm is considered to be too low for navigation beneath and a new bridge will therefore be needed to raise the access in order to provide the required headroom beneath. The former farm buildings are currently used as a rendering yard, requiring access for small lorries although the landowner envisages some form of future redevelopment. A number of options have been considered here and they are discussed below: -

- Raise the bridge by approximately 1.0m to provide a clearance of 2.5m beneath for the canal to pass. The access to the farm is directly off the A5, and to raise the access bridge will require entry and exit slips to comply with highway standards. To accommodate these slip roads it is thought that some additional land take will be required from the farm. It is unlikely any deviations from the Highway Standards would be allowed for this junction due to the volume of traffic that uses this road and its current Trunk Road status.



Limited space at this site also causes difficulty for construction and some extra land will be needed during the construction period, and possibly some partial lane closure of the A5. This is the preferred option and is illustrated above.

- Provide a new access to the farm where more room is available i.e. west of the Wash Brook. Slip roads would still be required for this option and additional land would be needed and retaining walls could be avoided if the canal channel is deviated slightly to the north
- Divert the canal around to the north of the farm, through land that is currently owned by the County Council. The land slopes relatively steeply upwards away from the A5 here and therefore this route would require the canal to be taken through a cutting some 8-10m deep. A bridge would still be required across the cutting to provide access and carry a public footpath that crosses the route.
- Purchase the farm in its entirety and remove the need for an access altogether.

After passing the farm the canal is raised via a 2.1m deep lock before it reaches the Wash Brook crossing.

3.23 Wash Brook – A5 Crossing.

A crossing of the Wash Brook is unavoidable at this point and the water levels and adjacent road crossings preclude the canal passing either over or under the brook. The simplest method would be an 'at-grade' crossing (sometimes referred to as a "level-crossing") with the brook flowing across a widened canal course and discharging over a long-crested weir that would maintain the canal level and allow the flows to re-enter the brook course. The adjacent lock would allow for some variation in level but in extreme flood events the canal would act as a flood relief channel, with navigation having to be temporarily suspended.

Both the Environment Agency and British Waterways have reservations about watercourses flowing through canals, for different reasons, and detailed proposals will need to be developed to address issues such as water quality, cross current velocities and siltation. To facilitate a "level crossing" of the canal at the Wash Brook, the canal level would need to

respect the normal water level of the brook and hydraulic modelling of this arrangement would be needed at the detail design stage to demonstrate that this.

If the above crossing solution cannot be achieved a carefully designed inverted siphon arrangement will need to be employed. It would then be advantageous for the canal to pass over the brook at as high a level as possible, although this is limited by the surface level of the A5 at its proposed crossing point.



From here the canal continues eastwards parallel to the A5 along the toe of the earthwork embankment of the M6 Toll road until it crosses the A5 near Norton Lane. This section includes an access track to a balancing pond which may need to be relocated when a more detailed design proposal is prepared.

3.24 A5 Crossing

The A5 is a wide, busy trunk road and constructing a culvert for the canal to pass beneath it will be a fairly major undertaking. The road has extra width at the proposed crossing location due to the provision of an acceleration lane to Norton Lane. As the canal crosses at a skew angle of approximately 45° , this means that the culvert would be approaching some 50m in length.

It is extremely unlikely that a closure of the A5 would be permitted during construction although restricting traffic to one lane in each direction may be possible. Using the width of the road (including a large central reserve) it is anticipated that a temporary traffic management scheme that maintains two narrow lanes in each direction would be possible with the culvert built in two halves using conventional cut and cover methods. A more detailed study with some additional field survey is required to verify this. If two phases were not possible three phases would be required as described for the A4601 crossing in Section 3.12.



The culvert and wingwall construction would be similar to that described previously.

The traffic management scheme should be designed to provide sufficient working space although some additional land take may be required for site accommodation during construction.

3.25 A5 Crossing to Gains Lane

Between the crossing of the A5 and where the canal crosses Gains Lane the canal passes through open fields and past the site of the abandoned Wyrley No. 3 Colliery. Along this length the canal rises over 3 locks with depths of approximately 2.1 to 2.2m.

In this length the LHCRT has already purchased land for the canal alignment. As part of this agreement the Trust has agreed to provide two permanent farm access bridges over the canal, with sufficient capacity for one for a 7.5 tonne vehicle the other for a 20 tonne loading suitable for a combine harvester. As these will be positioned adjacent to locks they will only need to cater for a fairly narrow canal channel crossing.

These accesses could be provided across the canal using the standard culvert solution, and a right of access for construction work has already been agreed via a farm track as part of the Trusts land purchase agreement. If access for delivery of precast units proves difficult or too costly a similar structure can be built in insitu reinforced concrete although this will need to be considered at the detailed design stage.

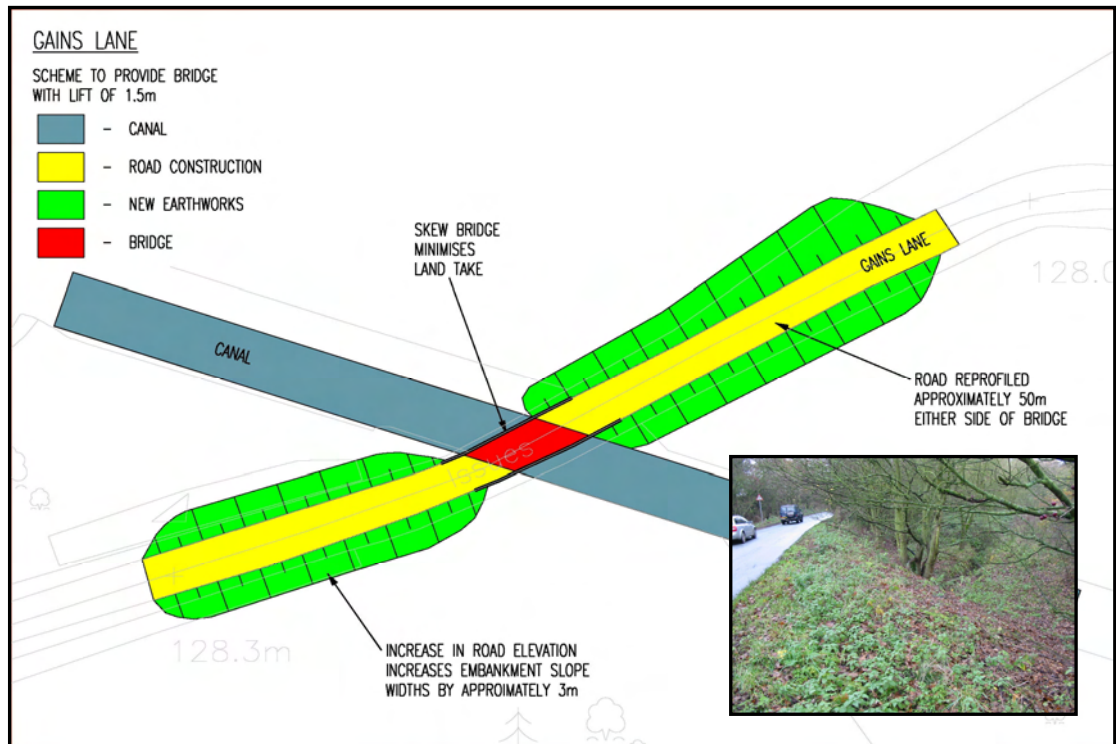
At approximately chainage 8+100 the canal passes the site of the former Wyrley No.3 Colliery, and quite close to the location of the abandoned mine shafts which we understand have now been capped off with concrete slabs. From here the canal enters a cutting of some 400m in length and potentially up to 8m deep at its deepest location. This then passes through a heavily wooded area which appears to be made up from colliery spoil from the former refuse tip which is located nearby. There is therefore the potential that the material excavated from this cutting will be contaminated and require special disposal. This will be better identified at the detail design stage when a more accurate assessment of the ground conditions and topography are available.

A colliery tramway historically ran between the Wyrley Colliery and the Cannock Extension Canal and the proposed new canal route follows this line from where it exits the cutting. At approximately 60m before Gains Lane the canal crosses the Wash Brook where it is proposed that the canal will cross over the top of the brook at this location. The brook already passes through a culvert where the old tramway used to cross it, however the culvert will need to be replaced to allow the canal to pass over the top of it and it will also require to be hydraulically modelled to demonstrate that it does not restrict the flow of the Wash Brook in any way.

3.26 Gains Lane Crossing

A new bridge will need to be constructed where the new canal passes beneath Gains Lane. To achieve navigation headroom the road will need to be raised by approximately 1.5m. This is despite the fact that the bridge is already on an embankment as this was the location of a bridge over the disused colliery tramway along which the proposed canal would follow at this location.

We believe achieving the raised alignment would be feasible albeit with departures from standard permitted. Care would be needed to design an alignment that ties back into the original without affecting the junction with Gorse Lane to the east and the bridge over Wash Brook to the west. The additional height would push out the toes of the embankment by approximately 3m at the highest point. If this extends outside the highway boundary, agreement from the adjacent landowner would be required. If this is not forthcoming, retaining walls parallel to the road would need to be constructed.



A standard culvert section could again be utilised as at previous similar bridges, the key issue at this site is how to divert the road during construction works. The road is quite frequently used and there is no short and simple diversion route available. Without more detailed considerations and further consultation with the Highway Authorities it should be assumed that the road would need to remain open and a diversion would therefore be required. Unfortunately the area is quite heavily wooded and several trees would need to be cleared. The amount of clearance and earthworks required could be minimised by building the bridge in two halves and controlled with traffic signals to provide for single lane operations.

The canal then continues substantially along or adjacent to the route of the former colliery tramway, at approximate chainage 8+960m the canal locks up 1.7m to reduce the depth of the cutting along this section but still maintaining the required headroom sufficiently enough to pass beneath Wyrley Lane.

3.27 Wyrley Lane Crossing

At Wyrley Lane the proposed canal continues to follow the route of the disused tramway where it crosses beneath Wyrley Lane and branches into two arms before the junction with Gorse Lane. Clearances appear to be adequate and road levels would not need to be raised which is fortunate as the road already has quite a severe hump, which impairs visibility.



The position of the crossing is at the point where the two lanes meet which means that the road width and therefore length of the culvert would be greater than the normal road width. This would however assist in the construction of the culvert as one arm of the junction could be closed and half of the structure built with the closed section of road serving as site accommodation and access. The second half of the structure could be built by switching to a closure of the other arm of the junction.

It is more efficient to have clear access to the site and if a full closure is not permitted the temporary lease of adjacent farmland would allow a simple temporary off line diversion of the road. If the road was closed during construction the diversion route required at this location is not as long as at other sites so the Highways Authority may be willing to accept a full road closure.

Whichever construction option is adopted in the detailed design a standard culvert solution is considered appropriate.

From Wyrley Lane the canal continues along the route of the former tramway rising steadily to the level of the Cannock Extension Canal over 6 locks, all of approximately 2.5m in depth although there may be some variations to this when full topographical and geotechnical details are available.

Some 200m prior to crossing the access road to the adjacent landfill the new canal passes the site of the former Grove Colliery. The canal, however, follows the line of an existing cutting at this location, to avoid passing directly through the Grove Colliery site and pit mound, which appears to contain a fairly extensive system of land drainage.

3.28 Landfill Access Road Bridge

Approximately 40m before it joins the Cannock Extension Canal the new canal passes beneath the access road to the adjacent landfill site.



Negotiation will be required with the owners to permit access to the site and to ensure that their operations are not unduly disrupted when more detailed proposals are available. Never

the less we anticipate that there is likely to be some flexibility in the exact location of the bridge and access could therefore be maintained throughout the construction period.

With the cooperation of the owners of the site the construction of this bridge should not pose too many difficulties. Here again a standard precast concrete culvert structure could be used.

3.29 Connection into Cannock Extension Canal

It is proposed to connect the new Hatherton Canal to the Cannock Extension Canal via the southernmost of the two existing mooring basins owned by Little Wyrley Estates. The basins are currently used for moorings, including residential; 4 boats were moored in the northern arm and 3 boats in the southern arm at the time of visiting in November 2004.

No information regarding the basin arm construction could be obtained, and therefore the following section is based upon information from Ordnance Survey maps and discussions with boat owners on the moorings.

Both basins are approximately 90 metres long, with the northern arm being approximately 7 metres wide and the southern arm being 12 metres wide. The depth of the basins is unknown, although these are likely to be deeper than a traditional canal due to earlier mining subsidence. However, as both have been extensively used for haulage in the past and now for mooring it is anticipated that depth will not be a problem for future navigation. From discussions with one of the boat owners at the moorings, it is thought that the southern basin arm is the deepest. From inspection of the top of the banks, it is thought the basins are constructed from brick with a concrete capping beam along the top.

Due to the fact that a bridge structure would be needed in order to gain access to the southern basin of the canal if it was connected to the northern arm, and that the southern basin is wider and thought to be deeper, it has been proposed that the southern arm is most appropriate connection point for the new Hatherton canal.



Currently, boats are moored down one side of the basin only, as access is restricted on the south side. As mentioned previously, the width of the basin is approximately 12 metres, which allows a minimum 6 metre navigation channel on the south side of the basin for the canal to pass, leaving a clear 6 metre strip for boats to be moored along the northern edge as is currently the practice. The number of moorings along the length of the basin would ideally be restricted to three so as to provide sufficient clearance at the mouth of the basin to allow easy navigation of boats onto the new canal. Other effects of the proposed canal on these moorings, would be the introduction of boat traffic passing by thereby creating possible security and noise issues. The effect of the proposals on the SAC and in particular the disturbance of the Floating Water Plantain in this area is discussed within section 12.

A new connection using a bridge will be needed between the new Hatherton Canal towpath and the existing Cannock Extension Canal towpath on its far side. A former railway bridge

narrows just south of the Grove Colliery basins would be a suitable location for such a footbridge, although we understand that there are current proposals to extend the life of the landfill site envisage providing a new road access at this point. From here a path along the south side of the southern basin would connect with the towpath on the north side of the new canal at the Landfill Access Road Bridge which, even if it ceases to be the main landfill access, is likely to still be needed for a road access within the site.

3.30 Moorings and Marinas

Moorings can be either 'on line' or 'off line' features. On line moorings are moorings located on the canal itself and can be located on either the towpath or off the side of the canal. Off line moorings are generally located within lay-by areas or purpose made marinas.

Moorings should, as a minimum, provide a safe and secure location for boats to be berthed, however they could also include facilities such as water and electric supplies, refuse and elsan disposal points, fuel and car parking etc.

The on line moorings on the Hatherton Canal are likely to be short term moorings only, to allow boat users to stop at places of interest along the route, or stop overnight.

The canal may need to be widened locally to facilitate mooring locations, and the banks will need to have vertical sides to enable easy boarding. Mooring rings will be provided typically at 6m to 10m centres to enable boats to be secured while stopped.

Moorings along the canal will be located at desirable positions along the route that may be in quiet rural areas, or areas that provide easy access to local amenities. However, the locations will be such so as to not cause any problems to the normal operation of the canal, for example by being located at least 30m away from a bridge or lock structure, and away from lock flights to discourage users stopping mid flight to avoid water supply problems. Although greater considerations will need to be given in the detailed design stage the locations where moorings may be suitable are: -

- Derelict land alongside the canal at Cats Bridge.
- Land behind the Roman Way Hotel, in conjunction with a canal related development.
- Moorings may be considered as part of the redevelopment of the Churchbridge area.
- The Grove Colliery site is already zoned for leisure and recreation uses which could include improvements and extension of the present moorings at Grove Basins, and a few moorings could be included in any future redevelopment of the Wyrley No. 3 Colliery site.
- Farm diversification opportunities could provide significant rural mooring opportunities at Norton Hall Farm.

Exact positions of moorings will however be determined with consultation with British Waterways, and other affected third parties.

The existing marinas at Hatherton Junction and Calf Heath may not be expanded but will benefit from the new route due to increased passing trade. There is also a current proposal for a marina above Meadow Lock, with road access from the A5. Additionally, the former settlement lagoons at Wedges Mills could host a large marina if potential contamination and access problems could be overcome.

Marinas generate significant boat movement and therefore need to be located as far away from any locks as possible to avoid the draining of upstream pound water supplies. A key consideration in the locating of marinas is water supply. Marinas obviously require a large amount of water to fill them initially, and then an available supply to mitigate the losses of water from them due to infiltration etc. This water supply may be from the canal itself, but

the canal's ability to supply the marinas would need to be thoroughly assessed when more detail is available on the canal's water supply. Clearly a marina which had access to a suitable water supply would have a distinct advantage over one that drew its supply off the canal.

As with the moorings, any marina proposals will be developed with consultation with British Waterways, and other affected third parties.

4 GEOTECHNICAL ISSUES

4.1 Introduction

A desk study has been undertaken of the Hatherton Canal restoration project, based on information from the following sources:

- 1) Available Geological Maps and Memoirs held by the British Geological Survey. (NB most of the route corridor falls with the Lichfield Sheet for which there is not an up to date memoir).
- 2) An Envirocheck Report as supplied by Landmark Information Group, specifically commissioned for the desk study.
- 3) A Coal Authority Mining Report.
- 4) Information from the M6 toll site investigations and Geotechnical Interpretative Report (Arup 2004).
- 5) A site visit and walkover carried out on the 23rd November 2004.

4.2 Site History

The history of the route of the Hatherton Canal restoration project is summarised below. This is based mainly on the old maps reproduced in the Envirocheck report referenced in section 4.1 above.

The line of the existing canal as far as the end of the STW lagoons (SJ 97298 08649) crosses agricultural land, which changed little between the time of the first edition Ordnance Survey map dated 1889, until the 1954 survey.

Between 1954 and 1968, poorly drained areas appear adjacent to the canal east of Cats Bridge, and just to the east of the A4601, as a result of mining subsidence, see section 4.5 below. In addition an iron foundry with an associated area of made ground appears between 1954 and 1968. The canal was abandoned in 1955, but this designation is not shown on the Ordnance Survey maps until 1972, by which time the alignment crossing the A4601 has been lost and partly built over.

From 1968 onwards, the A4601 corridor and much of the land to the east of the A4601 and north of the canal is affected by industrial development, which is partly replaced by retail premises by 2000. By 1972 the line of the canal east of the A4601 is replaced by a drain. However to the west of the A4601 the line of the disused canal remains essentially intact, although between 1968 and 1972 the poorly drained areas adjacent to the canal become more extensive. Some of these poorly drained areas have either been drained or infilled in recent years, and were not clearly evident adjacent to the Cats Bridge in a brief site visit conducted on the 23rd November 2004.

The proposed new line from the end of the STW lagoons (SJ 97298 08649) to where it crosses the A5 (SJ 99815 07832), follows the line of the Wyrley Brook. Records indicate that even by the first edition Ordnance Survey map, this section was being impacted by human activities. To the west of Walkmill Bridge there were brick and tile works across the valley bottom adjacent to the brook course, supplied by numerous small clay pits. To the

east of the Walsall to Rugeley railway, the proposed new line is just south of the Wyrley Brook for a short distance, and crosses a large industrial area, referenced in 1889 and 1903 as 'Edge Tool Manufactory'.

The brick and tile works progressively expanded during the early 20th century, reaching maximum extent by 1968/1972, when there were many flooded clay pits adjacent to the proposed new line. Subsequently the clay pits have been infilled and built over by industrial units. A large clay pit to the south of the proposed new line remains as a flooded depression. However, a flooded depression close to the western end of the proposed new line, still present on the 2000 Ordnance Survey map, has been infilled in the last few years, and the site visit on the 23rd November indicated that the filled area was being used for car sales.

Between the Walkmill Bridge and the railway, a sewage works is shown on the 1921 Ordnance Survey map. The filter beds are shown on all subsequent Ordnance Survey maps except the most recent (2000), suggesting recent demolition and reclamation, however some of the filter beds disappear between 1968 and 1975 suggesting that the works became disused in the early 1970s. The main event to impact this section, is the embankment construction to accommodate railway sidings serving the adjacent Old Coppice/Hawkins Colliery during the 1950s and 1960s. The railway sidings were removed in the late 1960s on the abandonment of the colliery, but made ground embankments remained. This area remained undeveloped until the late 1990s when the Walkmill Business Park was established.

The industrial area east of the railway is present up until the 1982 Ordnance Survey map. However, by 1985 part of the area had been demolished, but some premises remain.

The area from Walkmill Lane through to Churchbridge has been extensively altered in the last few years by construction of the M6 Toll motorway.

The proposed new line from the A5 crossing (SJ 99815 07832) to the Cannock Extension Canal (SK 01997 06022), is entirely agricultural land on the first edition Ordnance Survey map in 1887, except for the east end of the section where the Wyrley Grove Colliery was operational adjacent to the Cannock Extension Canal. By the time of the 1903 Ordnance survey map the Brownhills/Wyrley Colliery No 3 Pit had opened to the west of the Grove pit, within the valley of the Wash Brook, and was connected to the Cannock Extension Canal by a tramway. Both colliery areas expanded progressively until abandonment in the late 1960s.

Subsequent to abandonment, some of the colliery buildings were retained for industrial use, and the visit on the 23rd November 2004 indicates that this continues to the present in a low key way at both sites. Also at both the Grove and the Brownhills/Wyrley No. 3 Colliery sites some land filling has occurred. This is evident from the visit on the 23rd November 2004, and references in the Envirocheck report. During the 1980s, colliery spoil was removed from the mounds associated with both collieries to infill the West Midland Limestone mines. A significant volume of the Grove mound was removed,

The area between the Grove and the Wyrley No. 3 colliery remains in agricultural use to the present, as confirmed by the visit on the 23rd November 2004. However the land along the base of the Wash Brook Valley from the former Wyrley No. 3 colliery to the A5, was affected by land filling in the late 1960s. Information from the Coal Authority records the disposal of mine spoil from the Littleton Colliery. This infilled a large subsidence flash to the south of the A5 which formed in the 1960s as a result of mining from the adjacent collieries. The visit on the 23rd November 2004 indicated that some of this land has been restored to agriculture, but the land south of the A5 remains rough grassland.

4.3 Geology

A schematic geological section is included in the Hatherton Canal Scheme Drawings (Drg. No. C-36-017).

The solid geology of most of the line of the Hatherton Canal restoration project comprises Coal Measures Strata belonging to the South Staffordshire Coalfield. However, the western end of the existing canal, as far as the Bushbury Fault, located to the east of Saredon Bridge (SJ 94770 08950), is underlain by the Triassic Sherwood Sandstone, which forms part of the Stafford Basin.

The strata beneath the Bushbury Fault and a fault 100m east of the Wolverhampton Road (SJ 96800 08940), beneath the existing Canal, is dislocated by several faults in a zone that comprises the western boundary of the South Staffordshire Coalfield. From a location 500m to the west of the Wolverhampton Road (SJ 96270 09040) to 100m east of the Wolverhampton Road (SJ 96800 08940) the Sherwood Sandstone is downfaulted in a deep basin over 200m thick, while further to the west thin Sherwood Sandstone overlies the Upper Coal Measures Keele Formation.

To the east of the fault 100m east of the Wolverhampton Road, the Upper Coal Measures Etruria Formation underlies the existing canal and the proposed new line just south of Wyrley Brook park (SJ 97584 08234), where a further fault (The Mitre Fault), up faults Middle (productive) Coal Measures to the surface or sub drift outcrop.

Middle Coal Measures strata underlies the rest of the proposed new line of the Canal from the Mitre Fault, to the junction with the Cannock Extension. However this strata is also dislocated by several faults.

The solid geology beneath the existing canal and the proposed new line, as far as the Mitre fault, is overlain by thin and discontinuous glacial drift deposits, except probably for the section between SJ 95270 09040 located half way between Cats Bridge and Cross Bridge and a point 100m East of the Wolverhampton Road (SJ 96800 08940). Here a continuation of a glacial channel extending from the south, approximately on the line of the faulted Sherwood Sandstone basin, is probably present. Both glacial tills and fluvio-glacial deposits are present, whilst in the glacial channel, glaciolacustrine deposits are likely to be present

To the east of Wyrley Brook Park the glacial drift deposits overlying the Coal Measures strata, forms a continuous layer. In places the glacial drift deposits are very thick infilling a glacial channel eroded into the Coal Measures strata. The proposed new line of the canal crosses this channel where the line of the M6 Toll road crosses the new line at Churchbridge, and also south of the A5 in the Wash Brook valley. Glacial tills and fluvio-glacial deposits are present, with glaciolacustrine deposits within the channels. Information from the M6 toll boreholes and data held by the British Geological Survey indicates that fluvio-glacial gravel forms a continuous layer for some lateral distance within the channel deposits. This layer of gravel is water bearing, and forms a local supply of water see section 4.4 below.

4.4 Groundwater and Hydrology

Groundwater along the line of the Hatherton Canal restoration project is generally high reflecting the valley bottoms and adjacent brook courses traversed by much of the alignment. High groundwater also affects the valley side of the Wash Brook close to the Gains Lane.

The South Staffordshire and East Shropshire Groundwater Vulnerability map shows the line of the existing canal crossing a Major Aquifer 100m east of the Wolverhampton Road (SJ 96800 08940) reflecting the Sherwood Sandstone strata present. At the western end the vulnerability class is 'H2' but much is within a 'low' vulnerability class reflecting the drift

cover. The faulted inliers of Upper Coal Measures strata are classified as a minor aquifer with low vulnerability. The land traversed by the proposed new line is almost entirely classified as a minor aquifer with 'HU' vulnerability class, reflecting the past and present 'Urban' land use. However, some areas of a minor aquifer with 'low' vulnerability occur between the Wyrley No3 and Grove Collieries.

A review of the Geology and the borehole data from the BGS indicates that much of the proposed new line south of the A5, is underlain by a minor aquifer within a glacial channel. This aquifer within a gravel layer results in Artesian conditions being reported in boreholes sunk in the Wash Brook valley. This groundwater source probably diffusely supplies the Wash Brook, and may supply the inflow to the tramway cutting on the eastern valley side of the Wash Brook, noted on the 23rd November.

Groundwater within the Sherwood Sandstone aquifer will be present to the west of the Wolverhampton Road (SJ 96800 08940), and may diffusely supply the Saredon Brook, particularly where a deep down faulted basin of Sherwood Sandstone occurs.

4.5 Mining

The line of the Hatherton Canal restoration project crosses the South Staffordshire Coalfield, and has been significantly affected by past coal extraction, both underground and surface (opencast) extraction, refer to Coal Authority Mining report. Mining has now ceased with the abandonment of all the adjacent collieries.

The Coal Authority mining report identifies several mineshafts in the general vicinity of the alignment of the canal restoration line. However, one of the mineshafts at the Grove Colliery is very close to the proposed alignment. It was filled and capped by the National Coal Board in 1967 (reference 401306-002).

The effect of the past mining in the Churchbridge area was one of the factors which lead to the abandonment of the canal in the 1950s. However, it is noted that deep mining from the Mid Cannock Colliery and possibly the Littleton Colliery has affected the valley of the Saredon Brook adjacent to Cats Bridge. The valley has lost its westward fall in this area, leading to the formation of the subsidence flashes and poorly drained areas noted on Ordnance Survey maps from the 1960s and 1970s. This effect also increases the vulnerability to flooding of the Saredon/Wyrley Brook to the east.

Due to the thickness of drift cover, mining in the area of the South Staffordshire Coalfield adjacent to the proposed line commenced in the mid 19th century and continued until the 1960s. There is no indication therefore that any part of the project is affected by earlier ancient shallow mine workings and hence the likelihood of unrecorded mine entries is very low (none were encountered by the construction of the adjacent M6 Toll).

Part of the proposed new line has been affected by past opencast excavation for the Brooch and Bottom Robins Coal (Streetway Site). This specifically affects the section from the railway at Churchbridge to where the proposed new canal will pass beneath the A5. Extensive opencast excavation in this area, subsequent to the abandonment of the canal, has obliterated the old line, requiring the proposed construction of the new line on a different alignment.

4.6 Potentially Contaminated Ground

Due to past uses there are several areas crossed by the proposed new alignment that may be affected by contaminated land. The major areas are listed below:

- 1) Grove Colliery, tipping associated with past and ongoing low level industrial activity.

- 2) Tipping associated with the Brownhills/Wyrley No. 3 colliery, past and ongoing industrial activity (including Landmark Entry).
- 3) The industrial area at Churchbridge east of the Railway.
- 4) The area between the Railway and Walkmill lane bridge affected by filling and railway sidings associated with the Hawkins Colliery (n.b. this area was also considered in the construction of the M6 Toll).
- 5) The material used to fill the clay pits between the beginning of the new line and Walkmill Lane bridge.

4.7 Engineering Considerations

4.7.1 Anticipated Ground Conditions

The existing line of the Hatherton Canal, as far as the STW lagoons (SJ 97298 08650) is underlain by glacial deposits, and possibly local alluvial deposits associated with the Saredon/Wyrley Brook. Groundwater levels are expected to be high due to the adjacent Saredon Brook. Some made ground is locally present immediately adjacent, where mining subsidence flashes have been infilled. Apart from the potentially high groundwater, there are not expected to be any significant geotechnical issues associated with any reconstruction work on this section.

The proposed new line from the STW lagoons (SJ 97298 08650) to the A5 crossing (SJ 99815 07832) closely follows the line of the existing Wyrley Brook. The ground conditions are likely to be dominated by made ground from a variety of sources reflecting the industrial history of the area (infilled clay pits, infilled opencast excavations, colliery sidings and industrial premises). This together with high groundwater from the adjacent brook would make ground conditions for any construction locally poor or very poor. The made ground is also potentially contaminated.

The proposed new line from the A5 crossing (SJ 99815 07832) to the site of the former Brownhills/Wyrley No 3 Colliery, crosses land or is immediately adjacent to land, that has been filled with colliery spoil. Some of the made ground may be locally soft with high groundwater, and there may be contamination issues with the material.

The proposed new line crosses an area of made ground associated with the Brownhills/Wyrley No. 3 Colliery. A section of about 350m of the proposed canal is affected by this area. The Landmark database indicates that part of this area was used to dispose of household waste in the past. The visit on the 23rd November 2004 indicated much of the land has been restored and vegetated, and did not clearly identify the area of household refuse, but local tipping of farm waste was continuing. The made ground is potentially contaminated.

The land between the Brownhills/Wyrley No.3 Colliery and the Grove Colliery crosses agricultural land underlain by glacial drift deposits. High groundwater within the glacial drift deposits is likely, but apart from this there should not be any significant geotechnical issues with the construction of the canal and associated locks across this land.

The area of the Grove Colliery forms a zone of made ground which the canal will require to be cut through for about 200m. Due to the past (and present) use of the Grove Colliery site some of the made ground is potentially contaminated.

4.7.2 Mining

As noted in section 4.5 above, the line of the Hatherton Canal restoration project is not affected by shallow mining, and the effects of past deep mining are now thought to have ceased, though this should be confirmed via geotechnical site investigation. However, in places the landscape shows the effects of past subsidence, particularly along the valley

bottoms traversed by the existing and proposed new line, resulting in areas of poor drainage and possibly increased vulnerability to flooding.

The Coal Authority Mining report indicates that reserves of coal exist in the locality of the Hatherton Canal restoration project, which could be worked at some time in the future subject to feasibility licences and planning consents. However, in the present economic climate, this possibility is considered very remote.

4.8 Canal Lining Requirements

Based on the anticipated ground conditions and the natural ground water levels, some sections of the proposed new alignment may not require lining, as outlined below: -

Section	Anticipated Ground Conditions	Anticipated Ground Water Level	Remarks
Adjacent to the Wyrley Brook – SJ 97298 08649 to SJ 99815 07832	Made Ground Overlying alluvial clays and gravels	High	Lining probably not required, where alluvial clays are present.
Wash Brook Valley – SJ 99815 07832 to SK 00174 06593	Colliery Spoil Made Ground Overlying Glacial Deposits (mainly Sands)	High – supplied by groundwater within a glacial channel	Lining may be required in sandy glacial deposits despite high groundwater associated with the glacial channel, as the level of the groundwater within this cannot be guaranteed.
Line of Former Tramway	Glacial Deposits (mainly sandy)	Generally High	Lining may be required where sandy glacial deposits are present.

The Environment Agency have indicated that they would expect the canal to be lined along its entire length to ensure separation of the canal and groundwater, though if canal water is obtained by groundwater abstraction from glacial deposits (see Chapter 8) then there should be no water quality issues. The lining method employed will have to allow for the possible affects of any future settlement. Traditionally canals are lined with puddle clay, however modern lining techniques include butyl liners and bentonite mats. Factors to consider when evaluating the different types of linings include cost, availability of materials, labour requirements, durability and ease of repair.

4.8.1 Puddle Clay

Puddled clay is the traditional material for lining canals and other artificial waterways, as well as for repairing leaks in earth dams, and sealing joints between concrete and earth banks.

To puddle simply means to pound clay and water together in a dense mass, which resists water penetration. Puddling of the clay is undertaken using a mechanical roller. Canal linings are generally between 300mm and a 1m thick.

Advantages of puddle clay include: -

- A puddled clay lining may be very cheap if suitable clay is available nearby. This can be sourced from local developers, haulage contractors, plant hire or skip hire operators, as suitable clay may be available as a waste material from local development schemes.
- No special equipment or tools are necessary, other than those needed to transport and compact the clay.
- A successfully puddled clay bottom is virtually immune to leaks, decay and vandalism, provided it is made sufficiently thick, and is not allowed to dry out.
- Leaks in puddled clay linings can be traced and repaired relatively easily, provided the water level can be lowered temporarily.
- It is a traditional lining technique, proven by years of experience.

The disadvantages of using puddle clay are: -

- If a local supply is not available, purchase and transport costs may make puddle clay expensive.
- Spreading the clay is heavy work and will need to be done mechanically where possible. Puddling must be meticulous to be successful and the lining must be prevented from drying out while it is being constructed.
- Puddled clay is liable to crack if the water level falls and exposes the lining for any extensive period. When the level rises again, the clay is no longer watertight.

4.8.2 Flexible Liners

Flexible liners such as butyl rubber can be used to line canals. Butyl rubber is relatively durable, and suppliers can guarantee a life of up to 35 years. The liner would need to be of a heavy grade, typically 1mm thick or greater, and would normally be installed by specialist contractors.

Advantages of flexible liners include: -

- Flexible linings conform to minor undulations and will not fail if the underlying soil settles or cracks.
- Flexible linings are widely available commercially, and are easy to transport and store.

Disadvantages of flexible liners include: -

- All flexible linings are vulnerable to accidental or malicious damage. Butyl liners are fairly puncture resistant, but are easily cut with a knife. Maintenance is difficult, as mechanical dredging can damage the lining.
- Larger areas require on-site joining of the sheets, and this will need to be done by specialist contractors.
- Problems can occur under the liner. Strong growing weeds such as couch can push up through the liner, and rats and other small animals may burrow through and hole a liner. A geotextile layer beneath the liner would help prevent this.

4.8.3 Bentonite Mats

Bentonite mats are a synthetic lining material consisting of a layer of 'Bentonite' - a special type of clay - sandwiched between two layers of synthetic fabric. Bentonite is a very fine powder of clay particles which swells in contact with water to become a waterproof clay. The bentonite mats are then protected by being covered by clay, gravels or concrete. However, where the canal bottom interfaces with the walls this system is generally reinforced using puddle clay.

The advantages of bentonite linings include: -

- Self-sealing if punctured, as the mat swells to fill the gap
- Greatly reduced transportation costs compared to that of puddle clay if imported
- Resistant to freeze/thaw and desiccation/re-wetting
- Good slope stability characteristics
- Good differential settlement characteristics
- Mats can be easily joined together
- Successfully used on the Rochdale and Dudley canals

The disadvantages of bentonite linings are: -

- The mats are heavy to handle and mechanical systems are required to lay it.
- The mats need to be carefully stored to ensure they do not swell prematurely in adverse weather.

4.8.4 Preferred Solution

The preferred solution based on the above options would be either the puddle clay liner or the bentonite mattress because these two systems are the most durable and least likely to cause a long term maintenance problem. The decision on whether to use puddle clay or bentonite will probably come down to the local availability of puddle clay, as excessive transportation of the required amount of puddle clay would make this an expensive option.

Whichever option is chosen, the lining will need to be prevented from floating when the canal is drained as the high water table will provide an uplift on the canal lining system.

5 LOCK CONSTRUCTION

5.1 General arrangement

In the construction of the new locks along the canal, a number of generic features will be required, common to all lock structures. These features are required for both operation and the safety of the canal users.

The canal lock dimensions are dependent on the largest vessel to be using the canal (22m long by 2.2m wide by 1.1m draught). The dimensions will be consistent throughout all of the locks and will be equivalent to that of a standard narrow lock, at 26.3m in length and 2.3m in width. Depths will vary between 1.3m and 2.7m depending on location, however where locks are located on a flight of locks, the lock depths shall be as uniform as possible to minimise water use within the canal.

For operation, mooring bollards will be required on the approach to either end of the lock. The lock will require gates at either end. These may be manufactured from either a durable hardwood or a composite steel and hardwood construction. The later option provides greater strength and consistency of operation. Fender structures are typically found on the entry into either end of the lock to provide long-term protection to the canal bank in these areas, which are frequently impacted.

A recessed galvanised steel ladder is required in all lock chambers to allow access on and off boats and also a means of escape for any person who may be trapped within the lock.

5.2 Construction Issues

The following issues will need to be considered in the design of the locks regardless of the construction method adopted.

The high water tables found throughout the site will affect the stability of the locks. When at low level there will be a danger of floatation of the structure and overturning from the adjacent water pressure. The water table will also result in leakage through the lock wall into the canal, which must be prevented.

Future mine subsidence in the area can have a major impact on the longevity of a lock structure. Any underlying subsidence may distort the lock, either making it inoperable, or creating leakage problems as well as possible structural failure. It is however thought that subsidence in the area has now stopped.

The surrounding ground is in some locations colliery spoil. This material has low bearing strength and is sensitive to changes in moisture content. There is also a risk of contamination within this material that must be resolved with thorough site investigation.

Standardised lock construction and style throughout the length of the canal should be maintained if possible, but aesthetics will be assessed on an individual basis depending on the lock location and its surrounding landscape. The local vernacular and the normal midlands narrow canal construction is brick, either red or blue engineering bricks, and a brick facing to all the visible parts of the new structures will help integrate them with the canal tradition and the local environment.

Site access is extremely limited at a number of locations along the canal, which will restrict equipment and material selections.

5.3 Methods of Construction

The following methods of construction have been considered for lock structures.

5.3.1 Reinforced block work

Brick or stone block work is a traditional technique for lock construction. Due to the lock depths of over 4m, a reinforced structure will be required, to avoid excessive wall thickness. There are a number of reinforced options, but all consist of steel reinforcement running vertically and horizontally within the core of the brickwork, providing tensile reinforcement that is absent from standard brickwork.

Advantages

No major plant required and block units can be handled manually;

Block offers a hardwearing, durable attractive finish that will require no further finishing;

Flexible construction, allowing minor changes in detail within each lock to suit local issues;

With the correct choice of mortar a degree of flexibility can be provided in the structure;

Local repairs to future damage possible with minimal works;

Offers traditional canal appearance.

Disadvantages

Extremely slow and labour intensive construction process;

Not fully water tight requiring additional grout or clay surround;

Storage required on site for materials;

Given the environment, careful selection of brick type is required for durability, which can become expensive. Also, reinforcement can rust, leading to surface staining;

Consistency in supply required for constant finish.

5.3.2 Reinforced Concrete

The depths of over 4m involved preclude the use of simple mass concrete, as this become uneconomic at this depth. At these depths, simple cantilever gravity structures are adequate. This consists of cast in situ concrete structures, with steel reinforcement. Detailed consideration of stability, sliding and overturning will be required in the design of the walls. The grade of concrete used will also need to be considered carefully due to the harsh environment that it will be exposed to.

Advantages

One design for all locks can be developed allowing the reuse of formwork throughout the scheme;

Rapid and well-tried method of construction;

Providing a suitable grade of concrete is chosen, a watertight durable structure will be created;

It is possible to specify a variety of surface finishes.

Disadvantages

Does not produce a flexible structure and will require movement joints to be used;

Requires access for large vehicles for material delivery;

Require expensive specialised shuttering.

5.3.3 Sheet Piles

The most common technique used for retaining structures, involving the insertion of interlocking corrugated steel sheets into the ground to create a retaining structure. For the depths involved in this project, simple cantilever piles could be used (geology permitting) without additional anchorages points.

Advantages

Simple tried and tested solution with reliable results;

Relatively cheap solution with a low labour requirement;

Easy installation in expected ground conditions, but unsuitable for stiff or boulder filled materials.

Disadvantages

Will require cladding or other surface finish to provide an attractive surface, which leads to durability issues;

Limited life span in this immersed environment due to loss of thickness over time with corrosion;

Installation requires large, heavy equipment that requires good access;

Installation procedure creates extensive noise and vibration that could stimulate renewed subsidence;

Not completely impermeable, and would require additional grouting or clay surround.

5.3.4 Pre-cast Units

Standard precast reinforced concrete segments are manufactured off site to exact dimensions. These are transported to site and lowered onto a concrete base in the excavation. The units will be modular to allow adaptability within the scheme for different depths.

Advantages

Exact dimensions can be specified due to off-site quality control;

Thinner wall construction is available due to the greater control over quality off site, reducing excavation requirements;

Most of the new locks can be made to one of two standard sizes (2.5m or 2.2m depth) and therefore have interchangeable equipment;

On site installation is very rapid and low in labour;

Mass produced identical modular units will be efficient in price;

A suitable interlocking design will create a watertight structure without need for additional clay or grout surround.

Disadvantages

This procedure requires excellent access for craneage and segment delivery;

A good footing will be required adjacent to the locks for the crane positioning;

Lock size is limited by the size of segments that can be delivered.

5.4 Recommendations

The nature of the proposed design does not result in there being any great time restriction on the method chosen for the lock structure, and therefore speed of installation is not considered at this stage to be a critical factor. The major issue with a large proportion of the proposed route is ease of access to the work areas, and sufficient space available at these locations for plant and materials.

To maximise efficiency in the design and construction, one solution should be adopted throughout the scheme. If access issues can be resolved at all locations, it is recommended that a precast option be adopted. This option will allow accurate and repetitive construction throughout, of a very high quality. Excavation can be minimised on site without need for extensive buried structures or waterproofing surround.

Should access restriction not be resolved at individual sites, then it is recommended that reinforced block work be adopted for these lock structures. The block work option provides an excellent finish, and requires minimal plant or storage on site. However this is a labour intensive, slow and expensive procedure.

6 MULTI-USE TOWPATHS

6.1 Towpath Standards.

The canal system and its towpaths are enjoyed by wide range of people, including boaters, walkers, cyclists and anglers, as well as providing a useful route for people to commute to work. It is for this reason that the towpath and its access should be designed to allow easy and convenient use for all its users, including the disabled. To assist in the design and refurbishment of new and existing towpaths and associated accesses a number of design guides have been produced, the main guides being: -

- British Waterways, Design Manual Volume 3 – Landscape (1999)
- The National Cycle Network, Guidelines and Practical details, Sustrans, Issue 2, 1997
- Countryside for All, Fieldfare Trust, 2nd Edition.

6.2 Towpath and Access Considerations

To meet the requirements of The Disability Discrimination Act 1995 and to maximise the use of the towpath, the towpath should be designed for the combined use of pedestrians, wheelchairs and cyclists. Both the Sustrans and British Waterway's guides suggest that the minimum towpath width for combined use is 2.0 metres. Where this width cannot be achieved the towpath could be narrowed to a minimum width of 1.2 metres. Where narrower towpaths are required then signs should be provided to encourage cyclists to dismount. To ensure anglers do not obstruct the progress of people using the towpath, a grass verge should be provided between the canal edge and the towpath.

To encourage cyclists and wheelchair users to use the towpaths, accesses should be of a ramped form and not steps, where space allows. The design guides give guidance on ramp widths, gradient and the provision of passing places. However, generally a ramp should not be steeper than 1 in 12, with landings provided at a minimum of every 0.75 metre rise in height.

6.3 Towpath Route

The surrounding developments and the available land take restricts the alignment of the canal, and in some locations along the alignment there may be insufficient room to fit the desirable 3 metre width corridor for a multi-use towpath. At locations along the alignment where the full width towpath cannot be fitted, cyclists should be encouraged to dismount and angling discouraged by the provision of signs. The locations where a full multiuse towpath may not be fitted alongside the canal are detailed in the table below. In all other locations, except for under bridge structures etc., it is expected the full towpath width could be used.

Chainage	Location Description	Comment
0+320 to 0+620	Hatherton Marina to the Straight Mile	The canal alignment runs parallel to the back of gardens of adjacent properties along this length, some of which have encroached on the towpath. The canal level may also need to be lowered in cutting. If the original towpath can not be fully recovered or if additional land is not available to the north it may be necessary to reduce the towpath width along this length
3+280 to 3+600	Wedges Mills Industrial Estates	This section of the canal alignment passes through a heavily developed area and close by industrial and office units. It may be necessary to reduce the towpath along this length to help minimise the effects of any excavation on adjacent building foundations. Some building demolition will also be required in this area.
4+300 to 4+680	Area adjacent to Walkmill Clay Pit SSSI	This section of the canal alignment follows the line of the existing Wyrley Brook. The brook is to be moved onto a new line closer to the Clay Pit. To minimise the encroachment into the SSSI at this location a narrow towpath should be considered.
4+680 to 5+000	M6 Toll Tunnel	If future detailed hydraulic modelling indicates a need for a full height dividing wall within the tunnel

Chainage	Location Description	Comment
		to separate the canal and Wyrley Brook channels, then inclusion of a towpath will not be possible. A footpath connection can be provided from the towpath at Walkmill Lane to the motorway bridge and from there using the footpath alongside Hatherton Reservoir to reconnect with the towpath at the south end of the tunnel. This connection may be provided in any case as an alternative 'open air' route for walkers and cyclists
5+800 to 5+850	Churchbridge, adjacent to the David Suchet Tunnel	The canal is forced towards the M6 toll road at this location to avoid a pylon located close to the exit from the David Suchet tunnel. To help navigation around this twisty section of canal the navigable channel width has been increased. To minimise the amount of land take in this area the towpath could be narrowed. This would have little effect in this area, as the towpath would narrow to pass beneath the tunnel anyway.

6.4 Obstructions

The towpath encounters a number of obstructions along its route and these are discussed below.

Bridges create pinch points along most canals for both the navigable channel and the towpath so as to reduce the span as much as possible. Generally, the canal channel will reduce to 3.0 metres in width and the towpath to 2 metres, although perhaps locally to 1.2 to 1.5 metres in width may be advisable. Obviously, this reduction of the towpath width causes a number of safety issues with regard to multiuse towpaths, however these could be reduced by:

- Providing alternative routes for cyclists to use at bridge crossings
- Encouraging cyclists to dismount

Specific obstructions to the Hatherton canal towpath in addition to normal bridge pinch points include the M6 crossing, the M6 Toll Crossing and the David Suchet Tunnel.

The M6 crossing will consist of a new culvert structure that can incorporate sufficient space for a towpath to run within it. However, care needs to be taken to not create a 'subway' effect where towpath users find it an unattractive or unsafe space to use. This can be overcome by ensuring the tunnel is built to reasonably generous dimensions and the entrances are clear and open. The culvert could also be lit to help improve visibility within it. It is possible to provide an alternative or secondary surface route via the Straight Mile pedestrian footpath until it passes beneath the M6 where it can join the main canal alignment again if deemed necessary.

The M6 Toll crossing is already constructed in a concrete box culvert of internal dimensions of 6.4 metres wide by 4.2 metres high, and is 130m long. Even though the culvert is physically large enough to include a towpath within it, an alternative over-ground route may be needed here due to the following:

- The culvert is a combined crossing for the Wyrley Brook and the canal. In times of flood the water levels may be higher than the towpath hence creating a potential hazard or unavailable for towpath users.

- The subway effect mentioned above, providing an environment for possible anti-social behaviour, could deter people from using the towpath.

An alternative route would be similarly provided onto Walkmill Lane to cross over the M6 Toll and join the new path alongside the Hatherton Reservoir from Walkmill Lane back to the new canal alignment.

The David Suchet Tunnel has similarly been constructed as part of the advanced works, and it is a concrete box culvert in excess of 114 metres long, and 6.0 metres wide by 5.6 metres high internally. Here again, the culvert is physically large enough to include a towpath within it. However should a dividing wall be required by the Environment Agency as discussed earlier in this report, space will be somewhat constrained though it is still feasible that the towpath could be located above the brook channel. As with the earlier examples, this tunnel can be made more inviting to pedestrians by the provision of lighting within it. There is a risk of flooding of the towpath within the tunnel, although the additional height available means that the towpath can be given up to 1.2 metres extra freeboard to minimise this hazard. An alternative surface route may be required which bypasses the tunnel entirely although the logistics of this would need to be examined in detail with regard to road safety, particularly at the busy A34 and A5 road crossings.

7 SERVICES INVESTIGATION

The construction of the proposed canal will affect existing services along its proposed route such as water mains, sewerage systems, electricity cables and fibre optic cables. Services located within close proximity to the proposed route or crossing the proposed route may need to be rerouted to protect them from damage before construction begins. However, at this stage in the study we are only able to estimate the level of disruption that can be expected by searching available data on all the services in proximity to the proposed route. It will be vital that physical searches will be carried out at a more detailed design phase in order to better ascertain the likely impacts and diversion works required.

In order to locate the position of all the services that may be affected by the proposed canal, Groundwise Searches Limited were commissioned to approach all the appropriate bodies and request details of services. However, following inspection of the utility plans it is suspected that the plans have not yet been fully updated in the Churchbridge area where extensive service realignment has been undertaken during the construction of the M6 toll works. Using the information provided a schedule has been devised which details the noted position of services that cross the proposed route or lie within 25m of the proposed route. The schedule locates the services in terms of a 12 digit national grid reference, the chainage point along the centreline of the route and a written description of how the feature interacts with the proposed route. Only features of significance have been scheduled and minor property supply pipes etc. have been omitted. The completed schedule can be found in Appendix A.

As can be seen from the schedule the route of the restored canal crosses a number of existing services which include telecoms, water mains, gas mains, electrical cables and sewerage/drainage pipework. All service diversions will need to be agreed with the appropriate service provider and this will need to be fully addressed at the detailed design phase of the project.

Generally, traditional cable-related services such as telecoms and electricity cables are relatively easy to divert as they can be dropped under the canal alignment where crossings exist, or relocated to either side if room permits where services run parallel/along the proposed canal. Fibre optic services are generally quite costly to divert due to their nature,

however they can be dropped below the canal alignment where crossings occur. Two fibre optic crossings of the canal route occur at Churchbridge.

Gas and Water pipes again can be diverted in terms of their line and level, though consideration will need to be made to avoid air locks when diverting water mains. However, diversions of large trunk (gravity) sewers are expensive and may take a long time to undertake.

Sewerage pipes are generally either pumped or gravity systems. Pumped systems are relatively easy to divert, however as with water mains consideration needs to be given to avoid creating air locks, etc in the system. Gravity systems are much harder to divert as the levels of the up and downstream pipework dictate the level of the diversion pipework. Where possible, sewers that cross the canal will be diverted to adjacent sewers which have spare capacity. Where this is not possible and the levels permit, the sewer could be siphoned below the bed of the canal but full agreement will be required with the statutory authority before such a proposal was put forward as they have a tendency to block and therefore have ongoing maintenance issues. Alternatively, a pumping station could be used to transfer flows across the canal.

Two substations exist along the line of the route; the first just off the Wolverhampton Road at chainage 3+480, the other adjacent the A5 at chainage 6+840. Both of the sub stations will need to be moved, thus necessitating some quite substantial service diversions. Moving of substations takes considerable time and expense and should be undertaken in advance of any of the main construction works.

8 WATER SUPPLY STUDY

8.1 Overview of Existing Canal System

Based on the observations from a desk based investigation and discussions with British Waterways, it has been possible to gain a good understanding of the existing water supply network for the canal system in the vicinity of the proposed Hatherton Canal.

At a location just below Meadow Lock, situated approximately 2 km east of Calf Heath Top Lock, there is an authorised abstraction (feeder) from the Saredon Brook into the existing Hatherton Branch channel. British Waterways are currently exempt from EA abstraction licensing and are entitled to take water from the Saredon Brook at an agreed 12 MI/day. This abstraction is facilitated by virtue of a control weir. Approximately 1 km west of the abstraction point at Oak Lane Bridge, there is a sluice and valve system on the existing Hatherton Canal, designed to divert a proportion of the water towards the Gailey and Calf Heath reservoirs located to the north. The water stored in these reservoirs is then used by British Waterways to feed the summit level of the Staffordshire and Worcestershire Canal. The amount of water taken from the Hatherton Branch channel is dependent on the water level in these reservoirs, though as a 'rule of thumb' some 30% of the flow is directed to the reservoirs in the summer. This proportion is increased as and when it is necessary to raise the level in the reservoirs. The water remaining in the canal discharges directly into the Staffordshire and Worcestershire Canal at Calf Heath.

British Waterways require that the flow from the Hatherton Branch and the Calf Heath and Gailey reservoirs combine to total a minimum of 12MI/d reaching the Staffordshire and Worcestershire Canal. This figure of 12MI/d is used, as noted above, as the maximum permissible abstraction from the Saredon Brook, although British Waterways regulate this themselves.

An unnamed watercourse flowing from the north discharges surface water drainage straight into the canal west of the Wolverhampton Road.

Records show that consent to discharge treated effluent into the in-water section of the Hatherton Canal by a facility at Four Crosses was revoked in 2001.

8.2 Main Surface Water Drainage

The Wash Brook rises in the vicinity of Upper Landywood, approximately 3 km to the west of the Cannock Extension Canal. It flows to the east in a gentle arc, eventually flowing in a northerly direction. South of the A5 it is joined by Gains Brook, which drains the land to the northeast. The combined watercourse then continues to flow north and flows under the A5 and M6 Toll, approximately 1.5 km east of Churchbridge into Kingswood Lake, a permanent waterbody located on the north side of the M6 Toll, which acts as a collection point for water draining from the land to the north. The Wash Brook then flows back under the M6 Toll and A5 and through a lake before crossing back under the A5 near Churchbridge. In between the two A5 crossings a cut-off channel provides an alternative route for floodwater, running parallel with the A5 on its northern side.

The section of the Wash Brook between the Churchbridge Roundabout/M6 Toll and the Rugeley to Walsall Railway line has been heavily realigned with the construction of the M6 Toll Road. It flows through the David Suchet tunnel under the roundabout and artificially meanders through the legs of two HV Electricity pylons and a small culvert before meeting the railway line.

The Wash Brook then flows through pipes under the Rugeley to Walsall railway line where it is joined by the Wyrley Brook, which flows from the south. From this point the watercourse is known as the Wyrley Brook, with the proposed canal route following close to its course. The brook passes under the M6 Toll through a large culvert under Walkmill Lane through twin smaller culverts which marks the downstream limit of enlargement works carried out by the motorway builders. After passing the Cannock sewage works outfalls and redundant lagoons the Wyrley Brook flows under the Wolverhampton Road (A4601) and at this point becomes known as the Saredon Brook.

The Saredon Brook then flows in a westerly direction to a weir, where a feeder channel enters the Hatherton Canal just below Meadow Lock. The Saredon Brook continues westwards, flowing in the same direction as the canal route but with generally at least 25 m between the two watercourses.

The Ridings Brook drains the southern side of Cannock and flows towards the Severn Trent Water Cannock Sewage Treatment Works from the northeast. At the treatment works the Ridings Brook flows through the works site and then westwards alongside the A5 and into the Saredon Brook downstream of the Wolverhampton Road, while the Golly Brook continues south into the Wyrley Brook. Effluent from Cannock Sewage Treatment Works is also discharged into the Wyrley Brook.

Based on information received from a Landmark Envirocheck report there are a number of small trade effluent discharges permitted into the neighbouring watercourses that ultimately end up in the Saredon brook.

8.3 Groundwater Features

According to the Environment Agency's Groundwater Vulnerability Map for South Staffordshire and East Shropshire (Sheet 22), the eastern end of the route is located within a minor aquifer with Upper Coal Measures underlying the area. The western end of the route is characterised as a major aquifer with low permeability soil, by virtue of the Sherwood Sandstone deposits that underlie this area.

Arup have undertaken extensive geological investigation in the study area whilst working on the M6 Toll. Based on this work it would appear that some of the geological features have

not been included on older geological maps. As a consequence the Environment Agency groundwater vulnerability maps do not necessarily reflect the situation found in these more recent field investigations.

It is thought that the groundwater characteristics of the proposed route are strongly influenced by a small, localised aquifer located within a glacial channel at the eastern end of the study area. This aquifer lies within a gravel layer at a depth of approximately 70 - 90m. A borehole log from the British Geological Survey (SJ 90 NE/126) reported artesian conditions with a discharge of 100 gallons/minute with water first struck at 20 feet. However some test bore holes and pumping will be required in order to confirm the current conditions and this will be a requirement of the Environment Agency if this source was to be exploited.

Based on the site conditions observed during a site visit it is thought that the local water table is high. This is also suggested by the many small water bodies found within the Wash Brook valley and the reports of unchannelised stream flow in this area.

The local area has an extensive history of mining and there are numerous abandoned collieries. It is known that water is pumped from the nearby Mid Cannock Colliery, at a depth of 100m, and is discharged to the south to the Saredon Brook. This water has a high iron content and is saline. Because of this the water is treated in a processing lagoon with discharge consent of 5mg/l of Iron, which is met. The water is currently pumped at a rate of 386,400 l/d. There are also reports of shallower mine water within the Grove and Wyrley collieries at a depth of 20m.

8.4 Existing Water Supplies

Chasewater reservoir supplies water to the Wyrley and Essington Canal on the Wolverhampton Level of the Birmingham Canal Navigations system and is a significant source to the entire canal network to the south. British Waterways own the entire water abstraction rights to the reservoir, but the demand from the existing canal system is already beginning to exceed sustainable supply from this source.

The existing Hatherton Branch is supplied with a maximum of 12MI/d, abstracted from the Saredon Brook by a control weir. This input of water then flows in a westerly direction and either flows directly into the Staffordshire and Worcestershire Canal or is directed to the Calf Heath and Gailey reservoirs. The amount of water directed to the reservoirs is controlled by the sluice and valve system located by the Oak Lane Bridge, which are set depending on the level in the reservoirs. The outfall from the reservoirs and the water remaining in the Hatherton Branch both flow to the Staffordshire and Worcestershire Canal. The discharge from these sources is required to be at least 12MI/d.

The Ridings Brook supplies water from the north, and outfalls to the west of Cannock. There is no indication of the quantity or quality of this water and the Environment Agency will need to be consulted on how this outfall is to be dealt with in the future at a more detailed design stage. It is thought that this stream originally passed under the canal in an inverted siphon culvert to the Saredon Brook and that this may have become blocked by the considerable quantities of silt brought down and deposited in the canal over the 50 years since its closure. Further investigation of this will be required at a detailed design stage in order to fully understand how this operates and how this is to be dealt with in the restored canal scheme.

8.5 Water Requirements

Based on conservative estimates of the channel dimensions, it is thought that the canal will have a total capacity of approximately 408MI. The water supply will, however, be based on the amount of water used for the numbers of lock uses and the need for this to be replaced due to losses within the system.

A number of calculations have been undertaken in order to ascertain the water requirement of the proposed canal. Water will be lost from the system by lock movements and by residual losses e.g. lock gate leakages, infiltration, evaporation, transpiration etc.

British Waterways have undertaken analysis in order to calculate residual loss estimates. This analysis has produced an average figure of 1.75MI per km per week.

Three estimates have been made on the number of lock movements expected in a year, based on further information received from British Waterways.

Estimate 1 was based on lockages at Gailey Lock on the Staffordshire and Worcestershire Canal. This produced an estimate of 6121 lock movements per year. However, it is not expected that the level of boat traffic on the Hatherton Branch is ever going to reach the level of boat traffic on the Staffordshire and Worcestershire Canal.

Estimate 2 was based on lockages on the Wolverhampton Locks, which link the Birmingham Canal Navigations to the Staffordshire and Worcestershire Canal. This produced an estimate of 1895 per year. However, a principle aim of the Hatherton Canal restoration is a sustainable increase in boat traffic levels on the northern Birmingham Canal Navigations system.

Estimate 3 was based on a model of expected use on the Hatherton Canal. This model was constructed by British Waterways in 1993 and suggested that 3945 boats could be expected per year. The model then estimates that 1.4 boat movements is equivalent to 1 lock movement. Consequently this model estimates 2818 local movements. British Waterway has suggested that this figure should be increased by approximately 20 % to take account of the possible change over time. This gives a figure of 3382 lockages per year. This is the preferred estimate and has been used to predict water requirements

British Waterways have undertaken statistical analysis in order to produce a distribution weighting for lock movements for each week of the year. Using this weighting system it is possible to estimate the amount of lockages for any stretch of canal for each week of the year, as long as the total amount of lock movements in one year is known. Based on this information it is estimated that the maximum water demand during the year (during the summer months) will be approximately 5.78MI/d, whilst the minimum water requirement will be 2.55MI/d during the winter at times of no lock movement. This minimum figure will be required to compensate for the residual losses only. Clearly there will be some additional flows into the restored canal during the winter from surface water run off and no account of this has been taken in these estimates. In addition it has been accepted that the British waterways method of estimating losses come from statistical analyses of existing older canals and the losses attributable to a fully restored canal may be somewhat less than those derived above. Further work on refining the analyses of the average residual loss per annum should be attempted using data from newly restored canals as and when such data is available.

Currently the only measured input into the existing Hatherton Branch is 12MI/d from the Saredon Brook, a proportion of the water from the Hatherton Branch is then used to feed the Gailey and Calf Heath reservoirs. However, there is an unmeasured contribution entering the canal from the Ridings Brook, (above Bridge 8) although this water is thought to include some treated effluent. If the water is not diverted out of the existing Hatherton Branch to the reservoirs to the north, it flows directly into the Staffordshire and Worcestershire Canal with an approximate loss of 0.5MI/d, using British Waterway's standard loss estimate. The combined discharge to the Staffordshire and Worcestershire Canal from the Gailey Reservoir, the Calf Heath Reservoir and the Hatherton Branch is required to be 12MI/d.

The restored Hatherton Canal is essentially a flight of locks which needs its main water supply at the summit level in order to operate the locks and compensate for residual losses along the route.

Although the volume of water currently abstracted from the Saredon Brook is greater than the water requirement for the whole restored canal along its proposed route, this is towards the downstream extent of the canal and cannot in practice be used to supply the upstream sections and if extensive pumped recycling is to be avoided an alternative sources will be required.

It is concluded that a new water supply will be required to feed the summit level of the restored Hatherton Canal at or very near to Grove Basins with a minimum of 2.55MI/d and a maximum of 5.78MI/d, in order to maintain water after the entire length of the canal has been filled. This should provide sufficient water for normal channel losses and lock use by boat traffic. However, this estimate does not take into account possible increases in boat use or the effects of climate change. Neither does it take in to account actual data on water losses from newly restored canals which may alter these figures somewhat. However in line with current British Waterways 'best practice' it is recommended that a contingency of 20% is added to the maximum figure to allow for any increase in boat traffic or the effects of climate change. This provides a minimum of 3.05MI/d and a maximum of 6.93MI/d.

8.6 Possible/Potential Water Supplies

From our initial desk-based study we have identified all the likely sources of water within the area of the restored canal. These are summarised below.

- The Wyrley and Essington Canal system
- The Staffordshire and Worcestershire Canal system
- The Wash Brook/Wyrley Brook/Saredon Brook 'river' system
- Chasewater Reservoir
- Gailey and Calf Heath Reservoirs
- Hatherton Reservoir
- Groundwater
- Minewater

8.7 Feasibility of Water Sources

After the potential sources had been identified more detailed reviews and discussions took place with interested parties, stakeholders and regulatory bodies in order to better assess the viability of these potential water resources.

8.7.1 The Existing Canal System

The Cannock Extension Canal is the upstream end of the system and it is part of an extensive network including the Wyrley and Essington Canal and the Birmingham 'main line' as far as Smethwick. These are all at the same level. This level of the canal system is known as the Wolverhampton Level and is part of the Birmingham Canal Navigations (BCN). The Wolverhampton Level is supplied principally from Chasewater and Rotton Park reservoirs and from Bradley pumping station plus some additional inputs from land drainage etc. The Wolverhampton Level supplies water to lower level canals via 8 flights of locks and originally to the Ogley Locks down through Lichfield and via the Churchbridge Locks to the Hatherton Canal. The Trust understands there is generally a surplus of water from the Birmingham Canal Navigations system available to supply surrounding canals, except during prolonged dry periods, when any shortage can usually be made up by increased pumping from Bradley.

It is understood that an application has been made by British Waterways to abstract additional groundwater to feed the Birmingham Level but if this is not successful there may be a need to impose some dry weather restrictions although this will need to be investigated in greater detail in a later design phase.

Lockage water from the Cannock Extension Canal will necessarily feed under gravity into the restored Hatherton Canal, which in most years will be sufficient to operate the canal. Theoretically this supply could be incorporated into the water budget of the canal; however it is known that in approximately 1 year in every 10, the existing system can become stressed in dry summers. Therefore, this is not seen as a fully reliable source and in order to avoid restrictions in use, an additional source needs to be identified at or very near to this level.

The Staffordshire and Worcestershire Canal and the Gailey and Calf Heath reservoirs that supply it, lie at the downstream extent of the route and as such are unable to supply water. The Hatherton Reservoir was the original feeder to the canal below the Churchbridge Locks. However, it has since been reduced in terms of capacity and is now used for recreation. It may be possible to reinstate some supply from this source, although it is thought to lie too far down the system to be of much benefit.

8.7.2 The Existing River System

The Environment Agency has stated that the River Penk catchment, within which the Wash Brook, Wyrley Brook and the Saredon Brook lie, is closed to any surface water abstraction. However, applications for winter surface water abstraction can still be made but these are likely to come with certain constraints and restrictions.

British Waterways currently abstract water from the Saredon Brook for use within the existing canal network. This abstraction is currently exempt from licence and in theory there is no maximum limit to the water that can be taken. However, British Waterways restrict abstraction to be in line with the terminal flow requirement at the Staffordshire and Worcestershire Canal, and so the maximum flow abstracted is 12Ml/d as referred to elsewhere in this document. By 2007, British Waterways will have to apply for a licence to continue water abstraction. The licence will only be granted after it has been demonstrated that the use of water is necessary, the water is used in an efficient manner and that it does not have a detrimental effect on other water users and the environment. As British Waterways currently abstract from the brook, it is highly likely that the licence will be granted with a maximum discharge of 12Ml/d. However, as the catchment is closed to all further surface water, summer abstractions it is also unlikely that the Environment Agency would look favourably on an application in excess of 12Ml/d, and so this has not considered any further in this review.

It has been calculated that the existing abstraction from the Saredon Brook is able to provide sufficient flow to the proposed canal. However, the position of the existing abstraction is inappropriate to supply the entire length. In order to overcome this, the idea of abstracting a reduced volume at the existing abstraction point and then abstracting the remainder of the flow at various points upstream has been considered. However, this may have a negative impact on the upstream flow regime in the brook at times of drought and it may compromise the brook's ability to dilute final treated effluent discharges when it reaches Cannock Sewage Treatment Works site. It has not been possible at this stage to evaluate whether the upstream sections of the brook network are able to support abstraction and provide sufficient dilution during low flow conditions. This would require a carefully designed field-based study in order to identify the flow regime within the Wyrley and Wash Brook at times of low flow in order to demonstrate the sustainability of this proposal to the Environment Agency. It is known that the Environment Agency is sceptical that the necessary flows can be achieved in order to maintain good ecological and environmental requirements.

As explained in an earlier section, any new source is required at or very near to the summit level of the restored Hatherton Canal and it is likely that the upstream sections of the brook system may have insufficient water available for any significant abstraction(s) to take place. In addition, any abstraction from Wash Brook south of Gains Lane could not be facilitated without resorting to some form of pumped system.

Alternatively, the flow could be abstracted at the existing abstraction and then a proportion of it could be diverted by back pumping upstream and discharged into the canal at various points. This would require a large scale engineering solution in order to transport the water back upstream, and there are likely to be prohibitive capital costs and long term operating costs associated with such a water transfer system.

As any additional surface water abstraction is only likely to be permissible in the winter months, the abstracted water would then have to be stored during the winter months for use in the summer. This would require the provision of a large storage or ground water recharge facility. Consultations would need to take place with the Environment Agency on the design of any such storage facility and on the way this abstraction arrangement was to be managed. In addition it would have to be demonstrated that the required level of abstraction was achievable and sustainable. This could only be achieved by field investigation and the collection of brook level and flow/rainfall data.

The flow input from the Ridings Brook is unlikely to have been considered in the existing water balance models of the area. However, this source is limited by the fact that if it is likely to be of poor quality, which could have a detrimental effect on the overall water quality in the restored canal. However, under the Water Framework Directive the Environment Agency is concerned with point source and diffused pollution into watercourses with limited flow, such as canals and it is likely that this issue will need to be addressed in the short to medium term under the appropriate River Basin Management Plan.

It is therefore considered that the majority of the water supply required will have to be taken from sources other than surface water. If the existing Saredon Brook abstraction is maintained at its current level and location point then the flow of water to the Staffordshire and Worcestershire Canal remain unaffected by the restored Hatherton Canal.

8.7.3 Groundwater

Teddesley Groundwater Management Unit, comprising the Sherwood Sandstone found to the west of the proposed abstraction, and designated as a major aquifer on the appropriate groundwater vulnerability map, is closed to future abstraction. However, the layer of water-bearing sands and gravel discovered during the ground investigation stage in constructing the nearby M6 Toll, suggests that there is potentially a locally available groundwater supply; refer to details in Section 8.3. However any groundwater abstraction would only be allowed by the Environment Agency if it could be proven that the abstraction of this source did not affect the major sandstone aquifer to the west. This can only be demonstrated by undertaking a pump test or tests within a borehole or boreholes located within the gravel layer, and monitoring the water levels at observation boreholes within the sandstone aquifer. Some additional monitoring of the surface water features may also be required. In order to carry out such a test, an application would have to be made to the Environment Agency.

It is also possible that an appropriately located borehole in the vicinity of the summit level of the canal, between the top lock and Grove Basins, may be well able to yield sufficient volumes of groundwater that can be used without any pre-treatment. Although this lies outside the scope of this current report a definitive field investigation needs to be carried out to confirm this as it is the most likely source of additional water supplies to the restored canal.

8.7.4 Minewater

It is well known that the area has been extensively mined and it is probable that these old mine workings have collected a considerable amount of water. This is especially plausible considering the presence of the water-bearing strata described above.

Various reports of mine water have been made by colleagues, the Environment Agency and the Coal Authority and details of this water are given in Section 8.3. It would appear that this water is technically available, although here again pump tests would need to be undertaken in order to satisfy the Environment Agency and the Coal Authority that the pumping of water would not disrupt the structural stability of mines, promote incursions of gas in to subsurface voids or prejudice existing water users in the area. Again, such pump tests would have to be undertaken whilst observation boreholes were being monitored all under an agreement with the EA and BC respectively.

Mine water is commonly affected by a number of water quality issues such as high concentrations of iron in the ferrous form. When this is exposed to oxygen it oxidises to become ferric iron, which causes the precipitation of ferric hydroxide. This produces a thick solution that can coat the beds of watercourses and discolour the water. In addition, mine water often contains a vast array of other harmful chemicals, most notably heavy metal sulphates and sulphides and toxic minerals such as arsenic. The specifics of the contaminants found will depend on the geology of the water-bearing strata and will need to be fully investigated if this option is to be pursued in the detailed design stage.

Based on recent research it is known that the normal contaminants of mine water can be treated, either by using active methods, which involve applying chemicals to counteract the pollutants found within the water, or preferably by using 'passive' means of treatment, which involve sustainable technologies such as reed beds and settling ponds. Reed beds work by filtering out pollutants and then these pollutants settle to base of the reed bed. Ideally the plant matter will assimilate the pollutants. However, reed beds do require management in terms of cutting at strategic times of the year, otherwise the pollutants are released back into the system at times of natural die-back.

Water that is currently pumped from the Mid Cannock Colliery is understood to have relatively high iron content. This is reduced to 5mg/l after passing through a treatment lagoon. A modern, well engineered treatment lagoon however can treat raw water with an iron content of 10mg/l and produce a final effluent with less than 2 mg/l.

8.8 Recommended Water Supply Strategy

Based upon this initial desk study and consultation with the various stake holders, interested parties and regulatory bodies it would appear that a sustainable water supply can be achieved. However, it is likely that this will only be possible by using a variety of sources and through some fairly extensive testing regimes and negotiations with the Environment Agency and others.

Additional analysis and field-based investigations will involve evaluating the amount of water available from different sources and satisfying the regulatory bodies that any of the proposed water sources are sustainable. This type of investigation lies outside of this current report.

It is therefore recommended that a fully defined field-based investigation is undertaken to determine the summer flow regime of the Wash Brook. If this investigation is able to demonstrate that there is sufficient water to sustain the existing water use and ecological balance at times of low flow, and that the water course's ability to dilute final effluent is not compromised downstream of Cannock Sewage Treatment Works, it may be possible to reach an agreement with the Environment Agency to in effect 'trade' a proportion of the current Saredon Brook abstraction for a new abstraction further upstream. It is known that

British Waterways are not in principle opposed to this concept but additional and more detailed consultations with them is also recommended as this would provide the most cost effective water supply to the restored canal.

The evidence available at the time of writing this report suggests that there are fairly substantial sources of ground water available in a little-studied minor aquifer within glacial sands and gravels, and also in abandoned mine workings on route. The exploitation of either or both of these resources would require a formal application to test pump the sources whilst monitoring observation boreholes within the nearby major sandstone aquifer and the surface water features. It is recommended that the sustainability of the less polluted groundwater source is examined initially and that it is researched further in consultation with the appropriate regulatory bodies.

Water supply issues can be mitigated and water abstraction licence applications strengthened by early recognition of the following demand management techniques. The canal can be fully lined along its entire length as a suggested requirement of the Environment Agency's. Although this increases the cost of construction it reduces water being lost to groundwater it can also lead to better protection of ground water and quality issues. Other activities can reduce inadvertent loss of water from the system; these include the adoption of good design and build practices for locks, a SCADA system which will monitor flows and give a high degree of confidence in the management of the canal along with a regular inspection and maintenance system of locks and other flow control systems.

9 Water Quality

9.1 Introduction

It is recognised that canals can on occasions, contain water of impaired quality over that found in many natural watercourses due to boat movements, surface water inflows and overland flows. Canals controlled by locks will have a small quantity of residual flow moving downstream, with greater quantities during times of high boat use. Therefore, water quality in the canal may be quite variable, unlike in natural watercourses that are able to dilute pollutants and achieve self-cleansing conditions.

9.2 Potential Sources of Pollution

The water quality of any watercourse can be compromised by inputs from a variety of different sources, some of which are listed below:

- Surface water drainage from roads and urban developments, which could also contain de-icing salts. Contaminants from road accident are also a possibility.
- Treated effluents.
- Leachate from landfill (as mentioned in section 9.5).
- Untreated effluent from combined sewerage storm overflows.
- Diffuse sources from agriculture.
- Sources of pollution associated with boat navigation.

Most modern surface water drainage systems, from a road or urban development, would not be designed to feed directly into the canal network without some form of risk assessed protection device such as a petrol/oil interceptor. However, as canal and river networks are often interconnected, canals tend to be quite strongly linked to the general drainage systems. Therefore, it is likely that a canal will be receiving some surface water drainage. Pollutants associated with road and transportation often contain contaminants and consequently there is likely to be a presence of fuels, oils, heavy metals and PCB's.

Canals may suffer from high levels of ammonia (NH₃, mg/l), biological oxygen demand (BOD, mg/l), and lead to low levels of dissolved oxygen (DO, mg/l) in the water. Watercourses can also be affected by inputs of diffuse sources of pollution, often associated with agricultural activities and other land uses. These vectors for potential contamination of the canal will need to be examined in the detailed design stage of the restored and new sections of the canal and with good practice and attention to detail can be successfully addressed so as to maintain a good aquatic quality throughout.

9.3 Water Quality of the Associated Water Courses

The Environment Agency website, and the 'Water Quality in the Midlands – 2000' report, undertaken by the Environment Agency and other sources, have been accessed in order to determine the existing water quality status of:

- the Saredon Brook/Wyrley Brook/Wash Brook system,
- the Wyrley and Essington Canal,
- the Staffordshire and Worcestershire Canal.

The scores according to the water quality assessment methods used by the Environment Agency are shown in the table below.

Watercourse	Water Chemistry Score (A-F), (A- good F- bad)	Biology indicators (A-F), (A- good F- bad)	Nitrate (1-6), (1- good 6- bad)	Phosphate Score (1-6), (1- good 6- bad)
Saredon Brook	C	C	4	4
Staffordshire and Worcestershire Canal at Hatherton Branch	D	D	6	6
Cannock Extension	E	No data	1	2

The available data for water quality signifies that the stretches of canal that bound the proposed route have generally inferior chemical water quality when compared to the Saredon Brook. The levels of nitrates and phosphates detected in the Staffordshire and Worcestershire Canal are significantly high but there is no data for the Wash Brook or Wyrley Brook to make any comparisons with. Considerable efforts are now underway to define the River basin Management Plans as required under the Water Framework Directive and these will better inform the design process going forward as when these are published by the Environment Agency.

9.4 Implications of Proposed Scheme

The implications of the proposed scheme, which may affect water quality associated with possible changes in the interaction between the natural watercourses and the canal, are discussed in the following section:

9.4.1 Water Abstraction

Consideration has been given to abstracting water from the upstream sections of the Wash Brook/Wyrley Brook/Saredon Brook system, in order to supply the canal with water. Although the required flow data is not available to fully evaluate the water quality impact upon the Wash and Saredon Brooks, it is likely that abstraction from the upstream section of the brook system may compromise the brooks ability to dilute the consented flow of treated effluent from Cannock STW.

9.4.2 Combined Channels

The proposal for combining the restored canal with that of the natural watercourses within the area has been considered, as this would facilitate the engineering considerations, and it is well known that canals and rivers do historically run as a single watercourse in other locations of the country. However, the Environment Agency has made it clear that they would not support this approach based upon water quality considerations. This is likely to be impacted upon by the Water Framework Directive under the proposed River Basin Management Plans and much more detailed consultations will be necessary before this can be conclusively defined.

9.4.3 Canal/Brook Crossings

It is necessary to have a crossing of the brook course and canal near Streetway Farm on the A5 Trunk Road. The Environment Agency has stated that they are very reluctant to permit a 'level-crossing' at this location in order to avoid introducing any new potential water quality issues. Here again further investigations will be required at a more detailed design stage in order to progress this discussion with the Agency.

9.5 Groundwater Quality

There are few details available by which to assess the groundwater quality within the area of the proposed canal however the eastern end of the proposed route traverses a section of ground that has been used as land fill at Grove Colliery. There is, therefore a possibility that landfill leachate could contaminate the local groundwater and the nature of such contaminants would depend upon the materials disposed of in the landfill. In addition, there is a potential for the canal water quality to be compromised by infiltration from the groundwater. For these reasons it is recommended that the groundwater and the canal are kept isolated from each other by lining the canal in this area which is also an Environment Agency view.

Consideration has been given elsewhere in this report to abstracting mine water. It is known that the mine water within the area has high concentrations of iron and chlorides. This can be mitigated by the adoption of treatment processes such as reed beds, although careful monitoring of the water quality will be necessary as will determination of the long term effects of using this water..

It is not known, at this time, whether the water within the minor aquifer, referred to in Section 8.7.3 has been affected in any way by landfill leachate or contaminated by the many mining spoil heaps in the area.

9.6 Water Quality Conclusions

It is the Environment Agency's view that canals and natural watercourses should be separated as much as possible to avoid any potential future 'cross-over' water quality issues. Clearly there will be some greater definition of the ecological status requirements under the Water Framework Directive and the design proposals for the restored canal should progress in line with these requirements. However the Wash Brook and Wyrley Brook will tend to follow some substantially new artificial course due to the proximity of the

proposed restored canal and this may lead to the watercourses passing through land which has a history of industrial use. Due attention to this will need to be given in the detailed design phase when the results of the ground investigations are available. Nevertheless we would conclude that given the above comments there would appear to be no 'abnormal' or unusual constraints to maintaining a good water quality within the restored canal.

10 FLOOD RISK ASSESSMENT

10.1 Consultation With Operating Authorities

10.1.1 The Environment Agency

Consultation with the Environment Agency has been undertaken during this study, including a meeting at their Fradley Park offices in December 2004. This consultation, both with the Agency and other key stakeholders, will need to continue throughout the lifecycle of the project and more so during the detailed design stages in order to inform the design proposals further.

The Environment Agency has wide ranging responsibilities including permissive flood defence powers, the management of water resources, control of pollution in inland waters, and flood defence, including water level management amongst others. A principle duty of the Agency is to '*contribute towards the achievement of sustainable development*'. The design of the Hatherton Canal infrastructure should be carried out with this duty very much at the forefront of the project philosophy. It has been noted that it is currently the Agency's policy to oppose developments within a floodplain where adequate compensatory works or suitable mitigating measures cannot be demonstrated.

Under the provisions of the Water Resources Act 1991 and the Land Drainage Bylaws, the prior written consent of the Agency is required for any proposed works or structures in, under or over, or within 9 metres, of the landward toe of the bank of any main river.

10.1.2 Other Operating Authorities

For the watercourses not designated as "main rivers", local authorities have powers under the Land Drainage Act 1991, as amended by the Land Drainage Act 1994, to maintain or improve existing fluvial infrastructure works or construct new works some of which may be designated Critical Other Water Courses and fall under the jurisdiction of the Environment Agency.

South Staffordshire County Council and Cannock Chase Borough Council are the other main authorities with a vested interest in the project. The councils are the land drainage authorities for any watercourses or drains not controlled by the Environment Agency (or Internal Drainage Boards), and therefore will have an interest as key stakeholders in any outfalls to be constructed or modifications to a watercourse.

Severn Trent Water is the licenced operating authority for public sewerage in the area, including surface water drainage systems, combined sewer overflows (CSOs) and waste water treatment works.

10.2 Description Of Local Fluvial System

10.2.1 Local Watercourses

There are three significant watercourses that are close to the proposed route of the restored canal; Saredon Brook, Wyrley Brook and Wash Brook. All three watercourses are designated as main rivers and, as such, are controlled by the Environment Agency.

The exact routes of the watercourses in relation to the Hatherton Canal are shown on drawings C-36-001 to C-36-016. The Saredon Brook runs adjacent to the proposed canal

from chainage zero where it crosses the Staffordshire and Worcestershire Canal. From approximately 3.5km above this crossing, upstream of Wedges Mills, the watercourse is known as the Wyrley Brook, and from approximately 3.6km adjacent to the STW water treatment works settling ponds the proposed canal and watercourse are directly along side each other. At approximately 5.5km at the railway crossing, the Wyrley Brook turns away in a southerly direction and at this point the Wash Brook tributary joins in a confluence. The proposed canal continues to run adjacent to the Wash Brook until approximately chainage 8.5km where they separate and the canal runs the final 1.5km to the Cannock Extension Canal.

Further tributaries, the Ridings Brook at approximately 4.1km near the Wyrley Brook Retail Park and the Gains Brook at approximately 7.8km near the Wyrley No. 3 Colliery, join the line of the watercourse.

10.2.2 Combined Canal & Watercourse Tunnels

The recent construction of the M6 Toll Road necessitated the agreed (between the Lichfield & Hatherton Canals Restoration Trust, Environment Agency and CAMBBA Construction Group) construction of two large box culverts that are intended to provide a crossing for both the Wyrley Brook and Hatherton Canal within the same conduit. The two water bodies were intended to be kept separate by internal dividing walls. These culverts are designated as numbers 144 and 155 respectively. Culvert 144 is an oblique crossing of the actual motorway, with internal dimensions of 6.4m wide by 4.2m deep whereas culvert 155 (better known as the "David Suchet Tunnel") crosses beneath Churchbridge Roundabout, with internal dimensions 6.0m wide by 5.6m deep.

10.2.3 Historical Flood Events & Fluvial Floodplain

The Hatherton Canal route passes through areas that have a long history of fluvial flooding, of varying degrees of severity. Further study work is required to determine precise details of these flood events, including their likely or known recurrence intervals. This will only be able to be determined when a full topographical survey and flood model is available for the areas of particular interest.

The approximate extent of the Saredon Brook, Wyrley Brook and Wash Brook 100 year return period fluvial floodplain, directly affecting or in the vicinity of the canal route, was obtained from the Environment Agency website as an "Indicative Flood Map". It is considered using the currently available data that the floodplain may impact on the proposed canal alignment from chainage 1.5km through to chainage 8.5km. It is also well documented that regular flooding of the A5 takes place between the Wash Brook bridge and Churchbridge. A composite plan of the floodplain can be viewed in Appendix B.

10.2.4 Known Fluvial Flood Defences

This study has identified only one recorded formal Flood Defence structure along the route, although others may exist. Between chainages 6.0 and 7.0km, there is a flood relief channel adjacent to the A5 trunk road. This unlined earth structure serves as a relief channel for flood water surcharging in the Wash Brook, as the watercourse crosses back and forth beneath the A5 Trunk Road.

10.2.5 Additional Watercourse Structures And Features

Working from the top of the local fluvial system in a downstream direction, the following is a brief description of the more noteworthy watercourse features not previously discussed in this section. These features will act as hydraulic controls or constraints along the watercourse and will require more detailed hydraulic analysis to accurately determine their levels of performance:

- Wash Brook crossing; at 8.6km and adjacent to Gains Lane, the canal crosses over the Wash Brook. This crossing will require a modified structure to be constructed for the watercourse.
- Wash Brook pond; located at 7.5km and between the Wyrley No.3 Colliery and the A5 trunk road, this feature is flow controlled at its outlet, which implies the pond also acts as a balancing ancillary for the watercourse by attenuating high flows.
- A5 crossing; at 7.2km and opposite the M6 Toll pay stations, the Wash Brook crosses beneath the trunk road via a culvert (dimensions unknown).
- Control weir; at 6.2km and shortly before culvert 155, there is a hydraulic control on the Wash Brook in the form of a weir.
- Culvert 149; at 5.5km the Wash Brook crosses beneath the Walsall to Rugeley railway line. The culvert comprises of four 1950mm diameter pipes, with the outer two conduits set 600mm above the inverts of the inner pair. A detailed hydraulic analysis is required to determine whether this culvert imparts a throttling effect on the watercourse during high flows from severe storm events.
- Culvert 140A; at 4.7km the Wyrley Brook crosses beneath Walkmill Lane. The crossing comprises of two 3.3 x 3.3m box culverts. A detailed hydraulic analysis is required to determine whether this culvert imparts a throttling effect on the watercourse during high flows from severe storm events.
- M6 crossing; at approximately 0.7km, near to Calf Heath, the Saredon Brook crosses beneath the motorway in what is believed to be a twin pipe culvert. Exact details of the culvert are unknown.

10.3 Identified Risks And Potential Mitigation Measures

The following section will discuss briefly each of the Flood Risk Considerations (FRC) identified during this study for the proposed restored canal and suggest potential Flood Mitigation Measures (FMM) that may be adopted in the detailed design.

10.3.1 Combined Canal and Flood Channels

Between chainages 6.0 and 7.0km, there is a flood relief channel adjacent to the A5 Trunk Road. This unlined earth structure serves as a relief channel for floodwater surcharging in the Wash Brook. It is proposed that along this stretch of the alignment, the structure is used as a combined channel for the canal and for flood routing during severe storms. Any such combined channel must not only accommodate the canal, but must ensure that up to 100 year fluvial flood storage and flow paths are maintained, plus any allowance which the Environment Agency may require in respect of future climate change effects. However it must be understood that eventually an accurate, detailed hydraulic modelling analysis will be required to confirm this.

FRC: Potential loss of fluvial flood storage and/or flow path in a combined channel during storm events.

FMM: Ensure flood storage and flow paths are maintained and carry out detailed hydraulic analysis to confirm. Include additional capacity for climate change if required by the Environment Agency.

10.3.2 Combined Watercourse And Canal Tunnels

The two culverts designated as numbers 144 and 155 are large confined box structures that we constructed as part of the M6 Toll Road advanced works and provide a crossing for the Wyrley Brook / Wash Brook and the future restored Hatherton Canal within the same conduit. The design philosophy was that the two water bodies were to be kept separate by an internal dividing wall, which will be installed as part of the canal restoration project. Following some discussion with the Environment Agency there will be a need to demonstrate that these tunnels have sufficient cross sectional area/capacity to accommodate the full dimensions required for an operational canal and the 100 year return period storm flows in the Wyrley Brook. It is not possible within the confines of this report to comment in quantitative terms on the levels of flooding likely it is known that this section of the Wyrley/Wash Brook has a "rapid" response time to rainfall within its catchment. This would suggest that the frequency of flooding and the level of flooding can only be determined by a detailed hydraulic model of the two systems (canal and brook). However this is likely to be similar to a number of other such water course/canal interactions within the existing national canal network and no doubt can be dealt with in the future proposals for the Hatherton canal in much the same manner.

In the event that such further detailed modelling supports shows this to be a problem, then it may be necessary at some future stage to install an additional pipe culvert using a thrust bore tunnelling method. At both of these locations, detailed hydraulic modelling will be required to confirm the adequacy of the proposals.

FRC: Possible insufficient hydraulic capacity and internal dimensions of culverts 144 and 155 to accommodate both the proposed canal and the 100 year return period fluvial flood flows.

FMM: Provide additional tunnelled pipe culverts at each location to compensate for the shortfall. Detailed hydraulic analysis required.

10.3.3 Culverts & Bridge Crossings

Any modifications to existing culverts or bridge crossings, or the new build of additional structures, will require detailed hydraulic analysis to ensure that the crossing does not exacerbate local flooding or impinge upon floodplain storage.

FRC: Modifications to existing culverts or bridge crossings, or the new build of additional structures.

FMM: Undertake detailed hydraulic analysis to ensure that the crossing does not exacerbate local flooding or impinge upon floodplain storage.

10.3.4 Flood Levels & Floodplain Volumes

For much of the proposed alignment, the restored canal does not impinge on the capacity of the fluvial floodplain. However, where the canal is routed through a floodplain area, it may encroach upon the available volume/flood storage area and hence affect the current fluvial flood levels. The amount of floodplain storage lost from these works would appear to be minimal compared with that of the overall volume of the floodplain. However, it is the Environment Agency policy to ensure that existing flood levels are not worsened and the existing floodplain capacity is maintained by compensation storage. Therefore, any capacity lost from the floodplain must be mitigated against by the provision of additional level-for-level and volume-for-volume compensation storage, as agreed with the Environment Agency. This will need to be demonstrated in the future detailed design proposals.

- FRC:** Potential loss of floodplain volume and raising of current flood levels.
- FMM:** Ensure zero or minimal loss of floodplain by canal proposals and hence maintain current flood levels. Any capacity lost from the floodplain must be compensated by the provision of additional like-for-like flood storage volumes.

10.3.5 Water Quality

The effect of the proposed canal alignment on local fluvial water quality is a potential concern for the Environment Agency. Current water quality levels in the watercourses are affected by consented Combined Sewer Overflow which operate during time of storm spilling from the local sewerage infrastructure and at the Cannock Wastewater Treatment Works. It is also likely that surface water sewer outfalls are contributing to lowering water quality, due to their upstream connectivity to highway drainage.

The Environment Agency would oppose any combined canal and watercourse channel downstream of the Cannock Sewage Treatment Works outfall so as not to adversely affect general water qualities in both water bodies. However, the Environment Agency is currently developing their River Basin Management Plans under the Water Framework Directive for this region and this will assist in determining the degrees to which any combined flows can be achieved in the final design proposals.

- FRC:** Unsatisfactory fluvial water quality as a result of CSO spills and other sewer outfalls into a combined canal and watercourse channel.
- FMM:** Ensure the quality of water in canal and watercourses is kept satisfactory, throughout the detailed design process and by further consultations with the EA.

10.3.6 Health & Safety considerations for canal users from fluvial flood events

Wherever there is a potential flow path for floodwater from severe storm events to suddenly enter the canal as a consequence of storm overflow from an adjacent watercourse, the risks towards the health and safety for canal users must be assessed. This risk may be considered in the context of the M6 Toll tunnels (culverts 144 and 155), if any internal dividing wall allowed fluvial floodwater to suddenly weir over into the adjacent canal under storm conditions. However, as the canal and the wash Brook run so close to one another in upstream and downstream adjoining sections this effectively prevents such a flood wave from forming as this will form part of a more general flooding event and cannot be confined to just the individual culvert locations.

A combined canal and watercourse channel may also be problematic due to fluvial flood events. The upstream built environment sub-catchments of the Wyrley Brook has a rapid response time for generating flood flows during storm events and the subsequent impact on the canal could have an effect on boats using the canal. However, the upstream environment of the Wash Brook is not heavily developed and the current Kingswood Lakeside development includes several balancing ponds to reduce runoff rates. Detailed hydraulic modelling of these systems will need to be carried out in order to eliminate any such problems and on the probably rare occasions when high flood flows are present it may be necessary to close off venerable parts of the canal to navigation for short periods as is the case in some other canals..

- FRC:** Health and Safety risks for canal users from the sudden overflowing of fluvial floodwater from an adjacent watercourse.

FMM: Mitigate and reduce generic risk through design and flood monitoring systems.

10.3.7 Watercourse and Canal Crossings

There are two locations along the alignment, at approximately 4.1km and 6.6km respectively, where a watercourse and the canal are required to cross each other. However, the respective top water levels are approximately the same, resulting in there being insufficient clearance between the two facilitate a direct crossing by use of either a bridge (aqueduct) or culvert structure.

One feasible solution would be to allow the watercourse to weir into and out of the canal in a controlled manner as a "level crossing". As discussed in the earlier water quality section, the Environment Agency and British Waterways would wish to avoid such "level crossings" if possible so an inverted siphon may well provide an acceptable solution to this problem. Modern example of using inverted siphons can be found in a number of restored canals. Inverted siphons require adequate level differences if they are to be designed to operate successfully throughout the flow ranges and further analysis will be required to confirm this solution is satisfactory at both crossing locations for the Hatherton Canal. There are also maintenance issues to address and in a worst case scenario, blockages of the inverted pipework to consider. An example of how these issues can be overcome can be seen in the Arup design of similar inverted siphons on main sewers passing beneath the Ribble Link Canal and as proposed on the Droitwich Canal Restoration. In order to gain full approval for these siphons, it was necessary to provide two inverted pipes; one pipe was to siphon the sewer flows during normal operation, while the second was a dry pipe that will only operate if the other becomes blocked and an emergency overflow system operates. Duplicating inverted pipework for a watercourse crossing would involve consideration of 100 year flood flows, resulting in significant infrastructure.

FRC: Crossing of watercourses by the canal.

FMM: Carry out additional design work to confirm that inverted siphons or an at grade crossing is feasible in each location. This work should be undertaken with guidance from the Environment Agency and British Waterways.

10.3.8 Road And Rail Crossings

Wherever the proposed canal alignment is to cross existing road or rail infrastructure or vice versa, a suitable engineered crossing will be required in the form of bridges and tunnels

FRC: Existing road and rail infrastructure crossings.

FMM: Provide suitably engineered bridge and tunnel crossings.

10.3.9 Environmental Impact Assessment

The Environment Agency requires that any scheme that affects a Site of Special Scientific Interest (SSSI) or a Special Area of Conservation (SAC) has the prior consent of English Nature. To secure the necessary consents, the Hatherton Canal restoration project will require an Environmental Impact Assessment (EIA) to be carried out.

FRC: Consent and approval by the EA and EN for any project affecting the protected sites.

FMM: Commission and carry out a comprehensive EIA.

10.4 Flood Risk Assessment

To conclude this section, as this feasibility report is only a qualitative assessment of the flood and other associated risks involved with the proposed Hatherton Canal restoration project, it is recommended that significant further work needs to be carried out during design development of the scheme to ensure the risks identified within this report are addressed and that the associated mitigation measures are implemented. This should include for full and detailed hydraulic modelling wherever required. A detailed flood risk assessment (FRA), in accordance with Planning Policy Guidance Note 25, Development and Flood Risk (PPG 25 and any future editions or re-drafting of this guide), will be required by the Environment Agency for ultimate scheme approval.

FRC: Formal Flood Risk Assessment (FRA) required, in accordance with PPG 25.

FMM: Commission and carry out detailed FRA, including hydraulic modelling of watercourses, culverts and siphons.

11 PLANNING CONTEXT

11.1 Planning Policy Review

The following section focuses on the Planning policy context within which the Hatherton Canal restoration proposals sit and the framework within which any future planning applications would be assessed until such times as these plans are replaced. Planning policy is discussed in terms of national, regional and local level.

11.2 National Policies

At National level the following Planning Policy Guidance Notes (PPG's) are relevant:

Planning Policy Guidance 1: General policy and principles

Planning Policy Guidance 2: Green Belts

Planning Policy Guidance 7: The Countryside – Environmental Quality and Economic and Social Development

Planning Policy Guidance 9: Nature Conservation

Planning Policy Guidance 10: Planning and Waste Management

Planning Policy Guidance 13: Transport

Planning Policy Guidance 15: Planning and the Historic Environment

Planning Policy Guidance 16: Archaeology and Planning

Planning Policy Guidance 17: Planning for Open Space, Sport and Recreation

Planning Policy Guidance 21: Tourism

Planning Policy Guidance 24: Planning and Noise

Planning Policy Guidance 25: Development and Flood Risk

11.2.1 PPG1 “General Policy and Principles”

PPG1 sets out the Government's approach to planning and development. It states the key role of the planning system is to enable development that is consistent with the principles of sustainable development. The importance of good design is highlighted as helping to

promote sustainable development, improve the quality of the existing environment, attract business and investment and reinforce civic pride and a sense of place. It can help to secure continued public acceptance of necessary new developments.

PPG1 states that the planning system can help in the integration necessary to sustain economic development in rural areas. It adds that rural areas can accommodate many forms of development without detriment, if the location and design are handled sensitively.

Sustainability issues are being considered at this early stage in the project and are discussed in section 12.6 of this report. There should also be a commitment to sustainability through the more detailed design work. The development of Hatherton Canal assists in the retention of existing economic activity and planned expansion in a sustainable and sensitive way.

11.2.2 PPG2 “Green Belts”

There is a presumption in PPG2 against inappropriate development in Green Belts unless there are very special circumstances. The harm caused by inappropriateness, and any other harm, should be clearly outweighed by other considerations.

The canal alignment runs through the Green Belt but is considered to be appropriate development and is broadly compliant with the spirit and purpose of the Green Belt policy and in particular: maintaining its ‘openness’, not contributing to urban sprawl and assisting urban regeneration. Green Belt policy is looked at in the Local Planning Context in section 11.4. The proposals will be designed as far as practicable to be in keeping with the local characteristics of the area.

11.2.3 PPG7 “The Countryside – Environmental Quality and Economic and Social Development”

Advises on achieving good quality development and respecting the character of the countryside, and restates Government policy on protection of best agricultural land. It aims to reconcile the needs of development and conservation, and secure economic efficiency and amenity in the use of land. It advises that by integrating the two objectives, contribution can be made to sustainable development.

There will be some encroachment on previously undeveloped agricultural land for the new canal alignment in the southern section. The design of the proposals will respect the character of this area of countryside. The northern section of canal will follow the existing alignment and will not result in any loss of agricultural land. The proposals will demonstrate how they have carefully considered the character of the area. The area is currently ‘blighted’ to a certain extent by development, including the M6 Toll, and the proposals may improve the character in overall terms.

11.2.4 Draft Planning Policy Statement 7 (PPS7) (Sustainable Development in Rural Areas”

PPS7 is currently being prepared and, when adopted, will replace PPG7. Draft PPS7 sets out the Government’s objectives and policies for rural areas. These policies are based on the principles of sustainable development and the need to protect the wider, largely undeveloped, countryside for the benefit of all. The development proposals are within the existing curtilage of the northern section of the canal alignment and will not result in the loss of previously undeveloped land. The southern section of canal will encroach on some undeveloped countryside with the loss of some trees and hedgerows, but new hedgerow planting will be included.

The Hatherton proposals include the refurbishment and extension of existing facilities, which are currently not used to the best effect. The proposals will result in some loss of previously

undeveloped land but will create a more useful resource. The refurbishment and efficient utilisation of existing resources are preferential to a total new build in some other area.

11.2.5 PPG9 “Nature Conservation”

PPG9 contains the principles and policies that apply to the integration of nature conservation priorities and land use planning, emphasising the importance of both designated and undesignated sites for nature conservation.

The alignment is in close proximity to the Walkmill Lane Clay pit SSSI and the Cannock Extension Canal SAC. Full consideration of any potential impacts on these should be assessed through survey work, and potentially the Environmental Impact Assessment Regulations, and appropriate mitigation designed. Consultation with English Nature has been ongoing for sometime regarding the Floating Water Plantain and full consideration of any potential effects should be made and mitigation measures identified and implemented. There is potential for other nature conservation issues, affecting non-designated sites and species, to arise from the proposals. These should be assessed as part of future environmental impact work.

11.2.6 PPG10 “Planning and Waste Management”

PPG 10 provides advice about how the land-use planning system should contribute to sustainable waste management through the provision of the required waste management facilities in England, and explains how this provision is regulated under the statutory planning and waste management systems.

The guidance relates primarily to the management of 'controlled wastes', i.e. household, commercial and industrial wastes. The waste hierarchy, the proximity principle and regional self-sufficiency all need to be taken into account in identifying the combination of facilities and other waste management options which give the best balance between environmental, social and economic needs.

The Hatherton proposals will result in a significant quantity of construction waste, some of which will be special waste. A waste management strategy for the proposed construction phase will need to be drafted and approved prior to work commencing. British Waterways have a waste management strategy/manual, which covers issues such as:

1. How to deal with the disposal of the various types of waste.
2. Management of licensed dredging sites.
3. Areas of risk and potential liabilities associated with waste disposal, etc.

11.2.7 PPG13 “Transport”

PPG13 supports the sustainability principle and emphasises the need to reduce journeys by car and encourage the use of public transport, cycling and walking.

The proposals at Hatherton are already considering sustainability issues and will develop the options involving sustainable transport to reduce the impact of travel and transport on the environment. In subsequent stages of the project, visitors will be encouraged to come to site by alternatives to the private car: by boat, on public transport and as pedestrians and cyclists.

11.2.8 PPG15 “Planning and the Historic Environment”

PPG15 provides policies for the identification and protection of historic buildings, conservation areas, and other elements of the historic environment.

No listed structures are thought to be located along the route. However, if any buildings become listed before these works are completed, listed building consent will need to be sought. The redevelopment proposals should be designed in such a way as to limit any

potential impact on the historic context. British Waterway's corporate approach to conservation and historic environment has been successfully displayed in the number of sympathetic redevelopment projects across the country, where all due care is given to careful reconstruction and new build alongside the canal's original fabric.

11.2.9 PPG16 "Archaeology and Planning"

PPG16 sets out the Government's policy on safeguarding of archaeology within the planning process. PPG16 emphasises the fragility and irreplaceable nature of archaeological remains and the desirability of preserving these in situ where appropriate. The guidance also highlights the importance of early consultation with the local authority in the development process and suggests a framework for the archaeological mitigation process.

If there are areas where archaeology may be present, a staged approach to mitigation would be most appropriate with liaison and approval from the Local Planning Authority prior to implementation of any works along the canal route.

11.2.10 PPG 17 "Planning for Open Space and Recreation"

Open spaces, sport and recreation all underpin people's quality of life. Well designed and implemented planning policies for open space, sport and recreation are therefore fundamental to delivering the broader Government objectives: supporting an urban renaissance; supporting a rural renewal; promotion of social inclusion and community cohesion; health and well being; and promoting more sustainable development.

PPG17 deals with maintaining an adequate supply of open space and sports and recreational facilities, as well as planning for new open space and sports and recreational facilities.

The Hatherton proposals will contribute to the achievement of PPG17. They will provide a local recreational facility for local people to walk and cycle along, promoting health and social inclusion. The canal proposal will also make the link between the Staffordshire and Worcestershire canal and the Wyrley and Essington canal, enhancing the extent the canal system can be utilised and opening up access to more areas. The proposals will also make the site more accessible and enhance the open space and recreational resource.

11.2.11 PPG21 "Tourism"

PPG21 gives advice on tourism development and how rural schemes can bring major benefits to the national and regional economy, which should be taken into account in planning decisions. Tourist development projects that operate all year round may take pressure from popular but sensitive traditional tourist centres. They can contribute to sustained economic activity in rural areas and contribute positively to enhancement of local environment and avoidance of rural obsolescence.

The Hatherton project will provide a year-round tourist resource, for UK and international visitors to enjoy. The link that this project provides between two canals will also help take pressure off pinch points in the system during the busy times. The development will also raise some revenue for local business and create employment.

11.2.12 PPG24 "Planning and Noise"

PPG24 provides guidance on how to prevent noise-sensitive developments from being affected by noise-generating activities. It advises on the appropriate noise mitigation measures, and highlights the need to consider future generations, as operations expand or change, to prevent future occurrence of nuisance.

It may be necessary as part of an environmental impact assessment of the proposals for a noise assessment to be carried out. At this stage it is unknown if any on site noise

measurements would be required. The overall assessment would be carried out in accordance with PPG24.

11.2.13 PPG25 “Development and Flood Risk”

PPG25 sets out the importance the Government attaches to the management and reduction of flood risk in the land-use planning process, to acting on a precautionary basis and to taking account of climate change. It reiterates the role of the Environment Agency in advising on flood issues, at a strategic level and in relation to planning applications.

The Hatherton proposals impact a number of brook courses and potentially create new flooding mechanisms, but can also offer some additional capacity for flood relief. There are also some issues relating to potential water quality regarding the mixing of water from the Wash, Wyrley and Saredon Brooks etc. and what will be the new canal. Consultation with the agency has taken place and resolution of the identified issues will be required prior to planning consent being granted. A full assessment of the proposals against PPG25 will be required; refer to section 10.0 for further details.

11.3 Regional Planning Policy

11.3.1 Regional Planning Guidance for the West Midlands, RPG 11

RPG11 sets out a vision for land use and transport in the West Midlands to 2021. RPG 11 will be replaced by the West Midlands Development Framework in the future, but will remain a material consideration in the determination of planning applications in the meantime. The strategy has four key strands:

- a. Urban Renaissance - the Major Urban Areas (MUAs) of Birmingham/Solihull, the Black Country, Coventry and the North Staffordshire conurbation need to become vital, attractive places where people wish to live, work and invest.
- b. Rural Renaissance - dealing with the major changes that are affecting rural areas and the countryside.

In terms of the Rural Renaissance strand the Hatherton Canal restoration will improve an area, 'blighted' to a degree by the M6 Toll, that suffers from visual degradation in a number of places. The project will provide a new tourist and recreational facility for local people and will generate social and economic benefits. The project recognises the importance not only of employment to keep the rural areas afloat, but also of the facilities to attract and retain local residents.

- c. Diversifying and modernising the Region's economy, ensuring that opportunities for growth are linked to meeting needs and helping to reduce social exclusion.

With regard to the Region's economy, RPG states that 'Tourism and cultural activities contribute to the economy and quality of life and should be promoted in an integrated and sustainable way. Diversification is essential in rural areas and development plans must promote opportunities for this.' The Hatherton proposals make a strong contribution to this objective of RPG.

- d. Modernising the transport infrastructure of the West Midlands - supporting the sustainable development of the Region.

The regional priorities for transport focus on more sustainable transport options within the region and a move away from the private car. As a resource, the way in which people access the site should be considered with the promotion of walking, boating, cycling and public transport to site. The redevelopment will also promote water transport that is preferable over rail and road.

RPG states that 'The environment is a vital element of the spatial strategy and the RA and local authorities need to identify significant assets and areas for improvement or enhancement.' Hatherton Canal has been identified by the local planning authorities for improvement and the proposals will contribute to their objectives and those of RPG.

In overall terms the project makes a positive contribution to the objectives for the Region in RPG 11.

11.4 Local Policy

A review has been undertaken of the relevant development plan documents for the area, including:

- Staffordshire and Stoke-on-Trent Structure Plan (Adopted) 1996-2011
- South Staffordshire Local Plan December 1996
- Cannock Chase Local Plan 1997.

11.4.1 Staffordshire and Stoke-on-Trent Structure Plan (Adopted) 1996-2011

The Structure Plan for Staffordshire and Stoke-on-Trent was prepared jointly by Staffordshire County Council and Stoke-on-Trent City Council and proposes a broad planning framework for the period 1996-2011 for Staffordshire and Stoke-on-Trent. The County Council adopted the Structure Plan in 2002.

The following key objectives are relevant to the Hatherton Canal Proposals:

- Enhancing and protecting the Countryside and Built Environment.
 - putting a greater emphasis on good design as well as conservation, as advocated in Government guidance (PPG1);
 - ensuring that the particular character of landscapes is respected or enhanced by new development, or protected from new development;
 - continuing to protect areas of ecological, geological and archaeological importance;
 - promoting the protection, enhancement and, where appropriate, the recreation of relevant key habitats.

The Hatherton proposals will be largely in accordance with the principle of this policy.

- Sustainable Development

The task in southern Staffordshire is to balance these economic advantages and development pressures with protection of the environment and existing infrastructure in order to retain the sub-area's attractiveness.

The main points of the southern Staffordshire sub-area strategy of relevance to Hatherton include:

- Protect the environmental quality of southern Staffordshire settlements and countryside;
- Maintain and enhance the rural economy;
- Protect and, wherever possible, enhance natural and cultural assets, including open spaces.

The proposals at Hatherton will be in proximity to protected watercourse corridors, woodlands, hedgerows and trees, in addition to priority habitats and species identified in the Staffordshire Biodiversity Action Plan.

The following key policies from the structure plan are relevant to the Hatherton Canal Proposals:

D2 – The Design and Environmental Quality of Development

D4 – Managing Change in Rural Areas

D5B – Development in the Green Belt

D6 – Conserving Agricultural Land

D7 – Conserving Energy and Water

E9 – The Rural Economy

E11A – Tourism

T3 – Tourism in Rural Areas

T4 – Priority for Pedestrian Movement

T5 – Encouragement of Cycling

T7 – Public Transport Provision

T10 – Freight Traffic

T16 – Car Parking

NC1 – Protection of the Countryside: General Considerations

NC2 – Landscape Protection and Restoration

NC5 – Biodiversity

NC6 – Important Semi-natural Habitats

NC7B – Sites of National Nature Conservation Importance

NC7C – Sites of Local Conservation Importance

NC8 – Habitats of Protected Species

NC9 – Water Resources

NC10 – Flood Risk

NC13 – Protection of Trees, Hedgerows and Woodlands

NC14 – Sites of Archaeological Importance

NC18 – Listed Buildings

R1 – Recreation and Leisure Development

R3 – Recreational Facilities in the Countryside

R4 – Public Access Land

R5A – Water Areas and Rivers

R7 – Canal Facilities

‘New canal facilities and associated services, such as moorings, service facilities, marinas, hire and trip boat facilities, information points, restaurants and heritage attractions should be sited in or adjacent to towns, villages and canal junctions, subject to the need to protect the countryside and Conservation Areas. Canalside development should contribute positively to the function and appearance of canals, wherever possible, providing new life for redundant buildings. The wildlife value of canals is recognised and will be conserved and enhanced.’

R8 – Restoration of Canals

'Proposals for the restoration of former canals will be supported, having regard to the benefits to the canal system, urban regeneration and the impact on the nature conservation value of the land and any extant water.'

MW5 – Sustainable Waste Management

At this stage of the project a detailed assessment has not been carried out against each of the relevant policies. This will be a requirement of a subsequent environmental statement to accompany any planning applications for the site. In principal the proposals support policies for canal restoration, recreation and leisure development, the rural economy and tourism. At this stage in the design much of the detail is not known but it is considered that the proposals will be positively informed by policies for Design and Environmental Quality of Development and Managing Change in Rural Areas. The outstanding issues will be raised by those policies relating to the built and natural environment, conservation, the green belt and potentially transport. The proposals are currently in keeping with the principle of each of the related policies. The greenbelt policy is the most notable one that the proposal may not be in accordance with, however the proposals will most probably be considered 'appropriate development'.

The Hatherton Canal crosses two local district council authority borders; South Staffordshire and Cannock Chase District councils. The Local Plans for both councils have been reviewed.

11.4.2 South Staffordshire Local Plan December 1996

The South Staffordshire Local Plan was adopted in December 1996. Together with the Structure Plan prepared by the County Council for wider strategic matters, it forms the Development Plan.

The Deposit Local plan, dated November 2003 has been reviewed, together with the adopted plan. Relevant policies are presented below:

- Policy GB1 Green Belt – General
- Policy C10 Sport and Recreation
- Policy LS2 Landscape Improvement- Native Species and Habitats
- Policy LS4 Trees, Woods and Hedgerow- Protection
- Policy NC2 Sites Of International Nature Conservation Importance
- Policy NC3 Sites Of National Nature Conservation Importance
- Policy NC4 Sites Of Local Nature Conservation Importance
- Policy TSM6 New Canal-Side Development
- Policy R18 Canals- Environmental Improvement
- Policy R19 Hatherton Branch Canal

'The council will safe guard the route of the Hatherton Branch Canal shown on the proposals map to allow the restoration of the canal. Development proposals, which affect the route of the canal, will be expected to make adequate provision for or contribution to the restoration of the canal. Development that would prejudice the implementation of the restoration proposals will not be permitted.'

11.4.3 Cannock Chase Local Plan 1997

The canal passes mainly through areas designated as greenbelt. The eastern end of the canal runs into the Cannock Extension Canal, which is designated as a SAC. Associated with the Cannock Extension Canal is a Recreational Footpath/Cycle Route. The east end of

the Hatherton Canal runs through the Grove Colliery. The following policies are relevant to the canal in the Cannock Chase council local plan:

- Policy C6 Green Belt and Area of Outstanding Natural Beauty: Design & Development
- Policy CP1(11) Green Belt Boundary Alterations
- Policy C8 Protecting the Area of Outstanding Natural Beauty
- Policy C10 Protection of National Sites of Nature Conservation and Ecological importance
- Policy C11 Protection of Other Sites of Nature Conservation and Ecological Importance
- Policy C13 Safeguarding of Protected Species
- Policy C18 Forest of Mercia
- Policy TR3 Canals
- Policy TR4 Hatherton Branch Canal

'The district council supports in principle the proposal for the restoration and reinstatement of the Hatherton Branch Canal and will safeguard the route from any development, which would prejudice the restoration of the canal.'

- Policy TRP1 Recreational Cycle ways/Footpaths
- Policy TRP2 Tourism, Leisure, Recreational Development- Former Grove Colliery
- PEP1 Water Pollution Prevention
- Policy PEP2 Development of Contaminated land
- Policy B5 Ancient Monuments and Archaeology

11.4.4 Key Policies

The proposals are supported in each of the local plans through site-specific policies regarding the protection of the alignment and specific redevelopment policies. The two main issues faced at the local policy level are those of the Green Belt and Sites of National and Local Nature Conservation Importance. The green belt is thought to be less of an issue, as the development proposals should satisfy the requirements of the policy and be in keeping with the green belt.

With regard to Sites of National and Local Nature Conservation Importance, the Local Planning Authority will need to be wholly satisfied with the findings of ecology surveys, a potential environmental impact assessment and any mitigation suggested. The process of consultation has begun on these issues with the statutory consultees.

Other key policies in both plans include those regarding historic resources and landscape, tourism and leisure and water pollution and contamination. It is not anticipated that any of these will be significant issues in terms of policy.

11.5 Other Planning Issues

As a part of the current reform of the statutory planning system, there are a number of opportunities and considerations for the Hatherton Canal proposals. Local Development Frameworks (LDFs) and the Regional Spatial Strategy will replace the existing development plan system (Structure and Local Plans). Most Districts will be commencing work on their LDF in the near future; however it will be some time before they are adopted as statutory instruments. This will involve the preparation of Issues Papers, the review of written representations received and public consultation.

The canal alignment is currently protected and its reinstatement is supported by both of the local plans and the structure plan covering the site. The changes in the planning system now mean the policies will be reviewed again before the end of the original plan period. When the policies were originally included in the local plans it will have been the intention of the district councils to see the realisation of the policies during the plan period. Written representation should be made to the district authorities preparing the new LDF to continue the protection and to reiterate the intention to deliver the policy. This is also an opportunity to raise any other issues related to policy. Representations will only be required to the District Councils for the LDF preparation as the structure plan will no longer be prepared.

Under the reform of the planning system, structure plan policies will be taken forward instead in a new document called West Midlands Regional Spatial Strategies. The Regional Strategy will also replace and in part subsume Regional Planning Guidance for the West Midlands (RPG11). Preparation of the WMRSS will begin in the near future. In order to continue the support for the project in terms of heritage, tourism, economy and environment that are currently supported in the structure plan and RPG11, written representations to the new WMRSS should be made.

11.6 Planning Approvals Required

It is difficult at this stage to establish the extent of planning permissions required, as the proposals are not yet worked up to that level of detail. At this stage it is anticipated that the overall scheme would be submitted as an outline planning application accompanied by any Listed Building Consents, Planning Statements, Environmental Statements and potentially a sustainability appraisal. As the proposals run through two planning authority areas, the application (in most cases) will be submitted to the district council that has most land affected by the application. The second authority will then make representations to the lead authority during the determination. Discussion with the councils early in the process is advised.

11.7 Planning for Moorings and Marinas

Facilities such as marinas may need separate planning consents and most are likely to be developed by the private sector. However, it will be important in maximising the amenity and economic benefits from the canal to identify potentially suitable locations and, where necessary, seek prior provision for these in the appropriate Local Development Frameworks. Whilst both ends of the canal route are in Green Belt, moorings with limited built facilities are compatible with this designation, and there are a number of brownfield sites in these areas and also in the more developed middle section of the route that could be suitable.

12 Environmental considerations

12.1 Environmental Study Methodology

The environmental study has been based upon a desktop study using available data, photographs and plans of the route. Consultation has been undertaken with English Nature (EN) and British Waterways (BW), with regard to the proposals and their potential ecological impacts. A meeting was held with these two bodies, on site, on the 14th January 2005, to discuss the ecological implications of the proposals.

The findings of the environmental study are given below beginning with Tier One- Ecology and Biodiversity, and then the Tier Two topics of landscape, cultural heritage, contamination and waste management and sustainability. This primarily desktop study looks at each of the

topics in terms of the potential issues, consultation that has been or should be carried out, any mitigation and any recommendations for additional studies.

12.2 Tier One – Ecology and Bio-diversity

Significant sections of the canal route are “in water” and habitats include open water with water plants, waterway banks, grass towpaths, boundary hedgerows and built structures (e.g. bridges, locks and weirs). The route mainly traverses farmland, former mining areas and the built-up area of Cannock and Great Wyrley. The proposed route follows to a great extent the brook courses known locally as the Saredon Brook and the Wash Brook and these provide for a more or less continuous environmental corridor for much of the proposed length of the restored canal.

The habitats of nature conservation importance along and adjacent to the route are likely to include: aquatic, submergent and emergent vegetation, pioneering wasteland vegetation, unimproved and semi-improved grassland, scrub, hedgerows, mature trees and woodlands.

The habitats present along the route are capable of supporting a wide range of legally protected or otherwise notable species that could include:

- Badgers - setts are often found on sloping ground in woods and hedgerows
- Otters - tree lined watercourse banks
- Deer - there is a quite significant and frequently observed population present in the area
- Water voles - watercourse banks with marginal vegetation, and there are some records of water voles being present in parts of the Wash Brook near the A5
- Bats - roosts can occur in trees and built structures e.g. bridges
- Birds - particularly water birds and birds of farmland/woodland edge
- Reptiles - grass snakes are often found near watercourses
- Amphibians - anurans and newts can be found in watercourses and water bodies, usually where fish are scarce
- Terrestrial insects - butterflies, moths etc., particularly on grassland and wasteland habitats
- Aquatic insects - dragonflies and damselflies
- White-clawed crayfish - there are records from the adjacent Walk Mill Clay Pit SSSI
- Molluscs - aquatic snails
- Freshwater sponges - occasionally found in lock chambers and bridge walls
- Water plants - floating water-plantain (a species of European importance) is known to occur in the Cannock Extension Canal SAC.

12.2.1 Key Issues

Two key issues have been highlighted to date (by English Nature) as of primary ecological significance. These are:

- Walk Mill Clay Pit is a Site of Special Scientific Interest (SSSI) lying directly adjacent to the proposed route. Some land-take may be necessary from this site.
- Floating Water Plantain (*Luronium natans*) is present along the Cannock Extension Canal SSSI and Special Area of Conservation (SAC), where the proposed route joins the existing canal network.

It is apparent (both from desk study and opinions voiced during the site meeting) that the latter SAC issue is that of key importance and that this should be the focus of future ecological assessment.

12.2.2 Walk Mill Clay Pit SSSI

The Walk Mill Clay Pit is a flooded, disused clay pit, with its northern boundary defined by the existing Wyrley Brook watercourse. The clay pit is thought to be an isolated waterbody,

receiving no significant surface water inflows and with no definite outfall. The stated reason of notification is for its population of the scarce and declining native White-clawed Crayfish (*Austropotamobius pallipes*).

The (most viable) proposals in this area are to relocate the existing Wyrley Brook watercourse and to provide the new canal alongside. As a result, works will occur along the boundary of the SSSI and will require an additional band of land-take alongside. It is not known at this stage whether the proposals will impact directly upon the clay pit itself (although the intention would be to avoid it), but options are severely constrained by the built environment to the north.

The merging of water between the pit and brook or canal could result in other non-native crayfish species, such as the Signal Crayfish (*Pacifastacus leniusculus*), accessing the pit and either out-competing the native White-clawed or spreading disease (crayfish plague) to the native population. Thus, the pit's current isolation from other water bodies makes it a particularly important resource, in both a regional and national context.

Operations listed on the SSSI citation as those likely to damage its special interest include:

In relation to hydrology:

- The modification of the structure of pools, pits, ditches and drains, including their banks and beds, by re-alignment, re-grading and dredging.
- Alterations to water levels and tables and water utilisation (including irrigation, storage, abstraction from existing waterbodies or boreholes and through modifications to outfall structures).
- Infilling or digging of ditches, drains or pools and extraction of silt or clay.

In relation to land-take:

- The modification of natural or man-made features and clearance of boulders or large stones.
- The erection of permanent or temporary structures, or undertaking of engineering works such as drilling.
- Storage of materials.
- Destruction, displacement, removal or cutting of any plant or plant remains, including tree, shrub, herb or water plant.

If some land take were to be considered acceptable to English Nature, it will be necessary to restore worked areas to their recommended specifications and to prove to them that no deleterious impacts upon native Crayfish (and therefore the interests of the SSSI) will result from the works.

English Nature has confirmed that the northern boundary of the SSSI is a reflection of their need to retain control of the land surrounding the pit rather than of any inherent terrestrial value associated with the adjacent land (EN, *pers.com*). English Nature has now indicated that land-take could be acceptable in this area and that there are opportunities for ecological enhancement of the existing habitats along this stretch. At an appropriate later stage, a method statement for working within or adjacent to the SSSI will be required to address these issues and to confirm that none will have a damaging impact upon the interests of the SSSI.

12.2.3 Floating Water Plantain

The Floating Water Plantain is a nationally scarce species of aquatic plant, listed on Schedule 8 of the Wildlife and Countryside Act 1981 (as amended) and Annexes II and IV of the Conservation Regulations 1994. It is also a priority species under the UK Biodiversity Action Plan. This national and international-level protection makes it an offence to deliberately pick, collect, cut, uproot or destroy the plant.

Floating Water Plantain is known to occur throughout the length of the Cannock Extension Canal SSSI/SAC (plus along the adjacent Wyrley and Essington Canal) and is the primary reason for the designation of this watercourse. The uneven canal bottom and the low volume of boat traffic (to date) have allowed the development of a diverse aquatic flora, making it the richest known waterway of its type in Staffordshire and the West Midlands. British Waterways also hold records of white-clawed crayfish and water vole for this watercourse.

The principal threats to Floating Water Plantain are thought to be habitat degradation, physical habitat destruction and disturbance by recreational boat traffic. Ironically, it would also appear that the plant can become a permanent feature where there are very light levels of boat traffic, whilst dredging and similar activities that result in the clearance of more competitive vegetation can actually aid the establishment of this species. It may be that the careful design of new canal features (temporary open conditions) and appropriate regulation of new boat traffic may provide an opportunity for gain, but this research remains in its infancy. It is a complex and poorly understood species and other translocations have, in the past, been unsuccessful; much work may be required to secure an understanding of its persistence or otherwise on the site.

The issue does have historical precedent and has been addressed and progressed previously at other sites. British Waterways has previously undertaken the relocation of individual plants to refuge sites as part of the restoration of the Montgomery Canal. Relocation work is also being undertaken on the Rochdale Canal, to inline reserves in other sections of the canal. These inline reserves are protected from the affects of passing boats by the use of screens which also prevent silt from suffocating the Luronium.



A national survey of Floating Water Plantain was undertaken in 2000, with the results being held by both English Nature and British Waterways. Work is being undertaken for the Species Action Plan (SAP), being produced as part of the UK Biodiversity Action Plan, on a strategy for the conservation of Floating Water Plantain in canals. This is likely to take the form of identification notes and good-practice guidelines for canal management, addressing in particular the issue of recreational boat traffic. Specific research has also been undertaken on the impact of boat traffic upon Floating Water Plantain along the Montgomery Canal. All of the above may prove of some use in progressing this issue further, once more detailed assessment has been undertaken.

During the assessment, liaison with English Nature and British Waterways would be necessary to decide upon appropriate survey work, mitigation and/or compensation measures to secure the maintenance of this (and other) interest(s) in such areas.

Given the SAC designation, the supporters of the scheme will have to undertake further work to prove to English Nature (and other authorities) that the proposals will not result in a deleterious impact to the interests of the site (primarily that of the Floating Water Plantain).

The European-level designation of the Cannock Extension Canal may also mean that the Local Authority will require an appropriate assessment to be undertaken at the time of the planning application. The authority has a duty to undertake this themselves, but will utilise information provided within the Environmental Impact Assessment, thus (this aspect of) the assessment will have to be particularly thorough.

12.2.4 Other ecological considerations

Whilst English Nature has commented upon potential impacts to statutorily protected sites and scheduled species in association with the route (where these are known to occur), wider ecological considerations have not been discussed in detail at this stage. Over time, abandoned canal habitats across the UK have become significant refuges for wildlife. The presence of water and aquatic plant communities provide shelter and foraging grounds for a wide range of mammals, birds and invertebrates and many rare plants have been known to colonise such areas.

From available information on the proposals and the known baseline environmental conditions along the route, the following issues will also need to be considered at this stage:

- The loss of natural habitats along the route of the proposals. From existing baseline information, these can be broken down into the following generic groups:
 - 1) Ditch, marginal, flooded grassland and scrub habitat, primarily between the M6 and the A4601 Wolverhampton Road. This section represents approximately one third of the length of the proposed route (although broken in places) and will be a fundamental consideration. Its natural regeneration since abandonment may have permitted the development and influx of valuable ecological habitats and species, such as scarce plants and invertebrates.
 - 2) Hedgerow and spoil waste habitats between Great Wyrley and the route of the disused tramway. A hedgerow runs the length of the proposed canal route between these two areas across largely open farmland and areas of spoil exist around the colliery. The latter may contain scarce plants such as orchids, although this section of the route is likely to be the least ecologically valuable overall (with the exception of those worked areas around the M6 Toll Road).
 - 3) The copse areas and vegetated embankments (scrub and tree lines) of the disused tramway. As with the abandoned canal section of the route, this line will have regenerated naturally and may now hold significant ecological value, in part due to its undisturbed nature and linear function as a 'green corridor' for faunal movement.
- The potential presence of protected species along the route of the proposals. Due to the existence of a wide variety of natural habitats along the route (discussed above), it is likely that a number of statutorily protected species will also be present and thus (potentially) impacted by the proposals. These issues could be resolved (and used to inform design proposals for the route) from a combination of survey and further consultation. Examples of the more likely protected species issues associated with the proposals are:
 - 1) The disturbance of bats roosting within canal bridges. A number of bat species will roost unseen within the deeper crevices of damaged brick and mortar works, particularly adjacent to or over water.

- 2) The displacement of water voles as a result of changing aquatic conditions (water levels and quality) and the destruction of their habitat (loss of natural banks and fringing vegetation). Water voles are known to inhabit canal systems to the south of the proposed route (EN, *pers.com*) and, as such, should also be considered a likely presence along the affected sections of waterways.
- 3) The loss or disturbance of badger setts or key foraging areas within the copses and vegetated embankments, such as those along the disused tramway to the east.

A comprehensive survey and consultation exercise will be necessary to reveal all of the potential protected species issues to be encountered, as discussed in the recommendations section below.

12.2.5 Consultation

Consultation has been undertaken with English Nature (and British Waterways), with regard to the proposals and their potential ecological impacts. Those highlighted as of key significance are discussed in further detail below.

12.2.6 Mitigation

The restoration works should avoid or have minimal impact upon habitats and species of nature conservation importance. Where possible, opportunities for habitat creation and enhancement should be implemented.

The mitigation to be agreed with statutory and non-statutory organisations will be according to which habitats and species will be significantly affected. However, likely considerations would include:

- The retention of natural habitat (and in turn the protected species it supports) should be the priority throughout the length of the proposals. Where natural habitats are affected these will be replaced, and these may include features such as: -
 - badger setts
 - otter holts
 - deer passes
 - soft waterway banks for water voles
 - bat roosting structures in canal bridges
 - species-rich hedgerows alongside the canal, using local stock that is characteristic of area
 - reptile hibernacula
 - offline pools for aquatic invertebrates and amphibians
 - species-rich grassland for terrestrial invertebrates, using local seed that is characteristic of the area.
- Habitat enhancement, creation and replication works e.g. regarding the new Wyrley Brook line design. Improvements to habitat areas to be retained e.g. coppicing of scrub where over-dense, clearance of undesirable, invasive species etc. It is important to involve statutory and non-statutory advisers in this process. Above all, the canal itself must have ecological components to its design, focusing on natural banks and marginal planting, high water quality and uneven bottom structure etc.

- The scheduling of works to be appropriately phased so that not all resource is lost at once, but over a more staggered period of time and timed so that sensitive life-cycles of protected species taken into account, e.g. clearance of vegetation outside of peak bird nesting season, as driven by the legislation.
- Where habitat compensation is required, because the loss of existing habitats is considered inevitable, these should be created and permitted to develop/mature in advance of the loss of the existing resource. This issue requires careful consideration in order to secure its appropriate place within the phasing of the scheme.

More specifically, and to satisfy the requirements of English Nature, measures will need to be taken with respect to Walk Mill Clay Pit SSSI and the occurrence of Floating Water Plantain at Cannock Extension Canal SSSI/SAC.

Walk Mill Clay Pit SSSI: Key issues are likely to be water quality and turbidity and the use and management of the pit following the development. Mitigation in the form of avoidance of direct impacts and retention of pit isolation should be the focus of these proposals. Measures might include additional habitat creation for crayfish (canal and brook areas), scrub and/or grassland recreation.

Floating Water Plantain: Key issues are likely to be increases in boat traffic and predicted changes to the water flows and water quality where the plant is found to occur. Mitigation should focus on avoiding adverse impacts on the species and the proposals will need to prove that they will not have a negative impact upon the special interest of the site. Alternative routes not impacting upon the SAC site will probably need to be assessed as part of an EIA. Should the proposals be further progressed using the current route, further investigation will be required to assess the impact of the proposals on the site.

In other nature reserves where Luronium no longer exists, experimental dredging is being undertaken to give any remaining seed a chance to germinate. If this proves to be successful then the opening up of the Cannock Extension canal may actually help to increase the population of Luronium.

During the detailed development of the Hatherton Scheme, it is intended that information and data gathered from the translocation and protecting of Luronium on the Rochdale and Montgomery Canals is used to ensure best practice is developed and implemented for the protection of the Luronium on the Cannock Extension Canal. However, mitigation measures which will be employed to reduce the impact on Floating Water Plantain populations are likely to include: -

- dredging of the existing canal to remove mobile silts and reduce water currents and turbidity.
- cordoning off areas of the canal on the offside around existing plant outcrops to prevent boat incursion.
- Translocation would only be considered as a last resort, but nevertheless could be undertaken where impacts are likely to result in the direct loss of plants. The creation of new receptor sites should be designed according to species requirements and English Nature recommendations (essentially forming replica channel areas). Options for off-line receptor sites may include the ponds alongside the canal, thought to have formed by mining subsidence, some of which may be hydrologically connected to this watercourse. As with all new reserves, the reserves will need to be constructed well in advance of any engineering works being undertaken to ensure they have chance to establish ecologically before any translocation takes place.

The new sections of canal to be built also offer opportunities for an extension of the species habitat to compensate for any quantitative reduction in the existing site.

12.2.7 Recommendations

- A more detailed and extensive survey of the proposed route will be necessary to identify and map the key habitats present and inform as to any potential issues with regard to protected species. These could include badger setts, nesting birds and reptiles along the alignment of the proposed route, bats roosting within existing waterway bridges, and water voles within the watercourses. Further species-specific surveys are likely to be required as a result of this walkover and mapping, where potential for such species has been identified. All such surveys are likely to require scheduling between the months of April and September.
- A wide-ranging consultation exercise should be undertaken, at the same time as the walkover survey, as early as possible in the programme. To date, English Nature (and British Waterways) have been asked for their comments on the ecological aspects of the proposals, but this should be expanded to include the Environment Agency (Conservation team), the Staffordshire Wildlife Trust and/or the County Ecologist at Staffordshire County Council. In turn, these organisations may request that certain local interest groups be contacted for information, such as the badger or bat groups. This exercise should help to reveal all existing ecological data for the area of the proposals and identify other constraints or issues not found during the surveys.
- A specific survey of the Walk Mill Clay Pit SSSI would be necessary to identify the character and quality of land to be lost to the proposals and inform methods for minimising this land-take and its associated impacts. This survey would also focus upon the presence of White-clawed Crayfish within the pit and adjacent Wyrley Brook. Again, this survey should be undertaken in the spring or summer period and a survey licence will be required to undertake this work.
- A specific **survey for Floating Water Plantain** will be required to ascertain (identify and map) exactly where this species occurs along the route, in order to make a judgement as to the likely impacts of the proposals upon this species. English Nature will need to be consulted regularly on this issue to ensure they are happy with the proposals as these evolve. Conversations held to date with English Nature would suggest that **January** may be the optimal month to survey for this species (a time of maximum water clarity and prior to the development of other plant cover). Having said this, the plant would not have been visible at the time of the meeting on-site. At other times of the year, when intrusive survey might be required, a survey licence will be necessary to undertake this work.
- All of the above will be necessary to inform an EIA for planning purposes – a full assessment is considered to be the only way to adequately progress the proposals at this stage. Should the works programme slip or be scheduled for a date many years in the future, it is likely that these surveys would have to be undertaken again, between the time of the original application and initial site works.

12.2.8 Way Forward

The overall ecological interest of the route of the proposed works is poorly understood and largely unknown at this stage and will be heavily dependent upon time that the restoration works are likely to proceed as many ecological changes may have taken place within the canal corridor between writing this report and then.. Of the many organisations potentially holding ecological information, only English Nature and British Waterways have been contacted at this stage. A full consultation exercise and suite of ecological surveys (at an appropriate time of year) will be necessary to inform any assessment (EIA) to be used within a planning application and is the next necessary stage of works in relation to ecology. It is also possible that the Local Authority will require an Appropriate Assessment, because of

potential impacts to the interests of the Cannock Extension Canal SSSI/SAC, at this time in line with the EIA.

Of the known and likely ecological interests, those of Floating Water Plantain and its associated SAC are by far the primary considerations of the scheme. Substantial EIA work will be necessary to justify the scheme with regard to the potential impacts upon the site. So long as English Nature's recommendations regarding the Walk Mill Clay Pit are adhered to, this latter area is not considered to be a major ecological constraint.

It is considered inevitable that there will be some impact to and loss of habitats and species along the route, beyond the concerns of the designated sites alone and, as such, substantial mitigation and compensation measures will be required. These measures will need to focus upon the avoidance of impacts but, where not feasible within the limits of the scheme, will most likely require habitat creation and enhancement in advance of the loss of existing resources, and the appropriate phasing of these works.

It is imperative that regular contact be maintained with organisations such as English Nature (and others with roles in nature conservation) at all stages of the proposals. Their early input to project design and phasing, for example, will be invaluable in avoiding future costs and complications to the project and in ensuring that the important ecological interests of the route are maintained.

12.3 Landscape & Visual

The canal is routed along the following types of natural and man-made landscapes:

- Existing partially in-water canal.
- Urban and semi-urban areas consisting of industrial, retail and domestic properties.
- Rural/pastoral fields with mature hedge lines and a number of mature native species of tree.
- Former mine workings and colliery waste tips which are grassed over.
- Woodland plantations and thickets.
- Fields adjacent to and also within a line of a former, abandoned mine railway.

The Canal also passes through the Walk Mill Clay Pit Site of Special Scientific Interest (SSSI) and joins the Cannock Extension Canal SSSI and Special Area of Conservation (SAC).

12.3.1 The Cannock Extension Canal

The proposed route joins the existing canal at the Cannock Extension Canal that currently supports a diverse community of notable flora and fauna. The canal is a SSSI and has been declared a Special Area of Conservation. The design of the canal includes the management of an appropriate level of boat traffic, as predicted by British waterways but this level will need to be confirmed in the next design stage in order to ensure that the biological diversity of the Cannock Extension Canal SSSI and SAC are not damaged.

Due to the SAC/SSSI status of the Cannock Extension Canal it may be inappropriate to view this as a potential visitor centre, although the existing canal-side buildings would suggest restoration and some form of appropriate canal-side development may take place.

12.3.2 Disused Mine Tramway

From the Cannock Extension Canal the new canal route runs through the levelled mounds of former colliery spoil tips which have been colonised by scrub and silver birch. This will need to be treated in much the same way as at the Wyrley Colliery No 3 site by careful natural replanting so as to manage the transition from open land into the copse area around the connection with the Cannock Extension Canal.

The canal route then runs in a westerly direction along the line of a disused mine tramway, which is generally in shallow cutting or on a slightly raised mound. Since this tramway was abandoned the line has become overgrown with hawthorn, elder and birch trees and it is proposed that the more mature hedge to the south of the line will be used to demark the edge of the new canal. This hedge also has a number of mature and semi-mature trees which should be retained as far as is possible.

The obvious presence of deer will mean that crossing points will need to be considered in the detailed design so as not to interrupt the movements of the herd(s).

Landscaping will be very much in keeping with the existing natural pasture areas through which the canal runs. By virtue of judicious planting of some indigenous species of trees, and the planting of a new hedgerow to delineate the northern (towpath) boundary, little else is thought to be required unless there is the potential for public access and/or picnic areas.

12.3.3 Wyrley No. 3 Colliery

As the canal proceeds into the former Wyrley Colliery No. 3 site there is an opportunity to provide for visitor access, picnic areas and indeed potentially to convert the former mine buildings into canal side developments; and there are existing proposals for leisure, tourism and recreational development on the Grove Colliery site in the Cannock Chase Local Plan. There is much potential for appropriate landscaping and planting in this area of the restored canal and the transition of the route into the copse/plantation area around chainage 8+400 will need to be carefully planned.

It is anticipated that the canal at this location will be formed in a fairly deep cutting. Planting of the resulting slopes in what is essentially colliery spoil will not only provide for continuity of appearance but also afford natural slope stability.

12.3.4 Wyrley No. 3 Colliery to the A5 crossing

The proposed canal route follows the line of a mature field hedge which will define the canal's western boundary. Here again there are opportunities to consolidate the hedging and provide for appropriate planting of species of shrub, tree and grasses suitable for the environment, as much of the soils comprise colliery waste. It is expected that there will be a need to run the canal through shallow cuttings in this section and planting of such grasses and shrubs will also afford embankment stabilisation as well as a pleasing and wildlife friendly landscape.

In this location there are some areas of open water with some good quality vegetation associated with them along this section. These water bodies provide a positive feature in the landscape and could potentially be better integrated with the Canal and the surrounding landscape through appropriate planting.

12.3.5 A5 Section

The section of canal between the Church Bridge roundabout and the crossing of the A5 runs parallel to the A5 and the M6 Toll Road and is protected from the A5 by a mature hedge. Here replanting or reinforcement of these hedges should be considered and there may be opportunities to plant certain parts of the land-take with low level shrubs or trees to afford an attractive ecological corridor between what are two very busy highways.

The proposed canal then passes under the roundabout at Churchbridge and towards the railway. There is limited land in this area, and it has a more 'engineered' appearance. The area is designated for mixed-use development. A key issue is how the mixed-use development and the canal are integrated in order to maximise the amenity value of the canal.

12.3.6 Walkmill Clay pit

In this area a specific vegetation survey will be required to determine what vegetation may be lost and where it should be protected. The loss of vegetation should be minimised in this area. Close consultation with English Nature, the Ecologist on the project and the Forest of Mercia, will be required in relation to land take, loss of vegetation and new planting in this area.

Management of the water quality of the Wyrley Brook as well as the Canal is vital in order to encourage habitat and a variety of recreational activities.

A more natural, less linear treatment of the canal alignment, canal edges and marginal planting should be used in this area in order to create habitat and to achieve a better integration of the canal into the surrounding landscape.

12.3.7 Urban and Semi Urban Areas

In the urban and semi urban areas there is less opportunity to have large landscaping areas due to the confined width of the canal. However marginal planting of the bank(s) and reasonable planting of hedgerows may well be appropriate. There are certain areas of the restored canal, namely in the section around Church bridge and the M6 Toll Road that would benefit from landscaping by careful ground profiling and planting. This particular area currently presents a rather hard landscaping appearance and will benefit greatly from the visual presentations that will come with a restored canal, and may indeed afford opportunities for suitably scaled waterside developments.

12.3.8 In-Water Sections

The parts of the canal restoration that are currently defined as being "in-water" tend to follow well defined routes and it is anticipated that landscaping will be confined largely to reinforcing existing hedgerows, some planting of appropriate indigenous tree species and marginal planting. There are significant stands of Himalayan Balsam noted in certain areas of the "in-water" sections of the canal and in order to prevent spreading of this invasive species when the canal is restored, appropriate control methods will need to be employed in line with the current advice from the Environment Agency.

12.3.9 Consultation

Cannock Chase Council (Landscape Architect), and the Forest of Mercia were consulted in order to determine if there were any specific landscape issues beyond those outlined in the local plan in relation to the landscape and the Hatherton Canal restoration proposals.

12.3.10 Way Forward

A holistic approach to the restoration of the canal should incorporate a Master Plan, which addresses and weaves together all the various landscape and townscape improvement proposals for regeneration along the route. The master plan should also include proposals for different canal alignments, edge treatments and planting, as some areas offer greater enhancement potential, whilst others are significantly constrained by the built environment.

Future proposals could include two options; a 'do minimum' and an 'enhanced' option. These could be implemented at different stages as and when the finances become available. The key to the success of the restoration is through long-term maintenance and management plans along the entire route.

Other additional required work will include:

- A detailed vegetation survey to determine what vegetation should be protected and what mitigation measures can be taken in order to minimise the loss of vegetation and maintain the landscape's character.

- Further consultation will be required with British Waterway, South Staffordshire Council, Cannock Chase council, English Nature, and The Forest of Mercia.

12.4 Cultural and Built Heritage

12.4.1 Key Issues

The construction of the Hatherton Canal to bring it back into use will involve a range of issues relating to archaeology and cultural heritage. At this stage these can be divided into two broad categories: issues relating to the existing canal and areas of new canal construction. Within the area of the existing canal a range of cultural heritage/archaeological features relating to the former canal will be present. These include, for example, bridges, canal-side structures and other features relating to the construction and operation of the canal. Consideration of these features from a number of perspectives will be required to ensure their protection during construction, identify any remedial works that may be required as well as to determine their final place or utilisation within the completed scheme. These features may range from purely structural features, to features that may be considered and utilised as a tourist resource.

Within those sections of the alignment where new build is required, the principal issues relate to buried archaeological resources that may be present along the alignment. The proposed works will impact upon archaeological resources located in this part of the alignment and a programme of archaeological mitigation in advance of construction will be required.

12.4.2 Consultations

Consultations were held with both Staffordshire County Council and Cannock Chase District Council and a response was only forthcoming from CCDC. This shows that there are only two listed buildings within 500m of the proposed canal route, namely Little Wyrley Hall and the adjacent barn building, no SAM's and only one Conservation Area at Bridgtown on the north side of the A5 Trunk Road.

Clearly there will be a need to undertake more consultations with both authorities when more detailed routeing proposals are available. This will also need to take into account the extent of all earthworks along the canal corridor and temporary site compounds and access roads.

Much of the new canal is through former mining areas and as a result of this the natural and historic features in these areas have been greatly modified in recent times by this and the subsequent removal of spoil tips.

As referred to in this report many of the canal bridges have been heavily modified by the highways authorities in recent times and a number of other canal structures have been similarly affected by relatively modern changes. The final design proposal for this project will need to take into account the need to preserve such features as far as is possible.

Whereas little remains on the surface of the former colliery tramway it is likely that buried feature may well be present and encountered during geotechnical or subsequent excavation works. There will be a need for a "watching brief" for these and other buried features during the construction process.

12.4.3 Additional Work/Surveys Required

In order to understand the nature of the resource present both in terms of visible features as well as buried resources either archaeological or related to the canal, it is proposed that the following works and surveys are undertaken:

- Consultation with the County Archaeological Officer and other heritage bodies as appropriate

- A detailed survey to confirm the location of features identified from the desk based survey, identify any other features not previously identified, and to confirm the general status of alignment

The collection of this data will enable the characterisation and determine the spatial extent of the cultural heritage and archaeological resource present along the alignment of the canal. From this data the impacts of the scheme on these resources can be established.

As the works develop both in terms of engineering design and the understanding of the archaeological/ cultural heritage characteristics of the alignment it will be possible to define in greater detail the mitigation and survey requirements.

12.4.4 Mitigation

The development of mitigation proposals for archaeology/cultural heritage will require careful consideration of the impact of the proposed works on the resource. A range of potential mitigation options may be required depending on the nature of the resource at specific locations and the impact from development. As part of the formulation of the mitigation proposals, consideration should be given to the utilisation of the cultural heritage resource in the completed scheme. This may include for example points of specific interest or more general understanding the historic character and utilisation of the canal from the features of its original form that survive today.

12.4.5 Way Forward

As a first stage in the development of the scheme the collection of the data referred to above should be undertaken along with the commencement of the consultation process. Following this the walkover survey to provide an enhanced level of data would be required. From these sources and any others that may be identified combined with the engineering design, a programme of mitigation can be developed.

12.5 Contamination & Waste Management

12.5.1 Introduction

An assessment of baseline ground conditions has been made by the collection and review of publicly available information from the following sources:

- British Geological Survey (BGS) Maps and Memoirs Lichfield Sheet
- A Landmark Envirocheck Report
- A Coal Authority Mining Report
- Information from the M6 toll site investigations and geotechnical interpretative report
- A site visit and walkover carried out on the 23rd November 2004 by a member of Arup Geotechnics.

12.5.2 Potential Contamination Issues

The historical development of the site and the immediate surrounding area has been reviewed as part of the Geotechnical Feasibility study, refer to section 4.0, and has highlighted a number of areas which pose a potential contamination issue. Due to past uses there are several areas crossed by the proposed new alignment that may include contaminated land. The eastern part of the route of the proposed new canal alignment in particular has been subject to intense mining and there have been a number of collieries located along this section. A summary of the historical activity and potentially contaminated areas is given below:

- Grove Colliery, tipping associated with past and ongoing low-level industrial activity
- Tipping associated with the Brownhills/Wyrley No. 3 colliery, past and ongoing industrial activity

- The industrial area at Churchbridge east of the Railway
- The area between the Railway and Walkmill Lane Bridge affected by filling and railway sidings associated with the Hawkins Colliery (n.b. this area was also considered in the construction of the M6 Toll)
- The material used to fill the clay pits between the beginning of the new line and Walkmill Lane Bridge
- Iron Foundry (between 1968 –2000) east of the A460, sandwiched between industrial works/warehouses. The warehouse east of the A460 has more recently been replaced by the Linkway Retail Park
- Brick and tile works west of Walkmill Bridge (between 1881- 1972), subsequently, smaller pits were infilled and built over by industrial units (infill material unknown). The large clay pit is shown as flooded on the most up to date Ordnance Survey map (OS) (2000) although a recent site walkover revealed that this has since been infilled
- A large sewage works, situated to the north of the Canal (grid square 397400 308800) shown on the OS map since 1968
- Filling and construction of railway sidings to serve adjacent Old Coppice/Hawkins colliery during the 1950-60's. The railway sidings were removed late 60's on abandonment of the colliery, but bunds of made ground still remain. This area was redeveloped in the late 1990's when Walkmill Business Park was established
- Cannock Industrial Centre is present on the most up to date OS map, immediately north of the Walkmill Business Park. The Industrial centre was formerly occupied by a factory and engineering works between 1968 and 1995. The factory is referred to on the earlier maps as a 'manure factory/fertiliser factory'
- The proposed new route alignment follows a dismantled tramway, which connected Brownhills Colliery (Grove pit at Wyrley Common) to Brownhills Colliery No.3, east of Great Wyrley. There is potential for contamination along this stretch of the alignment, associated with both railways and the coal mining industry.

Envirocheck

An Envirocheck Report was commissioned for the full route alignment of the Hatherton canal (existing and proposed). A review of the potentially contaminative activities listed in the Envirocheck report is presented below:

- **Waste Sites**

The Envirocheck lists a number of recorded /registered landfill sites along the route, these are shown in the table below:

Landfill Name/ Location	Licensed waste	Status	NGR
Bilston Skip Hire- Pennymore Hay farm Landfill site	Construction/demolition/d redgings	Active	393440 308510
Bilston Skip Hire- Pennymore Hay farm Landfill site	Construction/demolition inert/ non-hazardous/non-toxic, earth fill	Closed	393450 308610
Nr sewage wks, Bridgtown	Not supplied	Unknown	3927280 308580
Iron Foundry, North Wedges Mills	Hardcore	Unknown	396740 308910

Hatherton Reservoir	Mixed	Unknown	397680 308130
North West, Wedges Mills	Household	Unknown	396620 309050
Adams Waste Services, Disused canal, walkmill lane bridgtown	Construction/ demolition, inert/ non- hazardous/non-toxic, excavated natural materials	Lapsed/cancelled/ defunct/ surrendered	397550 308300
Cannock concrete wks Watling Street, Hatherton	Waste produced on site only	Lapsed/cancelled/ defunct/ surrendered	396280 308990
Wyrley Grove Landfill, Grove Lane Little Wyrley	Co-disposal landfill	Active	401530 306010 / 401690305940
Wyrley Grove Colliery, Gorse Lane	Household, Commercial and industrial transfer station	Operational	401840 306010
Off Grove lane, Wyrley Common	Spoil	Unknown	401630 306360
South of Cannock	Not Supplied	Unknown	399140 308130
Near Gains Plantation, Great Wyrley	Household	Unknown	400200 308030
Northwest of Great Wyrley	Colliery	Unknown	400070 307460
Wyrley No.3 Colliery Mound, Gains Lane, Great Wyrley	Not supplied	Lapsed/cancelled/ defunct/ surrendered	400210 306860

- **Industrial Land Use**

The Envirocheck provides a list of all contemporary trades within the vicinity of the Canal and includes both active and inactive businesses along the route.

There are eight active contemporary trades adjacent to the canal route, including packaging and wrapping equipment supplies, car dealers, vehicle body builders and repairers, adhesive glue and sealants, damp & dry rot control, printers and a waste disposal service. Most of these businesses are located within the Wyrley Brook Retail Park, Linkway Retail Park or the Walkmill Business Park. The waste disposal service is located at the Wyrley Grove Colliery.

12.5.3 Potential Construction Issues

Waste generated from the construction works, i.e. excavation of the new section of the canal, will be potentially contaminated particularly where made ground such as embankment fill, colliery spoil, engineered fill and former tramway sidings are located. Such waste will be subject to Landfill Tax, which will add on additional costs to the overall project for any material taken off site and disposed of in such a manner. The aim of the tax is to encourage the re-use, recycling or remediation of material on site, however there will be costs associated with remediation/treatment of such waste.

The waste from the construction works must be re-used or recycled wherever possible, or otherwise disposed of in accordance with the relevant waste management legislation and Duty of Care.

Construction of the new canal section may lead to the creation of contamination pathways, which has the potential to introduce or draw in contaminated groundwater and gases from the surrounding areas.

The canal also crosses a number of brooks and streams, which will need to be protected from any influx of contaminated materials or dust. Baseline water quality monitoring and on-going monitoring throughout the works is recommended in order to protect surface and ground water in the area.

In order to reinstate the existing line of the Hatherton canal, a programme of dredging would be required. There is potential for contamination within the dredged material due to fly-tipping and surrounding industrial activities. Sampling and testing of material would be required to determine whether the dredgings will be suitable for bank-side deposition or spreading on agricultural land. Should the dredgings be unsuitable for the above they will need to be taken to a landfill. However, dredgings will be classed as 'liquid waste' after July 2005 and will require mixing with other waste before deposition within a landfill site.

12.5.4 Landfill Tax

The landfill tax was introduced on 1 October 1996. It represented a major shift in business taxation from employment to environmental issues and has been called the key economic instrument in the field of sustainable waste management.

The intention was to move waste up the waste hierarchy from disposal to reuse, recycling and energy recovery. The landfill tax is currently charged as follows:

- £15 per tonne for active waste from April 2004 (which then becomes £18 from April 2005)
- £2 per tonne for inactive waste

The budget report supporting the Finance Act 2003 highlights the Government's intent to increase the rate for active waste by £3 per tonne each April, until it reaches a rate of £35.

Inactive waste is defined as waste, which does not decay or have the potential to pollute ground water or contaminate land. Subsoil, glass, concrete and bricks will fall within this category, but it is not entirely clear which category will be applied to materials such as top soil, fuel ash, colliery spoil and industrial slags, all of which can either generate methane or produce contaminated leachate.

The Landfill Tax (Qualifying Materials) Regulations SI 1996/1528 set out definitions of the "inactive" materials which attract the lower rate of tax and is given in Appendix C.

12.5.5 Consultation

The canal route crosses two local authority boundaries, South Staffordshire and Cannock Chase District councils. Both councils should be contacted to confirm the details of the nearby landfill sites, such as monitoring, construction and operational details i.e. waste type, volume and if it is still active. The councils may have details of any registered contaminated sites that may occur within the vicinity of the site.

The Environment Agency should also be contacted regarding information on contaminated land and land fill sites which the canal may pass near.

12.5.6 Additional Works/ Surveys Required

A geochemical ground investigation, including gas and groundwater sampling, would be recommended along the proposed route, with a focus on areas of former colliery works, known infill/made ground and areas adjacent to industrial areas (either present or historical).

The level of contamination in the ground beneath the proposed route should be established, particularly where the new route is to be excavated. This material will need to be removed

in order to create the canal and therefore will require remediation/treatment or removal to a suitable authorised landfill site. Therefore there will be additional costs in remediation or removal of the waste material.

Baseline monitoring of the nearby surface waters would also be recommended prior to construction works.

12.5.7 Mitigation

Mitigation will need to be addressed in the detailed design phase of the scheme. However, likely considerations at a generic level would include:

- Development of a Code of Construction Practice (CoCP) that will present a set of procedures based upon a full environmental risk assessment. The CoCP will provide details of the following:
 - Procedures and protocols to prevent construction workers, visitors, occupiers and neighbouring areas, from being exposed to contaminated materials including adequate Personal Protective Equipment (PPE).
 - Monitoring of the excavation works to identify suspect ground.
 - Sampling and testing of excavated soils.
 - Developing an outline method statement for investigation, testing or excavating contamination encountered on site.
 - Outline emergency procedures to deal with the discovery of unknown contaminated materials, in accordance with established guidelines.
 - Monitoring of air quality and dust during ground work.
 - Limiting dust generation during excavation and handling and storage of potentially contaminated materials.
 - Control of surface water run-off by incorporating suitable measures for preventing pollution (any culverting or works affecting the flow of watercourses requires prior consent from the Environment Agency under the Land Drainage Act 1991/Water Resources Act 1991).
 - Systems to record and monitor the movement and deposition of waste material leaving or being transported to other parts of the site, and an appropriate waste management licence (or exemptions) and provisions under the Duty of Care.
- Site-specific risk-based remediation criteria shall be established to define chemically suitable and unsuitable materials for retention or removal from site, respectively. This will be completed as part of the detailed development strategy and will be subject to negotiations with the Environment Agency and Local Authority.
- A programme of environmental monitoring of surface waters and comparison of results with the baseline conditions will identify potential impacts on surface water bodies as a result of the construction process and allow further mitigating measures to be adopted, such as water treatment/settlement.
- Health and Safety procedures would ensure that ingestion of contaminated soil is avoided (e.g. by washing hands prior to eating, smoking and drinking).

12.5.8 Way Forward

At present the full extent of contamination along the route cannot be confirmed without further investigation, in the form of a geochemical site investigation. The eastern area, in particular, has been subject to intense mining during the last century and has left a legacy of

contamination along the proposed route. Other industrial activities such as the Iron Foundry and Brick and Tile work have also impacted upon the ground conditions. The material used to infill the brick pits is unknown and may contain contaminated/hazardous material.

Contaminated material will be encountered along the route and will need to be dealt with. This should not pose a constraint to the overall project, however the costs of remediation and/or removal will need to be taken into consideration.

12.6 Sustainability

12.6.1 Introduction

This chapter considers the sustainability of the project proposals, for both its construction and operation. The sustainability appraisal captured the need for environmental protection, social equality, economic vitality and efficient use of natural resources. A review of relevant literature and project documentation was carried out.

As the project is currently at the outline stage, it consists mainly of aspirational principles based on Arup's SPeAR sustainability model. A full sustainability appraisal would need to be based on the detailed proposals using a sustainability model such as Arup's SPeAR, in order to provide a true picture. To achieve this, we would need to be involved in the project at an early stage, working alongside the design team to influence choices that will affect performance in terms of sustainability.

For this outline appraisal we have addressed the headline sustainability issues, where information was available.

12.6.2 Project Proposals

A review of the development proposals was carried out to assess the sustainability of the construction and operational phases of the site redevelopment. The review has highlighted the following aspects:

- The canal could act as a flood relief channel
- SUDS should be used for the drainage of any impermeable areas associated with the proposed development e.g. ancillary car parking etc.
- A species-rich wildlife corridor should be planted
- Changing land from open agricultural land to canal and embankments is likely to have a beneficial effect, following the construction phase
- Existing structures will be re-used where possible
- A construction phase environmental management system should be put in place
- The proposed development should improve social identity
- It should add to the character of the landscape and soften existing hard urban structures
- The development of a continuous canal path opens up related leisure opportunities for walkers, cyclists, anglers and day trippers
- The development will improve access to good quality green space
- There will be considerable expenditure on environmental and social improvement
- Construction and operation of the proposed development will result in additional employment
- Regeneration will increase the vitality of the local area, by assisting in the creation of new opportunities for commerce and leisure

- The proposed development will act as a draw for local leisure spending and as an attraction to visitors in other nearby towns
- Potential to design out crime
- Aggregates, such as shales and gravels, recovered during the construction could be re-used on site
- Local materials should be used where possible
- Natural materials should be used where possible
- Modularisation of canal components should avoid and reduce the production of waste
- Water quality, water flow and boat numbers will be monitored regularly
- The operation of the development will require very little mechanical energy
- Topsoil will be re-used on site
- Contaminated land will be cleaned up
- The development will create land value
- Best Practical Environmental Options will be used for waste: avoid, reduce, reuse, recycle

12.6.3 Recommendations

A number of areas have been identified for further detailed consideration and are highlighted in the table below.

ISSUE	RECOMMENDATIONS
Habitat destruction/creation	Ensure the design of the canal embellishes existing habitat and any habitat destruction is mitigated by the creation of new habitat areas.
Integration of public transport	Promote the towpath as a means of commuting to work and provide signage to nearby bus stops and other public transport.
Local facilities	Provide signage next to adjoining footpaths to direct canal users to nearby local facilities.
Freight transport	Promote the canal for the use of small-scale freight transport.
Crime and security	Develop a canal design guide for security.
Timber sourcing	Implement a policy to ensure all timber is from sustainably managed sources.

13 ECONOMIC IMPACT ASSESSMENT

13.1 Introduction and Scope

This section of our report for LHCRT and BW highlights the potential economic impact of restoring the waterway and reconnection of the Hatherton Canal to the Cannock Extension Canal, thereby restoring a link between the northern BCN and the Staffordshire and Worcestershire Canal.

The brief requires that a detailed Economic Impact Assessment of the proposals for Hatherton Canal will be carried out. However adoption of the prioritised two-tiered study approach means that we have only gathered available information and data from BW, the Trust and relevant Local Authorities (Tourist Information, etc.) and commented on this information.

We will not, at this stage, undertake surveys, interviews or issue questionnaires. Our work will be limited to consultation with the relevant local authorities and the Regional Development Agency.

The costs for constructing the canal have been estimated at **£48.7m**. This undertaking and its related costs will need to be balanced by benefits accrued both directly and to the wider economy.

13.2 Context

The analysis requires a broad demand and supply approach to be adopted. On the demand side, a standard methodology is followed that produces a forecast of local economic impact by combining visitor projections under different activities with expected levels of expenditure.

These results allow an evaluation of potential development sites along the agreed route to be made. These can be assessed in terms of their potential uses and the likely value that they will bring, particularly in respect of the value over and above an equivalent site developed away from a canal side location.

The basis for this evaluation is that the general trends are for growth in water-based activities nationally. This is due to a variety of factors, including a strong economy, a growing population and the increase in demand for leisure activity.

Demand for leisure activities along the Hatherton Canal could potentially be generated by:

- Catchment of approximately 185,000 persons within Cannock Chase and South Staffordshire.
- A population of around a million in the adjacent West Midlands conurbation with other urban centres also in close proximity.

The majority of the proposed route of the canal runs through attractive countryside, while the middle section skirts close to the town of Cannock. The proposed canal project would create a draw for local leisure spending and generate an attraction for visitors of other nearby towns.

Other reasons why demand could be attracted to the proposed scheme include:

- Well positioned to be a base for visitors travelling along a wide range of canals in the area, including the Staffordshire and Worcestershire, the Shropshire Union, the Trent and Mersey, the Coventry, and the Birmingham Canal Navigations.
- Easy access to marinas and facilities on nearby canals.

- Numerous linkages to other waterways around Staffordshire, the West Midlands and Warwickshire that generate a range of cruising options, including rounds trips of 1 day to several weeks.
- The area is easily accessible via the road and rail network and is ideally situated at the heart of the country.

This report also succinctly lays out the direct benefits and issues that could be accrued, which have been tailored to the Hatherton situation:

- Income and employment will be generated primarily through the redevelopment of the canal, not just from the restoration of the waterway but also its operation and the additional development and operation of associated leisure uses. Therefore, reconstruction of the navigable waterway in conjunction with work to entice the visitor into Cannock or adjacent towns and villages along the canal route will result in economic benefit as well as increased land values and employment.
- Increasing leisure activity in Cannock Chase and South Staffordshire could positively impact tourism and leisure in other nearby towns, as water users plan for trips of several days with the intent of visiting a number of towns and using local amenities.
- Overnight moorings could lead to short stays and increased visitor spending in businesses along the route such as public houses, restaurants and shops.
- The construction of new boating facilities along the reinstated canal would not only lead to jobs in their construction but also in their operation. The provision of such amenities further increases tourism potential and thus the creation of associated jobs and income from this sector. As few boating facilities currently exist, there would be little effect on existing boat-related facilities.
- Boaters will take the opportunity to get off their boats and explore local attractions, if well signposted and advertised. Boaters consist of a wide cross section of society, with some in the older age group, who have retired early. People within this group typically have greater leisure time and higher spending potential.
- Other niche markets can be taken advantage of, including restaurant and hotel boats that make the canal an attractive option to those coming to the Cannock area or the wider region.
- The development of a continuous canal towpath opens up related leisure opportunities, particularly cycling and angling.

13.3 Methodology

13.3.1 Calculation of leakage, deadweight, displacement and multiplier effects

The section above outlines the potential for the development to generate jobs in both the construction of the canal and the wider impacts on the local economy. However, it is necessary to consider if these jobs may be merely replacing jobs in other nearby areas or may employ people from outside of the local area. Thus, the relative additionality of this employment is considered within this section.

The approach taken to identify the 'additionality' employment's impact on the development closely follows the English Partnerships' recommended approach to assessing the economic impact of projects recently set out in their guide to additionally. This approach seeks to identify both the gross impact and the net additional impacts of a particular project or proposal.

The starting point for this approach to economic impact appraisal is to identify gross direct impact, i.e. in the case of employment impacts, the number of jobs directly created by the proposed project. To identify the net impact (the actual additional impact of the project upon the economy) a number of factors need to be taken into account, as shown in the adjacent diagram.

leakage – the proportion of outputs, which benefit those outside the project's target area

dead-weight – the outputs which would have occurred anyway without the project

displacement/substitution – the proportion of the project's outputs accounted for by reduced outputs elsewhere in the target area

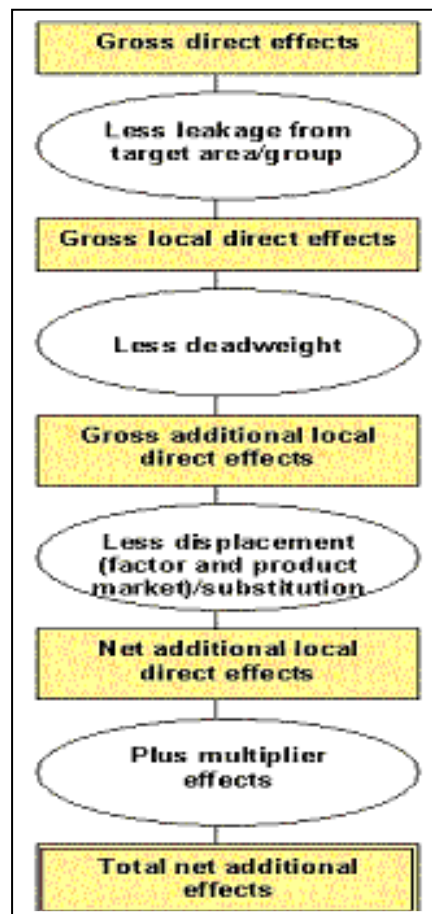
supply (or indirect) multiplier – the impact of project expenditure on demand for local suppliers' goods and services

income (or induced) multiplier – the impact of increased local income resulting from the project being spent on local goods and services.

In calculating the value and nature of the impacts arising from redevelopment, it has been necessary to start with a number of working assumptions and parameters. Where assumptions have been necessary, these are duly outlined and explained in the text. Where employment multipliers have been used, again this is duly outlined and justification provided.

Examples of the potential indirect benefits that accrue from the development of the Hatherton canal could include development benefits such as:

- Indirect employment and income - employment and income generated in the economy of southern Staffordshire and the West Midlands in the chain of suppliers of goods and services to the direct activities (both on and off the canal).



- Induced employment and income - employment and income generated in the southern Staffordshire and the West Midlands economy by the spending of incomes by the direct and indirect employees.

Other aspects that might be important for Hatherton and the surrounding area, and which could result in additional employment are:

- Property development – there will be opportunities for property development along the canal path in terms of additional residential units, leisure space or commercial land. Development will be limited where the canal route passes through Green Belt due to planning constraints, however the canal also passes large brownfield areas for which permission for development would be easier to obtain.
- Accommodation provision – extra hotels, guest houses, bed & breakfasts, camping sites, etc.
- Related entertainment – existing restaurants, cafés, bars, nightclubs, etc. could take on more staff or new entertainment facilities could perhaps be provided.
- Attractions – there could be increased demand for museums, galleries, exhibitions, parks, etc. in the area.
- Other leisure facilities – sports facilities, riding centres, nature trails, etc. could be provided.

13.3.2 Breakdown of Canal Users

The methodology adopted in this study follows that employed by the British Waterways Economic Development Unit and the Coopers & Lybrand 1996 study of the Kennet & Avon Canal.

British Waterways undertook a collection of national primary survey data on the UK's inland waterways in the early 1990s. The Arup team has reviewed these datasets and where appropriate updated them to 2004 prices so that the current economic impact of the inland waterways can be assessed.

Directly attributable leisure and tourist activity using inland waterways can be broken down into the following sub-categories:

- Private powered boats
- Timeshare boats
- Hire boats
- Trip boats
- Day boats
- Hotel boats
- Restaurant boats
- Canoeists and un-powered boat owners;
- Anglers
- Cyclists and informal visitors (day and holiday trips).

These categories of canal users have been assessed in turn in order to estimate the economic impact of the redevelopment of the canal.

13.4 Calculation of the Economic Impact

13.4.1 Private Boats

Private boats can be broken down into two sub-categories; boats on passage and boats moored along the waterway. In terms of those boats passing along the canal, the Hatherton waterway will form a key linkage in the local waterway network between the Staffordshire and Worcestershire canal and the BCN. According to the BW boat model data there are expected to be some 2,227 private boat movements by visiting boats along the Hatherton canal a year (we have assumed, following conversations with British Waterways, that the number of boat journeys has increased by 20% over the previous calculation of the BW boat model run in 1994).

According to the BW boat model, an average of 0.95 days will be spent on the Hatherton canal by private visiting boats, each of which has an average of 3.5 people on board. With an average spend of £8.60 (updated to 2004 prices from the 1994 price estimate given in the BW boat model) the total annual spend by visiting boats is estimated to be £63,672.

Boats based permanently on the Hatherton Canal: it is assumed that there are 180 (again 20% higher than in 1994) privately-owned boats with moorings along the 10.2km stretch of the canal, although not all of them will be moored at any one time. According to the BW Log Book Survey an average of 43 cruising days will be spent per year per boat. If we assume the same average spend as for the visiting boats of £8.60 with an average of 3 people on board, then the estimated yearly spend by private powered boats based on the canal is, in 2004 prices, £49,911.

Owners of these boats were also found by the BW Log Book Survey to undertake non-cruising visits. On average, private boat owners undertook 6 non-cruising visits per boat per year, each lasting an average of 1.5 days. Mean spend per person per day at 2004 prices is £10.29 and average occupancy was 2 people per boat. Total non-cruising spend by private powered boats can therefore be calculated to be £33,353 p.a.

There are costs associated with running boats and these costs would most likely be paid to local service or supply companies. The Waterways World data updated to 2004 prices found that private powerboat operators spend on average £2,034 per annum on their boats. This cost includes the mooring and licensing fees plus other care-related expenditures. Thus, the 180 private boats moored along the Hatherton waterway could account for £366,133 in boat-related expenditure.

The cost of travel to and from the moored boats, which is assumed to be by car, is assumed to be spent locally for trips that are less than 20 miles. 65% of trips to/from the canal are less than 20 miles according to the Kennet and Avon Boating Survey of 1990. A vehicle cost (full car cost) of £0.46 per mile and an average round trip of 15 miles (for those journeys that are less than 20 miles) are assumed. The estimated annual cost of travel that accrues to the local economy is £12,051.

Total private powered boat spend per annum of both moving and moored boats can therefore be calculated to be £525,120.

Table 13.4.1: Private Boat Spend

Private Boats	Annual Spend
Visiting Boats	£63,672
Moored boats, of which	£461,448
Boat movements	£49,911
Non-cruising visits	£33,353
Boat running costs (Boat spending)	£366,133
Travel to/from boat	£12,051
Total – All private boats	£525,120

13.4.2 Hire and Timeshare boats

The 1990 Hire Boat Survey found that for hire boats, there was an average of 4.1 people per boat, each spending £14.39 per day. With 2,507 boats passing through the Hatherton canal spending an average of 1.1 days, the annual estimated spend in 2004 prices is £135,822.

As for the cost of a hiring a boat for a holiday on the canal, we assume that there are 29 boats available for hire that will be moored on the Hatherton canal. With a 26 week hire season and 6 days utilisation and 1 day turnaround there will be approximately 150 days of use per boat, of which the BW boat model assumes that 20% will be spent on the Hatherton canal. If we again assume that visitors to the canal will each spend £14.39 per day and that there are 4.1 people per boat then we calculate that the total spend by moored boats available for hire per annum will be £42,557.

If, using the BW boat model assumption of £788 for the hire of a 4 berth boat for 7 days, we again estimate that the 29 canal boats will be hired for 26 weeks of the year then the total annual spend is £590,019.

Total annual spend due to powered hire boats is therefore calculated as £768,398.

Timeshare boats are a more recent development that are providing an alternative to some hire boats and may be assumed to generate a similar spend, although in practice they tend to be used for a much longer season and could therefore increase the above figures, particularly in the otherwise quieter winter period.

Table 13.4.2: Hire Boat Spend

Hire Boats	Annual Spend
Visiting boats	£135,822
Moored boats, of which:	£632,576
Boat movement	£42,557
Holiday cost (Boat spending)	£590,019
Total – All hire boats	£768,398

13.4.3 Day hire boats

We assume, as the 1994 BW boat model does, that there will be no day hire boats, trip boats or restaurant boats based on the Hatherton canal. However, there could be additional spending from this source.

13.4.4 Canoeing/ un-powered boats

Information on canoeing and un-powered boat activity on the Hatherton canal is based on averages calculated for the BW Midlands Region waterways. There are an expected 500 visits per kilometre per year, each spending £3.56. The BW boat model assumed a canal length of 12km, whereas, according to our calculations, the distance is in fact 10.2km. We have, therefore, adjusted some of the calculations that are based on the number of visits per kilometre such as un-powered boats, anglers and informal visitors. This gives an estimated annual spend of £18,141.

13.4.5 Anglers

As with unpowered boats, angling activity rates and spending levels are based on the estimates derived by the BW National Count for the Midlands Region carried out in 1989. However, in the absence of more up to date information and given that we are updating the estimated spend levels to 2004 prices, we have continued to use their assumptions here. We expect 3,600 angling visits per kilometre along the 10.2km length of the canal, of which 16% would not have gone fishing but for the canal, and who spend £5.11. This gives a total estimated annual angling spend of £30,032.

13.4.6 Informal Visitors/ Cycling

In addition to boating-related leisure and tourist activity and angling/cycling activity attracted to the waterways, there are substantial numbers of walkers, cyclists and day trippers. Based on the BW boat model, we assume that there will be an average density of 36,900 informal visitors a year per kilometre, of which 29% would not have gone anywhere in the region were it not for the existence of the canal. Each is expected to spend £3.56, which gives a total informal visitor spend per annum of £388,417. Total other canal spending is, therefore, £436,417.

Table 13.4.6a: Other Spending

Other Spending	Annual Spend
Day hire boats	£0
Un-powered boats	£18,141
Anglers	£30,032
Informal visitors	£388,244
Total – Other spending	£436,417

The total spend from all uses of the canal including private boats, hire boats and other users is, therefore, £1.73m.

Table 13.4.6b: Total Canal Spend

Total canal spending	annual spend
Private boats	£525,120
Hire boats	£768,398
Other spending	£436,417
Total Canal Spending	£1,729,935

13.5 Operational Employment Impacts

Having identified spend attributable to the canal development, it is possible to estimate the numbers of local jobs supported by this spend. The most appropriate multiplier dataset available is the urban tourism spend multiplier derived from the 1992 Scottish Tourism Multiplier Study. This study estimated that for every £33,500 of attributable visitor spend and £67,000 of attributable boat spend, one attributable Full Time Equivalent (FTE) job was created (this has been scaled up to 2004 prices). We have calculated boat spend as the sum total of private boat running costs and hire boat holiday costs (that is, the spending on boat hire), or £366,133 plus £590,019. The remainder of canal-related spending is visitor spending as shown in Table 13.5a.

Table 13.5a: Split of canal spending

Spending Split	Visitor Spend	Boat Spend
Annual spend	773,783	956,152
Jobs created	23	14

Boat spend should, therefore, equate to 14 FTEs and visitor spend would create 23 FTEs. A summary of the income and employment impacts is shown in Table 13.5b below.

Of the 37 jobs created we anticipate that 25%, or 9 jobs, will go to employees based outside of the Cannock area, while 14 will be lost due to deadweight and displacement impacts (an adjustment has been made for those outputs that would have occurred anyway without the project and those accounted for by reduced outputs elsewhere in the target area). Allowing for rounding, this gives a net direct job creation of 14 jobs.

Table 13.5b: Direct employment creation

	Visitor Spend	Boat Spend
Direct jobs created	23.0	14.2
Adjustment for leakage	-5.8	-3.6
Adjustment for displacement & deadweight	-8.6	-5.3
Net direct employment impact	8.6	5.3

Using multipliers from the Scottish Executive we calculate that these 14 jobs will lead to the creation of a further 11 jobs as a result of indirect and induced effects. The sum total effect is that visitor spending will create 11.0 FTE jobs, while boat spending will create 14.1 FTE's and a total of 25.1 FTE jobs.

Table 13.5c: Multiplier effects

	Visitor Spend	Boat Spend
Net direct jobs	8.6	5.3
Indirect jobs	1.4	5.3
Induced jobs	1.0	3.5
Total net FTE's created	11.0	14.1

Visitor spend used Scottish Executive's indirect multiplier of 1.16 and an induced multiplier of 1.27. Boat spend used multipliers of 2.00 and 2.66.

13.6 Construction Impact

The total construction and commissioning cost of the project is estimated to be approximately £48.7 million. The total capital expenditure (including materials, labour and professional services) is used to calculate the construction employment associated with that expenditure. This is based upon consideration of the average 'gross' output per employee per year in the UK construction industry; a figure provided by the Office of National Statistics (ONS). The direct construction-related employment impacts have been estimated on the basis of a 2001 average gross output (GVA) per employee in the West Midlands of £38,184.

The total cost of construction is forecasted to be £48.7 million. Dividing this construction cost by the average 'gross' output per employee per year in the UK construction industry gives a total number of 1,276 job years. The jobs created are conventionally referred to in 'job years' since they are temporary in nature and cease upon the completion of fabrication, construction and commissioning.

Employment studies typically consider that one full time equivalent (FTE) job comprises 10 construction job years. Thus the gross impact of 1,276 job years translates to 128 FTE (full time equivalent) jobs created and supported as a direct result of the proposed development.

Of these 128 FTE construction jobs, we assume that 25% or 32.0 jobs will be sourced from outside of the West Midlands region, leaving a net 96.0 jobs in the area. There are no other plans for the canal route so there will be no deadweight impact. We further assume that there will be a displacement factor of 25%, equivalent to a further 32.0 jobs since there is sufficient capacity within the local economy to absorb more employment and few people will have to leave other jobs in the area in order to take up canal-related construction. The total net effect is, therefore, for an extra 64.0 jobs.

Table 13.6a: Direct construction employment creation

	Employment
Direct FTE's	128.0
Adjustment for leakage	-32.0
Adjustment for deadweight and displacement	-32.0
Net FTE jobs created	64.0

These 64.0 jobs will, however, generate a knock-on effect on the economy. Using multipliers from the Scottish Executive input-output model published January 2004, we calculate that these 64.0 direct construction jobs will lead to the creation of a further 49.9 indirect jobs and 19.9 induced jobs. After rounding this gives a total net employment effect from construction of 133.8 FTE jobs.

Table 13.6b: Construction multiplier effects

	Employment
Net direct jobs	64.0
Indirect jobs	49.9
Induced jobs	19.9

Total net construction FTE's created	133.8
--------------------------------------	-------

Scottish Executive multipliers were used of 1.78 for indirect jobs and 2.09 for induced jobs.

13.7 Consultations

Canals have proved to be key components in the regeneration of many UK towns by assisting in the creation of new commercial, leisure and residential areas. In addition, they have created new jobs and have increased tourism levels through a variety of sources. We undertook consultations with the majority of the relevant local bodies with a view to examining these issues while also informing our study and ascertaining the local view on the redevelopment of the canal. Consultees included Local Authorities, the County Council and the Regional Development Agency.

The prospect of redevelopment of the canal was positively received by consultees and it was thought that there was a generally positive attitude towards canals among local residents. In view of the fact that Staffordshire has more miles of canal than any other shire county and that it, therefore, represents an important part of the area's heritage, this is unsurprising. This was seen as being particularly important for Walsall and Stoke-on-Trent, given the way that communities have developed around mining and industry and, therefore, the canal network.

In terms of the likely demand for the canal, it was felt by respondents that the Hatherton Canal could see a significant amount of boat traffic and that it would have a positive impact on the local economy. This was expected not just in the immediate canal area, but also in nearby towns and villages as people take the opportunity to moor their boats and explore further inland. For example the provision of extra mooring facilities in nearby Rugeley, on the Trent & Mersey canal was quoted as a significant factor in bringing extra business into the nearby town. Furthermore, with the positive environmental image that canals generally have, it was felt that there would also be a demand for informal uses such as cycling and walking.

The re-opening of the canal is likely to prove particularly important for Walsall. At present there is no canal route out of Walsall borough to the North, however, should the Hatherton Canal be re-opened it was felt that Walsall could become a halfway point for journeys between Birmingham and the North via the Wyrley & Essington canal. This could provide an important catalyst for regeneration, particularly of the Brownhills area. The potential of canals and of waterfronts in general to help regenerate areas is particularly apparent in Birmingham, with developments such as Brindley Place being based around canals.

The potential for regeneration could be particularly important in terms of encouraging new residential and commercial developments. Reflecting the heritage of canals, much of the land in the immediate vicinity is currently used by industrial companies, many of which have struggled in recent years. It was suggested that canals could help to encourage the diversification of the local economy by providing an attractive environment for businesses from other sectors to set up, while also encouraging labour to move to the area.

13.8 Wider Impact

Our assessment of the impact of the redevelopment of Hatherton canal focuses on identifying direct and indirect impacts, and is typically expressed in terms of 'additional' or 'gross' employment created using the methodology discussed above. This approach allows stakeholders to consider the relative attractiveness of different development options or public policy interventions in terms of quantifiable employment impacts.

However, in order to more fully assess the economic impact of the proposals, we have briefly outlined some of the wider economic factors that should also be taken into

consideration, in addition to those impacts expressed in terms of employment, and upon which the proposal could have an influence. These wider impacts are often difficult to quantify and sometimes can only be identified or assessed on a qualitative basis.

Improvements to canals have been shown to bring forward/speed up the development of previously under-used or vacant sites. Accordingly canal developments are usually underpinned by the regeneration strategies of public authorities, usually at a local level. Canals can, for example, assist in the creation of new commercial, leisure and residential areas. They can also create new jobs and increase tourism levels. In so doing they can help to raise the profile of an area. It has further been shown that the presence of a waterway such as a canal can help to raise the value of residential property, both for properties bordering the canal and those in the near vicinity.

Canals are more likely to attract residential, retail or leisure uses as opposed to industrial developments. The increase in residents could have an indirect impact on local businesses through their spending.

Parts of the route that the proposed Hatherton canal will take run close to industrial locations, such as that around Churchbridge. The re-opening of the canal, particularly in these locations can help to improve the environment of the area and, therefore, its image to visitors. The redevelopment of the canal can potentially also have an impact on the tourism market, not just in nearby locations, but also as a result of the improved overall impression of the whole region. This is particularly the case when compared to the 'do nothing' scenario, whereby the canal remains in disrepair and dereliction.

13.9 Economic Impact Assessment Conclusions

Table 13.9 provides a summary of the likely employment impact of the proposed redevelopment of the Hatherton canal. Total operational jobs created by boat and visitor spending equate to 14 direct jobs, with a further 11 created through second round operational and induced effects resulting in a total of 25 operational full time equivalent jobs.

The construction of the canal with an estimated cost of £48.7mn is likely to lead after adjustments for leakage, deadweight and displacement effects to the direct creation of 64 FTE jobs. In the case of construction, indirect and induced effects will lead to the formation of a further 69.8 jobs and a total of 133.8. Adding construction and operational employment together leads to a sum total employment creation estimate of 158.9 FTE jobs.

Table 13.9: Summary employment impact

Summary	Number of FTE's
Direct operational FTE's created	13.9
Operational indirect and induced FTE's	11.2
Total net operational FTE's created	25.1
Direct construction FTE's created	64.0
Construction indirect and induced FTE's	69.8
Total net construction FTE's created	133.8
GRAND TOTAL EMPLOYMENT	158.9

14 COST ESTIMATE

A cost estimate has been undertaken for the Hatherton Canal using a combination of rates from standard civil engineering costing guides, rates obtained from other similar canal schemes and specific schemes currently being developed by British Waterways, such as the Cotswolds and Droitwich Canal Restoration schemes.

14.1 Summary

The summary of the Cost Estimate indicated a value of **£48,721,000**. Please refer to appendix D for the detail of the summary.

14.1.1 Basis of Estimate

The following assumptions have been made in the development of the cost estimate:-

- Cost estimate represents 2005 Q1 prices;
- A combined percentage allowance of 23% has been added to allow for a number of specific risks and general contingency as identified in the summary cost estimate in appendix D;
- Contractors preliminaries have been included at 20%;
- The construction works would be let as a single works contract;
- A standard cost allowance has been included for all new locks, assuming the following design features:-
 - Structure to be reinforced concrete;
 - Length 26.3m;
 - Internal width 2.3 m;
 - Depth 4.3 m;
- The following assumptions have been used for the disposal of the canal excavated and dredged material:-
 - 20% of the material excavated from the canal channel may be contaminated and therefore will require special disposal off-site. This is based upon sections of the canal passing through former mine collieries;
 - 30% to be disposed of off-site but not contaminated;
 - Remaining 50% of the material will be disposed of on site by use within the canal infrastructure i.e. embankments or spread across adjacent land;
- Bridges have been estimated as reinforced concrete culverts with concrete wing walls;
- Puddle clay lining has been assumed, however if this is not available a bentonite mattress may need to be used

14.1.2 Canal Channel

The works to the Canal Channel represents over 40% of the overall total of the cost estimate, as detailed in Appendix D. The principle items and quantities of the channel works are summarised as included in the following table:-

Principle Item	Quantity
Steel sheet piling	59,600 m ²
Puddle clay	40,800 m ³
Excavated material	372,400 m ³
Dredging	124,200 m ³
Fill material	7,700 m ³
Rock filling	3,200 m ³
Disposal of contaminated material	97,800 m ³
Disposal off-site (non- contaminated)	146,600 m ³
Disposal on-site	244,400 m ³
Capping beam detail	3,000 m
Towpath	22,900 m ²
Hazel faggots	8,700 m

14.2 General Exclusions

The cost estimate excluded the following items:-

- Landowner Compensation;
- Value Added Tax;
- Fees To Local Authorities;
- Survey And Investigation Costs;
- Inflation Costs;
- Design And Construction Supervision Fees;

14.3 Risk/Contingency Allowance

A general risk/contingency allowance has been included in addition to a specific risk allowance of £3,525,000 for items as described below.

14.3.1 Specific Risk Items

During the undertaking of this cost estimate, several specific risk items have been identified which could significantly affect the final outturn cost of the canal refurbishment. These items are outlined in the table below with an indication of their potential cost implications. The total value has been included in the assessment of the risk/contingency allowance as included in the cost estimate summary sheet.

Specific Risk Item	Potential Cost
<p>Contaminated Land</p> <p>The degree of contaminated land is unknown until a full ground investigation has been undertaken. However, an increase of 5% in the anticipated 20% would have a significant affect on the final cost.</p>	£2,500,000
<p>Culvert Capacities</p> <p>Should hydraulic modelling show the M6 Toll and the David Suchet tunnel cannot accommodate both the canal and existing watercourses, then additional flood culverts may be required to be constructed adjacent to them.</p>	£675,000
<p>Creation of Offline Reserves</p> <p>Should inline reserves not be acceptable for the protection of the floating water plantain in the Cannock Extension Canal, sections of the Canal may need to be rerouted parallel to the existing canal thereby creating offline reserves</p>	£350,000
<p>Effects of subsidence</p> <p>Possible impact on canal excavation profile due to presence of abandoned mine workings.</p>	Not possible to identify at this stage
<p>Specific Risk Cost</p>	£3,525,000

15 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, it is felt that there is a definable and feasible route for the Hatherton Canal Restoration between Calf Heath and the Cannock Extension Canal. The restoration of the canal will bring a much needed feature to the region with some significant opportunities for amenity and leisure opportunities. It will also restore the waterway link between Staffordshire and the West Midlands. However, this study has identified some specific challenges which need to be addressed in order to enable the scheme to be realised.

The current route has been defined using Ordnance Survey plans and level data. However, there are 5 locations along the currently defined route which will need much closer investigation to fully identify the engineering required to enable the canal to pass these complex areas. It is recommended that specific studies be undertaken at the following strategic locations, with detailed topographic, geotechnical and hydraulic information being obtained: -

Key Constraints Table	
1	The crossing of the Straight Mile and the M6 Motorway (chainages 0+600 and 0+800) that is likely to be affected by the Highways Agency's proposals for the widening of the M6 motorway or the development of a new M6 Expressway.
2	The length adjacent to the Severn Trent lagoons (Chainage 3+800 to 4+100) needs further investigation in terms of how the canal interacts with the STW outfall and how the Ridings Brook crosses the alignment.
3	The area between Walkmill Lane (Chainage 4+700) and the Walsall to Rugeley Railway (Chainage 5+500). The main issues in this length are the interaction between the canal and the Wyrley Brook, and the crossing of the two water courses beneath the M6 Toll motorway.
4	The area between the Walsall to Rugeley Railway (Chainage 5+500) and the eastern end of the David Suchet Tunnel where the Wash Brook passes back under the A5 (Chainage 6+200). Again the issue of how the canal interacts with the Wash Brook needs to be studied, as well as how the two water courses pass through the David Suchet Tunnel.
5	The crossing of the Wash Brook at chainage 6+640.

In addition to the engineering issues it is considered inevitable that there will be some impact to and loss of habitats and species along the route. The most critical of these impacts is that of the Floating Water Plantain in the Cannock Extension Canal. However, it is likely that the restored canal will also provide additional habitat, and could also afford additional environmental improvements that should more than compensate for what may be lost in the short term. In addition, the canal will create a new wildlife corridor through the quite urbanised areas from Churchbridge to the Wolverhampton Road.

A full consultation exercise and suite of ecological surveys (at an appropriate time of year) will be necessary to inform any environmental impact assessment which will be required for any future planning application. The assessment is the next necessary stage of works in relation to the environmental issues, and should not only consider the proposed route but also alternative, potentially less environmentally sensitive routes.

It is imperative that regular contact be maintained with organisations such as English Nature and the Environment Agency at all stages of the proposals, and that other local organisations are consulted as the scheme's proposals become more detailed. This early

input to project design and phasing, for example, will be invaluable in containing future costs and complications to the project and in ensuring that the important ecological and environmental interests of the route are maintained.

In addition to the environmental benefits the canal will bring to the area in the long term, the canal will also lead to an equivalent of some 159 full time jobs being created in the area, through increased visitor numbers, establishment of new canal side businesses, and the construction and operation of the canal itself.

It is therefore concluded that the restoration of this canal will bring environmental, economical and social benefits to the areas through which it passes.

Appendix A

**Schedule of Service
Crossings**

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
BT	393483 308518 to 393502 308564	0+012 to 0+038	underground cable	Runs diagonally across route then follows route until 393563 308594 ch.0+118	Under existing Hatherton Branch canal - Service should not be affected by scoped works.
BT	394000 308800 to 394199 308803	0+695 to 0+711	underground cable	Cable runs horizontally under M6/canal etc possibly within 25m of route to the south	Trial pitting required to locate during detailed design phase - Possible diversion required.
Severn Trent Water Plc	393525 308562	0+068	public gravity sewer	150mm pipe crosses proposed route	Under existing Hatherton Branch canal - Service should not be affected by scoped works.
Severn Trent Water Plc	393525 308562	0+068	combined use pressure sewer	150mm pipe crosses proposed route	Under existing Hatherton Branch canal - Service should not be affected by scoped works.
Severn Trent Water Plc	393723 308610	0+270	combine gravity sewer	150mm pipe within 25m of existing route, flows S then NE, along Queens Road, within 50m of proposed Route	Route is clearly defined at this location by existing canal - No affect on service anticipated.
Severn Trent Water Plc	393723 308610	0+270	combine gravity sewer	150mm pipe within 25m of existing route	Route is clearly defined at this location by existing canal - No affect on service anticipated.
South Staffordshire Water	393525 308562	0+068	water main	4" diameter pipe crossing existing route along Kings Road. The pipe follows along Queens Road and joins another main on the Straight mile	Under existing Hatherton Branch canal - Service should not be affected by scoped works.
South Staffordshire Water	394052 308803	0+650	water main	4" diameter pipe crossing existing route	Minor arterial service, diversion should be relatively easy.

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
	394401 308803	1+050	water main	4" diameter pipe crossing existing route	Pipe crosses parallel to Oak Lane bridge - by inspection pipe looks high enough for navigation beneath.
Central Networks	393525 308562	0+065	overhead cable	Overhead cable runs along Kings Road	No direct effect, though should be considered for planning of construction activities.
Central Networks	393600 308570	1+160	underground cable	240 v cable runs behind Lock Cottage	No impact anticipated
Central Networks	393724 308600	0+260	conduit	Conduit marked on electricity plan. 240 v main then appears to head south towards Queens Road	Under existing Hatherton Branch canal - Service should not be affected by scoped works.
Central Networks	394075 308823	0+660	overhead cable	crosses route	No direct effect, though should be considered for planning of construction activities.
Central Networks	394181 308879	0+800	overhead cable	crosses route	No direct effect, though should be considered for planning of construction activities.
Central Networks	394130 308826	0+710	underground cable	underground cable runs east - west to the south of route under M6, within 20m of route	No direct effect, though should be considered for planning of construction activities.
Central Networks	394400 308980	1+060	overhead cable	Cable runs north -south away from route. Begins within 20m of route	No direct effect, though should be considered for planning of construction activities.

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
South Staffordshire Water	395624 308948	2+300	water main	4" pipe follows Wood Lane within 20m of existing Saredon Brook. Remote from proposed route of canal at the moment	No impact anticipated
Tansco	396714 308954	3+421	low pressure gas main	8" pipe crosses route, with a 3" spurs to the south and north lying within 25m	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal
BT	396715 308958	3+421	underground cable	crosses route	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal
BT	396734 308951	3+439	underground cable	crosses route	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
Severn Trent Water Plc	396717 308953	3+420	surface gravity sewer	150mm crosses proposed route	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal
Severn Trent Water Plc	396717 308953	3+420	Combine Gravity Sewer	150mm crosses proposed route	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal
Severn Trent Water Plc	396717 308953	3+420	culverted watercourse	Culvert north of proposed route	No impact anticipated
South Staffordshire Water	396714 308594 to 396734 308949	3+420 to 3+440	water main	2 water mains cross route on Wolverhampton Road	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal
South Staffordshire Water	396789 308945 to 396932 308888	3+493 to 3+650	water main	6" pipe runs e-w along route within 20m	No impact anticipated, though some local diversion may be required

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
Central Networks	396726 308950	3+435	electricity cables	33kv and 11 kv cables running up and down Wolverhampton Road, both sides of the road, crossing route. Then conduit runs alongside the proposed route on the north side of the route. Finally lots of small feed mains cables to the north of the route. All underground	Within Wolverhampton Road which the canal passes under. Trial pit required to determine depth of service, however service is likely to require diversion over the new culvert for the canal
Tansco	397625 308208	4+676	MP gas main	18" pipe crosses route running north to south	Within Walkmill Lane, which runs well above canal WL - No impact anticipated except in the selection of construction techniques.
Tansco	397642 308183	4+700	low pressure gas mains	Pipe crosses route then pipeline runs alongside route (bottom of Walkmill Way to the north) diameter unknown	Trial pitting required to locate during detailed design phase -diversion likely.
Severn Trent Water Plc	397124 308754	3+880	combined public gravity sewer	225m pipe flows towards canal from North	Siphon or pumping required to negotiate canal line.
Severn Trent Water Plc	397286 308654	4+068	culverted watercourse	Flows towards route	Watercourse to be siphoned under canal, or similar method used.
Severn Trent Water Plc	397570 308252	4+600	surface gravity sewer	Inflow from South	Outfall into canal or siphon under to outfall into brook
Severn Trent Water Plc	397578 308245	4+600	surface gravity sewer	975mm pipe crosses proposed route	Outfall into canal or siphon under to outfall into brook

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
Severn Trent Water Plc	397823 308191	4+873	combined gravity sewer	225mm pipe on right hand side of proposed route within 25m, proceeds East for 20m, then bears NE for 50m then south	No direct effect considered
Severn Trent Water Plc	397897 308191 to 397989 308012	4+900 to 5+058	abandoned sewer	375mm sewer within 25m of proposed route on left hand side of route	Check with Severn Trent this sewer can be removed.
Severn Trent Water Plc	397993 308106	5+058	combined gravity sewer	225mm crosses proposed route	Diversion required
South Staffordshire Water	397634 308203	4+682	water main	160mm runs n-s crosses route	Within Walkmill Lane, which runs well above canal WL - No impact anticipated except in the selection of construction techniques.
South Staffordshire Water	397726 308217 to 397870 308185	4+768 to 4+920	water main	100mm pipe runs along Walkmill Lane within 25m of route	No direct effect considered
Central Networks	397634 308203	4+685	electricity main	Underground cable runs along left hand side of Walkmill Lane (looking north) and crosses route. Then various conduits marked along bottom of Walkmill Way and a major 275 kv main shown running east - west north of industrial units on Walkmill way.	Within Walkmill Lane, which runs well above canal WL - No impact anticipated except in the selection of construction techniques.
Central Networks	397406 308367 to 397567 308261	4+400 to 4+592	electricity main	Major underground cable shown following route after coming in from west	Not thought to be a problem as canal will follow route of existing brook line at this location.

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
Central Networks	397489 308329 to 397633 308206	4+495 to 4+645	electricity main	Another major cable follows route coming in from east	Not thought to be a problem as canal will follow route of existing brook line at this location.
Central Networks	397567 308261	4+592	electricity main	Other cable running within 10m of route	Not thought to be a problem as canal will follow route of existing brook line at this location.
National Grids	397571 308256	4+600	overhead cable	Cable crosses	No direct effect, though should be considered for planning of construction activities.
Tansco	398634 308236	5+745	low and medium pressure gas mains	12"medium pressure main and 10" low pressure main cross route and then head south	Trial pitting required to locate during detailed design phase - Diversion probably required due to lack of space in this area.
Tansco	398736 308230 to 398890 308160	5+845 to 6+020	low and medium pressure gas mains	12"medium pressure main and 10" low pressure main within 50m on Southside	May be affected by Brook diversion works - Diversion likely to be required.
Energis	398761 308250	5+900	telecommunications cable	Cable crosses route	Trial pitting required to locate during detailed design phase -diversion likely.
Energis	398548 308125	5+655	telecommunications cable	Cable crosses route and then carries along near side of Watling Street	Trial pitting required to locate during detailed design phase -diversion likely.
BT	398458 308169	5+560	underground cables	Cables in vicinity of route	May be affected by Brook diversion works - Diversion likely to be required.
BT	398925 308185 to 399435 307985	6+000 to 6+440	underground cables	Cables follows route	May be affected by Brook diversion works - Diversion likely to be required.

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
Severn Trent Water Plc	397989 308012 to 398378 308072	5+058 to 5+451	combined gravity sewer	225mm to 600mm pipe runs alongside route within 25m of excavation on left hand side	May be affected by canal or Brook diversion works - Diversion likely to be required.
Severn Trent Water Plc	398480 308183	5+580	combined pressurised sewer	300mm pipe within 25m of route heads ENE towards A5 (on east side)	Works may affect sewer, though diversion should be relatively straight forward due to pressurised nature.
Severn Trent Water Plc	398480 308183	5+580	abandoned sewer	150mm pipe follows proposed route for approximately 50m 9 on east side)	Check with Severn Trent this sewer can be removed.
Severn Trent Water Plc	398577 308218	5+680	combined gravity sewer	300mm pipe crosses proposed route, then heads east along route for approx 50m before turning south	May be affected by canal or Brook diversion works - Diversion likely to be required.
South Staffordshire Water	398605 308230	5+720	water main	600mm pipe laid in 1080mm duct crosses route	May be affected by canal or Brook diversion works - Diversion likely to be required.
South Staffordshire Water	398729 308226 to 398866 308160	5+850 to 6+000	water main	Pipe runs within 25m of route, to the south, along Watling Street	Trial pitting required to locate during detailed design phase - Possible diversion required.
Central Networks	398383 308069	5+430	electricity cable	Underground cable crosses Wyrley Brook as it flows towards proposed route	May be affected by canal or Brook diversion works - Diversion likely to be required.
Central Networks	398380 308118	5+430	electricity cable	Underground cable crosses proposed route. Cable runs north-south alongside Wash Brook, heads north towards Watling Street	May be affected by canal or Brook diversion works - Diversion likely to be required.

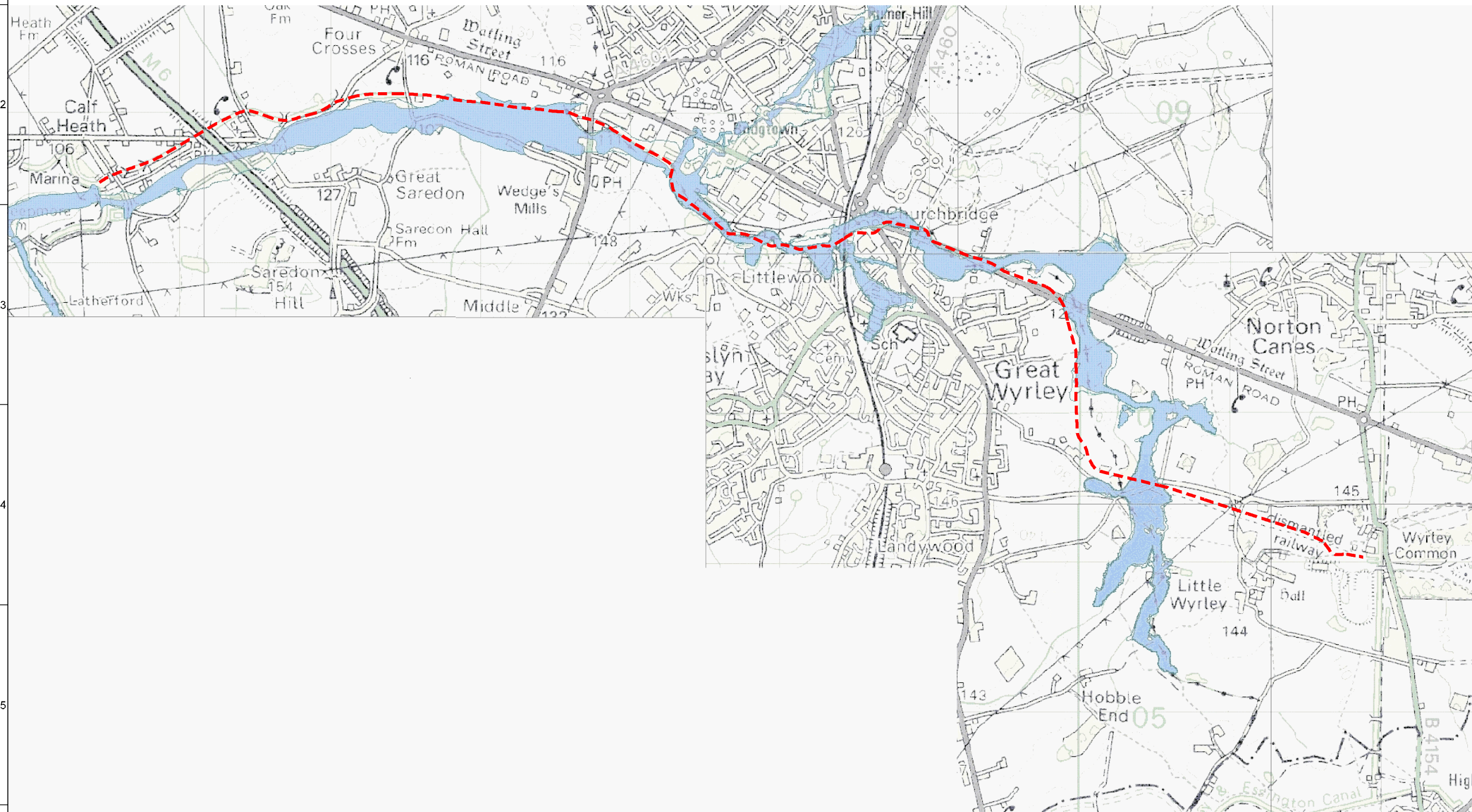
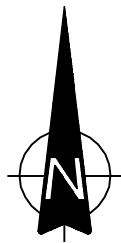
Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
Central Networks	398700 308000	5+800	electricity cable	Concentration of cables in the vicinity of route. Possibility that some have been rerouted due to new road layout and construction of M6(toll). Also cables run nw-se along Watling Street and down Walsall Road.	Trial pitting required to locate during detailed design phase -diversion likely.
Central Networks	398772 308254	5+840	electricity cable	Underground cable crosses proposed route.	Trial pitting required to locate during detailed design phase - Possible diversion required.
National Grids	398548 308210 to 399831 308242	5+650 to 5+940	overhead cable	Route runs under the cables	No direct effect, though should be considered for planning of construction activities.
Tansco	398890 308160 to 399890 307780	6+020 to 7+100	medium pressure gas mains	12"medium pressure pipe, west of route, within 50m, crosses route then runs along north side	Trial pitting required to locate during detailed design phase - Diversion probably required due to lack of space in this area.
BT	398895 308174 to 399576 307868	6+009 to 6+800	underground cable	Cable runs alongside A5	Trial pitting required to locate during detailed design phase - Diversion probably required due to lack of space in this area.
BT	399812 307801	7+040	underground cable	Cable crosses route	Trial pitting required to locate during detailed design phase - Possible diversion required.

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
South Staffordshire Water	399313 308030 to 399448 307978	6+485 to 6+635	water main	Within close proximity of route, pipe runs from Streetway Farm E-W along proposed route. At ch. 6+700 it becomes 600mm pipe south of A5 and follows route to 7+038	Trial pitting required to locate during detailed design phase - Diversion probably required due to lack of space in this area.
Central Networks	399498 307848 to 399633 307843	6+710 to 6+825	electricity cable	Underground cable runs south of proposed route within approximately 50m, then heads north towards proposed route and terminates at 399641 307873 ch. 6+825 , within 10m of proposed route	No direct effect considered
Central Networks	399788 307790 to 399813 307773	7+010 to 7+030	electricity cables	Overhead cables within vicinity of proposed route. Underground cable then runs south along Norton Lane	No direct effect, though should be considered for planning of construction activities.
Tansco	400387 3065457	8+587	LHP mains	Crosses route diagonally	Trial pitting required to locate during detailed design phase - Possible diversion required.
Central Networks	400203 306583 to 400447 306530	8+400 to 8+625	electricity cable	11 kv underground cable runs along route northwest to southeast then joins another cable running south west to northeast and crosses proposed route at 8+625	Trial pitting required to locate during detailed design phase - Possible diversion required.
Severn Trent Water Plc	401495 306204	9+748	Combined Pressurised Sewer	Pipe size not given. Crosses route.	Trial pitting required to locate during detailed design phase - Possible diversion required.

Company	Grid Reference	Chainage	Description of feature	Comments	Mitigation
South Staffordshire Water	401074 306332	9+308	water main	3" pipe crosses route - Wyrley Lane	Trial pitting required to locate during detailed design phase - Possible diversion required if canal does not pass beneath.
South Staffordshire Water	401674 306050 to 401790 306051	9+981 to 10+100	water main	4" follows route along Grove Lane	Trial pitting required to locate during detailed design phase - Possible diversion required.
Central Networks	401066 306340	9+290	electricity cable	Underground cable crosses route - Wyrley Lane	Trial pitting required to locate during detailed design phase - Possible diversion required if canal does not pass beneath.
Central Networks	401163 306306	9+400	electricity cable	Underground cable crosses route	Trial pitting required to locate during detailed design phase - Possible diversion required.

Appendix B

Flood Plain Map



Unauthorised reproduction infringes crown copyright and may lead to prosecution or civil proceedings. Reproduced with the permission of Ordnance Survey on behalf of Her Majesty's Stationery Office. © Crown copyright. All rights reserved. British Waterways Licence Number 100019843.

Key
 - - - - - Indicative route of canal

Notes
 1. Image courtesy of the Environment Agency's website

01	26/06/06	JDW	AW	PS
For Information Only				
Issue	Date	By	Chkd	Appd

ARUP
 The Arup Campus, Blythe Gate, Blythe Valley Park
 Solihull, West Midlands B90 8AE
 T +44(0)121 213 3000 F +44(0)121 213 3001
 www.arup.com

Client

British Waterways
 West Midlands Waterway
 Albert House, Quay Place
 92-93 Edward Street, Birmingham B1 2RA
 T +44(0)121 200 7400 F +44(0)121 200 7401
 www.britishwaterways.co.uk

Promoter

 3 Norfolk Court, Norfolk Road
 Rickmansworth WD3 1LT
 www.hcrt.org.uk

Job Title
Hatherton Canal Restoration

Drawing Title
Indicative Flood Plain Map for Watercourses Adjacent to the Hatherton Canal

Scale at A3
 1:30000

Plot ID
 PlotID

Drawing Status

Information

Job No	Drawing No	Issue
115356-36	C-36-020	01

Appendix C

**Schedule of Landfill
Tax Materials**

Landfill Tax (Qualifying Material) Order SI 1996/1528

The landfill tax came into force on the 1st October 1996. These regulations outline the materials that are eligible for the lower landfill tax fee and gives effect to Section 42 of the Finance Act 1996. The regulations apply to England, Scotland, Wales and Northern Ireland.

The standard rate of landfill tax of £15 per tonne does not apply to certain waste known as "qualifying material", for which the lower rate of £2 per tonne applies. The schedule to these regulations list the qualifying material (often called inert or inactive waste) which carries this lower rate of tax. The material listed in column 2 of the schedule must not be treated as qualifying material unless the conditions laid down in column three are satisfied.

All materials classified as qualifying materials in accordance with this statutory instrument must be described accurately at the site of disposal.

Schedule

Group	Description	Conditions
Group 1	Rocks and soils	Naturally occurring
Group 2	Ceramic or concrete materials	
Group 3	Minerals	Processed or prepared, not used
Group 4	Furnace slags	
Group 5	Ash	
Group 6	Low activity inorganic compounds	
Group 7	Calcium sulphate	Disposed of either at site not licensed to take putrescible waste, or in containment cell which takes only calcium sulphate
Group 8	Calcium hydroxide and brine	Deposited in brine cavity
Group 9	Water	Containing other qualifying material in suspension

Notes

1. Group 1 - includes: clay, sand, gravel, sandstone, limestone, crushed stone, china clay, construction stone, stone from the demolition of buildings or structures, slate, topsoil, peat, silt and dredgings.
2. Group 2 - comprises only the following:
 - Glass
 - Ceramics
 - Concrete.
3. Note for the purpose of Note (2) above:
 - glass includes fritted enamel, but excludes glass fibre and glass-reinforced plastic
 - ceramics includes bricks, bricks and mortar, tiles, clay ware, pottery, china and refractories

- concrete includes reinforced concrete, concrete blocks, breeze blocks and aircrete blocks, but excludes concrete plant washings.
4. Group 3 - comprises only the following:
 - moulding sands
 - clays
 - mineral absorbents
 - man-made mineral fibres
 - silica
 - mica
 - mineral abrasives.
 5. For the purposes of Note (4) above:
 - moulding sands excludes sands containing organic binders
 - clays includes moulding clays and clay absorbents, including Fullers earth and bentonite
 - man-made mineral fibres includes glass fibres, but excludes glass-reinforced plastic and asbestos.
 6. Group 4 – includes:
 - vitrified wastes and residues from thermal processing of minerals where, in either case, the residue is both fused and insoluble
 - slag from waste incineration.
 7. Group 5:
 - comprises only bottom ash and fly ash from wood, coal or waste combustion
 - excludes fly ash from municipal, clinical and hazardous waste incinerators and sewage sludge incinerators.
 8. Group 6 - comprises only titanium dioxide, calcium carbonate, magnesium carbonate, magnesium oxide, magnesium hydroxide, iron oxide, ferric hydroxide, aluminium oxide, aluminium hydroxide and zirconium dioxide.
 9. Group 7 - includes gypsum and calcium sulphate based plasters, but excludes plasterboard.

Appendix D

**Breakdown of Cost
Estimate**

Hatherton Canal Restoration

Cost Estimate
as at August 2006

Appendix D

Total Canal Length (m)

10.2 km

Item	Work Required	Quantity	Unit	Approx Rate	Allowance	% of Total
Earthworks						
Canal channel	Puddle Clay	40,811	m3	£ 35.00	£ 1,428,000	
	Hazel Faggots	8,685	m	£ 30.00	£ 261,000	
	Rock	3,223	m3	£ 20.00	£ 64,000	
	Sheet piling	59,575	m2	£ 94.00	£ 5,600,000	
	Concrete capping beam	2,979	m	£ 345.00	£ 1,028,000	
	Tow Path	22,925	m	£ 15.00	£ 344,000	
	Excavation	372,383	m3	£ 1.50	£ 559,000	
	Dredging	124,128	m3	£ 1.80	£ 223,000	
	Disposal of material on site	244,409	m3	£ 3.00	£ 733,000	
	Fill	7,692	m3	£ 2.00	£ 15,000	
	Disposal (5Km Haul + Land fill Tax)	146,646	m3	£ 9.00	£ 1,320,000	
	Disposal - U2	97,764	m3	£ 95.00	£ 9,288,000	
	Sub Total				£ 20,863,000	42.82%
Structures						
Calf Heath Bottom Lock	General refurbishment	1	Item	£ 25,000.00	£ 25,000	0.05%
Calf Heath Top Lock	Remove existing and reposition dry dock	1	Item	£ 350,000.00	£ 350,000	0.72%
Dog Bridge	New Bridge (culvert 4 x 5 m)	25	m	£ 4,500.00	£ 112,500	0.23%
	Raise road level by 1.5 m	1,500	m2	£ 100.00	£ 150,000	0.31%
	Sheet piling	250	m2	£ 100.00	£ 25,000	0.05%
Straight Mile - new lock	New lock	1	no	£ 200,000.00	£ 200,000	0.41%
M6 Crossing	Jacked Box Culvert.	100	m	£ 9,000.00	£ 900,000	1.85%
Oak Lane Bridge	New Bridge (Culvert).	15	m	£ 4,500.00	£ 67,500	0.14%
	Raise road by 1.3 m	1,500	m2	£ 100.00	£ 150,000	0.31%
Saredon Mill Bridge	Refurbishment to existing bridge.	1	Item	£ 25,000.00	£ 25,000	0.05%
Cross Bridge	New Bridge (Culvert)	15	m	£ 4,500.00	£ 67,500	0.14%
	Temp Road Diversion	1	No	£ 50,000.00	£ 50,000	0.10%
	Raise road by 1.5m	1,500	m2	£ 100.00	£ 150,000	0.31%
Cats Bridge	New Bridge (culvert),	15	m	£ 4,500.00	£ 67,500	0.14%
	Raise road by 2.1m	2,000	m2	£ 100.00	£ 200,000	0.41%
	Sheet piling	1,200	m2	£ 100.00	£ 120,000	0.25%
Meadow Lock	Refurbish existing / Replace with lock 1.7m deep	1	no	£ 275,000.00	£ 275,000	0.56%
Roman Way Hotel (Bridge 8)	Refurbish bridge	1	Item	£ 25,000.00	£ 25,000	0.05%
Wedges Mills and Wolverhampton Road	New Bridge (culvert)	25	m	£ 4,500.00	£ 112,500	0.23%
Wedges Mill Lock	New lock	1	No	£ 200,000.00	£ 200,000	0.41%
	Relocate sub station.	1	Item	£ 100,000.00	£ 100,000	0.21%
	Demolish warehouse.	1	Item	£ 50,000.00	£ 50,000	0.10%
Severn Trent Lagoons	Divert Wryley Brook,	1	Item	£ 30,000.00	£ 30,000	0.06%
	Modify pipe crossings.	1	Item	£ 10,000.00	£ 10,000	0.02%
	New lock	1	No	£ 200,000.00	£ 200,000	0.41%
	Siphon Outfall	1	No	£ 50,000.00	£ 50,000	0.10%
	Siphon Brook	1	No	£ 100,000.00	£ 100,000	0.21%

Hatherton Canal Restoration

Cost Estimate
as at August 2006

Appendix D

Total Canal Length (m)

10.2 km

Item	Work Required	Quantity	Unit	Approx Rate	Allowance	% of Total
Walkmill Lane Bridge	Realign brook	1	Item	£ 30,000.00	£ 30,000	0.06%
Walkmill Lane/M6 crossing	New Bridge (culvert)	35	m	£ 4,500.00	£ 157,500	0.32%
New Reservoir Lock	New lock	1	No	£ 200,000.00	£ 200,000	0.41%
Walsall Railway Crossing	New Jacked Culvert	80	m	£ 9,000.00	£ 720,000	1.48%
New Churchbridge Lock	New Lock	1	No	£ 200,000.00	£ 200,000	0.41%
Streetway Farm Bridge	New Bridge (culvert)	10	m	£ 4,500.00	£ 45,000	0.09%
	Raise road by 1.0 m	1,000	m2	£ 100.00	£ 100,000	0.21%
	New Lock	1	no	£ 200,000.00	£ 200,000	0.41%
	Pedestrian Footbridge	1	no	£ 25,000.00	£ 25,000	0.05%
Wash Brook Siphon	Inverted siphon	1	no	£ 100,000.00	£ 100,000	0.21%
A5 Crossing	New culvert (cut and cover)	100	m	£ 4,500.00	£ 450,000	0.92%
A5 - Gains Lane	3 new locks	3	no	£ 200,000.00	£ 600,000	1.23%
	2 access bridges.	25	m	£ 4,500.00	£ 112,500	0.23%
	New wash brook culvert. 2 x 2 m.	10	Item	£ 2,000.00	£ 20,000	0.04%
Gains Lane Crossing	New bridge (culvert).	15	m	£ 4,500.00	£ 67,500	0.14%
	Raise road by 1.5 m.	1,500	m2	£ 100.00	£ 150,000	0.31%
	Sheet piling	400	m2	£ 100.00	£ 40,000	0.08%
Wryley Lane Crossing	New culvert,	15	m	£ 4,500.00	£ 67,500	0.14%
	7 New Locks	7	no	£ 200,000.00	£ 1,400,000	2.87%
Landfill access road Bridge	New Bridge (Culvert)	15	m	£ 4,500.00	£ 67,500	0.14%
Pedestrian Footbridges to join proposed towpath to Cannock Extension Arm towpath	2Nr Pedestrian Footbridge	2	no	£ 25,000.00	£ 50,000	0.10%
Sub-Total					£ 29,478,000	60.50%
Preliminaries				20%	£ 5,895,600	12.10%
Construction Total					£ 35,373,600	72.60%
Other Items						
Provision of water supply	Water Supply	1	item	£ 1,000,000.00	£ 1,000,000	2.05%
Service Diversions	Service crossings	45	no	£ 12,000.00	£ 540,000	1.11%
Ecology and Landscaping	Provision of ecological and landscaping features	1	item	£ 750,000.00	£ 750,000	1.54%
ESTIMATED COST					£ 37,663,600	77.30%
Specified Risk Item					£ 3,525,000.00	
General Contingency Allowance		20%		£ 7,532,720.00		
Risk and Contingency Allowance					£ 11,057,720	22.70%
TOTAL ESTIMATED COST					£ 48,721,320	100%