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Part 15: Design Elements VI: Locks

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15 Design Elements VI: Locks

15.1 Introduction

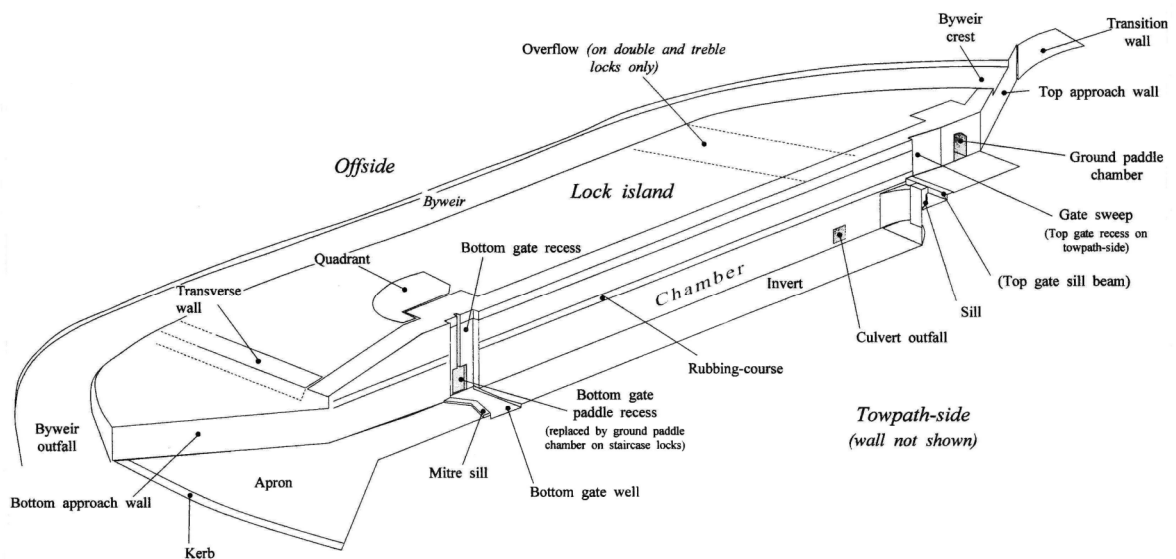
15.1.1 The single largest group of structures on the Killamarsh to Kiveton Park section are the locks. These are detailed in Appendix D, Table D2 and summarised in the table below.

15.1.2 It should be noted that in calculating costs and work programmes the number of locks is less significant than the number of structures. A structure is an indivisible unit which has to be built as a single entity or project element. While it is possible to build a single lock in isolation it is not possible to build one lock chamber out of a double, treble or quad lock structure. The summary table takes this into account by counting the number of structures first and the number of lock chambers second. Thus while there are some 13 original locks which remain to be repaired and reconstructed these are grouped into only four structures. The 23 new locks consist of 11 new structures. The design of these structures is discussed below.

	Proposed Working Sections					
	Killamarsh Town	Killamarsh East	Norwood	Wales	Kiveton Park	TOTAL
Length of Section	1354 m	1714 m	654 m	875 m	1845 m	6442
Existing Structures						
Treble Locks			3 (9)			3 (9)
Quad Locks			1 (4)			1 (4)
NEW Structures						
Single Locks	3 (3)	1(1)				3 (3)
Double Locks	2 (4)			2 (4)*		4 (8)
Treble Locks				2 (6)*	1 (3)	3 (9)
Five Rise Flight		1(5)				1 (6)
Totals						
Total Number of Locks	7	6	13	10	3	39*
Number of Existing Structures to be repaired	0	0	4	0	0	4
Number of New Structures to be constructed	5	2	0	4*	1	11

Figure 15.1 Summary of Proposed Locks (For all double, treble and quad locks the number is the number of structures – the number in brackets is the number of lock chambers or locks which make up the structure. Thus – one Double Lock Structure = 2 locks, one Treble Structure = 3 Locks, etc)
 (* = if a lower level passage under M1 can be secured the number of structures marked * can each be reduced by one and the number of locks adjusted accordingly)

Figure 15.2



Schematic arrangement of a typical lock on the Chesterfield Canal.

Source: Coxah & Gardner 2004, with permission (copyright British Waterways).

15.2 Historic Design & Appearance

- 15.2.1 All locks on the Chesterfield Canal west of (and including) Retford Town Lock were constructed as narrow locks with a chamber length of 72 ft and a nominal width of 7ft 6" although settlement has left several locks in the Turnerwood flight as narrow as 7ft in places. The original locks were all constructed between 1774 and 1777 and are of remarkably similar structure and design throughout the narrow length of the canal.
- 15.2.2 The general arrangement of a typical Chesterfield Canal lock is shown in Figure 15.2 above (British Waterways 2004).
- 15.2.3 The construction of these original locks was investigated in depth by archaeological excavation and recording during the reconstruction of the Turnerwood and Thorpe Salvin flights (British Waterways, 2004). This report showed how the locks were constructed and revealed many hidden features such as the presence of wooden "ground anchors" used to stabilise the lock chamber walls. The rotting of these ground anchors had led to structural failure and the bulging of the lock walls. By understanding the original construction methods British Waterways engineers were able to develop an appropriate and sensitive re-anchoring method and thus stabilise the Lock structures. These lessons have been well learned and will be applied to the repair and reconstruction of the Norwood flight.
- 15.2.4 The surviving locks the Derbyshire Section of the canal were all constructed of brick with large stone block coping or capping stones on the lock edge. Restoration to date has utilised both existing structures carefully repaired (e.g. Tapton Lock, grade II listed) and new structures constructed to give a similar visual appearance (e.g.

Dixon's Lock). The additional information afforded by the archaeological studies of the Turnerwood and Thorpe Salvin flights (Coxah & Gardner 2004) provides a wealth of detail which can be incorporated in the new structures between Killamarsh and Kiveton Park.

- 15.2.5 The structures of locks, flood gates and weirs are all similar and all employ similar materials and methods.

15.3 General Considerations in Design, Repair and Construction

- 15.3.1 Where the restoration and repair of original lock structures is required detailed archaeological work will be undertaken in parallel with the restoration process. This follows the best practice lessons learned from the Thorpe and Turnerwood Flights (cf. Coxah & Gardner 2004). All work on the structures will follow the guiding principles for the repair of heritage structures set out in Part Nine, above.
- 15.3.2 The materials used in the restoration will be congruent with those used on the new construction as described below. The historical design and traditional materials will contribute to the design of new structures.
- 15.3.3 All the locks on the diversionary route are to be built on greenfield sites – As new build structures they have no heritage component and as such can incorporate modern building materials. This freedom is tempered by a desire to incorporate traditional materials and to achieve an aesthetic blend with the restored structures.
- 15.3.4 The proposed new locks will be composite structures. The basic framework of the lock chamber, lock invert, lock sills and apron, ground paddle pit and sluice ways (culverts) will be cast using steel reinforced mass concrete. Where the site is physically constrained some elements may be prefabricated off-site and craned into position. The lock chamber will then be clad with high quality hard red brick, laid to Flemish bond, and tied back into the concrete by cast sills or lugs.
- 15.3.5 Brick will be locally sourced if at all possible. Coping stones will wherever possible be of recovered, recycled, local Coal Measures sandstone. Where this is not available then alternative stone of similar appearance (colour, structure and texture) will be employed.
- 15.3.6 For safety the lock chamber must incorporate a metal ladder with handrail. The ladder must be placed in a recessed slot in the centre of the lock wall on the towpath (i.e. most accessible) side. The ladder will extend the full depth of the lock and the handrails should extend above the lock chamber at the top to permit safe use. This “lock safety ladder” is a legal requirement. The methods used to introduce such ladders in the heritage structures on the Thorpe and Turnerwood Flights will be used on the Norwood Locks.
- 15.3.7 The lock gates consist of a single gate (with no gate paddle) at the top (uphill end) and two mitred gates with gate paddles at the bottom (downhill end) of the lock. Each gate has a balance beam which counterbalances the weight of the gate and is the lever which enables it to be opened or swung.
- 15.3.8 Timber gates with wooden balance beams will be employed. The alternative of steel gates was rejected as metal gates are notoriously difficult to swing, distort badly when subject to high temperatures or local temperature differentials and have been

a constant source of operational and maintenance problems elsewhere. Steel gates fitted in the 1980's are now being removed from other locations on the British Waterways network.

- 15.3.9 Lock gates are traditionally constructed from Oak and Elm which is proving difficult to source. Certified sustainable tropical hardwood timbers such as Ekki were recently employed in the renewal of the gates at Tapton Lock. These will be monitored over the next few years to determine their suitability in the local environment before a final decision is made as to the type of timber to be employed elsewhere. The key will be that whatever timber is selected it will only come from certified sustainable sources.
- 15.3.10 In order to operate the lock gates a space is required for the lock gate arms to swing in an arc about the pivot point. Although under special circumstances cranked arms can be constructed they are more difficult to operate and more costly to build than straight arms. The area covered by the arc of the balance beam swing is called a lock or gate quadrant and the ground under them always surfaced and is usually detailed in brick or stone with raised grip stones or bricks to enable the person swinging the lock to gain purchase.
- 15.3.11 Lock metalwork will, wherever possible follow the pattern employed by British Waterways in the restoration of the Thorpe and Turnerwood Flights. These are based on the design of the original paddle gear with the addition of modern safety features and an anti-vandal anti-tamper locking mechanism. The ironwork is craftsman produced locally in Worksop and is available to order.
- 15.3.12 Each lock has a **by-wash** to permit the flow of water along the canal even when the lock is not operating and all ground and gate paddles are shut – they prevent the canal from either becoming stagnant or flooding. The flow of water down the by-wash is controlled by a by-wash weir. The by-wash channel is usually situated on the non-towpath side of the canal. In some circumstance the by-wash is either partly or completely culverted or piped and underground.
- 15.3.13 All new by-washes channels will incorporate riffles to promote the oxygenation of the water. Where possible riffles will be introduced into existing by-washes where this does not damage the historic fabric.
- 15.3.14 Each new lock is designed with integral well and pump chambers to enable the fitting of back-pumping equipment should this be required as traffic increases.
- 15.3.15 To permit safe operation and access to the lock a bridge will usually be provided between banks. Where the local topography permits this often takes the form of a “tail bridge” over the downstream exit, or tail, from the lock. This arrangement it often combined with a minor road crossing and typical tail bridges can be seen at the Gringley Locks and Hollingwood Lock. A modern interpretation of this style is present at the new Dixons Lock (see figure 15.4, below).
- 15.3.16 In some cases there is no tail bridge and a simple narrow footbridge is attached to the upstream lock gate and swings with the gate. This design can be seen today at Tapton Lock and Forest Locks and is historically recorded at the Norwood Flight.

Figure 15.3



Tapton Lock

Surviving original lock (1777) much rebuilt by the Great Central Railway showing mixture of original stone and redbrick and later rebuilding with engineers blue brick

Figure 15.4



Hollingwood Lock.

Lock built by MS&LR in 1890 during construction of the Chesterfield Branch when the canal line was diverted from its original course around the Staveley Works. Note the extensive use of engineers blue brick with some red brick detailing & massive stone at wear critical points (e.g. copings).

Figure 15.5



Dixon's Lock.

Modern lock showing construction. The Lock is a replacement on new site for a lock which was destroyed in open cast mining. Hard red brick cladding on mass concrete walls, engineers blue brick detail, stone copings.

Largely constructed with volunteer labour by Chesterfield Canal Trust and Waterway Recovery Group.

Figure 15.6



Hollingwood Lock

Lower or “Downgate” end of lock, showing double gates with wooden balance beams above engineers blue brick quadrants. Note gate gear drive is off set from gate to enable the gear to be wound while the operator is on the bank, not on the gate plank.

Figure 15.7



Hollingwood Lock.

Downgate Gate Paddle Gear. Showing rack and pinion drive with off set drive shaft. Note ratchet and chain on bankside drive post.

Figure 15.8



Gringley Lock

Upgate Ground Paddle Gear showing later metal frame style with reduction gear and ratchet and pinion drive.

15.4 The Killamarsh Flight

15.4.1 Six new locks are required to carry the canal down from the long pound to the floor of the Rother Valley and Nethermoor Lake. None of these have historical precursors but all six will follow the basic design principles laid out above. The key structures are;

- Lock 6a Old Hall Farm Lock (rise 1.2 m)
- Lock 6b & 6c Killamarsh Top Double Locks (rise 3m + 3m = 6 m total)
- Lock 6d & 6e Killamarsh Middle Double Locks (rise 3m + 3m = 6 m total)
- Lock 6f Killamarsh Bottom Lock (rise 3 m)
- Lock 6g Nethermoor Lock and Floodgate

Lock 6a: Old Hall Farm Lock

15.4.2 This lock lowers the pound level by c.1.2 m. This is sufficient to enable the operation of the Walford Road Lift Bridge and reduces the pressure on existing earthworks throughout the Killamarsh section. The lock requires a diversion from the original route and will sit in a small landscaped area (“pocket park”) with access to and from the surrounding housing estates. To maintain existing route connectivity the lock will incorporate a tail bridge suitable for use by foot and cycle traffic (comparable with Dixon’s Lock).

Lock 6b & 6c: Killamarsh Top Double Locks

15.4.3 This is the first of the double or staircase locks with a total fall of 6 m in two 3 m steps. To maintain public rights of way the locks will incorporate a bridge over the lowermost lock tail.

Lock 6d & 6e: Killamarsh Middle Double Locks

15.4.4 The second staircase with an identical fall to that at 6b & 6c. A tail bridge is again present.

Lock 6f: Killamarsh Bottom Lock

15.4.5 This single lock takes the canal down a further 3 m to the Sheffield Road culvert level. The tail of the lock will be integral to the culvert.

15.4.6 The very short pounds between each lock on the Killamarsh Town Flight will only be large enough to permit boats to pass (mooring will be prohibited). The small size of the pounds could lead to water shortages on the flight as boat movements increase. To permit the latter installation of back pumping suitable pump chambers and sumps will be incorporated in all new locks from the outset.

Lock 6g: Nethermoor Lock and Flood Gate

15.4.7 This lock takes the canal through the Killamarsh flood-bank and lowers it to the level of the lake which occupies the partly infilled site of a former opencast coal mine. The lock has to be able to cope with potential flood conditions in Rother Valley Country Park and also with potential low summer water levels in Nethermoor Lake. The proposed lock has two parts; a conventional lock and a separate “guillotine” flood gate.

- 15.4.8 The lock will be constructed behind the flood bank with the bottom (down) gate well behind the bankcrest. It will incorporate a tail bridge (Nethermoor Lock Bridge, Bridge No. 27d) for foot, cycle and maintenance traffic which will maintain the current footpath along the flood bank. Beyond the tail bridge will be an independent electrically operated guillotine flood gate.
- 15.4.9 The lock chamber will be markedly deeper than normal operating requires to permit fluctuations in water level in Nethermoor lake. The lock is designed so that under normal circumstances it will have a fall of c.1.2 m, however the bottom sill level (lock bottom invert level) will be 1.0 m deeper than standard (i.e. in normal operation the lock will have c. 2.5 m of standing water at the end of its fall cycle) – linked to similarly deep exit channel linking the lock to the lake this will allow for lake level changes of around 1.0 m. Under drought conditions this will allow a safe fall of up to 2.7 m.
- 15.4.10 The lock bywash will be carried though the flood bank at 37.5 m AOD (just below the Sheffield Road Culvert pound level of 38.0 m AOD) by pipe and then flow though a non return flap valve to enter the lake via an concrete lined riffle channel. The oxygenating riffle extends from pipe entrance to below normal lake level to allow for water level changes.
- 15.4.11 The gates and paddles on the lock will follow normal practice, with the exception of the down gates being 1.0 m deeper to suit the lowered sill level. The flood gate will be an electrically operated guillotine gate operated by BW key (or local equivalent). Detailed design and decisions as to the method of operation (whether a local default closure system or a remote control linked to the flood control system in the Rother Valley) will follow the instructions of the Environment Agency.

15.5 The Moorhouse Flight

- 15.5.1 The Moorhouse Locks consist of a group of six locks which raise the diverted canal from Nethermoor lake back to the original line of the canal near the site of Ellison's Cottages. The six Moorhouse Locks will have a total rise of 20.1 m and each lock will have a rise of 3.35 m (approximately 11 ft).
- 15.5.2 At the bottom of the flight is Barber's Bridge (No.28). This will form the entrance to a flight of five locks in a single staircase formation (Moorhouse Five Rise, Locks 6h to 6l). Adjacent to the bridge and the bottom lock will be a pump house in canal vernacular style.
- 15.5.3 At the top of the Five Rise Locks will be a short pound bridged by Moorhouse Bridge (No.28a) and then a single lock (Moorhouse Junction Lock No.6m) which will bring the canal up to a junction with (and the level of) the original canal line. Moorhouse bridge is a foot and cycleway bridge designed to retain connectivity with the original towpath and its links into the village.
- 15.5.4 At the junction with original canal the mainline will be to the north, while the remains of the original line of the canal to the south will be reused to create a mooring arm – the Primrose Lane Moorings. At the head of the arm will be a full length winding hole, although shorter boats will be able to wind in the junction.

Figure 15.9



Modern Construction Methods: Droitwich Junction Canal Reinstatement

New locks under construction (spring 2009) showing similar style of construction to that proposed the chambers of the Norwood Extension, Wales and Hard Lane Locks.

These locks were designed by British Waterways.

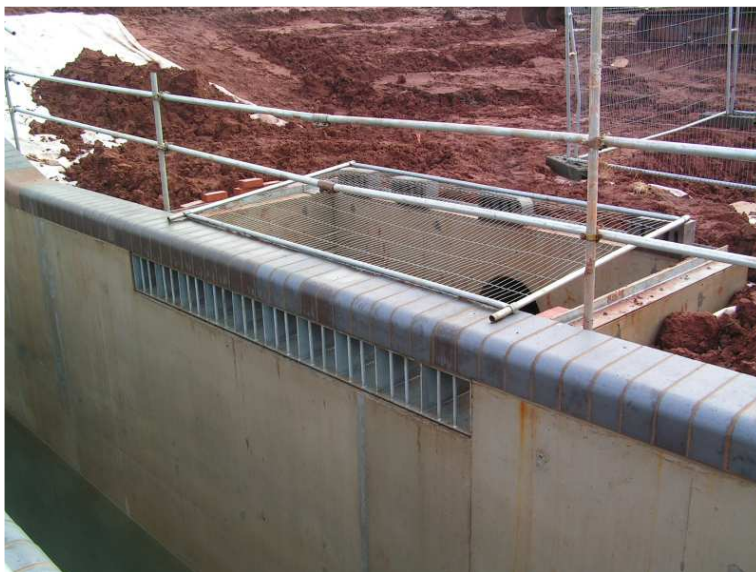
Figure 15.10



Modern Construction Methods: Droitwich Junction Canal Reinstatement

Top of the same two-rise staircase looking down. Note combination of traditional and modern materials.

Figure 15.11



Modern Construction Methods: Droitwich Junction Canal Reinstatement

Detail of Side Weir in lower lock chamber wall Showing composite concrete construction with visible brick capping

All photographs taken during site visit Spring 2009.

15.5.5 The Moorhouse Flight will be a very interesting and attractive group of features with considerable interest and incident for visitors. Given its location on the edge of

Rother Valley Country Park this has potential for development as a visitor attraction and the designs have identified possible locations for additional structures (such as visitor toilets and a small café) should this be required in future.

- 15.5.6 The flight has no historical precursor and will be built on a greenfield site with no previous built landuse. The approach to the locks from Nethermoor Lake will, however, be upon land previously mined by opencast methods.
- 15.5.7 The flight climbs the lower slopes of the Coal Measure escarpment. The slope profile rises quickly and then levels off as it approaches the line of the original canal. The structures will be founded upon weathered coal measure sandstones, shales and coals together with hill wash and solifluction deposits. Along the base of the escarpment (but not on the line of the flight) are a number of small intermittent springs and flushes. In consequence of the relatively unconsolidated substrate the flight will need to be anchored by extensive piling along its entire length.
- 15.5.8 The approach channel from Nethermoor lake to the foot of the flight will be partially founded upon opencast void backfill. The channel is an open cut and will have no structures which will cause loading problems. A flexible liner of traditional puddle clay will be sufficient for this length which will be at or near valley floor water level.
- 15.5.9 The flight will require back pumping from the outset. The necessary, sumps, pipe culverts and pipes will be integral to the structure. The pumphouse will be located at the foot of the flight. The pumphouse building will employ a canal vernacular style and has the potential to double as a visitor information point, lock keepers office or maintenance workers bothy.

15.6 The Norwood Flight

- 15.6.1 The Norwood flight is the single most significant waterways feature in the UK which is not legally protected. It is one of the nearly lost wonders of the waterways world and when restored has the potential to be an important tourist attraction on a par with the Caen Hill Flight on the Kennet and Avon Canal. Fortunately all the key structures including locks, byweirs and side ponds remain in-situ and are amenable to sympathetic restoration and re-use.
- 15.6.2 Finished and in operation by 1776, a year before the canal was formally fully open, the flight originally consisted of a single outlying lock at Belk Lane (now Sheffield Road) followed by a short pound and then the flight proper. This consisted of three three-rise locks and a single four-rise lock. These were linked to three large side ponds. The bywiers of these side ponds drained a boat dry dock and also drove a timber sawmill. The first boats on the canal were built here, while the timber yard and mill provided most to the original lock gates on the western section of the canal. The timber yard evolved into the main maintenance depot on the western half of the waterway and remained in use until the collapse of the Norwood Tunnel in 1907. The lack of re-development of the Norwood flight area has undoubtedly preserved much buried archaeological evidence for the methods use in the construction of the Norwood Tunnel and Flight (see archaeological assessment, Part 8).
- 15.6.3 The necessity of diverting the canal around Killamarsh means that Belk Lane Lock will not be re-used as it does not lay on the reinstatement route. Belk Lock is infilled

and only its coping stones are visible from Belk Lane (Sheffield Road) Bridge. It is proposed to erect display material to interpret the lock as part of an “old route” trail through Killamarsh once the reinstatement is complete.

- 15.6.4 Restoration of the thirteen original locks of the main flight will follow the heritage principles set out in Part 9 which were developed from the experiences gained in the restoration of the Thorpe Salvin and Turnerwood Flights. In short this means the locks will be restored to as far as possible their last working condition subject to any modifications required to meet modern health and safety legislation. This means retaining any rebuilding and modifications carried out prior to abandonment and clearly distinguishing modern modifications from original materials. Should the lock be too damaged or the previous repairs or modifications be obviously damaging to the older main fabric then these will be removed and the lock restored as far as possible to as close to its original condition as can be archaeologically established.
- 15.6.5 All the locks which comprise the Norwood Flight survive and are in varying states of preservation. The Lower Middle three-rise locks are infilled with earth and rubble although their outlines (marked by the lock wall coping stones) are clearly visible. The Lower and Upper-Middle three-rise locks have both had their lock gates removed and replaced by shallow brick weirs which allow water down from the summit to feed the side ponds (a pipeline maintains the water link through the Lower-Middle three-rise). Both the Lower and Upper-Middle three-rise locks are in reasonable condition and have received basic maintenance and repair. Both have been encroached upon by adjacent gardens and some imaginative landscaping will be required to meet landowner requirements. The side ponds have been recently dredged and are in use as ornamental and fishing ponds.
- 15.6.6 Within the flight the upper four-rise is in the poorest condition and has suffered from root penetration and frost damage. Water still, however, flows down the locks from the Tunnel entrance and the overall structure is clearly discernable. It should be noted that the overall condition of the main flight is no poorer than that of the Turnerwood and Thorpe Salvin flights which were sympathetically restored to full use in 2003.
- 15.6.7 Based on the experience gained by British Waterways in the restoration of locks to the east of the Norwood Tunnel it is likely that the lock walls will have suffered some movement since construction. The walls in all the locks on the Chesterfield Canal examined to date were originally anchored into the lock mound using wooden beams or “ground anchors” which have now decayed (see part 8). In many cases the lock inverts (lock bottoms) have also suffered damage or subsidence and were no longer effectively preventing the bottoms of the lock walls from settling or subsiding inwards. It is therefore likely that a number of the lock chambers on the Norwood flight will also be found to have developed irregular walls and/or will no longer be of a navigable width.
- 15.6.8 How these problems are treated will depend on the severity of damage:
- 15.6.9 Where the lock walls have only suffered slight movement and the lock invert is sound British Waterways and their contactors have developed a method replacing

Figure 15.12



Repairs on Misterton Top Lock showing bolting methods used to ground anchor lock walls.

This work was undertaken by British Waterways and their contractors using the methods employed on the restoration of the Thorpe and Turnerwood Flights.

the ground anchors. This involves drilling through the lock wall at an angle and inserting very long stainless steel ground anchors to which the wall is bolted via spreader plates (illustrated below). The spreader plates and bolt heads are embedded in the wall and their position is hidden by cosmetic bricks once the work is complete. This method allows some subsidence to be removed by gradual tightening and works to prevent further subsidence without the necessity of dismantling the heritage structure.

- 15.6.10 Where the damage is more extensive the lock walls or invert may require dismantling. Where this has to be done the section of lock will be archaeologically recorded and it will then be taken down under an archaeological watching brief. Materials will be salvaged and cleaned for re-use. The lock wall will then be rebuilt using modern ground anchors attached to the rear of the re-used heritage materials.
- 15.6.11 Based on the experience from Thorpe and Turnerwood it is likely that both methods will be used on a single structure. The methods developed by British Waterways are now recognised as industry best practice and are being applied on other waterways including the Cotswolds Canals.
- 15.6.12 The lower and middle sides ponds were originally navigable to enable access to the timber and construction yards and to lay up work boats when not required. As proposed here there is no requirement for the return of navigation to the side ponds and in-line barriers (together with fixed bridges) will prevent boating access. The ponds should however be dredged to their full original depth to ensure that they hold sufficient water to ensure the proper operation of the flight. This should be done cyclically to ensure a proper vegetated margin is maintained.
- 15.6.13 Water vole are present throughout the flight and works will be designed to improve vole habitats, notably by incorporating vole holes and soft banks in areas which are currently hard banked. A water vole protection strategy will be agreed with the Borough Ecologist and Natural England during the planning stage.

15.7 The Norwood Flight Extension

- 15.7.1 The Norwood Flight extension carries the canal up to the level where it passes under the M1 Motorway. The Flight extension consists of two treble (three-rise) locks. This may be reduced to two double (two-rise) locks if the lower option for the Motorway underpass is achievable.
- 15.7.2 Both the locks are sited on the coal measures escarpment and will require extensive piling to secure the foundations.
- 15.7.3 With the exception of the foundations the design will be visually comparable with the Wales and Hard lane Locks described below.

15.8 The Wales Locks

- 15.8.1 The Wales Locks carry the canal down from the M1 Motorway summit level to the level of the Kiveton Waters Ponds. They consist of two double (two-rise) locks; the Coalpit Lane Double Locks and the Wales Double Locks.
- 15.8.2 The locks are situated on the dip slope of the coal measure escarpment with relatively shallow (less than 1.5 m depth) superficial deposits. This is a relatively stable foundation environment and should not require piling.
- 15.8.3 Both Wales locks will have the same basic design based on a cast reinforced concrete invert and walls. The chamber walls will be cast smooth and there is at present no intention to clad these in brick. The walls will, however, be capped with local coal measures sandstone coping stones. These will “tie” the new structure to its historical surroundings. Leaving the working part of the lock – the chamber – in concrete reduces maintenance costs (no potential for damage to the cladding) and will not detract from the overall appearance as the walls will very quickly acquire a patina of dirt and algae. This style of construction has been used very successfully on the Droitwich Junction Canal reinstatement (see figures 15.9 to 15.11).
- 15.8.4 In common with the Drotwich locks the amount of water passing down the locks will be kept to a minimum. Open by-washes incorporating riffles and pools are proposed. Where space permits the by-washes may be enlarged to provide additional shallow water habitats.
- 15.8.5 The bottom and top approach walls will also be cast in steel reinforced concrete and will be integral to the main structure. These approach walls are very visible features extending 2 to 3 m above water level. Only the bottom parts will acquire a patina and the unlike the interior lock walls the majority of the wall will remain highly visible once the structure commences operation.
- 15.8.6 To reduce the visual impact it is proposed to clad them from c. 0.3 m below water level to the wall top in a single skin of hard red brick with a capping of the same local stone as is used on the lock margins. To enable this, the approach walls will incorporate a stepped profile with the upper part set back to accept the cladding. The brick courses will be tied back into the mass concrete using cast-in steel ties.

15.9 The Hard Lane Locks

- 15.9.1 The Hard Lane Locks carry the canal down into the last surviving fragment of the Norwood Tunnel and the Kiveton Park (Dog Kennels Bridge) pound level (the current “summit pound”).
- 15.9.2 The locks are a further Chesterfield style treble or three-rise staircase. The basic design will follow that for the Norwood Extension and Wales locks but with the chief modification that these locks will not have a separate bywash. For this pound the Broad Bridge Dike north of the canal will function as the lock bywash. This has the advantage of reducing sediment throughput to the foot of the locks where it could result in silting in the remaining fragment of the Norwood tunnel.
- 15.9.3 Provision will be made in the design for the addition of back pumping equipment should this be required by increased boat traffic at a later date.
- 15.9.4 The Hard Lane Locks will be founded on the remains of the Norwood Tunnel which is part infilled by a concrete plug (dating to the later phases of NCB operations on the site). The foundations will need to be designed in concert with those for the Hard Lane bridge / culvert.