





2. Aerial view of the Neptune Yard site in 2013, viewed from the west, showing the excavation site (arrowed), cleared of buildings prior to excavation and with the Ship Inn, site of the Segedunum Roman bathhouse, still standing 100 metres east of the waggonway site.

In response to a planning application made for the redevelopment of the site, which lies a little way to the west of the site of the Roman Wall fort of *Segedunum*, an archaeological assessment was carried out in order to determine its potential to preserve significant archaeological remains, although the likely presence of an early waggonway was not at that stage strongly suspected. The desk-based study provided to Shepherd Offshore, owners of the site, suggested that successive phases of heavy industrial development over the 19th and 20th centuries – most notably the insertion of a range of dry docks - had reduced the chances for extensive preservation of archaeological remains on the site, although it was considered that isolated pockets could have survived on the yard's upper terrace away from the river and along the northern riverside where developments had been less intensive. On that basis, invasive evaluation of the site by excavation was requested in order to test the possibility that significant remains could survive.

3. Plan of the Neptune Yard 2B Site (dotted red outline) showing the evaluation trenches excavated in May 2013 (red fills) and the principal site of excavation (purple fill).



Seven trenches were excavated across the site, revealing natural fluvial deposits at a depth of about 3 metres close to the riverside and clay sub-soil at shallow depths in the other trenches scattered across the terraced areas to the north-west. Significant archaeological remains were seen only in a trench close to the north-east edge of the site, where the remains of a sandstone rubble wall were uncovered on a north-west to south-east alignment. The presence of silt infused with coal dust below this feature, which appeared at the extreme south-east end of the evaluation trench, prompted further investigation. Thereafter, ground reduction works in the north-east area of the site – part of the development remediation programme - were monitored by archaeological watching brief in order to record any other remains of significance. It was stipulated that both time and resources would be allowed for the full excavation of any significant features revealed during the works and for the completion of specialist analysis of artefacts and other materials recovered.

#### *Geology and Topography*

The excavation site sits upon a solid geology of Carboniferous shales, sandstones and limestones interleaved with bands of coal and overlain by natural clay deposits which are in some places up to c. 7.6 m deep. These superficial deposits seen within the excavation site consist of dull brown to buff yellow clays formed as peri- and post-glacial drift.

The site is predominantly flat, but slopes or terraces sharply upwards to the riverside road on its landward side. However, the current flat topography of the site is partly a product of infilling and previous episodes of industrial development, including the construction of dry docks. Geotechnical data indicate that the made ground varies from 0.5 m thick in the north part of the site, increasing to around 11.5 m in south part nearest to the river. The made ground is typically a mixture of ashy gravel and reworked gravelly clay and silt, which towards the river, is underlain by a wedge of alluvium comprising silts, sands and clays which increase in thickness towards the River Tyne.

### Previous Investigations

Prior to the commencement of archaeological desk-top and fieldwork on the site in 2009, there had been no archaeological investigations within the Neptune Yard Site, although more than 20 episodes of archaeological work have been undertaken and reported in the wider vicinity, the majority in Wallsend associated with the *Segedunum* Roman Fort site. Since 2009, The Archaeological Practice Ltd. has carried out three main phases of archaeological works on associated parts of the Neptune Yard site to the south of Site 2B. In early 2009 the southern area of the former Neptune Yard was subject to an archaeological assessment followed by invasive trenching in March 2009 and further monitoring in October 2009 which recorded no significant archaeological remains or structures. In April 2010 the central part of the former Neptune Yard site was subject to an archaeological assessment, followed, in Summer 2011 by archaeological evaluation which revealed successive deposits of modern, industrial character, overlying a puddled natural clay deposit, but no archaeological remains of importance. Finally, in December 2010 and January 2011 a photographic survey record was carried out in advance of the proposed infilling of the docks in the northern part of the former Neptune Yard site.

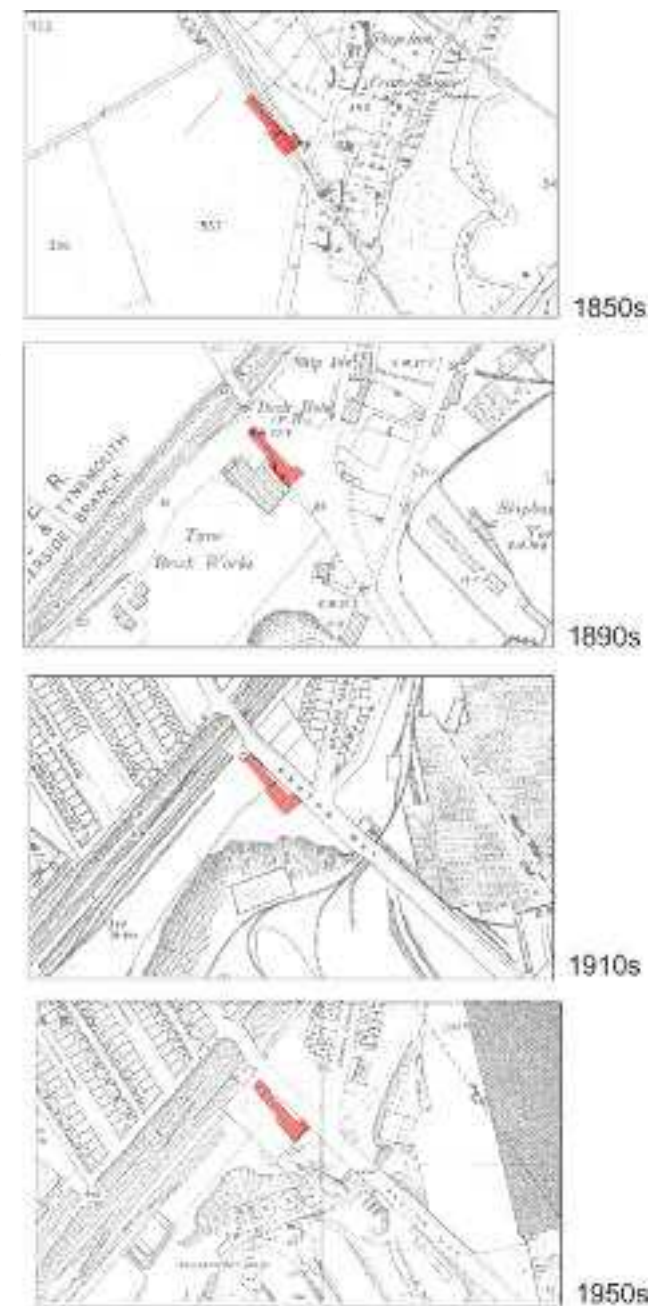
### Summary of historical development based on documentary investigations prior to excavation

A desk based cultural heritage assessment for the former Neptune Yard 2B site was undertaken by The Archaeological Practice Ltd in April 2013 (TAP 2013a), building upon and revising the results of earlier studies from the period 2009-11 (above). Based on historic accounts, maps, previous investigations in the locality and the Newcastle Historic Environment Record it was concluded that, while there is no evidence for settlement upon or use of the site during the prehistoric or Roman periods, the river and riverside was extensively used during those periods and it is almost certain that at least intermittent activity occurred on this stretch of riverside. The position of *Segedunum* Roman Fort, its associated vicus (HER ref. 806; see also TAP 2006) and other associated elements of the Hadrian's Wall frontier complex increase the possibility that Roman activity occurred within the site. Various antiquarian records noted by Breeze (2006) attest that the vicus, or civilian settlement associated with the fort, extended along the north bank of the river, while the antiquarian Horsley observed building remains on the slope between the south fort rampart and the Tyne, also extending south-west of the fort. Over the years many random finds of coins, metalwork, querns, animal bones and Roman pottery have been made in this area and excavations in advance of a new dry dock at Swan Hunter's Shipyard in 2002, revealed a sequence of banks and ditches 75 metres south of the fort, forming elements of a defensive cordon probably defining the south side of the vicus. These features lay parallel to the Roman riverbank, some 160 metres north of the modern high water mark. In 2014, the long-suspected location of the *Segedunum* bathhouse (see TAP 2013b) - first reported in 1814 during construction of a railway adjacent to the Willington line - was confirmed and opened to reveal its extensive remains some 100 m north-east of the Neptune Yard site.

Nothing substantial is known about medieval occupation or activity on the site following the Roman withdrawal, but it is possible that it continued to be used for various subsistence- and transport-related activities, including the shipment of coal. In the post-medieval period, the first

evidence for specific uses of the Walker and Wallsend riverside come from 17th and 18th century references to coal-mining, coal transportation and ironworking. Although historic maps indicate that the site is likely to have remained essentially rural in character until the mid-19th century, several late 18th and early 19th century maps show waggonways linked to local collieries at Walker, Wallsend and Bigges Main, running through the site and just to the east of it towards riverside staiths. The first of these waggonways, the Bigges Main or Willington Waggonway, was constructed close to the northern border of the excavation site, south of a contemporary windmill which lay some 100 metres to the north-west. A subsequent plan, dating from 1811, shows the (Bigges Main) Willington Waggonway in the same position, with the Coxlodge & Kenton Waggon Way and adjacent Fawdon Waggonway both running in obliquely from the north and all served by conjoining staiths on the riverside.

By the time of the first edition Ordnance Survey plan surveyed in the late 1850s (Illus. 04) there is no sign of the former Coxlodge & Kenton line, but the other two lines survive either side of it, that on the north side now reaching the 'Heaton Staiths' and that on the south, the former Willington Waggon Way, re-named the 'Gosforth & Kenton Waggon Way', running down to the Coxlodge Staiths on the riverside. The Gosforth and Kenton Waggonway - opened between 1808 and 1813, partially following the route of earlier waggonways - is subsequently shown as the 'disused' Coxlodge Waggonway on the 2nd edition Ordnance Survey Plan (published 1898). North of the site is a cluster of buildings including the 'Ship Inn' public house and 'Crane House' buildings (by the end of the century the Dock Inn public house was built at the south end of the same row); Wallsend colliery lies approximately 200 m north-east, a similar distance to the Roman fort which lies to the north.



4. Historic Ordnance Survey plans with excavation site highlighted.

The previous illustrations are part of the developments which changed the rural character of the area from the early 19th century, accelerating during the middle part of the century and thereafter (see Illus. 04), with shipbuilding, waggonways, coal staiths and related industries competing for space. The earliest known shipbuilding concerns adjacent to the site produced wooden vessels, but from the 1840s onwards construction changed to iron-hulled ships, rapidly making this stretch of riverside one of the most productive in the world. The Neptune yard 2B site appears to have been partially levelled for the installation of ship-building pontoons and a dry dock in the later 19th century - Wigham, Richardson and Co. Ltd. formed the Tyne Pontoons and Dry Docks Co. Ltd. in 1880 as a dedicated ship repair yard – and a 260 feet long pontoon dock was designed for the yard by Andrew Taylor, built in 1882. The yard became part of the new Swan Hunter & Wigham Richardson company in 1903. A third dry dock was opened in the mid-1930s with a fourth in 1957. In 1966, the Wallsend repair yard, along with Smith's Docks in North Shields became Swan Hunter Ship Repairers Ltd., and associated with this development was the removal of more of the artificial cliff created between the upper and lower parts of the site. Other than structures directly related to shipbuilding, the Tyne Brickworks is shown south-west of, but slightly encroaching upon the excavation site on the second edition Ordnance Survey plan. Davison (1988, 61) gives a likely date of inception for the Tyne Brickworks as 1895, noting that in 1897 a Porter's brick-making machine was producing 75,000 bricks per week but production soon increased to 100,000 per week. Davison (ibid.) states that the brick clay was derived from a local clay pit and also notes the presence on site of a large drying shed and external drying area, as well as seven kilns.

The later history of the site is one of repeated phases of construction and demolition of structures associated with the dry docks and development of railway lines and sidings on the upper, western part of the site, culminating in the abandonment of the site for shipbuilding in the late 20th century, since when all structures on the site have been razed and, latterly, the dry docks infilled. Later editions of the Ordnance Survey Map series and aerial views of the site show the site of excavations reported here to be occupied, until its demolition in the early part of the present century, by a large brick building, part of the ship-repair works. The Neptune Yard 2B site was eventually levelled, following archaeological evaluation, in the Summer of 2013, while three of the four dry docks on the site were infilled between 2011-13 with clay derived from the remediation of other parts of the Neptune Yard site and, latterly, river-bed deposits dredged from the Tyne in Summer 2013.

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## *Background to the History and Excavation of Early Wooden Ways in Northern Britain*

### *Introduction*

The Diolkos paved trackway allowed wheeled vehicles to cross the Isthmus of Corinth from around the 6th century BC to the 1st century AD., using grooves in the limestone bedrock to act as guides, or tracks. Wooden railways, where wheeled vehicles hauled by people or horses run

on rails, or tracks, appeared from as early as the early 16th century in Germany and Austria, from where the technology was transported, through mining engineers, elsewhere in Europe (Lewis 1970, 8-10), including the Carpathian Mountains in Central and Eastern Europe and the Cumbrian fells of Britain. Two systems were in use from an early period, one - as illustrated in Germany in 1556 (Georgius Agricola 1913, 156) - used 'Hund' carts running on parallel wooden planks or board rails steered by a vertical pin on the truck which fitted between the planks (see Illus. 05), while the other was the 'Reisen', using narrow rails and flanged wheels more akin to the modern railway. Although the first use of a waggonway in Britain appears to be the plank system used by German miners at Caldbeck, Cumbria in the 1560s (Allison et. al. 2010), the Reisen system was that adopted in Britain for above-ground use in association with coal transport.

The example of Goldscope, though arguably not integral to the subsequent development of overland waggonways in Britain, does serve to exemplify the way in which the involvement of financial investors was crucial from the outset. In the mid-16th century Britain imported most of its copper for domestic and military purposes, so in 1563 Haug Langnauer and Company of Augsburg were authorised by the Crown to prospect for copper in England where, in 1566 they opened 'Gottes gabe' ('God's Gift'; now corrupted to 'Goldscope') mine in the Newlands Valley near Keswick (Allison et. al. 2010, 54)<sup>1</sup>, as well as others across a swathe of Cumbrian fell country between Kendal and Buttermere. In 1568 Daniel Hoehstetter, the Austrian-trained mines manager of the German-English 'Company of Mines Royal', a newly-formed state monopoly established in 1564 by Elizabeth I (Allison et. al. 2010, 53), brought to the Cumbrian fells knowledge of the latest mining technology, which included 'Hund' trucks and 'Riesen', along with 150 Austrian and German miners.<sup>2</sup> While the topography probably precluded the building of 'Riesen' to bring ore to the smelting works (Gwynne 2009), 'Hund' (locally 'Rowle') trucks were certainly used, as evidenced in Hoehstetter's notebook and in the remains of Hund trucks found in Goldscope mine with plank rails and part of a continental shovel in 1997 (Allison et. al. 2010).



5. 'Hund' track remains, Caldbeck Fells, Cumbria in 2006 (in Gwynne 2009).



6. Wooden rails of a narrow gauge mineral railway in the Low Bottom Level on the Gilderdale burn, North Pennines photographed in October 2017.

The Wollaton Waggonway from Strelley to Wollaton near Nottingham, completed in 1604 by Huntingdon Beaumont, is the earliest proven British railway of Reisen type (another alluded to at Prescott, near Liverpool up to a decade previously (Jones 2012, 5), is unproven), but others rapidly followed, at Broseley & Willey in Shropshire by 1605 (King 2010) and in south Northumberland where Huntingdon Beaumont was operating at least three short-lived waggonways on the banks of the river Blyth at Bedlington, Cowpen and Bebside by 1608 (Palmer et al 2012, 243).<sup>3</sup> Evidence from Wollaton and Broseley indicate such early railways had flanged wheels running on wooden beams, or edge rails. On the Tyne, the Whickham Grand Lease Way, which probably opened around 1621, is the first such waggonway evidenced by surviving documents or material remains and its earthwork remains have been traced along part of its course by those pioneering historians of Tyneside waggonways, Bennett, Clavering and Rounding (Bennett et. al. 1990b, 8-9). The courses of other early 17th century waggonways on the south side of the Tyne, including The Selby Waggonway (1630s), Winlton or Brockwell Waggonway (1633), Stella Grand Lease Waggonway (1633), Chopwell Waggonway (by 1661) and Crawcrook Waggonway (by 1663), all of which terminate on the south bank of the Tyne at Stella, have also been traced (1990b, 17-21), but generally survive only partially.

The type of waggons used on these early waggonways is not known, but probably evolved from the standard coal wains used at the time. Later, the hopper body evolved as the best shape and the North East chaldron measure for coal became a standard measure with waggons built to take that load. The construction of waggonways changed relatively little during the remainder of the 17th century and into the 18th century, although the early single-track routes was replaced by the mid-18th century by a two-track system, with a main way for full chaldrons on their way to the staiths and a by way for the returning empty vehicles. Eighteenth century experiments with an L-shaped iron rail system and unflanged wheels - a now-redundant system known as a plateway - did not succeed but the introduction of flat iron plates in the later 18th century, fixed to the top of wooden rails in order to preserve them was more successful and led, ultimately, to the introduction of more resilient iron rails which came to replace wooden rails, a process hastened from around 1810 by the development of heavy steam locomotives. Wooden waggonways did not entirely die out at this time, however, since many already in existence, as at Lambton 'D' pit near Sunderland, continued in use for several decades while others were built for local mining operations throughout the 19th century and into the early part of the 20th century, as seems to be the case with the newly-discovered Gilderdale Low Bottom level waggonway near Alston in the North Pennines (Illus. 06 and see TAP 2017).

#### *Waggonways in North-East England*

The early adoption of waggonways in the north-east of England, responding to the region's increasing dominance in the British coal-mining industry of the post-medieval period, meant that the influence of the area on the worldwide development of the modern railway was pivotal. However, while the history of the railway and the North-East's critical role in it is well-documented - through primary accounts held by the North of England Institute of Mining and Mechanical Engineers among others as well as in derivative reports and publications (cf. Bennett 1990, Turnbull 2012 & 2017, Warn 1976 & Williams 2012) - there has been relatively little op-

portunity to compare and enhance such accounts with physical remains derived from archaeological investigations of specific sites. Since the discovery in 1996 of the Lambton 'D' waggonway remains, however, over a dozen excavations have taken place in the North-East, with others elsewhere, to add to current understanding of how waggonways were built and maintained in practice and how they survive and may be recognised archaeologically.

Two such excavations on likely late 18th-century waggonways in the vicinity of Houghton-le-Spring, near Sunderland, have led to published papers, the first reporting on an excavation at Lambton 'D' Pit, the second on investigations in 2001-2002 at Rainton Bridge South (PCA 2003; Glover 2005). Most investigations, however, remain unpublished in the form of reports submitted to local authority planning departments. By far the greatest number of field investigations of North-Eastern waggonways have taken place in the former county of Tyne and Wear comprising Newcastle, Gateshead, Sunderland, North Tyneside & South Tyneside in the lower valleys of the rivers Tyne and Wear, almost all of them in the last 20 years following the chance discovery and excavation of the Lambton 'D' Pit waggonway remains at Fencehouses, Sunderland (Ayris et. al. 1998), with most taking place since 2004.

#### *Lambton D Pit, Sunderland (Ayris et. al. 1998)*

At the time of their discovery in August 1995 and subsequent excavation in February and September-November 1996 the timber waggonway tracks forming part of the sidings of the former Lambton or Bournmoor 'D' Pit at Fencehouses, near Sunderland were the best preserved and most substantial early wooden railway remains uncovered in the UK. At the time, only three other examples of preserved wooden waggonway had been recorded and published: two examples from the later 18th century at Bersham Ironworks near Wrexham and at Bedlam Furnace, Ironbridge, and a later 19th century example at Killhope lead-mining complex in upper Weardale. Archaeological excavation at Lambton exposed over 150 metres of timber trackway from four tracks, with the remains of another four tracks visible as impressions, allowing an in-depth analysis of their construction and study of individual features, including points and check rails. The discovery of an associated brick rail-head platform and the remains of a colliery building added a functional context to the waggonway remains.

The wooden remains of the Lambton waggonway probably date to the period 1812-17, but could have been in operation as late as the 1830s and may be set on a track-bed dating to c. 1790. It is presumed that the waggonway was operated using horse-power - although no horse-related remains were found - pulling chaldrons which the authors presume were by that time iron-wheeled, "wooden wheels being rarely, if ever, heard of after about 1790" (op. cit. 20). The single-way wooden tracks were laid at 4 foot 3 inch gauge on a bed of ash and coal fragments in shallow trenches cut in the natural sub-soil, with ballast between the sleepers (op. cit. 17). The rails were mainly of oak with fir, ash and elm also in evidence, cut to 1.25-3.3 m lengths and generally around 0.12-13 m square. Many had coal and other grits pressed into their upper surfaces and all were drilled and pegged to the underlying sleepers with square and round wooden dowels. The sleepers themselves were of oak, 1.7-2 m long, mostly selected for straightness but, because many are not, they are erratically spaced between 0.4 and 0.85 m. The character of rail

construction suggested to the excavators a pragmatic, 'make-do-and-mend' approach involving continual re-use and replacement of timbers, with evidence of in situ wood-working seen in the presence of wood shavings, discarded dowels and timber off-cuts across the site. In the absence of double-rails or built features other than the rails and track-bed, the most interesting feature of the Lambton waggonway was the presence of crude points (op. cit. 13), lacking moving parts like those on the Bersham Ironworks found in 1990 and 1991 and probably operated using "a moveable blocking piece inserted into the flangeway where the diverging rail began", thereby guiding the wheels onto the desired rail, aided perhaps by the lateral pull applied by a horse walking on the outside of the track (op. cit. 20). Other features of interest associated with the Lambton tracks included the presence of several large square timber baulks of unknown function sunk into the boulder-clay beside the tracks (op. cit. 17), and drains of various types; one seven

metre section is formed of brick side-walls covered with timber off-cuts, running into a run of hollowed-out tree trunks (perhaps recycled parts of a mine pump mechanism). Despite the well-preserved nature of the tracks and associated features, associated small-finds were sparse, restricted to *relatively few shards* of pottery, glass and clay pipe of late 18th and early 19th century character, though none of them were found below the sleepers to give a date for the foundation of the waggonway..

*Seaton Burn Waggonway, Camperdown, North Tyneside (Muncaster 2004)*

The Brunton & Shields Railway (HER 1065), later known as the Seaton Burn Waggonway, ran for 9 miles from Brunton Colliery on a gauge of 3' 6" and was opened in stages from 1826 to 1837. Until at least 1853 the line continued to serve four staiths for collieries at Wideopen, Fawdon and Seaton Burn. Horse power would have been utilised on the flatter sections (The Archaeological Practice 2000). Excavation in 2004 identified two phases of the waggonway, the earliest phase belonging to the Brunton & Shields Railway. However, while the layout of the track could be discerned, the sleepers had been removed, leaving only shallow, square shaped impressions at the base of the robber trenches perhaps relating to the original setting of the individual stone sleepers which appeared to be set for standard gauge. A later phase of the waggonway utilised a greatly enlarged embankment raised over the earlier line but preserved no features other than a heavily degraded wooden sleeper.

*Rainton Bridge South Waggonway, Sunderland (Glover (2005)*

A phased programme of archaeological investigation carried out in 2001 & 2002 on the site of the former North Pit of Rainton Colliery uncovered the remains of its associated, NW-SE aligned 18th-century waggonway, shown on a 1777 plan of the area. The excavated evidence suggests that, for much of its length, the waggonway is likely to have consisted of two tracks, with a system of branch tracks fanning out from the main route to service the pit head.

The principal features surviving at Rainton South were trackside ditches and drains, filled with coal waste, along with small pits and stakeholes representing fencing. The trackside ditches, which showed evidence for re-cutting on a consistent alignment, were up to 1.50 m wide and likely to have been at least 0.50 m deep. The distance between the outer edges of the wayleave ditches was between 8-9 metres, sufficient to accommodate both a main way and a by way (and probably, it is speculated, a narrow path to accommodate footgangs or the waggonmen). Groups of stakeholes were recorded along the edges of the trackside ditches, suggesting fencelines to delineate the wayleave and keep livestock at bay. External to the trackside ditches along one section were lines of square post-holes, representing the remains of a more substantial boundary with adjacent farmland.

The sleepers and rails of the tracks had largely been removed, probably for recycling, upon the abandonment of the waggonway, leaving only coal-filled sleeper impressions. These remains suggest, however, that sleepers were irregularly-shaped (see Illus. 12) and up to 1.90 m long by 0.18 m wide. Two relatively intact lengths of sleepers made from roughly-trimmed oak branches were recorded in situ; one displayed dowel holes at either end 1.42 m apart, giving an estimated



*From top, left to right:*  
 7. Lambton 'D' Pit Waggonway - general oblique aerial view.  
 8. Lambton 'D' Pit Waggonway - general view of tracks.  
 9. Lambton D - detailed view of rails and sleepers.  
 10. Lambton D - drain comprised of various wooden elements  
 11. Stone-lined drain; looking north. (Glover 2005, Figure 8)  
 12. Timber sleeper and sleeper impressions; looking west. (Glover 2005, Figure 9)

*Images 7-10 courtesy of John Nolan  
 Images 11-12 courtesy of Pre-Construct Archaeology*



13. Wooden sleepers of the latest phase of colliery railway at Weetslade, North Tyneside. Carlton 1998



14. Undulations in a former trackbed where sleepers have been removed from a former colliery railway at Weetslade. Carlton 1998

gauge of 1.30 m (4ft 3 in.). The sleepers were covered with ballast for stabilisation and protection; a series of shallow, coal-filled sub-circular features recorded between sleeper impressions were interpreted as the possible impressions of horse hooves.

A mortar-bonded, stone-lined conduit (Illus. 11), presumably capped with stone or timber, crossed obliquely under the wayleave and was interpreted as a supplementary drainage feature (evidence from the Bigges Main excavation, where a similar drain also passes under the main way, provides an alternative suggestion, that it could have been involved in the management of water supplies for a wash pond or other significant feature related to the efficient functioning of the waggonway system.

*Weetslade Colliery, North Tyneside (NAA 2005; Wood 2010)*

Fieldwork here included excavation of the Brunton and Shields Railway which opened in 1826 and operated as a colliery railway until 1980. Two phases of track-bed were revealed, both dating to the first half of the 19th century; the original 1826 line subsequently being relaid in 1839 for the use of locomotives. Clear evidence was found for the construction method of both the 1826 and 1839 tracks, showing that the original waggonway was built in a cutting, 7-8 m wide and up to 1.35 m deep in the clay subsoil. No remains of sleepers or rails were found, but the remains of the track bed comprised carefully laid ballast layers of slag, shale and coal, while the cutting had shallow drainage ditches along its north and south sides. Also investigated were the remains of a later track, using individual stone sleeper blocks probably corresponding with the re-laying of the line in 1839. The excavation has shown that, despite continual use of the line for over 150 years, significant remains survived of the earlier track-beds, the depth of the cutting being the principal factor in their preservation. The remains of the latest phase of colliery railway represented on the site was previously photographed in 1998 (Illus. 13 & 14; Carlton 1998).

*Killingworth Waggonway, North of Great Lime Road, North Tyneside (Garrett 2005)*

An evaluation was carried out at the former Killingworth Waggonway site north of Great Lime Road, Killingworth in order to determine its state of preservation and to record surviving features. The track bed of compacted coal ballast deposits was identified directly beneath the present footpath, sitting on a deposited clay embankment and associated with trackside ditches, but no impressions of sleepers and rails had been preserved in the disturbed track bed.

*Killingworth Waggonway, Wallsend, North Tyneside (Telford 2006)*

Excavation on a 37 m stretch of the former Killingworth Waggonway within Wallsend Dene revealed the track bed of small coal ballast constructed in a sloping valley side where ballast had been dumped to level and widen the available area and create an embankment. A stone-lined drain ran along the west edge of the embankment. No structural elements of the early trackway survived in situ, but thirty sandstone sleeper blocks were recorded, along with associated spikes and rail chairs.

*Former Goodyear Dunlop Tyre Factory Site (Harraton Colliery Waggonway), Washington (PCA 2010)*

This site in the central eastern portion of the Durham Coalfield was close to the site of Harraton Colliery, potentially in operation as early as c. 1590, while the first edition Ordnance Survey plan shows part of a branching network of colliery waggonways crossing the site and serving numerous coal pits to the north and west. Archaeological evaluation in 2008 revealed the presence of waggonway remains dating from the mid-late 18th century to the mid-late 19th century.



15. Track remains of the Harraton Colliery Waggonway near Washington (PCA 2010: Plate 9 - Area A, view of Waggonway [180] looking south). Photograph courtesy of Pre-Construct Archaeology



16. Detail showing two rails pegged into an irregular sleeper on the Harraton Colliery Waggonway (PCA 2010: Plate 11 - Area A, Rails 217 and 218 on sleeper 193 in waggonway 180). Photograph courtesy of Pre-Construct Archaeology

The earliest remains comprised a built clay embankment of dumped clay, the upper part c. 4m wide with a track bed up to c. 1.80 m wide; two timber sleepers, one identified as oak, survived from the track, with the remainder represented by impressions (see Illus. 18) A possible trackside gully was recorded along the eastern side of the embankment. The remains of the second early waggonway survived to the east as a group of sleeper impressions, along with five surviving sleeper timbers, all being crudely worked branches (Illus. 15 & 16). A later, perhaps late-18th century, waggonway used redeposited natural clay beds more than 1.0 m thick to carry the track which comprised sleeper and rail impressions, along with more than 20 surviving oak sleepers and one surviving rail. Further west, another forty timber sleepers survived along with numerous sleeper impressions with a gauge of c. 5 feet indicated by traces of rails. The remains of trackside ditches were recorded along both sides of the waggonway embankment. The latest timber waggonways, of late 18th or early 19th century date, followed the same NW-SE alignment as the earlier routes. Enhanced drainage was provided in the form of a brick-walled culvert (Illus. 17) associated with ground-raising deposits infilling the earlier waggonway ditch. The tracks survived as sleeper and rail impressions with more than twenty timber sleepers and eight timber rails of variable length evident; many of the sleepers with peg holes. The latest phase of the waggonways from the first half of the 19th century was poorly represented, but stone blocks found may represent sleepers for iron rails, each with two fixing holes in its upper surface.



18. Track remains of the Harraton Colliery Waggonway near Washington (PCA 2010: Plate 18 - Area B, Trackbed [318] of waggonway [279] looking north). Photograph courtesy of *Pre-Construct Archaeology*

17. Track remains of the Harraton Colliery Waggonway near Washington (PCA 2010: Plate 13 -Area A, Culvert [333], looking south-east). Photograph courtesy of *Pre-Construct Archaeology*

*The Former CPS Haulage Site, Hawks Road ('Gateshead Ironworks'), Gateshead (PCA 2011)*



19. Track-bed impressions of the former 'Gateshead Ironworks' waggonway excavated at the former CPS Haulage Site, Hawks Road, Gateshead (PCA 2011: Plate 2 - Phase 3 waggonway [1131], looking south-west). Photograph courtesy of *Pre-Construct Archaeology*

The site, located in the historic 'New Greenwich' area on Gateshead's South Shore, was developed in the mid-18th century by the industrialist William Hawks for his iron manufactory, and later it became known simply as 'Gateshead Ironworks'. Two sections of a hitherto unknown timber waggonway were recorded running on a NE-SW alignment across the south part of the excavation area, with sleepers and rails visible as deep impressions in the underlying ballast (Illus. 19). Artefactual and cartographic evidence indicates that it was probably in use sometime after 1772 and may have been a branch line from a main waggonway leading to staiths on the Tyne. The earliest element of waggonway was a linear cut, c. 0.30 m deep created to make a level platform for the track by terracing into the naturally sloping ground. The track survived as a series of negative impressions of split-branch sleepers in a layer of compact sand and gravel - pottery recovered from the ballast comprised glazed red earthenwares and refined whitewares, datable to the late 18th or 19th century. Several post-holes, one associated with a shallow, 0.14 m wide slot running approximately parallel to the waggonway, are probably part of a fence-line associated with the wayleave of the waggonway. Two NE-SW aligned rail impressions were recorded within the secondary ballast, one measuring 3.30 m and 0.15 m square, the other 2.80 m long; the distance between the inner edges of the rail impressions was around 1.30 m or c. 4 feet 3 inches. Immediately to the north-west of the north-western rail impression were the remains of small brick structure, comprising six partial bricks laid parallel to the rail impression and probably associated with it.

*Archaeological Investigations at the Lightfoot Centre, Wharrier Street, Walker, Newcastle (PCA 2011; Proctor 2013)*

The St Anthony's waggonway, archaeologically excavated at Lancefield Avenue by PCA in 2011, had been a single-track line in the area investigated but survived poorly, though the route was defined by trackside ditches defining the wayleave with, on one side, a fence-line represented by wooden stake holes defining, as at Rainton (Glover 2005), the extent of the wayleave corridor on that side. St Anthony's waggonway led coal to St. Anthony's Quay from St Anthony's Colliery, won in 1770, using the same line as that from Lawson's Main on Walker Hill, won in 1753. The Heaton link was added in 1791 and remained in use until 1820 when Heaton coals were diverted to Wallsend. A later, but unrelated Lawson's Main pit, also served by a staith at St Anthony's and located close to the current Shields/Heaton Road junctions, closed in 1810, the iron rails and stone sleepers of its line through Byker being sold off the following year; this early iron railway had nothing to do with the original Lawson's Main and Heaton waggonways, however (Turnbull pers. comm.; contra. Turnbull 2009).



*Excavation on the line of the Walker Colliery waggonway at Sir Charles Parsons School, Walker, Newcastle upon Tyne (PCA 2012; Proctor 2011)*

Excavation in 2011 on the site of a colliery waggonway of late 18th-century origin associated with the Gosforth and Delight Pits of Walker Colliery revealed remains of a substantial clay embankment 27.60 m long by up to 7.60 m wide and up to at least 1.11 m high. Although no timbers survived, the impressions of sleepers and rails were recorded, as well as postholes representing fixings, across the upper portion of the embankment, along with a small assemblage of finds of 18th- & 19th-century date. The sleeper impressions suggest that they were hewn from roughly-trimmed branches up to 1.17 m long, but as only one rail impression was found, the gauge of the track could not be determined. Parallel trackside ditches 3.2 m apart, indicating that it was a single-track route, were up to 0.80 m wide and 0.50 m deep with vertical sides and flat bases, revetted in places with stakes which would have supported timbers (Illus. 20 & 21). On one side at least, as at Rainton (Glover 2005, 238-9) a double-ditch system seems to have been used, perhaps in response to particular drainage conditions, caused by the high embankment, or representing different phases of use. Other post- and stake-holes, 0.04 - 0.10 m in diameter, set in the base of a ditch, broadly forming two rows, are interpreted as representing a simple bridge across the ditches and a fence line alongside. The later development of the waggonway, probably during the late 18th or early 19th century, was represented by material dumped on the embankment at a time of trackway upgrade to stone sleepers and iron rails.



20. Remains associated with the Walker Colliery Waggonway excavated at Sir Charles Parsons School, Walker in 2011 (PCA 2012: Plate 6 - Area 1, south-east facing section across clay embankment [49] and trackside ditch [75], looking north). Photograph courtesy of *Pre-Construct Archaeology*



21. Remains associated with the Walker Colliery Waggonway excavated at Sir Charles Parsons School, Walker in 2011 (PCA 2012: Plate 8 - Area 2, ditch [8] and re-cut [5], showing stakes [4], [15] and [16], looking south-east). Photograph courtesy of *Pre-Construct Archaeology*

*Excavation on the course of the Stella Grand Lease Way on land adjacent to Landscape Terrace, Greenside (ARS 2013)*

Excavation on the line of the Stella Grand Lease Way, built as early as 1621 or in the 1630s, identified the waggonway as impressions of timber sleepers measuring c.1.8 x 0.2 m in the natural substrate at intervals of c. 0.65 m, with the remains of a shallow drainage gully on its south side backed by a low bank surviving to a height of 0.4 m. The track remains comprised a series of seven irregular linear features filled with a fine black silt, forming an east-west aligned track running parallel to the gully. All the timber impressions were irregular in shape indicating that the waggonway was probably constructed of roughly hewn rounded timbers. The seven sleeper impressions were generally regularly spaced at intervals of c. 0.65 m, but the easternmost three sleepers are separated by 0.26m and 0.88m

*Excavation on the course of the Holystone waggonway at Scaffold Hill, North Tyneside (ASDU 2015)*

A series of drainage ditches were recorded in the east and west parts of the site, the presence of five ditches of varying depths and widths in the east part was thought to indicate a sequence of replacements or re-alignments of the waggonway. Although purportedly the remains of the Holystone and Benton Square waggonways, these remains are most likely associated with the well-documented Benton Way of 1760 (pers. comm. Turnbull.)

*Excavation on the line of Jane Wharton's waggonway on land at Coaley Lane, Newbottle, Houghton le Spring (ASDU 2016)*

Evidence for the sleepers of an early waggonway track (Illus. 22), probably part of the line of Jane Wharton's waggonway, with associated trackside ditches and track bedding, was exposed in the south part of the site. Elements of two later post-medieval tracks were also revealed elsewhere.



22. Sleeper impressions on the line of Jane Wharton's waggonway at Coaley Lane, Newbottle, Houghton le Spring (ASDU 2016, Figure 11: Sleeper impressions [F54] at the west end of Trench 9, looking north) Photograph courtesy of *Archaeological Services Durham University*

*Excavation on the course of the Walbottle Moors Waggonway at Lower Callerton, Newcastle upon Tyne (ASDU 2015)*

Archaeological remains of the Walbottle Moors Waggonway were recorded in the form of a cutting, with sandstone bedrock base and sides up to 0.8 m high. Along the east side of the cutting its lower fill was overlain by two courses of brickwork which ran down the full length of the cutting within the trench. No such feature was present to the west, although a number of loose bricks were present within the overlying fill. This, along with the rather irregular edges to the clay

deposit on this side, suggests that there had originally been a similar brick edging on this side and that the width to the outside edge of both lines of bricks would be around 1.4 m (i.e. approx. that of the standard gauge). A large pit, 0.8 m wide by 0.7 m deep, on the east edge of the cutting and filled by a black silt is suggested to have held a post bracketing the waggonway, although no such pit was present on the west side of the cutting within the excavated area. Two shallow gullies, interpreted as boundary gullies, ran parallel and c. 8 metres outside the waggonway cutting

*Excavation at Redburn Row, Chilton Moor (ASDU 2017)*

Archaeological excavation at Redburn Row, Chilton Moor, Houghton-le-Spring uncovered two, probably contemporary, waggonway tracks, one on a substantial embankment up to 7.1 m wide and 0.9 m high (Illus. 23), the other parallel to it to the east and unembanked. The lower track had irregular sleepers (Illus. 24); the upper one had regular ones which appeared to have replaced an earlier, more irregular set. The remains of two phases of a coal depot, comprising buildings and a culvert, were found associated to the south-east, along with housing, while the artefactual assemblage from the site dated from the 1780s to the 1950s. Along the crest of the embankment was a series of track impressions formed by the lines of both rails and sleepers bedding into the underlying clay and filled with a mixed deposit of black silty grit with frequent inclusions of ash and occasional brick fragments. The sleepers varied in form, with some regular, similarly-sized beams laid at right angles to the rails, but others more sharply angled, irregular and curvilinear. It is considered by the excavator that these reflect two phases of track, with the more uneven sleeper impressions relating to the earlier phase. No physical remains of the track or any track bedding were observed. The main ditch, 3.1 m wide and 1.15 m deep, flanked the east side of the embankment and had a more rounded base than the west ditch. A stone culvert, 0.78m wide, 0.45m high, cut through its fill, its walls of angular sandstone blocks and with a capping of sandstone slabs. A second, later waggonway track was present between the wayleave and trackside ditches, with elements of both bedding and iron-railed track surviving.



23. Waggonway remains uncovered at Redburn Row, Chilton Moor, Houghton-le-Spring (ASDU 2017: Figure 16 - Waggonway embankment [F221], facing north). Photograph courtesy of Archaeological Services Durham University



24. Waggonway remains uncovered at Redburn Row, Chilton Moor, Houghton-le-Spring (ASDU 2017: Figure 19 - Track [F164], facing west). Photograph courtesy of Archaeological Services Durham University

## Summary

About a dozen excavations have taken place on other waggonways in the Tyne and Wear valleys, the earliest being an investigation on the course of the early 17th century Stella Grand Lease waggonway running to the south bank of the Tyne near Blaydon. The majority of these excavations have produced remains of waggonway embankments and parallel track-side ditches, with most also recording impressions of sleepers on top of the embankments but few surviving timbers. By far the best-surviving remains are those of the Lambton 'D' Pit waggonway excavated in 1995-6 at Fencehouses, near Sunderland which, at the time of their discovery were the best preserved and most substantial early wooden railway remains uncovered in the UK.

Other features common to most excavated waggonways of this period include ballast, usually comprising crushed coal, ash and small stones, packed around the sleepers and under the rails in order to bear the weight of the waggons upon the rails and sleepers; linear drainage ditches alongside the track serving to channel surface water from the trackway and define the extent of the wayleave and, with the addition of fences and hedgelines, provide a barrier to stock.

The Lambton 'D' Pit remains probably date to the period 1812-17 and comprise over 150m of in situ single-way wooden tracks on oak sleepers, of roughly end-sawn branches with flat upper surfaces to receive the rails, laid at 4 foot 3 inch gauge on beds of ash and coal fragments. Similar, irregular-shaped branches were found to have been used as sleepers at Throckley (Geoquest Associates 2002), *Redburn Row (ASDU 2017)* *Walker Colliery (PCA 2012)* and compare closely with several examples from the *Bigges Main waggonway*. The character of rail construction at these sites suggested a pragmatic, 'make-do-and-mend' approach involving continual re-use and replacement of timbers, with evidence of in situ wood-working in the presence of wood shavings, discarded dowels and timber off-cuts being a particularly interesting feature of the Lambton 'D' site. Another interesting feature of this waggonway was the presence of a crude set of points, lacking moving parts, at an intersection between tracks, which are considered likely to be closely comparable to those used on the Bigges Main waggonway. Other comparisons with the Bigges Main are seen in the materials and techniques used to construct drains found parallel with and cutting across the Lambton 'D' and Rainton Bridge South waggonway tracks and the rather surprising, relative scarcity of associated finds such as pottery, clay pipes and horse-shoes.

Also of interest with respect to the remains found at Neptune Yard are the findings of excavations held at Rainton near Sunderland and on the Walker and St Anthony's waggonways in Walker, Newcastle upon Tyne. As well as clay-based embankments to support raised trackways, these lines display amongst their surviving remains traces of track-side ditches which have been strengthened internally by wooden stake revetments and bear some resemblance, in the acute angles of their cuts, to the series of pits seen on the east side of the Willington waggonway. It is also of incidental interest to note that the dates of the second of Lawson's Main to St Anthony's line, in operation as one of the earliest iron railways from 1797 to 1810, almost exactly parallel those of the second (post-wash pond) phase of the Willington Waggonway which survived as a wooden track until its replacement by iron rails in 1812. The Lawson's Main to St Anthony's

line was one of those which proved the viability of iron rails, leading to the redundancy of wooden tracks – especially those intended for the use of steam engines being developed at that time - which meant that wooden tracks were no longer being replaced and had little recyclable potential.

### *Excavation of the Neptune Yard Site and discovery of the Waggonway in May 2013*

Following assessment it was considered that the extent of later 19th and 20th century phases of construction and demolition on the site, including the creation of dry docks, was likely to have had a negative impact on the survival of any pre-existing, post-medieval or earlier, archaeological remains. However, it was considered possible that some pockets of earlier remains could have survived relatively undisturbed where major earthworks or excavations for deep foundations had not occurred on the site. Taking these factors into consideration, the most likely locations for surviving pre-industrial archaeological remains

were considered to be the raised western part of the site, closest to *Segedunum* Roman fort, and in the extreme northern part of the lower, riverside component of the site. Accordingly, seven trenches were excavated in order to investigate the site of proposed ground reduction works. These investigations revealed no significant archaeological remains in the majority of trenches excavated on the raised platform area bordered to the north-west by the course of the former Newcastle & Tynemouth Branch Line Railway, now a footpath, where a uniform clay deposit interpreted as truncated natural sub-soil was encountered at shallow depths below overlying disturbed deposits. In the single trench excavated close to the riverside, apparently original riverside silt deposits were reached at about three metres below the current ground level. In the remaining trench excavated hard up against the north-east edge of the site bordering Benton Way, the remains of a stone-built, clay-bonded wall were found less than half a metre below the concrete yard surface (Illus. 25) and initially interpreted, on the basis of historic map evidence, as forming part of the former railway embankment serving the Coxlodge Staiths, a riverside complex of the early 19th century.



25. The west side of the Carville Hall boundary wall uncovered in May 2013.

On the basis of this discovery it was agreed to reveal more of the course of the stone wall by opening an additional south-eastward extension to the trench, and it was further agreed than

any ground reduction works in the north-east part of the site should be monitored by archaeological watching brief in order to record any archaeological remains of significance revealed there. At this stage, however, the nature and scale of preserved remains in this area was still not anticipated.

Continued excavation revealed more of the wall, which was cleaned by hand and recorded before more machining of dark patches in the area on its north-east side led to the discovery of a number of substantial timbers arranged in parallel formation (Illus. 26), identified as the sleepers of an *in situ* rail track. In agreement with the Newcastle Archaeological Officer and the site owner, the area of excavation was further extended along the line of the newly-uncovered waggonway to north-west and south-east. The part of the waggonway first uncovered was subsequently identified as the 'main way', but the discovery of additional timbers lying underneath the boundary wall to the south-west caused some puzzlement (Illus. 27) until further investigation revealed the remains of a second track parallel with and set at a lower level than the first. Further puzzlement was caused when this second track appeared to be sloping quite severely downhill to the south-east, but subsequent excavation showed it to be set in a hollow, soon interpreted as a wash pond.

The two lines discovered in this way – a main-way and a siding - extending over 33.3 metres (c. 67 metres of track) on a north-west to south-east alignment were fully excavated within the limits of the agreed excavation area between 25th June and 26th July 2013 (Illus. 28 & 29). This phase was followed by monitoring of ground clearance works along the line of the waggonway as both the upper (north-west) and lower (south-east) ends of the excavated area were extended between 19th and 31st August, revealing a range of additional features which were identified as integral to the operations of the waggonway complex.



26. Sleepers uncovered on the east side of the Carville Hall boundary wall with the remains of a brick floor, part of the Tyne brickworks, on its west side.



27. A test-pit cut against the east side of the boundary wall revealed timbers running transverse to the sleepers.



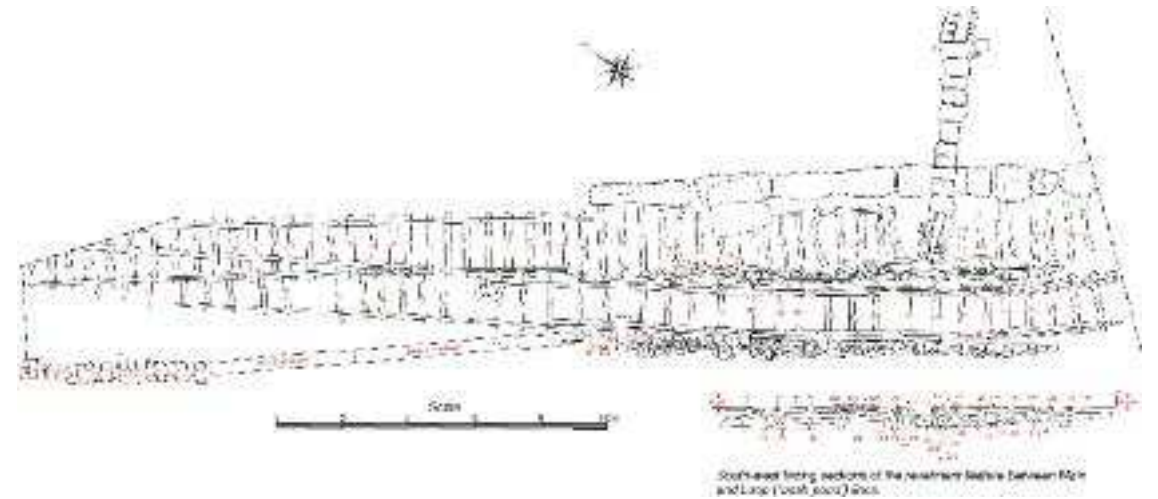
28. Excavation of the main way and horse-way siding with boundary wall overlying an earlier revetment wall. (see aerial view, below).



29. Carville boundary wall overlying an earlier revetment wall to the west (right of view), shown in an aerial view taken in July 2013.

Having uncovered the remains of a waggonway in such an excellent state of preservation, with the rails and sleepers of two lines surviving along with the remains of a revetment between them and a cobbled track within the siding, and recognition of its national and potentially international significance, a consensus arose that a sample of the remains should be preserved at an appropriate regional museum site. In view of the potential for deterioration of the remains following exposure by excavation and their location in an active construction site, funding was secured through the PRISM Fund and practical arrangements were made to enable the early removal of a representative sample of the track and associated features to a secure location at the Stephenson Railway Museum, North Shields, administered by Tyne & Wear Archives & Museums (TWAM), where their condition could be assessed with a view to full conservation and ultimate display.

Accordingly, between 4th and 13th September an eight metre (26 foot) length of the two tracks, including rails, sleepers, walkway metalling and a timber revetment between the lines was dismantled by the excavation team and moved to a storage facility by TWAM staff. A number of timbers



30. Plan and partial section of the waggonway remains uncovered at Neptune Yard in Summer 2013, showing numbered timbers.

beyond the identified eight metre section were also retained as replacements for some of the less well-preserved timbers in the sample section, and a length of the main way to the north was also dismantled and stored at the same facility for the National Railway Museum whose representative, Bob Gwynne, had earlier visited the site. All timbers to be removed were individually photographed in situ, as well as during and after the removal operation, for identification purposes and to reveal joints and other construction details for future reassembly. They were individually labeled with appropriate tags securely fixed to each piece and keyed to site drawings, then loosely wrapped in plastic sheeting after lifting to reduce the drying effect of exposure to the sun. Surfacing stones from the walkway along the siding line were marked to indicate their in-situ upper surface and then cleaned and loaded into crates for removal by crane onto a flat-bed truck. Following the removal of a large proportion of the best-preserved waggonway timbers, further monitoring work took place between 17th September to 1st October during the initial phase of rendering the site suitable for development by excavating to compact clay levels, revealing more of a stone drain or 'cundy' feature on the north-east side of the main way and exposing a long leet, stone-walled and timber-capped, running underneath the south-western (former Carville) boundary wall and extending downslope into the wash pond area.

Archaeological input temporarily ceased on the site when the remaining features of the waggonway complex were removed by machine during final groundworks on 8th October 2013, during which process it was observed that only part of the cobbled sleeper-bed forming the base of the wash pond and a small length of the foundations of the brick and stone drain running into the north (Benton Way)

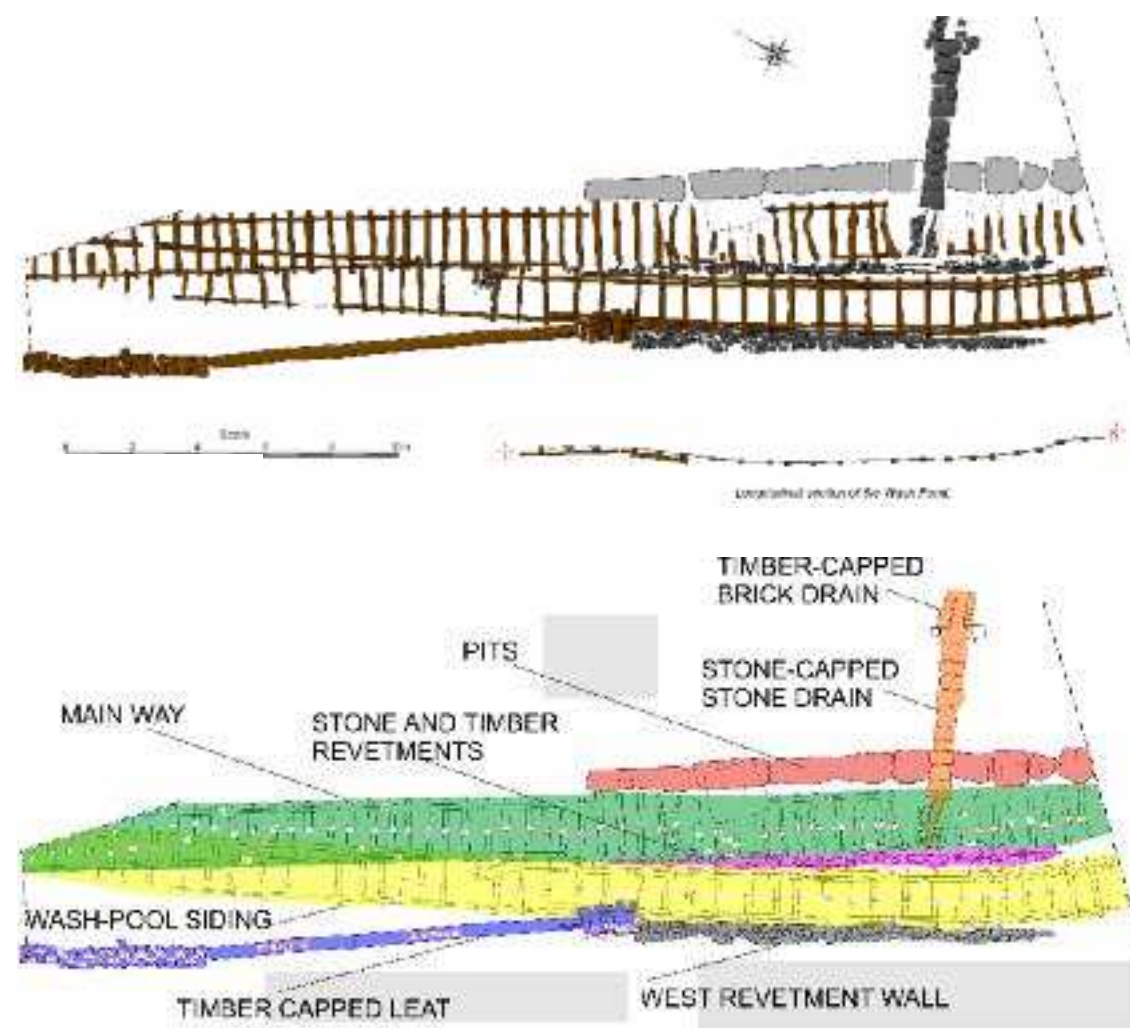


31. Timbers salvaged from the excavation site and removed to temporary storage at the Stephenson Railway Museum, North Tyneside in August 2013.

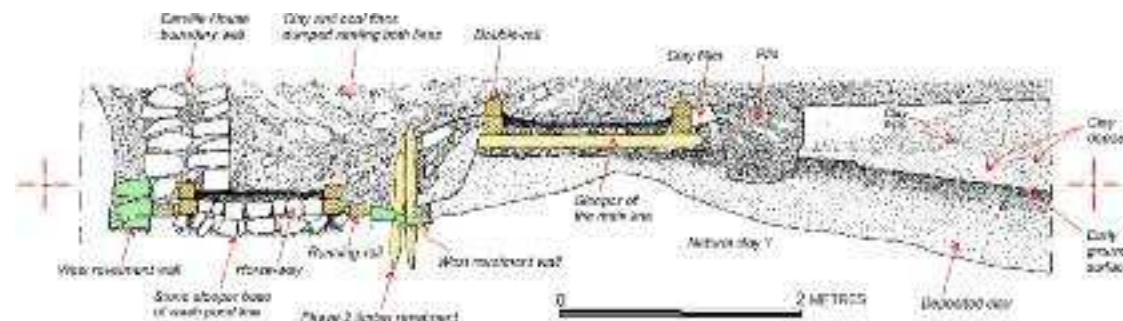
side of the site were left *in situ*. Further monitoring was carried out in April and May 2014 (completed May 21st) on the lower part of the site, however, between the Benton Way boundary and the first of the now-infilled dry docks, but produced no additional finds of significance.

*Features revealed by excavation and monitoring*

Archaeological features located in the Neptune Yard during the initial evaluation and subsequent full excavation lay within a single area which at its full extent was 33.3 metres long and between 3 – 9 metres wide, covering around 280 square metres. For convenience of description, orientations in the following text assume a north-south line for the waggonway through the long axis of the trench although it actually ran considerably skew of true north.



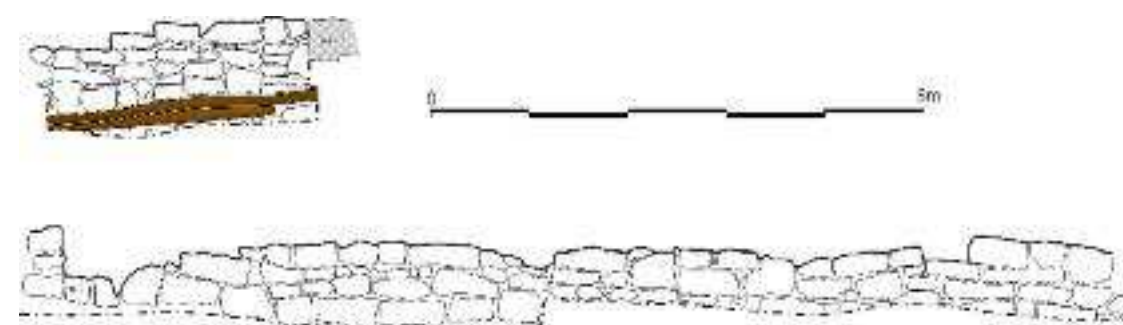
32. Coloured plan and partial profile of the waggonway remains uncovered at Neptune Yard in Summer 2013, with a key to the main structural features shown below.



33. Drawing of a south-facing section across the waggonway showing its principal features, including cuts and embankments made into and from the pre-existing ground surface

*The Carville Boundary Wall and Ditch*

The first archaeological feature of note encountered in the excavation area is one of only two now not considered to be integral to the waggonway, but part of a feature constructed to mark the re-imposition of a property boundary following the abandonment of the wooden waggonway. This is a stone wall, well-built of irregular courses, faced sandstone rubble blocks up to 0.49 m long, including some squared blocks which may have been reused roughly, irregularly coursed and of simple construction, up to four courses, 0.56 m high and 0.63 m wide towards the north end and centre of the excavated area, generally surviving less well elsewhere. At the north end of the original (prior to August 2013) evaluation trench it appeared to be of different construction, with several large stones, some placed on their sides across the breadth of the wall, perhaps rebuilt in an *ad hoc* manner or plugging a gap, perhaps associated with later disturbance caused by an east-west land division appearing on the 1910s edition of the Ordnance Survey map series..



34. Part of the east-facing elevation of the Carville Hall boundary wall (above) and (below it) the north part of its west-facing elevation



35. The Carville Hall boundary wall (*left*) running to the northern boundary of the site.

36. The Carville boundary wall sitting over the double-rails of the horse-way, but largely removed to reveal the west revetment wall to the siding.

Close to its north end the wall sat upon the fill of a cut feature, interpreted as a wide ditch or west side of a cutting (see Illus. 35, at extreme left of view), the course of which is slightly askew to that of the wall, its west side running gradually away from the wall towards the south (riverside). A section cut into this putative ditch against the west side of the wall found it to be slightly concave, descending at an angle of approximately 400 from the vertical with a flattish base running under the wall which sat upon and within a fill of coal finings and dust. This cut feature running askew to the course of the wall was traced towards the south for some 12 metres at which point it ended, or was interrupted by a concrete pad and natural or redeposited clay sub-soil, and not picked up further south, although relatively little exploration of the area west of the boundary wall occurred in the south-west part of the site. It is possible that this feature was originally a wayleave ditch along the western flank of the main line, partially destroyed and infilled when the waggonway complex was remodelled with the construction of the siding; or it may have been a drainage or water supply conduit made obsolete by the formalisation of water supply by construction of the timber-capped leet described below.

Approximately 12 m from the south (riverside) end of the boundary wall it was interrupted by a relatively-modern concrete pad set upon robbed wall-stones; thereafter, to the south its survival was poorer, although it did survive in the north-facing end section of the trench. Sitting either side of the concrete pad was a floor of re-used firebricks of early 20th century origin, the majority stamped and traceable to brickworks at Newburn, west of Newcastle. This feature survived in a position where the late-19th century Tyne Brickworks encroached slightly on the former course of the Willington Waggonway and is, therefore, likely to have formed part of the floor of the brickworks, although the use of Newburn bricks is puzzling and suggests the possibility of an alternative scenario, that it could be part of a floor belonging to the later building related to the Neptune shipbuilding and repair yard.

A peculiar feature of the Carville boundary wall is that for most of its length it sat partly or wholly upon wooden foundations provided by pre-existing, underlying features of the waggonway, notably a wooden-capped leet running 17.5 metres south from the northern extent of excavation, thereafter partly upon the outer (west-side) rails and false (horse-way) rails of the waggonway siding. Close to its southern terminus, where it had been truncated by the brick-built remains of a former shipyard building, it was supported by a short length of reused rail set on the upper, silty surface of the horse track parallel with and at the same level as the upper edge rail of the horse-way (west side).

### *The Main Way*

Emerging intact from beneath the concrete abutment wall bounding Benton Way in the north, the well-preserved main way ran on a straight line and on a very gentle and consistent gradient across the site to the southern edge of the excavated area where it was truncated by a modern brick structure, part of the mid-20th century development of the Neptune Shipyard, terraced into the riverside slope. The wooden track was very-well preserved with extensive survival of both sleepers and rails, the latter double-way with intermittently surviving upper rails (Illus. 39). All fixings, rail to rail and rail to sleeper were with wooden pegs in square or sub-circular peg holes. The rails ranged in length from 0.5 m (timber 22) to 4.92 m (timber 180) and, where preserved well-enough to measure accurately, were generally 0.12 m wide and 0.16 m deep. Only one seemed, on the basis of a surviving trenail hole, to have been derived from a reused ship timber but marks on others suggested they had been recycled from other sources. Many have multiple peg-holes (see for example Timber 145), some with surviving peg-stubs or complete pegs surviving from their last phase of use, indicating re-setting of the rails within the context of the waggonway. Some (notably Timber 39) have shallow cut depressions, 0.01 m deep and 0.25-32 m long, spaced some 0.50-60 m apart indicating the positions of sleepers laid across them; not all of the depressions are associated with peg-holes and it may be that reducing the number of peg-holes (which created weak-points in the timber) during any given phase of use may have holes may have been a deliberate strategy to lengthen the life of a rail.



37 The Main Way and horse-way siding line, showing remnants of the boundary wall sitting over the upper rail of the horse-way, with an additional plank inserted alongside it to provide additional foundation. The west revetment wall is to the west (*left in this view*) of the siding.

38 The Main Way with remains of double-rail.



*Clockwise from top left:*

39 Double-rails on the main way.

40 Vertical view of the remnants of the points between main way and siding in the north part of the excavation area.

41 View of the points looking south, including a remnant of double-rail on the east side of the main way.

The sleepers, which extended either side of the rails by between 0.07 and 0.47 m, were marked by their inconsistent nature – some being squared, many of them re-used ship timbers, others only lightly re-worked tree branches (see Illus. 37 & 38) - as also found at Lambton 'D', Rainton Bridge and other excavated waggonways sites in the region (see above). The sleepers, were spaced between 0.5 – 0.68 m on the main way and 0.55 – 1.08 m on the by way, with those in the wash pond averaging c 0.75 m. These spacings are towards the higher end of the spectrum provided by Lewis (1970) who suggests that main ways were generally constructed with their sleeper centres spaced between 0.30 m and 0.45 m, occasionally up to 0.61 m but only rarely outside that range, while by way sleepers were generally spaced at 0.61 m or more, with 0.91 m not uncommon. The sleepers were set in to a substantial bed of shale and yellow clay ballast and an additional bank of clay was laid along the external edge of the eastern rail, covering the sleepers extending beyond the rail. The latter perhaps marked a walkway alongside the waggonway or a means of deflecting water from the waggonway; there is no evidence to suggest there was ever a ditch on the eastern side of the waggonway.

At the north end of the excavated area, the main way and its wash pool siding converged at a set of simple points (Illus. 40 & 41), although the likely obsolescence of the siding prior to final abandonment of the waggonway means that the points themselves were not preserved sufficiently to allow analysis of their functional characteristics. The sections of upper rails were short here, however, suggesting that they had been more prone to damage caused by levering the waggons from siding to main way.

*The Wash Pool Siding*



*From top, left to right:*

42 The dip line viewed from the north-west  
43 Vertical view of the south part of the excavated area showing the cobbled track of the horse-way (right of view).

44 Recording the horse-way.

45 The double rails of the horse-way inside (east of) the revetment wall, both built upon by the later Carville boundary wall, with part of an even later brick platform also visible.

46 The partially-flooded wash pond siding viewed from the south, suggesting how it probably looked while in operation.

Parallel and associated with the underlying west revetment wall are the substantial and essentially complete remains of a timber single-rail track laid in a dished cutting, 2.6 m wide which dipped to a maximum of 0.7 m centrally and rose to either end, forming a waggonway siding of concave profile which at an early stage was interpreted as a 'wash pond' (Illus. 42-44). Most of this siding loop lay within the area of excavation - only the junction with the main way to the south and the final merging with the main way to the north lay beyond - giving a total estimated length for the siding of some 40 metres. The track of the siding, which almost directly abuts the foot of its west retaining wall, being separated from it by 0.09-0.10 m, is comprised of single-depth wooden running rails of the same gauge as the main way, about 1.44 m apart (4 feet 8 ½ inches) measured from the inside faces, each rail being 0.115 m wide and 0.16 m deep and measuring up to 3.4 m long. The rails are securely pegged into the sleepers - the presence of which within the pond is obscured by an overlying stone surface - and attached to the sleepers with pegs, further support being provided in places (notably on the slope at the south end of the loop) with off-cuts of timber forming chocks and wedges under the rails between sleepers.

Immediately inside both running rails of the waggonway track, but separated from them by some 0.05-0.07 m, are double-rails forming the raised sides of an inner track three feet wide (Illus. 45), upon which was a walkway of irregular, unbonded, pitched stone formed between the inner rails (Illus. 47 & 48). A number of the lower rails were of considerable length leaving gaps beneath, packed with stones and clay of the same nature as the overall bedding layer. The upper rails forming the sides of the horse-way are also of considerable length, up to 4.87 m long, pegged into the lower rails using oak pegs in neatly cut, square or sub-rectangular holes generally 0.02 square with some up to 0.03 m. The stone horse-way itself is comprised of deeply set, irregular stones, principally deep sandstone blocks or thinner blocks set on edge, but including some more rounded cobbles. Thus, the double-rails here are reused rails not serving as a track, but providing support and framing for a cobbled surface. The south end of the horse-way paving ends exactly adjacent to the end of the west retaining wall



47 Part of the horse-way cobbled surface lifted to reveal well-preserved sleepers beneath.



48 The stones of the horse-way marked during the process to remove them into storage.

feature, and the squared wooden sleepers onto which the rails of the 'wash pond' siding and check-rails of the horse track become visible; also at that point, the upper rails on both sides (though most obviously on the north side) are cut longitudinally to smooth the junction between double- and single-(height) 'rails'. At the north end of the horse-track, double-rail also gives way to single rail - the upper of the double rails simply continuing northwards beyond the lower rail, supported on cobbles and earth, rather than being cut to shape as at the south end - adjacent to the north end of the west-side retaining wall.

A discrete area of flat cobbles and water-worn stones lay over the northern upslope end of the horse-way, which would have allowed the waggonway draught horses to gain some purchase as they pulled up the slope on what was an increasingly smooth surface. Over most of the walkway was a layer of compacted coal fines and coarse sand which, given its level of compaction, must have developed during the working life of the siding. These obscured the smooth upper surface of the cobbled horse-way which, in turn, entirely covered the oak sleepers of both the running rails and internal horse-way, which emerged only where the cobbled surface ran out on the rising slopes of the dip line.

Removal of the horse track revealed the best-preserved oak sleepers, all at least roughly squared and from used ship timbers, set transversely at intervals of around 0.85 m on the base of the cutting. These sleepers are set in a second layer of cobbling (Illus. 49), similar in character to those described above, but generally with unworked sandstone blocks set on their sides to form paving, rather than on their ends to form the more resilient surface needed for the horse-way. In places the timber sleepers had been secured into place on the clay surface between the cobbles with stone packing bonded with grey clay, with larger packing stones set on edge between larger paving stones and the wooden rails.

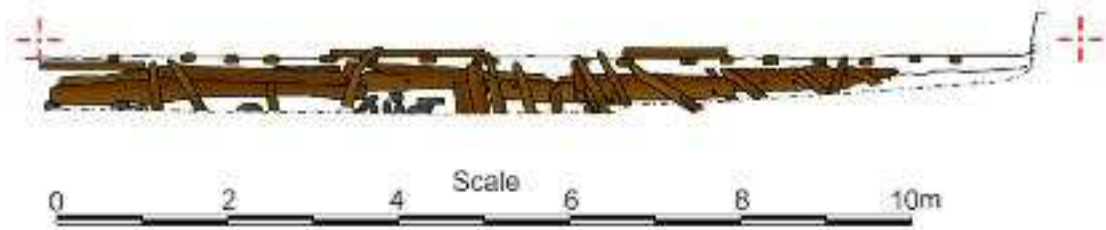


49 View of the siding following removal of the horse-way, showing the running rails pegged into well-preserved oak sleepers.



*East revetment wall and later wooden reveting of the wash pool cutting*

Between the two tracks - the lower, dipping siding with integral horse-way and 'wash pond' on the south side, and raised main way on the north side - is a timber, post and rail revetment constructed against the slightly raised south-facing bank of the main way (Illus. 50-52). The top of the planks forming the revetment appear originally to have been at about the height of the bottom of the sleepers protruding from the bank-side, although most appear to have slipped from their original positions. The remains of 21 wooden posts, mostly rounded and 0.09-0.10 m diam. survive, set into the ground at the level of the siding track; some have been cut off and some partially displaced, but the longest was exposed for at least 1.02 m length, just longer (higher) than the height difference between the two sets of rails at the deepest part of the dip in the siding track, which sits in a 0.81 m deep hollow. At least two lines of posts can be detected either side of the remains of a parallel stone feature (probably an earlier revetment structure, see below), perhaps representing different phases of construction or an attempt to create a more robust structure using double thickness of planks, supported by two lines of posts, infilled with clay. The rails or planks placed on the inside of the posts are of varied dimensions, up to 4.60 m long, between 0.19 and 0.29 wide and 0.04 - 0.06 m thick. At least four of the timbers (all of those on the east side of the bottom of the dip) have two or more holes of c. 0.04 m diam. bored through them suggesting that they are reused ship timbers. Behind the wooden revetment are stones set in the coal waste matrix forming the track bed of the main way, the stones probably serving as setting stones for its wooden sleepers.



50 Elevation drawing of the wooden post & rail structure forming a revetment to the east side of the wash pool siding.

The post and plank revetment adjacent to the bottom of the horse way depression is formed by an unusually thick (0.06 m) plank, parallel with, but off-set by c. 0.20 m from, the main planking, supported on its outside by three, perhaps four, squared posts, with additional squared posts to the west suggesting that the feature once continued in that direction. Between the inner and outer planks is a deposit of pure, light-brown clay and a second layer of planking is just visible in the south section, suggesting that this clay-filled wooden feature is at least 0.43 m deep (although the back of the feature, the 'original' revetment planking, is some 0.10 m higher still). An exploratory cut made on the east side of this feature revealed more large stones and the remains of wooden rails or posts apparently parallel with, and representing earlier phases of, the revetment; it was clear that several phases of some kind of sluice arrangement for draining water from the 'wash pond' in the siding were represented here.



*From top, left to right:*

- 51 Oblique elevated view of the wooden revetment on the east side of the wash pool siding.
- 52 View of the revetment from ground level.
- 53 Plank (no. 125) forming part of the revetment, showing evidence of previous use as part of a maritime vessel.
- 54 View eastwards from the wash pond over the revetment and its rudimentary sluice used for water control.
- 55 View of the revetment from the drain to the west showing notches in the timber suggesting a sluice-like mechanism.

*West revetment wall to the wash pool cutting*



56 East-facing elevation of the west revetment wall to the wash pond dip-line.

Dismantling of the post-waggonway Carville boundary wall revealed that part of its disturbed southern section had been partially built upon an older, underlying wall of similar construction (Illus. 56), which ran on a straight course, almost-parallel with the later wall, but set back a little to the west and with the last two metres orientated slightly (by c. 5°) towards the east, on a slightly different course to the remainder. The construction of the older wall was of similar, angular, roughly-faced rubble construction to the first, though generally smaller blocks were used up to a maximum of 0.39 m length. Like the first it is unbonded, formed of two faces with a narrow rubble core, but unlike the first it appears that the rear (east-) facing was set into a bank of deposited yellow clay, giving a variable width to the wall of between 0.50 - 0.74 m. Further excavation of this wall revealed it to be sitting on grey clay and surviving to up to six courses (see Illus. 59 & 60), a maximum of 0.63 m in height. This structure probably served torevet, or support the west side of the wash pool cutting (see Illus. 57), but may also have provided access to the waggonway at this point (perhaps allowing waggoners to negotiate the wash pond from dry land).



*Clockwise from above:*

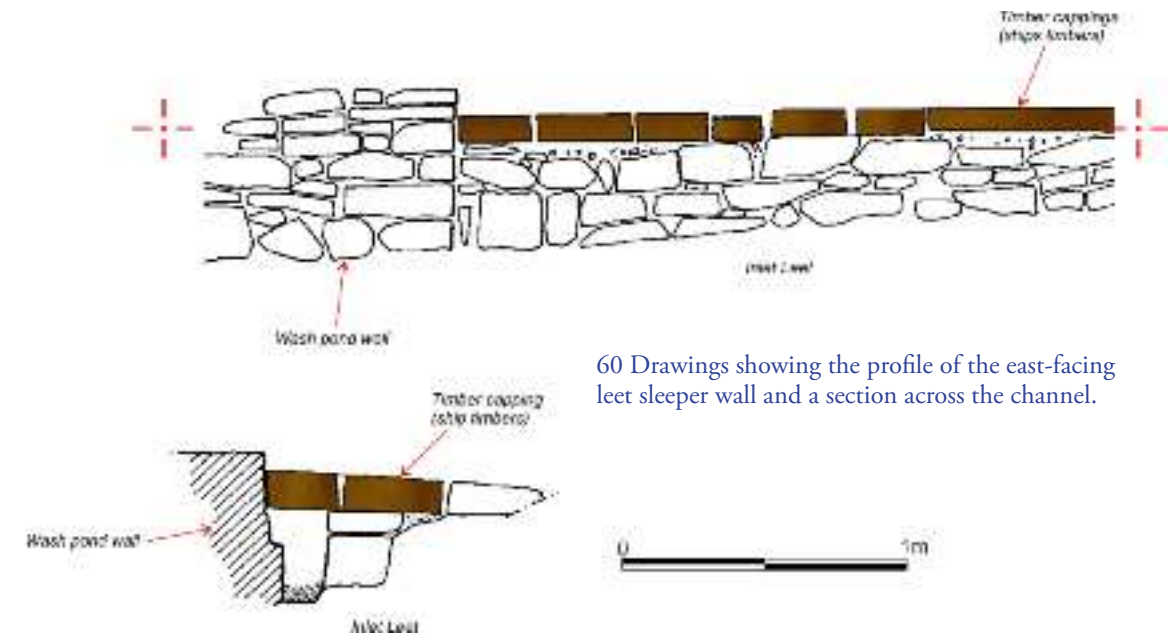
57 The siding viewed from the north following removal of the horse-way and rail track, with the remains of the east side revetment wall and, on the west side of the track-bed, a water-filled leet bounded by the west side revetment wall.

58 View from the south-east of the west side revetment wall and its intersection with the leet, covered at its south end by shorter lengths of transverse wooden planking.

59 Leet capping removed to show dry-stone walling at the junction between the west side revetment wall and leet channel.



*The Leet*



60 Drawings showing the profile of the east-facing leet sleeper wall and a section across the channel.

Further dismantling of the overlying boundary wall revealed that in the upper part of the trench it sat directly over a 6.75 m long, re-used ship's timber of oak, 0.37 m wide, which formed a covered channel, box-shaped in cross-section, on the same course as the wall but separated from it, at its bottom (south) end, by a layer of clay 0.07 m deep and at the north end by a total of 0.77 m, comprising 0.17 m of grey clay directly over the timber, 0.22 m of silty clay above that and 0.38 m of a coal-rich deposit upon which the wall sat.



61 Transverse planking capping the south end of the leet.

62 6.75 m long reused ship's plank over the south end of the leet, with transverse planking beyond.





63 View from the north of transverse planking capping the north end of the leet within the excavated area, with a 4.46 m long plank sitting over the leet between transverse planking and a longer, 6.75 m long plank (removed in this view, but see above).

64 View from the south of the north part of the leet within the excavated area, showing 4.46 m plank sitting over the stone sleeper walls of the leet.

The final, 1.35 m east (downslope) end of the channel (i.e. westwards from the start of the west-side retaining wall) was formed of six roughly-hewn planks (Illus. 61) also derived from ship timbers (perhaps part of a single reused ship timber), most of 0.27 m width with one much narrower, 0.80 - 0.98 m long and 0.09 m thick, arranged east-west transversely across the course of the channel and overlapping with the stone west-side retaining wall. All the timbers forming the channel capping were supported underneath by a stone sleeper wall, the south side of which abutted (and was contiguous with) the higher west-side retaining wall feature, though the latter was clearly a separate build. North of the 6.75 m long reused ship timber which formed the capping of the leet close to its south end was a second substantial timber (Illus. 63 & 64), also sitting directly on the stone sleeper walls, measuring 4.46 m long, 0.25 m wide and 0.09 m deep set at a slightly different angle (turned slightly to the west) in relation to the longer timber. The remaining 6.04 m of the channel before it ran into the north section of the excavation area was capped with 20 short, roughly-hewn planks (Illus. 63) also derived from recycled ship-timbers, arranged transversely over the course of the channel (as at its extreme south end). In several places, either embedded in the upper course of the sleeper walls or resting upon it, were short transverse timbers which acted as levellers for the planks above, in much the same way that wooden chucks and wedges supported the rails on parts of the main way, though perhaps here serving as spacers, shoring up the walls and preventing collapse.

The sleeper walls for the long leet channel varied somewhat in construction. Those under and north of the shorter of the two longitudinal planks (i.e. the northern 10.50 m) were generally of three regular courses, made of flattish sandstone pieces up to 0.45 m long, but generally around 0.20 m long and 0.05 m deep, the total depth of the walls being c 0.20 m, with a similar

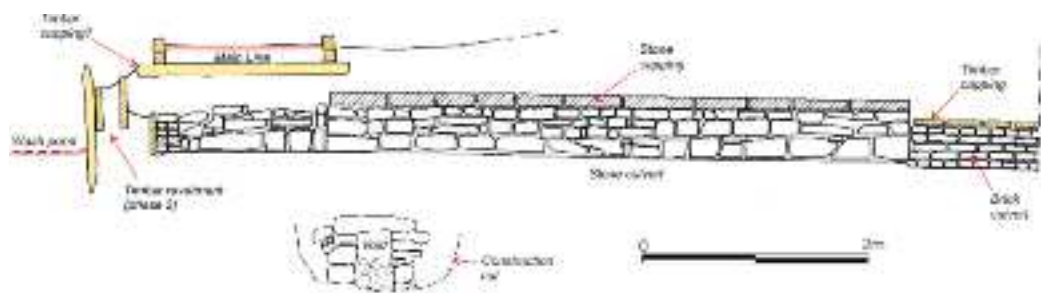


65 View of the course of the leet from the north, with capping removed.

66 View of the south end of the leet with capping removed but showing some short transverse timbers, providing support to the capping.

distance separating them (i.e. forming a 'box' 0.20 m square). The sleeper walls of the south part of the channel (i.e. under the longer plank and shorter section of transverse planking) was of much less consistent build, sometimes only a single stone resting on clay sides, or one deeper stone forming the sides, but generally up to a maximum of two courses deep except under the transverse planks close to its intersection with the 'wash pond' where it was up to three irregular courses deep. The depth of this length of channel was also around 0.20 m, for most of its length, though deepening under the transverse planks to c 0.30 m, while the width was much more varied, from 0.10 - 0.20 m. The width of the sleeper walls themselves also seemed to vary, ranging from the depth of a single stone to up to 0.48 m where backing stones were used, though only at the south end where the (less well-constructed) walls abutted the north end of the west-side retaining wall did they seem to have been made with deliberately-constructed inner and outer 'faces'. No remains of the eastern sleeper wall were seen south of the beginning of the west-side revetment wall to the wash pool cutting, which served from that point southwards to contain water flowing southwards from the gully into the wash pond area. Thus, the stone-built structure of the leet terminated at the north end of the west revetment wall, but the east face of the channel was continued for c. 2 m southwards in the form of a timber (of standard sleeper dimensions) pegged longitudinally beneath the normal transversely placed sleepers.

*The Drain Culvert*



67 Section drawing of the south-facing elevation of the north side of the drain channel under the main line and east of the main line embankment/wash pool siding revetment.

Underlying the main way and extending eastwards from the centre of the 'trough-like' wooden sluice feature in the revetment described above, is a stone-built drain or culvert (see Illus. 67) built of irregular, flat sandstone rubble blocks. The walls of the drain, resting upon pure, firm, light-brown clay are up to four courses high, 0.45 m on the north side and 0.50 m on the south side at the west end, 0.42 m and 0.47 m, respectively, at the east end. The entire structure is some 0.90 m wide, but the internal channel tapers from 0.36 m in the Benton Way section to 0.33 m wide at the east end of the stone-built section to 0.20 m at its west end, where it exits the revetment through the clay-filled, wooden trough-like structure (see above) which seems designed to ensure maximum water depth in the pond.



68 View from the south of the course of the drain across a line of pits parallel with the main way (track removed).  
69 View from the west of the course and west profile of the drain.

The drain is capped for most of its length by flat sandstone flags 0.16 m deep, up to 0.50 m long and up to 0.90 m wide (Illus. 70 & 71), but the capping had been removed over the final 1.5 m length of the west end (Illus. 71) where it underlay the main way and ran into the revetment. The likely reason for this is implied by slumping in the track-bed base seen in the adjacent south-facing section, probably caused by the downward pressure exerted by laden waggons,



70 The course of the drain with capstones removed, showing iron-rich orange fill.

71 View of the west part of the drain, from which capstones were absent, towards the lowest part of the revetment and remains of its integral water-control arrangement.

causing the track-bed, drain-capping and, quite possibly, also the revetment to be rebuilt. Fragments of wood found in association with the uncapped west end of the drain suggest that the slumped stone capping slabs may have been replaced by timber planks, perhaps at the same time the east revetment wall was replaced by a timber post-and-plank structure.

Beyond the uncapped first c 1.5 m length of the drain from the west, it survived for a further 5.5 m eastwards until the stone-built section ended close to the Benton Way boundary wall, beyond which it continued as a brick-lined feature with degraded plank-capping (Illus. 72 – 74). The open east end of the stone-built section displayed a neatly-finished face (Illus. 75) perhaps suggesting that it was intended to end there before an extension was found necessary to the east. The latter is a brick-lined, plank-capped feature which extends 1.70 m westwards from the end of the stone-built section until lost in the Benton Way section and is formed of parallel brick walls 0.36-0.37 m apart, each of five courses and 0.37 m high. The hand-made bricks, which are between 0.23 and 0.242 m long, 0.115 - 0.120 m wide and 0.060 m deep, are laid in mortar-bonded layers four bricks deep. The upper layer on both sides is a header course (laid at right angles to the line of the drain), the second is a stretcher course (face parallel to the wall with long dimension outwards) but thereafter, in the lower courses, there is some irregularity in orientation. The top of the bricks is some 0.19 m (on the south side) and 0.24 m (on the north) lower than the top of the stone sleeper walls of the east part of the drain; the bottom of the stone-built drain being about 0.10 m higher than the bottom of the brick-built part. This means that the brick-built part, while of similar overall capacity, is at a significantly lower level than the stone-built section, facilitating drainage away from the site to the east. The brick-built section is capped by short sections of cut planks which survive poorly; the only complete example surviving in the north section was 0.048 m thick, but other sections of timber pulled from the drain fill after excavation, and which are likely to have performed the same function, were up to 0.080 m (8 cm) thick.

The stone drain, or 'cundy' was filled with a 0.17 m deep deposit of a very soft, orange substance (see Illus. 70) held in jelly-like suspension and formed in thin, laminated layers, sitting upon a greyer, gravelly deposit which blended into the underlying grey clay. A sample of the orange deposit was analysed using non-destructive energy dispersive X-Ray Fluorescence (EDXRF)

techniques to determine its composition, which confirmed it to be high in iron content, but did not provide further indications of its origin.

#### *Pits along the east side of the Main Way*

Perhaps the most enigmatic and certainly the least understood feature of the waggonway complex is a series of pits recorded on the north side of the main way, adjacent to and apparently constructed to the same length as the retaining wall on the west side of the sidings track (see Illus. 68 & 69, above). At least six pit features were visible, arranged in linear formation on a north-south orientation adjacent to, but 4.5 m east of, the line of the west-side retaining wall. The pits varied in width between 0.65 and 0.99 m, the widest being that on the north side of the stone drain, while they vary in length between 0.68 m and 3.68 m, the most northerly being 3.15 m long and 0.24 m deep, the next to the south being 2.14 m and 0.49 m deep, the next (visible in the long exposed section) 3.74 m long and 0.64 m deep, the next 2.87 m, divided by the drain into sections 0.78 m long (where it backs onto the packing stones on the north side of the drain) and 1.04 m (on the south side where it backs directly onto the drain capstone, the packing stones having been removed), and is up to 0.23 m deep. Three more to the south have maximum length measurements of 1.05 m, 0.75 m and 1.1 m, respectively.

In section the pits displayed uneven sides (see Illus. 76 & 78) with at least one, seen in the machine cut section and 8 metre south-facing section, almost vertically cut with a break at half-way point, suggesting that it had been formed to contain, or stabilised by some kind of timber revetment, all material remains of which had been lost. Straight edges seen in plan, particularly on the section of pit on the north side of the drain, also suggested it had been excavated by spade in a series of edges and/or, more likely, lined with wood. Some of the pit edges were undercut into the clay (i.e. at more than vertical angles), again suggesting wooden lining against which surrounding clay had

#### *Left, from top:*

72 The east end of the stone-built part of the wash pond drain and its intersection with the brick-built eastern section.

73 The drain running into the Benton Way section of the site nearly 2 metres below ground level.

74 View of the well-coursed brickwork forming the sleeper walls of the drain at its east end.

75 View westwards towards the east outflow of the stone-built part of the drain at its intersection with the eastern brick-built part.

slumped. The pits were filled with a mixture of coal waste and silty soil, though fragments of wood were also found in most and the pit bottoms also contained a grey, apparently organic silty deposit, samples of which were taken for analysis, without significant results. The clay-based material into which the pits were cut, visible particularly in the section of the deep machine-sondage (marked on the site plan) and cut section was coal-streaked and contained sparse finds of early modern pottery, clay pipe and brick fragments. The relational phasing between pits and drain is unclear, but it is highly likely that they were in use at the same time as, or even constructed following, the wash pond drain which passed through them.

An eight metre section cut across the site through one of the pits, extending in total from the Benton Way site boundary eastwards across the main way embankment, revetment and siding to the west-side retaining wall, revealed a series of clay-based deposits underlying the pits, railway tracks and associated features. This south-facing section revealed an underlying base clay, brown in colour and somewhat coarse in texture, containing grit and small stone fragments but no obvious made material. This ran uphill from the east (from the bottom of the section south of the concrete pillar base adjoining Benton Way) until apparently peaking under the eastern edge of the main way before descending slightly and flattening to end under the west side of the main way bordering the revetment. Underlying the parallel horse-way within the wash pond siding is a cleaner clay extending to the west revetment wall, beyond which a similar clay to the original base material resumes, overlain by a much cleaner clay (cleaner and browner than that under the horse-way). Over the original gritty clay east of the revetment is a similar clean clay to that forming upper deposits west of the horse-way; this forms the base deposit for the main way, the sleepers of which rest upon a broken shale-like deposit mixed with coal finings. The top of the fine clay descends from the east side of the main way as a dark band, probably implying the presence of coal dust in the puddled upper surface, until reaching the concrete buttress c 0.40 m above the bottom of the cut at a depth of c 2.0 m bgl. Above the dark band east of the pit feature is a double raised undulation with a fillet of yellow clay infilling the raised undulation and east side of the pit. On the west side of the pit is another, different fillet of pure orange clay between the pit and main way. Apparent slumping of clay under the main way, presumably caused by the sustained and repeated trauma of heavy waggons moving across it, may explain the various phases of revetment on the east side of the siding cut, as well as the absence of capping stones from the western part of the drain underlying the main way (see Illus. 71 above).



#### *From left:*

76 The south-facing section of a pit infilled with coal waste on the east side of the main way; note also slumping in the clay base of the main way which probably explains the re-laying of the latter and absence of stone capping from the drain underneath it. 77 Vertical view of one of a series of infilled pits on the east side of the main way. 78 North-facing section of one of the infilled pits

## Analysis

In order to answer questions regarding the phasing of the waggonway and function of various of its constituent features, as well as the origin and original function of some of its timber and stone elements, a number of post-excavation analyses were carried out in conjunction with detailed documentary survey (see Turnbull, this Volume) and a comparative examination of other waggonway excavations in the valleys of the rivers Tyne and Wear. The principal such studies concerned palaeo-environmental analysis of deposits from pits and drainage gulleys (see *Appendix 1*), species identification of timbers (see Table), geo-technical analysis of stone to determine its type and original source (see Kille, this Volume), analysis of suspected ship timbers to confirm their original function and suggest sources (see Whitehead, this Volume) and further visual analysis of timbers to identify characteristic traces of shaping prior to use and of wear during use. In addition, dendro-chronological analysis of timbers to determine age and place of origin was also attempted but proved unsuccessful because insufficient numbers of growth rings were available for study in the timbers selected.

### Specialist Analyses of waggonway elements

Structural recording of built features and made deposits is often enhanced in archaeological analyses by information derived from the study of associated artefactual and ecofactual objects and deposits. In the present case, however, remarkably few artefacts of significance, other than the stone and timber elements of the waggonway itself, were recovered from the excavation site and the analysis of samples taken from various enclosed watercourses and pits also provided sparse return (see *Appendix 2, below*).

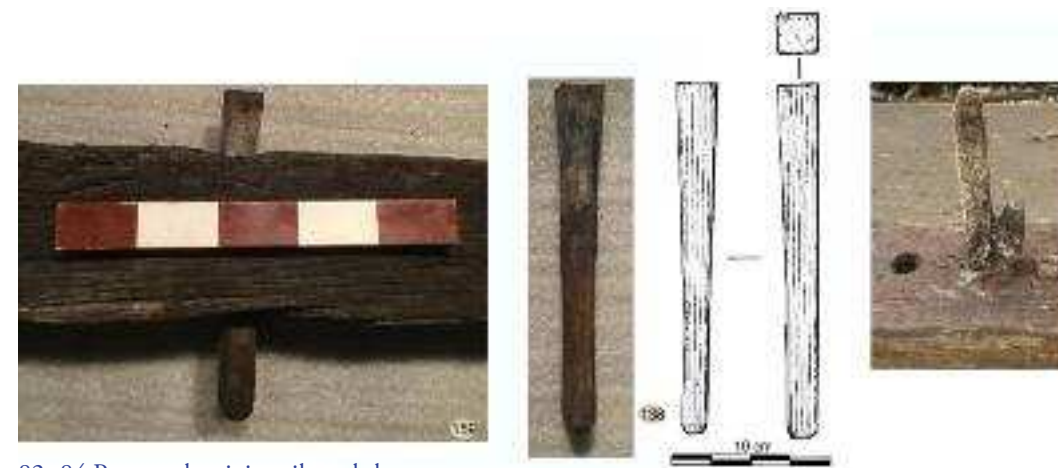
### Timber

Regarding the most significant surviving elements of the waggonway, the surviving timbers, of which a total of 237 were recorded, 66 of those revealed were rails (148 m length in total), the shortest 0.5 m [timber 22] and the longest 4.92 m [timber 180]. This included single running-way on the wash pond, double running-way on the main line and retaining rails for the horse way on the wash pond.



79-81 Timbers showing distinctive features of ship-building and waggonway construction -  
*Top:* pattern of trenails derived from ship-building on a short plank used as drain capping;  
*Middle & bottom:* multiple recutting of peg holes for waggonway construction interspersed with residual trenails/trenail holes from ship-building.

Only one rail [timber 19] had a probable trenail hole. Ninety six of the timbers were sleepers of which 33, just over one third, had either trenails or augured holes for trenails and were diagnostically ships' timbers, almost exclusively parts of ribs or futtocks. All of the sleepers on the wash-pond line were oak and derived from ribs; sleepers on the main line were more varied in character with fewer ship timbers. In addition to augered trenail holes in reused ship timbers (Illus. 79; see also Illus. 103-106, below), both sleepers and rails displayed chisel-cut holes for wooden pegs used to fix double rails together and bottom rails to sleepers (Illus. 80-81). In many cases two or more phases of holes, some containing the cut off remains of pegs, were present where rails had been reused or refixed, or new rails fixed to sleepers (see Illus. 84).



82- 84 Pegs used to join rails and sleepers -

*Left:* peg through a rail.

*Middle:* photograph and drawings of peg 138.

*Right:* rail turned over to reveal the lower part of a peg and remnants of its predecessors.

In addition to timbers used for rails and sleepers, 42 planks used for other purposes were recovered during the excavation, of which 28 had either trenails or the augured holes for trenails. Even without trenails, it seems very likely that all but two or three of the planks recovered from the site were from ships. The planks served in a number of locations including capping the inlet leet (two laid longitudinally and 25 laid transversely). Five (very eroded) planks also capped the brick-built western end of the outlet culvert. Other planks were incorporated into the phase 2 revetment of the east face of the wash pond. Almost all were ships' planks.

Supporting the planks in the phase 2 revetment were 28 vertical supports, most of which were roughly-trimmed branches. There was also one trimmed piece of ship's plank [timber 205] set vertically between two probably re-used piles [timbers 115] & [206].

Of the remaining timbers, three ([timbers 78], [85] & [157]) were supports set longitudinally under main-line rail sleepers alongside the revetment. A few other fragments of timbers were used to support and wedge rails in the wash pond where they ran over sleepers, and to support the Carville boundary wall where it partially overlay the former horse-way.

Species identification was carried out during the conservation process by York Archaeological Trust and showed that the great majority were either pine or oak, with beech, ash and elm also sparsely represented (see table on next page).

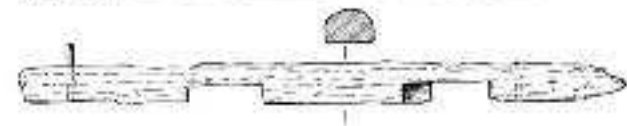
The great majority of sleepers in the wash pond were of oak, which it seems reasonable to assume would have been preferred for all elements of the waggonway due to its strength and resilience, but would only have been used when available (from ship-breaking) in appropriate lengths. Apart for oak, primarily used in the sleepers and pegs, pine is the most common wood used on the waggonway, especially for the rails. Although not particularly durable, it was cheap, being available from local as well as Baltic sources, and easy to work and transport, so won out over more durable but much more expensive timbers. The distribution of species used on a waggonway compares reasonably well with Buddle's advice on species selection for 18th century waggonway construction, quoted in Turnbull (This Volume): "*The best wood for constructing the Ways is Oak for the Sleepers and Bottom Rails and Beech for the Top Rails. Norway Fir Timbers is most commonly used for the bottom rails...*". One of the reasons for variation from this suggested norm is contained in another of Buddle's observations that "*(a newly-constructed waggonway) will last from 2 to 10 years or even much longer by occasional repairs*", suggesting that much of the timber of the Willington line - excepting the sleepers, horse-way rails and, perhaps even the running rails of the siding which were subject to lower impact, a shorter period of use and preservation under water - will have been replaced more than once during the lifetime of the line, in its latter years being subject to increasingly ad hoc repair when it became obvious that its closure (or replacement by iron rails) was imminent.

11	<i>Pinus sylvestris L.</i> (sleeper on Main Way)	138	<i>Pinus sylvestris L.</i>
19	<i>Pinus sylvestris L.</i>	139	<i>Pinus sylvestris L.</i>
50	<i>Quercus spp.</i>	141	<i>Pinus sylvestris L.</i>
52	<i>Fagus sylvatica L.</i> (top-rail of main way)	142	<i>Pinus sylvestris L.</i>
51	<i>Pinus sylvestris L.</i>	144	<i>Pinus sylvestris L.</i>
54	<i>Quercus spp.</i>	145	<i>Pinus sylvestris L.</i> (Bottom Rail of the Main Way)
56	<i>Quercus spp.</i>	153	<i>Quercus spp.</i>
62	<i>Quercus spp.</i>	154	<i>Quercus spp.</i>
63	<i>Quercus spp.</i>	155	<i>Quercus spp.</i>
66	<i>Quercus spp.</i>	156	<i>Quercus spp.</i>
72	Elm (Sleeper in dip of the siding)	159	<i>Quercus spp.</i>
73	<i>Pinus sylvestris L.</i> (top-rail of the horse-way)	160	<i>Quercus spp.</i>
82	<i>Pinus sylvestris L.</i> (running rail of the siding)	162	<i>Pinus sylvestris L.</i>
91	<i>Quercus spp.</i>	163	<i>Fagus sylvatica L.</i>
92	<i>Quercus spp.</i>	164	<i>Quercus spp.</i>
95	<i>Pinus sylvestris L.</i>	165	<i>Quercus spp.</i>
96	<i>Quercus spp.</i>	166	<i>Quercus spp.</i>
97	<i>Quercus spp.</i>	167	<i>Quercus spp.</i>
98	<i>Quercus spp.</i>	168	<i>Quercus spp.</i>
99	<i>Quercus spp.</i>	169 (x2)	<i>Quercus spp.</i> (both pieces)
100	<i>Pinus sylvestris L.</i>	170	<i>Quercus spp.</i>
101	<i>Quercus spp.</i>	171	<i>Quercus spp.</i>
102	<i>Quercus spp.</i>	182	<i>Pinus sylvestris L.</i> + <i>Quercus spp.</i> peg (Bottom rail of the horse-way)
104	<i>Fraxinus excelsior L.</i>	200	<i>Quercus spp.</i>
104	<i>Quercus spp.</i>	201	<i>Quercus spp.</i>
107	<i>Quercus spp.</i>	202	<i>Quercus spp.</i>
108	<i>Quercus spp.</i>	203	<i>Pinus sylvestris L.</i>
109	<i>Quercus spp.</i>	204	<i>Pinus sylvestris L.</i>
110	<i>Quercus spp.</i>	205	<i>Quercus spp.</i>
115	<i>Pinus sylvestris L.</i> (Pile with blind mortice housing truncated tenon)	206	<i>Pinus sylvestris L.</i>
115	<i>Quercus spp.</i> (in situ truncated tenon housed in blind mortice of 115)	207	<i>Quercus spp.</i>
116	<i>Quercus spp.</i>	208	<i>Quercus spp.</i>
117	<i>Quercus spp.</i>	210	<i>Quercus spp.</i>
118	<i>Quercus spp.</i>	211	<i>Fraxinus excelsior L.</i>
119	<i>Quercus spp.</i>	212	<i>Quercus spp.</i>
120	<i>Quercus spp.</i>	213	<i>Quercus spp.</i>
125a	<i>Quercus spp.</i> (poss. refitting to 125b)	214	<i>Quercus spp.</i>
125b	<i>Quercus spp.</i> (poss. refitting to 125a)	215	<i>Quercus spp.</i>
134	<i>Quercus spp.</i>	216	<i>Quercus spp.</i>
135	<i>Quercus spp.</i>	217a	<i>Quercus spp.</i>
137	<i>Pinus sylvestris L.</i>	218	<i>Quercus spp.</i>
		219	<i>Fraxinus excelsior L.</i>
		Unlabelled 'A'	<i>Pinus sylvestris L.</i>
		Unlabelled 'B'	<i>Pinus sylvestris L.</i>

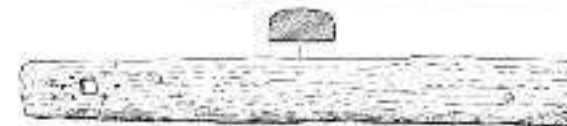
Botanical identification: *Fagus sylvatica L.* Beech, *Fraxinus excelsior L.* Ash, *Pinus sylvestris L.* Scots Pine, *Quercus spp.* Oaks (exact species not determinable)



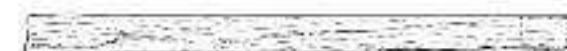
85-87 Main line sleepers (timbers 76, 104 & 108) of irregular unworked form.



Timber 47. Sleeper on main line.



Timber 31. Sleeper on main line.



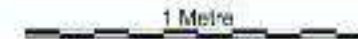
Timber 51. Sleeper on main line.



88-90 Main line sleepers (timbers 31, 47 & 51) displaying indications of prior use as ship timbers, with peg holes derived from their (re-)use as waggonway sleepers.



91 Timber no. 80 of the main line showing trenails and waggonway pegs.



Trenail Holes



92 Timber no. 93 of the dip line with trenail holes and multiple waggonway peg-holes.



1 Metre



Corner of TB

96 Timber 135 showing signs of its original use as a ship timber.

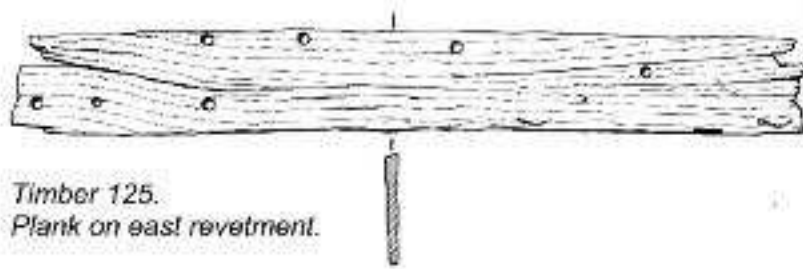




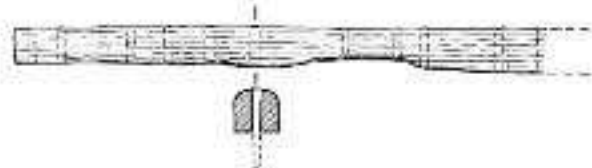
Timber 93. Upper rail on horse-way.



Timber 125.  
Plank on east revetment.



Timber 145. Part of rail.



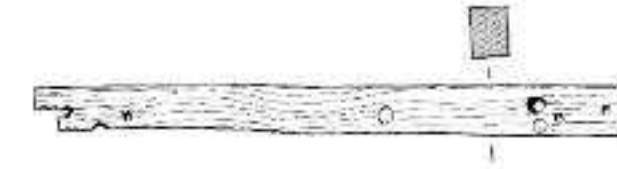
93-95 Horse-way and revetment timbers (nos. 93, 125 & 145) displaying indications of prior use as ship timbers.



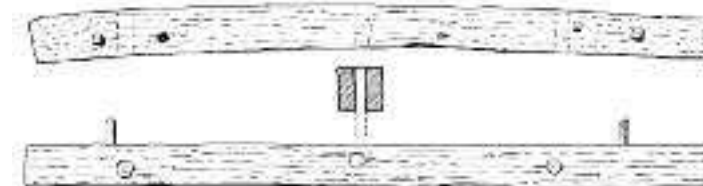
Timber 135. Sleeper on dip line.



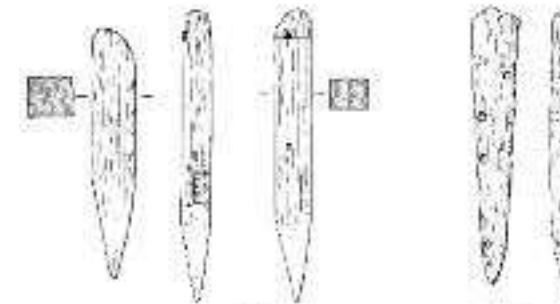
Timber 153. Sleeper on dip line.



Timber 170. Sleeper on dip line.



97-99 Sleepers of the wash-pond siding (Timbers 135, 153 & 170) showing evidence for prior use as ship timbers as well as rail fixings.



Timber 204 (left) and 115 (two perspectives) in Phase 2 revetment.

Timber 205 in Phase 2 revetment.



100-102 Revetment timbers (l-r nos. 204, 115 & 205) used as posts.

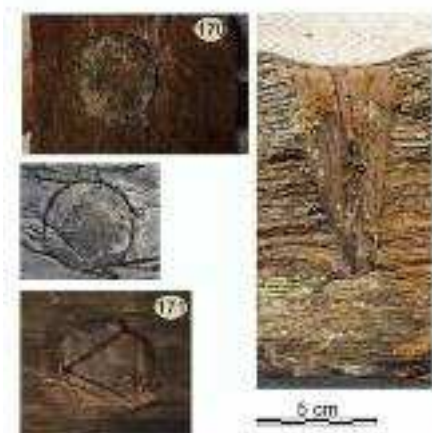
A study undertaken by maritime historian, Ian Whitehead (this Volume) on the use of re-cycled oak ship timbers,<sup>4</sup> which are known from contemporary accounts of waggonway construction to have been bought for that purpose, produced information about possible sources of timber used on the Bigges Main waggonway. An advertisement in the *Newcastle Courant* of 12th May 1803 is one of several contemporary advertisements for the sale of dismantled ships which provide a direct link between the sale of recycled timbers and the business of waggonway construction:

*“To be sold be auction, etc. ... A quantity of timber and oak plank, etc. ... suitable for Ship-Builders, House-Carpenters, and for laying Waggon - Ways, &c”.*

The study has ascertained that such auctions of wrecked or stranded ships, advertised regularly in the *Newcastle Courant*, were to a large degree weather dependent. 1784, for example, was particularly notable for the large numbers of ships wrecked during a great gale that blew from Sunday 5th until Wednesday 8th of December. Most ships advertised for sale in that year and in January 1785, when the Bigges Main waggonway is likely to have been under construction, were wrecks from this storm.

Of the 237 timbers recorded from the Neptune Yard excavation, 62 were provisionally identified as being of ship origins on the basis of their curved and tapering shapes, varying thickness or specialised fastenings and joinery. It was impossible to provide more than a tentative identification of original function for the recycled ship timbers but, on the basis of shape alone, two of them may be upper futtocks from the frame of a small vessel such as a sloop, while others appear to be cut from some of the thicker planking found in small to medium sized vessels.

The main indicator of ship origins, however, is the presence of treenails - *cylindrical oak pins driven through the planks and timbers of a vessel to connect them together* - and/or holes bored to take treenails, seen in 11 of the 13 conserved timbers available for study. The treenails found in the Bigges Main timbers suggest regional variation in the method of tightening them, including evidence that at least one was worked on in southern England, but evidence to connect timbers to any particular ship, or shipyard, was not found. The chances that the timber was not derived from a local source is increased by the fact that in 1785 the North-East shipbuilding boom had yet to come to fruition and many vessels operating locally were built in Whitby, London and abroad, including colonial America, although the number of ships being built on the rivers Tyne and Wear was increasing.



103-106 Details of treenails seen in plan and profile in waggonway timbers, including square and triangular wedges and crossways caulking seen in timber 170. (top left).

The failure of dendrochronological analysis means that there are no reliable means to determine the origins of the timbers with any degree of certainty. However, the suggestion that at least some of the reused ship timbers display features normally associated with southern British ports suggests that the oak wood, too, could have originated there or even further afield. There is also a strong likelihood that some of the pine may have originated in the Baltic, leaving only the unworked branches, used as sleepers, as of certain local origin. With regard to non-maritime-related carpentry marks, few specific observations have been made other than that the pegs and peg holes created to fix rails to timbers are generally square in profile, created using a chisel and hammer rather than a drill which is necessitated in ship-building by the need to create tightly sealable joints.

In addition to the reuse of timbers from maritime sources, Timbers 137 and 180, both pine bottom rails on the wash pond horse line, have numerals, or numeral like symbols (probably stamped with the flat blade of a cold chisel) suggestive of the joinery marks used in timber-framed buildings or roof structures. Timber 137 is 4.9 m long, square in section and tapering to one end, stamped 'VII' on the upper face; Timber 180 is 4.92 m long, also of squared section and tapering to one end, stamped 'XII V' on its side. The tapers are not related to the function of the rails and are, presumably, a product of earlier use. Although the timbers could be ship-related, there are no indications that this is the case and it is suggested that they are more likely to have functioned as parts of a building, such as roof trusses.

#### Stone

In addition to the analysis of the waggonway timbers, detailed study was made of the stones used to form a compact cobbled surface for a horse-path within the trackway of the wash pond siding, providing a firm base for horses pulling waggons through the ponded water. Geologist, Ian Kille (this Volume), has characterised these stones in order to attempt to determine their source of origin; whether they were quarried or imported specifically for use on the waggonway, or were a by-product of the mining process.

All 400 unworked blocks in storage were examined as part of the study, but 70 of them were cleaned and subject to closer study. A high proportion of the stones, which range in size from approximately one metre in their longest dimension down to approximately 10 cm in their shortest, are freshly broken, but some show weathering where the stone has been exposed to the elements for many years prior to incorporation in the waggonway. Further macroscopic and microscopic examination and measurement of surface geochemical characteristics using a portable X-Ray Fluorescence device, backed-up with a search for quarries shown on historic maps, research into the underlying geology of the area and examination of building materials found in local buildings determined that the stones from the waggonway probably come from a single, local source, probably from the Carboniferous Middle Coal Measures which crop-out locally and were cut into by local coal mines.

Whilst it is possible that the horse-track stones may have been imported by boat, it is highly unlikely they would have been imported for this specific purpose and their importation as

ballast also appears unlikely. It is also possible that they were a by-product of coal-mining, but several factors make this unlikely, most significant amongst which is evidence of weathering on some of the stones which could not, therefore, have come from recently-quarried, underground sources. The proximity of many quarry sources with properties consistent with the waggonway stones, combined with documentary evidence that local quarried stone was used to construct mine buildings, strongly suggests that the stones were sourced from a local quarry of which Benton, Willington and Scaffold Hill are the most likely contenders.

### *Ceramic artefacts*

The ceramic assemblage, summarily described in *Appendix 2*, below), comprising fragments of pottery vessels, clay pipe, roof-tile, brick and drainage pipe is not extensive and generally reflects the 18th century origins of the waggonway and the continued use of the site into the 19th century. The assemblage comprises both fine table-wares and coarse (utilitarian) cooking-wares as well as clay pipe fragments, but no vessels specifically related to the function of the waggonway, nor were any closely dateable enough to reflect phases of its construction or use. Some of the pottery, specifically the black-glazed, sgraffito-decorated and slip-trailed wares as well as some fragments of large, lead-glazed vessels in coarse fabric found on the west side of the Carville boundary wall, potentially-pre-date the construction of the waggonway, as does a single fragment of Roman pottery found in clay construction deposits close to the drain course, east of the main way. The latter certainly suggests that some of the pottery and tile found on the site is residual or, potentially, imported in deposits of construction material.

The above analyses, combined with the structural record of the site and comparative information on other waggonway sites makes it possible to develop a phased chronological sequence for the site which is summarised below.

## *Site Chronology*

Based on the structural observations made during excavation and subsequent analysis enhanced by specialist study of individual elements, five broad phases of land-use have been identified in association with the waggonway.

### *Phase 1: The Early Landscape*

The area of excavation sits on a terrace overlooking the River Tyne at the apex of a broad curve in the river where its course deflects from north to east. Hadrian's Wall ran past the site a little way to the north, terminating on the river bank to the east at the fort of *Segedunum* which was accompanied by an extensive vicus or civil settlement.

The early topography of the area has been altered by extensive industrial development, most markedly the growth of the ship repairing facility which included four graving docks on the riverside and associated industrial works, such as brickworks.

### *Phase 2: The Introduction of a Waggonway*

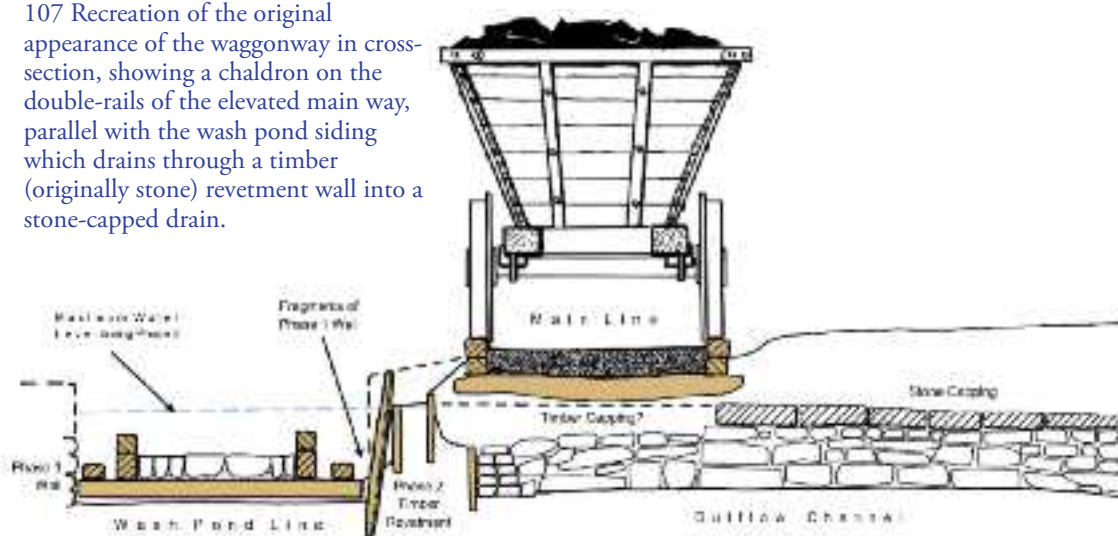
An important land division, marked by a ditch, ran towards the riverside to the east of Carville Hall; the apparent remains of a ditch slightly askew to the later (reinstated) property division was seen at an early stage in the investigation of the site and may be the only feature on the west side of the tracks. Documentary evidence suggests that a 'main way' seen within the area of excavation, serving coal pits to the north and accessing staiths on the riverside, was established along the eastern flank of this boundary in a narrow wayleave towards the end of the 18th century (see Turnbull, this report) in association with the Bigges Main pit, sunk in 1785.

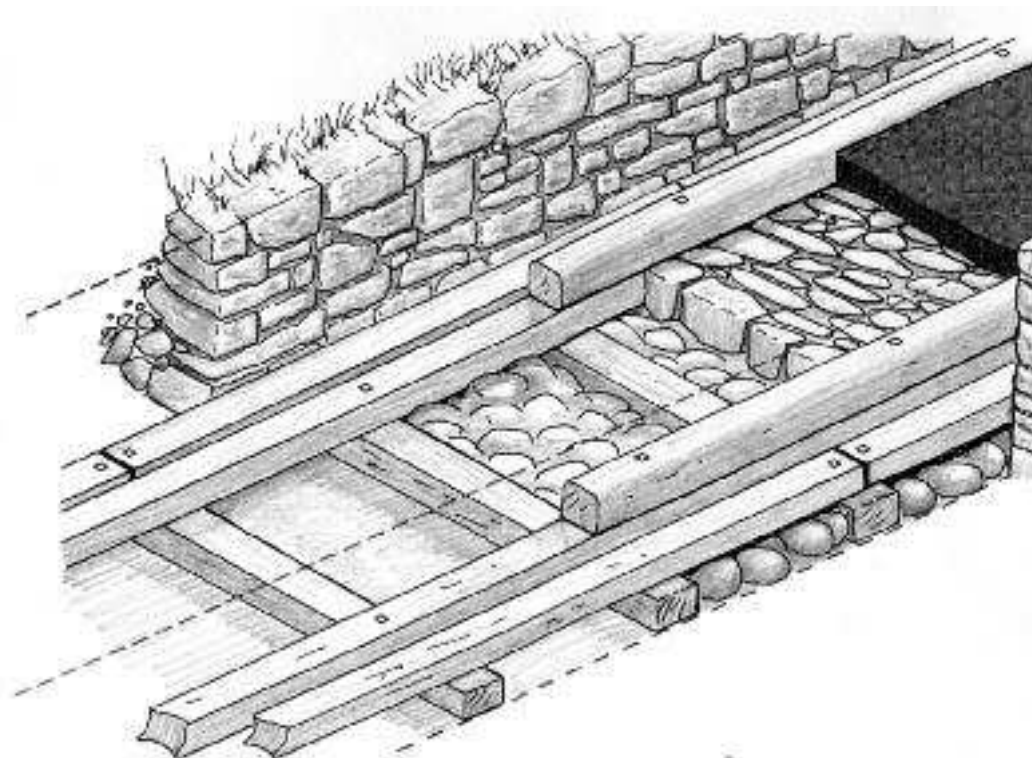
The well-preserved main way ran on a straight line and on a very gentle and consistent gradient across the site to the south edge of the excavated area. The wooden waggonway of the main way was very-well preserved with extensive survival of both sleepers and rails, the latter including intermittent preserved sections of double-way, the first such examples ever excavated, fixed to one another and to the underlying sleepers by wooden pegs. The sleepers were of inconsistent size and shape - some being squared for use or re-used ship timbers cut to length, others being lightly re-worked tree branches – their variety suggesting gradual accretion through reuse and replacement rather than a single phase of track construction. The sleepers were set on and within a substantial bed of shale and yellow clay ballast and an additional bank of clay was laid along the external edge of the eastern rail, covering the sleepers extending beyond, perhaps as a drainage device.

### *Phase 3: Insertion of the 'Wash Pond' Loop with its water management system and pits alongside the Main Way*

At some point after the construction of the main way a connecting siding was built on the west side of the main way. This cut down alongside the main way and apparently led to some subsidence of the track bed and attempts to alleviate this problem with the insertion of longitudinal timbers underneath a number of sleepers, notably on the west side of the main way. The loop was set in a dished cutting, 2.6 m wide which dipped to a maximum of 0.7 m centrally and rose to either end. Its excavation removed a length of the ditch which had run along the

107 Recreation of the original appearance of the waggonway in cross-section, showing a chaldron on the double-rails of the elevated main way, parallel with the wash pond siding which drains through a timber (originally stone) revetment wall into a stone-capped drain.





108 Schematic recreation of the original wash pond sideline, showing the outer running rails on sleepers, with the double-rails of the horse-way framing an inner raised cobbled track covered with coal finings. Stone revetment walls form or support the sides of the cutting.

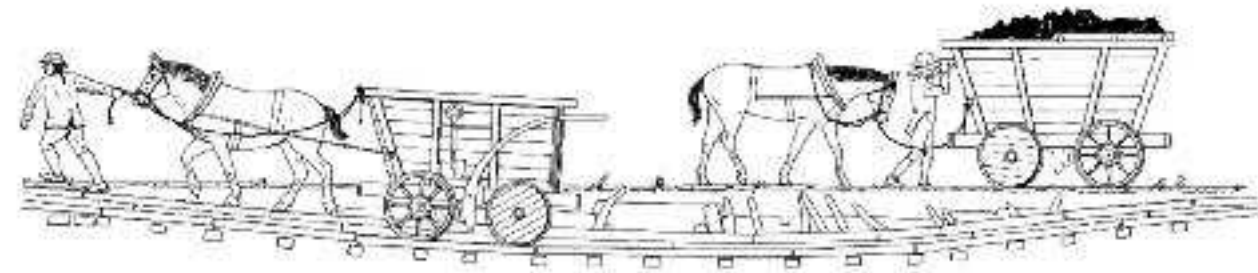
western flank of the main line. In addition to the cutting for the track, trenches were also cut for the insertion of a substantial stone drainage culvert across the main way and for a stone-lined leet running from the north into the loop line. Once the main cutting had been made, stone retaining walls, of irregular rubble work bonded in both clay and mortar, were set along either face (Illus. 108), both splaying slightly at the south end of the loop. A considerable amount of the west retaining wall survived intact in 2013, although at no point did it survive to its likely full height. The eastern wall was fragmentary and had at some point, whether as a result of acute failure due to the impact of coal-laden waggons above, or chronic deterioration, been replaced with a timber revetment which itself appeared to have been replaced or repaired piece-meal.

The track set into the walled cutting was designed specifically for use as a wash pond; no evidence was found to indicate that the structure was adapted to suit this purpose or, indeed, to indicate that any part of it, other than the east retaining wall was ever replaced. Further evidence that the walkway was of single phase in the surface of the stones which had worn flat and smooth with the impact of horses' hooves exacerbated by the grinding effect of grit between hoof and stone, and perfect survival of the underlying sleepers, re-used square-cut ship timbers of oak which could not have been replaced without enormous disruption and expense. It seems reasonable to conclude that the waterlogged nature of the wash pond, together with the

relatively low impact nature of activities within it – involving the act of pulling empty waggons through water – had a preserving influence upon its constituent features and the structure as a whole.

In order to function as a wash pond (Illus. 109 and see Illus. 46, above), water had to fill the dip in the siding to an optimal height, soaking the wooden wheels of the waggons whilst not unduly hindering their movement along the track. Water from an unknown water source to the north-west was fed into the wash pond along a narrow and shallow leet set in a trench cut down into clay subsoil and running for 17.5 m within the area of excavation. The channel itself was only around 0.2 m wide and 0.2 m deep, constructed of thin, unbonded stones forming sleeper walls mostly only one stone thick but intermittently widening to two or three stones. The leet was capped with re-used ships' planks, two of which were placed along the channel with the remainder sawn into lengths and placed across the channel.

Excess water from the wash pond was removed through a substantial stone and brick culvert set in a broad trench which ran under the main way and onward to the east beyond the area of excavation. From the east-side revetment of the wash pond siding for a distance of 6 m the culvert was formed of unbonded sandstone rubble walls, all but the first 1.5 m being capped with sandstone flags. The final section running into the Benton Way boundary was of mortared brick walls capped with re-used ship planks sawn and set transversely over the culvert. Although the west mouth of the culvert lay within the area of excavation, its early form is not known since it had been stripped away with the loss of most of the original sandstone retaining wall and its replacement with a wooden revetment. However, to function as an overflow mechanism and not as a plug, the mouth of the culvert must have been at a similar level to that seen in the later wooden revetment, which contained slots suggestive of a rudimentary sluice mechanism. The presence of a number of what would seem to be re-used 18th century bricks in the western end of the culvert north wall may indicate that the opening or sluice was expressed, at least in part, in brickwork.



109 Schematic recreation of the wash pond siding, or dip-line, showing wooden-wheeled chaldrons on their way to and from the riverside staites, a coal-laden waggon running downhill with horse walking behind while an empty waggon is pulled out of the wash pond by a draught horse, led by the waggoner.

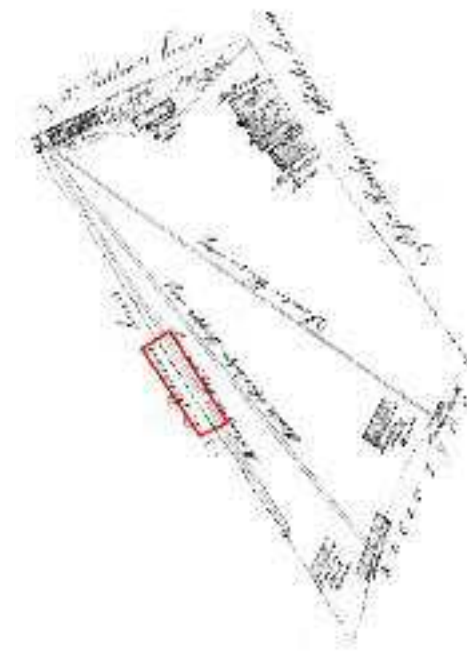
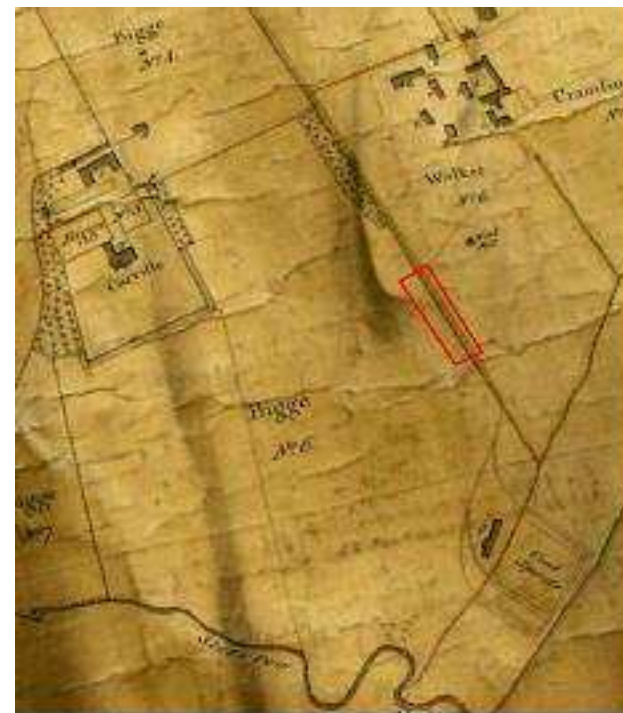
As noted above, the failure of the original retaining wall to the east side of the wash pond cutting led to the construction of a timber revetment along the same course as the wall, which was only incompletely removed. The revetment was formed of five horizontal re-used ships planks pegged with both rounded and squared timbers, the irregular spacing and orientation of which suggested more than one phase of installation. The inlet for the stone-built culvert draining the wash pool to the east was marked by a double skin of planks, a gap between which was filled with a pure grey clay.

At some point in the development of the route, a series of 'pits' was excavated along the eastern flank of the main way. These are currently poorly understood, but would seem to have formed a series of cells, demarcated by clay walls, possibly lined with timber. Their fills were fairly consistent throughout; coal fines and frequent pieces of pantile, but this almost certainly represents backfilling of disused features. Further analysis, archaeological and historic, has so far failed to elucidate the functional interpretation of these features. Palaeo-environmental analysis of their fills (see Appendix 1, below) revealed the preservation of a small amount of wood and uncharred seeds which reflects some anoxic preservation and could, though not conclusively, support the suggestion that the pits were used for water storage. Another proposed suggestion was that the pits may have been used for the storage of horse feed is not supported as plant remains associated with fodder, such as cereal remains, crop processing waste, grass/hay or weeds associated with hay, were absent from the samples.

#### *Phase 4: Abandonment of the Siding/Insertion of Carville Boundary Wall*

The lack of obvious repairs to structures of the siding, other than the replacement of the east side revetment wall with a wooden 'post & plank' revetment – probably a response to the collapse of the east side of the cutting due to the effects of heavy traffic on the main way - suggests that it was not long-lived. That the main way continued in use after the siding was abandoned is shown by the overriding of the track of the main way across the northern junction, rendering it unusable.

Bell's 1800 plan of the Bigges Main Waggonway (Illus. 110; *Durham Cathedral Library DCD/E/CC/62*) does not show the wash pond, suggesting that it had gone out of use by then. This is supported by a plan of 1810 (*NEIMME Watson 3/7/510*) which shows the branches of the waggonway before they joined to form the single main way to the north, and a plan showing the situation in the following year when the lines to Coxlodge and Fawdon to the east had been completed (*Illus. 111; Buddle Collection 53/1811*). The maps of 1800 and 1811 show the waggonway in relation to the Carville property boundary while the earlier two are detailed enough to include diverging branches in its final section to the riverside staiths. The boundary wall depicted on these plans is that found during excavation to be partly built over the west side of the siding, marking a very definite terminus to the use of the latter and probably re-imposing the line of an original property division.



110 & 111 Plans showing the Bigges Main Waggonway in 1800 (Bell's plan of May 1800 for the Dean and Chapter) and 1811 (Buddle Collection 53/1811), showing the site of excavation.

#### *Phase 5: Abandonment of the Main Way and Encroachment of Modern Industrial Features*

The wash pond siding was probably covered by colliery waste on its abandonment in the 1790s, a task completed hastily to avoid disruption in trade, allowing no time to recover the timbers. The main line was replaced with an iron railway in 1812, whereupon the wooden components, being of no salvage value, were deliberately covered with coal waste, thereby preserving them in an increasingly industrialised landscape. The Willington Colliery continued to use the line until 1820 when a new route was opened to Willington Quay; The Kenton & Coxlodge Railway was given running rights over a section of it, its line branching off to the east (see *Illus. 111*). The opening of the Blyth and Tyne line through Gosforth in 1863 seems to have enabled Gosforth and Coxlodge collieries to abandon the line to Carville, all traces of which had disappeared by the time the Riverside Branch was built in 1879.

The Kenton & Coxlodge line and its riverside staiths survived the opening of the Riverside Branch but went out of use by the 1890s; the Carville boundary wall, partly overlying the south-west side of the waggonway remains, survived this and the establishment of the Tyne brickworks on the same, south-west side of the former waggonway. A small platform of re-used bricks, many of which were identifiable from stamps as deriving from early 20th century sources in Newburn, are likely to date from this phase. Expansion of the shipyards in the hinterland of the shoreline meant that by the early 20th century the brickworks had been removed, the site remodelled and

its north-east boundary realigned with the establishment of Benton Way, removing and burying the remaining lower courses of the former Carville boundary wall.

By the late 1940s a large, hangar-like building (latterly, at least, with a centrally-divided roof structure) associated with Neptune Shipyard covered the entire site of the waggonway remains, its south-east side coeval with the south-east edge of excavation where brick foundations were uncovered during the excavations, while its north-west side extended almost as far as the Riverside branch railway from which sidings branched to serve the north part of the building. This building and subsequent replacements or modifications must have had shallow, raft-like foundations because they did not impinge upon the waggonway remains, although all traces of the successor, Kenton & Coxlodge railway line were lost, either when this building was constructed or when it was demolished and its foundation raft removed after the closure of the Neptune Yard in 1988.

The Bigges Main line, linked to the Willington line to east and north-east, the Killingworth line running to the north and the Kenton and Coxlodge line running west via the Heaton Banks colliery, where the origins of the standard gauge seem to lie earlier in the 18th century, is part of a network of largely vanished railways which can only be constructed through historic maps. However, within the urban landscape of North Tyneside and east Newcastle elements of this important network are fossilised by roads, tracks, pathways, cycle paths and field boundaries which allow some of these routes to be followed, conjuring up the echoes of 18th century industrial Tyneside at the centre of a world in transition towards the modern age.

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## Conclusions

Excavation in the Summer of 2013 uncovered the extremely well-preserved remains of an eighteenth century wooden waggonway, built to carry coals from local collieries to the River Tyne. The line comprised a main line of 'standard', four foot eight inch gauge, with single and double-rails laid on various kinds of wooden sleepers, some being neatly cut, others simply unworked tree branches cut to length. The intact double-rails, previously only known from documentary references and illustrations, were the principal unique feature of the main way, but the remains of a points system linking main and loop lines was also striking.

The other main constituent feature of the excavated complex was a loop line from the main railway which led to a loading bay for return cargoes and a soaking- or wash-pond for the waggons - the first such feature ever to be excavated. The wash pond comprised a heavy-duty, expertly-built cobbled stone surface upon which the horses pulling coal waggons gained purchase, set within parallel sets of double rails which, in turn, sat inside the single running rails of the loop line siding. Both the horse-way and running rails were pegged to oak sleepers set into a primary stone surface below the horse-way.

Between the main and loop lines was a revetment shown to have been first built of stone, but subsequently replaced by a wooden post & rail arrangement. And branching from the wash

pond at its lowest point, piercing the revetment and running north-eastwards underneath the main line, was a stone-built drain or 'cundy', the purpose of which was to maintain the water level of the wash pond. The water supply for the latter was via a stone-built channel entering upper part of the wash pond from the north-west, capped with lengths of recycled ship timber and running underneath a later stone boundary wall along the west side of the loop line.

While several of the above features, notably the surviving double-rails of the main line and the dipping horse-way of the wash pond loop line, are unique examples, having never been recorded before, it is worth emphasising that the real value of the excavated features is in their survival as a complex of interrelated elements from which their function can be deduced.

Indeed, the method of construction and *modus operandi* of the waggonway are now largely determined as a result of analysis alongside, and in the context of, rich documentary material made available by the diligent documentary research of Les Turnbull (*This Volume*), aided by the unusually high state of preservation, and completeness, of the remains. However, while the phasing and function of most structural elements of the waggonway are reasonably well-understood, some questions of interpretation remain, such as the date and function of enigmatic pits cut alongside the east side of the main way and the source of water supplied to the wash pond via a leet from the north-west. Further discoveries may elucidate this area of uncertainty, but other questions, such as the presence or otherwise of parallel wayleave ditches and fence-lines - only hints of which were found due to the restricted area of excavation and later disturbance - are likely to remain unanswered.

Notwithstanding a limited number of remaining issues of interpretation, this is the most complete, most complex and best-preserved 18th century waggonway ever excavated in Britain or abroad. It is also the earliest railway yet discovered built to what became the international 'standard' gauge, ultimately defined as 4' 8½" or 1.435 m; its association with Killingworth, with which it became linked following closure of Bigges Main makes it a find of international significance given the association of the Killingworth line with the origin of the standard gauge.

Finally, in addition to the construction, function and phasing of the waggonway and its individual elements, the excavation was significant in uncovering, recording and conserving a large number of timbers derived from ships, an assemblage which now constitutes the greater part of the surviving archive of 18th century ship timbers held in North-East collections and available for further study. The examination of these timbers as part of the present investigation has suggested that they probably derive from ships wrecked or decommissioned as a result of storm damage on the North East coast, although their ultimate origin and that of their timber may lie much further afield. The evidence for the re-use of ship timbers in the construction and maintenance of the waggonway thus provides insight into contemporary ship-building and -breaking activities whilst drawing attention to the prevalence of recycling in 18th and early 19th century construction and civil engineering projects.

## Appendix 1:

*Neptune Yard palaeo-environmental assessment, by Charlotte O'Brien, ASDU (Report 3636, July 2015)*

### Introduction

A palaeo-environmental assessment of six bulk samples taken during the archaeological works at Neptune Yard was conducted and reported by Charlotte O'Brien of Archaeological Services Durham University. Following is a summary of the findings of this assessment.

The bulk samples were manually floated and sieved through a 500µm mesh. The residues were examined for shells, fruit-stones, nutshells, charcoal, small bones, pottery, flint, glass and industrial residues, and were scanned using a magnet for ferrous fragments. The flots were examined at up to x60 magnification for charred and waterlogged botanical remains using a Leica MZ7.5 stereomicroscope. The works were undertaken in accordance with the palaeo-environmental research aims and objectives outlined in the regional archaeological research framework and resource agendas (Petts & Gerrard 2006)

### Results

Findings from the samples comprised glass fragments [context 1], fired clay/CBM [contexts 1, 2 and 3] and a fragment of pottery [context 1]. Coal was present in all of the samples and was abundant in pit fill [2]. Pre-Quaternary trilete megasporangia, which derive from coal deposits, were noted in conduit fill [1]. Clinker/cinder and magnetic fuel waste were recorded in contexts [2], [3] and [4]. Tiny fragments of charcoal were present in conduit fill [1] and ditch fill [3]. These were identified as oak and pine.

There is evidence for a degree of anaerobic preservation on the site, with small assemblages of uncharred seeds present in all of the samples except conduit fill [5], and fragments of worked oak timber preserved in [2], [3], [4] and [5]. These were generally small fragments of timber, but the three pieces in conduit fill [5] were moderate-sized, being 0.10, 0.16 and 0.20 m in length, respectively. The uncharred seeds mainly represented weeds of ruderal and damp ground habitats. A few fruit-stones of bramble and rose hip were noted, and a small hazel nutshell fragment was present in pit fill [6]. A small number of fig seeds were recorded in [3], [4] and [6]. The relatively fresh condition of the sycamore fruit in conduit fill [1] suggests that it is probably modern. No charred plant macrofossils were present in the samples. The results are presented in Appendix 1.

### Discussion

The samples provide little information about former activities on the site, due to the limited number of diagnostic palaeo-environmental remains. The preservation of a small amount of wood and uncharred seeds in the pit fills reflects some anoxic preservation which could tentatively (although not conclusively) support the suggestion that the pits were used for water

storage. Another proposed suggestion was that the pits may have been used for the storage of horse feed, but plant remains associated with fodder, such as cereal remains, crop processing waste, grass/hay or weeds associated with hay, were absent from the samples. Indirect evidence for the former presence of animals includes the quantities of nettle achenes which suggest nutrient-enrichment, possibly as a result of the proximity of manure, and the ruderal weeds such as knotgrass and prickly sow-thistle, and other species of disturbed ground, which may reflect trampling in the area.

A sample of conduit fill [5] was analysed using non-destructive energy dispersive X-Ray Fluorescence (EDXRF) techniques to determine the composition of the material. This confirmed that the orange colour was due to high iron levels, but did not provide further indications of the origin of this material.

All of the samples comprise evidence for the disposal of general waste including fuel waste in the form of burnt coal (clinker). Archaeological and historical evidence indicates that coal was the main source of fuel in the Newcastle area from the 14th century onwards, which is in line with the previously suggested post-medieval date for the features. The few fig seeds indicate the presence of some food waste or cess. Fig seeds are frequently recorded on urban sites in northern England from the medieval period onwards, with the majority deriving from imported dried fruits (Greig 1996). The remains of bramble, wild rose and hazel nutshell may derive from scrub vegetation growing nearby.

The wood and charcoal remains indicate that oak and pine were amongst the species used for timber on the site. These may have been locally sourced or imported.

## Appendix 2:

*Summary Analysis of Ceramic Artefacts Recovered from the Excavation.*

**Deposit above and either side of the culvert east of the waggonway:**  
 8 clay pipe fragments (5 stems, 1 complete bowl and 2 partial bowls);  
 5 coarse, black-glazed earthenware;  
 3 fine, black-glazed earthenware;  
 1 unabraded rim of a Roman Samian Ware bowl.

**Fills of pits alongside the east side of the main way:**  
 4 fragments of black-glazed earthenware (including one jar rim);  
 6 fragments of hard-fired white earthenware tableware;  
 1 low-fired, brown-glazed earthenware of post-medieval character;  
 11 tile fragments (including at least one pantile);  
 1 earthenware 'bread-crock' bowl rim with white-slipped interior under transparent glaze.

**Clay deposit beside line of pits east of the main way:**  
 1 hard-fired, fine, unglazed earthenware rim (waster?); 1 blue on white china body sherd;  
 1 black-glazed earthenware sherd ('utilitarian').

#### Infill deposits over the main way:

- 8 clay pipe stems;
- 14 plain brown earthenware sherds, the majority with transparent glaze, two of which are over a black slip and one (a bread-crock) over a white slip;
- 1 brow-body earthenware dish rim with lined sgraffito decoration in off-white slipped surface treated with blue-green oxide;
- 1 earthenware slipware with marbled decoration and transparent glaze.
- 1 earthenware body with slip-trailed decoration – white on brown body with transparent glaze over;
- 3 high-fired white-paste earthenware, one highly decorated with a blue and white transfer pattern;
- 1 stone-ware body sherd.

#### Primary make-up of the Main Way:

- 1 brown earthenware body/handle sherd with fine transparent glaze (appears relatively late in origin).

#### Culvert construction trench:

- 4 thick clay pipe stems; 2 low-fired earthenware with slip decoration – one green and brown banded under a transparent glaze, the other, lower fired, with white bands on brown body, part of it displaying feathering (dispersing white band into multiple micro-bands) and a serrated rim.

#### Construction trench of the east timber revetment to the siding:

- 2 sherds of sgraffito-decorated brown earthenware body, with external glaze over a white slip with greenish oxide sheen, the sgraffito being lines incised through the slip before glazing (probably part of same vessel represented by a sherd in the infill deposits over the main way).

#### Construction trench of the west revetment wall to the siding:

- 1 stoneware jar rim; blue oxide on grey body (probably of German origin).

#### Deposit overlying sub-soil west of the Carville boundary wall:

- 3 large fragments of coarse, black-glazed earthenware;
- 7 pieces of large brown earthenware in a soft, coarse fabric, with green-tinged transparent lead glaze. At least two large vessels of broadly post-medieval character, perhaps 17th rather than 18th century in origin, are represented here;
- 3 fine, externally black/internally white-glazed earthenware (the same as in the culvert area, above);
- 11 fine, hard-fired white earthenware, some displaying decorous moulded rims.
- 2 blue on white porcelain;
- 2 soft off-white earthenware with peeling blueish glaze;
- 1 slipware with banded decoration;
- 1 stoneware jar fragment;
- 10 tile fragments (including at least 3 pantile);
- 1 fragment of hand-blown window glass.



112 Slipware from the construction trench of the culvert and sgraffito-decorated sherd from the construction trench of the timber revetment.



113 Examples of clay pipe stems from deposits overlying the waggonway with a bowl from deposits underlying the main way.



114 Examples of earthenware – black- & transparent-glazed, and slip-coloured - from deposits associated with the waggonway.



115 Pantile fragments from deposits overlying the west side of the waggonway.



116 Examples of china and porcelain from deposits overlying the west side of the waggonway.



## *Endnotes*

1. Sources of copper in northern England were exploited in prehistoric and Roman times and there is an early 12th century reference to the 'Minery of Carlisle' (Allison et. al. 2010, 52). Specific references to the Caldbeck workings begin in the early 14th century but within a few decades working on Alston Moor are also attested and, in the 15th century, others in Swaledale and Blanchland in south-west Northumberland. The continuous working of mines for copper and other metals during this later medieval period, often with state involvement and hired expertise, means that there is a possibility that other, potentially earlier remains of underground trackways may yet survive.

2. As noted by Gwynne (2009) knowledge of the sophisticated techniques used by Germans to prospect for, mine and smelt copper ore in Cumbria and elsewhere led to the inclusion of some of those involved, including Daniel Hoehstetter Junior (1562-1638) and Joachim Gans of Prague, in an expedition to America in 1585, although this did not lead to the early adoption of waggonway technology there.

3. John New 2004: [http://www.island-publishing.co.uk/WRC\\_mirror/spread\\_20.html](http://www.island-publishing.co.uk/WRC_mirror/spread_20.html)

4. Although oak was the most common timber sourced from timber breakers for waggonway construction, the railway engineer Gibson also records, in a diary entry from 1st March 1774, the purchase of beech for this purpose: "On the afternoon went to the Point and ordered up the old Beech keel " (see Turnbull, This Volume).

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## Glossary

For terms used in this publication please see 'A Glossary of Terms used in the Coal Trade of Northumberland and Durham' by G.C. Greenwell, first published 1849, published as a facsimile 1970.

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