Desk-based assessment, evaluation and recording on the site of a bridge at the rear of High Street, Wednesfield near Wolverhampton

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Introduction

A desk-based assessment, evaluation and recording on the site ofa bridge at the rear of11-21 High Street, Wednesfield near Wolverhampton (SJ 9448 0032; Fig 1) was carried out at the request of Harry Patel of BWMorrison, according to a briefissued by Wolverhampton City Council (dated 12 June 2008). This project was undertaken in advance of the proposed replacement of the bridge in order to assess the remains of the bridge and to determine the need and scope of further investigation or recording. Additional recording was carried out within the northern bridge abutment in order to identify methods ofconstruction.

Brief background to the site

The Wyrley and Essington Canal

The Acts of Parliament for the construction of the Wyrley and Essington canal were those of 32 George III Cap 81, given Royal Assent on 30 April 1792 and 34 George III Cap 25 Royal, given Assent on 28 March 1794.

This canal, under the first Act of Parliament commenced at Wyrley Bank in the county ofStafford and from there ran over Essington Wood and Snead Common, then south-easterly passing Bloxwich. It then continued to near Birch Hill in the parish ofWalsall. Near Sneyd Common a cut was made from it, which took a westerly direction and passing Wednesfield, joined the Birmingham Canal near Wolverhmpton. This is the section of the canal which concerns the present project. By the Act of 1794 the canal was extended *via* Pelsall to Brownhills to connect with the Coventry Canal near Huddlesford (Priestley 1830).

The canal's engineer was W Pitt. It was 24 miles in length from the Coventry Canal to its junction with the Birmingham Canal, was 28 feet wide at the waterline, 16 feet at its bottom, 4½ feet deep and was considered to be of great service in conveying the produce of the mines, of which there were many in its vicinity, to the manufactories ofWolverhampton and its neighbourhood. Coal, iron and lime were the principal products. By its connections through the Coventry Canal with the Trent and Mersey Canal to the north and the Oxford Canal to the south a communication was opened with the rivers Trent and Mersey and also with the river Thames (Rees 1819-20).

Analysis

The documentary research

Documentary research took place on 20th June at the Wolverhampton Archives Service and on the 4th July at the Waterways Trust archives at Gloucester.

The map evidence

The earliest available map to show the bridge is the *Plan of the Township of Wednesfield in the County of Stafford*, dated 1842 (RD-24 101A) This is at a small scale –*c* 6 chains to the inch –and shows no significant differences from the 1st edition Ordnance Survey map of 1887. The adjacent field boundaries are mostly unchanged.

The Ordnance Survey 1:2500 maps of 1887, 1902 and 1919 (Fig 2.1) show the bridge, called 'Barn Bridge' from the 1902 map onwards. These three maps show the bridge, apparently with curving wing walls (see below) giving access fron the town ofWednesfield to what are probably agricultural fields on the north side of the canal. The Ordnance Survey map of 1938 (Fig 2.2) shows some significant changes. The bridge, still called 'Barn Bridge', seems to have lost its wing walls and now gives access to a public park.

Documentary evidence relating to canal bridges in general and those on the Wyrley and Essington Canal

The traditional canal bridge

A particular form of small, brick bridge has become associated with canals and was employed on the Wyrley and Essington (Fig 4.1). It was employed when it was necessary to re-establish access to lands which had been severed by the construction of the canal and was known as an 'accommodation bridge'. Such a bridge was described and illustrated by Rees (1819-20; Fig 3):

> *A kind of brick bridge has long since come into almost general use on canals of which an example is given. The form of these bridges is well calculated for saving of materials and giving strength at the same time, the whole of the walls being more or less battering and the side walls are splaying outwards at their ends to make the entrance onto the bridge the more easy, by*

which the side walls are rendered curving inwards in every part. In the building of bridges the utmost care must be taken to sink the foundations down to sound stuff, or todrive piles on which to begin the work; it is a good practice to have wedge-like or arching bricks made, on purpose to use after a certain number of courses of key bricks, or those forming the soffits of the arch, and to introduce oblique courses of bricks for the more effectual tying of the work together (see below). *Large bricks made of the best earth and well burnt should also be used, placed on edge upon the top of the walls of the bridges as a coping, unless very good stone is near at hand, the top corners of the stones or coping bricks should be carefully rounded off in the making in that the same should present as few angles as possible for the weather or the traffic to catch hold of.*

Care should be taken in every instance to find stuff with the least possible expense of moving it, for landing up the bridges [ie for the access ramps], *from these having, in some instances, being left too steep for the convenient and safe use of the public; it has not been uncommon in later Acts to make provisions on these subjects; on the Grand Western it is enacted that the ascents to the bridges shall not exceed 2 ½ inches in a yard and upon the Wiltshire and Berkshire this rise is limited to 3 inches in the yard at the most. The width of the carriageway on the bridge in the narrowest places, is also fixed in some Acts, wherein we have seen 12 feet mentioned as a limit in some cases.*

The canal ought, if practicable, to be conducted into deepish cutting, wherever a brick or stone bridge is to be erected, in order that the stuff might thereby be procured for landingup each side of the bridge and that the abutments of the bridge may be the more solid and the foundations more likely to reach sound stuff, without an extra depth of walling or the necessity of piling for such purpose.

On the Worcester and Birmingham Canal, 1793, such accommodation bridges were to be built 22 feet wide 'in the clear' including the towing path, and 10 feet 6 inches from water level to the underside of the arch. The roadway was to have a width of 14 feet between the parapets (White 2005).

Curved wing walls

The wing walls of accommodation bridges, in plan, were usually circular arcs. In elevation they took a helical form (Adams 1907). To construct the elevation the following technique was recommended (Fig 4.2):

Draw the plan and divide the wing wall coping into any number of equal angles by radial lines from the centre of the curve. Where these lines cut the inner and outer edge of coping, project vertical lines to the elevation. Then, in the elevation, set off the height a-b, which the coping will occupy and by means of the ordinary device of practical geometry [similar triangles] *shown on the left, divide it into the same number of equal parts as the coping was divided in plan. Now draw horizontal lines to intersect with the verticals from the plan, and draw the required curve through the intersections. The visible edge of the underside of the coping is obtained by setting off the thickness vertically at each point below the curve of the upper edge.*

Alternative bridge designs

A different design was also commonly used and this, too, was employed on the Wyrley and Essington Canal (Fig 4.3). This comprised brick abutments with the space between spanned by girders. Such construction was described by Davis (1908):

The floor of a bridge is usually carried on cross girders or floor beams and rail bearers on which the deck or platform is laid. In highway bridges it is the practice invariably, except where the traffic is very light, to cover the floor or platform with road-metalling, asphalteor wooden paving.

The road or deck ofthe bridge was supported in two ways (Fig 4.4):

…[on]*steel plates or corrugated steel sheeting and covered over with cement concrete. The cambered steel sheets, although offering substantial support to the concrete floor, act more particularly as centres for the concrete arches. Any thrust due to the arches is taken up by steel tie rods passing through the webs of the girders and tightly screwed up against them. The two outside girders are built-up of a channel bar and plate riveted together by an angle bar running longitudinally on the top flange of the channel.*

Alternatively:

...brick arches [were used] *having their abutments on the lower flanges of the main girders, instead of the cambered steel plates. In other respects the construction is very much alike.*

Both types of floor are suitable for carrying the heaviest class of road traffic for spans up to 30 feet, provided the main girders are spaced and proportioned for the load. The dimensions given in [Fig 4.4] *are of sufficient strength to carry a uniformly distributed load of 1 cwt per square foot of floor area, or a traction engine weighing 20 tons.*

It is not known which ofthese forms ofconstruction were used at Barn Bridge.

The possibility of a skew or oblique bridge

It is possible that the former Barn Bridge (at Wednesfield on the Wyrley and Essington Canal) was of a skew or oblique form (ie it crossed the canal at an angle other than a right-angle). Bridges of this design were generally avoided before the railway age as the construction principles involved were poorly understood and such bridges as were built tended to fall down! Certain underlying principles ofarch construction, not fully appreciated in the early years ofthe canal age, were: that the forces acting through the arch, act perpendicularly to the joints in the masonry that it is important for the forces acting through the arch to remain within the section ofthe arch

A useful over-simplification is that an arch is in equilibrium (ie it stands up) when each part ofone abutment pushes against an equivalent part in the opposing abutment. This state ofequilibrium is easily attained when the bridge is symmetrical and its abutments are at right angles to its longitudinal axis. Examples of such bridges are commonplace across the canal system. An example of such a bridge may be seen at Tardebigge (SO 989 891) on the Worcester and Birmingham Canal (Fig 8), as is the example given in Rees (1819-20; Fig 3). However, in the case of an oblique or skew bridge, the bridge's abutments are not at right anglesto its longitudinal axis. The result ofthis is that the ends of the abutments on two of the opposing corners have nothing against which they can push. Effectively, in these positions, only halfofthe bridge has been built. The result is that the arch ring is forced away from the core of the arch on both sides of the bridge. This effect of this may be seen on a bridge at Hockley Heath (SO 146 729) on the North Stratford Canal (Fig 9).

A passing references to the solution to this problem is found in Rees (1819-20):

,,,wedge-like or arching bricks made, on purpose to use after a certain number of courses

and an example ofsuch construction may be seen on the Worcester and Birmingham Canal (Fig 10) at Lower Bittell Reservoir (SP 020 738).

A fully satisfactory solution awaited the coming ofthe railway age and, after the construction ofthe Stockton and Darlington railway, and its various branches, the following article was published:

The construction of the [Hagger Leases branch] *was supervised by the author in 1830. The Hagger Leases branch joins the Stockton and Darlington railway. This being the first public railway constructed in Great Britain, many of the works on it were of a novel character and among these were the bridges constructed in an oblique direction in order to avoid curves in the line of the railway. The building of oblique arches was at that time but little practiced and the author was considered very adventurous in attempting this construction at such an acute angle as 27 degrees. It was, however, very successful as, when the centres were struck the* *crown of the arch did not drop half an inch, although the centering was placed parallel with the abutments instead of being parallel with the faces of the arch as is customary at present* (Storey 1845).

The author is aware that since the erection of these oblique bridges, they have become, comparatively speaking, common, and that some of very great span have been built but he is not aware of any being previously constructed in England

In a commentary Mr G Rennie said he believed that few, ifany, examples ofoblique bridges existed in England prior to those which had been mentioned. [thus they both ignored the work done by the canal builders].

The fieldwork

Fieldwork was undertaken on the 11th, 12th, 13th, and 17th February 2009. An 'L' shaped trench, approximately 3.5m long and 2m wide at its widest point, was excavated in a position to take in the projected position ofthe carriageway and the western wing wall (Figs 5 and 11).

Beneath the topsoil (context 001) were a number of deposits (Fig 6). The most recent ofthese was modern disturbance caused by tree-boles or burrowing animals (Fig 11; contexts 003 and 004). However, two deposits were relevant to the construction ofthe bridge. The first ofthese was a layer of tenacious clay (context 002). This was clearly not the natural subsoil but its significance was not realised at this time (see below). The second (context 006) was revealed when an overlying layer (context 005) was removed. Context 006 was a sloping surface, cut into benches, and is believed to be the western side ofthe ramped approach to the bridge (Figs 6 and 12).

With the removal of the vegetation covering the site of the northern bridge abutment it was clear that the design ofthis bridge was that ofthe traditional canal bridge described above (Fig 13). It was possible to obtain measurements of the bricks used. These were unfrogged, measured 250x110x80mm and were laid in lime mortar.

A meeting on site was convened between the author, Mark Sabbato, Elizabeth Turner, and Mike Shaw in order to discuss the results of the evaluation. It was decided that some further recording of the remains ofthe bridge would be undertaken in order to identify details ofits construction.

A layer of tenacious clay (subsequently shown to be context 002) was removed by mechanical excavator adjacent to the remains of the western wing wall of the bridge (Figs 7 and 14; context 009). This revealed context 008, a very sandy orange clay with occasional medium rounded cobbles. This was shown to be the fill of a gently sloping cut, context 011, which was clearly the construction cut for the western wing wall, context 009. Remarkably, context 011 cut a buried topsoil (context 010) which is presumably the remains ofthe agricultural soil ofthe field shown on the Ordnance Survey map of 1887 (Fig 2.1). A sample of this soil was taken and analysed for environmental evidence (see below).

The soil analysis

The sample was dominated by abundant clinker fragments, with a single charred seed of corn marigold (*Chrysanthemum segetum*) and a possible, unidentified, cereal grain (cf Cereal sp indet). Unidentified root fragments, which had presumably survived in anaerobic conditions, were also abundant. The corn marigold is a common weed of acidic arable soils, and is most likely to have been introduced in burnt waste (which included crop material) added to the soil from domestic or industrial hearths or bonfires. The clinker suggests the presence ofwaste from coal fires.

Commentary

Some general remarks can now be made regarding the construction of the traditional canal bridge. Unlike modern practice, the first stage ofconstruction was not to strip the topsoil. Instead, a trench, gently sloping on its internal face, was excavated from contemporary ground level around the periphery of the abutment. The abutment wall and wing walls were then constructed. The abutment wall was vertical until the springing of the arch was reached and would have presented no unusual problems. However, the wing walls curved in both the horizontal and vertical planes (see above). To facilitate construction in the vertical plane, the construction trench was probably progressively backfilled as the wing wall rose in height until contemporary ground level was reached. At this point the filling of the abutment was changed to tenacious clay which, from the evidence ofcontext 002, must have been taken almost up to the carriageway surfacing. In the case of this bridge, the presence of occasional cobbles in context 008, and elsewhere on the site, indicate the likely surfacing.

It is possible that something a little more sophisticated than just a cobbled surface was provided in order to facilitate the movement of carts. In a letter emanating from the British Transport Commission (BTC 1958), the following observations were made:

> *In some cases, due to the speed of motor vehicles using certain of the bridges it was impossible to maintain a waterbound road surface as the tyres constantly kicked loose stones away, leaving a very uneven and rutted surface. In such cases we provided over the bridge two strips approximately 3 feet wide on each side of the road, leaving a 3 foot or thereabouts width in the centre waterbound as I always felt that there was a distinct possibility that immediately we provided a tarmac surface for road vehicles, someones horse would fall down, sustain a broken leg and a claim would result because the surface was unsuitable for horse traffic.*

Summary

A desk-based assessment, evaluation and subsequent recording were undertaken of a demolished late 18th century canal bridge at Wednesfield on the Wyrley and Essington Canal. The work demonstrated that the bridge was of the traditional type associated with canals, being built ofbrick with the wing walls curving in both the horizontal and vertical planes. Excavation within the surviving abutment threw light on construction methods of this period and identified a buried soil pre-dating the construction ofthe canal.

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Acknowledgements
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Archive
The archive consists of:

2	Drawings
1	CD-ROM
1	Processed environmental sample

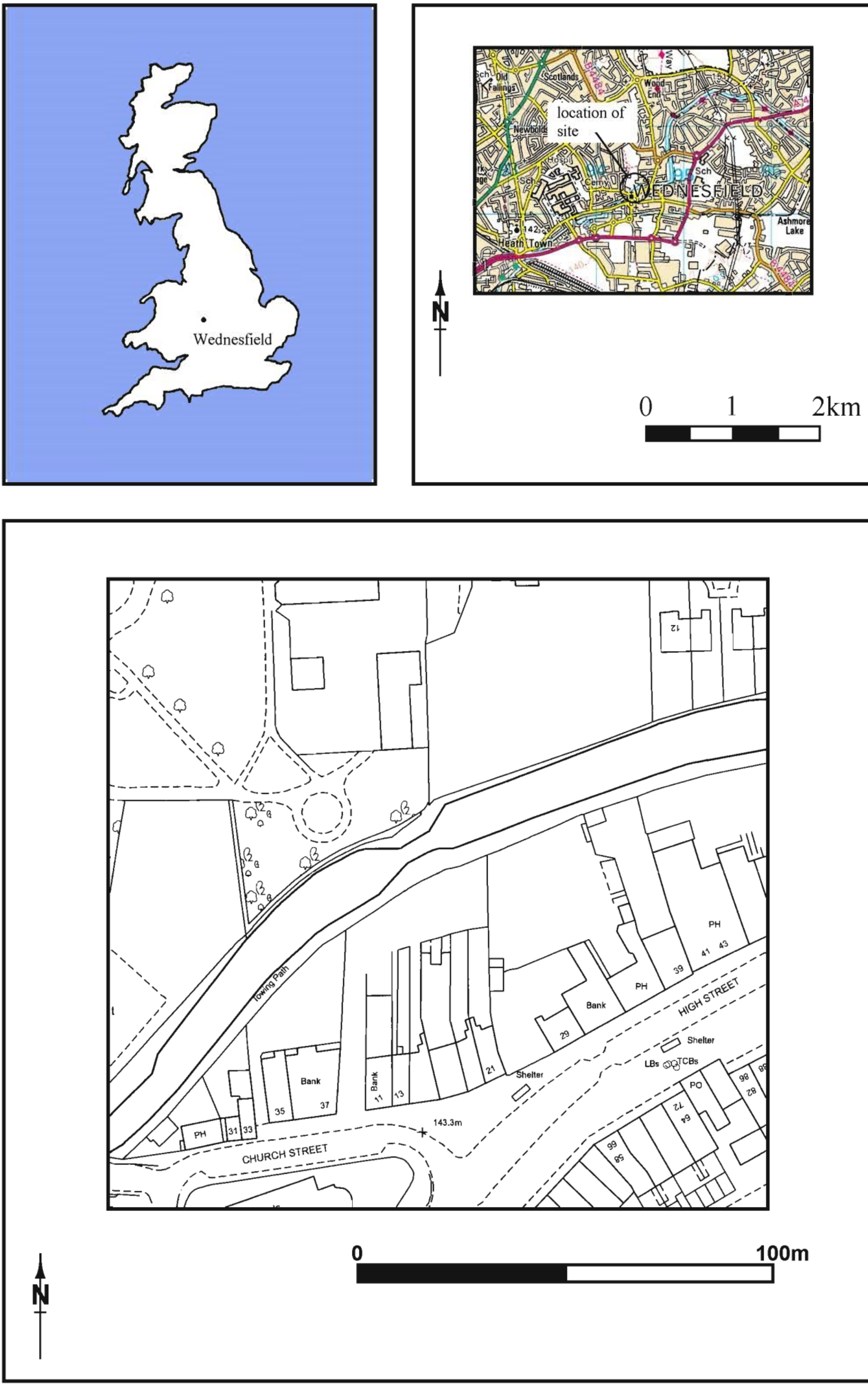
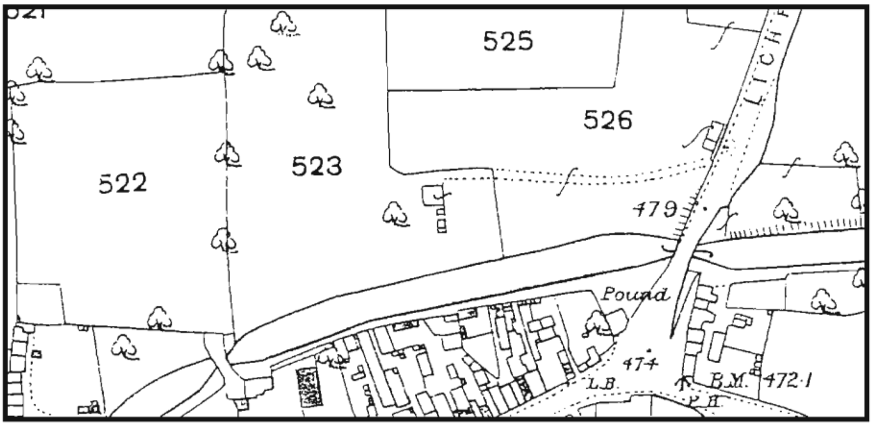
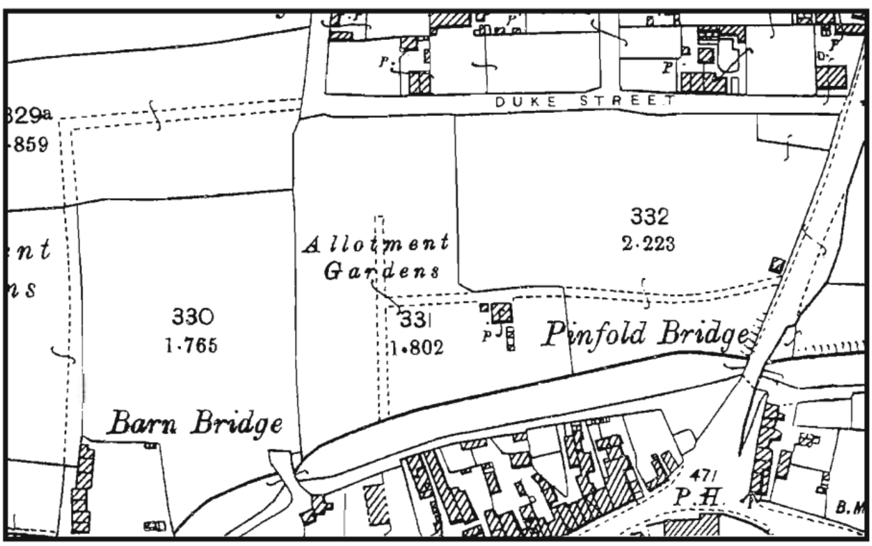


Fig 1: Location of site

1887



1902



1919

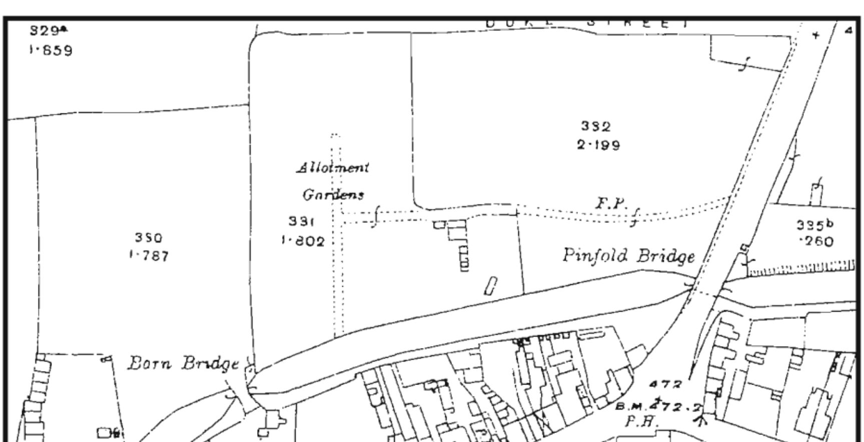


Fig 2.1 Historic mapping

1938

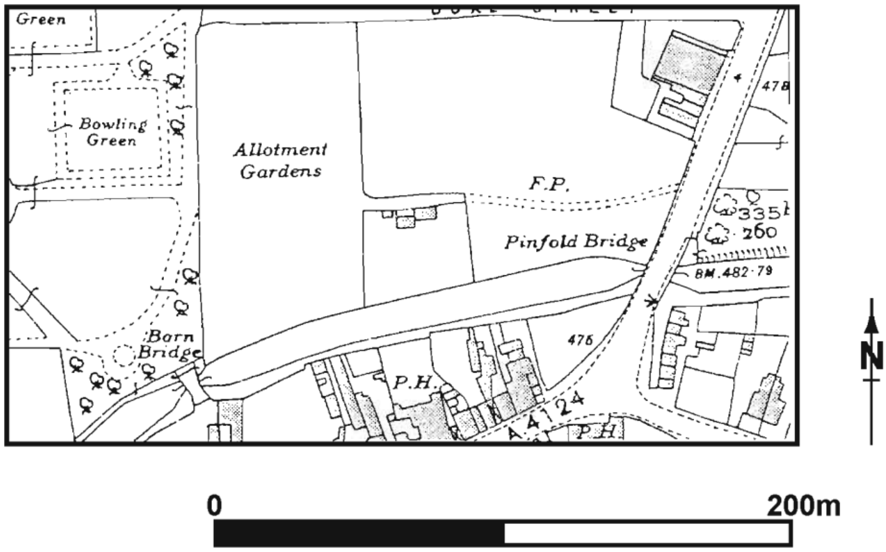
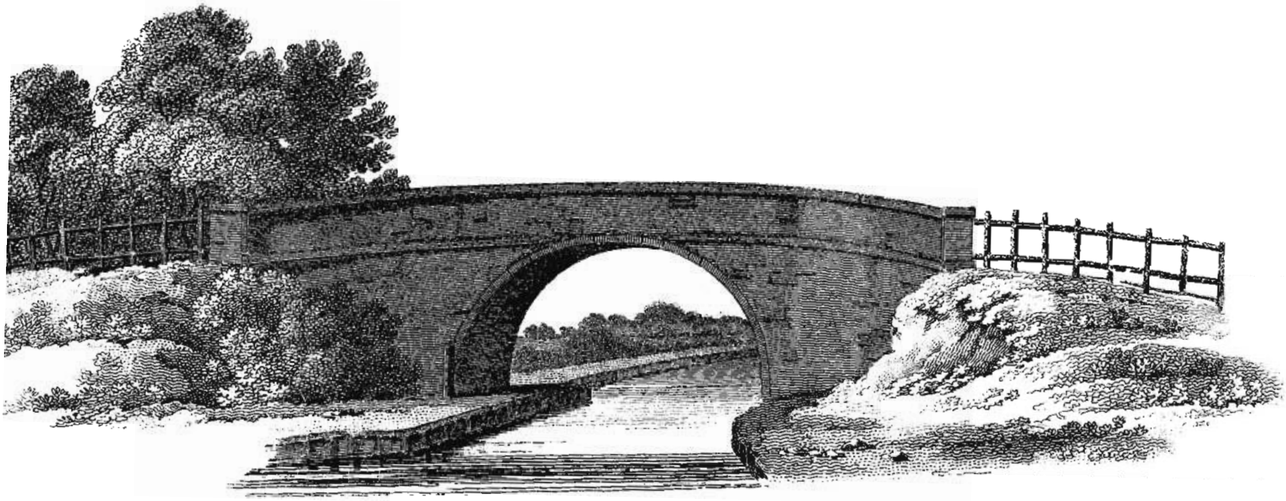
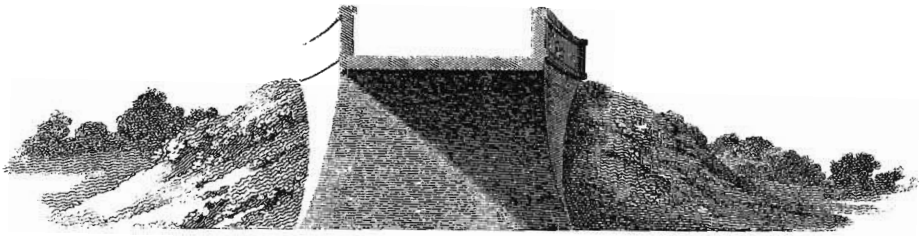


Fig 2.2: Historic mapping

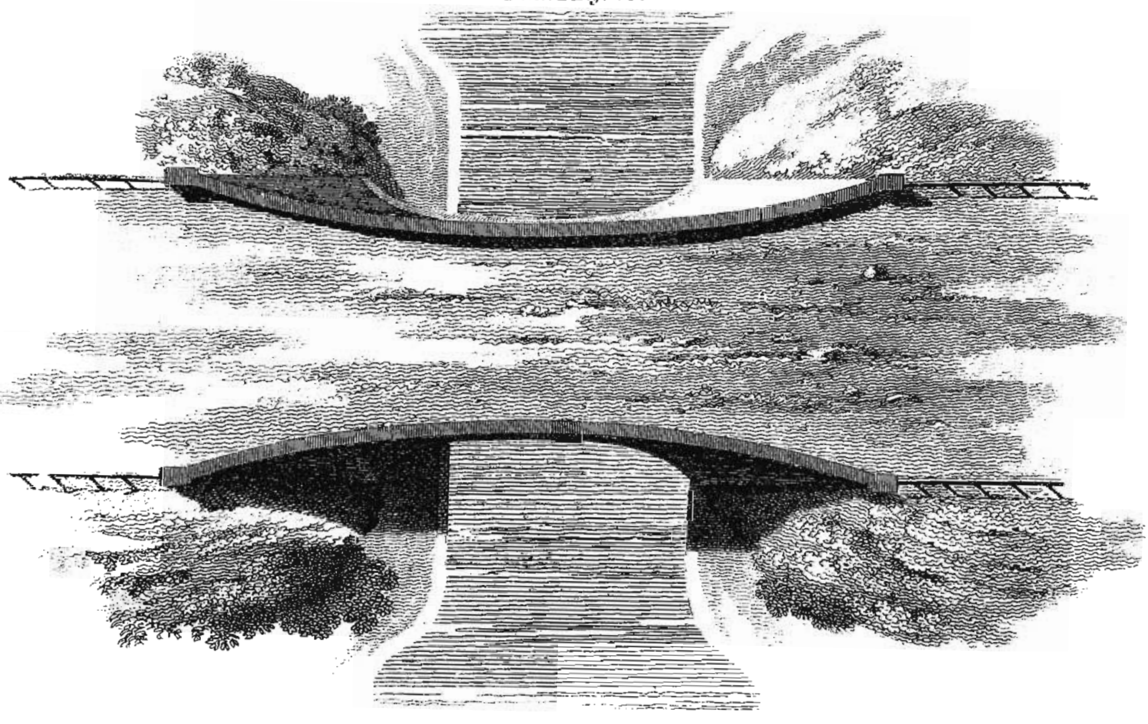
View_ Fig.42.



Section_Fig.41.



Plan_Fig. 40.



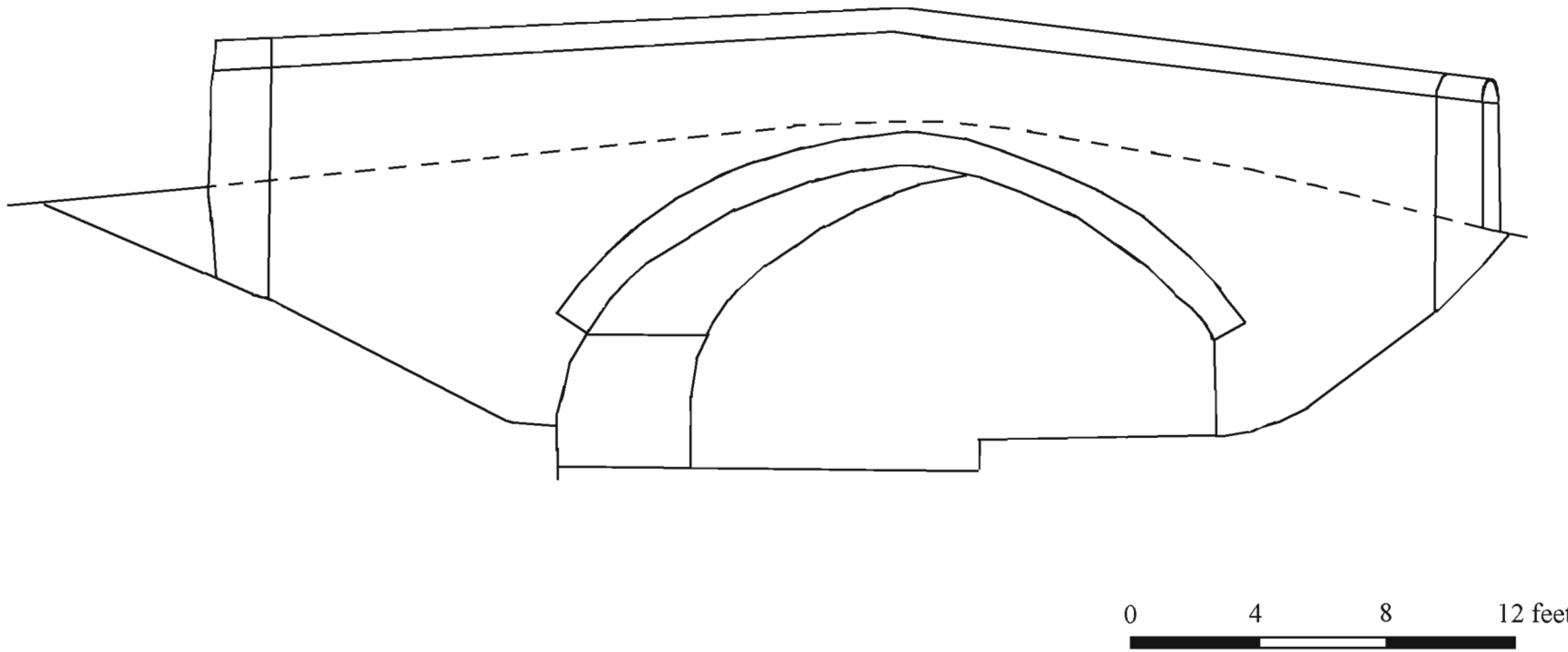
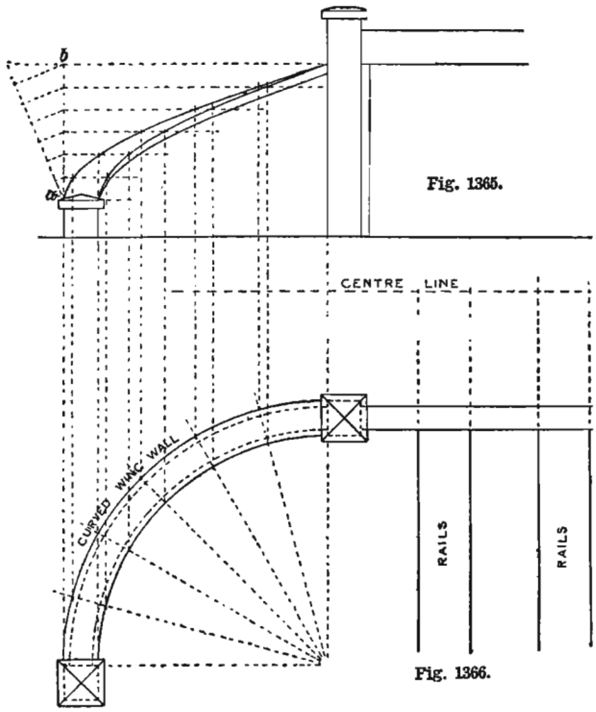


Fig 4.1: Woods Bridge, Lichfield Road, Wyrley and Essington Canal



Figs. 1365 and 1366.—Elevation and Plan of Curved Wing Wall to Overbridge.

Fig 4.2: Adams 1907, method of designing a curved wing wall

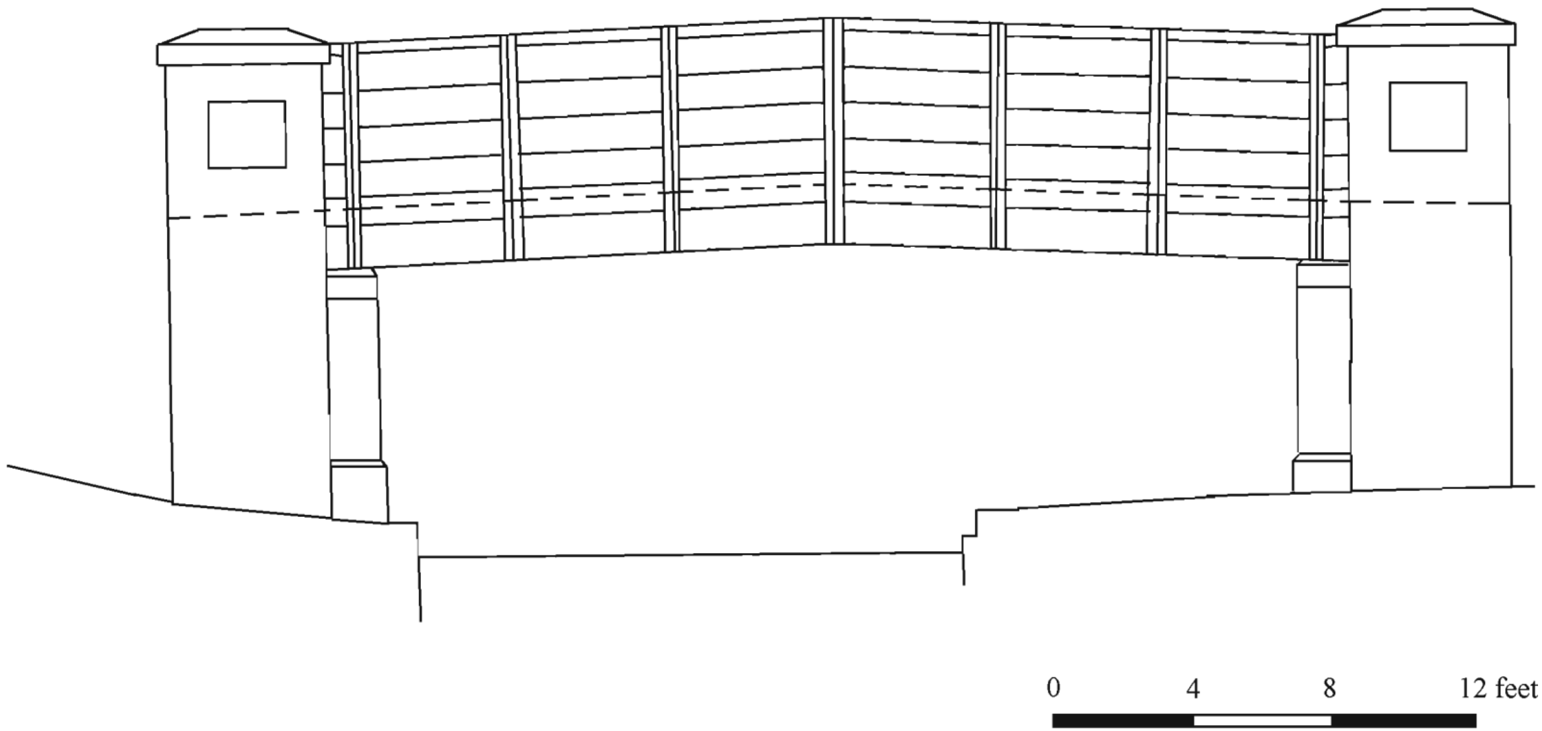
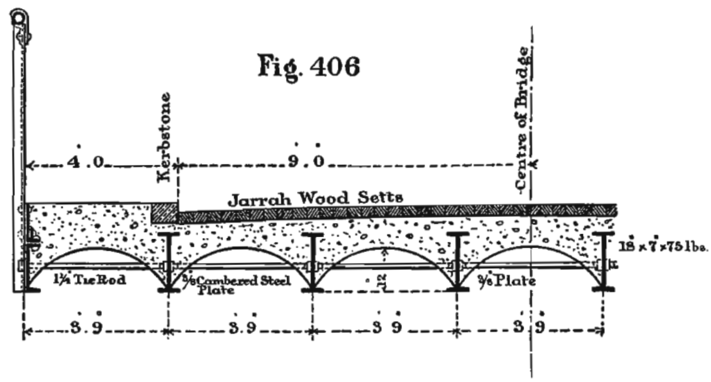


Fig 4.3: Edwards Bridge, Wyrley and Essington Canal



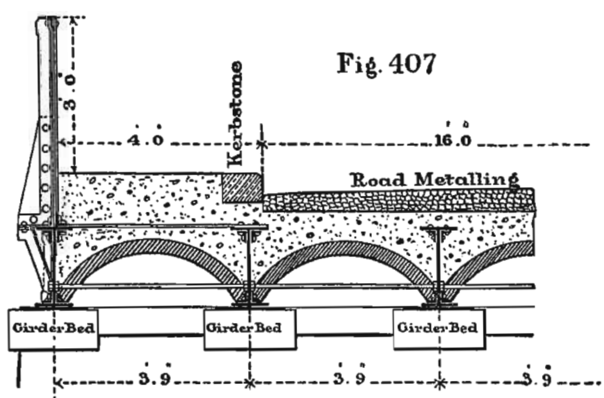


Fig 4.4: Davis 1908, design of bridge deck

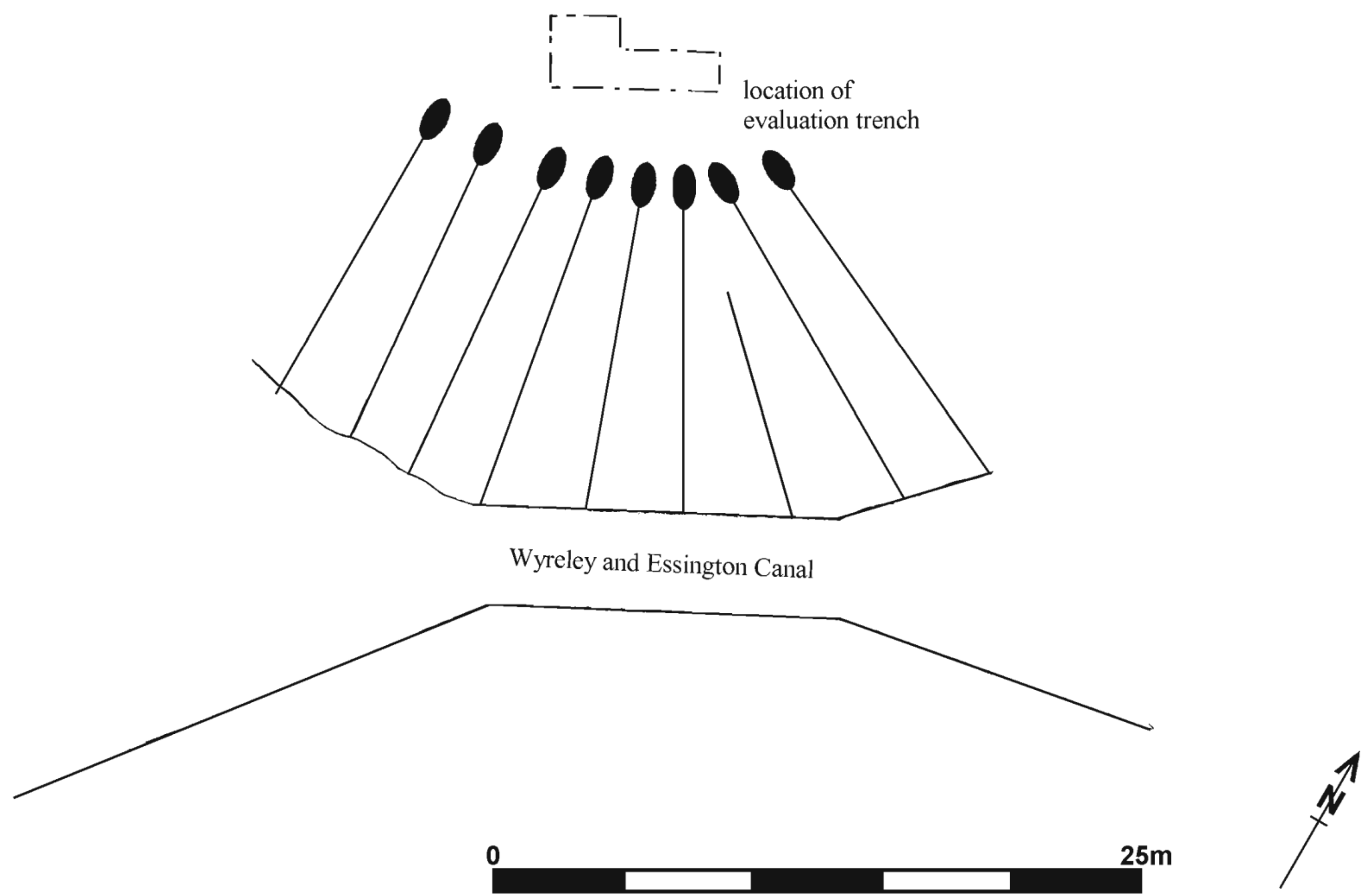


Fig 5:Location of evaluation trench

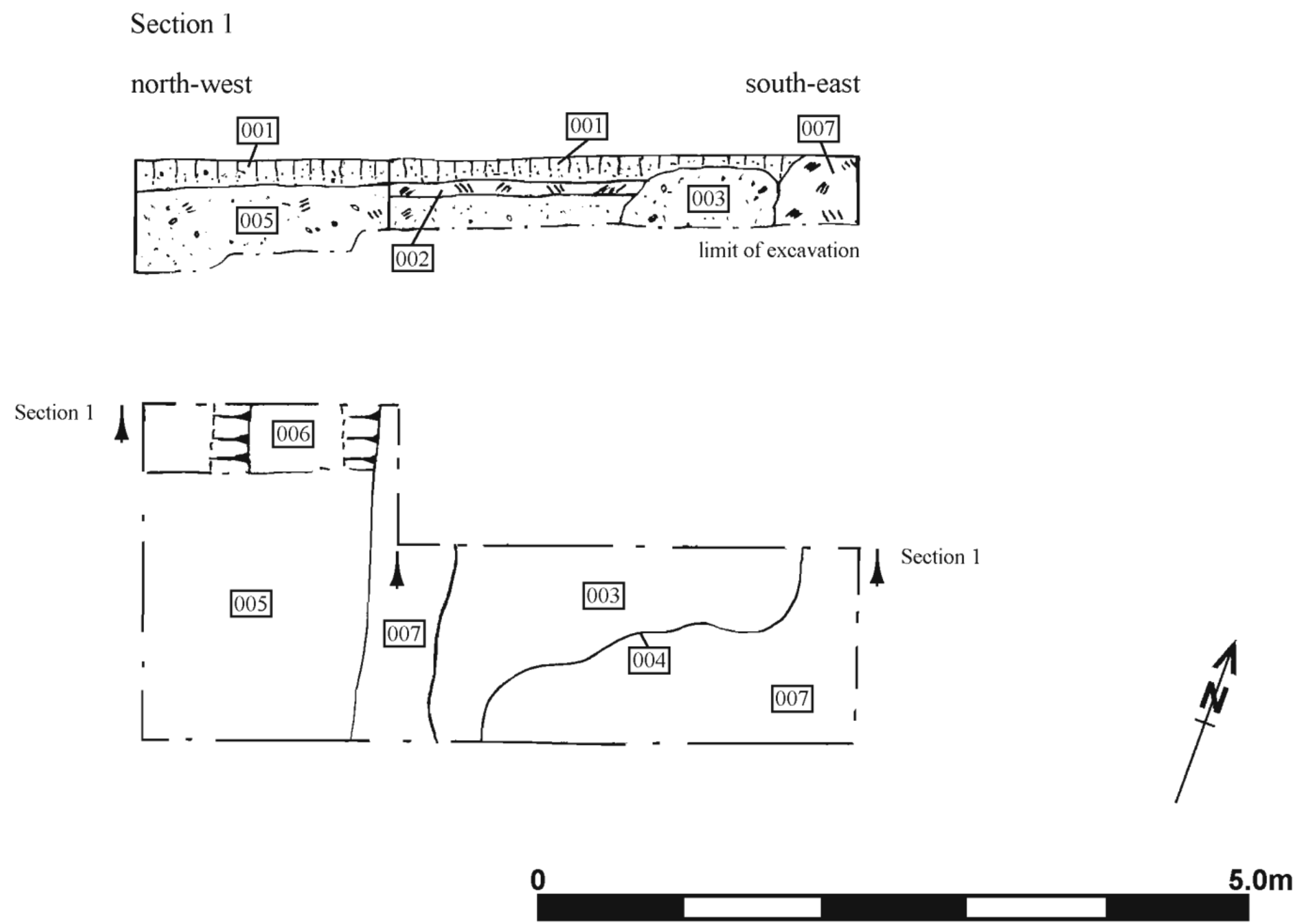


Fig 6: Evaluation plan and section

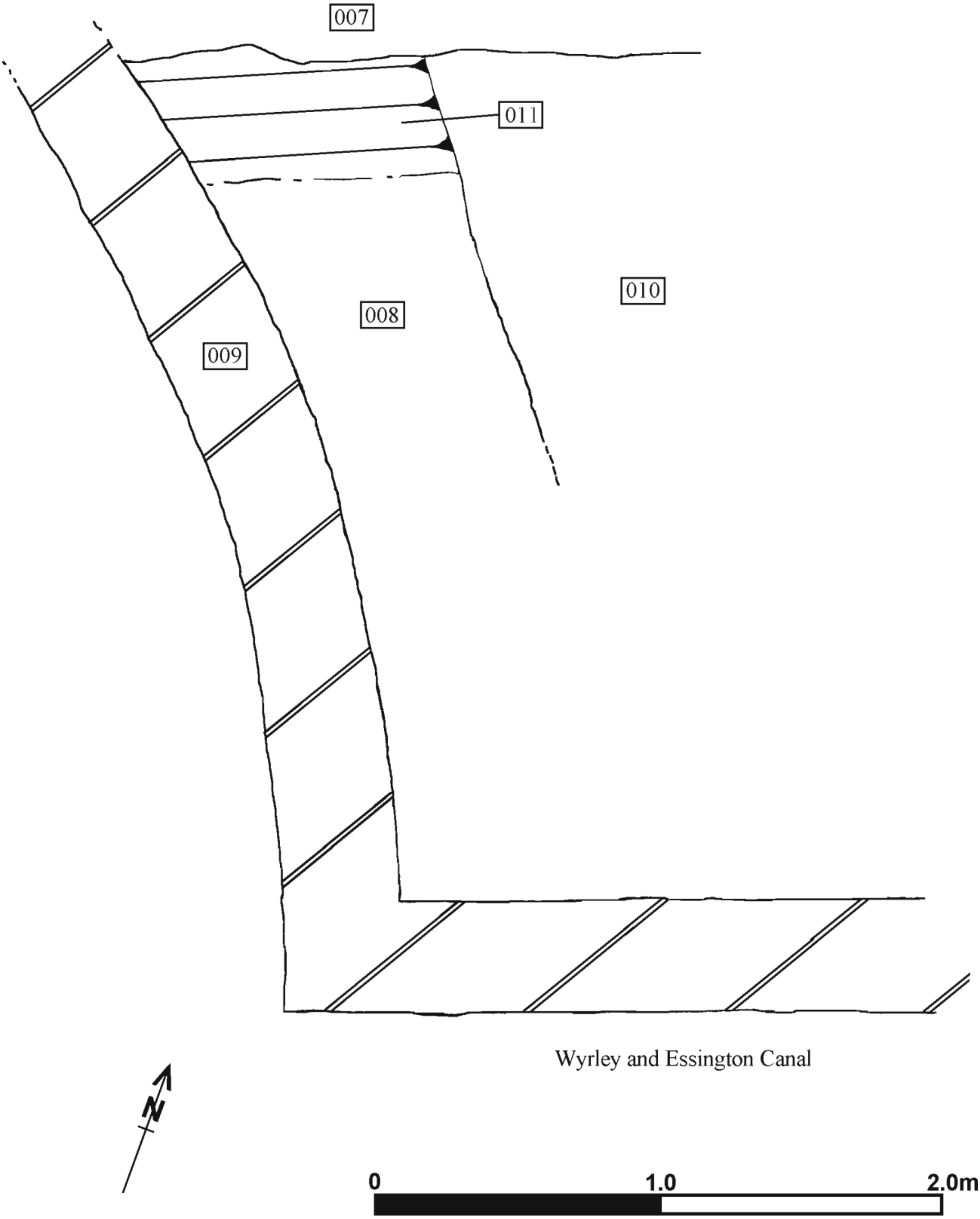


Fig 7: Recording of bridge abutment

Fig 8: Bridge at Tardebigge; Worcester and Birmingham Canal

Fig 9: Bridge at Hockley Heath; North Stratford Canal

Fig 10: Bridge at Lower Bittell Reservoir; Worcester and Birmingham Canal

Fig 11: General view of trench looking south-east

Fig 12: Contexts 005 and 006

Fig 13: View of northern bridge abutment showing curving wing wall

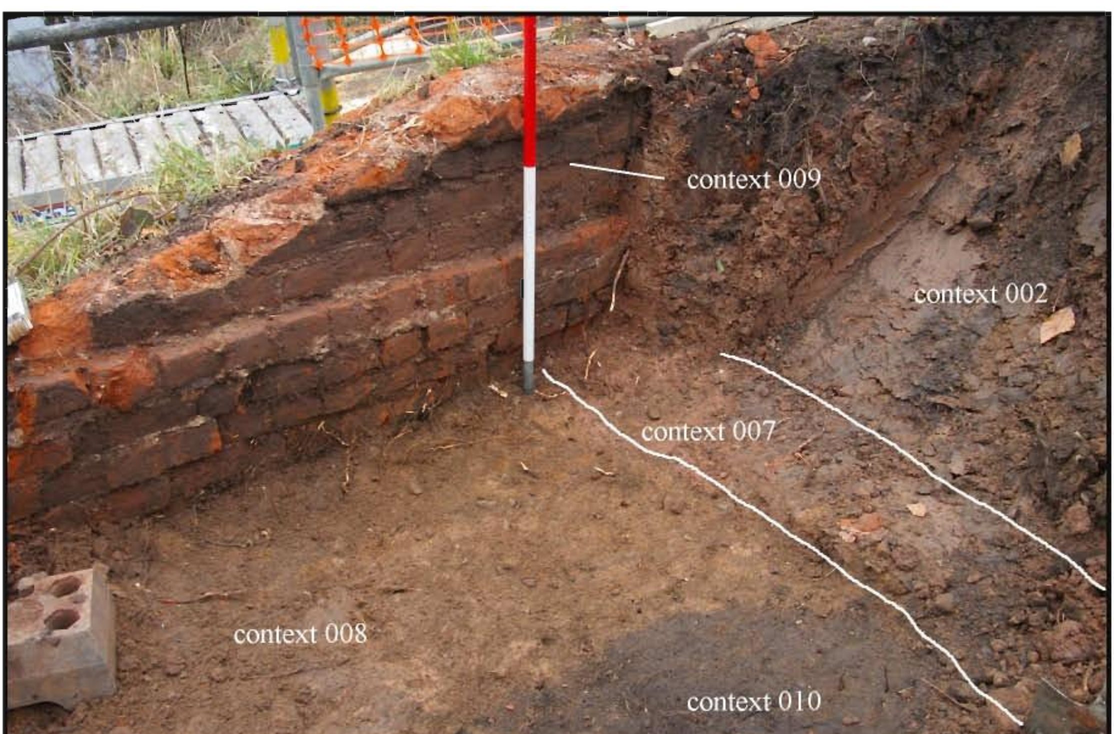


Fig 14: Contexts 008, 009 and 010

Appendix 1: Copy of the brief

Brief for archaeological desk-based assessment andrecording on site ofnew footbridge over Wyrley andEssington canal, rear of Wednesfield High Street, Wolverhampton 1. Introduction

1.1 British Waterways have been granted permission for the construction of a footbridge and approach ramp over the Wyrley and Essington Canal at rear of 11-21 High Street, Wednesfield.

1.2 The new footbridge is sited upon the footprint of an earlier bridge, the abutments of which can still be seen. Accordingly a condition has been attached to the permission requiring a scheme of archaeological work in advance of, and during, the construction work.

2. Site Location andDescription

2.1 The site lies to the rear of 11-31 High Street, Wednesfield, at SJ94480032. A footbridge over the Wyrley and Essington canal is shown here on the Ordnance Survey1st edition plan of 1887 (Black Country HER No 8500). It connected the town on the south bank of the canal with fields on the north. The bridge survived until the 1960s when it is marked on an A-Z street atlas as 'Barn Bridge'. It was subsequently demolished but its position is marked by a narrowing of the canal. Possible foundations for the bridge abutments can be seen on its north side.

3. Specific requirements

3.1 The purpose of the work is to assess the likelihood of the recovery of remains of the former bridge during the new work, to devise a strategy for the recording of any remains which are located and to carry out the recording.

3.2 The work should comprise:

(1) desk-based assessment to establish the history of theearlier bridge

(2) recording of the visible remains of the bridge

(3) evaluation to establish the nature, date, location, extent and quality of survival of archaeological deposits

(4) a strategyfor dealing with the archaeological remains, to be agreed with the Wolverhampton Council Archaeologist

(5) undertaking of the archaeological work

(6) analysis of the findings and production of a report upon the work

3.3 The desk-based assessment should comprise examination of material in the Wolverhampton Archives, including maps, primary documentation and secondarymaterial, and consultation of British Waterways records.

4. General conditions

4.1 The work should be undertaken by suitablyqualified and experienced archaeological staff, preferablyunder the supervision of a Member of the Institute of Field Archaeologists.

4.2 An appropriate recording strategy should be used and the method and justification for this stated in the reports.

4.3 The code of conduct, standards and guidance of the Institute of Field Archaeologists should be adhered to.

4.4 On completion of the work a report on the work should be compiled.
A draft of the report should be submitted to the Wolverhampton Council Archaeologist for comment ahead of its finalisation.

4.5 On completion of the report the site archive should be deposited with an appropriate museum/public archive. The site owner is encouraged to deposit any finds with the archive. In this case archives should be deposited with the Wolverhampton Archives Service (01902 552480).

4.6 Copies of all reports should be provided to the LPA,
Wolverhampton Archives Service and the Black Country Sites and Monuments Record. The report will normally become a publicly accessible part of the BCSMR within 6 months of completion. It is intended that a small number of slides or digital images shouldbe stored with the BCSMR. The contractor should therefore submit a copy of the digital images or the most relevant slides to the BCSMR together with the report.

4.7 Reports should contain the following information:

- Location, aims and methodology
- Results of documentary research
- A written summary of the findings together with appropriate illustrations, which should be related to the national grid. Levels should be related to the Ordnance Datum.
- An analytical summary of features and deposits
- A table showing categories and quantityof finds recoveredfrom each feature/deposit and where finds are dateable, such as pottery, their date
- Finds research to an appropriate level to be agreed with the Wolverhampton Council Archaeologist
- List of sources consulted and their full titles/reference numbers
- A copyof the brief

4.8 On completion of the work an OASIS record form should be completed and a summary report should be sent for publication in West Midlands Archaeology and anyother appropriate local or national archaeological journal.

4.9 Health and Safety

It is the responsibility of the contractor to ensure that all work is carried out in accordance with relevant Health and Safety regulations.

Site procedures should be in accordance with the guidance setout in the Health and SafetyManual of the Standing Conference of Archaeological Unit Managers

4.10 Monitoring

The work will be monitored bythe Wolverhampton Council Archaeologist on behalf of the Planning Authority and provisions for monitoring should be agreed with him. At least five working days notice of commencement of any fieldwork should be given to the Wolverhampton Council Archaeologist.

A draft of any report should be submitted to the Wolverhampton Council archaeologist for approval ahead of finalisation.

Contact details for Mike Shaw: tel 01902 555493; e-mail mike.shaw@wolverhampton.gov.uk; fax 01902 555637; address Wolverhampton Council Archaeologist, Wolverhampton City Council,

Regeneration and Environment, Civic Centre, St Peter's Square,
Wolverhampton WV1 1RP

Prepared on 12th June 2008 by Mike Shaw, Wolverhampton Council Archaeologist, on behalf of Wolverhampton City Council

Appendix 2: List of the contexts

Context No	Description	Interpretation
001	Dark grey brown sandy clay with occasional brick, tileand glass	Topsoil
002	Mid yellow orangetenacious clay	Redeposited natural subsoil
003	Dark grey brown sandy clay	Fill of 004
004	Cut	Treebole/animal burrow
005	Dark grey brown sandy clay	Fill of 006
006	Linear, stepped- bottom cut	Banked approach to bridge
007	Orange tenacious clay	Natural subsoil
008	Very sandy orangeclay with occasional medium rounded cobbles	Backfill of construction cut - 011- for 009
009	Brick wall - bricks are unfrogged; 250x110x80mm in lime mortar	Bridge wing wall
010	Dark grey brown sandy clay with common charcoal	Topsoil predating construction of bridge (sample)
011	Gently sloping cut from topsoil into subsoil	Construction cut for bridgewing wall; context 009

Appendix 3: Environmental analysis

Environmental remains from the Wyrley and Essington Canal, Wednesfield, West Midlands

Elizabeth Pearson

Introduction

Environmental remains from the Wyrley and Essington Canal, Wednesfield, West Midlands were analysed on behalf of Martin Cook. A single sample (context 010) of 5 litres was taken from the topsoil beneath a bridge on the canal. The canal was given Royal assent in the early 1790s and the bridge is thought to have been in existence from the mid 1800s when it is shown on a map (Martin Cook pers comm.). The aim of the analysis was to determine if any information could be provided on the crops grown in the field before the construction of the bridge, or any other activity carried out nearby.

Methods

The sample was processed usinga flotation tank by Martin Cook. The flot was collected on a 250□m and 1mm sieve. The flot was fully sorted usinga low power Brunel stereo light microscope. The abundance of each category of environmental remains was estimated and the plant remains identified usingmodern reference material and a seed identification manual (Capper *et al* 2006). Nomenclature for the plant remains follows the *New Flora of the British Isles*, 2nd edition (Stace 1997).

Results

The assemblage was dominated by abundant clinker fragments, with a single charred seed of corn marigold (*Chrysanthemum segetum*) and a possible unidentified cereal grain (cf Cereal sp indet). Unidentified root fragments, which have presumably survived in anaerobic conditions, were also abundant. The corn marigold is a common weed of acidic arable soils, and is most likely to have been introduced in burnt waste (which included crop material) added to the soil from domestic or industrial hearths or bonfires. The clinker suggests the presence of waste from coal fires.

Bibliography

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