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Canal and River Navigations National Overview:
An appraisal of the heritage and archaeology of England's present and former inland navigable waterways

Keith Falconer

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Canal and River Navigations National Overview: An appraisal of the heritage and archaeology of England's present and former inland navigable waterways

Keith Falconer

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ACKNOWLEDGEMENTS

The Overview, and its accompanying Gazetteer, was mostly informed by desk-based research embracing a review of the extensive literature, the internet, national heritage databases and national archives supplemented by material accumulated from occasional fieldwork over the last fifty years. The two main general references have been Paget-Tomlinson (1993) Bradshaw (1904 reprinted 1969) while Priestley (1831 reprinted 1967) provides a check for waterways missing from Bradshaw. These have been supplemented the copious information contained in the fifty years of the Journal of the Railway & Canal Historical Society and by the many books on individual waterways and groups of waterways references to which are made in the Literature review and in the individual entries in the Gazetteer. Wikipedia has also been extensively used as a source of information, cross checked against other sources, and for reference to other internet sources.

Wherever possible, illustrations have been drawn from the online version of Historic England's Images of England Collection which was originally created as a Millennium project by the Royal Commission on the Historical monuments of England and is held in the Historic England Archives in Swindon. These images are copyright of the individual photographers whose names are cited in the captions and grateful thanks is extended to them for providing such a comprehensive snapshot record of listed heritage assets at the beginning of the new century.

Wikipedia has also been extensively used as a source for illustrations which are in the common domain and the intellectual property holders are cited in each case. They are to be thanked for placing this material in the common domain and as are contributors to the Geograph national photographic database. The copyright of theses images rests with the photographers and are licensed for reuse under the site's Creative Commons Licence Similarly, the internet site Pennine Waterways provides detailed virtual tours along many of the waterways of northern England and grateful use has been made of this source to supplement the above sources. Pennine Waterways can be accessed by the caption citation.

Throughout the compilation of the Overview I have benefitted from advice and comment from Nigel Crowe, Head of Heritage at the Canal & River Trust and his team of regional advisors and from access to the Canal & River Trust's Waterways Archive which supplied some of the historic images. The Waterways Archive is the national archive for the canal network and is housed in the National Waterways Museum at Ellesmere Port. This important archive holds a wide range of primary material relating to the history of Britain's canals and inland waterways and more than 22,000 images and 37,000 records can be accessed online.

My requests to the many individual canal societies for information and use of images has universally been met with generous response and these societies are duly credited in the captions. In discussion of the River Thames great use has been made of the material assembled by Michael Truman for his reports to the Environment Agency and English Heritage.

Historic England (as English Heritage) first commissioned an earlier version of this Overview some years ago and have since sought to enhance the interim version of the Overview, which was placed on its website, with explanatory and descriptive images. I am grateful to the steering group, John Cattell, Shane Gould, John Minnis, Tony Calladine, and Eric Branse-Instone for their comments and guidance and to Kath Buxton and Gareth Watkins for their forbearance in the delays in submitting the final product.

EXECUTIVE SUMMARY

The navigable inland waterways that are subject of this Overview constitute an immense heritage resource that has developed over many centuries. It is a resource that has fundamentally changed in its use from a privately and commercially developed transport system for heavy goods to a public leisure and heritage resource enjoyed by wide range of users. It has been subject to periods of great expansion, prolonged decline, contraction and then renaissance. It has witnessed an extraordinary triumph of voluntary enthusiasm and campaigning zeal over official disinterest and obstruction. From years of neglect, abandonment, dereliction and turmoil, a slimmed down waterways system which, through a remarkable partnership of official agencies working with voluntary bodies and with the support of Lottery funding, has emerged as a national treasure.

The **Overview** comprises Two Parts with three Appendices. Part One in three Sections provides the background to the project; a review of the literature pertaining to navigable waterways in England; and an outline of the historical development of the system with an appraisal of the protection of its infrastructure. Part Two is a Gazetteer, arranged alphabetically, of all navigations and canals operating in the 19th century identifying and evaluating their significant structures. Appendix A tabulates the Waterways covered by the Overview, Appendix B is a waterway-by-waterway tabulation of designated sites with their Historic England's National Heritage List for England (NHLE) Numbers while Appendix C was provided by Canal and River Trust (CRT) and details size and date of the reservoirs inherited from British Waterways.

Part One, Section 1 records the transformation of the system by chronicling the growth of public awareness of its value as demonstrated by the literature, both academic and campaigning, that informed and fuelled the transformation. It shows how early interest in the 1940s and 1950s led, through detailed research, to a comprehensive public appreciation of the historical framework of the system by the 1970s and encouraged Government departments to re-evaluate their approach to its management. Subsequently, the literature has swelled enormously providing more detail, more images and the historiography of the restoration movement.

Part One, Section 2 traces the salient historical periods in the development of the system and discusses the heritage legacy of each of the periods. It outlines how, by the end of the 18th century, the emphasis on traditional river navigation had been supplemented, and to a degree supplanted, by the growth of an artificial canal system which by crossing watersheds opened by inland areas and became the arteries for the Industrial Revolution. It shows that these early canals have to a greater degree have generally survived to leave a more substantial heritage than those of the 19th century, though some of the latter canals have left a significant archaeological legacy.

Part One, Section 3 considers the infrastructure of the system feature by feature and examines the current state of designation of these features. The following asset types are discussed:

Changing Levels – Locks, inclines and lifts
Crossings – Aqueducts, Bridges
Earthworks – Tunnels and horse lanes, cuttings and embankments, retaining walls,
Water Supply – Reservoirs, weirs and pumping stations.
Operation – Lock keepers' and lengthmens' cottages, tollhouses and Offices, company housing and Company workshops, dry docks and gauging locks
Trading – Inland ports, basins, interchange facilities, cranes, warehouses and hotels.

Designated or undesignated remains of early horse-drawn tramroads and plate-ways, serving canals will be generally excluded, unless particularly relevant.

It highlights the discrepancies in protection between types of features and seeks to identify key features that have not been assessed for designation and appraise their significance.

For those parts of the waterways system that are managed by the Canal & Rivers Trust it finds a fairly satisfactory situation as almost all of the significant aqueducts, bridges and tunnels are designated and most of the significant associated buildings. Protection extends to many of the more mundane structures thus, for example, some 650 locks out of 1600 are listed (40% of the stock) as are some 800 traditional arch masonry bridges out of 5000 (16% of the Stock). There are also many mileposts listed though the coverage of these seems less comprehensive while water supply features have attracted considerably less attention. In all CRT has 43 Scheduled Monuments and some 2475 Listed Buildings on its estate in England but it also maintains a condition-based database that contains information on many thousands of other historic sites in its ownership that are undesignated.

On those parts of the system that are not managed by CRT the situation is much less clear. Desk-based research, combined with a search of the National Heritage List for England (NHLE), indicates that many of the most substantial features of historic interest are designated but less obvious features, though of considerable archaeological significance, are less well protected. Indeed, for long-abandoned canals field verification of literature and internet references may be necessary, while for non-CRT navigable waterways consultation with owners such as the Environment Agency, allied with field verification, may produce satisfactory results.

Part One, Section 4 Initial Findings and Conclusions summaries the salient points that emerged from the previous three sections: the extent to which evidence for how the system evolved has survived to be an unrivalled national heritage resource; how the historic decline in the fortunes of the system was reversed by a transformation in the national appreciation of the waterways; how the comprehensiveness of protection of the system varies by ownership, by type of structure and by status – whether navigable or abandoned.

It suggests that further work is needed to establish what survives of significance of the earliest types of locks, lifts and inclines and of the BCN's many abandoned branches. It also draws attention to the under-designation of the engineering masterpieces of the Manchester Ship Canal and to the possible impact of the new

proposed high speed rail lines where they impinge on both navigable and abandoned waterways. Lastly, in the context of the current discussion about the possible transfer of Environment Agency waterways to the CRT, it suggests that an audit of the heritage assets of these waterways is needed and that the heritage must be regarded as a priority to rank equally with other waterways interests in these deliberations.

Part Two, the Gazetteer is arranged alphabetically and covers all the canals and navigations operating in the 19th century as identified from the main contemporary reference books. It provides a waterway by waterway evaluation, summarising the history of each waterway and identifying significant surviving structures and historic buildings.

Appendix A alphabetically lists the waterways covered by the Overview with their ownership, the heritage values accorded by the Overview and other agencies and the main qualifying references.

Appendix B provides a list of designated sites with their grade and the National Heritage List for England (NHLE) number for each of the waterways covered by the Overview arranged alphabetically.

Appendix C Canal Reservoirs is an 2008 article kindly provided by David Henthorn Brown, formerly of British Waterways, giving details of the development of canal reservoirs in Britain and the date and size of the reservoirs in the responsibility of British Waterways in 2008. These are now mostly managed by CRT.

PART ONE SECTION 1

Introduction

This current overview replaces the interim Overview that was prepared in response to a need identified in the English Heritage National Heritage Protection Plan 2011-15. That plan recognised that changes in the ownership and management of England's canal network, from the nationalised British Waterways to the charity Canal & River Trust, made it an appropriate time to establish a national context for improved understanding of the heritage assets of canals and river navigations. This illustrated version of the overview with its accompanying Gazetteer, containing heritage assessments of some 200 waterways, seeks to inform not only Historic England (HE) in its consideration of sites for designation but also the management and funding of historic waterways and associated archaeological sites by a wide range of diverse interests. These include the Canal & River Trust, the Environment Agency (EA), the Inland Waterways Association, local planning authorities and the Heritage Lottery Fund (HLF) and also historic waterways owned by other river authorities and private owners and the landowners of long abandoned waterways whose remains may be of considerable archaeological significance.

It was considered that such an overview was needed as much of the most detailed literature and research in this area was undertaken in the 1960's through to the 1990s while the only official review of waterway sites for protection was by the Dept of Environment Panel on Industrial Monuments in June 1976 and again in November 1977. Since then many more historic waterway sites had been covered by area re-listing under the accelerated Listing Review programme of the 1980s but this did not cover all the relevant local authorities throughout the country and despite broad agreement on the need to protect the heritage of our inland waterways, there had been little new research to confirm the efficacy of protection. Furthermore the programme of canal restorations and the reopening of sections of abandoned canals, the land use pressures affecting the lines of abandoned canals, the considerable changes in management regime of the navigable system as of 2012 and the demise of the Inland Waterways Advisory Council in 2012 all made such an overview timely. This is even more so today in the context of the possible transfer of Environment Agency waterways to the Canal & River Trust which is being so assiduously lobbied for by the Inland waterways Association. Within these current discussions, the heritage must be regarded as a priority to rank equally with other waterways interests.

Accordingly the overview seeks to provide a concise national high level overview of the historic development of England's navigable waterways by historical phase, by asset type and by individual waterway of all historic navigable waterways that operated in the 19th century including abandoned canals and former river navigations where there are significant relic structures and to assess their heritage credentials. It strives to achieve this by; reviewing the extensive literature on the inland waterway system that has developed since nationalisation of the waterways in 1947 and analysing how this body of literature has influenced the appreciation and

management of the system and by characterising the historic assets and discuss the significance of various asset types.

The ultimate aim of the Overview is to provide a better understanding of the character and importance of the surviving assets of England's historic navigable waterways to enable the best use of limited resources to be able to protect them and their associated built environment.

1.1 Background

Inland waterways, with their immediate built environs, constitute a very important element in the historic landscape and because of their particular usage they often preserve original historic features to an extent far beyond most other heritage sites. Enjoyed by millions of walkers, cyclists and anglers and tens of thousands of boaters they have become the focus of regeneration and redevelopment, much of which has been sensitive to their character, but their infrastructure and environs can still be vulnerable to pressures of over-development and unsympathetic restoration and conversion.

Canals, in the global context, came comparatively late to Britain but it was in this country, in the late 18th century, that their economic potential was fully realised and many technological advances were pioneered. Navigable inland waterways were to become the arteries of the Industrial Revolution and much of the system that was developed in the 18th and early 19th centuries has survived, along with spectacular later examples of engineering innovation. Canals and certain river navigations are currently seeing the biggest change in their ownership and management for over 60 years with the creation of the Canal & River Trust and this has positive implications for the many historic buildings and structures associated with them.

Many heritage assets on, and beside, England's navigable waterways now benefit from relatively benign attention but for the earlier part of the last 70 years this attention was only partial. More recently, the cruising network, under the aegis of British Waterways and the river navigation authorities, has generally been upgraded and the majority of its historic assets, which are now in the care of the Canal & River Trust (CRT), are appropriately regarded and designated. The Canal & River Trust which operates in England and Wales is the guardian of 2,000 miles of historic waterways across England and Wales, home to over 2,700 listed structures, 50 scheduled ancient monuments and five UNESCO world heritage sites of which 43 Scheduled Monuments and 2475 Listed Buildings are in England. It has heritage advisors in each of its regions led by Nigel Crowe as Head of Heritage.

However, the Canal & River Trust holdings do not cover anything like the entire historic navigable system that once existed and there are over 1000 miles of abandoned canals and many former navigations where the protection and management of historic assets are much less certain. There are also other operational historic waterways that are not in the CRT ownership and industrial sites served by internal waterway systems such as the Royal Gunpowder Works Waltham Abbey where there are significant canal structures. This report therefore seeks to provide

an overview of the surviving heritage of all historic navigable waterways in England that operated in the 19th century, set the significance of that heritage in its historical context and appraise the comprehensiveness of its protection.

The report covers the lines, and the immediate built environs – lock keepers cottages, basins, pumping engine houses and warehouses – of all these historic navigable waterways that operated in the 19th century including abandoned canals and former river navigations where there are significant relic structures. Some of these latter waterways are not only now the subject of study but also face both threats to their survival and opportunities for conservation. The threats may materialise from the recent concerns over flooding and impediments to drainage on water channels that are primarily used for drainage while in some cases of disused waterways opportunities for the consolidation of remains and restoration of sections of waterway by local interest groups have arisen throughout the country. In the latter cases, the activities of the Somerset Coal Canal Society, the Dorset & Somerset Canal Society and the Shrewsbury & Newport Canal Trust provide examples where sections and structures of abandoned waterways are being excavated or restored. Hence a high level assessment of their significance, to inform such work, is urgently needed. This overview therefore seeks to aid the assessment of sites for grant aid, support and management by bodies such as the HLF, the Princes Regeneration Trust, the Inland Waterways Association and, if appropriate, for designation by HE.

Recommendations for the designation of nationally significant canal infrastructure features, both operational and abandoned, were made in the mid-1970s in two lists compiled by the Industrial Monuments Survey but since then the accelerated Review of Listed Buildings, in the 1980s, added many hundred of sites in the local authority areas that were subject of review. However, the geographically patchy nature of that exercise has left a designation legacy of uncertain comprehensiveness. In addition, some canals are the main focus of conservation areas and the boundaries of these may not be as appropriate as might be desired. In Stage Two of the project, in consultation with the Heritage Team at CRT, any possible inconsistencies would be identified and highlighted for consideration by the local authority.

For the last four decades of British Waterways operation there were external committees advising the relevant Government Department on the Agency's strategy, priorities and management – firstly The Inland Waterways Amenity Advisory Council (IWAAC) and from 2007 The Inland Waterways Advisory Council (IWAC). The IWAAC was formed under the 1968 Transport Act as the Inland Waterways Amenity Advisory Council, solely covering the inland waterways managed by the then British Waterways. It was reformed as The Inland Waterways Advisory Council in April 2007 under the Natural Environment and Communities Act 2006, covering all inland waterways in England and Wales and the waterways then managed by British Waterways in Scotland. The Inland Waterways Advisory Council, was abolished on 2nd July 2012 upon the creation of the Canal & River Trust. The Head of Heritage at CRT now convenes an internal Heritage Advisory Group, chaired by, and composed of, external experts, to advise on heritage matters. This Overview has been produced in close collaboration with CRT Head of Heritage and seeks

to provide a heritage context for CRT and its heritage partners in managing that resource.

On the demise of the IWAC the Inland Waterways Association generously accepted responsibility for electronically archiving the reports of both the IWAAC and IWAC on its website thus retaining public access to these reports. The IWA is now considering how the valuable work of these Advisory Committees in monitoring the progress and success of canal restoration projects can be continued and continues to act as both as unofficial watchdog on the various waterways authorities and active partner in the restoration and maintenance of waterways.

The IWA recent *Manifesto - Securing the Best for the Waterways* which has gained support from all the main parties in the run up to the last election, identifies five key points that IWA is asking Members of Parliament to support. The five points are protecting waterways heritage, building a relationship with waterway groups, joining the All Party Parliamentary Group for the Waterways, supporting the transfer of navigations currently managed by the Environment Agency to Canal & River Trust, and to support the provision of new affordable off-line moorings. This Overview seeks to inform the first key point – protecting waterways heritage.

1.2 Review of Canal Literature

> *"Is it not surprising that so little has been written about this world of waterways? Ships and the sea have inspired some of the greatest prose and poetry in our language, while a volume of railway literature pours from the presses in an ever-increasing spate to cover every minute detail of the subject..... Yet the literature of our inland waterways is confined to a handful of historical and technical works and to a few travel books which are primarily records of personal experience. Add to these the tabulated guide books of Westall, De Salis and Wilson and the catalogue is complete. It includes no book designed to give the general reader a picture of the history, construction and working methods of the Waterways."*

So wrote L.T. C. Rolt in 1948 in his Preface to his seminal book *The Inland Waterways of England* which was published in 1950.[1] How he and his fellow founders of the Inland Waterways Association were to change that! Indeed, Rolt's own *Narrow Boat* published in 1944 had already proved of considerable impact. It introduced the attraction of inland waterways, and also the threats that they faced, to several people who were to become leading figures in researching the history of the waterways such as Charles Hadfield and championing restoration of the canal system including Robert Aickman and Eric de Mare. The latter was inspire a new appreciation of the visual heritage of the waterways system, captured in his evocative photographs first published in July 1949 as a special number of *The Architectural*

1 Rolt was under-estimating the volume of earlier works. Subsequent research by Mark Baldwin indicates that there were some 700 books, pamphlets etc. on waterways in the British Isles produced over a period of 350 years prior to 1950 but he would concur with the general tenor of Rolt's remarks. (Baldwin 1984 Canal Books)

Review and then by the Architectural Press as *The Canals of England* in 1950. That book with its photographic essay on the 'functional tradition' so forcibly exemplified by canal structures and its poignant images of canal life was to presage a boom in nostalgic image canal books fifty years later. It was also to draw attention to the plight of the waterways under the disinterested management of the Transport Executive and detailed a score of notable waterways as 'Derelict, Semi-Derelict or Unused' including the Basingstoke, the Chesterfield, the Huddersfield, the Kennet & Avon , the Lancaster, the Macclesfield, the Peak Forest, the Rochdale, the Stratford and the Thames & Severn. The book's concluding chapter 'Have the Canals a Future' drawing on the IWA's 1947 memorandum to the Minister of Transport and of Rolt's Report in 1946 to the Association for Regional Planning and Reconstruction, is a plea for the resuscitation and development of commercial carrying and is thus a potent reminder of the times when leisure boating was relatively undeveloped and the heritage and amenity assets of the system largely unidentified and their significance certainly unrecognised.

Tom Rolt's book and Charles Hadfield's *British Canals, an Illustrated History* first published in 1950, with numerous subsequent revised editions, ushered in an exceptional period of study of canal history in the 1950s and 1960s. Hadfield's book was to be the master volume in the David & Charles '*Canals of the British Isles*' series which, over the next quarter of a century, was to run to ten English regional volumes (seven of which Hadfield wrote, collaborated on two and edited the other) and more than twice that number of books on individual waterways. Researching these waterways by a corps of dedicated enthusiasts and scholars led in 1955 to the formation of the Railway and Canal Historical Society (RCHS) whose members have subsequently produced most of the original research on the subject. Typical early studies included Holt's '*The Trent Navigation*' and Hadfield's '*The Cromford Canal*' in 1957, Talbot-Smith's 'The Oakham Canal', Gordon Biddle's 'Short History of the Bradford Canal' and Palmer and Berrill's '*Andrew Yaranton and the Navigation Works at Astley*' in 1958. Hadfield's own first regional volume *The Canals of Southern England* was published in 1955 - the same year as the British Transport Commission's unenthusiastic *Canals and Inland waterways: Report of Board of Survey* which was to so exercise the IWA and energise its campaigning output through its *Bulletin*, the main mouthpiece of protest, edited, and mostly written, by Robert Aickman. At the same time Aickman also published *Know Your Waterways* and *The Story of our Inland Waterways* books aimed at a popular market.

The trickle of canal volumes was to swell appreciably in the 1960s as the David & Charles canal histories came on stream with regional volumes for the West Midlands and the South West and on individual waterways such as those to Stratford, from London to Portsmouth, the Kennet & Avon Canal and the Thames & Severn Canal. These were supplemented by Baron Duckham's *Navigable Rivers of Yorkshire* and *The Yorkshire Ouse* and by David Tew's *The Oakham Canal*. The RCHS Journal continued its stream of short studies including ones on specialised structures such as the Trench inclined plane, the Kings Weir and Lock and the Lancaster Tramroad in 1963 while in 1965 *Industrial Archaeology*, the new journal for that subject, published the 'Canal Inclined Planes of East Shropshire and in 1969 Lewis *et al*'s

'Flashlocks on English Waterways: A Survey' which remains one of the classic studies of these structures.

With the authoritative historical detail of waterways thus emerging, and the historical significance of the British system more firmly established, the waterways conservation movement was better equipped to make the case for retaining most of the system. Similarly Government Departments had no excuse for underrating that significance and the early 1960s witnessed a slight softening in its attitude to the leisure use of waterways. The BWB's interim report *The Future of the Waterways* was submitted to the Minister of Transport and significantly it suggested a 'multi-user' role for waterways. Thus when in 1965 the Government through HMSO published British Waterways Board's The Facts about the Waterways which included in its category of 'remainder waterways' some very significant canals, it provoked a less vigorous and more measured response of campaigning literature produced by the Inland Waterways Association. The ambivalent Government White Paper in 1966 on transport policy rekindled some opposition but the *British Waterways: Recreation and Amenity* published the following year somewhat defused the protest by recognising the amenity value of the waterways and establishing the Inland Waterways Amenity Advisory Council which over the next three decades was to produce a series of significant reports on restoration priorities (see Bibliography IWAAC).

At the end of the decade Rolt's *Navigable Waterways* in the Longman's series on industrial archaeology and Robert Harris's *Canals and their Architecture* further broadened the study to related fields. Harris's book, though branded in the 'excursions into architecture' series is very much concerned with the wider fabric of canals – the machinery, engineering structures, the use and traditions as well as buildings. Indeed, treatment of the latter forms only a small part of this picture-led book, though its coverage of Ellesmere Port shows the degree of tragic loss of the magnificent warehouses in those docks. When allied to the dramatic rise in interest in cruising the waterway network which had already led to a plethora of guide books ranging from the comprehensive regularly updated national editions of *Inland Waterways of Great Britain* complied by L. A. Edwards and published by Imray, to lock-by-lock tours of individual waterways such as the Nicholson's Guides to the Waterways, the trickle of books had become a torrent by the early 1970s.

An analysis of the books produced over this period is revealing. While throughout the late 1960s and the early 1970s most of the more substantial books concentrated on establishing the detailed history of waterways either regionally or individually, at the same time attention was turning to other issues such as examination of abandoned canals as in Ronald Russell's *Lost Canals of England & Wales*, evoking the historic charm of the waterways system or chronicling the efforts to restore many of the disused canals which languished in BWB's 'remainder canals' category. Thus P J G Ransom's *Waterways Restored* published in 1974, and detailing what he had found in the previous two years, presents a very varied picture of worthy achievement and enormous problems and in 1976 Derek Pratt's photographs superbly complement Anthony Burton's evocative text capturing the essence of the still 'un-sanitised' system in *Canals*. Many of the scenes depicted in these books can

still be visited but are altered almost beyond recognition – most of the grim canal-side buildings which turned their back on the waterways but provided so much character, as at the Gas Street reach in Birmingham, have gone, with the canal now being the focus of a rather bland mix of fashionable and historic redevelopment. The transformation of derelict Caen Hill flights of locks at Devizes, on the other hand, is a wonderful achievement of conservation and BWB themselves were to publish a slight, but delightful, book *Canal Architecture in Britain* – a subject that had been covered in 1973 by the equally slight Shire Album 3 indicating the growing popular appeal of waterways. In 1975 the DoE published the Fraenkel Report, an engineering study of the operating and maintenance costs of the nationalised inland waterways highlighting the challenges to come.

The Journal of the RCHS throughout the 1970s maintained its record of publishing short but significant pieces of research on a host of lesser known canals, on aspects of engineering such as the role of iron in reconstructing the Oxford Canal, on structures such as cast iron aqueducts and on installations such as the Smethwick and Claverton Pumping Stations. The short piece in 1974 by Frank Sharman on 'New Bolingbroke: A Nineteenth Century Canal Town' added a new entry to the list canal derived settlements.

By mid-decade when the last of David & Charles volumes about individual canals were being published, the emphasis was widening to discuss the effect of canals on their immediate environment as in Lewis Braithwaite's *Canals in Towns* and J D Porteous's *Canal Ports, The Urban Achievement of the Canal Age* which, based on his 1968 thesis *Urban Genesis and Development: the Case of Canal-Created River Ports in the English Industrial Revolution*, focussed very much on Goole. A further notable addition to the literature on canals settlements also appeared in 1977 with Adrian Jarvis's perceptive *Ellesmere Port –Canal Town 1795-1921* which, though comparatively short, encompasses canal related housing and industry as well as providing a regional context for the facilities at Ellesmere Port.

The general scene was also greatly augmented firstly in Hugh McKnight's *The Shell Book of Inland Waterways* in 1975 followed in 1978 in Edward Paget-Tomlinson's magisterial volume *Complete Book of Canal and River Navigations*. Then in 1979 Roger Squires *Canals Revived* was to return to the travails of the restoration movement while Ransom's *The Archaeology of Canals* was to concentrate on the fate of the inland waterways system's historic built environment. In the same year Michael Ware was to lavishly illustrate with some 280 historic photographs *Britain's Lost Waterways* but while many of these images were to provide much more visual evidence to many of the abandoned canals detailed in Ronald Russell's earlier book on the same subject thankfully some of the canals, the Basingstoke, the Rochdale, the Stratford-on-Avon and the Kennet & Avon canals in particular, have now been retrieved from being 'lost'.

Over this 30 year period, most of the historical and descriptive detail about England's inland waterways system had been comprehensively established and the succeeding three decades saw some refinement of detail and a great deal of elaboration by way of historic and modern images. Many authors such as Anthony

Burton and Hugh McKnight who first published on canals in the early 1970s were to maintain to this day a stream of further books. Burton, for example, has authored or co-authored more than a dozen books building on his early work and is still bringing to new audiences some new insights to the familiar story.

After the 1970s hectic decade of publishing – the select Bibliography below lists more than 50 books – the 1980s were comparatively quiet though some notable books appeared. Charles Hadfield, the doyen of all canal authors, who had written, or co-authored, more than 25 books on British canals, published his magisterial summary *World Canals, Inland Navigation Past and Present* which placed the British canal system in its international context. By this time Hadfield, who was a founder member of the Railway and Canal Historical Society and co-founder of the publishers David & Charles, had also contributed more than 30 articles to journals and periodicals. He was to publish one more book – on Thomas Telford - before he died in 1996 but new editions of his seminal *British Canals* (revised by Joseph Boughey) are constantly being posthumously published. Hadfield's great contribution to the study of canals was honoured by the publication in 1984 of *Canals – A New Look* edited by Mark Baldwin and Anthony Burton. This contains an appreciation of Hadfield's works and seven interesting essays including Skempton's 'Engineering on the English River Navigations to 1760', Peter White's 'What is Conservation' and Roger Squires ' Waterway Restoration: Public money, private muscle'. By this time, the flourishing leisure boating industry were catered for by more guides including a new and enlarged edition of L A Edwards *Inland Waterways of Great Britain* while David Tew's *Canal Lifts and Inclines* placed the pioneer British structures in their international context and R Harris had produced a second revised edition of his *Canals and their Architecture*.

The 1980s were comparatively lean years as far as the RCHS Journal was concerned averaging only one canal article per year with further notes Nottingham's canals, Bridgwater's dock, Runcorn and Warrington on the Bridgewater Canal and on inclined planes, on planning the routes of canals and novel pieces on water supply and closing canals. However, two articles in the Transactions of the Newcomen Society made up for this shortfall with important piece by Skempton in1983 on 'Engineering on the Thames Navigation 1770-1845' and by Schofield in 1985 on the planning and construction of the Cromford Canal.

The 1990s started with another important book on the evolution of the restoration movement - David Bolton's *Race Against Time, How Britain's Waterways Were Saved*. This chronicled in great detail – some of it candid and personal – the trials and tribulations of the fledgling combative IWA in its early years and its maturing 25 years later, after a few spectacular restoration campaign successes, into a formidable waterways lobby, and partner, respected by Government waterway agencies. The 1990s also witnessed a resurgence of books concentrating on individual canals or on county groupings. Amongst the former, some of which detailed relatively minor canals which had previously been sketchily treated, were Roffey's *The Chesterfield Canal* (1990), Clarke's *The Leeds & Liverpool Canal* (1991), Stevens *The Leicester & Melton Mowbray Navigation* (1992), Vine's *London's Lost Route to Midhurst* (1995), Richardson and Lower's *The Complete Guide to the Sheffield and South Yorkshire*

Navigation (1995), Gray's *The Manchester Ship Canal* (1997), Ramshaw's *The Carlisle Navigation Canal 1821-1853* (1997), Vine's *The Wey & Arun Junction Canal* (1999), Clarke's *The Aire & Calder Navigation* (1999),and Small's *The Wiltshire & Berkshire Canal* (1999). Amongst the latter were Vine's *Hampshire Waterways* (1990), Chester-Browne's *The other sixty miles: a survey of the abandoned canals of Birmingham and the Black country* (1991) and Morris's *Canals of Shropshire* (1991).

In the mid-1990s there were several significant publications, including in 1994 Edward Paget-Tomlinson's *The Illustrated History of Canal & River Navigations* (followed in1996 by his *Waterways in the Making*) and Nigel Crowe's *English Heritage Book of Canals* and in 1996 ICOMOS Central's *The International Canal Monuments List* compiled by TICCIH. These identified and detailed canal structures and buildings of historical significance and set them in their national and international contexts. In addition, Paget-Tomlinson's 1994 *magnum opus* in a 124 page A –Z of Waterways section, accompanied by 32 maps, provided a concise but authoritative historical introduction to some 340 waterways in the UK and Ireland. The much changed attitude of British Waterways towards the cultural heritage of its waterways was evidenced by its association with two books in 1994 - Marin Evans and Robert Reichenfeld's photographic essay *Canals of England* and Ivan E Broadhead's *Up the Cut, An Anthology of Inland Waterways* a collection of articles that first appeared in the British Waterways staff magazine. In a similar vein, the social history of Braunston, a very individual canal settlement, was well served with David Blagrove's *At the Heart of the Waterways* while pictorial books focussing on the nostalgic aspects of canal history became ever more popular.

The RCHS *Journal* returned to form with a score of relevant articles such as those on Weedon Military Dock (1990), a previously unrecorded example of a cast iron aqueduct (1991) Christopher Wren's survey of the River Lea (1993), decline of the Derby Canal showing how an independent waterway was notable to survive (1993), Vermuyden's navigation works on the River Don (1994), Congreve's hydro-peumatic lock (1995), surviving earthworks on the Southampton & Salisbury Canal, England's 'first iron bridge' (1996), structures on the Peak Forest Canal (1997 and 1999) and on the construction of locks (1999) and the building of the Macclesfield Canal (1999). *Industrial Archaeology Review* – the journal of the Association for Industrial Archaeology – also carried significant articles including in 1992 'Canal pumping engines', and in 1994 'An archaeological survey and watching brief at Garston Lock Kennet & Avon Canal, and 'The canal at Smethwick – under, over and finally through the high ground' while in 1992 the *Transactions of the Newcomen Society* published 'Navigation devices along the River Lee 1600-1767'.

In 1998 Joseph Boughey published a book which threw new light on the evolution of appreciation of the UK waterways. Entitled *Charles Hadfield, Canal Man and More*, the first half of the book traced Charles Hadfield's involvement in canals from his early youth in Devon when in 1923 he moved to a house near the Grand Western Canal to his death almost eighty years later when he was venerated internationally as the father of canal history. It candidly outlined the familiar story of the foundation of the IWA by Robert Aickman, Tom Rolt and Hadfield and the bitter falling out in 1950 between Aickman and his erstwhile friends which was to effect the relationship

between the waterways management agencies and the canal enthusiast movement for the next twenty years. It also showed that two of the three main protagonists for the retention on the canal system – Hadfield and Aickman - were not primarily concerned with the preservation its historic fabric but rather as a boating network. Rolt, after his expulsion from the IWA, focussed his energies, to great effect, elsewhere though he did stay in touch with Hadfield. (see Section 2)

The new century continued the trend of the 1990s with picture-led books and saw a major new player in canal book publishing with the emergence in 2007 of a reconstituted History Press which has integrated other canal book imprints including Phillimore, Sutton Publishing and Tempus Publishing. Phillimore and Sutton had a canal book record stretching back more than 30 years while Tempus, an off shoot of Alan Sutton, had become a leading publisher of transport books in the 1990s and was to produce a score of canal books before it was absorbed into History Press. Amongst these was Antony Burton and Derek Pratt's *Anatomy of Canals* trilogy – *The Early Years*, *The Mania Years* and *Decline and Renewal*, a trilogy which comprised an attractively illustrated and very readable and comprehensive introduction to the history and development of the canal system. The last three chapters of the third volume 'The Restoration Years', ' Leisure and Conservation' and 'Canals in the Twenty-first Century' are a perceptive, candid, yet affectionate, review of the first years of the canal movement when desire to open waterways to navigation often over-rode concerns about the conservation of their heritage.

These were accompanied by a dozen books on individual canals including further offerings by P A L Vine on southern waterways - *The Wey & Arun Junction Canal* (1999), *The Arun Navigation* (2000) and *London's Lost Route to Portsmouth* - and by David Viner's *The Thames & Severn Canal, History & Guide* (2002), Mike Taylor's *The Calder & Hebble Navigation* (2002) and two on the Kennet & Avon Canal. In 2002 the international context for Britain's pioneer canal lifts was further established by Mike Clarke's translation and editing of H-J Ullemann's *Canal Lifts & Inclines of the World*, re-affirming their international significance.

In 2005 Tempus published Nick Corble's biography of James Brindley and the following year a brace of introspective books the waterways campaigning movement, David Blagrove's *The Inland Waterways Association: Saving Britain's Canal and River Navigations* and Neil Edward's *The Inland Waterways Association: 60 years of canal restoration*. In 2006, Derek Pratt, the photographer whose images had graced canal books over three decades, took the opportunity to publish *Waterways Past and Present*, an evocative selection of contrasting black and white and colour photographs. The following year English Heritage, in its 'Informed Conservation' series and in association with British Waterways and local partners published *Stourport-on-Severn, Pioneer Town of the Canal Age* which showed how the town had retained its distinctive identity as a canal-created settlement.

The flood of nostalgic picture books commencing in the 1990s was continued by publishers such as History Press and Amberley. Some of these offerings such the dozen canal volumes in Amberley Publishing's *Through Time* local history series are fairly slight with some of the latter volumes, such as that on *East Midlands Canals*,

containing 96 pages of which 76 pages are illustrations and only 16 pages of text. However the situation is somewhat redeemed as the 180 illustrations in this book are generously captioned, some up to 100 words, while the images themselves, the majority drawn from the Railway & Canal Historical Society Collection, are a source of both fascination and archaeological evidence.

Alongside these picture-led books both publishers produce more substantial books which contain much new material. Tempus and History Press in a series on regional groups of canals such as *Birmingham's Canals*, *Black Country Canals* and *Waterways of the West Midlands* while Ray Shill's *Silent Highways: The Forgotten Heritage of the Midlands Canals* brings new and up-to-date material, and insights, to canals ranging in area from the Trent & Mersey to the Droitwich. Similarly, Amberley have recently published Andy Wood's alphabetically arranged compendium of all *Abandoned & Vanished Canals of England* (2014) which, in extreme contrast to the picture-led books, has less than a dozen images in its 224 pages of closely spaced text covering over a hundred such waterways.

Meanwhile, the canal restoration movement was the subject of further significant study in Roger Squires *Britain's Restored Canals* (2008) which updates his 1979 book by drawing on the IWA's archives and key players' personal papers to produce a detailed chronological examination which pulls few punches. The later chapters chronicle a mixture of success tempered by disappointment, the Millennium Fever generated by huge capital grants alongside concern dwindling Government annual grant-in-aid to the agencies maintaining the waterways.

In the new millennium and continuing throughout the present decade, the historical, technological and industrial archaeological interest in waterways was maintained with a healthy stream of articles. The Railway & Canal Historical Society continued its output of detailed research pieces on subjects as varied as London's canal branches and docks, Foxton Inclined Plane, the archaeology of navigation on the upper Severn, Chesterfield Canal locks, Bullbridge Aqueduct, the K & A's Caen Hill Horse Railway, the abandonment of the Grand Western Canal, the building of, and breaches on, the Peak Forest Canal, Wappenshall Wharf, Linton Lock, the boat lifts of the Grand Western Canal, the Ketley Canal, Thorney Half-lock, Hardham Tunnel and water management and flood control on various waterways. The Newcomen Society published articles on Brindley's Norwood Tunnel, on staunches and sluices and their confusing terminology and on constructing the Staffordshire & Worcestershire Canal and Wilts & Berks Canal.

Alongside these, studies on the Midford Aqueduct, the Tone Aqueduct, Weldon's patent caisson lock, the archaeology of north-western canal warehouses, Manchester's historic waterfront and on Bugsworth Basin appeared in local and national industrial archaeological journals while Barrie Trinder's chapter on the Shropshire canal system and its various devices for overcoming differences in height in his *Industrial Revolution in Shropshire* (2000) is masterfully concise and lucid. In a similar vein, in 2007, TICCIH's *Patrimoine de l'industrie No 18* was mostly devoted to the nomination of the Llangollen Canal as a World Heritage Site, and as well as articles on Pontcysyllte and Chirk Aqueducts and their surrounding landscapes,

contains general articles such as Nigel Crowe's 'Conserving the Waterways Heritage' and Stephen Hughes's Introduction to the 'International Canal Monuments Study' and his 'Conclusions of the Pontcysyllte Conference'. Inter alia, the latter reports on the papers on World Heritage Canals and Aqueducts, on the international diffusion of canal technology and on metal aqueducts and their construction. Also first published in 2007 John Blair's *Waterways and Canal Building in Medieval England* was a salutary reminder of earlier phases of inland waterway use and canal construction though they lie outside the scope of this overview. In 2009 British Waterways, in partnership with English Heritage produced a small book England's Historic Waterways: a working heritage which was subtitled Promoting high quality waterside development and, by presenting examples of good practice, was 'intended an antidote to the spread of mediocrity' which it claimed 'can harm this heritage almost as much as neglect'.

The provision in planning legislation for archaeological investigation of sites being redeveloped generated a considerable amount of material on former canals and on canal-side sites. Most notable amongst this corpus of material has been the work done in the Manchester area and in particular the archaeological investigation of the Bridgewater Canal and associated sites. Discussion of this material was brought together in a conference in October 2011 to mark the 250 anniversary of the canal and the published proceedings *Bridgewater 250: The Archaeology of the World's First Industrial Canal* edited by Michael Nevell and Terry Wykes and published by the Centre for Applied Archaeology, University of Salford Bridge is the most detailed examination of the inception, evolution and heritage of any single canal.

Finally, the demise of the Inland Waterways Advisory Council in 2012 brought to an end a series of very valuable and candid reports which, continuing the work of its predecessor body the Inland Waterways Amenity Advisory Council, had monitored the progress and success of various restoration schemes since the late 1970s and established strategy and priorities for the Nationalised waterways. These are listed in the Bibliography below and, as the Inland Waterways Association has archived electronic versions, can be downloaded online. They have informed some of the observations made in discussing the achievements and tribulations of the restoration movement in Section 2. The Inland Waterways Association, in addition to supporting and initiating restoration projects, through its quarterly magazine Waterways regularly reports on the work of its branches and, indeed, has expressed interest in continuing the work of the IWAC in monitoring restoration schemes.

It can be seen from the hundreds of books and articles detailed above, that Tom Rolt's concerns in 1948 about the paucity of waterway literature has been well and truly answered.

1.3 Bibliography and Sources

The Bibliography below lists over 200 books and some 180 articles that have been consulted, or at least considered, in the above literature review. As can be seen, there is now a plethora of published material on every conceivable canal subject and individual waterway and when allied to the equally copious amount of material

available on the internet with this potential overload of information discretion must be observed to identify the significant from the ordinary, the genuine from the over enthusiastic claims and the impartial from the vested interest. On the internet perhaps the most obvious and valuable source is Wikipedia whose treatment of individual canals varies greatly. It is generally informative and reliable, is often well referenced, sometimes contains information and links to designated sites and restoration societies and has the virtue of often being up-to-date, but the caveats expressed above must be employed when dealing with its material.

The Canal & River Trust has recently published online more than 37,000 archive records and 22,000 historic images from its archive housed at the National Boat Museum Ellesmere Port. (canalandrivertrust.org.uk/archive) Many of the images in Nigel Crowe's *English Heritage Book of Canals* published in 1994 are drawn from this archive which is the largest source of primary waterway related material in the country. Collections such as the Arthur Watts Collection which contains thousands of photographs of the operational and disused canals and their related buildings in the period 1953-1971, are a very important source of information on all aspects of waterway's historic built environment. The CRT also produces an annual *Heritage Report* the 2015-16 issue of which is available in hard copy as well as online.

1.4 Bibliography

A select list of English inland waterways books and articles arranged chronologically.

Books on boats, boat building, boaters, carrying and cruising, biographies of canal engineers and on Fenland and Broadland waterways are generally excluded as are towpath guides.

Pre 1950

1800	Telford's article of Canals in J Plymley *General View of the Agriculture of Shropshire*		
1805	John Farey's article on Canals in *Rees Cyclopaedia*		
1805	ed. John Philips	*General History of Inland Navigation*	rep. D & C
1831	Joseph Priestley	*Historical Account of navigable rivers and canals rep*	D & C 1969
1882	L F Vernon-Harcourt	*Treatise on Rivers and Canals*	
1904	De Salis	*Bradshaw's Canals & Navigable Rivers*	rep D & C 1969
1906	E A Pratt	*British Canals: Is their Resuscitation Practicable?*	
1907	Royal Commission on the Canals and Inland Navigations of the United Kingdom *Report* (12 volumes HMSO 1907-11)		
1914	F S Thacker	*The Thames Highway: a history of inland navigation*	D & C reprint 1968 as 'General History Vol 1'
1920	F S Thacker	*The Thames Highway: History of the Locks & Weirs*	D & C reprint
1936	T S Willan	*River Navigation in England 1600-1750*	O U P (rep Cass 1964)
1939	L A Edwards	*Inland Waterways of Great Britain*	Imray
1944	LTC Rolt	*Narrow Boat*	Eyre & Spottiswoode 1944
1945	F Eyre & C Hadfield	*English Rivers & Canals*	

1950s

1950	LTC Rolt	*The Inland Waterways of England*	Allen & Unwin
1950	Charles Hadfield	*British Canals An Illustrated History*	Allen & Unwin
1950	Eric de Mare	*Canals of England*	Architectural Press
1950	L A Edwards	*Inland Waterways of Great Britain*	new enlarged edition
1951	TS Willan	*The Navigation of the River Weaver in the Eighteenth Century*	
1955	Charles Hadfield	*The Canals of Southern England*	D & C
1955	Charles Hadfield	*Introducing Canals: A Guide to British Canals Today*	Benn
1955	Robert Aickman	*The Story of our Inland Waterways*	G & D
1955	Robert Aickman	*Know Your Waterways*	G & D

1955	BTC	*Canals and Inland waterways: Report of Board of Survey*	BTC
1956	Darby H. C.	*The Draining of the Fens*	Cambridge University Press
1958	HMSO	*Report of the Committee of Inquiry into Inland Waterways*	

1960s

1961	Manchester Ship Company Pyramid Press	*The Bridgewater Canal Bi-Centenary Handbook*	
1962	Charles Hadfield	*Waterways to Stratford*	D & C
1962	Robert Calvert	*Inland Waterways of Britain*	
1963	Robert Calvert	*Inland Waterways of Europe*	Allen & Unwin
1964	B F Duckham	*Navigable Rivers of Yorkshire*	
1964	BWB	*The Future of the Waterways*	HMSO
1964	BWB	*The Waterways Museum*	BWB
1965	TS Willan	*The Early History of the Don Navigation*	
1965	BWB	*The Facts about the Waterways*	HMSO
1965	Eric De Mare	*Your Book of Waterways*	Faber & Faber
1965	P A L Vine	*London's Lost Route to the Sea*	D & C
1966	Charles Hadfield	*The Canals of the West Midlands*	D & C
1966	Edwin Welch	*The Bankrupt Canal*	Camelot Press
1966	Viscount St Davids	*The Watney Book of Inland Cruising*	Queen Anne Press
1966	Charles Hadfield	*Brief Guide to canals and waterways*	Raleigh Press
1966	M C Ewans	*The Haytor Granite Tramway & Stover Canal*	D & C
1967	B F Duckham	*The Yorkshire Ouse*	
1967	Charles Hadfield	*The Canals Of South West England*	D & C
1967	David Tew	*Oakham Canal*	
1967	DD Gladwin, JM White	*English Canals Part 1: A concise History*	Oakwood
1967	BWB	*Leisure and the Waterways*	BWB
1968	Charles Hadfield	*The Canal Age*	D & C
1968	Roger Wickson	*Britain's inland waterways*	Methuen
1968	Kenneth Clew	*The Kennet & Avon Canal*	D & C
1968	H D Debens ed Canal Society and IWA	*Basingstoke Canal, the case for restoration*	Surrey & Hampshire
1968	P A L Vine	*London's Lost Route to Basingstoke*	
1969	Humphrey Household	*The Thames & Severn Canal*	D & C

1969	Robert Harris	*Canals and their Architecture*	Hugh Evelyn
1969	De Salis	*Bradshaw's Canals & Navigable Rivers*	rep D & C
1969	L T C Rolt	*Navigable Waterways*	Longmans
1969	IWA	*Canal and River Towpath Walks*	IWA
1969	Dunham and Manion IWA	*The B.C.N. A cruising Guide*	Staffs & Worcs Canal Society and

1970s

1970	Charles Hadfield and Gordon Biddle	*The Canals of North West England Vols I & II*	D & C
1970	Frederick Doerflinger	*Slow Boat through England*	Allan Wingate
1970	Kenneth Clew	*The Somerset Coal Canal and Railways*	D & C
1971	Dennis Dalton, ed.	*The canal Book 71Waterways Series*	Link House
1971	Ronald Russell	*Lost canals of England & Wales*	D & C
1971	Kenneth Clew	*The Dorset & Somerset Canal*	D & C
1971	P Stevenson	*Nutbrook Canal*	D & C
1971	L J Dalby	*The Wilts and Berks Canal*	Oakwood Press
1972	Anthony Burton	*The Canal Builders*	Methuen
1972	J H Farrington	*Morphological Studies of English canals*	Univ of Hull
1972	Alan Faulkner	*The Grand Junction Canal*	D & C
1972	Philip Stevens	*The Leicester Line*	D & C
1972	P A L Vine	*The Royal Military Canal*	D & C
1972	Helen Harris, Monica Ellis	*The Bude canal*	D & C
1973	Helen Harris	*The Grand Western Canal*	D & C
1973	B F Duckham	*The Inland Waterways of East Yorkshire (1700-1900)*	E Yorks Hist Soc
1973	Dorothy Summers	*The Great Ouse*	D & C
1973	John Vince	*Canals and Canal Architecture*	Shire Album 3
1973	DD Gladwin	*The Canals of Britain*	Batsford
1973	Charles Hadfield	*The Canals of Yorkshire and North east England Vols I & II*	D&C
1973	BWB	*The Last Ten Years*	BWB
1974	S R Broadbridge	*The Birmingham Canal Navigations 1768-1846*	D & C
1974	The National Trust	*River Wey and Godalming Navigations*	IWA
1974	H Conway-Jones	*Gloucester Docks*	Alan Sutton
1974	P J G Ransom	*Waterways Restored*	Faber

1975	Hugh McKnight	*The Shell Book of Inland Waterways*	D & C
1975	A H Body	*Canals and Waterways*	GMC
1975	Harry Hanson	*The Canal Boatmen 1760-1914*	D & C
1975	E Wilson	*Ellesmere & Llangollen Canal*	Phillimore
1975	IWAAC	*Priorities for Action on the Waterways of British Waterways Board*	
1975	Anthony Burton	*Remains of a Revolution*	
1975	Ian Langford	*Staffordshire & Worcestershire Canal*	Goose & Son
1975	DoE	*The Fraenkel Report*	HMSO
1976	Hugh Compton	*The Oxford canal*	D & C
1976	A Burton, D Pratt	*Canal*	D & C
1976	F Pratt	*Canal Architecture in Britain*	BWB
1976	A Sealy	*Bridges and Aqueducts*	Hugh Evelyn
1976	Michael Handford	*The Stroudwater Canal Vol 1 1729-63*	Moonraker
1976	Lewis Braithwaite	*Canals in Towns*	A & C Black
1977	Ronald Russell & J Boyes	*The Canals of Eastern England*	D & C
1977	Martyn Denney	*London's Waterways*	Batsford
1977	D Owen	*Canals to Manchester*	Manchester Univ Press
1977	J D Porteous	*Canal Ports, The Urban Achievement of the Canal Age*	Academic Press
1977	A E Jarvis	*Ellesmere Port, Canal Town*	Avon-Anglia Pubns
1977	P J G Ransom	*Your Book of Canals*	Faber & Faber
1978	Edward Paget-Tomlinson	*Complete Book of Canal and River Navigations*	
1979	P J G Ransom	*The Archaeology of Canals*	World's Work
1979	C Hadfield, A W Skempton	*William Jessop, engineer*	D & C
1979	P Lead	*The Caldon Canal & Tramroads*	Oakwood Press
1979	Michael Handford	*The Stroudwater Canal*	Alan Sutton
1979	P Lead	*The Trent & Mersey Canal*	Moorland Publishing
1979	J Lindsay	*The Trent and Mersey Canal*	D & C
1979	Roger Squires	*Canals Revived*	Moonraker Press
1979	David Bick	*The Hereford & Gloucester Canal*	Pound House
1979	Michael Ware	*Britain's Lost Waterways*	Moorland

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1980	G Biddle	*Lancashire Waterways*	Dalesman Books

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1983	R W Squires	*The New Navvies: A History of the modern waterways restoration movement*	Phillimore
1983	M Handford, D Viner	*Stroudwater and Thames and Severn Canals Towpath Guide*	Sutton Publishing
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1984	P J G Ransom	*Archaeology of the Transport Revolution*	Guild Publishing
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1987	Peter L Smith	*The Aire & Calder Navigation*	Wakefield Hist Pubns
1989	D Ripley	*The Peak Forest Tramway including the Peak Forest Canal*	Oakwood Press
1989	Peter Lead	*Agents of Revolution: John and Thomas Gilbert – Entrepreneurs*	Univ of Keele

1990s

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1993	Anthony Burton	*Canal Mania, 200 Years of Britain's waterways*	Aurum Press
1993	Anthony Burton	*Controlling the Thames*	ICE London
1993	Pocklington Canal Amenity Society	*The Pocklington Canal*	PCAS
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Publications of The Inland Waterways Association (IWA)

The Inland Waterways Association was formed in 1946 to campaign for the greater use of the waterways and to resist the deterioration and frequent abandonment of the canals that was taking place then. Founded on the 15th February in 1946 by Robert Aickman and Tom Rolt, in November, the first Bulletin was issued informing members that the Kennet & Avon, the Stratford Canal and Suffolk Stour were among their most prominent campaigns. Since then the *Bulletin* was published at regular intervals until superseded by the glossy *Waterways Magazine* produced for members and the Bulletin is now issued in electronic form as the business update from IWA Head Office. Several books listed above chronicle the IWA's rise from a tiny band of enthusiasts to a major membership organisation and a very significant player in the use and operation of the waterways. The IWA website contains as of 2016, the Inland Waterways Directory of Great Britain and several lists pertaining to restored waterways and those under restoration.

Publications of The Inland Waterways Advisory Council

IWAC was first formed under the 1968 Transport Act as the Inland Waterways Amenity Advisory Council, solely covering the inland waterways managed by the then British Waterways. It was reformed as The Inland Waterways Advisory Council in April 2007 under the Natural Environment and Communities Act 2006, covering all inland waterways in England and Wales and the waterways then managed by British Waterways in Scotland. The Inland Waterways Advisory Council (IWAC), was abolished on 2nd July 2012. Before its demise, IWAC authorised IWA to publish any of IWAC's works so that its reports and research was not lost to the benefit of the inland waterways community. A select list of relevant IWAC reports is given below.

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Mike Clarke	'A Leeds and Liverpool Canal Boatyard: Hodson's of Whitebirk'	Vol 12
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Alf Hayman	'Liverpool Docks of the Bridgewater and Mersey & lrwell Navigations'	Vol 5

SECTION 2

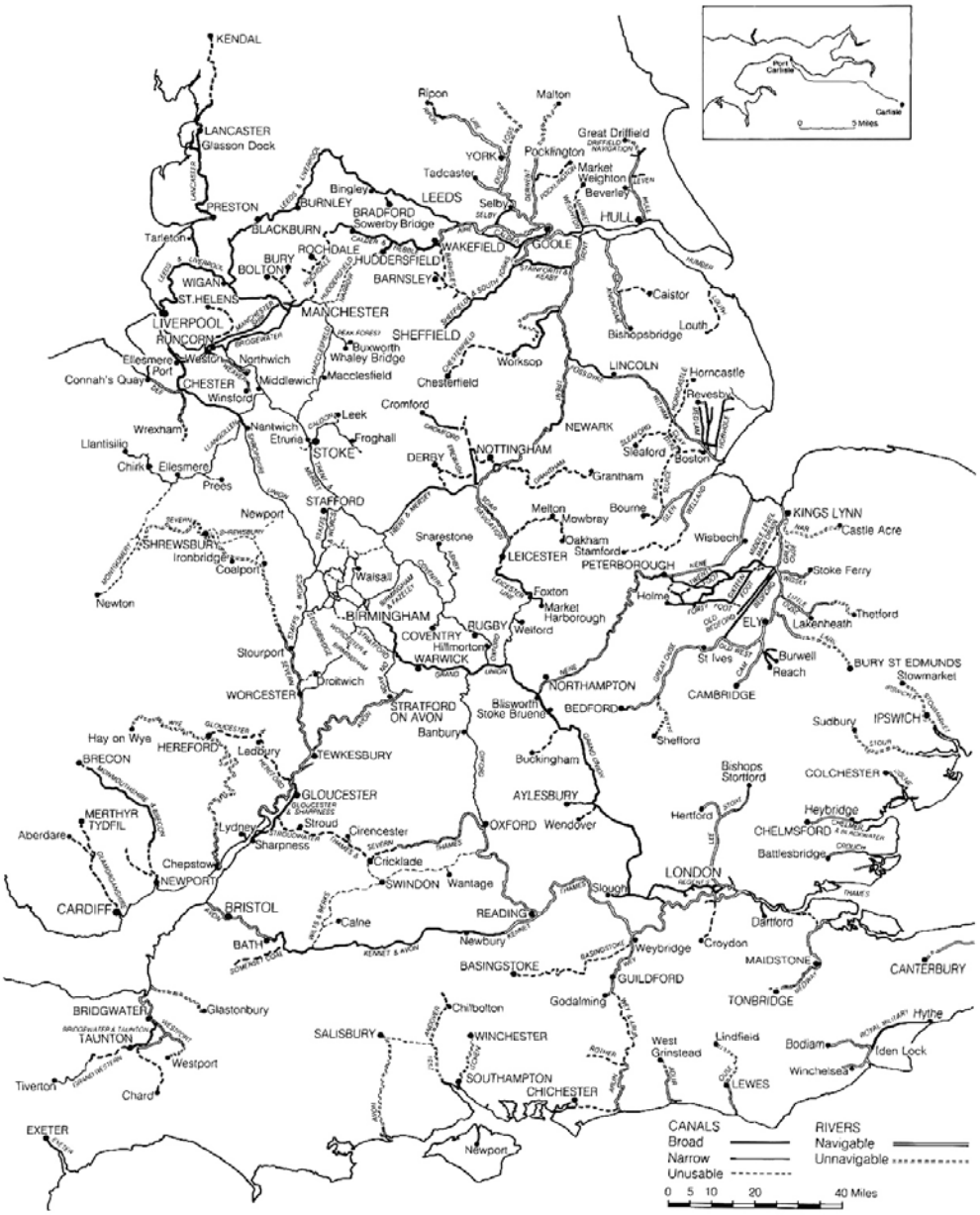
The heritage of the main historical phases of inland waterway development, contraction, renaissance and current use

Introduction

Inland waterways, and canals in particular, were for a century the arteries of the Industrial Revolution and this summary account of the development of the system in England seeks to outline, from the heritage point of view, how we have arrived at the present day situation. It is not intended to be a general historical discussion of the development of the system which is fully covered in several books noted in the review of literature. Hence it concentrates mainly on the system's historic engineering features, on its operational built environment and on the survival of these, whether or not operational. The heritage assessments as to significance are essentially a personal ones by the author and are mostly desk-based from publically accessible sources augmented by the author's occasional field verification over the last forty years working initially for the Industrial Monuments Survey, then the Royal Commission of the Historical Monuments of England and until 2012 English Heritage.

It does not deal with inland waterways in Ireland, Scotland or Wales. In the case of the two former, the systems are entirely isolated from the English system though sharing the involvement of many waterway engineers. Hence, while the completion of the Newry Canal in Ireland, the first summit canal in Britain, predated the Bridgewater Canal by twenty years, and was thus earlier than the St Helens Canal which it resembled, the circumstances of its construction - direct Irish Parliament intervention – and comparative lack of success makes comparison, while of some relevance in engineering terms, less relevant to the English story in an economic historical context. The exclusion from consideration of canals in Wales is an administrative one and, as some canals cross the border between England and Wales and are under CRT ownership, is less defensible. Where significant mention is made of individual waterways that are in the Gazetteer, these waterways are highlighted in bold italics and further detail can be found in the Gazetteer.

Navigable Waterways have been fundamental to the growth of Britain as an industrial nation being the main arteries of trade and industry since medieval times and have facilitated both the quantitative and qualitative demands of a growing population. In 1600 the population of England and Wales was some 4.8 million, by 1750 it had risen to 6.5 million and by 1800 it had almost doubled to 8.8 million. By the mid 19th century when railways had supplanted waterways as the dominant transport the population had doubled again to 18 million. This four-fold increase in population was reflected in a comparative expansion of the inland waterways system.



2.1 The River Navigations

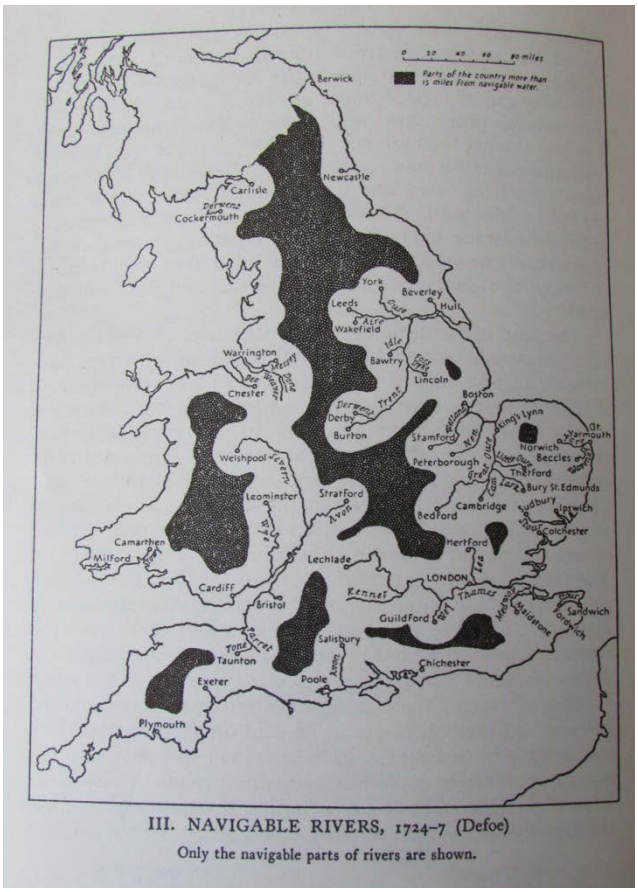
River navigations predate canals, were constantly improved throughout the canal era and, as far as commercial carrying use is concerned, outlived most of the canal system. Their non-tidal sections were a fundamental part of the 19th century inland waterway system and therefore lie fully within the scope of this overview.

However, they are in some respects the Cinderella subject in the literature of the inland waterways system and despite the historical details on individual waterways contained in the various volumes of Charles Hadfield's *Canals of the British Isles* series and in Paget-Tomlinson (1994) the fullest general historical treatment of river navigations up to 1750 is still Willan's classic monograph of 1935 which makes the

point that these navigations were symbiotic to the sea which could be regarded as 'merely a river round England, a river with peculiar dangers, peculiar conditions and peculiar advantages'. This seminal work, however, has been considerably augmented by Willan's own studies of the Don and Weaver (1951 and 1965), by several other publications including works by Rolt (1969) Hugh McKnight (1975) and articles by A W Skempton (1953, 1957 and 1984), by the contributions in various journals including those of the Newcomen Society and the Railway & Canal Historical Society. In addition, regional studies and those of individual waterways such as Baron Duckham's *Navigable Rivers of Yorkshire* and *The Yorkshire Ouse* (1964 and 1967) and Dorothy Summer's *The Great Ouse* (1973) have broadened the picture. An examination of the trade and vessels on the River Severn 1660-1900 has been published by Trinder (2005 and 2016) and illuminates the wide range of traffic carried by the major river navigations in this period. It shows how widespread and frequent were the wharfs on the river and traces their remains and those of the towpath.

The series of essays in John Blair's *Waterways and Canal Building in Medieval England* (2007) present the case for according an even earlier phase of use than is generally recognised. However, the following summary examining the development of the asset base as it existed in the 19th century is based on Skempton's summary in Baldwin's *Canals: a New Look* (1994) augmented by historical material in Paget-Tomlinson (1994) and in the series of unpublished reports on the River Thames (2004 and 2008) produced by Michael Trueman for the Environment Agency and English Heritage. Stuart Fisher's *British River Navigations* published in 2013 provides a popular touristic guide to the attractions along many of these waterways. Details of the survival of types of structures can be found in Section 3 and details of individual waterways in the separate Gazetteer again informed by the above sources.

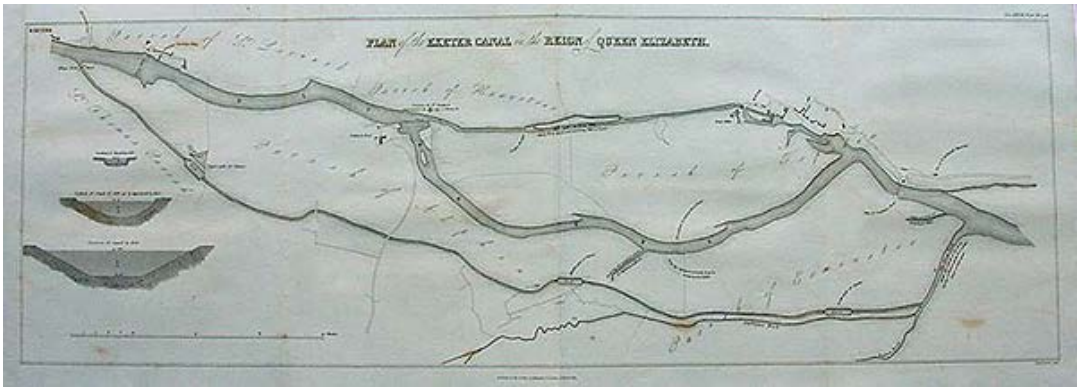
Rivers in their natural state had provided the rudiments of a national transport system since Roman times and until numerous obstructions such as mill weirs, fords and bridges were built in medieval times many rivers were tidal far inland. The Romans in their occupation of Britain made extensive use of both maritime and inland navigation and indeed have been credited with improving some waterways such as the Fossdyke and the Witham but little, if anything can be specifically attributed to of their endeavours. From medieval times the inland waterways system navigated by river craft as distinct from sea-going vessels was quite extensive (see Blair 2007).



III. NAVIGABLE RIVERS, 1724–7 (Defoe)
Only the navigable parts of rivers are shown.

Navigable Rivers 1747 (shaded areas showing parts of the country more than 15 miles from navigable water). (Willan 1936)

Thus by the period with which this Overview is concerned, Skempton (1994) suggests that some 650 miles of open river had been used from 'time immemorial'. Of immediate relevance to this Overview, Skempton notes that a further 90 miles had been added by engineered river improvements by 1600 including the *Exeter Canal* where, in circa 1564, pound locks were introduced for the first time to the English waterways system.



Exeter Canal Plan in the Reign of Queen Elizabeth (I)
James Basire Society of Antiquaries of London 23rd April 1839

As built by John Trew, the three locks were turf-sided and large enough to accommodate several vessels and may have used upstream mitre-gates with sluices and single down stream gates. The canal opened in 1566 and after some

improvement in 1581 remained essentially unchanged for nearly 100 years but led to significant developments of the canal head in Exeter itself.

The Custom House (IoE 418578 Ben White)

Quay House, 17th century transit shed (IoE 418586 Ben White)

Shortly afterwards, in 1576, the Commissioners of the *River Lee* had a timber walled pound lock built at Waltham and because of settlement this was reconstructed in 1579 with masonry foundations by a Mr Trew (perhaps the same man of Exeter). Illegally demolished in 1592, this is recognised as the first 'modern' pound lock in England.

The ***River Thames*** is the longest river in England and the navigable, non tidal, section above Teddington Lock has 45 locks in its 126 miles, it also has 138 weirs. In the Middle Ages the Crown exercised general jurisdiction over the Thames. However, navigation was increasingly impeded by weirs and mills, and in the 14th century the river probably ceased to be navigable for heavy traffic between Henley and Oxford. In the late 16th century the river seems to have been reopened for navigation as far as Oxford by flash locks and a survey in 1585 names 23 such locks in a 63 mile stretch of river. In 1751 the Thames Navigation Commission was formed to manage the whole non-tidal river above Staines and in 1866 its the functions were transferred to the Thames Conservancy, which thus had responsibility for the whole river.

The original locks were flash locks, Osney Lock being mentioned as early as 1227, and though some survived well into the 19th century, they were gradually replaced by pound locks from the 1770s onwards, initially with turf sided locks, and there have been many re-buildings since and few display pre-19th century features. Many are associated with complicated weirs with paddles and rymers and these weirs, despite constant re-builds, are also of very considerable significance. Some of these improvements have also left archaeological evidence in the redundant sections of river bed.

Pound lock c 1620? on Swift Ditch Culham (IoE 248813 A H Jacobs) and Old Iffley Lock 1632? Oxford (IoE 245663 Chris Tresise)

The 17th century witnessed concerted efforts to improve river navigations with some 200 miles of engineered stretches added, involving significantly the construction of at least 50 pound locks in addition to numerous weirs , sluices flash locks and new cuts. Some of the latter could be quite appreciable. The engineering work on the River Wey in the mid 17th was particularly impressive. Designed and partly financed by Sir Richard Weston in 1651 and finished after his death by his son George Weston, the navigation opened in 1653 with a length of 15 miles of which 9 miles were in cut, with 10 turf-sided pound locks, four new weirs, 12 bridges and a wharf at Guildford. It was further improved under an Act of 1671.

(Left) Papercourt lock (Wikipedia Colin Smith)

(Right) The Treadwheel Crane Guildford (IoE 289006 Norman Wigg)

The engineering work on the ***Stamford Navigation***, which opened in 1670 with an artificial cut some 6.8 miles long and containing 10 pound locks, was also impressive but has left but little trace.

Briggins lock in Deeping is the most complete of the remaining structures on the Stamford canal.

The ***Thames*** itself was further improved above Oxford to at least Lechlade (32 miles) which could be reached through 20 flash locks by barges of 50 tons burden and the section immediately below Oxford improved by three pound locks. The 1630s stone pound locks at Iffley (1047190), Sandford and Swiftditch (1059788) were amongst the earliest built in the country, and are notable survivals, possibly the earliest pound lock remains in England.

The ***Warwickshire Avon*** and the ***Great Ouse*** were also improved by the end of the century but regrettably very little survives above ground, or above water, of any of these pioneer improvements though recent work on the Thames and the Avon basin suggests that there may still be significant archaeological remains on such waterways. The navigable section of the Great Ouse below Bedford has a tortuous history illustrating the conflicting interests between drainage concerns of local landowners and navigation. The Hundred Foot River (New Bedford River) was cut c.1650 to provide a new direct link to Downham Market while the Old River via Ely picked up tributary rivers such as the Cam and the Lark and re-joined the Main Channel at Denver Sluice at Downham Market. All the locks, staunches and sluices, including Denver Sluice, have been rebuilt many times.

The pace of navigation improvement increased in the early 18th century with the ***Aire & Calder*** leading the way at the start of the century with 15 locks, and a warehouse at Leeds, opened by 1704. The 25 mile stretch of the ***Essex Stour*** was opened to Sudbury with 13 pound locks and 13 staunches by 1709 and the ***Kennet*** from Newbury to the Thames at Reading when it opened in 1723 had involved cuts totalling 11 miles in length and 20 pound locks. All but three of the latter were timber-framed and turf-sided locks but the locks at Aldermaston were brick and thus some of the earliest of such structures. Reputedly 100-ton barges could then pass from Newbury to Reading and a small complex of navigation-related buildings grew up around a basin in Newbury.

Newbury Wharf (Wikipedia Tom Bastin)

Skempton suggests that from an engineering point of view the Kennet is the outstanding early 18th century navigation and this fully justifies the recognition by designation that some of the locks on the navigation have received (Aldermaston Lock (1006970), Monkey Marsh Lock (1006971) and Sheffield (or Shenfield) Lock (1006972) are scheduled monuments).

Monkey Marsh Lock
(Wikipedia Graham Horn)

The ***Bristol Avon*** (which in the 1790s became the western end section of the Kennet & Avon Canal system) was also improved at this time with six masonry-walled pound locks in cuts by-passing mills and providing a 11.5 mile connection between Bath and Bristol but some of these have been much rebuilt in subsequent improvements though Weston Lock (1395660), on the Lockswood cut in Bath, is designated Grade II as reasonably unaltered.

(Left) Weston Lock, River Avon, Bath (Keith Falconer)
(Right) Elvington Lock (2015) Upper and lower gates in different ownership. (Keith Falconer)

The 23 non-tidal stretch ***Yorkshire Derwent*** from Sutton Bridge to Malton was opened in 1724 with five pound locks. Navigation rights are now disputed on the upper Derwent River and the river is open to navigation on the lower reaches with only the lock at Stamford Bridge (1309871) designated Elvington lock at Sutton BBetween 1724 and 1736 the ***Mersey & Irwell Navigation*** was improved by eight

pound locks but these have been subsumed in later developments notably when the Manchester Ship Canal was constructed and slight remains such as those of the Paddington Lock on the New Cut are early 19th century.

The ***River Don***, though of significant economic potential, posed greater problems for improvement, as below Doncaster it flowed through low lying land subject to flood, and the 16 miles to Wilsick was tidal. Furthermore, above Doncaster the river was much steeper with weirs for mills and the final section from Tinsley to Sheffield was so problematical that it was omitted from the 1726 Don Navigation Improvement Act. Therefore the section below Doncaster was built with locks and weirs not more than four feet high and with very ample sluices gates and, somewhat later, a 2-mile cut below Wilsick improved that section. Above Doncaster all the locks had finally been built by 1751 and the 33 mile long navigation now had nine miles of cuts and 17 locks suitable for 30-ton vessels. The locks on the Don have been enlarged on many occasions into the 20th century and little survives of the early versions though some such as at Kilnhurst have been bypassed by the later locks.

Kilnhurst Lock, with the older, disused lock to the right. (www.penninewaterways.co.uk)

The improvement of the ***River Weaver*** was a much simpler affair which was achieved between 1730 and 1735 by building wooden locks within the river attached to weirs but none of these have survived the major late 19th century campaign of improvements. In contrast, the contemporary low cost attempts to improve the ***Yorkshire Ouse*** were unsatisfactory and less-hindered navigation had to await the construction of the impressive Naburn Lock in 1757 which is now paired with a late 19th century lock.

Naburn Locks and Banqueting House of 1823 (IoE 326198 John Turner)

On the ***Great Ouse*** navigation was further improved by the construction of the equally impressive Denver Sluice in 1750 which prevented tides overtopping the

lower banks upstream while its lock allowed passage at all normal states of the tide. On the ***River Nene*** the first work to improve navigation began in the Middle Ages, and an Act to improve navigation on the river was passed in 1713, enabling Northampton to be reached from the sea by 1761. The Act of 1713 allowed cuts and 20 locks by-passed 21 mills and when completed in 1761 provided a much improved 26 mile navigation downstream of Northampton and Ferry Bridge (1126812), a three span masonry bridge 'built at the sole cost and charge of the It Hon William Fitzwilliam 1716' is testimony to the early engineering.

Ferry Bridge (Wikipedia Terry Butcher)

Thus by 1760, when it is generally recognised that the Canal Age begins, a further 370 miles had been added since 1700 and the system, by Skempton's reckoning, totalled some 1320 miles of which around 700 miles had been engineered.

Trinder's study (2005 and 2016) of the ***River Severn*** indicate the measures taken to circumvent impediments to river navigation such as the fish weirs which were constructed from the medieval times onwards – at least 28 such weirs in Shropshire in 1575. Artificial cuts were made and created islands known as a bylet and several of these are identifiable today. Trinder, quoting observations by George Perry in 1758, shows the considerable number of barges in use on the Severn in 1756 – some 313 working from Bewdley and places upstream alone. It also distinguishes between long haul voyages undertaken by large trows of between 40 and 80 with more than one mast and capable of navigating the tidal reaches below Gloucester, and engaged in high value trade, and smaller vessels of between 20 and 40 tons used on the river above Gloucester primarily carrying lower value cargo such as coal and iron. Both types of barge were up to 60ft long and they traded from multiple wharfs on the river – there were some 16 principal wharfs in the Ironbridge Gorge upstream of Coalport Bridge. On the Severn some of the river wharfs such as The Wharfage in Ironbridge and Underhill Street in Bridgenorth had multi-storey warehouses with taking-in doors while transhipment facilities could be quite elaborate as between the Shropshire canal and the river at Coalport. These types of wharf are to be found on most river navigations and while the tidal ranges and difficulties on the Severn called for extreme measures the use of specialised vessels is also common to many other rivers. Paget-Tomlinson (1994) discusses the variety of craft used on various rivers and their propulsion.

On most river navigations sail was used whenever possible but on occasion resort had to be made to hauling. In this respect, due to legal wrangling, the Severn, for example, was late to be improved. The towpath between Bewdley and Coalbrookdale, authorised in 1772, was not completed until 1800 and upstream to Shrewsbury only by 1810. The towpath had to cross the river several times and bridges were provided across tributary streams. At least three small such bridges survive, two of cast iron - over the Mor Brook dated 1824 cast by Onions of Broseley and over the Borle brook cast by the Coalbrookdale Company in 1828 while a small masonry arch crosses the mouth of the Leighton Brook. On the Severn, locks between Gloucester and Stourport had to wait until the 1840s to be constructed by William Cubitt and Edward Leader Williams.

One waterway which spanned the transition between navigations and still water canals and indeed involved both of the Canal pioneer engineers – James Brindley and John Smeaton – was the ***Calder & Hebble Navigation***. It encapsulates the complex interaction of early canal engineers and the constant changes in both engineering and economic factors. Following a survey made by John Smeaton in late 1757 a scheme was produced for an improved navigation from Wakefield to Halifax which involved dredging shoals, making 5.7 miles (9.2 km) of cuts, the building of 26 locks, to overcome the rise of 178 feet (54 m) between Wakefield and the Halifax Brook, and the construction of a reservoir at Salterhebble bridge. An Act was obtained on 9 June 1758, for this route extended to Sowerby Bridge rather than Halifax and construction started in November 1759, with Smeaton acting as engineer. He was briefly replaced by James Brindley in 1765-6 but returned in 1768 to complete the work after disastrous floods earlier that year, while other engineers were also involved with reports and inspections. The Calder & Hebble opened throughout as river navigation in 1770, was constantly improved and canalised over the next 50 years with several resident engineers involved– Thomas Bradley (1792-), Robert Carr (1769-74), Luke Holt (1769-74)- until it was largely artificial with 26 locks, four flood locks and four flood gates. Halifax had been the destination of the original 1757 scheme and Halifax was eventually reached in 1828 but only by a short branch which had a further 14 locks and a basin behind the railway station. This late branch was abandoned in 1942.

Brighouse locks, Calder & Hebble
(www.penninewaterways.co.uk)

Hence it an be seen that improvements to river navigations did not cease with the advent of canals – quite the opposite – as exemplified by the Calder & Hebble and also the Trent, the Weaver, the Don and the Aire & Calder all of which have been

considerably upgraded into recent times. However, the linear extent of the engineered sections was to reach its maximum by 1815 with the completion of lock building on the Thames by when almost 1600 miles were navigable in England. Thereafter, while some of the locks and other water control structures on major rivers were to be improved and greatly enlarged, over the next 150 years, the system itself, while accommodating ever larger vessels, was not to grow appreciably in length or geographically.

Some late improvements to ancient waterways did little to prolong their use. The River Wye and its tributary the Lugg had been improved in the early 18th century and the addition in 1811 of a horse path up to Hereford, built under a separate Act, increased traffic considerably but the advent of railway competition in the 1850s caused the towing path company to be dissolved ending Wye traffic to Hereford. The lock (1348710) on the River Lugg towards its confluence with the River Wye survives and is designated grade II.

Heritage of river navigations

What then of heritage significance survives along these 1600 miles of river navigations? In contrast to artificial still-water canals, river navigations are largely natural water courses and therefore very much subject to the regimes of weather conditions and consequent drainage. As the basis of the original navigable system, they have also been constantly upgraded and in some instances, as with the ship canals, continue to carry commercial traffic with much larger vessels than operate on the traditional narrow and broad canals. A consequence of these factors is that heritage, with perhaps the exception of the Thames above Teddington, has usually been very much a lesser consideration than commercial carrying, flood control and drainage. The recent concerns with widespread flooding, and media criticism of the Environment Agency in this respect, has put pressure on waterway authorities to remove any possible obstructions to free flow. Thus it is likely that very few of the structures recorded in the Lewis et al survey (1969) on the minor rivers now survive to any great extent in height though vestiges may survive in plan. (See Section 3) The fate, after the recent floods, of any vestigial historic navigation remains on the Rivers Tone and Parrett in Somerset has not yet been ascertained.

Modernisation of commercial carrying on waterways, over the last century-and-a-half, has created its own heritage. As noted in the Gazetteer the Aire & Calder is a particularly fine example of an early 18th-century river navigation that was constantly being developed and improved as a system until recent years.

(Left) A late large lock, Aire & Calder (Wikipedia Mike Reay)
(Right) Sykehouse Lock, New Junction Canal (Wikipedia Bob1960evens)

It has many large-scale engineering structures, culminating in the docks and former Aire & Calder Navigation company town at Goole and a number of locks modernised in 1970s to European standards, with coloured light operation. These locks with their accompanying control cabins and houses have some historic value and represent a final 20th-century phase of waterway business development. The opening of the ***New Junction Canal*** in 1905, jointly funded by the Aire & Calder Navigation and the River Don Navigation witnessed the construction of a new 5-mile canal – the last new canal to be built until recently.

During the 20th century, there were several plans to upgrade the Don itself, to handle larger craft. It was eventually upgraded to take 700-tonne barges in 1983, but the scheme was a little too late, as the anticipated rise in commercial traffic did not occur.

Aldwarke Lock, River Don Navigation
(Wikipedia Bob1960evens)

Most use of the Don navigation is now by leisure boaters, whose boats are dwarfed by the huge locks such as the Aldwarke Eurobarge Lock, complete with traffic lights. At Kilnhurst and Long Sandall, the new larger locks were built alongside the original locks, and so a comparison of the relative sizes can be made. The disused Strawberry river lock (1314870) at Milethorn Lane, Doncaster is designated Grade II as it has retained early fabric while the tidal Keadby Lock (1342734) on the Stainforth & Keadby Canal section though listed Grade II was modernised in the 20th century.

Weaver Saltersford locks

Acton Swing Bridge 1932 (Geograph David Dixon)

The Weaver has important waterway archaeology (from successive improvements) but its main heritage significance is achieved by the uniform, high quality engineering and architectural embellishment of its locks and associated structures, weirs and sluices and swing bridges of the 1871-97 and later periods.

The Weaver Navigation Head Office (1139112) in Northwich, which is still used as offices and has a fine Board Room, is Grade II as is the adjacent detached Clock Tower (1161109). However the Weston Point Dock which retains large basins, swing-bridges, are disused though the rare waterway chapel in Gothic style, built for the Weaver Navigation trustees is Grade II.

Navigation House and Clock Tower (IoE 57634, 57635 R.G. Noxon)

There have been several efforts in the past to modernise the non-tidal River Trent between Shardlow and Newark to accommodate commercial traffic including the rebuilding of locks such as that at Cromwell which can take 300-ton barges but now most use is for leisure. In recent times a conflict of interest between heritage and the sustainable re-use has recently surfaced over the Holme Lock hydro-scheme proposed by CRT. The hydro-power installation was to cause the loss of 40% of the historic fabric of William Jessop's defunct lock chamber which was not designated. The view was taken that the public benefit of the renewable power generation scheme, coupled with the opportunity to investigate, record and interpret the historic engineering structure, and the conservation of that part of the lock chamber retained, outweighed the loss of 40% of the original structure.

In the early years of the waterways restoration movement, the conflict between the desire to open up disused navigations for boating as cheaply and speedily as possible and survival of heritage assets was not satisfactorily resolved. In the early 1960s, in the case of the Warwickshire Avon, the pioneer restoration campaign paid scant heed to heritage considerations while, somewhat later, on the Kennet at

least some concessions were made to heritage with the rebuilding of the interesting Aldermaston Lock and the retention of the scheduled Garston and Monkey Marsh turf sided locks. However the restoration of the River Wey in the 1960s witnessed the disappearance of the other group of significant turf-sided locks.

Aldermaston Lock
(IoE 39700 Richard Swynford-Lain)

Garston Lock (IoE 40058 Mary Auckland)

2.2 The Canal Age (c.1760 – 1840)

The above account of the improvement of river navigations before 1760 does not include the ***St Helens Canal (***or ***Sankey Brook Navigation)***. Built under a Navigation Act of 1755 and completed in 1759, it was in reality a 15-mile long canal and as such is widely regarded by some as the first industrial canal in mainland Britain and it has a second claim to fame as it contains remnants of perhaps the earliest pair of staircase locks in England (see below Section 3). Though later than the Newry canal in Ireland, and very much a lateral canal paralleling a river, the St Helens Canal, with its emphasis on the transport of coal, should perhaps be regarded as a transitional waterway heralding in the age of industrial canals so triumphantly exemplified by the Bridgewater Canal.

Old Double Locks (www.penninewaterways.co.uk)

The account of the development of the canal system from the opening of the Bridgewater Canal in 1761to the completion of the Birmingham & Liverpool Junction Canal in 1835 has been detailed in countless books such as those by Rolt (1950, 1969) Hadfield (1950, 1955, 1986), Burton (1972, 1975, 1993, 2001, 2002, 2003 and 2001), McKnight (1975) and Paget –Tomlinson (1978 and 1994) and therefore need not be repeated here at any length. Hence only the main periods of activity will be briefly discussed, the opening of canals of current heritage significance chronicled and significant engineering advances noted, all from the perspective of surviving heritage.

Pioneer Phase

It is generally recognised that there was a Pioneer Phase from 1760 to 1780 typified by the canals surveyed, designed and engineered by James Brindley, John Smeaton and their pupils and associates.

Brindley, a mill wright and self-taught surveyor and engineer, was a prolific canal designer with a school of engineers who carried on his work after his premature death in 1772. These included Hugh Henshall, Samuel Simcock, Robert Whitworth, Josiah Clowes, Thomas Dadford, John Varley and Samuel Watson. His preference for contour canals with an avoidance of major engineering works wherever possible has left its legacy on many pioneer canals following the lies of the landscape. His other legacy was the introduction of narrow locks brought about by his decision for economic and engineering reasons to drive the Harecastle Tunnel on the Trent & Mersey Canal at a gauge of 7 foot. Brindley's vision of a Great Cross of canals joining the rivers Mersey and Trent to the Severn and Thames was only completed some years after his death in 1772 by his assistants but his decisions were to influence not

only the gauges of locks and the bore of tunnels but also the use of pairs of staircase locks was to determined much of the canal system of central England. His pupils and especially Robert Whitworth were to survey and/or build many of the later 18th century canals

James Brindley (1716-1772)

John Smeaton (1724-1792)

Canals Brindley as Surveyor and Chief Engineer		(with & finished by)
Bridgewater Canal I (1760-63)	open 1761	(John Gilbert)
Bridgewater Canal II (1762-72)	open 1776	(H. Henshall)
Trent & Mersey Canal (1766-72)	open 1777	(H. Henshall)
Staffs & Worcs Canal (1766-72)	open 1772	(Simcock & Dadford)
Droitwich Canal (1768-71)	open 1771	(Whitworth & Priddy)
Coventry Canal (1768-72)	open 1789	(Dadford & Whitworth)
Birmingham Canal (1768-72)	open 1772	(Whitworth & Simcock)
Oxford Canal (1769-72)	open 1790	(Simcock et al)
Chesterfield Canal (1771-72)	open 1777	(Varley & H. Henshall)

The basic skeletal framework of the canal system linking four great navigable rivers – the Mersey, the Trent, the Severn and the Thames – Brindley's Cross - was thus developed at this time. Hence the Bridgewater itself connected via the Trent & Mersey (Act 1766, completed 1777), to the Staffordshire & Worcestershire (Act 1766, opened 1772) and hence the Severn and to the Birmingham (Act 1768, opened 1772), and onward to the Coventry (Act 1768, opened 1789) and the Oxford (Act 1769) opened 1790 and south to the Thames and via the Trent to the Chesterfield (Act 1771) opened 1777 and northwards to the Yorkshire waterways system.

Brindley's ***Bridgewater Canal***, commissioned by the Duke of Bridgewater and built in association with John Gilbert, was opened in 1761 from Worsley to Castlefield, Manchester thus creating a lucrative coal trade from the Duke's mines to Manchester. By avoiding the use of locks the canal had to follow the contours where possible and cross several roads and rivers requiring a number of small squat aqueducts. Most of Brindley's aqueducts were much less spectacular the one over the Irwell that over the Lumb Brook and the adjoining road being more typical.

Brindley's Barton Aqueduct over the River Irwell was a wonder of its day while the Lumb Brook Road Aqueduct is more typical of Brindley's engineering. (IoE Number: 58948 F. Bryan Basketter)

The Bridgewater being lockless (other than the flight at Runcorn down to the Mersey) and by following a contour set an example for many canals over the succeeding decades to do the same (whenever the landscape allowed). The original line of the ***Oxford Canal***, surveyed by Brindley and engineered after his death by his assistant Samuel Simcock was to be the supreme example of a contour canal - almost circumventing the spur of Wormleighton Hill. Originally 91 miles long it was shortened to 77 miles in the 1830s by employing more direct adventurous engineering. At the same time, Brindley's ***Trent & Mersey Canal***, while adhering where possible to the principle of a contour canal had to traverse much more diverse landscapes and was heavily locked. Built with narrow locks for economy reasons the Trent & Mersey with the Staffs & Worcs Canal set the pattern for the West Midland canals to be plied by narrow boats. The Yorkshire waterways, on the other hand, mostly running with the lie of the land, had broad locks used by barges while on the plateau of the Shropshire coalfield, where water was relatively scarce, tub-boat canals with inclined planes such as the Donnington Wood and the Shropshire Canal became the norm.

Hay Incline (IoE 362004 J K Aldred)

Meanwhile John Smeaton, recognised by contemporaries as the first Civil Engineer and a Fellow of the Royal Society, was designing harbours, lighthouses and bridges around the country as well as being very much involved in navigations such as the Calder & Hebble (see above) and on the Forth & Clyde Canal – the first cross-country ship canal – and consulted on many other schemes. His pupil William Jessop was to become one of the most significant and prolific canal engineers of the late 18th century and Smeaton's more scientific and theoretical approach to engineering was to inspire other great canal engineers including Thomas Telford, John Rennie and

Josias Jessop. As well as the Calder & Hebble (1758 -1770 and the strategically important Forth & Clyde Canal (1768-77), he worked on the Ripon Canal (1766-73), the Birmingham & Fazeley Canal (1782-89) with the short Curdworth Tunnel one of the first tunnels with a towpath and lowering the summit level of the Birmingham Canal (1784-1789) originally surveyed by Brindley.

Curdworth Tunnel (IoE 443797 Keith Wise)

Thus in the decade immediately following the commercial success witnessed by the opening of the Bridgewater canal in 1761 most of the canal activity focussed on completing the Brindley-surveyed canals discussed above and on the other significant canal on which construction started – the Leeds & Liverpool Canal with which Brindley was also associated and its short linking canal to Bradford (1771-1773).

The ***Leeds & Liverpool Canal*** was authorised in 1770 and sections either side of the Pennines opened from 1774 onwards by John Longbotham and traded profitably between local towns. One of these sections is notable for the Five Rise, Three Rise, and Two Rise staircase locks at Bingley of 1773 engineered by Longbotham to plans by Brindley.

Bingley Five Rise (www.penninewaterways.co.uk): (Right) Gannow Tunnel 1801 (IoE 467038 Peter J. Sturtivant)

However the long distance trade from sea to sea had to wait until two main tunnels were completed. The Foulridge Tunnel engineered by Whitworth was opened in 1796 and Gannow Tunnel engineered by Fletcher in 1801.

Improvements also continued to be made to several major navigations such as the Aire & Calder and the River Weaver and besides these the short Louth Navigation was authorised in 1763 and opened in 1770 (John Grundy and Smeaton) and the minor Driffield Navigation which was authorised in 1767 was opened in 1770 (Grundy and Samuel Allam) . The Louth Navigation was partly a canalisation of the River Ludd and six of its eight locks are of some engineering interest being built with

chamber sides composed of six segmental arches in the vertical plane to resist lateral earth pressure.

Louth Navigation Alvingham Lock
(IoE 195450 Trevor Sowray

Heritage of the pioneer canals

Many of these early canals, and especially the longer ones, were at the heart of the waterways system and, although most suffered decline and lack of care, many survived reasonably intact until they once again were cherished. Thus the Bridgewater, the Trent & Mersey, the Staffordshire & Worcestershire, the Birmingham, the Coventry and the Leeds & Liverpool retain much of their historic fabric.

The ***Bridgewater Canal*** has retained many of its pioneer features at its origin in Worsley such as the entrances to the mines at Delph which were its raison d'etre and other features of its early operation such as the Packet House and dry docks while at Castlefield Basin in Manchester much altered warehouses, a reconstructed waterwheel driven hoist and water management arrangements survive.

Delph Basin entrance to coalmines and The Packet House, Worsley (Wikipedia Parrot of Doom)

Castlefield Basin (Wikipedia Clem Rutter), and Giant's Basin circular weir. (IoE 456065 Mike Widdas)

Though Brindley's seminal Barton Aqueduct has gone, it was replaced by the magnificent Swing Aqueduct and the line from Stretford, extending past the Preston Brook junction with the Trent & Mersey to Runcorn is largely original. Regrettably the Runcorn flight of 10 barge locks arranged in staircase pairs dating from 1773 has been infilled as it was the earliest such substantial flight in the country but much of it may survive and there are proposals, yet to be detailed, to restore sections of the flight. Also at Runcorn, Bridgewater House, where the Duke would stay to inspect the work in progress, has been restored.

Bridgewater House, Runcorn
(IoE 56039 Martin Byrne)

Brindley's ***Trent & Mersey Canal*** and his ***Staffordshire & Worcestershire Canal*** have also fared well. Although his Harecastle Tunnel which when opened in 1775 was the first major canal tunnel in the country, was replaced 50 years later by Telford's larger bore tunnel, his other tunnels Preston Brook, Barnton and Saltersford Tunnels dating from 1777, engineered by his brother-in-law Hugh Henshall who had assisted him with Harecastle Tunnel (and finished it after his death) are also of great significance as amongst the earliest canal tunnels in the country. The Preston Brook and Barnton Tunnels have circular brick Ventilation Shafts (1244328) which may be original and are listed.

Brindley's south portal Harecastle Tunnel
(Wikipedia Akke Monasso)

South portal, Preston Brook Tunnel
(IoE 436331 Keith Walker)

Many of the bridges, some of the locks and the aqueducts over the River Trent (1096525) and Dove are typical Brindley structures, the aqueduct over the Trent with its ten low segmental arches is archetypally Brindley.

Aqueduct over the Trent (IoE 82704 Geoffrey R Hood)

Graceful canal bridge of 1772 at junction of the Staffs & Worcs Canal with Trent & Mersey Canal at Heywood (IoE 443269 Howard Bagshaw)

It is claimed by Priestley (1831) that the Staffs & Worcs Canal witnessed Brindley's first construction of a narrow lock – that at Compton at the end of the summit pound from Gailey c.1766 – while the staircase locks at Bratch are c 1771 so also date to before his death.

(Left) Staffs & Worcs. Bratch Lock and house (IoE 407805 Mark Hadley)
(Right) Oxford Canal, Tilting Bridge Adderbury (IoE 243821 J. B. Moseley)

Elsewhere Brindley's winding ***Oxford Canal*** was streamlined fifty years later but much of Brindley's work and that of his school of engineers, has survived.

The ***Chesterfield Canal,*** another early canal, with its problematic Norwood Tunnel, has suffered much more and for many years has been severed but is now being valued and partially restored and thorough archaeological recording preceded the work on innovative staircase formations of Thorpe and Turnerwood locks (1192731).

Restored Turnerwood Locks, bridge and overflow (1314642) (IoE 335811 335809 Paul Eggleston)

The ***Leeds & Liverpool*** canal in addition to its impressive locks and tunnels has an outstanding collection of heritage assets ranging from its numerous early warehouses and its Company Office of 1816 in Leeds to the dam of its Winterburn Reservoir (1885) with its magnificent ornamented water-ladder.

(Left)Lock No1 and warehouse, Leeds (www.penninewaterways.co.uk):
(Right)Canal Company Offices 1816, Leeds (IoE 465728 David Karan)

Winterburn Reservoir water ladder (IoE 382302 Stewart Cardwell)

The mid 1770s–late1780s: the lull before the Mania

The economic turmoil caused by the American War of Independence and the accompanying hostilities with European powers had put a considerable dampener on the expansion of the canal system from the mid-1770s to the mid-1780s so that even schemes requiring only modest amounts of capital had difficulty in raising finances such as the Market Weighton Canal which took 10 years to complete after its Act of 1772 and the Basingstoke where work started following an Act of 1778 but was only completed by Jessop in 1794 with another Act of 1788.

Hence, though the rudimentary framework of the canal system had been assembled by the late 1770s, these two decades, due to uncertain economic times, witnessed only a steady expansion and consolidation of the existing inland waterway system. These decades saw some elaboration of what was to become the Birmingham Canal Navigations with Birmingham & Fazeley and the first Dudley Canal and the adjoining Stourbridge Canal

(Left) Birmingham & Fazeley Aqueduct over the River Tame (IoE 217362 Brian R Edwards)
(Right) Delph Locks where the Stourbridge and Dudley Canals meet (IoE 217976 Colin Cundy)

At the same time, in the Shropshire Coalfield a system of tub-boat canals was developing quite detached from the main network, this comprised the Donnington Wood, the Ketley Canal, the Wombridge and the spine to the system, the Shropshire Canal, which was authorised in1788 and surveyed by Jessop.

Shropshire Canal at Coalport (Wikipedia Cripin Purdye)

The decades, significantly, also saw the construction of a southern cross country route – the ***Thames & Severn Canal*** authorised in 1783 and opened in 1789 including the 3817 yard Sapperton Tunnel engineered by Josiah Clowes – the longest canal tunnel then built. Clowes was a friend and business colleague of Hugh Henshall and had worked as a contractor on the Harecastle tunnel. Later, in 1783 he was appointed engineer to the Chester Canal rebuilding locks and then had assisted Thomas Dadford on the Stroudwater Canal. Initially he was assistant to Robert Whitworth on the Thames & Severn Canal but became resident engineer when Whitworth left. The Sapperton Tunnel was built to take barges and driving it was to prove problematic and called for the pioneer use of a driving frame.

(Left) Sapperton Tunnel South portal (IoE 12929 Lorna Freeman): (Right) Caldon Canal, East portal Froghall Tunnel (1783) (Wikipedia Akke)

Meanwhile existing canals and navigations spawned other smaller canals and branches. These included the Caldon Branch off the Trent & Mersey, the Bradford off the Leeds & Liverpool and the Huddersfield Broad (also called Sir John Ramdsen's Canal) off the Calder & Hebble. The Erewash Canal off the River Trent led on to the Cromford Canal giving access to rich coalfields and a 26 mile connection from the Derwent Textile mills.

Of the new waterways authorised and constructed in this period prior to 1790 William Jessop and Robert Whitworth were most prominent amongst those surveying and engineering the lines. The following table summarises this activity:

Chester Canal	Act 1772	open 1779	(Weston)
Market Weighton	Act 1772	open 1782	(Grundy/Whitworth)
Huddersfield Broad	Act 1774	open 1776	(Whitworth/Holt)
Dudley Canal	Act 1776	open 1779	(Whitworth/Dadford)
Stourbridge Canal	Act 1776	open 1779	(T. Dadford Ygr)
Caldon Branch	Act 1776	open 1779	(T & M Canal)
Stroudwater Navigation	Act 1776	open 1779	(Dadford/Yeoman)
Erewash Canal	Act 1779	open 1779	(Varley)
Birmingham & Fazeley	Act 1783	open 1789	(Smeaton)
Thames & Severn	Act 1783	open 1789	(Whitworth & Clews)
Basingstoke	Act1788	open 1794	(Jessop)
Shropshire	Act 1788	open 1792	(Jessop)
Andover	Act 1789	open 1794	(Whitworth)
Cromford Canal	Act 1789	open 1794	(Jessop/Outram)

With the return to a healthier economic climate in the late 1780s, the renewed commercial success of the early waterways caused the pace of canal promotion and construction to quicken. The canals around Birmingham continued to elaborate with the BCN's numerous branches and some significant improvements to its Main Line such as Smeaton's lowering of the summit at Smethwick and with the addition of the Birmingham & Fazeley in two stages. Many of the branches that were linked to these canals, from this time onwards, were privately built and were quite substantial. In

Silent Highways Ray Shill (2011) has identified 26 such waterways of length, nine of which had locks. Indeed, the Foxyards Canal off the Main Line had four locks as did the Scott & Foley's branch of the Walsall Canal and the Bradley Marr branch had a staircase pair. Elsewhere, the Basingstoke (Act 1788) the Andover(Act 1789) and the Cromford (Act 1789) all opened in 1794.

Heritage of the pre-Mania waterways

Most of these Pre-Mania canals have left a significant heritage. The Chester Canal which was later to open up the route to northern Shropshire and mid Wales has an impressive flight of locks ibn Chester itself while in the West Midlands elaboration of what was to become the Birmingham Canal Navigations with Birmingham & Fazeley, the first Dudley Canal and the Stourbridge Canal attracting canal-side industry was to create the area to become known as the Black Country.



(Left) Northgate Locks Chester (IoE 469913 Michael J Tuck); (Centre) Tollhouse of original Delph flight 1779 (IoE 403768 Colin Cundy): (Right) Sapperton Tunnel North Portal (IoE 128352 E. Currier)

The ***Thames & Severn*** on the other hand, though authorised somewhat later in 1783, was opened in 1789 and, in addition to the Sapperton Tunnel with its different classical and crenelated portals, it has distinctive Wharf Houses, cum warehouses, at Cirencester, Kempsford and Cricklade and five round lock-keepers houses as at Chalford, Coates, Cerney Wick, Marston Meysey & Inglesham.


Wharf House Cricklade (IoE 317836 John Rendle): Chalford Round House (Wikipedia David Stowell)

However though many of its most historic features are designated and partially conserved, and the line of the canal is protected by the planning system the canal remains dewatered for much of its length and is the missing link in the Cotswold Canal scheme.

The small canals and branches off the main early canals tend to have suffered even more. The Bradford Canal has gone and very little survives of the Shropshire tub-boat system other than the Hay Incline and associated stretches of canal, but the vestiges of inclines that do survive are significant as evidence of pioneer canal engineering structures. However, the Stroudwater has been partially restored and, hopefully, will eventually be fully restored and the Droitwich and the Caldon have re-opened while a section of the Cromford Canal has been opened to Cromford Wharf and includes Jessop's impressive aqueduct over the Derwent.

Stroudwater Navigation, Ryeford Double Locks before (2003) and after restoration (IoE 132063 Jonathan Briggs and Cotswold Canals in Pictures)

(Left) Caldon Branch 1779 Lock altered mid-19th century Cheddleton (IoE 274532 Robin Harper)
(Centre) Droitwich Canal, Hawford Bottom Lock, junction with Severn (Geograph Roger Kidd)
(Right) Cromford Basin (Wikipedia Craig Carter)

Even more of the ***Basingstoke Canal*** has been restored. Originally 37 miles long with 29 locks and the 1230 yard long Greywell Tunnel the canal was never profitable and was disused progressively eastwards from 1910 to 1949 and the western five miles built over. The canal was not nationalised and was one of the first projects of the restoration movement. After many vicissitudes, thirty two miles of the waterway, from the Wey Navigation junction to the Greywell Tunnel(1339863), were reopened in 1991.

Greywell Tunnel (IoE 136606 Charles Cordy-Simpson)

The Mania years

Although around 70 Acts authorising various waterways had been passed between 1750 and 1790, not all were constructed. Indeed only some 25 canals were built in the thirty years following the opening of the Bridgewater in 1761. These were to presage the so-called Canal Mania when in a period of four years from 1791-1794, in England alone, no less than 37 canals and navigations were authorised and in the two decades 1791-1810 some 215 waterway Acts were passed. While some of the Mania canals were to become valuable and commercially successful additions to the system, others hastily proposed, surveyed and authorised, were rather unrealistic in their aspirations.

Amongst the former were such notable waterways as the Lancaster, the Kennet & Avon, the Grand Junction and other of the canals which later were to form the Grand Union, the Stratford, the canals of the Cheshire Ring and two further cross-Pennine canals – the Rochdale and the Huddersfield Narrow. Many of these canals are testament to the advances in both canal routing and engineering and in architectural accomplishment that had been made over the thirty years since the Brindley's pioneer waterways. Canals no longer clung to winding contours but now sought more direct lines as evidenced by new routes especially out of Birmingham. The canals that were later to form the ***Grand Union Canal Main Line*** – the Grand Junction (masterminded by William Jessop) ran from Brentford to Braunston, where it picked up a section of the Oxford canal and then the Warwick & Napton and the Warwick & Birmingham continued the route to Salford Junction, Birmingham – a total of 135 miles and 165 locks.

(Left) Grand Junction Canal, Braunston Tunnel 1796 (IoE 360963 John Airlie Hunter): (Right) Warwick & Napton Canal, Stockton Locks 1799 (IoE 307229 (Helmut Schulenburg)

This mainline, built between 1793 and 1805, greatly improved the reliability of the route from Birmingham to London and by-passing the upper reaches of the River Thames and the lower Oxford Canal, it shortened the journey by 60 miles. As a result, it thrived: in 1810 it carried 343,560 tons of goods through London, with roughly equal amounts into and out of the capital.

The ***Worcester & Birmingham Canal*** (59 locks in 30 miles) while greatly shortening the route from Birmingham to the Severn took somewhat longer to complete reaching the Severn at Worcester in 1815. It had 59 locks in its 30 miles and these included the Tardebigge flight of 30 locks – the longest flight in the

country and the deep Top Lock was the site of an experimental canal lift and had a beam engine pumping station.

Lock Cottage Tardebigge Flight
(IoE 355192 Geoff Dowling)

The waterway route to the Bristol Channel was further greatly improved with the construction of the ***Gloucester & Sharpness (Ship) Canal*** which was authorised in 1793 but only opened to Sharpness in 1827. It started from Gloucester Docks, which were accessed by a lock off the Severn, and continued to a tidal basin at Sharpness

River Severn Lock, Gloucester Docks
(Canalplan, David W Clegg)

The engineering achievements were no less spectacular. Rennie's aqueducts on the Kennet & Avon and the Lancaster Canals are amongst the finest masonry aqueducts in the country.

Rennie's Lancaster Canal Lune Aqueduct (1797) (IoE 182235 Malcom Shaw) and his Kennet & Avon Dundas Aqueduct 1801 (CRT)

Meanwhile Jessop and Telford's engineering structures were to introduce iron as a major structural element on their Ellesmere Canal Llangollen Branch. Telford's Shrewsbury Canal with its pioneer Longdon-on-Tern Aqueduct 1797 had demonstrated the success of iron.

Telford's Longdon-on-Tern Aqueduct 1797 (Wikipedia Priewis) Chirk Aqueduct 1801 (IoE 255822 John Garton-Jones)

Jessop and Telford were then to use iron was in the Chirk Aqueduct of 1801 with an iron plated channel and masonry parapets and across the border in Wales the use of an iron trunk was to reach its zenith with Pontcysyllte Aqueduct which opened in 1805 to great acclaim. It is the main component of the Pontcysyllte Aqueduct World Heritage Site. Jessop was later to adopt its use on the Grand Junction with his Iron Trunk aqueduct of 1811 which replaced his masonry aqueduct which had failed.

Iron Trunk Aqueduct 1811 (Wikipedia Dr Peter R Lewis)

The architectural treatment of some of these canals is quite magnificent and the section of the Kennet & Avon through Sydney Gardens in Bath is one of the key elements in the World Heritage Status of that city.

Tunnel and Cleveland House, Sydney gardens, Bath (IoE 442751 Micaela Basford) 1810 Iron Bridge Sydney Gardens, Bath (IoE 442753 Michael Perry.

Water supply was also made more reliable with more use of pumping engines – waterwheel driven as at Claverton on the Kennet & Avon and steam powered as at Crofton on the Kennet & Avon, a chain of pumping stations on the Grand Junction and several on the BCN.

Claverton Pump House (Keith Falconer) and Crofton Pumping Station (IoE 310817 B.J.W. Heath)

As we have seen, some of these 'Mania' canals took many years to complete, the section of the Stratford Canal south of Kingswood, built under an Act of 1793 by William Whitmore with three iron aqueducts, was not opened until 1816 while the Worcester & Birmingham (Act 1791 opened 1815) and the Gloucester & Berkeley (Act 1793 opened 1827) took even longer to complete, 25 years and 34 years respectively, but were eventually reasonably successful. Indeed the Gloucester & Berkeley renamed the Gloucester and Sharpness Canal developed at Gloucester the largest inland canal port and later was to was to construct the New Sharpness Docks.

Gloucester Docks (Hugh Conway Jones) (Right) Gloucester & Sharpness Canal, Entrance to Old Basin (Keith Falconer)

Amongst the over-ambitious canals, where construction actually commenced but never reached their intended extent, were the Ellesmere, the Hereford & Worcester, the Somerset Coal Canal and the Leominster Canal which, while incomplete, were nevertheless opened and traded on. Indeed the Somerset Coal canal even in its incomplete state was reasonably profitable.

Somerset Coal Canal*:* Combe Hay Locks (Wikipedia spoonfrog) and Midford Aqueduct (Geograph, Guy Wareham)

The Ellesmere Canal was of course to become a major component of the Shropshire Union Canal and much of it is still a part of that busy cruising system.

(Left) Ellesmere Canal, Hurleston Junction Lock (Wikipedia Roger Kidd): (Right) Wrenbury Church Bridge (IoE 422451 Howard W Hilton)

On the other hand, the Dorset & Somerset was a complete waste of money with only the Frome Branch, which included aqueducts such as Murtry (1174214) and Coleford 1175761) and patent lifts, only partially built and never traded on.

Dorset & Somerset Canal Murtry and Coleford Aqueducts (IoE 267107 Robert O. Caudwell), (IoE 267856 Neil Bentham)

Other canals such as the Manchester, Bolton & Bury, the Barnsley, the Dearne & Dove and the branches of the Ashton served coal mining areas and prospered and declined with that industry and suffered severely from subsidence. The impressive Prestolee and Clifton Aqueducts survive on the Manchester, Bolton & Bury Canal.

Prestolee Aqueduct over River Irwell (IoE 210525 David H Swain)

The following table summarises the frantic promotion of canals over just six years and indicates their subsequent fate.

Table of Waterways Authorised 1791 - 1796 (P = partially)

Waterways	Act	Completed	Closed	Restored
Worcester & Birmingham	1791	1815		
Leominster	1791	1796	1859	
Manchester, Bolton & Bury	1791	1796	1925 onwards	
Hereford & Gloucester Canal	1791	1798 & 1845	1881	
Ashton	1792	1797		1974
Coombe Hill	1792	1796	1876	
Horncastle	1792	1802	1889	
Lancaster	1792	1797 & 1819	1955 (P)	
Nottingham	1792	1796	1936 (P)	
Sleaford Navigation	1792	1794	1881	1986
Wyrley & Essington	1792	1795		
W & E Extension	1794	1797	1963 (P)	
Barnsley	1793	1802	1946	
Caistor	1793	1800	1877	
Chelmer & Blackwater	1793	1797		
Dearne & Dove	1793	1798	1952	
Derby	1793	1796	1964	
Dudley No.2	1793	1798	1953 (P)	1974 (P)
Ellesmere (& Llangollen in England)	1793	1801	1955	
Foss Navigation	1793	1804	1859 (P)	
Gloucester & Berkeley	1793	1827		
Grand Junction	1793	1805		
Grantham	1793	1797	1936	
Huddersfield Narrow	1793	1811	1944	2001
Nutbrook	1793	1796	1949	
Oakham	1793	1802	1847	
Old (L & N) Union	1793	1805		
Shrewsbury	1793	1797	1944	
Stainforth & Keadby	1793	1802		
Stratford	1793	1802 & 1816	1945	1964
Ulverston	1793	1796	1945	
Warwick & Birmingham	1793	1799		
Ashby	1794	1804		
Kennet & Avon	1794	1810	1990	
Peak Forest	1794	1805	1960s	1974

Waterways	Act	Completed	Closed	Restored
Rochdale	1794	1804	1965	2002
Somerset Coal Canal	1794	1801	1904	
Warwick & Napton	1794	1799		
Wisbech	1794	1797	1922	
Southampton & Salisbury	1795	1802	1808	
Paddington Arm	1795	1801		
Wilts & Berks	1796	1810	1914	some restoration
Grand Western	1796	1814 & 1838	1867 & 1962	1971
Dorset & Somerset	1796	never opened		

Heritage of Mania Canals

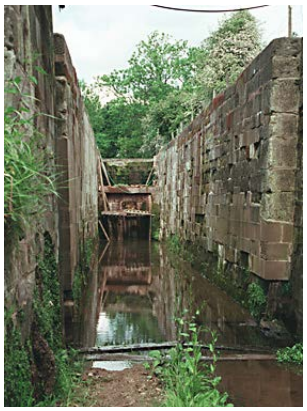
The 'mania canals' that made up sections of what became the Grand Union Canal – the Grand Junction, the Old Union, the Warwick & Birmingham, the Warwick & Napton – have survived in use and have a huge stock of heritage assets, hundreds of which are designated ranging across all structures and building types. However, as the closure column in the Table above indicates, traffic on many of the other major 'mania canals' was to decline to such an extent in the 20th century that that by the 1960s they had become disused and unnavigable in practical terms. Several notable canals such as the Kennet & Avon, the Rochdale, the Huddersfield, the Peak Forest, the Stratford and even the Lancaster were in danger of being officially abandoned and closed. However, due largely to the vigorous opposition of the IWA and allied bodies, such a fate was averted and the canals were gradually restored to navigation. Although some of the early restoration carried out under pressure for rapid results, but seriously under-funded, was careless of heritage assets, most of the later restoration, especially in partnership with expert professional guidance, sought to preserve the heritage. (see below) Therefore almost all the above major canals have retained their heritage in use to a remarkable degree. This has been recognised internationally: for instance the Chirk Aqueduct on the England/Welsh border is included in the World Heritage Site which is centred on the Pontcysyllte Aqueduct and the upper stretches of the Llangollen Canal.

Two canals crossing the Pennine watershed were authorised during the Mania and they took quite different engineering solutions. One, the ***Rochdale Canal***, surmounted the divide by a very short summit level supplied by reservoirs, the other, the ***Huddersfield Canal***, pierced the watershed by a tunnel. Both had water supply problems solved by the extensive use of reservoirs. The Rochdale Canal, authorised in 1794 and surveyed by John Rennie and Jessop using 92 locks, was first to open in 1804. It ran 32 miles from Castlefield Basin In Manchester to Sowerby Bridge where it joined the Calder & Hebble Navigation. It had only two short tunnels at its ends but three, and eventually eight, reservoirs and a summit pound which is less than a mile long.

(Left) Longlees Lock, the Yorkshire end of the Rochdale Canal summit pound (www.penninewaterways.co.uk): (Right) East Portal Standedge Tunnel (Wikipedia Chris Wood)

The Huddersfield Narrow Canal, authorised the same year was engineered by Benjamin Outram and only 20 mile long. However it was not completed until 1811 and connected the Aspley Basin in Huddersfield to the Aston Canal near Manchester. It used 74 locks, the short Scout Tunnel and 5700 yard long Standedge Tunnel – the longest and highest tunnel in the country. It too needed multiple reservoirs – ten on the moors above Standedge.

Many of the minor 'mania waterways' were comparatively short-lived and several indeed were bought by railway companies to use sections for their own lines, while the coalfield canals generally suffered not only from colliery closures but from subsidence. Hence only isolated remains survive of canals such as the Leominster, the Hereford & Gloucester, the Oakham and the Southampton and Salisbury and few of their features are of very great significance.



Teme Aqueduct blown up WWII (IoE 484205 Richard Summers): (Right) House Lock (1248345) before restoration (IoE 429926 Brian F. Squires)

There are valiant attempts to restore sections of some of these canals and the Herefordshire & Gloucestershire Canal Trust has reconstructed a basin at Over while a section at Oxenhall has been partially restored and is of particular interest, featuring a tunnel, a length of branch canal, a series of locks including House Lock.

On the coalfield canals such as the Manchester, Bolton & Bury, the Barnsley, the Dearne & Dove and the branches of the Ashton, dismemberment due to subsidence and consequent breaches has meant that some structures such as four aqueducts on

the Manchester Bolton & Bury have gone but the Prestolee (1162420) and Clifton Aqueduct (1162680) on that canal have been designated, while on the Barnsley the Dearne Aqueduct, its main feature, has been demolished.


(Left) Manchester, Bolton & Bury Canal Clifton Aqueduct. (IoE 211968 Brian Lomas): (Right) Nynehead Lift (Wikipedia NH Savage)

Similarly many of the branches, and most of the private branches, off the BCN built to accommodate the burgeoning trade have gone and left little trace but paradoxically, the canals that were the least successful have sometimes left very significant remains.

On the ***Grand Western*** there are the most complete remains of any lift-operated tub-boat system surviving nationally while on the Frome Branch of the uncompleted ***Dorset & Somerset Canal*** there are also features of considerable archaeological interest (see above).

On the Dorset & Somerset Canal, the site of James Fussell's trial balance lock which he patented in 1798 has recently been found near Mells and the subsequent excavation showed that the chambers survived to almost full height. Accordingly the lift and the nearby flight of uncompleted lift chambers are of very considerable interest and merit assessment for designation.

Excavation of Fussell's Trial Balance Lock (Dorset & Somerset Canal Society)

Early 19th-century canals

In the first quarter of the 19th century, which was dominated by the Napoleonic Wars and subsequent recession and civil unrest, there was relatively little canal building compared to the previous quarter century. Only 14 canals were authorised in the first quarter of the 19th century and most were of little importance. Some were directly prompted by the hostilities – The Royal Military canal was a defensive measure while the Thames and Medway, the Wey & Arun Junction and the

Portsmouth & Arundel canals provided via other waterways secure inland routes from the Channel to London avoiding marauding French vessels. Elsewhere a group of canals in the West country including the 35 mile Bude Canal served mostly rural markets, limekilns or mines through difficult terrain. Three of the canals in Devon and Cornwall were mainly tub-boat canals and made use of inclined planes to cope with the terrain.

As the table below shows most of the canals authorised and built in this period were minor or peripheral and only the short Sheffield Canal, the Tavistock, the Royal Military and the Bridgwater & Taunton survive reasonably intact. Most of the other canals have been closed and several partially built over by railways.

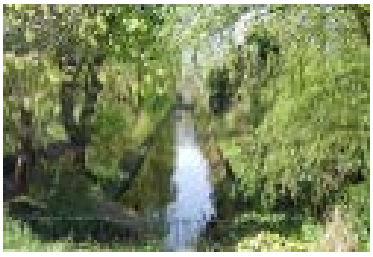
Canals Authorised 1800-1825

Waterway	Act	Opened	Closed
Croydon Canal	1801	1809	1836
Tavistock	1803	1817	1873
Royal Military	1804	1806	1909
Thames & Medway	1810	1824	1847 onwards
North Walsham & Dilham	1810	1825	1912 onwards
Wey & Arun Junction	1813	1816	1871
North Wilts	1813	1819	1914
Sheffield	1815	1819	
Portsmouth & Arundel	1817	1823	1896
Bude Canal	1819	1824	1891
Carlisle	1819	1823	1853
Torrington	1823	1827	1871
Bridgwater & Taunton Canal	1824	1827	
Liskeard & Looe	1825	1828	1862

Heritage of early 19th century canals

While the early 19th century canals have generally fared badly as concerned commercial success they have in some instances left a rich archaeological heritage especially in the south west. On the Bude, the Tavistock, the Torrington there are significant remains of inclined planes and a couple of impressive aqueducts. Other peripheral or rural canals such as the North Wilts (and its parent canal the Wilts & Berks which was only completed in 1810 and can be considered here) have left scant remains other than locks and bridges though in the case of the Wilts & Berks there has been some restoration of short stretches of water and more is proposed.

The heritage of these canals varies greatly. The Sheffield Canal and the Bridgwater & Taunton are cruising CRT canals and while only two original bridges survive on the former the latter is fairly original.



Lower Maunsell Lock and Bridge (IoE 269436 Michael Perry): (Right) Section of canal in Betts Park, Anerley (Wikipedia Nigel Chadwick)

On the closed canals there is little left, for example, of the Croydon Canal which was authorised under an Act of 1801 and opened in 1809 as a barge canal with 28 locks arranged in two flights with reservoirs at Sydenham and South Norwood. Its main cargo was timber but it was linked to the Croydon Merstham & Godstone Railway enabling it to also transport stone and lime from the Merstham quarries. It was never a commercial success and closed in 1836 being the first canal to be abandoned by an Act. Much of its line was used by the London & Croydon Railway while sections were retained for pleasure use as in Betts Park which was used as a boating lake and at Dacres Wood where a pond is a nature reserve.

Of the other canals partly converted to railways there are significant remains of the 7 mile long ***Thames & Medway Canal*** which cut across the Hoo Peninsula from Strood to Gravesend. The Strood tunnel was built to such a generous bore that, for a time, it accommodated the railway and canal and now is used as a rail tunnel while the basin at Gravesend is still open. The sea lock at Port Carlisle on the Carlisle Canal partly survives as do two aqueduct and some bridges and several sites are designated.

Sea Lock, Port Carlisle (IoE 71919 John Wright)

Much of the ***Bude Canal***, on the other hand, though closed for over a century has survived and is of considerable interest. The barge section from the sea lock at Bude is extant, as is most of the feeder from Tamar Lake and much of the tub boat section with its six inclined planes is discernible in the landscape. Some of the small accommodation bridges retain their cast iron girders while Brumsdon Aqueduct still spans the River Tamar.

Bude Canal, Sea Lock Bude (Gd II* IoE 64771 Brian French) and Brumsdon Aqueduct (IoE 64841 Brian French)

Similarly there are significant heritage assets on both the ***Tavistock Canal*** and the ***Torrington Canal.*** The former, constructed by John Taylor under an Act of 1803, was completed in 1817 to link Tavistock via a level waterway and an inclined plane with a 237 ft drop to Morwellham Quay on the River Tamar. The 4.5 mile canal had an aqueduct over the River Lumburn, a 2,540 yard tunnel and now supplies water to power a hydroelectric station beside the Tamar.

Tavistock Canal, Morwellham Tunnel (Towpath Treks)

The Rolle Canal (or Torrington Canal) in north Devon was unusual as it was built without an Act as it was constructed on private lands owned by its promoters – principally John Rolle 1st Baron Rolle. A tub-boat canal engineered by James Green, it had a sea lock at Landcross, an inclined plane from the basin at Weare Gifford rising 60 ft to the canal level which crossed the Torridge by the five arched Beam Aqueduct to the terminus at Rosemoor where there were a bank of limekilns. The impressive Beam Aqueduct now carries a drive to Beam Mansion.

Rolle canal, Beam Aqueduct (Wikipedia Roger A Smith)

There are efforts to restore some of the closed canals – notably the Wilts & Berks and North Wilts Canals, Wey & Arun Junction Canal and the Portsmouth and Arundel. Indeed the Chichester Canal section of the latter is open from a basin in Chichester to

the open channel while restoration of the Wey & Arun continues apace with by 2009 twenty-four bridges had been reconstructed, eleven locks restored, two aqueducts re-instated, and several miles of canal bed cleared and dredged.

Wey & Arun, restored Loxwood Lock (Wikipedia geni): (Right) Wilts & Berks, Lift Bridge and Lock Foxham (Geograph Vieve Forward)

On the ***Wilts & Berks*** canal volunteer efforts over the last 40 years have led to several isolated sections, including locks, having been restored to waterway use. However the canal with its North Wilts and other branches was some 64 miles in length with 54 locks so the task of restoring the entire canal is daunting. The flight of three locks at Pewsham is interesting as it is flanked by the archaeological remains of a dry dock and boatbuilding and maintenance facility.

The ***Royal Military Canal*** was engineered as a defensive measure in the invasion scare of 1804 by Lt. Col. Brown and built by civilian navvies (and the ramparts by soldiers) but wasn't completed until late1806 when threat of invasion had gone. In peacetime that section of canal which had access via Iden Lock was managed by commissioners and used by traders, the last barge passing in 1909. Twenty-one of its sections covering locks, bridges and cottages are scheduled monuments including Iden Lock (1003259).

Canal showing defended kinks
(Kent Military Forum)

Post-1825 canals

The second quarter of the 19th century was quite different and witnessed the consolidation and improvement of the canal system in central England. There was the further improvement and elaboration of the ***BCN*** (which had come together from 1794) with such engineering achievements as Telford's Smethwick Cutting, his Galton Bridge (1214833) and Engine Arm Aqueduct (1391874) (graded I and II* respectively) and several substantial new lines including the Coseley Tunnel and Titford Branch, the Tame Valley Canal and the Rushall Canal.

Galton Bridge (IoE 219212 D R Smith)

It also saw the streamlining of the route between Birmingham and Liverpool and its better links to the region through which it passed with the construction of Telford's Birmingham & Liverpool Junction Canal, the Newport and Middlewich Branches and the Macclesfield Canal. The three former, with the earlier Chester and Ellesmere Canals, were to form the Shropshire Union Canal

Canals Authorised or Built 1825-60

Waterway	Act	Opened	Closed
Birmingham Canal New Line	1824,	1829	
Coseley Tunnel	1835	1838	
Titford Branch	1835	1847	
Tame Valley	1840	1844	
Rushall Canal	1844	1847	
Netherton Tunnel Branch	1855	1858	
Macclesfield	1826	1831	
Birmingham & Liverpool Junction	1826	1835	
B & L J Newport Br	1827	1835	1944
Ellesmere & Chester Middlewich Br	1827	1833	
Glastonbury	1827	1833	1854
Chard	1834	1842	1868
Manchester & Salford Junction	1836	1839	1936

Telford's 40-mile long ***Birmingham & Liverpool Junction Canal*** was the last great canal to be built on traditional lines and is a superb late example of canal engineering

cutting across the landscape with many buildings and structures of high heritage value. These include numerous high quality bridges in brick and stone spanning deep cuttings, cast-iron and stone aqueducts including 1832 cast iron trunk, Nantwich (1229541).

B & L J C, Hollings Bridge Loggerheads (IoE 362640 Clive Shenton) and Nantwich Aqueduct (IoE 57006 Howard W Hilton)

The Middlewich Branch and the Newport Branch built at this time and of similar high quality are both 10 miles long and linked to the Trent & Mersey Canal and the Shropshire Canal respectively. The Middlewich Branch is a cruising waterway while the Newport Branch is closed but under restoration.

The ***Macclesfield Canal*** was a late canal designed as a direct link between Manchester and the Midlands, and following its Act of 1826, the canal opened five years later. twenty six miles long it was one of the last narrow-gauge canals (112 locks 7ft wide) to be built, and the audacious 'cut and fill' techniques, high embankments and ambitious cuttings and eight aqueducts are all indicative of Thomas Telford's hand with William Crosley as resident engineer. It has one of the few canal aqueducts carrying one canal over another.

(Left) Pool Lock Aqueduct carrying the Macclesfield Canal over the Trent and Mersey Canal. Dated 1829. (IoE 56499 J M Pickering):
(Right) BCN Coseley Tunnel North Portal 1837 (IoE 442574 D R Smith)

These engineering advances were also noticeable in the West Midlands, where the BCN's merger with the Wyrley & Essington in 1839 and with the Dudley in 1846 was to maintain canal construction for another twenty years.

The old main Line was shortened by the building of Coseley Tunnel in 1837 and several new small link canals were built including the Hatherton Branch and the Birchills Branch and a new main line canal, the Tame Valley Canal, which involved 13 locks and seven aqueducts three of which were iron trunks.

(Left) Tame Valley Canal, Walsall Road Aqueduct (IoE 437039 Steve Davis)
(Right) Netherton Tunnel 1858 (Wikipedia Oosoom)

Further links such as the Warwick & Birmingham Junction Canal opened up alternative long distance routes while the merger with the Dudley Canal led to the Netherton Branch and Tunnel and the new Delph locks all of which were finished in 1858. Netherton Tunnel, built in 1850s, was the last and the largest canal tunnel to be built in UK. It had twin towpaths and was gas lit in working days.

Elsewhere, other than the south west where the Glastonbury and Chard Canals were built, efforts concentrated on upgrading existing waterways in the face of competition from the railways. The Droitwich Junction Canal was completed in 1854 and the Hereford & Gloucester Canal finally reached Hereford in 1845. The Droitwich Junction Canal was a narrow canal, unlike the barge-width Droitwich Canal, which it linked with six narrow locks to the Worcester & Birmingham Canal, and was the last such canal to be built.

Droitwich Junction canal, rebuilt Hanbury Locks
(Wikipedia, geni)

The expansion of the railway network indeed also caused a considerable amount of construction work on the canal system especially of aqueducts over the lines of the railways themselves. Thus in the Midlands there were more than a dozen such aqueducts some involving iron trunks such as the 150ft extension to the Bullbridge Aqueduct on the Cromford Canal.

In the South West, two late minor rural canals were to be constructed the Glastonbury authorised in 1827 opened in 1833 and the ***Chard Canal*** authorised in 1834 opened in 1842. Both were to be short lived the 14 mile long Glastonbury closed in 1854 and the 13.5 mile long Chard in 1868. Whereas the Glastonbury Canal was a gloried drainage level with three small aqueducts and two locks, the Chard was a tub-boat canal that overcame a fall of 231 feet between Chard and

Taunton by means of four inclined planes, three tunnels, two aqueducts one lock and a stop lock.

Chard Canal River Tone Aqueduct in1972
(Geograph Robin Webster)

Heritage of the post-1825 canals

Of the mid-19th century canals, many of the short branches of the BCN have gone but the system still retains its major elements and has been much enhanced recently by urban landscaping in the centre of Birmingham and constant canal restoration undertaken by BW/CRT with the BCN Society.

Similarly, most of the components of the Shropshire Union Canal, other than the Newport Branch, have benefitted from increased leisure use and are well protected by designation (some 250 designated structures) as is the Macclesfield Canal with some 116 listed structures. At Ellesmere Port the dock facilities were greatly expanded with a corresponding development of the settlement into a town and the dock system and, despite some losses, it retains a port canal landscape of huge significance centred on the basins and buildings of the National Waterways Museum such as the Island Warehouse, the Clay Warehouse, stables), Boiler houses and hydraulic accumulator tower and lock keepers hut.

Ellesmere Port, Whitby Locks and Basin (Wikipedia Traveler100)

The Droitwich Canals have now been completely restored; the huge volunteer effort involved was recognised by the Droitwich Canal Trust winning the 2012 Heritage Angel Award.

However, in Somerset little of significance survives of the Glastonbury Canal while the Chard has survived patchily as some short watered sections. Portals to two of the three tunnels survive, as do discernible inclines and a listed bridge near Thornfalcon. The three-arched aqueduct which carried the canal over the River Tone is largely intact, although it no longer has its parapets.

(Left) Hawford Bottom Lock, junction with Severn (Geograph Roger Kidd)
(Right) Chard Canal Lillesdon Tunnel (Geograph Noel Jenkins)

Late 19th century Canals and Navigations

Waterway	Act	Opened
Manchester Ship	1885	1894
New Junction Canal	1891	1905

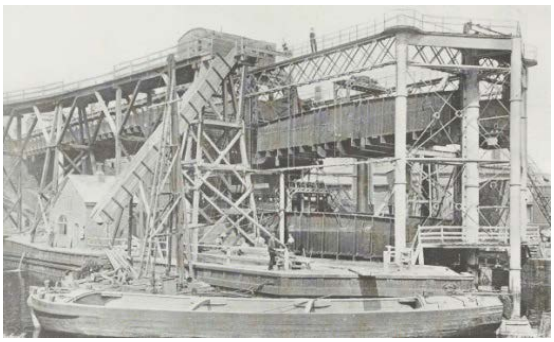
The second half of the 19th century witnessed a change of fortunes between canals and navigations – generally canal traffic dwindled and navigations with further investment prospered. The *Map of Canals and Navigable Rivers of England & Wales* published by Lionel B Wells in 1894 illustrates the early stages of this decline in canals showing more than a score of waterways already abandoned or derelict.

The narrowboat canal system of Central England suffered particularly from railway competition except in the Birmingham region where, in its complete form in 1906, the ***BCN*** totaled 159 miles with 216 locks and the system was supplied with water by six reservoirs and 17 pumping stations Indeed, a symbiotic relationship between the two transport systems led to an increase in trade on canals and the provision of transhipment basins. In all there were 41 such railway/canal interchange points and this interchange trade, which peaked between 1900 and 1910 when over a million tons were handled annually at these basins, accounted for about a seventh of the total tonnage carried on the BCN at that time.

Elsewhere railway competition seriously affected rural canals both major and minor with many closing. Hitherto important cross country routes such as the Kennet & Avon Canal where there was no profit from the canal after 1877 and the Thames & Severn Canal where the commercial situation was so poor that the railway interests were transferred to a trust to be transferred to the County Council in 1900.

Navigable rivers and ship canals, on the other hand, with their potential to be upgraded to accommodate larger vessels, attracted considerable investment in engineering. The ***Weaver Navigation***, for example, which had been improved throughout the earlier part of the century underwent a major engineering campaign 1871-1897 when many of its structures were rebuilt by Edward Leader Williams. Everything was large scale by comparison with other UK waterways. It has big locks

operated (originally) with water-powered Pelton Wheels and grand weirs and sluices with architectural features such as Gothic traceried ironwork/rusticated piers.



(Left) River Weaver, Weir Hunts Lock, Northwich (IoE 57638 R G Noxon):
(Right) Anderton Lift c.1900 before conversion (Waterways Archive)

This modernisation of the Weaver also witnessed the construction, in 1875, of the spectacular Anderton Boat Lift (1021152) to facilitate transfer of boats to the Navigation from the Trent & Mersey Canal 50 feet above. This pioneer hydraulically powered lift was to inspire the construction of much larger capacity lifts in Europe.

The Weaver has big swing-bridges of iron and steel such as in Northwich (1329879)) which opened in 1899 was one of the earliest electrically powered swing bridges in Britain.

Town Bridge Northwich (IoE 57622 R.G. Noxon) (Right) Aire & Calder Navigation, Stanley Ferry Aqueduct 1839 (IoE 436888 George Hodlin)

The ***Aire & Calder Navigation*** also benefitted from constant improvements throughout the 19th century. The opening of the new Knottingley and Goole Canal in 1826 and the accompanying development of its docks and company town at Goole was a boost to traffic while large engineering structures exemplified by the magnificent Stanley Ferry Aqueduct of 1836-1839.

The Goole Docks were to expand throughout the century and the introduction of Tom Pudding coal tub boats in 1863 worked in long train and loaded by hydraulically powered hoists in Goole from 1864 onwards was greatly to facilitate the cheap transport of huge quantities of coal.

Tom Puddings at Stanley Ferry and Hoist and Accumulator Tower Goole (Wikipedia Chris55)

The ***Gloucester & Sharpness (Ship) Canal***, after its tardy opening in 1827, was to develop further docks and quays both at Gloucester and Sharpness. At Gloucester, Bakers Quay was constructed in the late 1830s to provide much needed additional quay-space and, the Victoria Dock with even more warehouse provision was opened in 1849. Further warehouses were to be built including huge 1873 Llanthony Warehouse which houses the National Waterways Museum Gloucester. (see below section 3)

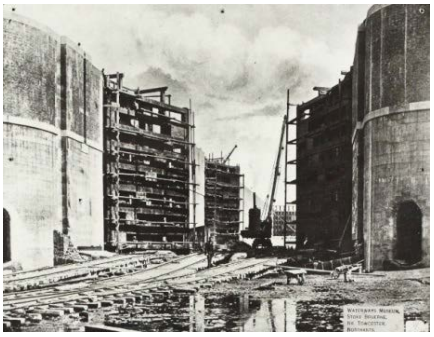
Gloucester, Pillar Warehouse 1838, Bakers Quay (IoE 472349 Jack Farley) and Victoria Dock (Hugh Conway-Jones)

At Sharpness the tidal basin entrance which was flanked by only rudimentary facilities was supplemented (and largely replaced) in 1874 by a New Dock with a new entrance and large warehouses where cargoes could be transhipped from large vessels to ones capable of reaching Gloucester and beyond

Sharpness Main Dock (Wikipedia Steinsky)

At the end of the century, the spectacular 36 mile long ***Manchester Ship Canal*** opened in 1894 and ten years later the last major waterway to be built in England until 2002, the New Junction Canal linking the Aire & Calder with the Don, was opened.

One of the heroic feats of Victorian engineering, the Manchester Ship Canal, built under an Act of 1885, had a difficult gestation and cost more than twice its original estimate. It had to acquire the Bridgewater Navigation to be supplied by water from the River Irwell and build numerous high level rail bridges and swing road bridges and replace Brindley's Barton Aqueduct with the Barton Swing Aqueduct to carry the Bridgewater Canal over the Ship Canal.



(Left) Manchester Ship Canal
(Right) Manchester Ship Canal Eastham Locks under construction (Waterways Archive)

Engineered by Leader Williams, it opened in January 1894 and deadweight ships of 12,500 tons could now reach the extensive new docks at Salford and Manchester. It was then the largest river navigation canal in the world, and enabled the newly created Port of Manchester to become Britain's third busiest port despite the city being about 40 miles inland.

Manchester Ship Canal Plan and Profile.

Most of the immense engineering works are of considerable significance as examples of very fine large scale Victorian construction, though being filled with water are scarcely appreciated.

The ***New Junction Canal***, constructed jointly with the Aire & Calder Canal was authorised in 1891 and opened in 1905 to link the Don Navigation and Stainforth & Keadby canal with the Aire & Calder Navigation (Knottingley Canal). It is completely straight, and was the last canal built in England for commercial purposes. The 5 mile long canal has one lock, five lift or swing bridges and two aqueducts with the one over the River Don protected by large guillotine gates, which can be lowered when the Don is in spate, to prevent the surrounding countryside from being flooded.

River Don Aqueduct (Wikipedia Bob1960evens)

The Heritage of Late 19th century Canals and Navigations

At its working peak, the ***BCN*** contained about 159 miles of canals as well as several hundred wharfs, short private branches and basins; today just over 100 miles are navigable. In 1991 Richard Chester –Browne published *The Other Sixty Miles: A survey of the abandoned canals of Birmingham and the Black Country* based mainly on his work in the 1970s updated to 1991. This seems to indicate that little of any great significance survives on these abandoned sections. Very little survives of the numerous canal railway interchange basins which had all closed by 1960 other than Chillington Basin (1252658) at Monmore Green which is Grade II listed and is now of such rarity as to be of national significance.

Chillington Interchange basin
(IoE 435701 Peter Garratt)

Most of the CRT waterways of the BCN and especially those close to urban centres are now much more appreciated and many are the focus of urban landscaping. There are still sections and structures that are largely disused and the Birmingham Canal Navigations Society with CRT and the IWA (WRG) are engaged in a long programme of upgrading these and the BCN Society has its headquarters at the restored Titford Top Lock.

Titford Top Lock and Pumphouse, 1999 and 2007 (IoE 219235 JJ Sheridan and Wikipedia Oosoom)

The major river navigations, other than the River Thames and the Manchester Ship canal, are now managed by CRT and these are generally appropriately protected. The ***Manchester Ship Canal*** is still a major waterway receiving much of the region's drainage and its impressive structures are in good repair. Most of the immense engineering works are of considerable significance as examples of very fine large scale Victorian construction. Though the Ship Canal is currently only lightly used, there are plans to significantly increase traffic over the next few years. The Grade II* Barton Swing Aqueduct (1162870) which replaced Brindley's Aqueduct is one of the most significant monuments of the canal system and three bridges and a magazine are also Listed but it would appear that none of the locks themselves or wharfs are designated. Hence in view of the proposed plans for expansion of container traffic an assessment of all the historic structures along the canal is perhaps needed.

Barton Swing Aqueduct (Geograph David Dixon)

2.3 Decline of the Waterways

The end of the 19th century and the early 20th century was a period of declining traffic on canals and much heart-searching in official quarters as to the future of the system. So much so, that, while Parliament was framing a Railway & Canal Traffic Act, the Royal Society of Arts summoned a conference in 1888 to debate the subject. A plea was made for a national Water Commission responsible for co-ordinating all aspects of water supply and drainage as well as transport. The outcome was that a Royal Commission on the Canals and Inland Navigations of the United Kingdom sat from 1906-11 and produced no less than 12 volumes of *Report* published by HMSO. At that time 3639 miles of waterway were in use in England but the lack of gauge and toll standardisation rendered all but the wide waterways, such as the Trent and Weaver, uncompetitive with railways. To sway the debate, E A Pratt, an advocate firmly in the railway lobby, produced his *British Canals: Is their Resuscitation Practicable?* in 1906 and his *Canals and Traders* in 1910.

Some improvements were made at this time to the ***River Trent*** under an Act of 1906 and Cromwell Lock and Newark Town Lock were enlarged. At 188 by 30 feet, Cromwell lock could hold a tug and three barges, and was opened in 1911, but although trade on the river increased, little more work was performed before the beginning of the World War I.

Some attempts were also made at this time to speed up traffic on the better used canals and to widen locks to take barges. Hence on the main through route from the Midlands to London the Grand Junction acquired the waterways of the Leicester Line as part of its plans to widen its own canal. To overcome the bottleneck at the

Foxton locks on the ***Leicester Line***, Gordon Thomas, the Grand Junction Canal's engineer, designed the Foxton Inclined Plane (1018832) to widen the canal to take bigger boats whilst conserving water and speeding up traffic. Opened in 1900, the Plane was 307 feet long and overcame the 75ft change of level with a 1 in 4 gradient and could pass a pair of boats in 12 minutes as compared with 70 minutes by the flight of narrow locks. but the main benefit was the enormous amount of lockage water saved. However, it was never used to its full potential and was mothballed in 1911 and finally dismantled in 1928.

Leicester Line, Foxton Inclined Plane under construction 1900 and in use c.1905 (Wikipedia and Waterways Archive)

The Anderton Boat Lift connecting the River Weaver with the Trent& Mersey canal had been originally hydraulically operated but, after problems with corroded cylinders, was converted to counterbalanced electric operation in 1910. The weight of this latter arrangement caused its own problems and though the lift operated until 1983 the problems finally caused it to be closed (and rebuilt to work hydraulically again in 2002 see below).

Anderton Boat Lift after 1910 conversion (Waterways Archive)

Though a Waterways Association was set up in 1912 dedicated to implementing the recommendations of the Royal Commission for upgrading a 'cross' of major waterways, the First World War intervened. During the war there was some subsidy of independent canals and the BCN saw an increase in traffic but generally there was further decline and after the war in 1920 a committee chaired by Neville Chamberlain was set up to re-examine the question. One of its recommendations, for the further improvement of the River Trent was taken up. The Ministry of Transport took over the navigation from 24 September 1920, tolls were increased and Nottingham Corporation invested some £450,000 on building other locks authorised by the 1906 Act, starting with Holme lock on 28 September 1921 and finishing with Hazelford lock June 1926.

However little else happened and the Royal Commission on Transport in 1928 was more concerned with the development of road transport and devoted little time to inland waterways. Despite this, in 1932-34, most of the locks on the canals forming the Grand Union Canal which indeed had only come together as an entity in this period, were widened to 83-6 ft x 15-0 ft, with the exception of Camp Hill Locks.

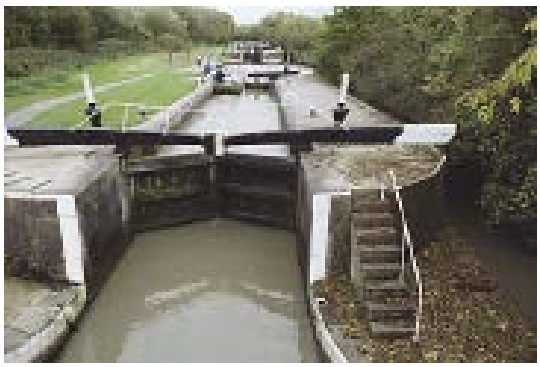
(Left) Holme Lock, River Trent (CRT): (Right) Hatton Middle Lock showing 20th century lock and the weired original narrow lock alongside.(www.GrandUnionCanal.co.uk)

This 'modernisation', which involved new flights of locks at Hatton, Napton and Knowle, is significant as being one of the last large scale attempts at improving a UK canal, as opposed to a navigation, for 20th century transport purposes.

During the Second World War the waterways continued to do valuable work and in 1942 the most important were taken over by Government with the original owners being compensated by subsidies. In 1947 the Transport Act nationalised most of Britain's inland waterways as well as the railways, railway-owned ports and much of the road haulage industry. The waterways which had come under Government control during the war were vested in the British Transport Commission and running the 2,064-mile waterway system entrusted to a Docks and Inland Waterways Executive. Many river navigations were excluded from this take-over including the Thames and Yorkshire Ouse, most of the east coast waterways and some nearly- disused canals such as the Rochdale.

Heritage of early 20th century waterways

The improvements to the River Trent continued post war a with further rebuilding of the locks with a subsequent loss of early fabric but on the Grand Union Canals the 1930s widening of flights of locks was to leave a legacy of magnificent structures.



Stockton Locks (IoE 307229 (Helmut Schulenburg)

Despite its short life the remains of the Foxton Inclined Plane are of international importance and are a Scheduled Monument and since 1980 the Foxton Inclined Plane Trust has been working towards a better understanding of the site but no longer towards full restoration.

Foxton Incline 2009 (Wikipedia Yohan euen o4

The Anderton Boat Lift which had closed in 1983 was rebuilt with Millennium and English Heritage funding and re-opened in 2002 to operate once again hydraulically. Evidence of its earlier counter-balanced electrically powered operation has also been preserved.

Restored lift from canal level.
(Wikipedia Mike Peel)

2.4 Renaissance of the Waterways

After the Second World War the vesting of most of the country's inland waterways in the British Transport Commission under the 1947 Transport Act was to be to the detriment of the still water canal system. While there was indeed some upgrading of major waterways such as the Aire & Calder, the River Don and the Trent – the commercial waterways - in this period the still water canals, being very much the poor relation within the British Transport Commission, were starved of funds and deteriorated to such an extent that there were proposals to close most of the system and the BCN alone was to lose some 60 miles of its network over the next few years. From this nadir of the waterways there were the stirrings of public opinion that were eventually to produce a remarkable triumph of popular enthusiasm over official indifference and hostility. The scene was set for the rise of the Inland Waterways Association to campaign vociferously for the retention of the system and it was the remarkable change in fortunes of the still water canal system over the last 60 years that distinguish the era. It is the seminal example of popular enthusiasm, prompted

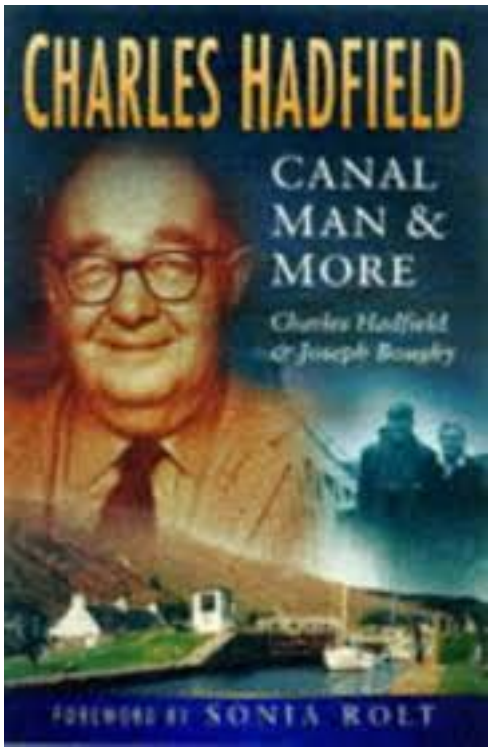
by a small band of activists and nurtured by a voluntary lobby, influencing, reversing and eventually shaping official Government attitudes to part of the heritage.

The plaque erected in 1981 commemorating the meeting of the founders of the IWA at Tardebigge Top Lock, the incorrect date (1946) was amended to 1945 by a second plaque in 2007. (Wikipedia Oosoom)

In 1978 Roger Squires published a book *Canals Revived* describing the challenges faced as the deterioration of canal network was slowly being reversed by the efforts of a relatively small but influential band of enthusiasts. Some 30 years later he was to publish a greatly extended new book *Britain's Restored Canals* which brings the story up to date, chronicling the many successes, but also the tribulations, of the waterway restoration movement. It also details the ever-changing local and national political contexts within which the canal restoration movement had to operate. Much of the succeeding section of this overview is drawn from, but greatly summarises, material in the latter of the two books. Fittingly, the book starts and ends with an appreciation of a small group of founding fathers and early campaigning practitioners of that movement the last of whom, Sonia Rolt, died in October 2014.

Champions of the waterways. Robert Aikman and Tom Rolt (Wikipedia)

The story may be well enough known but, as a saga of an astonishing triumph of public opinion over official indifference bordering on hostility, it is worth repeating and, the more so, as some of the achievements, from a heritage point of view, were double-edged. The Inland Waterways Association, founded by Robert Aickman, Tom Rolt, Charles Hadfield and a couple of other waterways enthusiasts in May



Charles Hadfield (Sutton Publishing)

1946, was very much the outcome of Tom Rolt's inspirational book *Narrow Boat* (1944) leading to meetings between Aickman, Rolt and Hadfield all of whom had independently seen the need for an association to champion the use of inland waterways. The fledgling association, with Aickman as Chairman, Hadfield as Vice-Chairman and Rolt as Secretary, immediately mounted a publicity campaign and published a booklet *The Future of the Waterways* written by Rolt and elaborating the association's ideals.

The different talents of the founders were now collectively to be harnessed to an effect far exceeding the meagre resources at their disposal. Rolt and Hadfield provided the sound factual base firstly in 1945 with Hadfield's *English Rivers and Canals*, then Rolt's *The Inland Waterways of England*(1950) and Hadfield's *British Canals* (1950) (the latter leading to David & Charles's magnificent series of canal histories). Aickman, though also a talented writer, main contribution was to provide the driving force and the networking contacts. Recruitment of celebrities such as Sir Peter Scott and assiduous lobbying of influential decision makers and opinion formers was backed up by rousing grass-root support for key threatened waterways, such as the Kennet & Avon Canal and the Stratford Canal, with letters to the press, by public meetings and by protest cruises.

However the IWA was to learn some early lessons in commercial manoeuvring and negotiation in1948 when the privately owned Basingstoke Canal was put up for sale. Despite making the running in the lead up to the auction, and successfully countering local authority plans for infilling sections of the canal and lowering bridges, the Association were lulled into allowing a 'Purchase Committee' composed of seeming allies to buy the canal.

Greywell Tunnel (IoE 136606 Charles Cordy-Simpson)

This Committee then distanced themselves from the Association's direct involvement. Criticism from within the IWA of the Council's handling of the negotiations eventually led to a personal rift between Aickman and Rolt which, for other reasons, was to widen subsequently, to tragic effect. Within three years the small band of a dozen activists had grown into an association of over 800 members but as David Bolton was to chronicle in 1990 in his book *A Race Against Time* the conflicting personalities of its founding members were almost to tear the Association apart. By the time of the triumphant Market Harborough Rally in August 1950 which attracted over 50,000 visitors, Rolt and Hadfield had left the Council and in the following Spring they and other perceived 'dissidents' were to be expelled from the IWA. The contentious issue was a fundamental one – whether the IWA should fight to campaign to save every single mile of canal or whether it was prepared to compromise and focus on those that were realistically viable. Aikman's championship of the former position was to prevail and for many years the IWA was to be regarded in Government circles as an uncompromising protest group and awkward, if influential, nuisance. Joseph Boughey's book on Hadfield published some nine years later was to qualify the IWA leanings of Bolton's book from the perspective of Hadfield advising the fledgling BWB from 1962 onwards. Aickman's reaction to Hadfield's appointment to the BWB Board was uncompromising: '...the most personally insulting yet and the most damaging to the waterways'.

There was perhaps a need for such an intransigent stance by the IWA throughout the 1950s, as most of the inland waterway system, which had been nationalised along with the railways, was now owned and managed by the British Transport Commission which had little regard for the lesser waterways. Indeed, the BTC 1955 Report of the Board of Survey identified three classifications of waterway:

Group 1 336 miles of waterway that should be developed most of which were major river navigations or ship canals such as the Aire & Calder Navigation , the Gloucester & Berkeley Canal, the Sheffield & South Yorkshire Navigation and the rivers Severn Trent and Weaver;

Group 2 994 miles of waterways to be retained (though the Report saw no need to retain both the Staffordshire & Worcestershire Canal and the Worcester & Birmingham Canal as they duplicated access to the Severn) ;

Group 3 771 miles of waterways having insufficient prospects to justify their retention for navigation.

Amongst the last group were such notable historic waterways as the Ashton, Peak Forest and Macclesfield Canals, the Chesterfield, the Huddersfield, the Kennet & Avon (from Reading to Bath , the Lancaster, the Llangollen, the Oxford Canal (southern section) and the Stratford Canal (southern section).

Such was the public outcry mobilised by the IWA, whose membership had risen to over 2000, that the more savage proposals of the Report were shelved though the Kennet & Avon was still singled out for abandonment. For the IWA, this was a fortunate error of judgement as it focussed campaigning on the Kennet & Avon

where support for retention was particularly strong and politically articulate. A petition to the Queen, comprising 22,000 signatures, was carried by water from Bath to Westminster and the IWA itself petitioned Parliament.

Garston Lock, Kennet & Avon Canal before restoration.

The result was a climb down by BTC, it was agreed that the Kennet & Avon should not be allowed to deteriorate any further and the Bowes Committee of Inquiry was set up. That Committee's Report when it was published in the summer of 1958 was very much a watered-down and rather imprecise version of the earlier Board of Survey Report but it did lead to the creation of an Inland Waterways Redevelopment Advisory Committee in 1959 to assist in the promotion of schemes and to make recommendations for the redevelopment of uncommercial waterways.

The long time taken to produce the Report, and the lengthy deliberations over the implementation of its recommendations, did however buy much needed time for the IWA to put its own house in order and for the canal lobby to demonstrate its potency by other, more tangible, means. By this time, the IWA and the newly formed Inland Waterways Protection Society were able to demonstrate some minor success stories in restoring short sections of canal and considerable progress in planning the restoration of significant disused waterways. Plans for the restoration of the Coventry Canal and the southern section of the Stratford Canal were well advanced and in 1960 the latter was leased to the National Trust and with funds from the Government, the BTC and the Pilgrim Trust work began on restoring the canal.

As Section One, in its review of the literature of the 1960s, has indicated, the Government Departments had little excuse for underrating the historical significance of most of the canal system but nevertheless the 1962 Transport Act was not particularly encouraging as regards disused waterways though the British Waterways Board was set up with Charles Hadfield as a member. It is worth noting, however, that preservation of the heritage of the waterways system at this time was not a priority for either BWB or the IWA or a matter of contention. Indeed it is clear from Boughey's biography of Hadfield that, while dedicated to establishing the history of canals, he was at the same time advocating a complete transformation of most of their structures to allow leisure boats up to 15ft wide comparable to those in Europe to navigate the system. Indeed he suggested that the Caen Hill locks at Devizes be replaced by a 'marine railway' and was also advocating a separation between commercial and leisure waterways with the former enlarged to accommodate large barges conforming to European dimensions.

The IWA, led by Aickman, was also not overly concerned with heritage and was regarded in official quarters with disdain and suspicion as an internal letter on November 1961 quoted by Boughey (1998 p 60) makes clear. The IWA was described as 'well known to the Ministry as a body devoted to promoting, behind an allegation for general concern for the waterways, the interest of pleasure boaters ... In prosecuting these interests the Association has shown tremendous energy and an unhesitating readiness to falsify facts provably known to it'. Meanwhile, for whatever motives, in June 1962 the Lower Avon Navigation had been re-opened (at the cost of the destruction of most of its historic fabric), moves to repair and designate Marple Aqueduct (1001954) were being made and momentum was growing for restoration of the lower end of the Chesterfield Canal and the Kennet & Avon Canal.

Logo adopted in 1991

At the end of 1963 the BWB's interim report *The Future of the Waterways* was submitted to the Minister of Transport and significantly it suggested a 'multi-user' role for waterways thus weakening the traditional official view of them as simply a part of the national transport system. Its publication in 1964 opened the way for dialogue between BWB and various canal restoration societies including those campaigning for the Kennet & Avon, the Stourbridge and the Staffs & Worcestershire Canals.

The re-opening of the Stratford Canal by Queen Elizabeth, the Queen Mother, in July was a triumph for the restorationists and Robert Aickman, whose intransigence had been double-edged, was able to stand down from his role as director of the IWA national campaign. Henceforth the IWA, under Lionel Munk's chairmanship, adopted a somewhat more realistic and flexible policy. Thus, when in 1965 British Waterways Board's published *The Facts about the Waterways* which included in its category of 'remainder waterways' some very significant canals, this was seen as a basis for negotiation and did not provoke quite such an uncompromisingly vigorous response of campaigning by the waterways lobby as it would have hitherto.

Re-opening of the Stratford Canal by the Queen Mother, 1964 (Stratford Canal Society)

However a Government White Paper in 1966 on transport policy proposed that only part of the network should be maintained for pleasure craft and once again the IWA had to mobilise opposition. The following year the IWA submitted a memorandum to the Minister of Transport *The Way Ahead for Amenity Waterways* and the

Government's response was to publish a white paper *British Waterways: Recreation and Amenity* and concluded with a chapter which noted the waterways as 'a priceless asset whose value would grow as the demand for leisure facilities intensifies'. This sea change in official attitude must be credited to the Minister, Barbara Castle, who records in her memoires (published in 1993) was horrified that the Treasury proposals involved closing down miles of inland waterways. Hence, despite the 'verbal vitriol thrown in the faces of all politicians' by some of the leadership of the IWA, she needed no urging to fight for the safeguarding of the 1400 miles of non-commercially viable canals. The White paper also proposed the creation of an Inland Waterways Advisory Council which came into effect in 1968 with three prominent IWA members in its membership.

Meanwhile pilot collaboration between BWB staff and volunteers had achieved considerable success with the re-opening of the Stourbridge Canal in 1967 and urban landscape value of the BCN was beginning to be recognised with tentative steps at regeneration led by Peter White one of Birmingham Council's development architects who had been inspired by the restoration of the Stratford Canal.

Canal landscaping, Brindley Place 2003
(Wikipedia G-man)

As Section One has detailed, the 1970s were the heyday of canal book publishing and by the end of the decade the national canal context, operational and disused, had been comprehensively established and the priorities for usage and restoration had largely emerged. The decade began with the BWB's first report to the Secretary of State in which it outlined its restricted financial powers and lack of ability to deal constructively with 'remainder' waterways. Despite this, it had opened up dialogue with several local authorities to pursue support to secure the future of some waterways. This encouraged the IWA for its Silver Jubilee in 1971 to adopt the theme of Remainder waterways and organise a programme of rallies to publicise these while in July that year the IWAAC report *Remainder Waterways* was published.

This focus on disused waterways culminated in an agreement between BWB, the IWA and riparian owners to restore the Ashton and Lower Peak Forest Canals. Operation Ashtac in March 1972, involving over 1000 volunteers, was to further prove the efficacy of the Waterways Recovery Group and set the bar for subsequent canal restoration.

By this time Peter White had been appointed as BWB's chief architect and, though starved of funds for even basic maintenance, BWB was becoming very much more aware of its heritage and sought to emulate the Birmingham experience of regeneration elsewhere.

Restored Ashton Canal in Manchester
(www.penninewaterways.co.uk)

At the same time the Government unemployment relief initiative 'Operation Eyesore', which provided generous grants to remove local eyesores, was used to great advantage in the restoration of canals including the Ashton, the Lower Peak Forest, the Dudley, the Pocklington and the Caldon canals. The IWAAC report Upgrading the Remainder Waterways could therefore in 1974 detail restoration work on eight waterways which it recommended should be given Cruiseway status. Emboldened by these success the IWAAC the following year published *Priorities for Action on the Waterways* of the British Waterways Board which recommended that Remainder Waterways should be safeguarded against further deterioration so that they might ultimately be restored.

The launch of the MSC Job Creation Scheme in October 1975 was also to have a profound effect on the restoration movement. Nationally, twenty canals projects, employing some 500 young people at a cost of c. £1 million, were approved including, in England, projects on the Basingstoke, the BCN, the Coventry, the Cromford, the Droitwich, the Kennet & Avon, the Rochdale, the Shropshire Union and the Thames & Severn Canals.

Kennet & Avon Canal Caen Hill Locks 1970s
(Wikipedia geni)

The change in BWB's attitude to the built heritage over the last few years was very apparent when in 1975 it won a number of European Architectural Heritage Year awards for its conservation projects and followed this up by publishing *Canal Architecture in Britain* which its Chairman Sir Frank Price launched at a RIBA exhibition entitled *The Fabric of our Waterways*. However, when in 1977 the DoE finally published the Fraenkel Report, a two year engineering study of the operating and maintenance costs of the nationalised inland waterways, to no one's surprise

a huge backlog of maintenance was exposed which could only be rectified by a substantial increase annually in Government grant.

The 1980s opened inauspiciously with the closure of the Anderton Boat Lift in 1981. This was initially due to a cable failure but subsequent examination revealed serious structural problems and the lift remained closed until rebuilt nearly twenty years later. Further, less dramatic closures, followed throughout the system vindicating the Fraenkel Report's claims of the effects of underfunding on routine maintenance. The early years of the decade did witness some progress on waterways awaiting restoration including local authority financed work on derelict sections of the Rochdale Canal, re-opening of sections of the Kennet & Avon including the locks at Crofton and the rebuilding of locks on the Kennet Navigation.

Aldermaston Lock (IoE 39700 Richard Swynford-Lain)

Also, notably, the re-building, largely funded by a large Heritage Memorial Fund grant, of Linton Lock (1151005) on the Yorkshire Ouse as this allowed renewed access to the Ripon Canal.

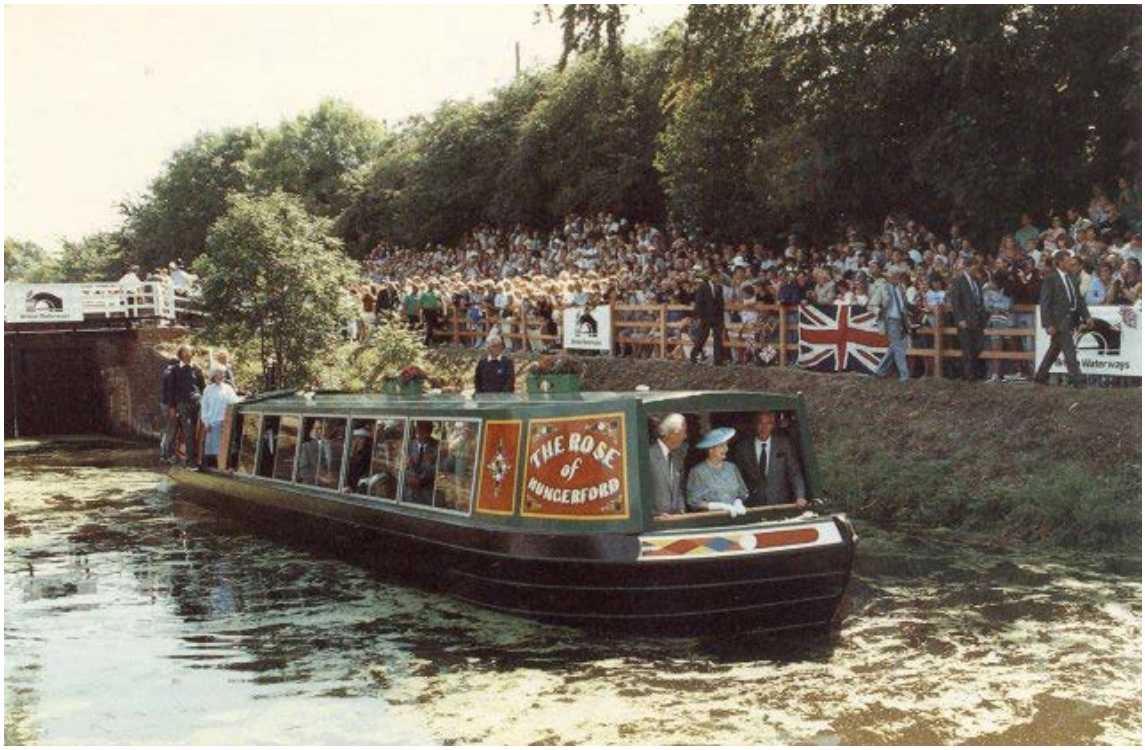
Linton Weir and Lock before restoration. (IoE 332108, 332107 Malcolm Harwood) and Ripon Canal Basin (Wikipedia Nigel Homer)

In 1985 the IWAAC published a report entitled *Waterways Architecture – an economic return from conservation* which made some very worthy recommendations such as establishing a Waterway Heritage Trust analogous to that for historic railway structures, more use of conservation area designation, guidelines for the assessment of historically significant buildings, more sympathetic treatment of repairs etc. While symptomatic of good intentions many of these recommendations took many years to see realisation – the Waterways Trust was only eventually created in 1999.

However, British Waterways assessment of its own heritage assets was to be much better informed when, in 1988, Nigel Crowe was appointed officer in charge of the

jointly funded British Waterways/English Heritage 'architectural heritage survey'. Nigel Crowe became British Waterways' first heritage manager in 1993 and went on to be Head of its Heritage Team (a position he now holds in the Canal & River Trust).

The decade was to culminate in the re-opening in August 1990 of the Kennet & Avon Canal by HM Queen Elizabeth. The fight to save the Kennet & Avon had been one of the original IWA campaigns in 1946 and hence its re-opening more than forty years later was of particular significance.



Re-opening of the Kennet & Avon Canal by HM Queen Elizabeth 1990 (HungerfordVirtualMuseum)

2.5 The New Waterways Age

The early 1990s saw some progress across many restoration projects underpinned by Derelict Land Reclamation grants and numerous feasibility studies were commissioned. Then in 1994 the Heritage Lottery Fund (HLF) and the Millennium Fund were created as distribution arms for the proceeds of the National Lottery. For the first time large amounts of funds, out-with Government Departmental budgets and independent of Government, were available for waterway restoration. In 1994 work started on the rebuilding of the Anderton Boat Lift grant aided by the Heritage Lottery Fund (HLF) and English Heritage. Elsewhere however, realisation of the true costs of restoration were becoming all too apparent. Hence, despite its opening in 1990, further remedial work was needed on the Kennet & Avon to be partly funded by the National Heritage Memorial Fund and though these works were completed in 1997 the Heritage Lottery Fund was still to fund some £24 million in later years. Meanwhile, four years after the first Government proposals, the Environment Agency was finally created in 1996 and one of its roles was to take over the responsibilities of the National Rivers Agency. In the same year, the IWA Annual Report was able to record that some 37 sections of waterways had been restored totalling 450 miles and138 restoration schemes were underway.

The IWAAC picked up this theme in its report *Britain Inland Waterways An Undervalued Asset IWAAC Final Recommendations (1997)* and then followed this up with *Waterways Restoration Priorities (1998)* which provided a three tiered framework for funding from the Millennium Commission. The main beneficiaries of this money were identified as a top tier - the Lowland Canals in Scotland, the Huddersfield Narrow Canal and the Rochdale Canal. In the second tier there were 18 schemes that needed funding in the short term (1-5 years) and 12 others in the medium term (5-10 years).

The 47 schemes in the third tier were considered ready for funding in the long term – more than 10 years. The Government statement the following year entitled *Unlocking the potential – a new future for British Waterways* recognised the waterways as a valuable public asset and that there was a huge backlog of maintenance estimated at £260 Million. British Waterways pursued the idea of developing a partnership with the public by creating the Waterways Trust as a charity responsible for its waterways museums and able to provide support for restoration schemes.

By the end of the century the Inland Waterways Association had matured into a vital element in the operation and safeguarding of the waterways system. Its Waterways Recovery Group, working closely with BW professional staff, provided the necessary voluntary manpower for a multitude of maintenance and repair tasks as well as remedial projects.

The first years of the new Millennium saw some very considerable achievements with the opening of the Huddersfield Narrow Canal, the opening the new lock on the upper section of the Ashby Canal and the opening of the remodelled Anderton Lift. The IWAAC was also able to report in its *A Second Waterway Age: Review of Waterway Restoration and Development Priorities* (2001) that the Rochdale Canal and the new Ribble link were likely to open in 2003.

(Left) Transhipment Warehouse Dobcross home to Huddersfield Canal Society (www.penninewaterways.co.uk): (Right) Rochdale Canal, Deansgate (www.penninewaterways.co.uk)

The report also analysed 104 projects assessing their progress as Advanced (7), Substantial progress(19), Intermediate (18) and At an Early Stage (46) there was insufficient information to assess the rest. In 2002 it was reported that 220 miles of new canal and restored waterways had been opened so far at a cost of some £120 Million in England and a further £84 Million in Scotland. There was however much still to be done with half a dozen major new projects in England being considered totalling some £275 Million while numerous smaller projects were under way. Only a few of the larger projects, including the Droitwich Canals and the Liverpool Link were to be realised over the next few years while the Bow Back Rivers was to benefit from regeneration of the area for the Olympic Games in 2012.

Opening of the Liverpool Link 2009, Leeds & Liverpool Canal (www.penninewaterways.co.uk)

In 2005 the National Lottery announced two new award schemes 'Living Landmarks' and Changing Spaces' which were of relevance to waterway restoration, in addition to the existing HLF. These new schemes funded development work on some schemes but were not to prove as influential as might have been thought originally. Indeed further reduction in funding to British Waterways and the Environment Agency in the second half of the decade and diversion of funds to the

2012 Olympics were seriously to affect canal maintenance as well as restoration. Nevertheless the HLF in the 20 years since the Lottery was inaugurated has made grants of some £800 million to UK inland waterways

In 2006 the IWAAC produced its last report *Inland Waterways Restoration and Development (2006). Projects in England Wales and Scotland: Third Review Report* before being reformed as the Inland Waterways Advisory Council, an independent body with a wider remit covering all navigable inland waterways. The IWAC was to produce five more significant reports reviewing the progress of restoration projects. These commenced with *Waterways for Tomorrow review* (2007) and concluded with The Value of Inland Waterways in England & Wales (2011) (see Bibliography) before being itself wound up in 2012 by which time the Canal & River Trust (CRT) had been created with the transfer of the British Waterways staff and assets.

The Canal & River Trust was launched as a charity on 2nd July 2012, taking over responsibility from British Waterways and The Waterways Trust in England and Wales. It is amongst the UK's biggest charities, with responsibility for 2,000 miles of canals, rivers, docks and reservoirs, along with museums, archives and the country's third largest collection of designated historic sites. The Waterways Infrastructure Trust settlement agreement with Government contained a detailed working definition of the infrastructure property and included all land and infrastructure that was necessary to inland navigation on a waterway or public access to a towpath.

The asset was indeed impressive: 2,528 km (1,580 miles) of canals, 500km (312 miles) of rivers, 185km (115 miles) of feeders and 3148km (1967 miles) of towpaths. These contained 337 aqueducts, 1650 accommodation bridges, 883 public road bridges, and 439 towpath/turnover bridges. There were 1581 locks and 84 weired-locks, 55 tunnels, 72 reservoirs 99 pumping station buildings of which 27 were operational, 16 docks and one boat lift while there were a further 1400 sluices, flood gates and waste weirs.

Canal & River Trust

Motto: Living waterways transform places and enrich lives

As noted in Section 1 one of its charitable objects is 'to protect and conserve for public benefit sites, objects and buildings of archaeological, architectural, engineering or historic interest on, in the vicinity of, or otherwise associated with Inland Waterways' To achieve this the Trust has an in-house Heritage Team of regional advisors led by Nigel Crowe and a sophisticated GIS data system that monitors the designation status and condition of all its historic assets. This shows that in 2013-14 the CRT has 43 Scheduled Monuments and some 2475 Listed Buildings in England

but it also contains information on many other sites in its ownership that are undesignated.

The Trust also has a Heritage Advisory Group, composed of external members representing a wide constituency of waterway interests, to advise on heritage matters. The Trust's State of the Waterways Heritage report 2013/14, the first reporting on a full year of operation, reflects on and draws attention to the Trust's record in meeting this object over the past year. The report measures change and charts progress towards the achievement of the Trust's Heritage Action Plan 2013-2018. It notes the progress the Trust has made, working with English Heritage and DCLG, on the development of a bespoke National Listed Building Consent Order for locks and traditional masonry arch bridges. The CRT has seamlessly continued the relationship that British Waterways developed with the IWA and continues to work with the WRG to restore and maintain waterways. The CRT produces an annual Heritage Report – that for 2015-16 was available in hard copy as well as online and amongst its case studies were features on repairs to Telford's Nantwich Aqueduct, the relining of his Engine Arm Aqueduct and the restoration of Jessop's Grantham Canal.

However some of the most vulnerable heritage assets are located on, or beside, waterways that are not owned or operated by CRT and information on these has not been readily available. The Environment Agency, for example, has been pre-occupied with problems of the widespread flooding in early 2014. As there are proposals to transfer some of these waterways to the CRT a stock-take of their assets is urgently required if it does not already exist. Similar concerns may arise over waterways in private hands such as the Manchester Ship Canal and its sister waterway the Bridgewater Canal though for the purposes of this Overview no approach for information has yet been made to their owners.

The Inland Waterways Association

Keeping our waterways alive

The Inland Waterways Association continues to play a crucial role in the stewardship of the waterways system. Its various mouthpieces - the Waterways magazine, the regional branches publications and the electronic HQ Bulletin and its association with the *Towpath* newspaper – keep its wide membership well informed. It acts as a partner (and unofficial watchdog to CRT) and lobbies and co-operates constructively with Government through the activities on an All Party Parliamentary Group for the Waterways.

It has not neglected its campaigning stance as witnessed by the production of a *IWA 2015 Manifesto* prior to the 2015 election to demonstrate the importance of our waterways heritage and encourage future MPs to work with the IWA to protect it. Subtitled *The Inland Waterways: Supporting Britain's Waterways Heritage* the *Manifesto* is asking candidates to sign up to a Five Point Partnership and pledge their support for the waterways. The Five Point Partnership includes the following: Protect our Heritage; Build a Local Relationship with Constituency Waterways

Groups; Work with IWA in Parliament - Join the All Party Parliamentary Group for the Waterways; Support the Transfer of Navigations Currently Managed by Environment Agency to Canal & River Trust and Support Affordable New Off Line Moorings. An examination of the case for transfer appeared in the Spring 2016 issue of the IWA magazine *Waterways*.

It was announced at the end of February 2016 that a joint EA and CRT working group had been set up to explore different options for running the 620 miles of EA-managed river navigations. It was stressed that EA , CRT and Defra are committed to finding a sustainable future for the EA's river navigations and to working with the communities who use them.

This will be perhaps the next major development in the operation and stewardship of the English navigable inland waterways system and it is to be hoped that safeguarding and enhancing the waterways heritage is a high priority.

SECTION 3

Consideration of the infrastructure and identification of key features for protection

Introduction

This section reviews the development of key features of canal infrastructure from the perspective of assessing their significance. It therefore relates them to Historic England's *Listing Selection Guide on Transport Buildings* and to the NHLE asset numbers provided in Appendix B. It is based on a wide variety of sources including the survey report on canals presented to the CBA/DoE Advisory Panel in 1976 incorporating material from M J T Lewis, W N Slatcher and P N Jarvis 1969 article in *Industrial Archaeology* entitled 'Flashlocks on English Waterways: A Survey' and Ronald Russell's *Lost Canals of England and Wales* (1971). It has been amended and updated by material in Edward Paget-Tomlinson's *The Illustrated History of Canal & River Navigations* (1994), Nigel Crowe's *English Heritage Book of Canals* (1994), David Tew's *Canal Inclines & Lifts* (1984), Hans-Joachim's *Canal Lifts and Inclines of the World* translated and edited by Mike Clarke (2002), Andy Wood's *Abandoned & Vanished Canals of England* (2014) and incorporates the relevant sites on the TICCIH/ICOMOS International Canal Monuments List (1995) edited by Stephen Hughes. Paget Tomlinson (1996) *Waterways in the Making* details, from the technical perspective, the creation of waterways.

The following topics and features are covered and the waterways for which there are entries in the **Gazetteer** mentioning particular sites are shown in bold:

Changing Levels – Locks, inclines and lifts
Crossings – Aqueducts, Bridges
Earthworks – Tunnels and horse lanes, cuttings and embankments, Retaining walls,
Water Supply – Reservoirs, weirs and pumping stations.
Operation – Lock keepers' and lengthmens' cottages, tollhouses and Offices and Company workshops, dry docks and gauging locks
Trading – Inland ports, basins, interchange facilities, cranes, warehouses and hotels.

For sites already designated the NHLE asset is given and if that number is prefaced by the link http://list.historicengland.org.uk/resultsingle.aspx?uid= the NHLE entry can be viewed from the Historic England website.

3.1 Changing Levels

Locks

Devices for overcoming differences in height between waterway levels have been used for thousands of years in various parts of the world but for the purposes of this report only English examples that have left appreciable remains are considered in any detail. They include various types of lock – flashlocks, watergates, staunches, half-locks, stop locks and pound locks - lifts or balance locks and inclined planes.[5] The Canal article in Rees Cyclopaedia (1806 onwards) contains a good general description of the contemporary construction of locks (see also Paget-Tomlinson 1996). However Chisholm (2005) in the context of the waterways of the fens, has explored the confusion in terminology that besets early navigations and has stressed that the word sluice can in fact mean, contrary to much received wisdom, a device that can convey boats. Thus many early classic works by authorities such as Skempton (1953) Boyes & Russell (1977) Summers (1973) and Darby (1956) may have failed to recognise navigational use of some early engineered drainage channels. Accordingly some of the attributions below, particularly introduction of pound locks, must be regarded with care.

Flashlocks et al[6] In 1969 M J T Lewis, W N Slatcher and P N Jarvis contributed an article to *Industrial Archaeology* entitled 'Flashlocks on English Waterways: A Survey' which recorded the remains of fifty flashlocks where some trace survived. It noted that a century before, 63 examples were in use, fifty years before about 21 and by 1969 there were none. The study excluded single tidal gates, sea doors and single stop and flood gates. Of the 50 flashlocks surveyed only four retained the major part of their gates, but 24 had their brickwork or masonry more or less intact. The article uses flashlock as a generic term to cover both closed flashweirs and open staunches and identifies four main areas in the country where their use was common – the Thames basin, some tributaries of the Severn, the West Country and the rivers fringing the Fens. It discusses the borderline between staunches and pound locks because, where staunches were grouped closely together, they could act as primitive pound locks and indeed in some cases were converted into un-walled pound locks. Prophetically, the survey stressed the vulnerability of flashlocks to flood prevention work by river authorities and improvements for navigation by agencies and restoration societies.

In summary, the survey found that:

In the west of England at the ***Dick Brook Canal*** a short tributary of the Severn there were remains of two flashlocks built of sandstone blocks one of which bears the date 1715.

5 Paget-Tomlinson (1994) pp 49-63 discusses in detail the various types of locks.

6 MJ T Lewis et al, Flashlocks on English Waterways: A Survey *Industrial Archaeology* Vol 6 1969 No 3 pp 209-253

Dick Brook Bridge Astley
(IoE 152272 Philip Williamson)

On the Warwickshire Avon the weirs and Watergates at Cropsthorne and Pershore had been removed by the restoration of the waterway by the Lower Avon Navigation Trust. Of the three half-locks that existed on the River Lugg in 1906 there were partial structural remains of the Longworth and Mordiford half-locks.

(Left) Thorney Half-lock (Geograph Liz Martin)

On the ***River Tone*** flood prevention works in the 1960s had removed all the half-locks while on the ***River Parrett*** there were substantial remains of the unusual Thorney Half-lock which sat beside a weir and a mill waterwheel.

It was in the region fringing the Fens that most significant sites were to be found including Castle Mills and Tempsford staunches on the ***Great Ouse***, underwater remains of Tempsford Little, Sandy Doors and Beeston staunches on the ***River Ivel***, substantial brickwork remains of West Stow, Lackford, Mill Heath Jack Tree, Mildenhall, Cow Gravel and West Row staunches and wooden remains of Tuddenham Mill Stream staunch.

Tuddenham Mill Stream staunch, looking downstream. The footbridge is modern

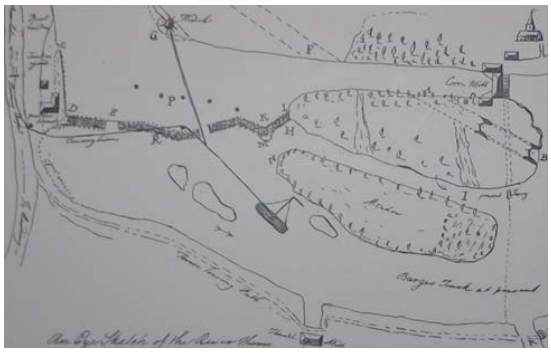
Tuddenham Mill Stream Staunch

Most of the guillotine staunches on the Little Ouse were removed in the 1930s but details had been published in a paper to the Newcomen Society[7] and some vestigial remains can be identified while in 1969 a similar guillotine example still survived in a rotten state at ***Bottisham Lode, River Cam***. The latter was demolished the same year by the Great Ouse River Authority with parts removed for preservation to the Authority's Ely office.

On the ***River Nene*** there were slight remains of the modernised steel guillotine staunches which had been built in the 1930s at Wansford, Woodston Thorpe and Alwalton while there were almost intact masonry remains of the wooden framed Perio staunch below a bridge built in 1967, as a new cut had left the staunch on a superseded loop. In 1970, an Addendum to the paper gave details of staunches on the River Nar with brickwork remains of Bonemill Upper Staunch and under water remains at several other staunches. Further work is needed to address the uncertainty regarding the current state of survival of the vestiges of any of these types of primitive locks.

On the ***Thames*** only vestigial remains survived at Hart's weir, Kent's weir, Langley's weir and Ark weir while at Hurley weir the capstan winch survived and timber structural remains of Eynsham Wharf stream flashlock. The Environment Agency has since commissioned detailed audits of early navigation remains on the Thames. In river engineering terms, the history of the ***Thames*** is of major significance. In the medieval and post medieval periods, flashlocks and weirs were fundamental components of river navigation systems. The Thames navigation specifically employed the Paddle & Reimer type of flashlock and weir and the only extant examples of this type of structure appear to be on Thames.

7 R H Clark, The Staunches and Navigation of the Little Ouse River, *Trans Newcomen Society* Vol 30 1957



(Left) 1786 Plan of Whitchurch flash lock and weir (from Thacker 1914).
(Right) Teddington Weir, Barrage and Lock (Wikipedia, Mike Ricard)

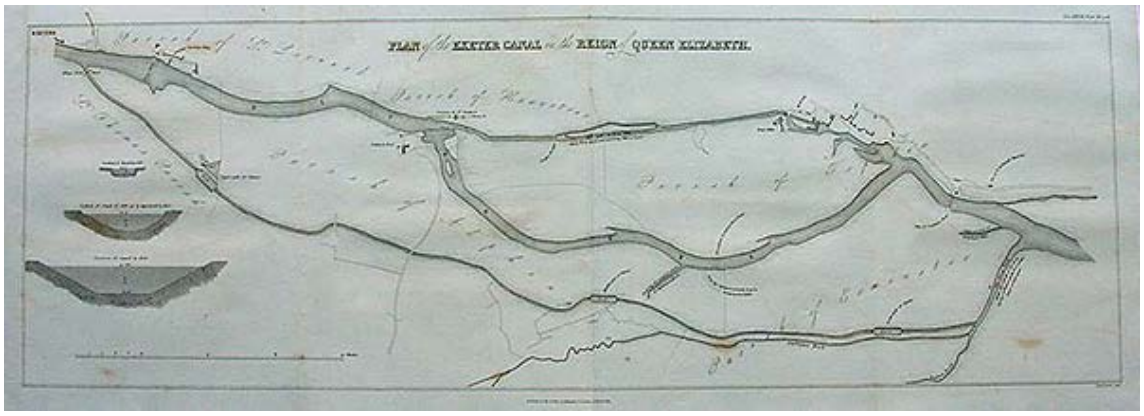
Wittington Winch, Hurley Weir (IoE 47071 Mr AS Heywood - Jones

Sets of paddles (Michael Trueman)

Pound locks

The lack of survival of any operational or even partially complete flashlock gives greater relevance to early examples of pound locks. England was comparatively slow to adopt their use, as pound locks had been first used in medieval China during the Song Dynasty having been pioneered by Qiao Weiyo in 984. These had replaced earlier double slipways that had caused trouble and the water level could differ by 4 feet or 5 feet at each lock - in the Grand Canal the level was raised in this way by 138 feet. In medieval Europe the true pound lock came in 1396 with the one built at Damme near Bruges but more relevant were the 18 of them constructed by Bertola da Novate on the Naviglio di Bereguardo (part of the Milan canal system) between

the years 1452 and 1458 while Leonardo da Vinci is credited with introducing paired mitre gates in 1497 for a canal in Milan.



Exeter Canal Plan in the Reign of Queen Elizabeth (I) James Basire *Society of Antiquaries of London* 23rd April 1839

In England the first pound locks were three constructed with vertical gates on the ***Exeter Canal*** between 1564 and 1566, and the first with mitred gates on the River Lee in 1577. The 1577 Pound Lock on the ***River Lee*** was built on a cut made between the Corn Mill Stream and the Old Barge River. Detailed specifications have survived, from which we know that it was built and lined with timber and had mitre gates at each end, making it probably the first true mitre-gated pound lock in the country. The lock was completely destroyed in June 1592 and navigation returned to the Old Barge River course but the route of the channel built between the Cornmill Stream and the Old Barge River 400 years ago is still discernible and the site of the pound lock has tentatively been identified.

On the ***River Don*** Vermuyden seems to have built four sasses (pound locks) between 1626 and 1630 at Thorne, Turnebridge, Stockwith and Misterton as shown on a map of1633 (Jones 1994) but these were destroyed during the Civil War. Christopher Wren also refers to sasses in his 1670 report on the River Lea.

On the ***River Thames*** with the building of pound locks from the seventeenth century onwards, the use of flashlocks declined, but the weirs of which they had been a part remained integral to the system. The 1630s stone pound locks at Iffley (1047190), Sandford and Swiftditch (1059788) were amongst the earliest built in the country, and are notable survivals, possibly the earliest pound lock remains in England.

Pound lock c 1620? on Swift Ditch Culham (IoE 248813 A H Jacobs) and Old Iffley Lock 1632? Oxford (IoE 245663 Chris Tresise)

Other than the short-lived example off the River Lee, the first group of pound locks on an artificial cut or canal were on the Wey Navigation which was a remarkable work of mid-17th century waterway engineering. Opened in 1653 it had 9 miles of canalised river and 10 pound locks. Unfortunately the two surviving early locks were rebuilt in brick in 1966 when the navigation was transferred to the National Trust. The second group of pound locks on an artificial cut or canal were built in 1670 on the 8-mile long Stamford Navigation cut between Market Deeping and Stamford bypassing the River Welland. These 12 locks, sketched by an engineer in 1699 seem to have been turf-sided with masonry abutments and chain operated mitre gates but seemingly there are only slight remains and foundations of two rivers locks in the Deepings.

Remains of Deeping St James High Lock (Wikipedia Richard Croft)

None of these pioneer locks survive in anything other than vestigial form but until comparatively recently there were several examples of early turf-sided locks on the River Kennet and on the Wey Navigation. Similarly all but two of the early 18th century locks on the ***River Kennet*** were replaced in the 1970s when the navigation was being restored for cruising. Garston, one of the remaining turf-sided locks is still used and therefore of great significance and has been listed Grade II*(1117125) while Monkey Marsh Lock is a scheduled monument (1006971).

Garston Lock (IoE 40058 Mary Auckland)

Monkey Marsh Lock (Wikipedia John Lloyd)

On the Stover Canal which was a small lateral canal off the River Teign there are remains of three earth-banked chambers over 100ft long dating from c1792 and these have been designated at Grade II (1097339, 10973374 and 1334126).

(Stover Canal Trust)

On the Warwickshire Avon, where navigation was improved in three phases in the 17th Century, four locks retained their early diamond shaped chambers until the drastic restoration in the 1960s and little of historic significance remains. Other early pound locks which display pioneer structural features survive in derelict form on river navigations such as the Louth where six of the locks were built in 1770 with chamber sides composed of six segmental arches in the vertical plane to resist lateral earth pressure and Alvingham lock (1063080) is the best surviving example and has recently been listed at Grade II.

(Left) Alvingham Lock 1767. (IoE 195450 Trevor Sowray detail)
(Right) Aldermaston Lock (IoE 39700 Richard Swynford-Lain)

Aldermaston Lock on the Kennet & Avon shares these features but has been sensitively rebuilt (1319515) and is designated Grade II.

It can be seen from the above that there was still a good deal of uncertainty in the second half of the 18th century as to the configuration of masonry lock chambers. The early continental models such as the Canal du Midi employed barrel shaped locks to counter water pressure and some of the early masonry locks followed this example while others went for scalloped sides. This was only to be fully resolved by the end of the century when, led by skilled practitioners such as Smeaton, Jessop, Rennie and Telford, there had been advances in all aspects of canal engineering and locks with walls with only a slight outside batter and buttressed on the land side and with stone or brick invert floors become the norm.

Paget-Tomlinson (1994) gives a detailed account of lock construction with an annotated exploded illustration based on a Rennie specification showing to what

lengths engineers had to go to counter both water pressure and earth pressures and expansion. He also discusses the various types of lock gates, their paddles and paddle gear and their geographical variations. The lock floors could be set in puddle when the ground was porous but a much later solution to uncertain geological conditions was Telford's iron-sided lock of 1828 at Beeston on the ***Shropshire Union*** which is a scheduled monument (1006759).

(Left) Beeston Cast Iron Lock 1828 (IoE 439175 Mr Keith Walker)
(Right) Old Double Locks, St Helens Canal (www.penninewaterways.co.uk)

On some canals the use of cast iron lock gates was introduced as these lasted much longer than wooden lock gates which had to be replaced every twenty or so years. However iron gates could be subject to catastrophic shatter and their use was not generally adopted though examples survive on the Hilmorton flight of locks.

The Canal Age ushered in the widespread use of flights of locks in England though the first staircase locks had been completed in 1638 at Rogny on the Canal du Briare where the seven original staircase locks were preserved as a monument when replaced by another staircase in the late 19th century. The earliest two-rise staircase in England is probably the Old Double Locks on the ***St Helens Canal*** (Sankey Brook Navigation) opened in 1757 while the nearby New Double Locks date from 1770

The Old Double locks have a slightly barrel-shaped plan perhaps reflecting similar constructional concerns over water-pressure as evidenced in the contemporary river navigation locks noted above.

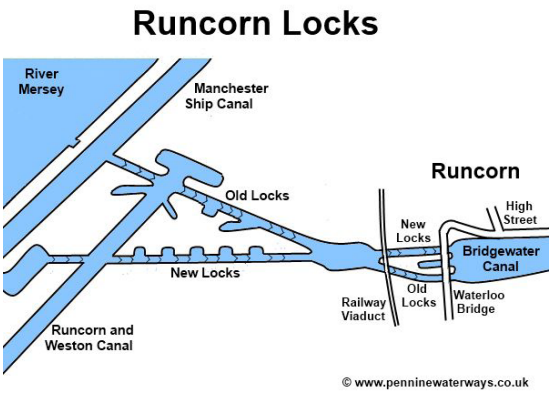
Once again Paget-Tomlinson (1994) discusses in some detail the introduction of staircase locks and their disadvantages as far as water consumption is concerned. Brindley is thought to have built a two-rise staircase at Salterhebble in 1765 on the ***Calder & Hebble*** and certainly had overall responsibility for the triple staircase lock at Bratch on the ***Staffs & Worcs Canal*** which was completed before his death in 1772. These locks, as originally built, show inexperience in the use of such a staircase as the rise of locks varies between locks. This, in the absence of overflow weirs, would have been both wasteful and wet in operation. (Cross-Rudkin 2005).

Bratch Lock and house of 1771
(IoE 407805 Mark Hadley)

Brindley also favoured the use of staircase locks in his survey for the ***Leeds & Liverpool Canal*** and some of these proposals survived when the canal was constructed after his death to the alleged detriment in the operation of the canal due to their extravagant water consumption. The magnificent group of staircase locks near Bingley are appropriately designated, the Five Rise (1314303) at Grade I, the Newlay Three Rise (1133361) and the Two Rise (1133359) at Grade II*.

Bingley Five Rise and Newlay Locks Three Rise Staircase (www.penninewaterways.co.uk)

Brindley's influence, even after his death in 1772, can also be seen on his other canals where locks were grouped in considerable numbers in flights and staircases the earliest of any size being the, now infilled, flight of ten constructed in pairs in 1773 at Runcorn to bring the ***Bridgewater Canal*** down to the River Mersey. These were supplemented by a second flight of ten single locks opened c.1827 which was closed in 1966 and largely obliterated.



The Old flight of locks was infilled c 1949 but the line is protected and used as a footpath for much of its length. (copyright Neil Arlidge www.penninewaterways.co.uk)

On the disused section of the Chesterfield Canal either side of Norwood Tunnel Brindley also grouped flights of locks in short staircases but these were not finished when he died. There is some uncertainty over the exact original arrangement of this pioneering work of canal engineering with the possibility that a six-rise staircase once existed but latterly there were two treble staircases and two double staircases interspersed with single locks. (Richardson 2004).

Turnerwood Locks (1314642)
(IoE 335809 Paul Eggleston)

The Bingley Five-Rise is the steepest staircase in the country with a gradient of 1:5 other significant staircase of locks are the Bath Locks on the Kennet & Avon Canal with six locks in an ornate setting, and the two staircases of five locks at Foxton which replaced the inclined plane.

The most impressive lock flight in the UK is perhaps the 16 locks at Caen Hill, part of a longer 29-lock flight on the ***Kennet & Avon Canal*** at Devizes and John Rennie's solution to climbing the very steep hill up to Devizes. Because of the steepness of the terrain there was not the space to use the normal arrangement of water pounds between the locks. As a result, the 16 locks utilise unusually large side ponds to store the water needed to operate.

Caen Hill Locks (Wikipedia Adrian Pingstone)

However, the Tardebigge Flight is the longest flight of locks in the UK, comprising 30 narrow locks on a two and a quarter mile stretch of the Worcester and Birmingham Canal, it raises the waterway some 220 feet and the deep Top Lock was the site of an experimental canal lift and had a beam engine pumping station.

Lock Cottage Tardebigge Flight (IoE 355192 Geoff Dowling) and the Engine House Tardebigge (IoE 156241) Helmut Schulenburg)

The Hatton flight of 21 locks on the ***Warwick & Napton*** raising the canal 146 feet in a couple of miles, with its lock cottage half way up and maintenance yard and toll office at the top is also impressive. They were broadened in the 1930s and the earlier locks survive alongside.

(Left) Hatton Locks (Wikipedia Roger Kidd): (Right) Combe Hay Locks (Wikipedia spoonfrog)

On the abandoned canals, the Somerset Coal Canal flight of 19 locks at Combe Hay, which replaced the inclined plane in 1805, is of note as is the flight of 17 locks built in 1835 on the Newport Branch of the Shropshire Union, most of the locks on the former are protected.

Locks: Assessment of significance and protection

> *Locks, usually of the pound type (the first in England was on the Exeter Canal, 1564-6), are listable if appreciable parts of the original stone pound walls (and associated surfaces) survive; lock gates will rarely be early as they require regular renewal, and appropriate allowance must be made.*
> HE Listing Selection Guide on Transport Buildings

As discussed above very little survives of the lock devices on waterways other than pound locks though the English Heritage internal report on ***Thames*** rymers and weirs demonstrated the archaeological potential of detailed local survey. Elsewhere the ***Dick Brook*** remains of two flashlocks built of sandstone blocks should be assessed as should be the ***River Ivel*** for the alleged substantial brickwork remains of West Stow, Lackford, Mill Heath Jack Tree, Mildenhall, Cow Gravel and West Row staunches and wooden remains of Tuddenham Mill Stream staunch. Similarly on the ***River Parrett*** the substantial remains of the unusual Thorney Half-lock should be assessed, as should remains on the pioneer ***Stamford Navigation***. As these types of lock were the main devices for changing levels for several centuries their remains however vestigial are of considerable significance and the uncertainty regarding their current state of survival should perhaps be resolved by a separate study building on the pilot study on underwater remains by Anthony Firth and by consultation with river managing bodies such as the Environment Agency.

Early pound locks which display pioneer structural features survive in derelict form on river navigations such as the ***Louth*** where of the six locks built in 1770 with chamber sides composed of six segmental arches. As noted above Alvingham Lock is the best surviving example and has been listed at Grade II while the remains of an earth-banked chamber over 100ft long dating from c1792 on the ***Stover Canal*** have recently been designated (see above). Masonry remains of Sillom pound lock of c.1760 of the redundant River Douglas Navigation survive on the Rufford branch of the ***Leeds & Liverpool Canal*** where the canal absorbed the line of the navigation and as these have been little altered as they no longer operate as a lock they might merit assessment.

The earliest two-rise staircase in England is probably the Old Double Locks (1343270) on the ***St Helens Canal*** opened in 1757 while the nearby New Double Locks (1283484) date from 1770. The claim to pioneering date and their barrel-shaped plan of the Old Double locks has been noted in their designation but their significance has only been recognised at Grade II.

New Double Locks (IoE 216373 Peter Sargeant)

A great many of CRT's canal locks will have already been assessed for designation as indicated by the number of locks in the NHLE but there are certainly discrepancies in coverage caused by local authority boundaries, with identically significant locks being assessed (or not) in different past listing surveys. The relevant regional CRT Heritage Team will be aware of any discrepancies. On the ***Don Navigation*** there is reputedly an early lock built by John Smith, of Naburn Lock fame, at Milethorn in the mid-18th century but by-passed and abandoned by later improvements and certainly some other redundant locks survive alongside later replacements, as at Kilnhurst.

Kilnhurst Lock, with the older, disused lock to the right. (www.penninewaterways.co.uk)

The recent, somewhat controversial, project to utilise one of the long-abandoned, and undesignated, Jessop locks on the ***River Trent*** for hydro-electric generation indicates a need for assessment of early locks which have become disused.

On the Environment Agency unnavigable waterways, as noted above, little of significance may have survived flood prevention measures over the years while on the main waterways, for which EA is responsible most locks, will probably have been assessed. On the abandoned canal system on the ***Somerset Coal Canal*** the Combe Hay locks are designated (1115372) and the re-excavated entrance lock with its intriguing amount of masons' marks at Dundas Basin is also designated Grade II (1276919). The significance of Brindley's closely spaced locks on the ***Chesterfield Canal***, though formerly much decayed, has been recognised by designation and the restoration of Thorpe (1192850) and Turnerwood Locks (1192731) has been preceded by thorough archaeological investigation before their £4.3 million restoration, which was partly funded by the HLF and English Partnerships.

Inclined Planes

Ramps to overcome varying levels of water and paved portages over short distances have been much used in China and in use since Classical times in Europe where they were further developed in medieval times leading to horse gin powered wheeled cradles in the 15th century. Davis Ducart (Daviso de Atcort) adopted the device for use in hilly country for three inclines on the tub-boat Tyrone Canal in Ireland in 1777 but without much success. Around the same time John Edyvean used inclines to raise and lower boxes to the beach at either end of his uncompleted ***St Columb Canal*** which was disused after his death in 1780 and little trace of the inclines, if indeed both were finished, remain.

St Columb Canal Incline on extreme left
(Wikipedia Tony Atkin)

However, as Thomas Telford's article in Plymley (1800) recounts the Shropshire ironmaster William Reynolds, founder of three canals of the East Shropshire tub-boat network, had more success in 1788 with a self-balanced, double tracked incline from his ***Ketley Canal*** (an arm off the Shropshire Canal system) to his furnaces 73 feet below. It worked until the furnaces closed c.1816 and while most of the incline is obliterated, some brickwork and small tunnels near the top survive. This incline was much visited and indeed inspired similar ones in Silesia built by John Baildon, a pupil of Smeaton who managed an ironworks served by the ***Klodnice Canal***, Meanwhile elsewhere on the tub-boat sections of the Shropshire Canal system inclines were increasingly being used. At Hughes Bridge on the ***Donnington Wood Canal*** in 1790 a steam powered 363 feet tub-boat incline replaced a box hoist to overcome a 43 feet change in level and cottages at the incline are designated (1038250). On the ***Shropshire Canal*** itself, tub-boat cradle inclines were built in 1792 to overcome a 120 feet rise at Wrockwardine Wood, a 126 feet rise at Windmill Farm and a 207 feet rise at The Hay Incline, Coalport (1054161).

The Hay Incline (Wikipedia David Stowel, Andy Bennet and Riggwelter)

These inclines worked throughout much of the 19th century and the lines of some of the inclines can still be traced. The Hay Incline, a highly-scored site on the International Canal Monuments List, has been restored as part of the Ironbridge Gorge Museum and the encompassing World Heritage Site. Finally, at Trench, Reynolds built another steam powered incline 670 feet long to connect to the Shrewsbury Canal to the tub-boat system 75 feet above but despite surviving in use until 1921to be the last working incline in the country, only vestigial fragments remain.

As mentioned above an incline conveying waggons carrying boxes of coal was employed in a temporary capacity in 1801 on the ***Somerset Coal Canal*** when the flight of 19 locks at Combe Hay were being built, the proposal for caisson locks having been dropped (see below). The height difference was some 110 feet and the incline worked until 1805 when it was closed six weeks before the locks opened to allow for their completion.

The success of the Shropshire inclines prompted the American artist and inventor, Robert Fulton, in 1794 to patent inclines using wheeled cisterns to convey boats hauled onto the cistern by water power and then, encouraged by Lord Stanhope, to publish in 1796 *Treatise on the Improvement of Canal Navigation*. His ideas for wheeled boats and for bucket-in-a-well or water wheel powered inclines were taken up by James Green twenty years later in the West Country in his proposed Bude Canal. As built in 1823, the ***Bude Canal*** had five inclines the largest of which, the 935 feet long Hobbacott incline (1005459) rose 225 feet and was worked by Fulton's bucket-in-the-well arrangement and has been designated as a scheduled monument. The other four, details of which are in the Gazetteer, were worked by large diameter waterwheels and most of the incline alignments and some of the wheel-pits such as that at Merrifield survived to be recorded in 1972. The system operated until 1891and as evidence of the most extensive use of canal inclined planes in the country these remains merit fuller investigation and consideration for protection.

Former incline keeper's house and toll house to the Hobbacott Down incline plane (IoE 64843 Barbara Hilton)

James Green was later responsible for a 60 feet rise, double tracked, waterwheel driven, incline near Weare Gifford on the ***Torrington (Rolle) Canal*** which opened in 1827 and closed in 1871 when the succeeding railway was built across its top. Green's next incline was the 440 feet long Wellisford incline rising 81 feet on the ***Grand Western Canal*** which opened in 1836 but here the bucket-in the-well

system proved inadequate for powering cradles for the larger tub-boats used on this canal. After Green was dismissed, on the advice of W A Provis, a steam engine was employed but this lasted less than 30 years when, succumbing to railway competition, the tub-boat section of the canal closed in 1867 and the incline dismantled.

Green had also been involved with the planning of the ***Chard Canal*** but, as Green was not engaged as engineer, it may have been Sir William Cubitt who was responsible for the four inclines. The inclines at Thornfalcon (28 feet rise), Wrantage (27.5 feet rise) both of which were open in 1841. Ilminster with a 82.5 feet rise opened in 1842 and was a twin incline using a continuous cable. It was waterwheel driven and had the tub-boats floating in caissons while that at Chard Common (86 feet rise) was powered by a turbine with a wheeled carriage which took boats dry over the summit. It also opened in 1842. The canal closed in 1868 and the alignments of the inclines were still discernible in 1972.

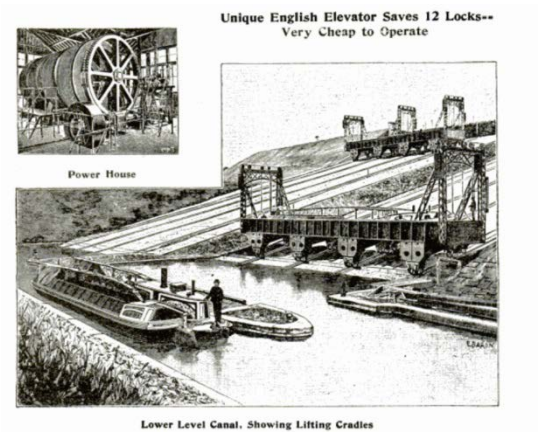
Chard Canal, Ilminster twin incline. (www.hows.org)

Finally in the West Country there were two inclines on the Tavistock Canal which was engineered by John Taylor a mine manager. The 936 feet long Mill Hill Branch incline only operated from 1819 to c.1844 and rose a mere 19.5 feet and carried tub-boats dry in cradles. The other, at the Morwellham end of the canal was shorter at 720 feet but much steeper and, waterwheel-assisted, took trucks down 240.5 feet from the canal to Morwellham Quay (1021461) which is a scheduled monument.

The next major technical advance in Britain was the installation of a double track, counterbalanced steam assisted 1040 ft long incline on the Monkland Canal in Scotland where large empty flat bottomed barges, locally known as scows, were conveyed floating in caissons up a 96 feet rise. Completed in 1850 a problem with surging caused the caissons to be drained in use. The incline was very heavily used for the first 20 years but eventually railway competition caused a decrease in traffic and the incline was closed as unnecessary about 1887 and the machinery cleared though the incline itself could still be seen in 1984.

The success of the Monkland Incline probably encouraged the construction by the newly formed ***Grand Union Canal*** of the Foxton Incline(1018832) in 1900. Here a

75.5 feet rise which was overcome by the Foxton Locks (1360753) was speeded up by two counter-balanced caissons each conveying two narrow boats or one barge down the 307 feet long, steam assisted, incline. To counter the surging problem encountered on the Monkland incline the caissons at Foxton ran transversely down the incline necessitating a very wide apron which had necessitated extensive and expensive civil engineering works (see Section 2.3). After initial problems with too light rails the incline operated successfully for 10 years but lack of traffic rendered it somewhat of a white elephant and it closed in October 1910. It was worked occasionally thereafter and was only sold for scrap in 1928. As stated in the BW 1999 Statement of Significance: 'Foxton Inclined Plane (engineer Gordon Thomas) is of international importance and together with the locks, cottages and associated buildings, forms a canal site of very high archaeological and heritage value'.



Popular Mechanics Vol. VII
No. 10, October 1905

Other than the Hay Incline the only English site mentioned in the incline section of the International Canal Monuments List with a score of 6 is the incline in the Worsley Underground system on the ***Bridgewater Canal***. Constructed by John Gilbert between 1795 and 1797, the 453 feet long incline connected two levels of coal mining canals at 106.5 feet difference in height. Double tracked and counterbalanced, it was self- acting, but manually assisted by winches and brakes, and conveyed narrow tub-boats of about 12 tons. It was abandoned in 1822 due to exhaustion of the upper seams but substantial remains survive underground.

Inclined Planes: Assessment of significance and protection

> *Inclined planes to lift vessels out of the water usually by means of caissons (also associated with early railways) were introduced on the canal system in the 1780s but most extant examples are late nineteenth-century and were tended to be short-lived; intactness (or otherwise) will be a key determinant.*
> HE Listing Selection Guide on Transport Buildings

In contrast to the historic development of locks, Britain played a more significant role in developing canal inclined planes and the evidence of these experiments should be duly recognised. Hence, though most of William Reynold's pioneer self-balanced, double tracked incline of 1788 on his ***Ketley Canal*** has disappeared, some brickwork and small tunnels near the top survive and should be assessed for protection as

should the remains of the Hughes Bridge on the ***Donnington Wood Canal*** and the inclines on the ***Shropshire Canal*** at Wrockwardine Wood and Windmill Farm. The Hay Incline has been restored as part of the Ironbridge Gorge Museum and is the iconic example of such inclines. The underground inclines at Worsley are also of great significance and should be assessed for designation if safe access is possible.

As detailed above, the most extensive use of inclines was somewhat later in the South West with a total of 14 inclines of which James Green was responsible for at least seven – five on the ***Bude*** and one each on the ***Torrington*** and ***Great Western Canals*** and he may also have planned the four on the Chard Canal which Cubitt engineered.

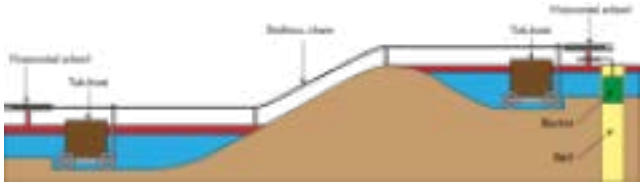


Diagram showing the arrangement of the Wellisford inclined plane (Wikipedia Fred the Oyster)

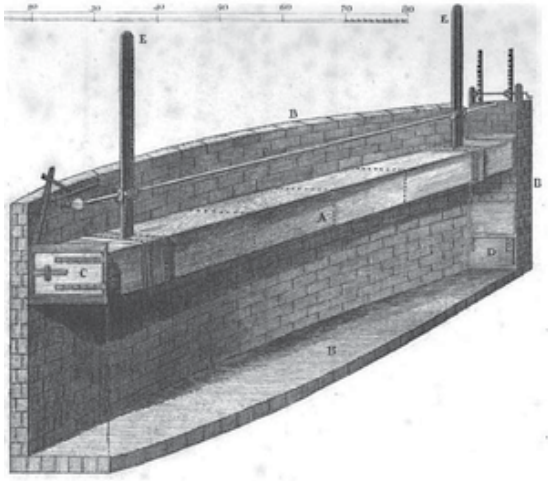
This group of inclines is of considerable significance and their remains and the two on the ***Tavistock Canal*** which are not already designated should be assessed. The incline on the ***Somerset Coal Canal*** which worked from 1801-05 was replaced by locks some of which are designated and the incline, conveying boxes rather than boats, has left only slight trace. The much later and much more impressive Foxton Incline which conveyed boats is already designated by scheduling. (See above)

Hoists, Lifts and Balance Locks

Concurrently with the development of inclined planes, the idea of lifts or balanced locks was being explored. A fairly crude manually operated example was built in 1788 at Halsbrucke on the Churpinz Canal in Germany to convey 2.5 ton boats 20 feet between canal levels but this does not seem to have influenced the introduction of lifts in England. Hoists conveying cargo from short canal tunnels to street levels above were from 1765 a feature of the Castlefield Basin at the Manchester end of the ***Bridgewater Canal*** where a reconstructed example of a waterwheel driven crane exists and this system was used by Ducart on the Tryrone Canal in Ireland in 1767, and by Reynolds on the ***Ketley Canal***, at Hugh's Bridge on the ***Donnington Wood Canal*** and Brierley Hill Coalbrookdale on the ***Shropshire Canal*** before being replaced by inclined planes. Remains of the tunnel of the Donnington Wood hoist system at Hugh's Bridge survive.

The last decade of the 18th century witnessed several attempts to develop lifts capable of carrying up to full size boats. In 1792 Robert Weldon patented a system which he trialled in 1794 with a demonstration model near Oakengates but his idea was not pursued there. It was however taken up by the ***Somerset Coal Canal*** in 1796 to overcome the 120 feet height difference between levels of the canal at Combe Hay (see above locks and incline). A trial chamber with a 46 feet lift was constructed in 1797 and public demonstrations were given in 1798 and again in 1799 when the Prince of Wales attended. However the hillside it was built on was geologically

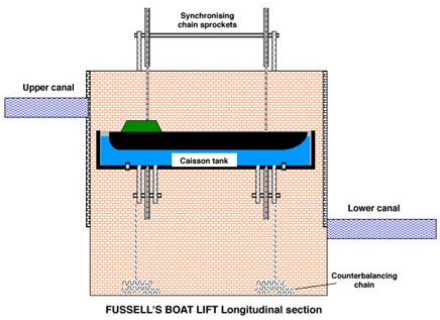
unsuitable for such tall, water-filled, chambers and bulging in the walls presented insurmountable problems and the scheme for a series of such chambers was abandoned in favour of locks. The precise site of the trial chamber has not yet been found despite several well-informed searches and it is thought that the masonry may have been re-used in nearby canal structures.

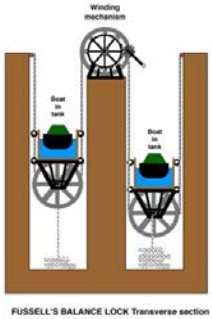


Combe Hay Caisson lock 1799

Meanwhile lifts were being considered for the Ellesmere Canal and in 1796 trials of a lift built to the patent taken out by Rowland and Pickering two years earlier were made near Ruabon, to the south of Wrexham in Wales. The demonstration lift, made at the expense of the patentees, seems to have worked but Jessop and Telford as engineers to the canal did not pursue the idea though some recompense was made to Rowland and Pickering to assist with their losses on the trial. The site of the trial chamber has not yet been identified.

Around the same time, James Fussell an ironmaster at Mells patented in 1798 his ideas for balance locks to be built on the proposed ***Dorset & Somerset Canal***. A series of four such locks were to be built at Barrow Hill and a fifth with a lift of some 20 feet was trialled quarter of a mile to the east. The trial of the completed balance lock was reported in the press on October 1800 and work seems to have started on the other four before money ran out and the whole canal was abandoned. The trial lock was excavated recently and the twin chambers survive to almost full height – as the earliest surviving such chamber of a balance lock that seems to have worked, it is of considerable significance and merits assessment.





Excavation of Fussell's Trial Balance Lock (Dorset & Somerset Canal Society)

The lack of success of these experiments did not deter further such trials and John Woodhouse took out patents in 1806 and 1810 for lifts to be built at Tardebigge on the ***Worcester & Birmingham Canal*** where the line of the canal was faced with a large drop in height. The trial lift, with a 12 foot rise and a single caisson capable of taking a full sized narrow boat counter-balanced with weights, was built in 1808 but was not tested until Tardebigge Tunnel was completed in 1810. Although several successful trials were conducted the following year, the Canal Committee consulted with both Jessop and Rennie and the latter recommended that although the lift worked satisfactorily it was too delicate for constant use and locks, despite problems over water supply, would be preferable. These were duly built and opened in 1815. The Top Lock of the Tardebigge flight is at 11ft unusually deep as it replaced the experimental lift The lift mechanism has gone but the outline of its balancing pit may be seen near the lock keeper's cottage.

Top lock Tardebigge (Wikipedia Oosoom)

On the ***Regents Canal*** in 1815 yet another experimental lock, a hydro-pneumatic lock' was built and trialled in 1816 in the vicinity of Hampstead Road lock. Its inventor and patentee was Col. Congreve (of rocket fame) and it was constructed by Henry Maudslay & Company. It was to be capable of lifting the wide barges used on the canal 6.6 feet and its principle relied on airtight and watertight caissons and hydraulics, a rather impossible prerequisite for the technology of the time.

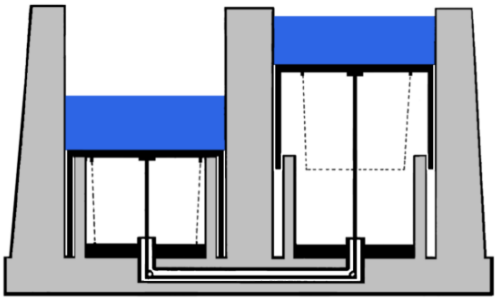
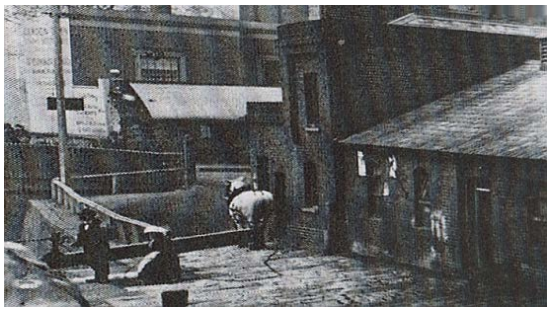


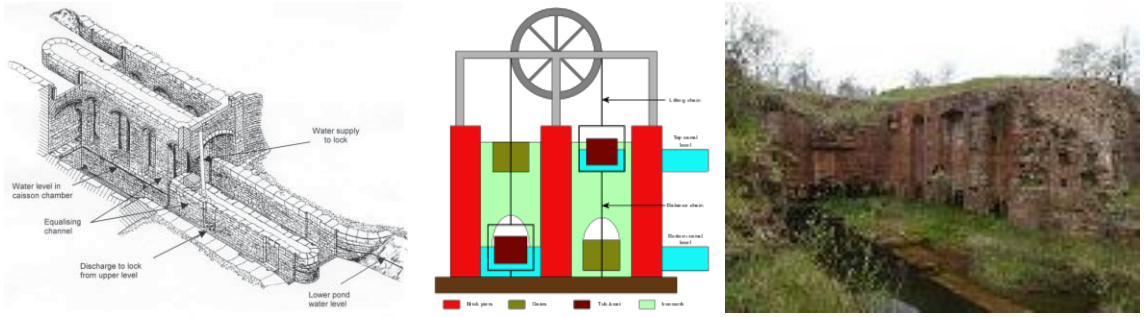
Diagram (based on Congreve's drawings) showing how the hydro-pneumatic lift would have worked. The Regent's Canal Company changed the design to a longitudinal arrangement which made it more difficult to operate. (Londons Canals)

It worked after a fashion but not up to Congreve's expectations and everyone lost money on the venture. This indeed was to be the general story of all these experimental lifts – they were ahead of their time as regards materials and structural technology.



Remains from Congreve's Hydro canal lift trial. The lock house and adjacent lean-to seen in 1876.(London's Canals)

Once again it was James Green in the West Country who persevered with alternatives to locks and this time on the ***Grand Western Canal*** he had a measure of success. In 1834/5 he built seven twin caisson counter-balanced lifts to take tub-boats 26 feet by 6.5 feet and these worked after a fashion until the canal passed into railway hands and traffic declined. When the railway bought the canal in 1865 the Taunton to Lowdwells section was closed in 1867. The lifts varied greatly in rise from 12.5 feet at Norton St Warren to 38.5 feet at Trefusis and 42 feet at Greenham. The best preserved is at Nynehead which had a 24ft lift.



Nynehead Lift: Conjectural view of lift and lock modifications (Denis Dodd) (Wikipedia NH Savage)

In the later 19th century as materials and the available technology had greatly developed hoists and lifts once again became relevant. At the port of Goole on the ***Aire & Calder Navigation*** five huge compartment boat hoists were built from 1863 onwards and these were capable of lifting the 40 ton 'Tom pudding' compartment coal boats that were operating in strings on the navigation. The last of these hoists worked until 1986 and the surviving examples are listed II* (1083214).

Hoist and Accumulator Tower, South Dock Goole (IoE 165281 Les Waby)

An even more spectacular structure was erected in 1875 at Anderton on the ***Weaver Navigation*** to transfer pairs of narrow boats or a wide barge 50 feet between the Weaver and the Trent & Mersey Canal . The Anderton Boat Lift (1011152) was built by Edward Leader Williams to the designs of Edwin Clark and the system

adopted was of two counterbalancing troughs each on a central hydraulic ram. The lift worked fairly satisfactorily but over time the polluted water of the Weaver had a corrosive effect and the rams had to be constantly repaired.

Anderton Old Lift c.1900 before conversion. (Waterways Archive)

This problem was diagnosed in 1895 and the use of condensed water extended the life of the rams till 1904 when the whole system was overhauled and the caissons were converted to electrically operated with huge counterbalance weights. This arrangement persisted until 1986 when the strain on the foundations caused such distortion that the lift, now an Ancient Monument, was closed. However, around the Millennium, the availability of HLF money allied to funding from BW and English Heritage enabled the lift to be rebuilt and restored to hydraulic operation and it opened again to traffic in March 2002.

Lifts and Balance Locks: Assessment of significance and protection

> *Boat lifts (that at Anderton, Greater Manchester, completed 1872-5, being the first) proved similarly uneconomic and accordingly are rare. Some of the more monumental structures, and some lengths of relict canals, are scheduled as ancient monuments.*
> HE Listing Selection Guide on Transport Buildings

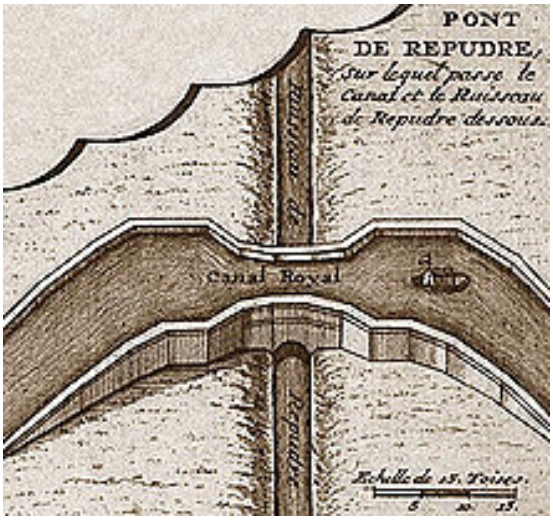
Britain had a pioneering role in the use of lifts and balance locks as these developed from simple hoist systems such as of the Donnington Wood hoist system where remains of the tunnel at Hugh's Bridge survive and should be investigated. Other than the substantial remains of Fussell's balance lock of 1800 recently excavated near Barrow Hill on the abortive ***Dorset & Somerset Canal*** very little survives of the five experimental caisson and lifts that were trialled by Weldon at Combe Hay 1796, Ruabon 1796, Tardebigge 1810 and on the Regents canal in 1815. The Fussell balance lock should be assessed for designation as should the nearby line of unfinished chambers on Barrow Hill.

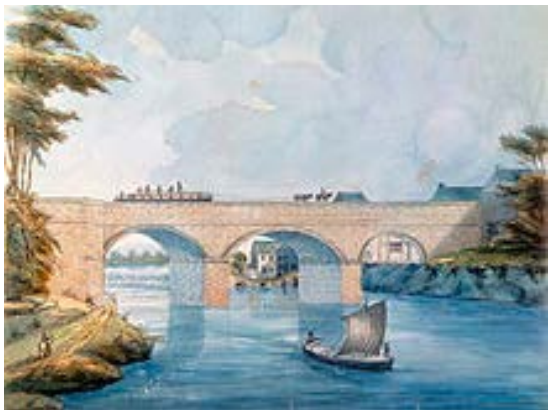
In contrast James Green's seven twin caisson counter-balanced lifts on the ***Grand Western Canal*** worked after a fashion from 1834/5 until the tub-boat section the canal closed in 1867. Nynehead (1177043), the best preserved lift chamber, is listed and is a significant site while the site of the larger Greenham Lift should be investigated as to what of significance survives as it was reputedly built to the principles first advocated by Dr. Anderson in 1796. The hugely significant late 19th century Anderton Lift and the Tom Pudding Hoists (1083214 and 1160288) at Goole are, of course, already designated.

3.2 Crossings: Aqueducts and Bridges

Aqueducts

Aqueducts built for navigation rather than water supply have a comparatively short history. Whereas in Classical times huge structures conveyed water many miles and sometimes at great height to Roman cities, the aqueducts built primarily for transport having to resist much greater load were initially much lower and meaner looking structures. Italy is credited with pioneering these with one on the Martesana Canal over the River Adda built 1462-1470 but it was the Repudre Aqueduct built on the Canal du Midi two hundred years later that was to influence later canal builders.





Thus the Duke of Bridgewater was inspired to build his canal from his coal mines at Worsley direct to Manchester by means of an aqueduct over the River Irwell rather than locking down into the river.

Built by James Brindley, and opened in 1761, the 600 feet long Barton Aqueduct carried the ***Bridgewater Canal*** 38 feet above the river with a sixty feet central span and two slightly lesser side arches and was an engineering wonder of its day. It lasted for over a century but had to be demolished in 1893 to be replaced by a swing aqueduct when the ***Manchester Ship Canal*** was built. So solidly built was the old aqueduct that dynamite had to be used to expedite its demolition but the approach embankment and some of the buttress still survives.

Such was the regard for this pioneer aqueduct that some of the stonework has been preserved. When the portion spanning Barton Lane was being cleared, the side of the arch and its two buttresses facing Barton was re-erected on the north wall of the approach to the present swing aqueduct on Barton Lane. The Barton Swing Aqueduct (1162870) itself is still in use and is a monument of great engineering significance.

Despite the success of his Barton Aqueduct, Brindley was only too aware of the difficulties in its construction which had been dictated by having to provide ample clearance for boats on the Irwell Navigation and thereafter preferred to play safe and build his aqueducts as low and a massive as possible as illustrated by his Barfoot Aqueduct (1067872) on the Bridgewater. This led to him building c.1770 two squat brick aqueducts on his ***Trent & Mersey Canal***, a 12 arch one over the Dove and a six arch one over the Trent (1096525) and similar structures Great Haywood and Sow aqueducts (1273478) on the ***Staffs & Worcs Canal***.

Trent & Mersey Canal Aqueduct at Egginton (IoE 82704 Geoffrey R Hood)

A generation of engineers initially followed Brindley's precepts but by the 1790s had broken free; Whitworth in Scotland on the Forth & Clyde, Rennie with his grand aqueducts on the ***Kennet & Avon*** over the Avon at Avoncliff (1798) (1021876 Grade II*) and the Dundas Aqueduct (1364071 Grade I) at Limpley Stoke and his five arched Lune Aqueduct (1362451 Grade I) in 1797 on the ***Lancaster Canal***.

Lune Aqueduct (Wikipedia Humphrey Bolton)

Jessop had initial problems on the ***Cromford Canal*** with his 80 feet span aqueduct (1007025) over the Derwent which had to be rebuilt. His others include the four arched Black Pit Aqueduct (1230245) at Hebden Bridge, his three arched aqueduct over the Luddenden Brook on the ***Rochdale Canal***, and the five arched aqueduct over the Dearne (now demolished) on the ***Barnsley Canal***. His three-arch brick aqueduct carrying the Grand Junction over the great Ouse was opened in 1805, but a section of the canal embankment collapsed in January 1806; this was repaired, but the aqueduct structure itself collapsed in February 1808, severing the canal. It was replaced by an iron trunk which was completed in 1811.

It was however Thomas Telford working with Jessop that brought a new dimension to aqueduct construction with his use of iron. Telford's Longdon-on-Tern Aqueduct of 1797 (1037006 Grade 1) on the ***Shrewsbury Canal***, a rebuild of a masonry aqueduct swept away in a Severn flood, was the first major iron aqueduct - though a 44-foot-long single-span cast iron structure had been devised by Benjamin Outram, and completed in 1796, at Holme on the Derby Canal a few months earlier.

Longdon-on-Tern Aqueduct (Wikipedia Priewis)

Longdon-on-Tern presaged the use of iron plates for the canal bed at Chirk Aqueduct (1801) (1295150 Grade II*) a section of which is in England and then as a trunk for the spectacular Pontcysyllte Aqueduct in Wales on the ***Llangollen Canal*** in1805.

(Left) Chirk Aqueduct with the railway viaduct behind (Wikipedia Akke Monasso)
(Right) Pontcysyllte Aqueduct (Wikipedia Akke Monasso)

The Stakes Aqueduct on the ***Huddersfield Narrow Canal*** rebuilt by Outram in 1799 with a cast iron span after being damaged by a flood. Although strengthened by cross bracing in 1875 it is the oldest surviving iron aqueduct that is still in use for its original purpose.

(Left) Stakes Aqueduct, 1799, Stalybridge (Wikipedia Bob Gough)
(Right) Cosgrove Aqueduct (Wikipedia Peter R Lewis)

The rebuild by Benjamin Bevan of Jessop's collapsed masonry Cosgrove (Wolverton) Aqueduct (1006934) on the ***Grand Junction Canal*** followed in 1811.

Two other major iron aqueducts were constructed in 1816 on the ***Stratford Canal*** at Wootton Wawen (1382215 Grade II*) and Edstone (1005740) and a third (1184618 Grade II*) in 1834 when the Yarningale masonry aqueduct was washed away in a burst. The 475 feet long Edstone aqueduct is the longest iron aqueduct situated entirely in England.

Edstone aqueduct (Wikipedia DeFacto)

On the ***Carlisle Canal*** there were two very much smaller aqueducts (1144626 and 1335635)) constructed in 1823 near Carlisle and converted to railway bridges in 1853 when the canal was converted into a railway which itself is long since disused. Telford later built several further iron aqueducts such as Stretton (1039259) and Nantwich (1330146) when he improved the lines of canals as on the ***Shropshire Union*** and Congleton (1130449) on the ***Macclesfield*** and the magnificent Grade II* all-iron Engine Arm Aqueduct (1391874) of 1828 on the BCN.

Engine Arm Aqueduct (Wikipedia Oosoom and Shantavira)

The two aqueducts of 1836 on the disused section of the ***Grand Western Canal*** have cast iron troughs sheathed in masonry at Nynehead (1307612) over a drive and over the river Tone (1060354) (see Tyson 'cast Iron Aqueducts in England and Wales J.RCHS Nov 1975). The final pre-railway flourish of iron aqueducts was in 1839 with George Leather's bowstring arch truss design Stanley Ferry Aqueduct (1261690 Grade I) on the Wakefield Arm of the ***Aire & Calder***.

Stanley Ferry Aqueduct (Wikipedia Chris55)

In the railway era several iron aqueducts were built when railways passed under canals and one, James Walker's 1844 Grand Junction aqueduct in Sandwell, is an example of an aqueduct built by a canal company Tame Valley over a pre-existing main-line railway - the Grand Junction Railway which had opened in 1838. In 1840 the North Midland Railway intersected with the canal at Bullbridge and an iron trunk was inserted into the canal by Robert Stephenson when the railway passed under it. The aqueduct was demolished in 1968.

Bullbridge Aqueduct over the North Midland railway

If the railway cast iron level beam aqueduct at Hazelhurst is contemporary with the adjacent Leek Branch Canal aqueduct (1038095) over the ***Caldon Canal*** built in 1841, it would be the earliest such aqueduct. Somewhat later Tunnel aqueduct, close to the Leawood Aqueduct (1007025) over the ***River Derwent***, and carrying the ***Cromford Canal*** over Robert Stephenson's railway of 1849 is of interest as a rare surviving example of Robert Stephenson's wrought iron trussed cast iron level beam bridges while there is another example on the ***Tame Valley Canal***.

From 1848 Brunel built several aqueducts over his various railways some of which were cast iron trunks cased in masonry while others such as the Ladydown aqueduct, Trowbridge, carrying the ***Kennet & Avon Canal*** over the Wilts, Somerset & Weymouth Railway are all masonry. The iron aqueduct of 1848 at Halberton on the ***Grand Western*** over the Bristol & Exeter Railway branch to Tiverton has a cast iron trough contained within a two-arch masonry structure, but it is of interest due to the crowns of the arches being of cast iron.

Grand Western Canal Halberton Aqueduct (Engineering Timelines)

Brunel's Mytton aqueduct of 1851, carrying the ***Warwick & Napton Canal*** over the Birmingham & Oxford Railway near Leamington Spa, is also a brick-encased iron trough, supported by multiple exposed cast-iron arches. Somewhat later, in 1859, Brunel built the Three Bridges' aqueduct at Windmill Lane, Southall with its self-supporting cast iron trough.

Three Bridges' aqueduct, Southall (Wikipedia J Taylor)

Two other such aqueducts (1246077) dating from 1856 carry the ***Wyrley & Essington*** over the South Staffs Railway and these are fine examples of self-supporting cast iron troughs, with decorative cast iron face girders and parapets.

A similar self-supporting cast iron trough aqueduct is the Biddulph Valley Aqueduct (1237570), Congleton built in 1859 to carry the ***Macclesfield Canal*** over the Potteries, Biddulph & Congleton Railway.

In the late 1870s three small iron aqueducts made from three huge cast iron plates (the base and two sides) were constructed on the private canal system at the

Waltham Abbey Royal Gunpowder Works (1016618) where internal traffic was water borne with a total length of the system some 5 miles on two levels.

(Left) Royal Gunpowder Works Aqueduct 1878-9 (RGMWA) (Right) Holiday Street Aqueduct, Birmingham (Wikipedia)

Meanwhile on the ***BCN*** there are examples of small iron aqueducts over minor roads and close to the centre of the city the impressively wide iron-supported Holliday Street Aqueduct (1076303) of 1871 which carries the ***Worcester & Birmingham*** over the road of the same name.

A century after Pontcysyllte opened, the ***New Junction Canal***, built in 1905, has huge metal-trough aqueducts over (or nearly resting on) the River Don and the River Went.

The Don Aqueduct (www.penninewaterways.co.uk)

In spite of the success of iron as a structural alternative, masonry aqueducts continued to be built in the last decade of the 18th century and throughout the first half of the 19th century with notable examples on the ***Macclesfield*** at Red Bull (1038594), Dane Aqueduct (1135940), Gurnett (1139475) and Bollington (1136400), in addition to the Lune, the Holme, Wyre and Sedgwick aqueducts on the ***Lancaster Canal***, the Marple (1001954) and Goyt (1242267) Aqueducts on the ***Peak Forest Canal*** and the Store Street (1270666) Aqueduct on the ***Ashton Canal*** which is notable for its skew angled arch. Other major masonry aqueducts include the Dowley Gap Aqueduct (1133357) on the ***Leeds & Liverpool Canal***, Prestolee (1162420) and Clifton (1162680) Aqueducts on the ***Manchester, Bolton and Bury Canal***, the five-arch Rolle Aqueduct (1104782) of 1827 on the ***Torrington Canal***.

(Left) Store Street aqueduct (Wikipedia Pit-yacker) (Right)Steward Aqueduct Birmingham (Wikipedia Oosoom)

Telford himself also used brick or masonry for aqueducts where circumstances dictated as with his Steward Aqueduct (1077161)on the ***BCN*** which carried the Old Main Line over the new Main Line and is now crossed by a railway and the M5 motorway.

When a junction is being made between canals at different levels this can lead to quite complicated arrangement of locks bridges and aqueducts as with the Pool Lock Aqueduct (1330050) built in 1831 that takes the Hall Green Branch of the ***Trent & Mersey*** over the main line to join the Macclesfield Canal and with the Hazelhurst Aqueduct (1038095) taking the Leek Branch over the ***Caldon Canal*** in 1841.

Poole Lock aqueduct carrying the Hall Green Branch over the Trent & Mersey Canal to join it at Harding junction. (Wikipedia Akke)

Aqueducts: Assessment of significance and protection

> *Aqueducts are the most spectacular of all canal structures, displaying both high architectural quality, engineering boldness and technological innovation in the form of cast-iron troughs: Longdon Aqueduct (Shropshire) (by Thomas Telford, 1795-6; a scheduled monument and listed Grade I) is among the earliest use in England of such features. Almost all surviving examples are already protected; later examples which have avoided designation will be assessed on the basis of age, intactness, design interest and group value.*
> HE Listing Selection Guide on Transport Buildings

Aqueducts are such prominent features of the canal system that the earlier examples have been relatively benignly treated as far as protection is concerned and most, apart from very minor aqueducts and a few major but ruined structures on the abandoned canals, are designated. Thus amongst the latter there are discrepancies, the two ruined aqueducts on the Leominster Canal (1383584 and 1383773) are designated while the parapet-less Tone Aqueduct on the Chard Canal and the Orfold Aqueduct on the Arun Navigation should perhaps be assessed. The later aqueducts built over railways are less comprehensively protected. Six are designated – Tunnel Aqueduct on the Cromford, Ladydown on the Kennet & Avon, Three Bridges over the Grand Union, Middleton aqueduct and Pratt's Mill aqueduct on the Wyrley & Essington Canal and the Biddulph Valley Aqueduct, Congleton, on the Macclesfield Canal – the others mentioned above appear to be undesignated including Brunel's Halberton and Mytton Aqueducts.

Bridges

Bridges, with locks, are the most common structures on canals as they were required under a Canal Act for highways and when properties were split by the canal. They are also required to carry towpaths from one side of the canal to another, to carry towpaths over canal junctions and sometimes to cross locks. The commonest solution was a simple hump back brick or masonry bridge which represents a compromise between an arch sufficiently high to pass a boat without employing extensive earthworks, yet not interfering unduly with wheeled traffic on the roadway. A less expensive solution initially, though on requiring continual maintenance and a source of inconvenience, was variations of low level bridges which could be swung, lifted or drawn back. Where one canal joined another, or when it was necessary for the towing path to continue on the other side of the canal, a roving bridge could be built. These did not have to cater for wheeled traffic and accordingly they could be less substantial, narrower and steeper than public bridges. Occasionally bridges had to be designed to mollify influential landowners or to blend with their environments or to cross deep cuttings and in these instances some grand or unusual bridges were built.

The 1976 Industrial Monuments Survey of Canal Structures provided a summary account of bridges and, with amendments, is the basis of the present discussion where brick and masonry public and accommodation bridges are considered, then roving bridges, iron bridges and finally moveable bridges.

Public and accommodation bridges

The material of which these bridges are built usually reflects the local availability of good building stone or otherwise bricks. Canal such as the Shropshire Union and the Kennet & Avon displays this availability distinctly – the western section of the latter has bridges of dressed stone while the eastern section has brick bridges and most, but by no means all, of these bridges are listed.


(Left) Kennet & Avon masonry bridge Claverton (IoE 399479 Beryl Murray) (Right) Kennet & Avon brick bridge, Enborne (IoE 394019 James A Irving)

There are also listed masonry bridges of comparable quality on the ***Lancaster***, ***Peak Forest***, ***Leeds & Liverpool***, ***Macclesfield***, ***Rochdale*** and ***Grand Western Canals***. The ***Oxford Canal*** has a fine series of brick bridges most of which are listed as do the canals of the ***Grand Union***, the ***Shropshire Union*** (which also has many fine stone bridges), the ***Birmingham and Worcester***, the ***Pocklington*** (1815) which has particularly graceful bridges.


(Left) Pocklington Canal Church Bridge (IoE 167663 Janet Roworth) (Right) Hollings Bridge Loggerheads (IoE 362640 Clive Shenton)

Smeaton's impressive Summit Bridge (1391875 Grade II*) over his improved ***Birmingham Main Line*** was an early designation. While Telford's bridges over the deep cuttings of the ***Birmingham & Liverpool Junction Canal*** (Shropshire Union) such as those at Woodeaves and Loggerheads are particularly spectacular

Canal engineers seem to have been pioneers in the use of skew bridges with winding courses the earliest probably being by Chapman in Ireland but March Barn Bridge, Castleton on the ***Rochdale Canal*** built in 1800 by Jessop is the first correctly designed oblique arched (skew) bridge in England and is scheduled (1005559). Made of stone, it sits at a skew angle of 60 degrees and the stones that form the voussoirs and span are laid in winding courses, a very difficult form of construction.

Rochdale Canal March Barn Bridge
(www.penninewaterways.co.uk)

A brick skew bridge at SU 270 630 near Crofton on the Kennet & Avon Canal has claims to be the earliest surviving brick skew bridge (1798) in the country but because of its mutilated condition and WWII tank trap was declined protection when Panel assessed in 1976, this might now merit a second assessment as the WW II tank defence may now add to its special interest. It was built by Rennie to carry a private avenue over the canal.

By the end of the canal era skew bridges built of either stone or brick had gained much more sophistication as the masonry Sugar Lane Bridge on the ***Macclesfield Canal*** and the brick built Priory Bridge,(1349186) Monkshide, built c.1843 on the ***Hereford & Gloucester Canal*** demonstrate.

(Left) Sugar Lane Skew Bridge Macclesfield Canal 1831 (www.penninewaterways.co.uk)
(Right) Hereford & Gloucester Canal 1840 Skew Bridge at Monkshide (Wikipedia Bob Embleton)

Where the canal severed the parkland of an estate, or carrying private drives to country seats, an ornate bridge might be provided. Both can be found on the Grand Junction, the former at Cosgrove (1190608 Grade II*) and the latter at Grove House. Cosgrove Bridge is built of Gothick-style dressed limestone while Grove House is brick built in classical style and elaborately stuccoed.

Cosgrove Bridge (IoE 235242 Alistair F Nisbet) Grove House Bridge (IoE 158164 Jane Black)

The ***Kennet & Avon*** in Bath ran through the Sydney Gardens Pleasure Park and is graced with two fine cast iron bridges (1395952 and1395961 both Grade II*) and a monumental façade to the bridge/tunnel carrying the road fronting Cleveland House – another entry on the ICM List.

1810 Iron Bridge Sydney Gardens, Bath (IoE 442753 Michael Perry) Tunnel and Cleveland House, Sydney gardens, Bath (IoE 442751 Micaela Basford)

Elsewhere those carrying private drives include Ellel Bridge (1317881) on the Lancaster Canal and Avenue Bridge (1180238) on the ***Birmingham & Liverpool Junction***.

Avenue Bridge 1830, Brewood
(IoE 271403 GW Tanner)

Sometimes a later bridge would be built to provide private access across a canal as with the Stowell Park Suspension Bridge (1193314) on the Kennet & Avon. This is built to the suspension bridge pattern designed by James Dredge and pioneered in 1836 in Bath.

Stowell Park Suspension Bridge (Grace's Guide to British Industrial History, IoE 311791 Andy Domeracki)

Roving Bridges

Possibly the first specialised roving bridge to carry a towpath over another canal was that at Great Haywood (1357559) where the ***Staffs & Worcs Canal*** meets the ***Trent & Mersey Canal***. Probably designed by Brindley and built c.1770 by Whitworth its design was perpetuated until the end of the canal age. As late as 1835 a superb example at Dukinfield was built at the junction of the ***Ashton*** and ***Peak Forest Canals***.

Roving bridge of 1772 at junction with Trent & Mersey Canal at Heywood (IoE 443269 Howard Bagshaw) and Roving bridge of 1835 Dukinfield Junction (www.penninewaterways.co.uk)

Further fine examples are to be found on the ***Shropshire Union*** at Norbury (1243062) Wardle(1312853) and Hurleston (1136464) Junctions. Coffin Bridge (1081249) on the ***Worcester & Birmingham*** is of similar type though for an entirely different purpose – built just wide enough for coffins from the nearby monastery. In many instances roving bridges were built as integral parts of accommodation bridges by adding an extra component on one side, allowing towing horses to cross without being unhitched. This could be achieved quite simply by a separate causeway as at Stratford on Avon on the ***Stratford Canal*** and at Newport (1002952) on the ***Newport Branch*** or by graceful sweeps as on the ***Macclesfield Canal***. A great many roving bridges were to be built of iron (see below).

Turnover Bridge (Bridge 43) Macclesfield Canal (IoE 391036 Patricia Layhe) and Congleton (IoE 55952 Graham R. Heasman)

Peak Forest Canal Hyde
(IoE 212487 Frank Bennett)

On the ***Peak Forest Canal*** a combined roving and road bridge is designated as an example of such bridges evolutionary development. Built 1804 it was widened twice and the towpath bridge with its masonry spiral approach now has a panelled cast iron parapet and a stone flag floor.

Iron Bridges

The nineteenth century saw much greater use of iron as a structural material for canal bridges. Sometimes it was used for its ornamental qualities as at Sydney gardens in Bath on the Kennet & Avon Canal with two footbridges dating from 1810 (see above) and the 'Blow Up' Bridge on the Regents Canal. It was also used for footbridges at locks as at Widcombe in Bath, and they could be composed of two cantilevered halves allowing the tow rope to pass in a gap as at Yarningale Wootton Wawen Locks on the Stratford Canal and Stourbridge locks on the Stourbridge Canal.

K & A Canal Widcombe Bath (IoE 442752 Micaela Basford) Canal Bridge Wootton Wawen Stratford Canal (IoE 482584 William S. Thorne)

The use of iron varied between the spectacular as when Telford spanned his improved ***BCN Main Line*** with the soaring 150 ft span Galton Bridge which is included in the International Canal Monument List to the utilitarian as at Runcorn.

Galton Bridge (IoE 219212 D R Smith)

It was also used increasingly for roving bridges as at Chester (1375933) on the ***Shropshire Union*** or sometimes replacing earlier structures as at Braunston Junction and Camden (1272428) on the ***Grand Union***.

(Left) Telford Roving Bridge c.1800 Chester Canal (IoE 469912 Michael J Tuck)
(Right) Cast iron roving bridges at Braunston c.1830 (IoE 360964 John Airlie Hunter)

These were often standard bridges supplied by the specialist maker Horseley Ironworks and examples of these are to be found at other locations on the ***Grand Union*** as at Braunston Boatyard and on the ***Oxford Canal*** near Rugby while more spectacular examples are to be found at Smethwick on the ***BCN*** and on the ***Regents Canal*** at Camden.

(Left) Cumberland Bridge (1227628) a Grade II* cast iron footbridge of 1864. Manufactured by Henry Grissell, London (IoE 477804 Steve Kirkland)
(Right) Iron bridge Nether Heyford (IoE 234767 Michael E. Megeary)

Iron was also used increasingly for minor bridges as at Bridge (No.33) at Nether Hayford on the ***Grand Union*** which has five cast-iron beams with three wrought-iron tie rods and arched brick vaults between beams presaging later railway bridges. Railway bridges, that were not the responsibility of the waterway being crossed, are not considered here though many were very impressive structures.

Low Level Bridges

These bridges are, by their nature, less substantial and have usually undergone extensive overhauls involving much replacement of components. On busy crossings heavier duty bridges have been substituted while on abandoned waterways they have usually been fixed and therefore are the first casualties of any restoration. There are three basic types – those that are swung, raised or drawn back.

Swing bridges, or turnbridges or swivel bridge as they are sometimes called, were used on many canals and indeed on the Sankey Brook (St Helens Canal) to allow sailing flats up to St Helens and these seem to have employed a roller race. Other examples on early canals include Kingsbury Swivel Bridge on the ***Birmingham & Fazeley***.


(Left) Kingsbury Swivel Bridge (IoE 309273 Denis True): (Right) Fordgate Swing Bridge, Bridgwater & Taunton Canal (Wikipedia Derek Harper)

The ***Kennet & Avon*** furnishes numerous examples of simple swing bridges which, designed by Rennie and illustrated in his work book, have not been radically altered since their introduction at the beginning of the 19th century. They formerly employed runs of 4-inch cast iron balls as bearings and were possibly the earliest examples of this principle on the English canal system but they all seem to have been replaced and therefore any other examples elsewhere are of significance. The bridges at Seend Park and Wilcot were recommended by the Panel for listing in the 1970s while a later example on the ***Bridgewater & Taunton*** was already protected and the much smaller swing bridge at Bulls Bridge on the ***Cromford Canal*** was recommended for scheduling.

Swing Bridges are also common on the Leeds & Liverpool, where many of the wooden ones have been replaced by steel, and were used on the Peak Forest, Basingstoke, Grand Junction and Macclesfield where some such as at Scholar Green have been reduced to footbridges.


(Left) Scholar Green swing bridge Macclesfield Canal (www.penninewaterways.co.uk)
(Right) Poyntz Bridge (Chichester Ship Canal Trust)

On the ***Gloucester & Sharpness Canal*** which had bridges with two swinging spans all these have been replaced by single spans in the 1960s. A small iron example, Pontz Bridge, has been restored on the ***Chichester Canal*** – a branch of the ***Portsmouth & Arundel Canal***.

Powered examples of swing bridges had to be introduced in the mid-19th century to cope with the heavier bridges required by railways and then to span the wider channels of ship canals and navigations. Few early railway examples survive but at Selby (1419063) an electric swing bridge of 1891 replaced a cast iron bascule

bridge with two leaves was built in 1834 for the Hull & Selby Railway. However numerous road swing bridges are still in use – seven hydraulically worked over the ***Manchester Ship Canal*** and five electrically powered on the ***Weaver***.

Moore Lane Bridge Manchester Ship Canal
(IoE 58966 Keith Walker)

Weaver Navigation Town Bridge 1899 Northwich (IoE 57622 R.G. Noxon) and Acton Swing Bridge 1932 (Geograph David Dixon)

Bridges that are raised can be of the drawbridge type, bascule or lift. Drawbridges are commonly wooden structures though many on the East Anglian waterways have been replaced in steel. On the ***Oxford Canal*** the numerous timber lift bridges (eg 1046362, 1046364, 1200121 and 1200139) are balanced by beams at an angle of about 140 degrees from the platform.

Oxford Canal Tilting Bridge, Adderbury
(IoE 243821 J. B. Moseley)

On the Llangollen Branch of the ***Shropshire Union*** they have overhead beams with a balance box, the beams being braced together unlike those on the ***Caldon*** where each beam is independent and separately counterweighted. Allmans (1237206), Wrenbury Frith (1357424) and Stark's Lift Bridges (1244333) on the Shropshire Union are Graded II*.

(Left) Shropshire Union Wrenbury Church Bridge (IoE 422451 Howard W Hilton)
(Right) Turn Bridge, Huddersfield (Wikipedia Richard Harvey)

The Turn Bridge(1005793) c1865 is a unique although altered survivor of a vertically rising deck type bridge, originally wound up and down by hand and counter balanced by means of an overhead chain and wheel mechanism. It was refurbished in 2002 and converted to electric power.

Powered bascule bridges are quite rare with probably the largest being that over the Trent at Keadby built by Sir William Arrol in 1916 to replace a swing bridge of 1864 built by the South Yorkshire Railway. It was the 160 ft opening span (now fixed) of a 440 feet long girder bridge and carries road and rail traffic.

(Left) Keadby Bridge, River Trent (Wikipedia Asterion) (Right)Telescopic Bridge, Bridgwater (Wikipedia Geof Sheppard)

There is also the unique sliding railway bridge at Keady which takes a still in use railway line across the ***Stainforth & Keady Canal*** and is operated from a signal box, while the formerly steam driven telescopic railway bridge of 1871 over the River Parrett at Bridgewater is now a footbridge and fixed.

Bridges: Assessment of significance and protection

> *There are two essential divisions which characterise canal bridges: one is whether they are fixed or movable – the latter can be swing bridges, as seen in the series of listed late nineteenth-century bridges over the Manchester Ship Canal, or bascule bridges (drawbridges) – the second is whether they carry public roads or provide access between private estates divided by a canal (in which case they are known as accommodation bridges).The latter were quite often movable.*
> HE Listing Selection Guide on Transport Buildings

There are several thousand bridges on the inland waterways system and a great many are protected, though with the vagaries of the designation programmes over the last 40 years discrepancies between local authority areas covering the same canal are common. These may have been picked up by the Architectural Heritage Surveys for individual canals where these have been undertaken by BW, and now CRT, staff. Almost all the bridges mentioned above are designated though the pioneer brick skew bridge near Crofton on the Kennet & Avon Canal which was declined protection in 1976 because of its mutilation by WWII tank defences perhaps might now be re-considered for designation and these defensive features are now recognised as historic. Even on the abandoned parts of the waterway system most bridges also seem to be designated.

3.3 Tunnels and Earthworks

Tunnels and their horse lanes

The civil-engineering technology applied to canal tunnels was not an innovation: Roman water-supply and drainage tunnels of quite large section were not uncommon. That built in AD 41-52 to drain Lake Fucino was 5.5km long and 6m high and had some 40 construction shafts on its line while the surviving *Cloaca Maxima* draining the Forum area of Rome (a World Heritage Site) was large enough to take boats used in periodic cleaning of the silt. There were also Roman road transport tunnels such as the 3000ft long tunnel through the Posillipo Hill between Naples and Pozzuoli. thought to date from the time of Augustus (31 BC-AD 14). However, the Canal du Midi was the first heavily engineered summit canal of the modern age and has the 160-yard-long Malpas Tunnel of 1679 which inspired British canal builders to build heavily engineered canals with much longer tunnels.

Indeed, the British canal network was notable for the extent of tunneling needed to adequately serve the upland districts at the heart of the Industrial Revolution. The origin of this use may have been in flooded mining tunnels or 'levels' where boats were used as a convenience on the large amounts of mine drainage water. At the Worsley Collieries end of the ***Bridgewater Canal*** (1759-60) the waterway was tunneled into a hill for a at least a mile to drive directly into colliery workings. By 1878 it extended for a total of 40 miles underground on three levels connected by winding shafts and an inclined plane, and this well-publicized system was widely copied in Britain and on the mainland of Europe. The entrances to the mines at Worsley Delph basin (1001956) are scheduled. At the Bridgewater Canal's other terminus in Manchester it terminated in a tunnel under Castle Hill, from whence coal was wound up for sale via a vertical shaft. A second longer tunnel of this type was added later.

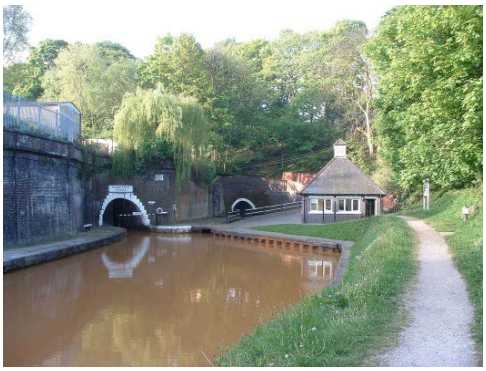
Bridgewater Canal, Delph Basin, Worsley and one of the tunnel entrances to the Worsley coal mines (www.penninewaterways.co.uk)

While working on the Bridgewater Canal, its engineer, James Brindley, agreed to carry out a much larger canal, the Grand Trunk, connecting the Trent and Mersey rivers. Near the middle of the ***Trent & Mersey Canal***, just north of the potteries at Stoke-on-Trent, was the Harecastle Ridge which Brindley pierced with the 2880 yard Harecastle Tunnel. Hugh Henshall, who was tasked with finishing the tunnel canal, told a parliamentary committee in March 1775 that 'the great Tunnel through Harecastle Hill of the length of about 2900 yards' was made. Thus, when it was

finally opened in 1775, three years after Brindley's death, it shared the distinction with Brindley's other great tunnel on the ***Chesterfield Canal*** (Norwood Tunnel) which opened in May 1775 of being the first summit tunnels on the British canal system and the first long tunnels on any navigable waterway in the world.

(Left) Brindley's south portal Harecastle Tunnel (Wikipedia Akke Monasso)
(Right) South portal, Preston Brook Tunnel (IoE 436331 Keith Walker)

Brindley's Harecastle Tunnel is now impassable, as are the earlier Worsley mine tunnels and is his 2850 yard (now 2884 yards) Norwood Tunnel on the Chesterfield Canal, but the 1239 yard Preston Brook Tunnel(1775) (1104925) and the other early short tunnels on the ***Trent & Mersey*** are still navigable. These were also engineered by Hugh Henshall after Brindley's death in 1772.



(Left) Dudley Canal Tunnel, south portal (Wikipedia Harrias)
(Right) North portals of Brindley's and Telford's tunnels. (Wikipedia Akke Monasso)

The slightly later (1775-92) Dudley limestone mining canals and associated 2942 yard ***Dudley Canal Tunnel***, near Birmingham are still navigable as is Telford's Harecastle Tunnel which replaced Brindley's in 1827.

The two Harecastle tunnels (1210692), built more than 50 years apart, convincingly demonstrate the increase in size of tunnel bores and sophistication in tunnelling techniques that occurred during the Canal Era and this was to continue well into the railway period when, in the face of competition, congestion at tunnels on busy routes could no longer be tolerated. Most of the longer early canal tunnels, for economic reasons, were built to as small as possible dimensions for the craft navigating them and were therefore without towpaths. These tunnels were mostly designed to be 'legged' but in some there was provision for other means – chains stapled to the walls in the 502 yard Bruce Tunnel(1808) (portals 1035927 and 1194523) on the Kennet & Avon Canal, handles on the side walls in the 433 yard Shrewley

Tunnel(1253006) (1799) on the Warwick and Birmingham and rings in the roof in the 1800 yard Crimson Hill Tunnel (1842) on the Chard Canal.

(Left) Kennet & Avon East Portal Bruce tunnel, Burbage (IoE 312259 B.J.W. Heath)
(Right) Berwick Tunnel, Shrewsbury Canal (Wikipedia Mark Evison)

The first tunnel of appreciable length to be provided with a towpath (a timber path built out over the water) was the 970 yard Berwick Tunnel (1239507) on the ***Shrewsbury Canal*** in 1797. To speed up traffic some canals have passing places – four in the longest of all tunnels, the 5686 yard Standedge Tunnel (1266901) on the ***Huddersfield Canal*** completed in 1811.

Huddersfield Canal, Standedge Tunnel East and West Portals. (www.penninewaterways.co.uk)

The later canal tunnels notably those of Thomas Telford such as the second Harecastle and the new Newbold Tunnels were provided with towpaths while his 360 yard Coseley Tunnel on the ***BCN*** finished in 1838 after his death was wide enough for two narrow boats to pass with towpaths either side. Also on the BCN the 3027 yard Netherton Tunnel (1215046), the last major tunnel to be built in England, followed suit in 1858 and was even lit by gas. Only the 3800 yard Strood Tunnel (1824) on the ***Thames & Medway Canal*** in Kent was of a greater bore and water width, but had only a single towpath.


BCN Netherton Tunnel 1858 (IoE 219226 J J Sheridan and Wikipedia Oosoom)

Other notable tunnels are 3075 yard Blisworth (1294177) (1805) which was wide enough to take two narrow boats and also on the Grand Junction Canal the 2075 yard Braunston Tunnel (1076445), the 3795 yard Lappal Tunnel (1798) on the BCN fourth longest in the country, the 2900 yard Butterley Tunnel (1404832) on the Cromford (1794) and the 3817 yard Sapperton Tunnel (1089301, 1089674) on the Thames & Severn which has the most ornate portals of any tunnel.


Sapperton Tunnel, North and South portals. (IoE 128352 E. Currier, 12929 Lorna Freeman)

Other tunnels over 1000 yards long are Wast Hill ***Worcester & Birmingham*** (2726 yard), Morwellham (1105707 and 1105729) ***Tavistock*** (2540 yard), Oxenhall (Hereford & Gloucester 2192 yard), Foulridge ***Leeds & Liverpool*** (1640 yard), Crick (1076426) ***Grand Union*** (1528 yard), Southnet ***Leominster*** (1254 yard), Wrens Nest ***Dudley*** (1227 yard), Greywell (1339863) ***Basingstoke*** (1200 yard), Husband's Bosworth ***Grand Union*** (1166 yard).

As Crowe (1994) details, only a few canal tunnels possess any architectural pretensions. The pioneering examples, such as the three on the ***Trent & Mersey Canal*** and Norwood Tunnel on the ***Chesterfield Canal***, have simple brick or stone portals and plain wing walls and some have been rebuilt.

Trent & Mersey Barton Tunnel
(IoE 435806 R G Noxon)

Somewhat later tunnels, such as the Greywell on the Basingstoke, the Braunston on the Grand Union, the Brandwood (1290690) on the Stratford-on-Avon, the Gannow and the Foulridge (1073395 and 1361715) on the Leeds & Liverpool and the Snarestone (1295233) on the Ashby are enlivened with architectural detail while as we have seen both portals of the Sapperton Tunnel on the Thames & Severn are elaborate architectural compositions.

Leeds & Liverpool, Foulridge 1796 and Gannow Tunnels 1801 (IoE186239 Brian Lomas, IoE 467038 Peter J. Sturtivant)

The Sydney Gardens tunnel portal (1395965) on the Kennet & Avon is appropriately grand given its setting and is Graded II*.

Kennet & Avon, Tunnel and Cleveland House, Sydney Gardens, Bath (IoE 442751 Micaela Basford)

Vertical shafts were employed to drive tunnels from intermediate headings and some of these survive as ventilation shafts protected by towers and these can be followed across the lines of the tunnels. Some such as that above the Blisworth Tunnel can be quite imposing while others can be rather incongruous such as the pepper pot

structure of the Gosty Tunnel on ***Dudley No 2 Canal*** now in a suburban front garden.

The northern airshaft (1130435) to the Preston Brook Tunnel and that above the Barton Tunnel on the ***Trent & Mersey*** are designated.

(Left) Blisworth Tunnel Ventilation Shaft, (Grand Union Canal)
(Centre, Right) Trent & Mersey, Airshafts above Barnton Tunnel (IoE 449370 R.G. Noxon) and Preston Book Tunnel (IoE 429730 Keith Walker)

The line of Sapperton Tunnel on the ***Thames & Severn*** is marked by clumps of beech trees planted by the canal proprietors on the vertical shaft spoil heaps in deference to Lord Bathurst, the local landowner.

Horse-paths

Where Tunnels were not provided with towpaths paths had to be provided to lead horses from one end to the other and in some instances these horse-paths were a landscape feature in their own right. Of the very earliest tunnels Preston Brook (1775) on the ***Trent & Mersey*** has a recognisable horse-path and the Norwood (1775) on the ***Chesterfield Canal*** has a combination of unfenced footpaths. A map-based survey in 1979 indicated that of the some 50 tunnels over 200 yards long only 15 showed distinct paths and only five of these had formation features worthy of note. The horse-path over the Hincaster Tunnel (1086577 and 1086575) on the ***Lancaster Canal*** is bordered by retaining walls and resembles a sunken lane cut into the hill. It requires two accommodation bridges over it to join neighbouring fields and even a later railway bridge. In each case the arch over the horse-path is extremely narrow – only wide enough for a horse – possibly to prohibit use by carts.

Hincaster Tunnel West and East portals with accommodation bridge for horse-path
(IoE 76445, 76442 CJ Wright)

The horse-path over the Saddington Tunnel, on the Leicestershire and Northamptonshire Union Canal section of ***Grand Junction Canal***, though a distinct landscape feature is very different, it is embanked for much of its length and

bordered by hedges. Elsewhere on the Grand Junction the Braunston Tunnel has a well-defined path but without significant physical formation while a short section of the original path over the Blisworth Tunnel has a substantial brick-lined drain (latterly a culvert) alongside a section of the path and abutments of a later railway bridge bracket the line. The line itself would seem to be continued by Stoke Road.

Shrewley Tunnel North Portal with horse tunnel alongside. (IoE 436126 Helmut Schulenburg)

The Shrewley Tunnel on the ***Warwick & Birmingham*** though only 433 yards long has a short tunnel on its horse path and then a long ramp down to the deep canal cutting below while the Bruce Tunnel on the ***Kennet & Avon*** where it is crossed by a railway assumes a distinctive formation. Strangely, the Sapperton Tunnel despite one of the earliest long tunnels with its line marked by beech clumps (see above) has no defined horse-path.

Horses could also be provided with tunnels as on the Marple flight of locks on the ***Peak Forest Canal*** to lead horses under a broad bridge and accommodation tunnels just wide enough for horses or cattle are to be found at Cosgrove and Wolverton on the ***Grand Union***.

(Left) Peak Forest Canal Horse tunnel (IoE 432085 Philip B Wilson)
(Right) Grand Union Canal Horse tunnel below canal embankment, Cosgrove (IoE 235243 Alistair F Nisbet)

> *The same emphasis on authenticity of fabric applies to tunnels: the first, near Preston,(sic) was opened in 1775; age, intactness and the design interest of the portals will determine eligibility.*
> HE Listing Selection Guide on Transport Buildings.

LA Edwards (1985) lists a total of 72 tunnels (defined as over 50 yards in length) of which 51 are still open however of the tunnels over 1000 yards only 12 of the 23 are still open. Many pioneer canal tunnel portals are already designated, as is appropriate given their early date, while most of the tunnel portals with any architectural pretensions are also designated but with lesser tunnels, such as Wellow Tunnel (1158774 and 1320467) on the disused Somerset Canal comprehensiveness of designation cover can vary.

(Left) South west entrance to Wellow Tunnel (IoE 32365 John Peters)
(Right) Engine House Red Brook (IoE 420021 Nigel Wood)

Much less protection is offered to tunnelling engineering features and evidence in the landscape above the tunnels themselves. Tunnel ventilation shafts are the main surface expression of a tunnel and significance of shafts is further enhanced where they form part of wider surface landscapes demonstrating evidence of navvy habitation, pumping and spoil disposal with other surface features. Shafts should be regarded as being of particular importance if they are associated with very early or particularly notable tunnels, if they were designed to be in keeping with a designed landscape or have a particular monumental quality or if they form elements of a wider, open upland landscape of high quality as in the Pennines. As noted above the northern airshaft to the Preston Brook Tunnel on the ***Trent & Mersey*** is designated as is the Red Brook Engine House (1224052) and pit situated midway above the immensely long Standedge Tunnel on the ***Huddersfield Narrow Canal*** while Standedge Tunnel portal itself is graded II*.

The exceptional horse-path over the Hincaster Tunnel is already designated while the well-defined Saddington Tunnel horse-path may be embanked with material from the tunnel itself and therefore might merit assessment.

Cuttings and embankments and retaining walls

Early canal engineers tried to avoid large earthworks whenever possible – the winding contour canals are witness to this aversion. Sometimes major earthworks could not be avoided and Brindley himself on his pioneer canal had to construct a long approach embankment to his Barton Aqueduct across the Irwell and this survives ending in the truncated abutments. There are two other similar approach embankments on the Bridgewater canal – to cross the Mersey near Stretford and the Bollin near Altrincham, the latter being the work of Thomas Morris under the supervision of John Gilbert.

Cuttings are especially difficult earthworks and on the Trent & Mersey and the Staffs & Worcs are short and shallow but in the 1790s, despite the problems of disposing of spoil with poor transport facilities, they became longer and deeper as at Burbage on the ***Kennet & Avon*** summit, Tring on the ***Grand Junction***, Royston on the ***Barnsley***, Burrow Heights on the ***Lancaster***, Deepcut on the ***Basingstoke*** and Shrewley on the ***Warwick & Napton***.

Later engineers had a less regard for the problems posed by terrain and constructed much straighter canals with all that implied for cuttings and embankments. Thus the cutting approaching Wast Hill Tunnel on the Worcester & Birmingham is impressive as are those of Thomas Telford. Telford had a splendid disregard for terrain – his Birmingham & Liverpool Junction is the supreme example with great cuttings at Tyrley and Grub Street - the former 90 feet deep and one and a half miles long – where slips are common today.

(Left) Birmingham & Liverpool Junction Canal, Hollings Bridge Loggerheads (IoE 362640 Clive Shenton)
(Right) BCN Smethwick Cutting (IoE 219213 D R Smith

His two-mile long Smethwick Cutting on the ***Birmingham Main Line*** up to 60 feet deep is less narrow but equally impressive and involved one of the greatest engineering excavations to that date in the country to be only rivalled in the 1840s by the cutting of the Tame Valley Canal.

The Albert Street walled cutting (1197423) in Bridgwater on the ***Bridgwater & Taunton Canal*** where it approaches Bridgwater Dock though a much lesser scale is also quite dramatic and as is the Northgate cutting below Chester's city walls.

Albert Street Cutting, Bridgwater
(IoE 374026 Michael Bass)

Notable embankments are to be found at Wolverton on the ***Grand Union Canal*** and Burnley on the ***Leeds & Liverpool Canal***. The latter carries the canal for almost a mile over the valleys of the rivers Brun and Calder at a height of some 36 feet and through the town and a further seven large embankments were constructed on the section of canal between Burnley and Wigan from 1796 onwards.



Leeds & Liverpool Canal Burnley Embankment (www.penninewaterways.co.uk)

John Rennie employed an unusual aqueduct or under-bridge structure to carry the Barton embankment of his ***Lancaster Canal*** over the New Mill Brook when there was only a shallow clearance.

Hollowforth Aqueduct, Barton
(IoE 185849 Peter Sargeant)

Retaining walls were less common as canal engineers generally preferred earthen embankments on the down slopes of contour canals but on the Bridgewater Canal there is a fine retaining wall on the approach to the Bollin Aqueduct.

(Left) The north-western curved retaining wall for the Bollin aqueduct (copyright MRIAS)
(Right) Brunel's retaining wall, Sydney Gardens, Bath (Geograph Gareth James)

A rather vernacular example of c.1800 on the unfinished Dorset & Somerset Canal still exists in a field near Frome. One of the finest retaining walls was built in 1840 by I K Brunel to buttress the Kennet & Avon Canal high above his Great Western Railway on its approach to, and through, Sydney Gardens in Bath.

Wash walls are a little noted but significant features of canals and with the advent of motorised craft are all too often damaged and replaced by piling. Historic lengths have survived on some abandoned waterways and those on the Botany Bay Branch of the Bridgewater Canal are of interest as relatively unaltered remnants of the pioneer phase of canal building.

Stone wash wall abandoned 1760 Botany Bay Woods Branch of the Bridgewater Canal (www.penninewaterways.co.uk)

Earthworks: Assessment of significance and protection

Relatively few earthworks in England are designated in their own right though some may have a measure of protection by being included within conservation area, while in Scotland the entire lines of some canals have been designated as scheduled monuments, one of the many examples of differing designation policy between England and Scotland. Canal formations on the operational canal system have to be routinely maintained and therefore preserving their structural integrity is not generally of great concern though modern engineering solutions may have deleterious effect on their historic integrity and detail. Accordingly prime examples such as many of those mentioned above should perhaps be assessed for designation. On the abandoned canals formations are much more vulnerable and notable examples have even more need to be assessed. Thus features such as the remains

of the impressive cutting at West Dean on the Southampton & Salisbury Canal and the retaining wall know as Whatcombe Wall on the line of the uncompleted Dorset & Somerset Canal are strong candidates for designation assessment. A canal embankment of 1793 by William Jessop and Benjamin Outram on the Cromford Canal near Ripley is designated Grade II. Constructed of coursed squared stone and 100 feet long and 40 feet high with stone retaining walls it has a central barrel vaulted tunnel through the embankment with rubble arches and buttress-like jambs to the entrances.

Ripley embankment, Cromford Canal (IoE Steve Watson)

3.4 Water Supply

Reservoirs

Supplying water to summit levels of canals was always one of the major problems facing canal engineers. It was achieved triumphantly in France by Riquet in 1661 with his St Ferreol dam in the Montagne Noire with its 26 mile feeder to the Canal du Midi and this was to inspire later engineers to build numerous reservoirs on the English canal system though mines, lakes, rivers streams and springs were utilised wherever possible. One of the earliest was the ***Staffs & Worcs Canal*** opened in 1772 which had reservoirs at Gailey (replaced with two in 1855) and at Calf Heath (1779) while the same year the Smethwick Great Reservoir and the Titford supplied the ***Birmingham Canal.***

The Pebley reservoir on the ***Chesterfield*** dates from 1776 and, somewhat later, in 1779, the ***Trent & Mersey*** was supplied via the Caldon Canal from a reservoir at Stanley and from Rudyard in 1802 (the latter being the largest built in England by this time). The ***Dudley Canal*** built a reservoir on Pensnett Chase with a 25ft high dam in 1779 and on the ***Oxford Canal*** the Clattercote and Wormleighton reservoirs were built in 1787 and 1788 respectively. It was not until the 1790s that reservoirs became usual features of new canals such as two reservoirs above Whaley bridge on the ***Peak Forest***, Slaithwaite and Brunclough (1798) (two of ten eventually) on the ***Huddersfield*** and Foulridge (1798) on the ***Leeds & Liverpool***, three (eventually eight) small reservoirs supplying on the ***Rochdale*** which had only a short summit.

(Left) Nottingham Canal, Moorgreen Reservoir (A Nicholson, 2004 Nottinghamshire History).
(Right) Killington Reservoir built in 1819 covers 153 acres and is one of the CRT's largest reservoirs.

Reservoirs from this decade still in use and the responsibility of British Waterways in 2009, in addition to some of those above, included Moorgreen (***Nottingham Canal*** 1794), Harthill (Chesterfield Canal 1796), Codnor Park (Cromford Canal 1796), Knipton (1796) and Denton (1799) on the ***Grantham Canal*** and Olton (1798), Saddington (1799) and Weston Turville (1799) on the ***Grand Union***.

The two reservoirs on the ***Dearne & Dove*** at Elsecar and Worsbrough also date from this decade and the dam c.1799 of the latter above the corn mill of the same name may be worthy of assessment for designation.

The early 19th century witnessed the construction of numerous reservoirs with notable examples at Wilstone, Daventry, Drayton, Sulby, Marsworth, Napton Tringford and Naseley Wolds on the ***Grand Union***, Rittol and Tardebigge feeding the ***Worcester & Birmingham*** and Killington (the largest in England) on the ***Lancaster Canal***.

The ***BCN*** had its first reservoirs at Smethwick and Titford but these proved unsatisfactory and were replaced later at Rotton Park (1828) and Birmingham Heath. A fine late example listed grade II, is the dam of the Winterburn Reservoir (1281534) on the ***Leeds & Liverpool*** with its magnificent ornamented water-ladder and low level outfall culvert. It was constructed between 1885 and 1893 by civil engineers Henry Rofe and Edward Filliter at a cost of £45,000.

(Left) Leeds & Liverpool Canal, Winterburn Reservoir water ladder c.1885 (IoE 382302 Stewart Cardwell)
(Right) Shropshire Union, Telford's Grade II* Belvide Reservoir Round Valve House and Retaining Wall Brewood (IoE 435135 GW Tanner)

Reservoirs are largely a 'forgotten face' of the waterways system as they are often at some distance removed from the line of the canals themselves. They received scant mention in canal literature except when disaster strikes - in 1799 the embankment of the Cannock Heath reservoir on the Wyrley & Essington gave away causing a widely reported flood. Only a few retain their original valve houses such as the stone-built circular plan iron domed building of the 1830s at Telford's Belvide Reservoir (1252181) on the ***Shropshire Union*** and the similar but brick built valve-houses at the foot of Rotton Park Reservoir in Birmingham.

The CRT inherited from British Waterways and is today responsible for some 71 statutory reservoirs in England. Many of them remain in use for supplying water for navigation but others, such as Trench Pool in Telford, no longer serve an operational canal but must still be maintained in a safe condition. (See Appendix C) There were once more than fifty other reservoirs serving canals. Some, such as the ***Wilts & Berks Canal*** reservoirs, Coate and Tockenham, still exist, put to other uses. Most of these canal reservoirs were built in the late-18th and early-19th centuries and are therefore considerably older than most UK water board reservoirs. Continual monitoring and surveillance is required to manage the risk by identifying early indications of problems, so that appropriate actions can be taken.

Weirs

Controlling water on both canals and river navigations is a continuous operation but one that requires different types of device between those water channels that have a natural flow and those with 'still' water. Hence, as discussed above, weirs are integral components of river navigations either passed by flash-locks or by-passed by pound locks. The Thames is noted for its weirs while on the ***Weaver Navigation*** some of the weirs and sluices built in the 1870s improvements are quite grand.

The Weaver Navigation, Weir, Hunts Lock, Northwich (IoE 57638 R G Noxon) and Flood Gates and Sluice Bridge Winsford (IoE 57405 John Riley)

On canals control devices include by-weirs, flood paddles and spillways. By-weirs are used to send excess water down a bypass channel and are often found at locks. Brindley created an amazing six-petal pattern weir in the ***Bridgewater*** Castlefield Basin to maximise sill length to take water entering the basin from the River Medlock down to the River Irwell but this has been rebuilt smaller and simpler.

(Left) Giants Basin circular weir, Castlefield (IoE 456065 Mike Widdas)
(Right) Hurdesfield Sluice Macclefield Canal (IoE 57983 J M Pickering)

However some of his weirs on the Staffs & Worcester canal survive including circular, oval, half-moon and rectangular examples. Flood paddles though very efficient at passing water are largely now disused as they require to be worked. Spillways are crested apron-like slopes in masonry, brick or concrete set at intervals in the canal bank allowing excess water to escape into a stream or river and when executed in fine masonry as on the ***Macclesfield Canal*** can be attractive features and designated as at Hurdsfield where a sluice on the towpath side controls the height of the canal and has an overflow that curves to join the clough before entering the culvert below (1136511).

Pumping Stations

If the summit was higher than the water supply or if consumption was heavy some form of pumping was required. Wind-pumps were an early but unsuccessful solution tried on the Thames & Severn for a short time and persevered with on the Oxford from the 1780s to the 1830s, on the Kennet & Avon before Crofton Pumping Station was commissioned in 1809 (see below) and two were even installed on the Wey & Arun as late as 1833-34. These latter worked until 1853. Water driven pumps were more reliable but more expensive and only could be used where the canal ran close to a river or stream. There were such installations on the canal section of the ***Arun Navigation*** powered by a stream at Orfold and it is being restored while that on the Carlisle Canal powered by the River Eden does not survive.

Lordings Lock Waterwheel being restored
(Wikipedia Charlesdrakew)

The canal basins at Stourport were also originally topped by a waterwheel driven pump abstracting water from by the River Stour but that was replaced by a Boulton & Watt steam engine in 1804. The outstanding example of this arrangement is the Claverton Pump (1214608) on the ***Kennet & Avon Canal*** near Bath. Built by Rennie in 1813 beam worked bucket pumps of classic steam engine design are powered

by a 25 feet wide, 18 feet diameter waterwheel and lift water 50 feet from the River Avon to the canal. Housed in a functional Bath stone engine house this installation is a scored entry on the International Canal Monument List and thus of international significance but is presently comparatively lowly designated at Grade II.

Claverton Pump House (Keith Falconer and Claverton Pumping Station Trust)

Steam pumping was to be the preferred solution to water supply problems and there were 17 steam pumping stations on the ***BCN*** alone – 12 recirculating water and 5 supplying water and refreshing reservoirs - and 40 engines were in work by 1813. The first was at Spon Lane in 1778 pumping from the 273 feet Wolverhampton level to Brindley's summit at 291 feet and the second more powerful engine at Smethwick pumping from the 253 feet Birmingham level to the summit. Both were Boulton & Watt engines and the Smethwick engine has been preserved off-site and restored to working condition at Thinktank in Birmingham while the later Smethwick Engine House (1077154) of 1892 is designated.

1779 Boulton & Watt engine from Smethwick (Wikipedia IMechE1)

Cromford Canal Leawood Pumping station (Wikipedia chevin)

The 1804 steam pumping house at Stourport is till recognisable though converted to a cottage while Charlton Engine House which pumped from the River Tone to supply the Bridgwater & Taunton is unconverted and forlorn.

The outstanding surviving example of steam pumping is the Crofton Pumping Station (1034049) on the summit level of the ***Kennet & Avon Canal*** which is also a scored entry on the ICM List and is designated Grade I. The first Boulton & Watt engine was installed in 1809 but was replaced in1844 by a Sims engine but the second Boulton & Watt engine which began work in 1812 was converted to high-pressure working in 1844 and did duty until 1958. It has since been restored and is now the oldest working steam engine in the world doing its original work. The flue at Crofton Pumping Station is Listed Grade II*.


Crofton Pumping station (Wikipedia Chris Allen, chris j wood)

Another preserved steam engine still occasionally worked is in the Leawood Pumping Station on the ***Cromford Canal*** where a tall ornate engine house contains a 50 inch Cornish beam engine built in 1849 by the Milton Ironworks pumps water from the Derwent to the canal. It is designated as part of the scheduled monument (1007040).

Cromford Canal Leawood Pumping Station (Wikipedia chevin)

There are numerous historic engine houses surviving without their original engines – some still in use with electric pumps such as at Tringford, Ivanhoe and Braunston on the ***Grand Union Canal***.


Tringford Pumping Station (IoE 355766 A. Gude) and Ivanhoe Pumping Station Lock 35 1838-41 (IoE 42047 Richard Hart)

Some engine houses have found new uses such at that at the Tardebigge flight of locks on the ***Worcester & Birmingham*** converted into a nightclub (1168077), at Stourport Basin into a house and Titford Top Lock on the BCN which now accommodates the BCN Society while others are ruined. Excavations at some of the latter have yielded valuable knowledge of early steam technology.


The Worcester & Birmingham Engine House Tardebigge (IoE 156241) Helmut Schulenburg) and BCN Titford Top Lock Pumphouse (Wikipedia Oosoom)

The canal system in the Midlands also made much use of water pumped from coalmines as at Windmill End Engine House close to the ***Dudley No 2 Canal*** and some of these engine houses such as the 1831 Cobbs Engine House (1229552) which pumped mine water to supply the ***BCN*** are comparatively early.


(Left) Dudley No2 Canal Bumble Hole Junction with Cobbs Engine House in distance (IoE 442609 D R Smith): (Right) Hawkesbury Junction with the Oxford Canal. The Coventry Canal and Hawkesbury Engine House to left (Wikipedia Oosoon)

The engine house at Hawkesbury (1365077) where the Coventry and Oxford Canals meet housed the Newcomen engine that was removed for preservation to Dartmouth. There is also a later Grade II designated Engine House at Earlswood Lakes on the Stratford Canal.

Water Supply: Assessment of significance and protection

As remarked on above, canal reservoirs are largely a 'forgotten face' of the waterways system as they are often at some distance removed from the line of the canals themselves but as many of them predate the better known public water supply reservoirs which have been the subject of Monument Protection Programme Surveys, advice should be sought from the CRT Heritage Team as to the survival of significant features and examples assessed accordingly.

Weirs on river navigations are historically very important but most have been rebuilt on numerous occasions and as part of flood protection measures the Environment Agency would be best placed to consult on their survival and protection. On the canals a few weirs have been designated in conjunction with locks and CRT staff should be consulted if there are any that merit separate consideration as should flood paddle installations should any still exist while spillways may be too minor to warrant protection.

Pumping installations, especially steam pumping, have attracted academic attention for many years and most sites have been identified and many investigated and assessed. However, as noted above the water powered Claverton Pumping Station on the ***Kennet & Avon*** might merit assessment for re-grading.

3.5 Operational Buildings: Company offices, workshops, dry docks and gauging locks

Company Offices

At either end of the ***Bridgewater Canal*** there were imposing buildings occupied by the main players in the canal's construction. At Worsley by the canal-side there was Packet House (1162797) where Brindley was based and at Runcorn the Duke built Bridgewater House (1330334), a large three storey Georgian house with projecting central bays, as a temporary home to enable him to supervise the construction of the canal at that end. These then served for many years as company offices.

The Packet House, Worsley (Wikipedia Parrot of Doom) and Bridgewater House, Runcorn (IoE 56039 Martin Byrne)

Elsewhere most canals started life at meetings in large inns or public rooms and many continued to be based initially in such premises. However as early as 1773 the Birmingham Canal company built a large three storey office on Paradise Street this

having an octagonal central section flanked by wings pierced by archways to wharfs behind. It was demolished in 1913.

Birmingham Canal Company offices fronting Paradise Street. They backed onto the Old Wharf terminus.(Wikipedia)

In the 1790s the ***Ellesmere Canal*** and the ***Chester Canal*** shared offices in what is now known as Raymond House and this later was to become offices for the ***Shropshire Union*** after 1849. The Ellesmere also had the company head office in the bow fronted Beech House (1176445), which was possibly designed by Telford and is graded II*, at its wharf and yard at Ellesmere.

(Left) Canal Office, Beech House, Ellesmere. The committee room of the canal company was on the ground floor of the semi-circular projection overlooking the 3 branches of the canal. (IoE 260797 Les White)
(Right) Worcester & Birmingham Offices, Kings Norton Junction (IoE 217364 Peter Garratt)

The ***Worcester & Birmingham*** also provided company offices with architectural pretensions at its Kings Norton junction with the Stratford as do the ***Birmingham & Fazeley*** Offices overlooking its junction with the Coventry canal.

Kennet & Avon, Tunnel and Cleveland House, Sydney Gardens, Bath (IoE 442751 Micaela Basford)

In Bath c.1810 the ***Kennet & Avon*** built the fine Grade II* Cleveland House (1395310) above its short Tunnel at Bathwick and reputedly a small chute in the roof of the tunnel allowed packages to be dropped into the company flyboats that plied the canal.

The 1816 offices (12556930 of the ***Leeds & Liverpool*** on the other hand are a very modest affair at the approach to the canal basins.

This was relegated to more modest uses when replaced in 1906 by large ***Aire & Calder*** corporate offices in Dock Street; before that the Aire & Calder used the Lowther Hotel (1310687, grade II*) in Goole as its headquarters.

(Left) Canal Company Offices 1816 Leeds (IoE 465728 David Karan)
(Right) The Lowther Hotel, Goole 1826 (165274 Janet Roworth)

Some River navigation commissioners seem to have indulged themselves, those of the ***Yorkshire Ouse*** erecting an imposing Banqueting House (1167224) at Naburn Lock in 1823.

Banqueting House (IoE 326197 John Turner)

The Conservators' House, Clayhithe (Wikipedia Cruccone)

Wharf House Marlbrook, Leominster Canal Company (IoE 484020 John Burrows

Weaver Navigation House and Clock Tower Nantwich (IoE 57634, 57635 R.G. Noxon)

The Conservators of the Cam built a jaunty Dutch gabled house in 1842 while the ***Weaver Navigation Trust*** in 1830 built a free-standing clock tower (1161109) with a cupola beside Navigation House (1240207) a plain Georgian head office. The ***Oxford Canal*** also built a grand classical head office designed by Richard Tawney in1827-29 while Wharf House on the ***Leominster Canal*** which was the canal company's headquarters has survived better than the canal.

Lock keepers' and lengthmens' cottages, hovels and tollhouses[5]

Canal companies may not have initially required very much in the way of office accommodation but from the outset they had to provide some facilities for staff tending the infrastructure of the waterways. On early canals these facilities may not have been much more than hovels for shelter and equipment with staff expected to live nearby. There are examples of beehive-shaped hovels on the Chester Canal (now the Shropshire Union) and brick huts on the Trent & Mersey, and the Staffs & Worcestershire and on the ***Shropshire Union*** a two-roomed lock keeper's hut at Ellesmere Port (1130344) is designated.

Two room hut, Tollhouse Ellesmere Port (IoE 56296 K Truman)

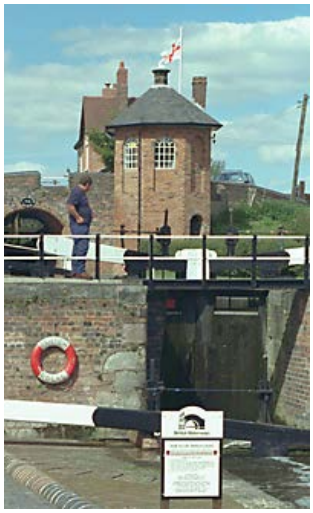
Similarly on the western end of the ***Kennet & Avon*** there are three small stone-built lock-up hovels at Saltford and Swinford locks and at Bathampton locks. On the ***Gloucester & Sharpness Canal***, where many of the swing bridges had classical bridge houses, at Pegthorne Bridge there is only a small brick hut with a fireplace and small squint holes for the bridge-keeper to watch for approaching vessels. His house was located at the nearby Whitminster Mill weir where he had also responsibility for water management. On a number of railway-owned canals there are platelayers'/ lengthmens' sleeper huts dating from the railway era.

5 A much fuller discussion of canal housing is to be found in Crowe (1994) pp 82-94.

However by the 1780s certainly, lock-keepers houses were being built and most of these were just typical two-storey vernacular cottages sited by locks or at the top and bottom of flights of locks. The two storey cottage at Chemistry Lock (1375739) in Chester on the ***Shropshire Union*** is designated along with its privy which originally discharged into the lock sluice way which ran under the yard at the rear of the cottage. The form and materials of the cottages often reflected local practice and geology and just could vary along the length of canal. The ***Kennet & Avon*** for example has four room single storey Bath stone cottages with hipped roofs at its western end and red-brown and grey brick cottages with half-hipped roofs on its eastern section.

(Left) Lock Keepers Cottage, Bath(IoE 442750 Micaela Basford)
(Right) Lock Keeper's Cottage, Sandiacre Lock at Junction with the Derby Canal (IoE 82216 Peter Holt)

Similarly, the cottages of the upland sections of the cross-Pennine canals are generally stone-built with stone slate roofs. There is a short range of cottages (1109194) with a three storey central range along side the ***Cromford Canal*** and a Toll House (1076441) and Toll Keeper's House (1054856) at Braunston Junction on the ***Grand Union***. Where canals met the lock keepers houses could be quite substantial though plain as at Sandiacre Lock on the ***Erewash Canal***.



(Left) Bratch Lock and house of 1771 (IoE 407805 Mark Hadley and(Centre) Gailey Round House of c.1805
(Right) Chalford Round House (Wikipedia David Stowell)

In contrast, others were to be quite exotic. The round tower at Gailey and the octagonal tower at Bratch (1232421) on the ***Staffs & Worcester*** are non-domestic

office versions of similar three storey tower houses on the ***Thames & Severn*** which resemble local drying stoves – as these canals shared some directors it is perhaps no coincidence. These provided a canal-side stable and store with offices or accommodation on the floors above and some of the Cotswold examples have inverted conical roofs with cisterns to catch rain water.

Equally eccentric are the single storey barrel-roofed cottages built c.1811-13 on the ***Stratford Canal***, six of which survive.

Barrel-roofed Lock-keepers Cottage
Kingswood Junction (Wikipedia Oosoom)

As the 19th century progressed, while most canal cottages remained stubbornly modest others were to reflect topical fashion. Thus the Greek Revival bridge-keepers cottages on the nationally financed ***Gloucester & Sharpness Canal*** (1826) were designed somewhat later by William Clegram c. 1845 and have prominent Doric porticoes as at Hinton (1237982).

(Left) Gloucester & Sharpness Canal, Swing Bridge Keeper's House (H Conway-Jones)
(Right) Sycamore House Maesbury Marsh (IoE 255665 R L Francis)

On the ***Ellesmere*** section of the ***Shropshire Union Canal*** the Telford-designed cottage at Grindley Brook with its rounded bay and veranda and giant pilasters is pure Regency while near Maesbury Marsh Sycamore House (1177300) is a smaller version of Beech House at Ellesmere.

Canal settlements and wharf houses

At busy junctions, wharfs and basins and around workshop complexes small canal communities developed such as that at Fradley where the ***Trent & Mersey*** was joined by the Coventry Canal, and Stoke Bruerne on the ***Grand Union Canal***.

(Left) Trent & Mersey, Swan Inn housing and warehouses, Fradley (IoE 272497 Dave Jones)
(Right) Top Lock Stoke Bruerne (Wikipedia Stephen Dawson)

Shardlow on the ***Trent & Mersey*** was to develop into a large village while some such as Stourport, Goole, Ellesmere Port and Runcorn were to develop into small towns – albeit with most of the housing provided by speculative builders. (See below)

The canal companies themselves were not generally much concerned with building houses for their employees other than those houses needed to collect tolls and serve locks, moveable bridges, maintenance yards etc. However at Ellesmere Port, starting with Porters Row in 1833, the ***Ellesmere*** Company provided housing for more of its employees and continued to do so under the Shropshire Union until the end of the century. Indeed, at Stourport and Ellesmere Port there are some surviving modest canal company houses within the basin complexes as at Stourport where a dwelling is attached to the former Iron warehouse (1292376) but elsewhere at Goole and Runcorn most have gone. (see canal towns below).

The grander houses provided for company officers have a better rate of survival as witnessed by the 'Navigation Offices'(1291474) at Kings Norton Junction and the Chief Engineer's house at Stoke Wharf on the ***Worcester & Birmingham Canal***, at Fazeley Junction on the ***BCN*** and at Baunston Stop, and by Horbury Bridge House on the ***Calder & Hebble*** built c.1842 for a senior member of staff.

BCN Junction House at the junction of the Fradley to Fazeley and the Minworth to Fazeley branches (IoE 272795 David R. Grounds)

At the canal head wharf on the ***Cromford Canal*** there is a pair of handsome semi-detached wharf houses (1244633) dating from c1796. Those in Lower Mersey Street built for senior staff of Ellesmere or ***Chester and Ellesmere Canal Co***. at Ellesmere Port though quite grand were in poor condition when photographed in July 2000.

(Left) Ellesmere Port Lower Mersey Street (IoE 56295 K Truman)
(Right) Wharf House Cropredy Oxford Canal (IoE 436637 Alistair F Nisbet)

Telford also provided a series of less imposing single-storey bay-fronted cottages on the ***Shropshire Union*** in the 1820s such as the Wharf Cottage (1225551) at Audlem Wharf. Other designated Wharf Houses are to be found on the ***Basingstoke Canal*** at Greywell (1116898) and Odiham (1244409), on the ***Rochdale*** at Sowerby Bridge(1134549), on the Grantham at Hickling ((1235817), on the ***Grand Union*** at Crick Wharf (1252319), a wharf house combined with a tollhouse at Cropredy (1253432) on the ***Oxford Canal*** and at Fradley Junction (1295214) and Barton-under-Needwood on the ***Trent & Mersey***.

Some good examples of wharf houses where a dwelling was combined with a warehouse survive as at Ripon and Tardebigge wharfs but on the ***Thames & Severn*** the handsome Georgian wharf houses with a central dwelling section flanked by storage sections have mostly been demolished other than those at Cricklade and Kempsford (1341290) while at Chalford a Wharf House has an attached workshop (1091194).

(Left) Wharf House Cricklade (IoE 317836 John Rendle)
(Right) Wharf House Marlbrook, the headquarters of the Kington and Leominster Canal Company (IoE 484020 John Burrows)

Another variant where office and living accommodation was above a storage basement can be found on the abandoned ***Leominster Canal*** at the Southnet Wharf House (1383588) which doubled as the Canal Company headquarters while in the West Country other small wharf or basin complexes are now often the only witness to a canal's existence.

Company maintenance yards and workshops, dry docks and gauging locks

Most river navigations had a rudimentary yard and workshop where repair materials and tools were stored and equipment mended. With the coming of canals with their greater requirement for lock gates and their equipment and servicing of work-boats and horses much larger yards, some even with dry-docks were established. On long canals there could be a main yard and outposts at intermediate points along the canal with additional huts sited alongside junctions, locks, tunnels and reservoirs. Crowe (1994 pp 41-46) discusses the siting, operation, construction, layout and facilities of these yards in some detail and a summary is presented here with noteworthy examples identified.

From the outset the Duke of Bridgewater provided maintenance and boat-building facilities on his ***Bridgewater Canal*** at Worsley (1215143)

Worsley Dry Docks and 19th century boathouse (IoE 400046 F. Bryan Basketter)

Other early examples survive on the ***Coventry Canal*** at Hartshill (1034747), the ***Trent & Mersey*** had a main yard and office at Stone and intermediate yards at Red Bull (Kidsgrove), Etruria and Fradley (1295214).

Coventry Canal Hartshill Yard (CRT)

Trent & Mersey Canal Four Barge Docks at the boatyard Stone (IoE385986 Brian Peach) and workshops at Fradley (IoE 272498 Geoffrey R Hood

The Staffs & Worcester had facilities at Stourport, as did the Stratford-on-Avon at Lapworth and the ***Oxford Canal*** at Hillmorton, Claydon and Napton (1024443).

Oxford Canal Napton lock and workshops.
(IoE 305642 Helmut Schulenburg)

The ***Leeds & Liverpool*** had facilities at several places including Burscough (1297511), Banknewton, Foulridge and Gargrave.

Dry Dock Burscough Leeds & Liverpool Canal
(IoE 386319 Simon Barker)

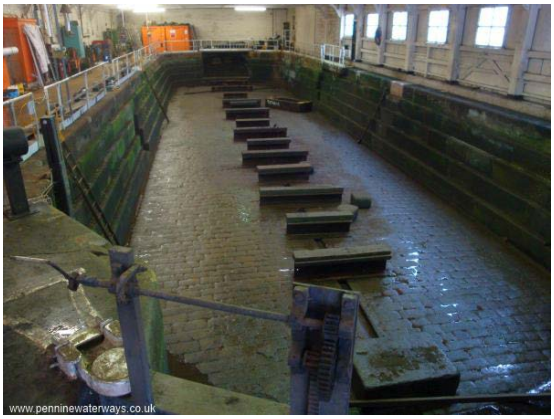
The ***Shropshire Union*** at Ellesmere (1176445), and at Norbury (1273014) and of course within Ellesmere Port.

Shropshire Union Timber Store Ellesmere Yard (IoE 260794 Les White) and Norbury Junction Workshops (IoE 446526 Steve Davis)

The ***Grand Union*** had yards at Gayton, somewhat later at Hatton and the impressive Bulbourne Yard (1117890 and 1117891) built by the Grand Junction Canal in the 1890s and unmatched for their exuberance and completeness.

Bulbourne Workshops (IoE 42075, 42074, 42073 Nick Jarvis)

Around Birmingham there were yards at Oldbury on the ***BCN***, at Tardebigge on the ***Worcester & Birmingham*** and Sneyd on the ***Wyrley & Essington***.



(Left) Tardebigge Workshops (Geograph Chris Allen)
(Right) Aire & Calder Dry Dock Stanley Ferry workshops (www.penninewaterways.co.uk)

Later yards were built beside the ***Manchester Ship Canal*** at Old Quay Runcorn (replacing earlier Irwell Navigation facilities) and on the ***Aire & Calder*** at Stanley Ferry.

Many of these yards had dry-docks as at Stanley Ferry and Little Braunston on the ***Grand Union*** and the basin at Paulton on the Somerset Coal Canal which has recently been excavated and shown to be larger than would be expected on this small canal.

Grand Union Little Braunston lock and dry dock (IoE 360967 John Airlie Hunter)

There were also boat-gauging facilities at many yards and exceptionally, to counter rife fraudulent practice, even sophisticated weighing machines, the Somerset Coal Canal being credited with building one of the first in 1831 under a roof supported by 8ft stone Doric columns. It was dismantled in 1914 and the adjoining single storey office converted to a two storey cottage. Similarly the iron-columned 1845 example at Brimscombe Port on the Thames & Severn was dismantled in1937. The only

surviving example is preserved off-site at the Waterways Museum at Stoke Bruerne – the 1836 machine from the Glamorganshire Canal.

Grand Union Stoke Bruerne re-erected Weighing Machine in disused lock (IoE 234982 Neil Guiden)

The Tipton Gauging House on the ***BCN*** is dated "1873" and contained gauging mechanisms used to assess canal tolls on two boats at a time and registered over 10,000 boats between 1873 and 1900.

Tipton Gauging House (IoE 219202 J J Sheridan)

Operational Buildings: Assessment of significance and protection

> ***Repair and maintenance yards****, often linked to canal company offices, seem more susceptible than other canal structures to unsympathetic development: intact examples should be carefully assessed as to whether any of their boathouses or workshops are of particular interest.* ***Stables*** *were a necessary adjunct to these yards and warehouse complexes.* ***Lock keeper and bridgeman's cottages*** *range from unremarkable structures which could as readily be considered as typical houses of the period to distinctive, sometimes quite sophisticated pieces of 'polite' architecture (as with tollhouses) which sometimes share a company style such as the Neo- classical cottages on the Gloucester-Sharpness canal.* ***Mileposts and toll offices*** *are normally eligible for listing, particularly when they have a clear visual relationship with the canal.*
> HE Listing Selection Guide on Transport Buildings

As mentioned above there were numerous boatyards situated along canals and on the Leeds & Liverpool Clarke (1990) has identified more than 30 which can be divided into three groups – those belonging to the canal company for the repair of

their own boats, privately owned yards belonging to carriers for the repair of their own boats and general repair yards. Graving docks built by the Leeds & Liverpool Canal company survive at the eastern end of the canal in Leeds and are listed. (1255711). Of the private boatyards Taylor's boatyard on the ***Chester Canal*** section of the Shropshire Union is a very fine extensive complex of workshops and graving docks and are scheduled (1375715).

(Left) Dry Dock at Junction of Ellesmere (Wirral) and Chester Canals (IoE 469910 Michael J Tuck)
(Right) Graving Dock Lock (Stover Canal Society)

The CRT Maintenance depot at Ellesmere on the Llangollen Branch of the ***Shropshire Union Canal*** with its attached covered dry dock for the manufacture and repair of canal barges, is designated Grade II* and is described in the NHLE as 'of great significance in relationship to the canal industry, for it comprises one of the key functional buildings in what is now acknowledged to be the best-preserved canal workshop site in Britain. The dry dock, which has access direct to the canal, comprises an exceptionally early example of such a structure' (1366122). On the same canal the maintenance complex at Norbury Junction is Grade II (1273014).

Indeed most of CRT's operational buildings will have already been assessed for designation and CRT Heritage Team will be aware of any omissions this leaves the sites out-with CRT responsibility. There would appear to be relatively few such sites on EA's unnavigable rivers and also not many on its navigations other than on the Thames at Richmond where there are a series of boathouses built in 1917 by Augustine Alban Hamilton Scott for the Thorneycroft firm to build fast launches carrying torpedoes for the Admiralty (1254428). On the abandoned canal system as noted above there are the significant remains of a dry dock at the basin at Paulton on the ***Somerset Coal Canal*** which might merit assessment as do the archaeological remains of a boat building and repair facility at Pewsham Locks on the ***Wilts & Berks Canal***. The graving dock/lock on the ***Stover Canal*** is already designated.

The Selection Guide identifies mileposts as normally eligible for listing and indeed they are now perhaps the most prolific type designated canal features other than bridges. The ***Trent & Mersey Canal*** alone has some 45 listed mileposts.

(Left) Trent & Mersey Milepost near Stone (IoE 386043 Brian Peach)
(Right) Modern Milepost BCN (Geograph Alan Murray-Rust)

3.6 Trading Infrastructure – Canal ports, towns, interchange facilities, basins, wharfs and warehouses.

The inland waterway system being an extension of the maritime coastal trade historically shared many of the features of estuaries, harbours and maritime ports. Thus on many rivers wharves lined by warehouse and basins with boat building, repair and maintenance facilities were developed at inland towns when navigation was improved beyond the tidal range. At Exeter the handsome Custom House was built in c.1680 on the quay a century after the ***Exeter Canal*** by-passed the river, on the ***Severn*** the towns of Gloucester, Worcester and Bewdley all had river wharfs from an early date while on the ***Trent*** warehouses were built where tidal waters reached Gainsborough and occasionally Newark. However it was the development of the canal system that was to greatly expand the role of these inland ports and call into existence brand new transhipment nodes, ports and even towns.

Canals, as the arteries of industry, attracted all types of industry dependent on coal and water and therefore in urban centres were soon lined by industries such as textile mills, foundries, gas and chemical works, potteries and glassworks and many of these sites had their private wharfs, canal arms and basins but, though some are noted when designated, generally these latter are not covered by this report which is primarily concerned with the canal company wharfs and basins.

Ports, Canal Towns and interchange facilities

By the middle of the 19th century four settlements around new inland ports had developed into small towns – Stourport-on-Severn, Runcorn, Ellesmere Port and Goole. Of these Stourport was the pioneer and arguably the finest as Runcorn, its contemporary, was built on a steep hillside and was very much a settlement of two parts never achieving the urban identity of Stourport.

On the ***Staffs & Worcestershire Canal*** the creation and development of Stourport, with its series of seven basins built between 1771 and 1812, is detailed in *Stourport-*

on-Severn: Pioneer Town of the Canal Age[6] and here many of the earliest canal and basin features (1209441 and 1209450) have survived.

The basins (1209441, 1209450) at Stourport are exceptional and some of the warehouses (1292376) and cottages date from the 18th century. The former Tontine Hotel (1292639) and its stables (1292169) and the Workshops (1209471) at Parke's Passage are Grade II. The later southern basins were in-filled in the 20th century but have recently been re-excavated.

CRT

Despite the demolition of most of the 18th century warehouses other than the Iron Warehouse (1292376) and the infilling of the early 19th century basins, (which have only recently been re-excavated for additional moorings bordered by residential developments), the canal landscape with the Clock Warehouse, the converted Tontine Hotel (1292639) (originally a hotel and lodgings for visiting traders. c.1773, built for Staffordshire and Worcestershire Canal Company), the tiers of basins locking down to the Severn and with the fine Georgian houses overlooking the basins and the rows of lesser early housing alongside, still presents an 18th-century feel.

6 2007 Colum Giles et al *Stourport-on-Severn: Pioneer Town of the Canal Age* English Heritage

Stourport, former Tontine Hotel (IoE 393321 Philip Williamson)

Iron Warehouse c. 1773 office and Clock Warehouse (IoE 393322, 393323 Philip Williamson)

Canal Maintenance Yard and Quay (IoE 393374) and Canal Company Stores and Stabling Mart Lane (IoE 393388)

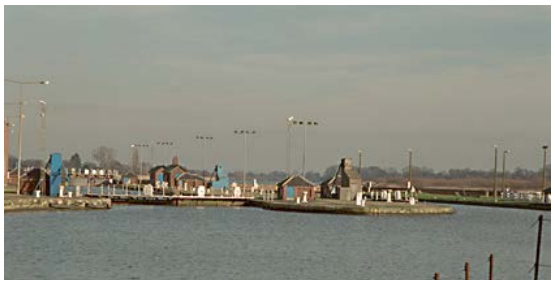
Houses in Mart Lane on side of the main canal basin (IoE 393361, 393362

York Street c. 1780 houses and Lock Cottage (IoE 393394, 393392, 393393 Philip Williamson)

Runcorn on the other hand has suffered much more severely. The flight of 10 broad locks linking the upper and lower basins have been in-filled and in an area dominated by the later chemical industry little survives of the gracious 18th and early 19th century buildings such as Bridgewater House (13303340 built from 1770s onwards) by the ***Bridgewater Canal***.

Similarly at Goole where in 1820s the ***Aire & Calder*** developed docks to tranship goods, including huge coal tonnages, between the Knottingley & Goole Canal and the Ouse much of the early infrastructure has gone. The docks were expanded with the arrival of the railways and two of the impressive late 19th century 'Tom Pudding Hoists' (1083214) still survive and are designated but the identity of the company town with its civic and commercial institutions was to be largely submerged by later building. There has been a revival of interest in recent years thanks to an active civic society and the Lowther Hotel (1310687) with its suite of board rooms once used by the Aire & Calder was upgraded to II*.[7] The hotel was the first permanent building to be completed in the new town, started in 1824 and open for business before the opening of the Knottingley and Goole Canal in 1826. It was built for Sir Edward Banks, of Joliffe and Banks (the constructing contractors for the first docks) and was initially called the Banks Hotel. It was sold to the Aire & Calder in 1828 and renamed following the death of the company chairman Sir John Lowther c.1836. The Aire & Calder Navigation Company effectively acted as the local authority for Goole, operating out of the Lowther Hotel, which acted as the town's principal civic building for much of the C19, including the use of one of its cellars as the town lock-up. The Lowther also acted as a Customs House for a time following the opening of the port to foreign trade in 1828, using one of the cellars as a bonded warehouse until the construction of a purpose-built Customs House in the 1830s. Only Aire Street and some of the side streets off it remain of the original town. Aire Street was originally wide and grand with imposing buildings such as the Lowther Hotel and many of the Aire & Calder buildings had distinctive round corners. Goole is also home to the Yorkshire Waterways Museum which, based at Dutch River Side, displays Tom Pudding compartments boats and Wheldale one of the last remaining coal tugs.

7 Baron F Duckham, The Founding of Goole *Industrial Archaeology* Vol 4 1967 No 1 pp 19-28
J D Porteus, Goole: A pre-Victorian Company Town *Industrial Archaeology* Vol 6 1969 No 2 pp 105-113




Victoria Lock and Ouse Lock and South Dock Boat Hoist (IoE 165275 Les Waby)



West Dock (Pennine Waterways, Waggon Hoist ((IoE 165283 Les Waby Detail of boardroom murals c1834. Lowther Hotel (Howdenshire History)


Goole Aire Street Lowther Hotel, Royal Hotel (IoE 165274, 165273 Janet Roworth)

Ellesmere Port, where the ***Shropshire Union*** joins the Mersey, developed on a more modest scale in the first half of the 19th century and despite its massive 20th century expansion and some tragic losses (to fire) of the magnificent Telford-designed warehouses still retains a port canal landscape of huge significance centred on the basins and buildings of the National Waterways Museum such as the Island Warehouse (1330390), the Clay Warehouse (1329999), stables (1130339), Boiler houses and hydraulic accumulator tower (1130338) and lock keepers hut (1130344) etc.


Locks c1801 (IoE 56278 K Truman) Tollhouse Early C19, Thomas Telford (IoE 56275)

Island Warehouse 1871 (IoE 56276) Pumphouse 1876 (IoE 56277)

Former Gasworks (1861), chain shop, foundry and workshops c 1895 (IoE 56282) Lime Shed 1880-85 Dock Street (IoE 56283)) Iron Shed 1880-90 Dock Street (IoE 56284)

Clay Warehouse 1880-90 (IoE 56328, Dock offices 1890 (IoE 56280)

Ellesmere Port, unlike Stourport, was very much a company town. After its expansion of port facilities under Telford in the early 1830s company housing was to follow, first with Porters Row (1130337) and then in 1837 by Union Street, Back Union Street and Shropshire Row. Somewhat grander houses were built for senior staff in Lower Mersey Street.

Porters Row Cottages 1833 (IoE 56274) Lower Mersey Street (IoE 56295 K Truman)

The provision of housing stock was to continue for the next sixty years firstly with the purchase of some streets of newly built speculative houses and subsequently by terraces built by the company itself. The housing was certainly needed as it was stated in 1852 that out of 611 people living in the port area 577 were directly connected with the canal. The canal company also provided the gas works (1145858) and over much of the town was responsible for sewerage, shops and roads and helped fund the building of a parish church and non-conformist chapel.[8]

Christ Church 1869-71.(IoE 56322 K Truman)

At a more modest scale Shardlow on the ***Trent and Mersey Canal*** is the most complete surviving example of a canal village, with over 50 Grade II listed buildings within the designated Shardlow Wharf Conservation Area of which 16 are directly canal related. James Brindley developed his canal through Shardlow in 1770, to join the River Trent at Great Wilne half a mile further down-stream. As a result, Shardlow quickly developed as a trans-shipment point between the broad river barges and the canal's narrow boats.

Trent Corn Mills, Warehouse, Iron Warehouse (IOE 83168, 83201, 83197 Nigel Ward)

No 2 Store GV II Salt warehouse Late C18 (IoE 83186) 'Nos 1 and 3 Warehouses' 1792 (IoE 83196)

8 1977 A E Jarvis, *Ellesmere Port, Canal Town* Avon-Anglia Pubns

Canal warehouse late C18 (IoE 83194) Trent Corn Mill No 1 (former warehouse) 1816 (IoE 83195) Milepost (IoE 83160)

The port outline was formed by 1816, when the 12 small canal basins had been excavated, but the warehouses around them were extensively reconstructed as trade developed, so that by 1820 the larger structures which exist today, had replaced the earlier buildings. The wharfs and associated warehouses each had designated functions, which included: coal; timber; iron; cheese; corn; and salt. Other business which developed alongside the port included: boat builders; ropewalks; stables; offices, including the head office site of the Trent and Mersey Canal. Typical warehouses are The Old Salt Warehouse (1088364), the Trent Corn Mill (1088364), Stores 1 and 2 (1088369 and 1205245) and iron warehouse (1334640) while there are three canal bridges and four mileposts.

Elsewhere, some canal ports did not develop large settlements thus at Port Carlisle (1137097) on the 12-mile long ***Carlisle Canal*** the sea basin had only rudimentary facilities including the former Steam Packet Inn (1312489).

Sea Lock, Port Carlisle and Steam Packet Inn (IoE 71919, 71917 John Wright)

Similarly Glasson Dock, the outport for Lancaster itself, had in 1787 only a sea basin which was supplemented in 1825 by a basin and branch from the ***Lancaster Canal*** with locks wide enough to allow sea-going vessels to enter the main canal. This meant that although a shipyard and Customs House (1164654) were built in 1834, a Watch House in 1836 and a Dry Dock in 1841, the settlement remained small.

(Wikipedia Rwendland)

Lighthouse and former Customs House (IoE 182292, 182291 Ruth Pavey

On short canals with only a tidal lock such as those serving Ulverston, Pocklington and Market Weighton, small inland basins attracted a few small warehouses but little else. The Crescent (1147919) built in 1823 for John Parkinson is an enigmatic survival at New Bolingbroke in Lincolnshire of Parkinson's scheme to found an industrial town served by a navigable cut off the Medlam Drain that he had dug. His textile factory or warehouse seems to have been along low wide brick building at a basin at the head of the cut with a putative office nearby. Though the settlement grew to an appreciable size by the mid-19th century Parkinson himself was ruined by his outlay.

When the ***Sharpness and Gloucester Canal*** opened in 1827 Sharpness Old Dock, the estuary entrance, had rudimentary facilities including a dock house and stabling.

Sharpness Old Dock (K Falconer)

All the commercial storage buildings were located at Gloucester where a basin had been in use for some years and the North Warehouse (1245466) had just been built. By the middle of the century trade, especially in corn, was so prosperous that facilities at the docks at Gloucester were greatly expanded. The Victoria Dock was opened in 1849 and both docks were surrounded by multi-storey warehouses of which fifteen still survive and are mostly designated, with Llanthony Warehouse (1245607) which now houses the Gloucester Waterways Museum, the latest and

largest. Gloucester Docks despite some losses are the finest complex of 19th century canal warehouses and dock facilities in the country.

River Severn lock 1826, Lock keeper's cottage 1826 and Dock Office 1831
(IoE 472560, 472462, 472555 Jack Farley)

Former office and store for the former weighbridge at the east gate entry to the Gloucester Docks. 1849 Dry Docks 1837 1852-3 (IoE . 472522 472557, 472558 Jack Farley)

North Warehouse 1827 , Lock Warehouse 1834 and Sturge's Warehouse 1840
(IoE 472566 , 472564, 472569 Jack Farley)

Vining's 1840, Herbert 1846, Kimberley 1846, Philpotts Warehouses 1846
(IoE 472571, 472561, 472562, 472567)

Victoria 1849 and Albert Warehouses 1851 (IoE 472570, 472550)

Alexandra Warehouse 1870 Llanthony Warehouse 1873 (IoE 472552, 472563)

Pillar Warehouse 1838, and Llanthony Provender Mill 1862 Bakers Quay (IoE 472349 472348 Jack Farley)

In 1874 the New Dock was opened at Sharpness and large warehouses erected allowing even larger vessels to partly unload to proceed lightened up the canal to Gloucester and the North Warehouse (1237989) at Sharpness New Dock is Grade II.[9]

9 H Conway-Jones *Gloucester Docks*, Alan Sutton 1974; *Gloucester Docks: an illustrated history* Alan Sutton 1984; *Gloucester Docks: An Historical Guide*, Black Dwarf 2009; *The Gloucester and Sharpness Canal*, Amberley 2009

Entrance to New Dock and North warehouse (Keith Falconer and Gloucester Docks)

The opening of the New Dock and its facilities required a much larger workforce than hitherto and the company therefore provided offices, housing and shops. This settlement initially comprised only two terraces of housing – Severn and Great Western Rows – but over the next three decades it expanded greatly with the population rising from 562 in 1871 to 1763 in1901by which time a school and a gasworks had been provided.

The ***Exeter Canal*** basin, though not as extensive as Gloucester, developed from the opening of the canal in the late 16th century and the Custom House complex (1223038) and Quay House (1223047) are designated Grade I while the fine group of 19th century warehouses such as the Warehouse Vaults (1223045) are mostly Grade II* or Grade II.

The Custom House and Quay House (IoE 418578 418586 Ben White)

Exeter Quay warehouses. (David Cornforth)

Gloucester remained the largest inland port until the ***Manchester Ship Canal*** was opened in 1894 and extensive docks were developed at Salford over the next 20 years which by the mid-20th century were handling 20 million tons of goods a year. However although the quays remain and are the focus of much new 21st century developments the huge ranges of pioneer reinforced concrete warehouses have been demolished.

At established ports the experience could be quite different. At Liverpool down the Mersey from Runcorn the ***Bridgewater Canal*** developed Duke's Dock as a transhipment dock from 1773 onwards and its early warehouses were to be dominated by a grand pedimented warehouse of 1811. Unfortunately little now remains of Duke's Dock. At Bridgwater in Somerset the ***Bridgwater & Taunton Canal*** had a basin at Huntworth where it entered the River Parrett. To counter railway competition the canal company constructed a non-tidal harbour to the west of Bridgwater and extended the canal to join it. The new facilities were opened in1841, after which the basin and locks at Huntworth were filled in Today the entire docks including the tidal basin, locks, quaysides, bridges and fittings (1197401), the 1850s warehouse (1197403), now converted into apartments and the telescopic rail bridge (1020624) leading to the dock are designated.

Bridgwater Dock (IoE 373958 John H. Sparkes)

In London relatively little of significance, other than a very few historic buildings, survives of the extensive facilities that once lined the numerous basins on the Regents Canal end of the Grand Union, though it is crossed by a number of fine bridges. At Limehouse Basin where the canal made its junction with the Thames the hydraulic pumping station is preserved and close to the 1820s Battlebridge Basin the London Canal Museum is housed in the former Ice House

Battlebridge Basin and London Canal Museum (Wikipedia SteveF and Oxyman)

The GNR Granary at Kings Cross and at Camden the Interchange Warehouse (1113238) with its covered dock are witnessed to the railways' close relationship with the canal system.

Interchange Warehouse, Camden
(IoE 477688 Vlasta Rousalova)

The Interchange Warehouse itself was built 1901-5 to incorporate a 1850s dock basin, vaults and horse tunnel. Some of the other basins of the 1820s such as the Wenlock and City Road preserve the water space but no other historic features. The Paddington Basin, on the Grand Junction arm of the same name, has been extensively redeveloped preserving and opening up access to the water space while at the junction itself there is a small group of early canal features, bridges and buildings including the CRT London office (1189553).

At Limehouse Basin where the ***Regents Canal*** connects to the Thames the entrance lock survives but most of the early buildings have gone.

Entrance to Limehouse Basin 1823 and 2005 and entrance lock to Thames. (Wikipedia Pierre Terre and ThirteenthGreg)

Inland Basins, Wharfs and Warehouses

Fittingly, Manchester, the first major town to benefit from canals, has retained notable warehouses and the Castlefield Basin where the Bridgwater Canal entered the city and later made junction with the Rochdale Canal has the Giants Basin (1247068) and the basin at Potato Wharf (1246959) and a fine collection of grand, converted or rebuilt, warehouses including Middle Warehouse (1208653) and Merchants Warehouse (1197778).

Castlefield Canal Basin panorama (Wikipedia Parrot of Doom)

Merchant's Warehouse 1823 and Middle Warehouse !828-31 Castlefield
(IoE 387967, 388007 Peter Sergeant)

The River Irwell also has some fine warehouses such as the Albert and Victoria Warehouses (1254727).

(Left) Victoria and Albert Warehouses River Irwell Manchester (IoE 457837 Peter Sargeant)
(Right) Underground section transhipment wharf (Wikipedia Grimey121uk)

At the end of the 19th century the GNR built a transhipment facility from the covered ***Manchester & Salford Junction Canal*** to the railways entering its huge warehouse above.

In a partially in-filled basin further up the ***Rochdale Canal*** the equally fine stone-built 1806 Dale Street Warehouse (1200845) is Grade II* as it is of special interest because of its ground floor occupied by four barge-holes and its use of cast iron columns in its internal structure. It is also of special note for a subterranean waterwheel used to drive hoists both in this building and in a former warehouse to the south via a line-shaft tunnel which mostly survives beneath the car-park.

Dale Street Warehouse, Manchester
(IoE 388078 Brian Lomas)

On the Rochdale there is a second warehouse with barge-holes at Gauxholme (1133780) and at Sowerby Bridge where it connects to the Calder & Hebble. At the junction of the Ashton and Rochdale Canals the massive brick-built 1836 Hall & Rodgers Warehouse, though pierced by two barge-holes, presents a very utilitarian aspect. At the other end of the Ashton Canal, where it joins the Peak Forest Canal at Portland Basin, the large 1834 warehouse which was rebuilt after severely damaged by fire to house the local museum is also notable for its waterwheel driven hoist system and cast iron internal structure. On the ***Peak Forest Canal*** itself, there is a trans-shipment warehouse of 1832 at Whaley Bridge which is Grade II* while Bugsworth Basin (1021384), the interchange wharf with the Peak Forest tramway, with its wharfinger's house and office, inn and limekilns is much more representative of early canal facilities that were not urbanised and is a scheduled monument.

(Left) Whaley Bridge warehouse 1832 (IoE 81879 Philip B Wilson)
(Right) Granary warehouse and Lock No1 Leeds (www.penninewaterways.co.uk)

In Leeds several notable warehouses have survived at the head of the Aire & Calder Navigation and at the end of the Leeds & Liverpool Canal. Amongst the former are those lining the Calls and across from them the exceptionally wide Fly-boat or Flax Warehouse has wooden roof trusses which are some of the longest in the country. All of these have been converted, as has the Granary Warehouse on the Leeds & Liverpool.

On the ***Leeds & Liverpool Canal*** to the west there are fine warehouses at Skipton, Shipley, Foulridge, Eanam Wharf Blackburn (1239471) and at Wigan where the Terminal Warehouse (1384555) and Gibson's Warehouse have been restored.

(Left) Burnley Warehouses (IoE467117 Graham R. Heasman): (Right) Wakefield Warehouses (www.penninewaterways.co.uk)

On the Calder & Hebble at Wakefield there is group of warehouses including the particularly fine grade II* Navigation Warehouse (1242353) which was built in 1790, and subsequently altered in 1810, as a grain and storage granary.

On its adjoining ***Huddersfield Broad Canal*** there are very early warehouses dating from c 1780 at Aspley Basin one of which is also listed Grade II*.

1780 Warehouse, Aspley Basin
(IoE 419740 John Turner)

At Sowerby Bridge where the ***Rochdale Canal*** joins the ***Calder & Hebble*** is a fine group of restored warehouses including the Wet Dock Warehouse Grade II*, The Moorings (1366092) and Salt Warehouse (1134472).

Sowerby Bridge Canal Basin, with the restored Salt Warehouse c.1796 on the left.(Pennine Waterways)
(Right) Wet Dock Warehouse 1775 Sowerby Bridge (IoE 339344 Norman Hurst)

In south Yorkshire in the Victoria Basin, Sheffield, at the head of the ***Sheffield Canal*** there are a number of buildings include the original Terminal Warehouse of 1819, (Gd II* 1247016) the Straddle Warehouse (1895–1898), a grain warehouse (c1860) and a curved terrace of coal merchant's offices (c1870).

(Left) Terminal Warehouse Sheffield (IoE 456134 Barbara A West)
(Right) Coventry Canal Basin (Wikipedia E Gammie)

In the Midlands many towns had at least one canal basin while the BCN system was lined by industrial sites many of which had small private basins and the canal companies themselves had basins in the city centre some of which have long since been built over while Gas Street basin is heavily redeveloped though retaining its water space and some early buildings. In Coventry the ***Coventry Canal*** Basin was opened in 1769 and expanded in 1788 and many of the listed buildings including warehouses the Canal House (1342940) and a bridge were restored between 1993 and 1995.

In Nottingham the FMC Wharf with its stables, crane and warehouse with covered boat dock and the imposing British Waterways warehouse at the former Castle Wharf depot are of note and in Worcester the Diglis Island Basin retains some of its ***Worcester & Birmingham Canal*** related buildings (1389767, 1389768 and 1389769)

(Left) Castle Wharf Warehouse, Nottingham (IoE 459075 Patrick Banister)
(Centre) Straddle Warehouse, Worksop. (IoE 241244 Derek E. Godson)
(Right) Cromford Basin (Wikipedia Craig Carter)

On a lesser scale is the Straddle Warehouse (1045059), Worksop, the ***Chesterfield Canal*** Cuckoo Wharf and the warehouses on the Nantwich and Wappenshall Basins on the ***Shropshire Union.***

At the canal head at Cromford there are two warehouses of 1796 and 1824 (1144629 and 1244631) and a Counting House (1244630), while the ***Trent & Mersey*** at Fradley Junction, the Derby Canal at the Little Eaton Wharf with its Clock House

(1329210) and the ***Stourbridge Canal*** at Town Wharf retain warehouses or associated buildings.

In Shrewsbury although the ***Shrewsbury Canal*** basin has long been in-filled the Butter Market or Howard Street Warehouse (1254526), with its Doric portico, is a reminder of the times when canals were busy trading arteries.

Bonded Warehouse Stourbridge (Wikipedia Stephen McKay) and Howard Street Warehouse Shrewsbury (IoE 457386 M. I. Joachim)

Similarly the navigation or canal-head wharfs at Ripon, Louth, Leven, Pocklington, Tavistock, Tiverton, Westport, Horncastle all have surviving warehouses or canal buildings some of which have been sympathetically converted where there are viable community uses, as have the wharf buildings at Devizes on the Kennet & Avon and the Wharf House at Marlbrook on the Leominster. On the most rural canals the original wharf buildings such as those on the ***Bude Canal*** at Druxton and Blagdonmoor the original rudimentary storehouse buildings have been more vulnerable but the Wharf at Bude retains some of its storehouses.


Warehouses on Bude Wharf (IoE 64773, 64772 Hilary Phillips)

Crowe (1994) identifies three types of warehouse by relationship to waterway – lay-by, boat hole and straddle – while CBA Industrial Archaeology Handbook 21(2012) suggests four types – those with internal canal arms (boat holes), those detached from the canal-side, multi-storey flush with the canal and single storey transit sheds flush to the canal-side. These can be further qualified by function – trans-shipment, secure and bulk storage. All these factors can affect appearance, construction and layout and there are several permutations where functions are combined.

On the canal system the companies rarely provided built facilities for passengers though some flyboats conveying passengers were used on canals such as the

Bridgewater Canal where by 1790 a healthy income was made from passenger carrying to which the Packet House at Worsley basin is testimony.

Packet House Worsley
(Wikipedia Parrot of Doom)

However, there are few hotels to rival those on the Grand Canal in Ireland though the Tontine Hotel (1292639) at Stourport Basin on the ***Staffs & Worcestershire Canal*** is a notable and very early example while, much later, the ***Aire & Calder***'s Lowther Hotel (1310687) at Goole was the Company's Board Room as well as providing accommodation (see above).

Stourport, former Tontine Hotel (IoE 393321 Philip Williamson)

Rail interchange warehouses, basins and transit sheds

Where canals met tramroads and railways transhipment of goods could be effected immediately in open sided sheds as at Wolverhampton or in secure warehouses as in Camden with the Interchange Warehouse (see above). One of the earliest examples of both arrangements is at either end of the Cromford & High Peak Railway. At Whaley Bridge there is a stone-built transit shed with a canal dock off the ***Peak Forest Canal*** dating from 1832 (1088081)Graded II* (See above) and at the other end on the wharf alongside the ***Cromford Canal*** there is an open shed and warehouse incorporating the engine shed (1007025) which is a scheduled monument.

Cromford & High Peak Railway wharf , terminus workshop (Wikipedia, Steve Brown)

In Manchester the Great Northern Railway Warehouse had a facility at ground level for raising goods from a dock on the Junction Canal that ran below it. (see above)

The BCN was extensive enough that its own self-contained trade thrived with the coming of the railways and the railway interchange trade on a score of transhipment basins and wharfs peaked at more than a million tons in the first decade of the 20th century when it accounted for a seventh of the trade on the West Midlands system (see Foxon 1998 *The Industrial Canal Vol 2 The Railway Interchange Trade*). However, traffic on the private and railway basins declined after World War I and even more so after World War II and by the end of the 1960s all the interchange basins had closed. As noted above very little survives of the canal railway interchange basins other than Chillington Basin (1252658) at Monmore Green which is Grade II listed and is now of such rarity as to be of national significance.

Chillington Interchange basin
(IoE 435701 Peter Garratt)

> ***Canal warehouses*** *range from massive complexes like Ellesmere Port to small individual warehouses such as those along the Grand Union Canal via the early specialised warehouses serving the Bridgewater Canal in Manchester. These can possess group value with other canal elements, and are eloquent reminders of transport's role in the Industrial revolution.* ***Settlements*** *like Stourport (Worcestershire) grew up in the later eighteenth century, with new sorts of canal-related buildings creating a new form of settlement.*
> HE Listing Selection Guide on Transport Buildings

Until the increased interest in leisure boating in the 1960s, canal basins, especially those situated in town centres, were particularly vulnerable to redevelopment and many have been built over. Those that survived the decline of the canal system have found a new life as marinas and foci for residential developments and indeed some in-filled basins are now being re-excavated as at Stourport where the later basins dating from the early 19th century are being brought back into use. In 1998 British Waterways also excavated North Basin Tower Wharf, recorded the sunken boats there, and re-watered it in 2000. Restoration of historic basins can be fraught by problems as demonstrated by the experience at Bugsworth Basin which was scheduled in 1977. The basin had become derelict by the 1960s when restoration was begun by the Inland Waterways Protection Society (IWPS) helped by the Waterway Recovery Group (WRG) and many locals restored parts of this important site over three decades though unforeseen problems caused it to be closed again shortly after its opening to boats in 1999 and it was not until 2005 the basin reopened to boat traffic after a £1.2 million restoration, undertaken by British Waterways working with IAW's Waterways Recovery Group.

Middle Basin and Arm and Upper Basin and Arm (www.penninewaterways.co.uk)

While many canal basins have been built over and their warehouses demolished there are several hundred warehouses still surviving and most would seem to be

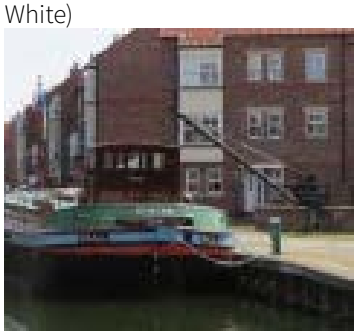
listed as befits their historical interest. Indeed, the CBA Handbook 21 (2012) claims that canal warehouses are a building type specific to the canal network and that this type of carriers warehouse had a number of unique features. However, this might be somewhat disputed as most of their early features are similar to those of early navigation and maritime warehouses and the same is true across the whole two century date range with railway and canal warehouses sharing similar features and appearance. Nevertheless, apart from a few isolated examples in rural areas most warehouses would appear to be adequately designated.

Unfortunately many of the dockside fittings to canal basins and wharfs have long gone and therefore those, such as cranes, that do survive merit assessment for protection. Some notable cranes are already designated such as the Grade II* Treadwheel Crane (1377866) at Guildford, the wharf cranes at Dundas Basin (1364071) and at Burbage (1035906) on the ***Kennet & Avon***, at Maesbury Marsh (1177520) on the ***Shropshire Union***, at Bumble Hole (1005884) and Rotton Park Loop maintenance yard (1234114) on the ***BCN***, the remains of the Mount Zion Steam Crane at Little Lever on the ***Manchester Bury & Bolton Canal*** and examples of hydraulic cranes at Ellesmere Port. Others such as those at Canal Head Great Driffield (1083382 and 1346637), at Dudbridge (1392897) on the ***Stourbridge Cana***l, on the ***Chesterfield Canal*** (1236509) at Retford basin, at Leeds Wharf (1255705 , 1255706) on the ***Leeds & Liverpool Canal***, on the Lee & Stort Navigation (1101629), at Bridgwater Docks (1197422) and at Gloucester Docks (1245602) are all designated at Grade II.

A Medley of cranes



Treadwheel Crane Guildford (Wikipedia Colin Smith), Hartshill Yard (CRT), Ellesmere Yard (IoE 260793 Les White)




Beverley and Driffield (Keith Falconer) Bridgwater Dock (IoE 373958 John H. Sparkes)



Burbage (IoE 312215 B J W Heath) Newbury Wharf (Wikipedia Tom Bastin) Dundas Basin (Keith Falconer)


Granary Wharf Crane, Leeds (Pennine Waterways), Mount Sion Steam Crane (Wikipedia Parrot of Doom)

SECTION 4

Initial Findings and Conclusion

The navigable inland waterways that were subject of this Overview constitute an immense heritage resource that has developed over many centuries. As Section 2 outlines in some detail, the historical interest of the early river navigations is considerable but the built heritage of their pre-19th century operation is meagre. Furthermore, apart from the major navigations and rivers their heritage where the later engineered improvements to navigation can be impressive, the survival of historic assets on lesser waterways has generally been patchy and is still extremely vulnerable. The remedial measures taken in the face of widespread flooding over the last few years has shown how riparian navigation features are under-protected and subject to constant threat.

The canal system on the other hand has fared somewhat better. Despite the drastic decline and virtual cessation in traditional heavy goods traffic, which started with the coming of the railways and accelerated with the advent of lorries, there are now more boats, albeit cruising vessels, on the still water canal system than ever before. Although the system overall has contracted by about one third, the 2000 miles of waterways that are now the responsibility of CRT, along with their docks, warehouses and reservoirs, constitute the country's third largest collection of designated historic sites. Still in use for their original purpose, relatively little altered and with the emphasis on heritage allied to public access and leisure navigation, they are an unrivalled national heritage resource.

This has not always been the case. The heroic efforts of enthusiasts over the last 70 years to halt and reverse the closure large parts of the system, to forge partnerships to restore closed waterways and repair others, to enhance the canal-side environment and to develop museums and archives, has been truly astounding. The subsequent renaissance of the waterways and their appreciation by the public has been a late 20th century phenomenon now being fully realised in the 21st century.

Indeed, one of Canal & River Trust's charitable objects articulated in 2012 is 'to protect and conserve for public benefit sites, objects and buildings of archaeological, architectural, engineering or historic interest on, in the vicinity of, or otherwise associated with Inland Waterways' To achieve this the Trust has a Heritage Advisory Group of external experts and an in-house Heritage Team of regional advisors informed by a sophisticated GIS data system that monitors the designation status and condition of all its historic assets. This shows that in 2013-14 the CRT has 43 Scheduled Monuments and some 2475 Listed Buildings in England but it also contains information on many other sites in its ownership that are undesignated. Cursory sample examination of the database seems to confirm that the designated cover is somewhat patchy due to the historic changes in criteria and methods of designation surveys. Rather than dealing with this on an ad hoc basis via individual assessment requests, this could be rectified more efficiently via strategic projects using detailed examination of the database allied to advice from CRT regional heritage staff backed up by efficiently organised field verification. The CRT is also

advised on all planning applications having a bearing on any of its canals and the Heritage Team consults with its Heritage Advisory Group on those with perceived significance. This arrangement would seem to be unique to waterways within the national transport infrastructure sphere.

The extensive use of volunteers on the CRT's waterways for heritage restoration, repair and maintenance projects, and for public interface interpretation, is also to be greatly commended as is the close relationship with the Inland Waterways Association. The IWA is justifiably proud of campaign to save the waterways, which has spanned some 70 years, and resulted in a complete transformation of national policy regarding the management of the navigable inland waterways system. The IWA website, with its new Directory, contains a vast resource of information on waterways in general and on the restoration of waterways in particular. Its sections on restored waterways details the mileage and date of opening of over 75 lengths of waterway totalling some 600 miles and provides links to some 50 current restoration projects and over 30 proposed restoration schemes (see the Introduction to the Gazetteer). Its publications such as Waterways and the WRG's Navvies, along with its electronic bulletins and its relationship with Towpath, provide topical information on the state of waterways and current issues affecting their management.

The situation regarding the protection of abandoned canals and waterways and those waterways that are out-with CRT responsibility remains much less certain. In the case of the River Thames a series of reports commissioned by the Environment Agency, and then jointly with the erstwhile English Heritage, have audited and assessed heritage assets on the Thames in considerable detail. Regrettably, no such information is easily available on the other EA waterways. For other non-CRT navigable waterways consultation with owners with a degree of field verification may produce satisfactory results.

Two of the most significant operational waterways are not owned or managed by CRT. The Manchester Ship Canal and the pioneer Bridgewater Canal are owned and managed by Peel Ports. Research on the Bridgewater Canal has been pulled together in 2012 in *Bridgewater 250: The Archaeology of the World's First Industrial Canal* (Nevell & Wyke) but there has been no such recent appraisal of the Manchester Ship Canal whose immense engineering works are of considerable significance as examples of very fine large scale Victorian construction. Under its *Atlantic Gateway* plan Peel Ports predict that the number of containers transported along the canal could increase from the 8000 carried in 2010 to 100,000 by 2030. The scheme involves the construction of a large distribution centre to be named Port Salford and an additional six sites along the canal for the loading and unloading of freight. The Swing Aqueduct (1162870) is one of the most significant monuments of the canal system and three bridges and a magazine are also Listed but it would appear that none of the locks themselves or wharfs are designated. Hence in view of the proposed plans for expansion of container traffic an assessment of all the historic structures along the canal is perhaps needed.

Elsewhere, desk-based research, combing the existing literature and the internet, indicates that many of the most obvious notable features of historic interest are

designated but less obvious features, and those that have only recently been researched and identified or for which appreciation has been revised, are less well protected. Most long-abandoned canals have attracted their own websites, and indeed restoration schemes, but some field verification of unsubstantiated literature and internet references may be necessary if representative designation is to be achieved.

The discussion of early lock devices in Section Three was principally drawn from 'Flashlocks on English Waterways: A Survey' (MT Lewis et al 1969) which recorded the remains of fifty flashlocks where some trace survived though no such locks were in use. Prophetically, the survey stressed the vulnerability of flashlocks to flood prevention work by river authorities and improvements for navigation by agencies and restoration societies. In the wake of last two year's floods further work is needed to address the uncertainty regarding the current state of survival of the vestiges of any of these types of primitive locks. The national context for early navigation lock devices was discussed by Trueman in his reports on the River Thames for EA while the survival of under water remains of all periods was examined in the pilot project by Anthony Firth in 2013 for EH on the Rivers Kennet and Avon catchment basins. As, in 1969, it was in the region fringing the Fens that most significant sites were to be found and more recent work has established that the terms sluice and staunch were loosely used historically and some early drainage channels may have been also used for navigation, East England should be the initial focus for identifying what remains of these structures.

Similarly, Britain's pioneering role in the use of powered inclines, lifts and balance locks was fully demonstrated in Section 3 and therefore its role in developing these features and the evidence of their use, or experimental use, should be comprehensively assessed for protection. There are two main areas where substantial evidence survives of these features Shropshire and the South West of England. There are considerable documentary sources on these structures and some past and recent field investigation. The current state of these remains should be ascertained and assessed.

Lastly in the context of non-CRT waterways, the current state of the BCN's 60 miles of abandoned waterways, private branches, basins and wharves should perhaps be ascertained. Building on Richard Chester-Browne's *The Other Sixty Miles: A survey of the abandoned canals of Birmingham and the Black Country* (1991) which seemed to indicate that little of any great significance survives on these abandoned sections, a report, perhaps utilising the expertise in the Birmingham Canal Navigations Society (BCNS), could be fairly easily produced.

In recent years plans for the new high speed rail links, firstly HS1 to Birmingham and immediately beyond, and secondly HS2 to Manchester, Sheffield and Leeds have raised concerns where the proposed lines cross or impinge on canals. The CRT has established a team to examine in detail these plans, to liaise with the promoters and to ensure that CRT waterways are adequately protected in the subsequent parliamentary scrutiny of the proposed routes. The CRT involvement indeed has

refined the proposed routes and achieved positive alterations to the design of some of the proposed structures over waterways.

Similarly the IWA has established a HS2 Campaign & Communications Group and has expressed its concerns over details of the routes and has made representations to several public consultations citing numerous examples of negative impacts on navigable waterways. The IWA is also rightly concerned with the instances where the high speed routes cross the lines of abandoned canals which are, or may be, candidates for future restoration. As there is often no statutory protection of these latter sites, the IWA is the main watchdog and champion. The IWA's *Waterways* Issue 255 Spring 2017 summarises some of the most recent concerns.

In conclusion, the above review of the historic infrastructure of the waterways system would indicate that its heritage is generally well served. The navigable canal component of the system, mostly now managed by the Canal & River Trust, has benefitted from its two hundred year old age by being eminently listable and most of its significant features have indeed been designated. Those historic assets that are still undesignated are covered by the CRT's asset management databases and would appear to be at little risk. The analysis of the NHLE suggests that the better known historic assets on waterways in private ownership also seem to be reasonably protected by designation but the comprehensiveness of that cover is uncertain. The situation as regards significant historic sites on the abandoned component of the system is even less certain. Again, most of the better known sites are protected by designation but there are many fairly significant sites that have not been assessed.

As noted above, the situation as regards river navigations is also rather uncertain where they are not under CRT management. There would appear to be very few standing remains of any type of early lock and almost no designation of these. A review of the heritage assets on rivers managed by the Environment Agency would have to extend beyond the parameters of this Overview as many of the waterways had ceased commercial navigation by the 19th century. However a national survey of EA navigable river heritage assets, comparable to the series of reviews of the heritage assets on the River Thames under taken by M Trueman for EA and EH in the 2000s, would be of considerable value. Within the current discussions about the possible transfer of EA waterways to CRT prompted by the Inland Waterways Association the heritage must be regarded as a priority to rank equally with other waterways interests.

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