

WILLIAMSON 'TUNNELS', EDGE HILL, LIVERPOOL: AN EXAMPLE OF GEORGIAN AND EARLY VICTORIAN QUARRY RESTORATION

G R LUCAS¹, D BRIDSON² AND T JONES¹

¹ Edge Hill University, Department of Geography and Geology, St Helens Road, Ormskirk, Lancashire L39 4QP.

² Williamson Tunnels Heritage Centre, The Old Stable Yard, Smithdown Lane, Liverpool, Merseyside L7 3EE.

ABSTRACT

The Williamson 'tunnels' are a hidden labyrinth of around 15 'tunnels' cut into Permo-Triassic sandstone in what is now a suburb of Liverpool. At the time of Williamson it was frontier land between the sprawling urban mass of the growing city and the countryside. Joseph Williamson (1769-1840) was an affluent tobacco merchant residing in Edge Hill during Liverpool's heyday as a commercial port. Edge Hill at the time was an undeveloped sandstone outcrop overlooking the bustle of Liverpool city and was under pressure from advancing urban development. The location was ideal for constructing shipping merchant properties as there was a clear view of the docks. There are a number of theories for the origin and purpose of the Williamson 'tunnels'. Some suggest they were constructed to store smuggled contraband from the port or as a refuge for a religious cult who believed the end of the world was nigh. Others suggest that Williamson was philanthropic and used his wealth to employ demobbed Napoleonic War soldiers to no real purpose other than to provide them with paid labour by digging 'tunnels' to nowhere.

The authors posit that the 'tunnels' were wildcat sandstone slot quarries providing dimension stones for some of the buildings of the expanding and rich mercantile Liverpool and that Williamson saw an opportunity to develop land on the scarred hill. He did this by building a system of arches that covered the slots and which then provided the foundation for urban dwellings and gardens. In effect his business acumen produced one of the earliest and most profitable forms of quarry restoration. Subsequently, these restored quarries have acted as the sites of dwellings, rubbish depositories, shadows of intrigue, drains and more recently as a tourist attraction in the form of the Williamson Tunnels Heritage Centre.

The authors have reviewed the evidence for their origin and dispute that they were the burrowings of a philanthropist, instead arguing that they were dimension stone quarries that were restored to good land by a novel technique.

Lucas, G. R., Bridson, D. and Jones, T., 2014. Williamson 'Tunnels', Edge Hill, Liverpool: An example of Georgian and early Victorian quarry restoration. Pp. 7-23 in Hunger, E., Brown, T. J. and Lucas, G. (Eds.) Proceedings of the 17th Extractive Industry Geology Conference, EIG Conferences Ltd. 202pp. e-mail: Lucasg@edgehill.ac.uk

INTRODUCTION

The Williamson 'tunnels' in the Edge Hill suburb of Liverpool city are a network of about 15 underground passages and vaults created approximately 150 years ago by retired tobacco merchant Joseph Williamson (Figure 1). The number mentioned is somewhat vague because excavation is still occurring, finds are still being made and the authors believe some 'tunnels' have been lost to development. The reasons for construction are a matter of debate and there is much speculation and intrigue associated with them.

These excavations which now carry the misnomer of 'tunnels' have been attributed to Joseph Williamson (1769-1840). Little is known about his early life although it is believed he was born in Yorkshire, later moving to Warrington with his family. At the tender age of just 11

years he left his family and moved to the thriving port of Liverpool to seek a fortune eventually finding employment at a dockland tobacco and snuff factory owned by the Tate family. He proved to be a diligent employee and worked his way up through the company. In 1802, to his good fortune, he married into the family taking the hand of Elizabeth Tate, the sister of the firm's owner, Richard Tate. The following year ownership of the factory was sold to Williamson and shortly afterwards Williamson started to expand his business interests.

After securing the lease to a steeply sloping piece of waste land called 'Long Broom Field' from the West Derby Waste Lands Commission in 1806, Williamson built a number of 'mansion houses' along Mason Street (which

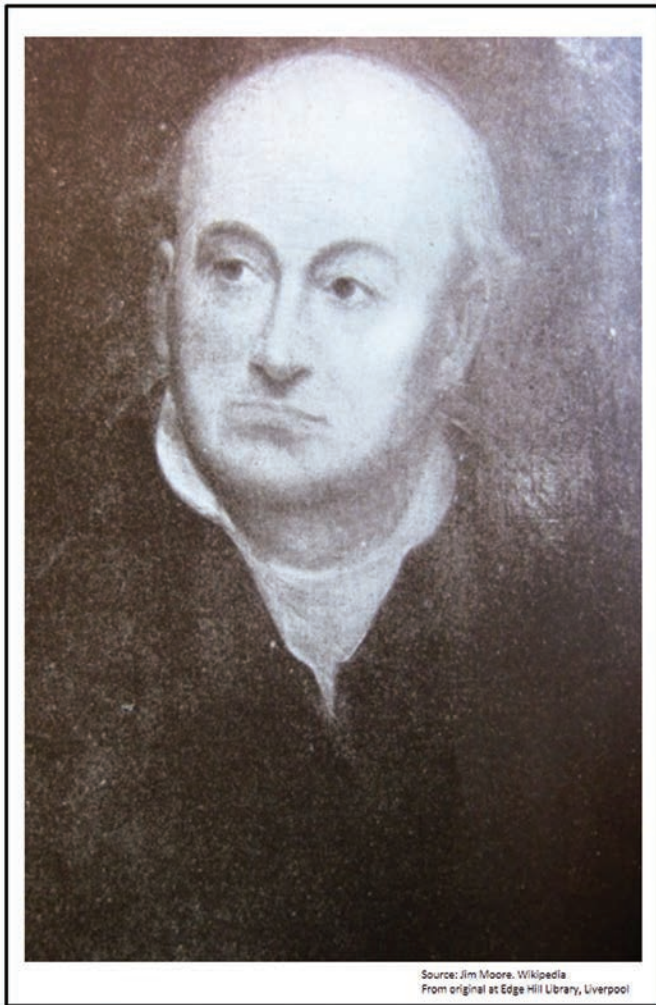


Figure 1. Vignette of Joseph Williamson, 1769-1840.

defined the eastern boundary of his leased land). Many of the houses were constructed over apparently very deep cellars and vaults, which often seemed to have the appearance of 'tunnels'. These 'tunnels' or vaults extended from beneath the houses in Mason Street particularly towards the west.

Though many of these 'tunnels' have been filled with building rubble and domestic waste or were destroyed in the intervening years, and some are curtailed or bisected by the Lime Street railway cutting (which divides the 'Triple Decker' tunnel, one of the longest and potentially most impressive vaults), many 'tunnels' still exist. The 'Triple Decker' tunnel has only recently been 'rediscovered', with its excavation still in its early stages. A small portion of the 'tunnels' are accessible to the public at the Williamson Tunnels Heritage Centre, Edge Hill and on occasion by the Friends of the Williamson Tunnels who manage the Paddington branch of the 'tunnel' complex.

Brick and quarried sandstone were used to build arches and vaulted ceilings in the 'tunnels', providing solid foundations in places for the houses above, and were also used to build some of the houses themselves (Cuss and Styles, 1999). Some sources suggest that initial tunnelling was carried out for reasons mainly to do with this house building, and that latterly the only purpose of the excavations was to provide paid work and distraction (as a more palatable alternative to charity) for hundreds of men returning from the Napoleonic Wars (1803-1815).

It is possible these men were a cheap and plentiful source of labour for Williamson's building work. Williamson is also said to have donated large quantities of quarried sandstone to various building projects in the city most notably the building of the nearby and now demolished St Jude's church. There is speculation that the sandstone he donated may actually have been bartered for brick with which he built houses on the land above. Other possible explanations for the 'tunnels' construction range from a refuge for an impending apocalypse, contraband warehouses, and as a means of moving unseen through the area. There does not appear to be any evidence for these theories other than Williamson's reported religious fervour and highly secretive nature. It is worthy of note that his workings took place out of sight behind "a massive stone wall of singular appearance, more like that of a fortress than a mere enclosure" (Stonehouse, 1863:62). Security of quarries is an important issue today but less so then. Thus the significance of this substantial barrier can only be a matter of speculation.

Williamson continued to build houses in the area until his death in 1840 when all 'tunnelling' suddenly ceased. After his death the 'tunnels' became derelict and gradually filled with rubble and refuse, until archaeological investigations began in 1995 that predominantly concentrated on excavating the 'tunnels' and documenting the entombed finds.

The purpose of this research was to:

- (i) explore the origin and purpose of the Williamson 'tunnels' from the perspective of the physical and documentary evidence of their layout, construction techniques used and the occurrence of similar practices and techniques in 19th century quarries. (The authors will posit that they may have been examples of slot quarries extracting sandstone to supply a building stone resource for the growing Liverpool City.)

and

- (ii) to produce a retro GIS (Geographical Information System) capturing and layering various maps and plans from 1725 to the modern day from a number of sources to show the geographical context of the Williamson 'tunnels' and the growth of the city of Liverpool. Three detailed surveys (First Lancashire Royal Engineers and Territorial Army (1907), Cuss and Styles (1999) and Dave Bridson (ongoing)) of the tunnels have also been digitised and added to the retro GIS of Liverpool City plans and maps, for use in the authors study.

Though there is much speculation and legend surrounding Williamson, his activities and motives, this paper demonstrates that there was comparatively little 'tunnelling' as portrayed in the folklore (i.e. digging or boring of conduits through solid bedrock). In fact the majority of the (now) underground workings were at one time excavations (probably quarries) open to the sky, and subsequently covered over to produce 'made ground' on which buildings were erected and gardens laid. In this situation we believe the 'tunnels' were early examples of 'quarry restoration' and ground improvement in an area that had been extensively quarried over a period at least 32 years (1808-1840). They

were ripe for Liverpool's expansion, providing it was remediated to form level and stabilised ground.

Some of the data presented to support this theory is mapping in the form of the 'Retro GIS' which demonstrates the extent of the 'tunnels' and the growth of the urbanised extent of the city of Liverpool; an 'urban spread' which may have in some part been the catalyst for Williamson's activities. City maps dating from 1725 to the present Ordnance Survey sheets and other data sources were used in the analysis. 'Retro GIS' is defined here as a geographical information system which makes use of spatial documents produced long before the digital age. The documents were scanned, georeferenced, stacked as layers in the normal manner and then subject to spatial and temporal analysis in a combined geographical context. The GIS was also used to calculate the tonnage of stone won from the excavations.

SITE DESCRIPTION

The main area of study is the tract of land in Edge Hill, Liverpool, leased (at the time) by Joseph Williamson from the West Derby Wasteland Commission. The area, shown on Figure 2 is bounded by Grove Street, Mount Vernon Road, Mason Street, Grinfield Street and Oxford Street.

Williamson moved to Mason Street in 1806 and shortly afterwards set about the excavations (Hand, 1916). Roughly bisecting the site (and several of Williamson's excavations) running approximately east-west is the

Edge Hill railway cutting which passes between Edge Hill station to the east and Lime Street station in the city centre to the west. This railway line comprises sections of both tunnel and cuttings (some of which were originally constructed as 'tunnels' and subsequently 'opened up'), and was constructed contemporaneously with Williamson's endeavours. Several anecdotes describe Williamson's men coming 'face-to-face' with those digging the railway tunnel and Stonehouse (1863) describes how Williamson encountered George Stephenson, the Lime Street Tunnel engineer, when his tunnel intersected the Williamson excavations and comments that the latter had a "high estimation of his works" (Stonehouse 1863:57) following a tour of the labyrinth.

The southern and western portions of the site now have areas of housing comprising older social housing and a relatively new development of student flats. The authors were able to make use of the ground investigation data produced for these constructions, to add subsurface information to the database that would not otherwise have been possible to acquire with a limited research budget.

Between these new and older developments, on Smithdown Lane is the Williamson Tunnels Heritage Centre, built in the area of the disused Liverpool City Council stables and yard. The centre provides information on, and public access to a limited section of the tunnel complex.

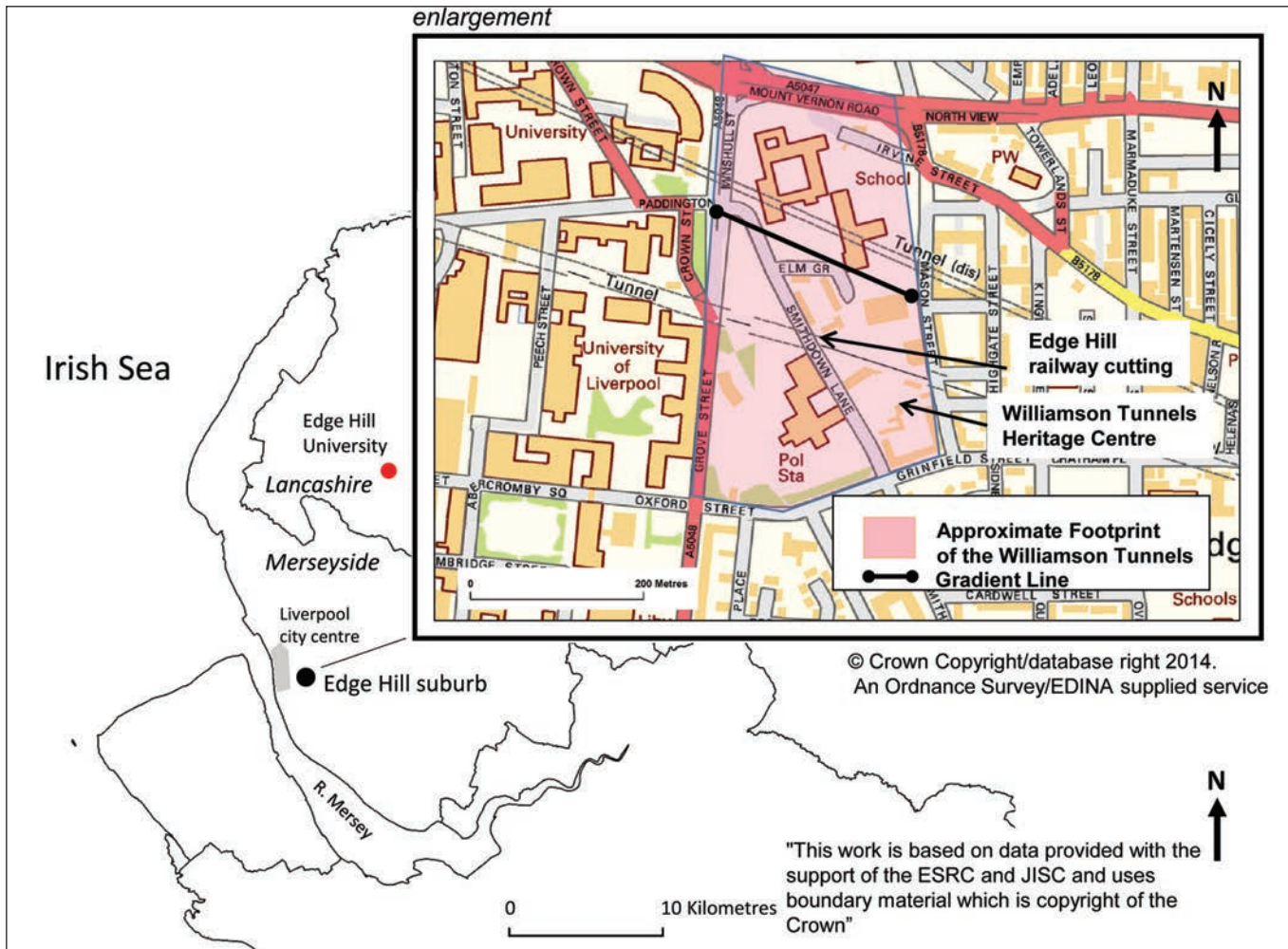


Figure 2. Location map of the Williamson 'tunnels'.

Mason Street (where Williamson’s own residence was situated, and of which the decaying façade still stands) has a mix of social housing (flats) and private dwellings on its eastern side, and several small businesses and a timber yard to the western side. Many of these properties have suffered repeated episodes of subsidence as the ‘tunnels’ below have decayed. Some of the properties have been demolished as a consequence.

The approximate footprint of Williamson ‘Tunnels’ is shown in Figure 2. The site rises from the street called Paddington at 48m to 61m over a distance of 250m to the Mason Street/Edge Hill Railway cutting intersection (this line of gradient is shown on Figure 2). This gives a grade of 5% (1:20) and at the time of Williamson this may have been exaggerated by rocky ledges. As such the ground would have been suitable for driving hillside quarries in the form of open pits.

GEOLOGY

The geology of the area is described in Morton (1863, 1891). The stratigraphic sequence found in the area of the Williamson ‘tunnels’ is shown on Figure 3. The area including and adjacent to the excavations is in the Upper Pebble Beds of the Bunter (now the Chester Pebble Beds in the Sherwood Sandstone Group) a 400 feet (121m) thick, hard, red brown sandstone with few joints and despite its eponym is devoid of pebbles.

The structure and lithology of this sandstone would make it suitable for extraction as a building stone,

particularly for lintels and sills, much in demand at the time for the substantial building programme supporting Liverpool’s expansion as a global mercantile centre. The location of the excavations and the size of the stones would make transport around the city by horse and cart feasible. Interestingly there are no records associated with Williamson relating to stone cartage although prices for carriage were regularly advertised in Kelly’s directories of the time.

HISTORIC ACCOUNTS OF THE ‘TUNNELS’ AND PREVIOUS INVESTIGATION WORKS

Thomas Kaye (1812) in his book “The Stranger in Liverpool” describes Edge Hill as improving but comments that Edge Hill was “land barren even in summer and roads of sand are equally unexpected and unpleasing in the vicinity of so large and improved town” (Kaye, 1812:183). This suggests that the area may have been denuded by rock extraction and the “roads of sand” is reminiscent of quarry access tracks.

Morton (1861) describes quarries working the Pebble Beds in Edge Hill but does not specify exactly where. Morton (1887) as the President of the Liverpool Geological Society in his annual address describes the historical geology of the city and in doing so provides the best description of quarrying in and around the city at the time. Although not referring to the Williamson excavations, which by that time had faded from many memories, he makes a number of germane references to

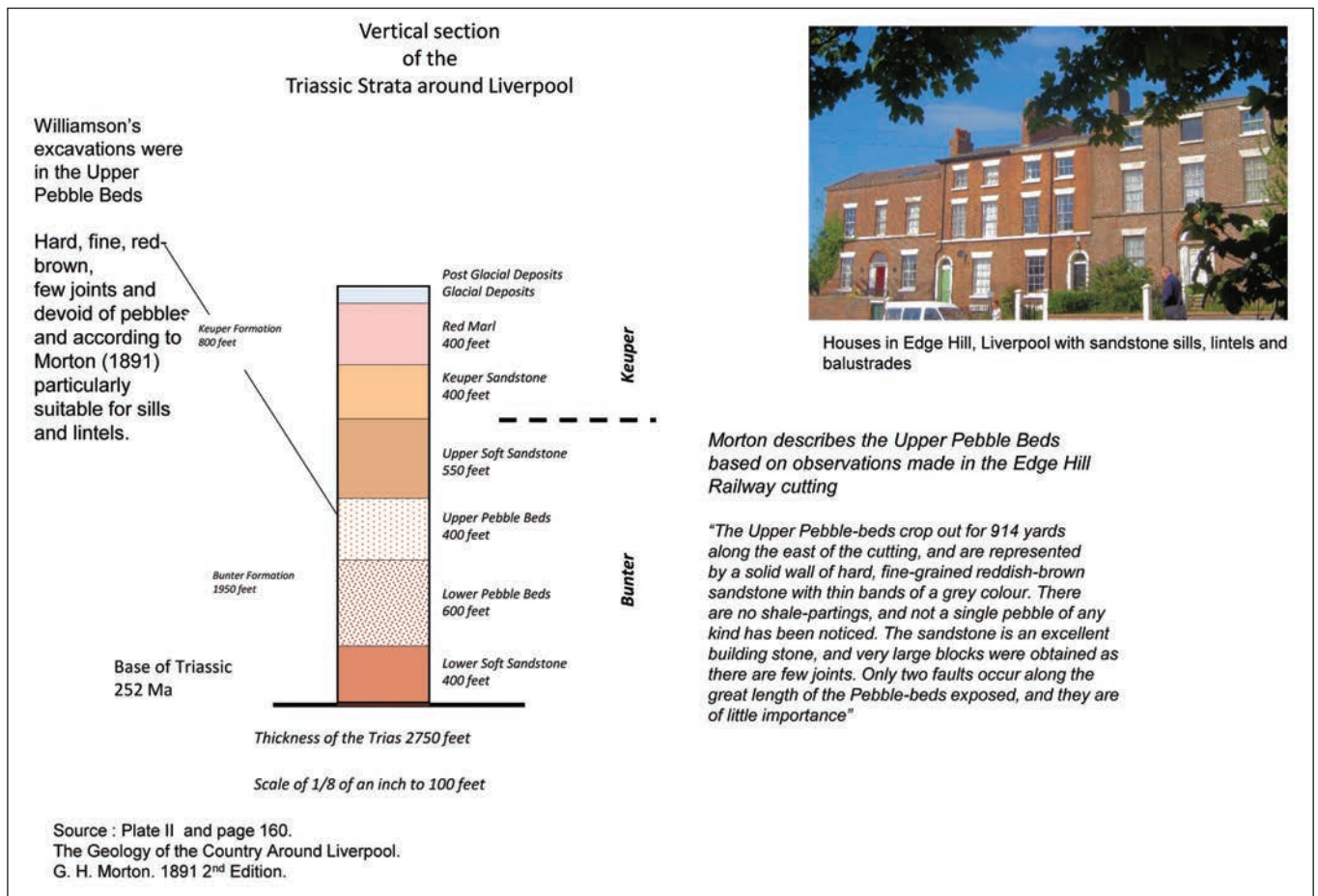


Figure 3. The geology in the area adjacent to Williamson’s ‘tunnels’.

quarrying in the area of Edge Hill, such as;

- “In 1836 there was a deep quarry on the east side of Edge Hill church, and the present condition of the houses built over it indicates the subsidence of the *débris* with which the quarry was filled up” (Morton, 1887:310).
- “Paddington (*meaning the general area around the street indicated on Figure 2*) was formerly very steep towards Edge Hill, and the central portion, between Smithdown Lane and Mason Street was filled up about 1846, so as to obtain the present more gradual incline” (Morton, 1887:311).

He then goes on to describe how the land in the Edge Hill area has been lowered or raised by as much as 15 feet (4.57m) and of the presence of rocky banks in the area. This is the best geological evidence that exists for excavations in the area that Williamson leased but again somewhat mysteriously perhaps there is no allusion to Williamson.

Wilding (1888), describing the building stones of Liverpool comments favourably on the Pebble Beds (actually referring to Woolton Quarry some 7 kilometres from Edge Hill), describing it as rich red in colour, and “when it can be got free from pebbles it is, in my estimation, by far the best stone that can be used in Liverpool for building purposes” (Wilding, 1888:33). This in essence confirms that the Pebble Beds that make up the faulted escarpment of Edge Hill would have been similarly valuable and in a better geographical location for the market of urban Liverpool.

There is a dearth of published literature on the construction of the ‘tunnels’ or excavations and especially on their extent, the reasons for and methods of construction. In terms of the history of the ‘tunnels’, the area in which they are built, and Williamson’s motives for building them we have to rely on the 19th and early 20th century accounts of James Stonehouse and Charles Hand, both prolific writers on all matters, and especially Liverpool. Their writings appear to form the basis for the extensive conjecture and folklore which comprise the bulk of the available ‘knowledge’. They tend to focus upon the idiosyncratic Williamson and his legend as the ‘Mole of Edge Hill’, rather than providing any documentary evidence relating to the pre-existing topography or quarrying techniques, and only offering anecdotal ‘evidence’ for their purpose. Hand (1916) describes how Williamson had “delved into a rocky hill, creating subterranean caves and galleries; and finally succeeded at incredible expense in making the locality too grotesque for description” (Hand, 1916:3). He then presents a treatise purporting to be from James Stonehouse stating “I have it from a credible person, who once joked with Mr Williamson about the money he had made by excavating so much good stone” (Hand, 1916:6). These statements have elements of falsity and some pointers to the truth. Claims that Williamson excavated caves or proper ‘tunnels’ is false on the basis of current evidence because all examples appear to have been open slots cut into rock that were subsequently roofed by combinations of brick or stone to make ‘tunnels’. Claims that Williamson had substantial funds to excavate the ‘tunnels’ and from selling stone however may be true. Williamson’s estate was valued at £40,000 in 1841 (Whittington-Egan, 1952). This amounts to £45

million at today’s value (National Archives, 2013) so it is clear his wealth was maintained if not enhanced following his marriage into the Tate tobacco family most probably from the sale of the sandstone and his house building interests.

Stonehouse (1863) gives an account from memory of the ‘tunnels’ extent having visited them surreptitiously in 1845 and producing a note on the excavations in 1846. In addition to extensive description of Joseph Williamson’s personality, habits and several famous encounters with local people, tenants, and ‘celebrities’ such as George Stephenson he described how the houses on Mason Street were built on brick piers and arches over vaulted cellars linked in some instances into the wider tunnel system.

Several surveys of the ‘tunnels’ have been undertaken though most (with the exception of Stonehouse’s own hand drawn, not to scale 1846 plan) have encountered the same problem; that of mounds of refuse / building rubble blocking or completely filling sections of the tunnel network.

In 1881 the North Staffordshire Institute of Mining and Mechanical Engineers on a field trip to Liverpool investigated the ‘tunnels’ and produced a plan and dog leg cross section of the excavations (Anon,1881), shown on Figure 4. Figure 4(a) shows the positions of the ‘tunnels’. Figure 4(b) shows the profile of the excavations and how the ground had been raised by a series of ‘tunnels’ and arches as a consequence of the restoration of the slot quarries. The section’s geometry is typical of a building stone quarry where the resource is extracted in the form of blocks.

In 1907 the Royal Engineers and the West Lancashire Territorial Forces Association produced detailed plans of the ‘tunnels’ (Figure 5) which were “...almost certainly incomplete due to the amount of rubble blocking the various ‘tunnels’” (Moore, 1998:79, Cuss and Styles, 1999).

Cuss and Styles (1999) undertook a high-resolution micro-gravity survey of the site. The aim of their study was to evaluate micro-gravity for investigating industrial archaeology in ‘brown-field sites’ and not to specifically investigate the ‘tunnels’ in respect of their origin. Using this method they were able to verify known and suspected ‘tunnels’, and also identified anomalies / voids which could possibly indicate previously unknown ‘tunnels’, the results of which are shown on Figure 5. They were also able to delineate the geographical extent of the tunnel complex, for example demonstrating that Williamson does not appear to have strayed beyond the boundaries of his property in the south-western corner of the site (where the ground level is considerably lower), but almost certainly did to the north and east where there appear to be (in some cases verified) ‘tunnels’ linking Williamson’s property to local landmarks such as St Mary’s church on Mount Vernon Road.

Clensy (2006:92) describes four key aspects of Williamson’s work; these being the previously mentioned “...vaulted arches that supported the gardens at the back of the Mason Street houses, the extensive cellars and vaulted foundations of the houses themselves, ...obscure caverns, immense in size, deep below ground, and a complex network of smaller ‘tunnels’ linking the three previous types of construction”.

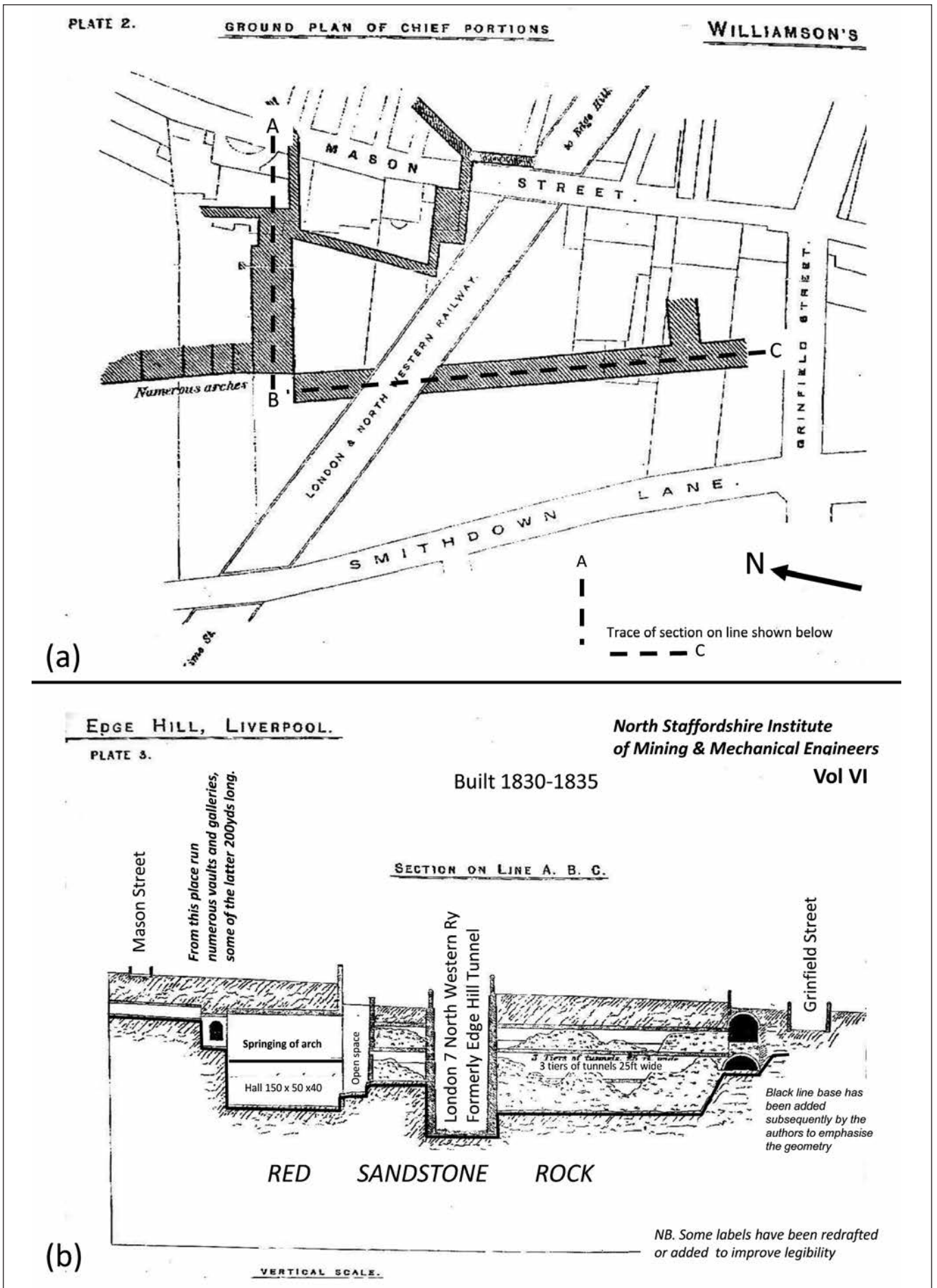


Figure 4. Reproduction of the plan (4a) and section (4b) drawn following the North Staffordshire Institute of Mining Engineers and Mechanical Engineers visit to Liverpool 1881.

Moorehead (2009:27) hints at quarrying having taken place prior to the building of these arches (either by Williamson himself or prior to his acquisition of the land) stating that they were built over not merely steep ground but ground "... backed by a previously quarried steep ridge".

In 2010 and 2011 a series of surveys and ground investigations (LK Consult, 2010, Oxford Archaeology North, 2011) were carried out in advance of the construction of the student flats and some of the information contained in these reports has been utilised in the authors study.

In addition to excavating and exploring the 'tunnels', David Bridson (Manager, Williamson Tunnels Heritage Centre), the Friends of Williamson's Tunnels and the Joseph Williamson Society and their large teams of volunteer researchers and diggers have uncovered much historical information. Bridson and both organisations have produced numerous publications and maintain regularly updated websites.

The extent of the 'tunnels' surveyed by the 1907 Royal Engineers and the West Lancashire Territorial Forces Army survey and Cuss and Styles (1999), as held in the GIS for this study are shown in Figure 5. An ongoing, separate survey of the tunnels by Dave Bridson largely agrees with the 1907 Army investigation except for some alignment variations and the existence of a large tunnel to the west of the eponymous 'Banqueting Hall' tunnel, also shown on Figure 5 (Williamson is reputed to have held dinner parties in this cavernous space).

METHODOLOGY OF THE STUDY

This study reviewed all of the literature available (described in the previous section), particularly the originals of Stonehouse and Hand, deposited in Liverpool Record Office. Drawings from pictorial sources especially those of William G. Herdman and Matthew Gregson were collected and subject to scrutiny. Archaeological evidence from the area around Williamson Heritage Centre was reviewed and incorporated in the analysis.

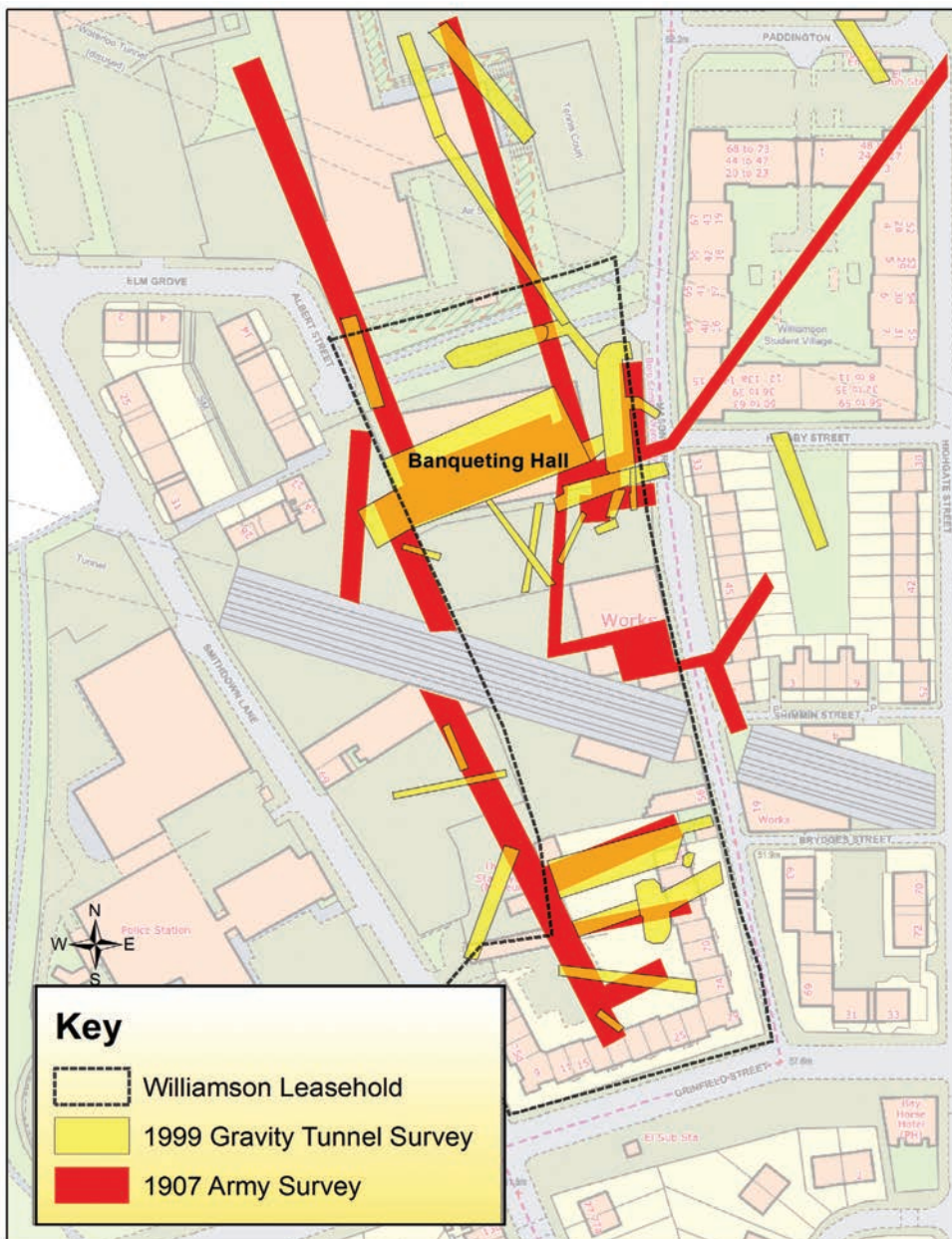


Figure 5. GIS map showing the extent of the Williamson 'tunnels' as described by the 1907 Army survey and Cuss and Styles (1999).

OS Mastermap 1:1250 base
 © Crown Copyright/database right 2014
 An Ordnance Survey/EDINA supplied service

Due to the lack of documentary evidence for the 'tunnelling' a series of map data were collected, georeferenced and incorporated in a GIS. The authors have called this the 'Retro GIS' because a number of the GIS layers are map data generated many decades before the advent of digital technologies. The map data was sourced from Liverpool Record Office, pictorial collections and collections of old maps especially those provided by the Scouse Press Liverpool Packet Series. These historical maps and plans of Liverpool City used in the retro GIS are listed in Appendix 1. They were examined and photographed at Liverpool Record Office as loose leaf copies or as integral pages in the antiquarian books listed in the references. Fritz Spiegl (1966, 1978) and the Scouse Press have also published reproductions of many of the antique maps. These maps were georeferenced and assimilated in the retro GIS for further analysis.

EVIDENCE

It is not the purpose of this paper to repeat the story of Williamson and the various theories behind the tunnelling. Moore (1998) and Clensy (2006) provide comprehensive coverage of this aspect. Here we will describe the systematic evidence that points to the excavations being building stone slot quarries that were subsequently restored by a novel restoration technique that created valuable building land for an encroaching city.

A perspective view dating from the middle of the Sixteenth century is shown in Figure 6. Although 250 years before Williamson's time it shows the nature of

Edge Hill as a (sandstone) escarpment overlooking Liverpool. Liverpool's expansions occurred in the three cardinal directions adjacent to the river. The lower flatter land was preferred to the higher stony land of the eastern hills until the 19th century when population pressure mounted. Everton Brow with a similar spatial disposition to Edge Hill was also the location of extensive sandstone quarries supplying stone for the building of nearby Liverpool.

No maps were uncovered which show quarrying in the specific region of Smithdown Lane and Mason Street although we present the evidence contained in the West Derby Wasteland Commission ledger maps. Quarries are shown in the general area on various maps dated from the beginning of the 19th century in Edge Lane and at St James Mount (now the site of the Anglican cathedral) so it is clear that stone was being extracted from the bedrock resource. The only direct documentary evidence of quarrying uncovered so far is contained in the Liverpool Poor Rate assessment for 1826-1827. This contains the names of ratepayers, amount due and a brief description of the assessed property. Williamson appeared to possess three properties on Smithdown Lane identified as a "site of a quarry with three houses" (Anon, ca.1827).

Stonehouse (1863), in a full description of Williamson describes some of his idiosyncrasies and builds upon the detail contained in his field notebook 'Brief Notice of the Excavations at Edge Hill, near Liverpool' (Stonehouse, 1846). The latter is a description of a site visit that he made to the workings behind Williamson's houses

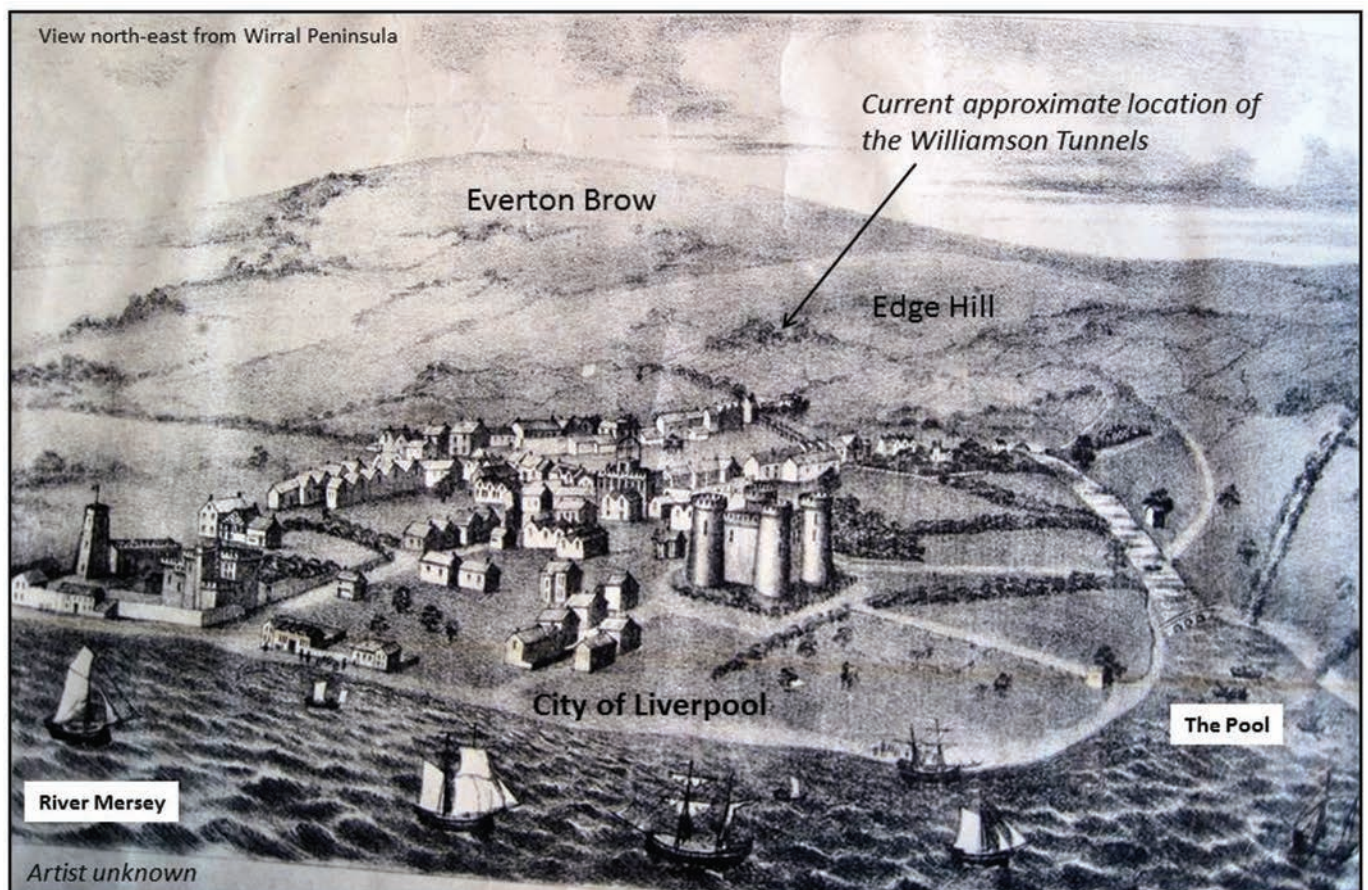


Figure 6. Perspective view of Edge Hill on the outskirts of the City of Liverpool in 1550. Artist unknown. Source: W. G Herdman's *Pictorial Relics of Ancient Liverpool* 1857.

following his death earlier in 1840. The field notebook consists of written descriptions, sketches of the workings and a detailed plan sketch. In many ways it is a model of a geological field notebook. The visit was made without the permission of his estate and when he tried to publish the findings in 1858 he was threatened with proceedings by Cornelius Henderson, the artist for whom Williamson had built a house on Mason Street. Henderson threatened action for “trespass on the property and proceedings for a libel against Williamson’s character” (Hand, 1916:3). We can only speculate on why Henderson was so keen to protect the secrecy of the ‘tunnels’ and the activities of Williamson. Presumably his workings had been carried for some nefarious purpose and Henderson had been aware of this. It is quite possible this was the sale of stone and the avoidance of payment of income taxes/mineral rights duties to the West Derby Waste Lands Commission. Stonehouse’s sketch plan is reproduced in Figure 7(a) and a neat representation shown in Figure 7(b).

Figure 7 lacks a scale but clearly highlights the spatial context of the excavations. It was drawn just 6 years after the ‘tunnelling’ ceased and is probably the best map evidence that exists from that era. The shape is angular and regular, typical of building stone quarries. There appears to be a series of levels, some filled with water. The ‘tunnels’ are shown as arches. Restoration has taken place in some parts, and this is shown as gardens sitting above the ‘tunnels’. The arches vary in size, some are single, some multiple, and in places they are nested. The presence of vaults with arches is germane to our

argument that the plan shows a building quarry complex that was restored by making ground using arches. The known excavations (based on our GIS) spread across an area of approximately 43,000m² in a spider like fashion. This, presumably, was to work good “seams” of sandstone avoiding areas of colour imperfections, faults and most likely master joint intersections.

Historical maps of the city do exist but they tend to concentrate on the urban development of the city. Edge Hill in the early 19th Century was beyond the urban limits and was either not surveyed or represented in detail. The first published Ordnance Survey of Liverpool was the County Series 1:10,560 sheet dated 1848 some forty years after the excavations began. However, estate maps of the surrounding countryside had been constructed. The West Derby Waste Lands Commission had been created in 1753 (British History Online, 2013) following the Enclosure Acts. They held the deeds to land that had previously been considered waste or common land and their duty was to manage the land for the benefit of the local township; in this case West Derby. The main way of raising finance was to lease land and Williamson leased the land on which he built his houses in Mason Street. The ledger of the West Derby Waste Lands Commission consists of a series of large scale maps (circa 1:5,000) constructed from 1824 to record the leases made by the Commission. Figure 8 is a georeferenced extract from the ledger and shows Mason Street with a line enclosing a blue coloured area; the leasehold plot of Williamson. The GIS overlay shows the ‘tunnels’ as surveyed by the Army in 1907 and is improved by more

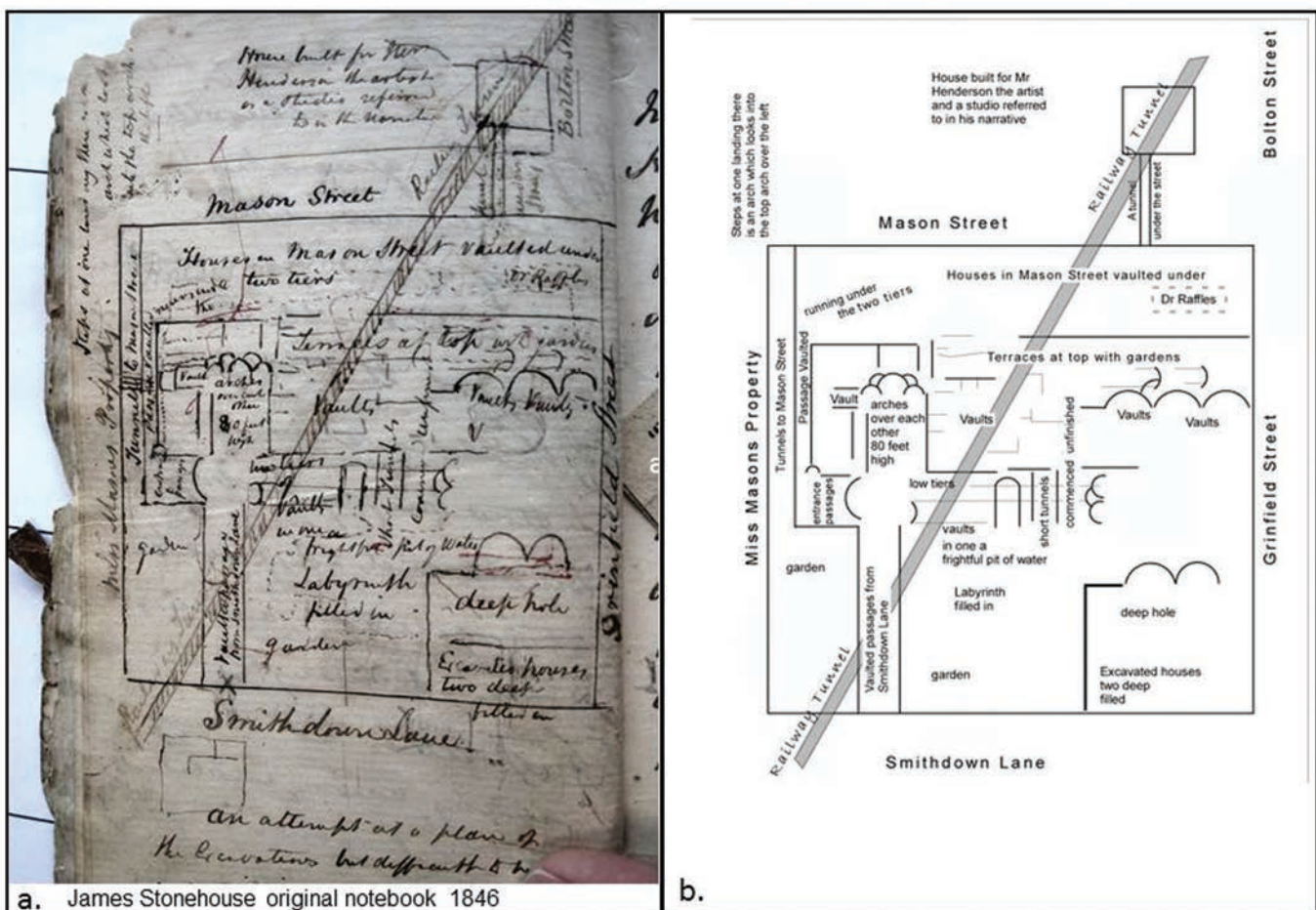


Figure 7. 7a. An attempt at a plan of the Excavations at Edge Hill. J. Stonehouse, 1846. 7b. Neat representation of Figure 7a.

recent David Bridson plans which are based on actual surveys and suspicions of infilled excavations suggested by surface movements, engineering probes and geophysics. Figure 8 clearly shows the close correlation of excavations and Williamson's leasehold. It also shows some excavations beyond his domain. These maybe earlier slots that provided the idea for the later more extensive excavations of Williamson or they may be openings made outwith his leasehold by others or himself seeking to extract good bands of rock.

Figure 9a shows the context of Mason Street and the land eastwards of it, which had yet to be built upon. The blue polygons shown on the map to the east of Mason Street are areas that are being leased from the Waste Lands Commission. They are too small to have been agricultural plots, and their spatial pattern, location and shape is inconsistent with allotments although the movement had existed from the middle of the 18th century (Savill, 2009). Characteristics such as their shape,

size, and apparently random location suggest that they were plots of land that were used for mineral extraction most likely wildcat sandstone slot quarries because of their position on Edge Hill summit. It is likely that the sandstone was exposed at the surface because the hill was widely described as waste, commons or heathland. Glacial till was likely to be thin on the hill although it was extracted in lower areas of Liverpool for brickmaking. The sandstone resource would have been readily available for extraction with such limited overburden. The distribution of the plots suggests that the plots were found where the rock was easily won and of the most suitable quality in terms of bedding plane/joint spacings and colour. One of the characteristics apparent on other maps of the time such as the Plan of the Town of Harrington (Toxteth) (1805) show the location of similar sized plots labelled as quarries adjacent to new buildings illustrated as 'B' in Figure 9b and an identical situation is visible at A in Figure 9a.

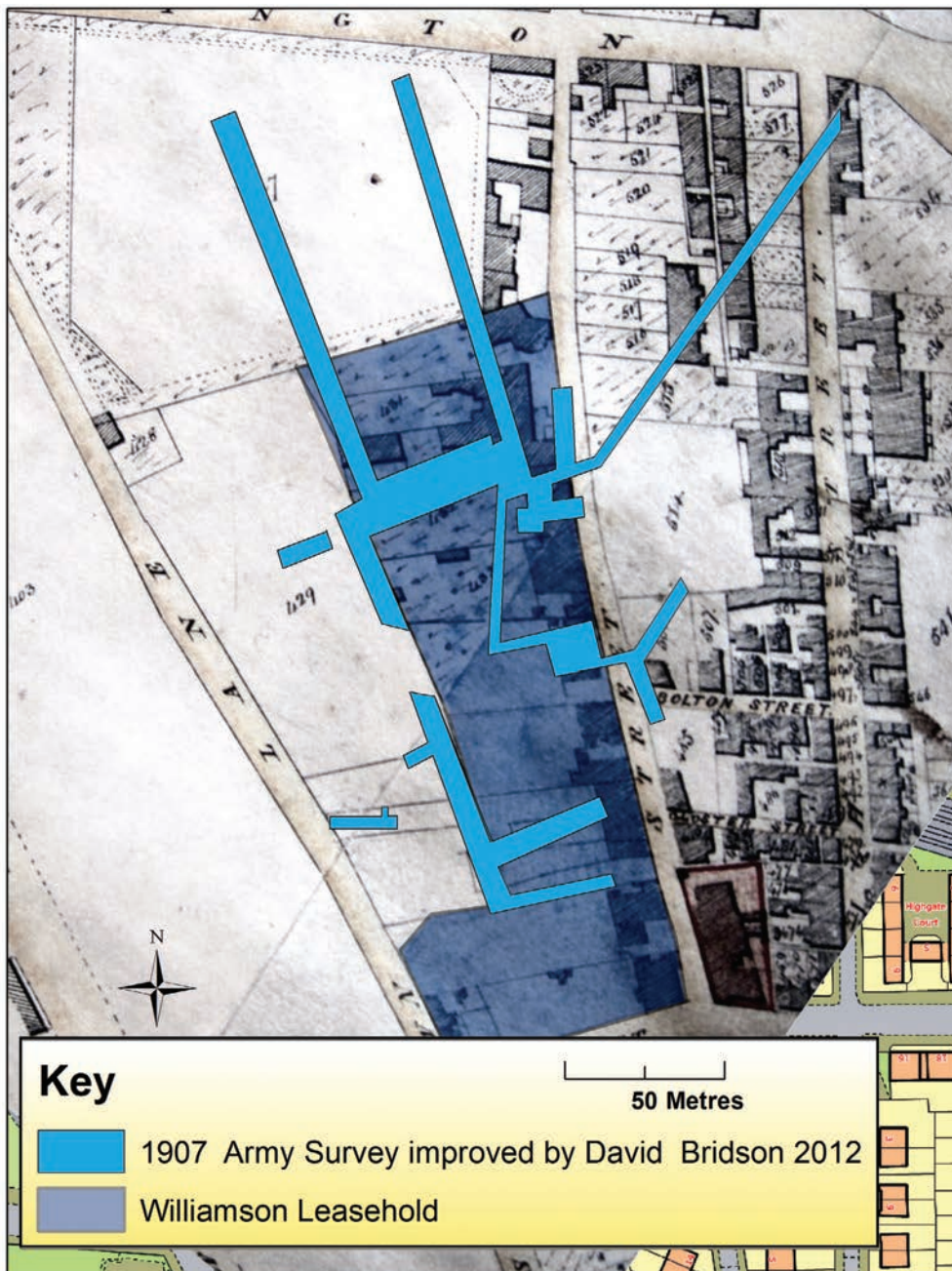


Figure 8. Extract from West Derby Waste Lands Commissions ledger (1824) with a retro GIS overlay of the 1907 Army survey, improved by David Bridson's 2012 and ongoing surveys.

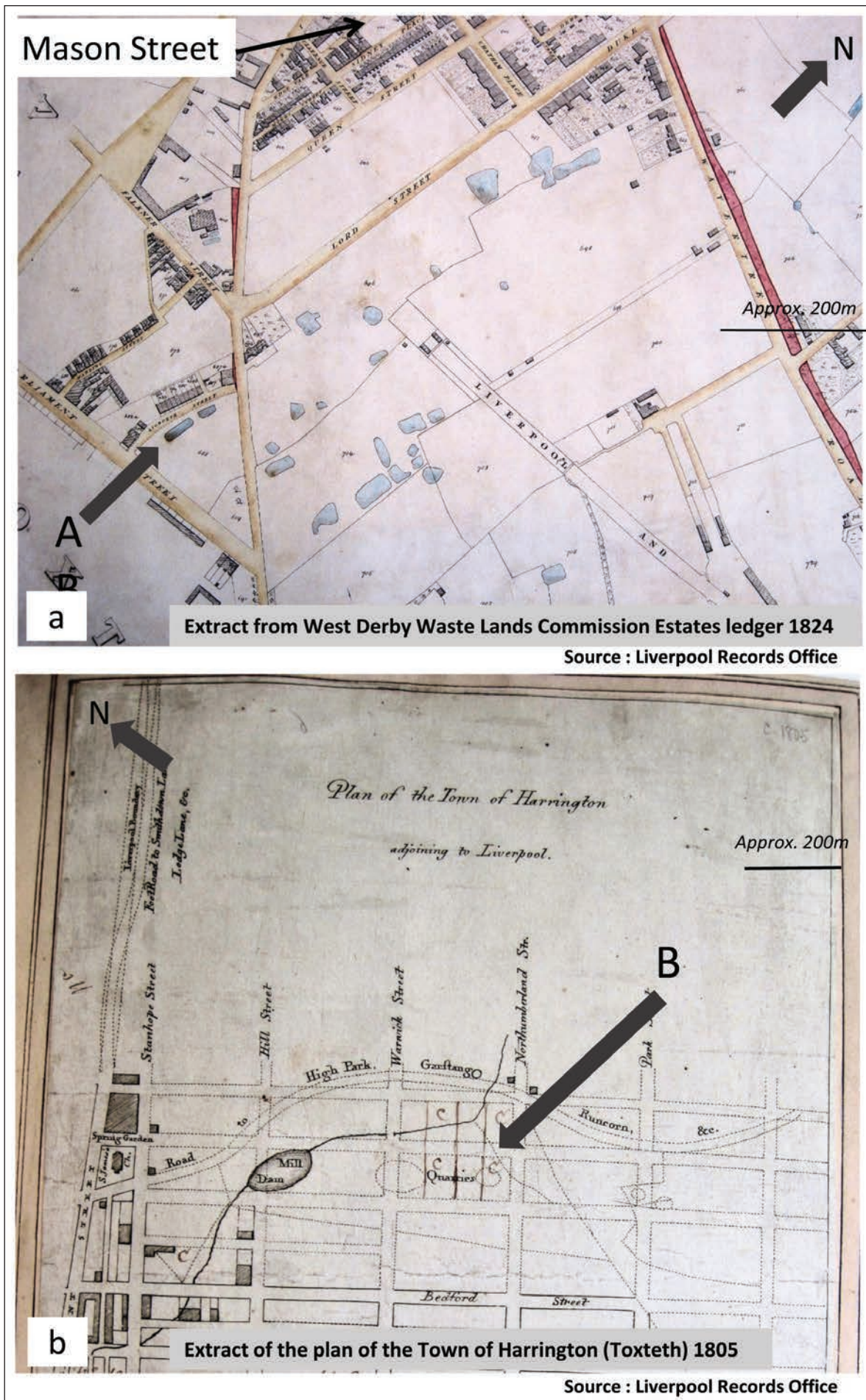


Figure 9. 9a Extract from West Derby Wastelands Commission Estates Ledger. 9b Plan of the township Harrington (Toxteth) Liverpool.

Figure 10 is a graph of the population growth of Liverpool City, the main dock building period and the era of the Williamson's excavations. Various maps of Liverpool dating from the 17th century were georeferenced and the city boundaries digitised. They were then added as layers to a DTM (Digital Terrain Model) which when extruded clearly shows the sandstone escarpment of Edge Hill. Figure 11 shows the expansion of Liverpool City in conjunction with the DTM, the position of the Williamson excavations and the nature of the Edge Hill escarpment. (The DTM overlays should be read in conjunction with Figure 10.) Figure 11 shows

the excavations were in close proximity to the city limits under pressure from rapid building expansion.

Figure 10 shows that at the time of Williamson the rate of population increase was approaching its steepest and it also coincided with the main dock building period. Thus Williamson had a business motive to supply building stone and in addition the location was perfect in a time when heavy stone transport to market would have been difficult. The authors suggest that dressed stone could have been used for building purposes and any waste materials may have been used as an aggregate fill

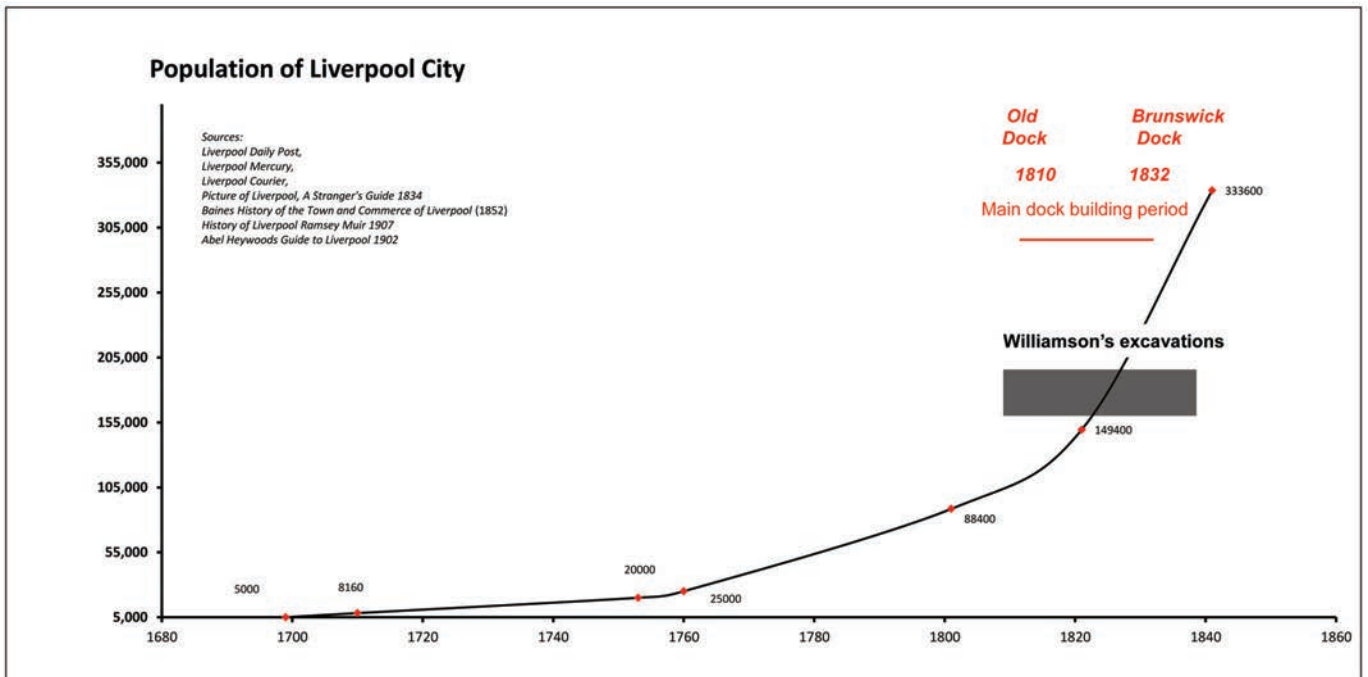


Figure 10. Population growth of Liverpool City.

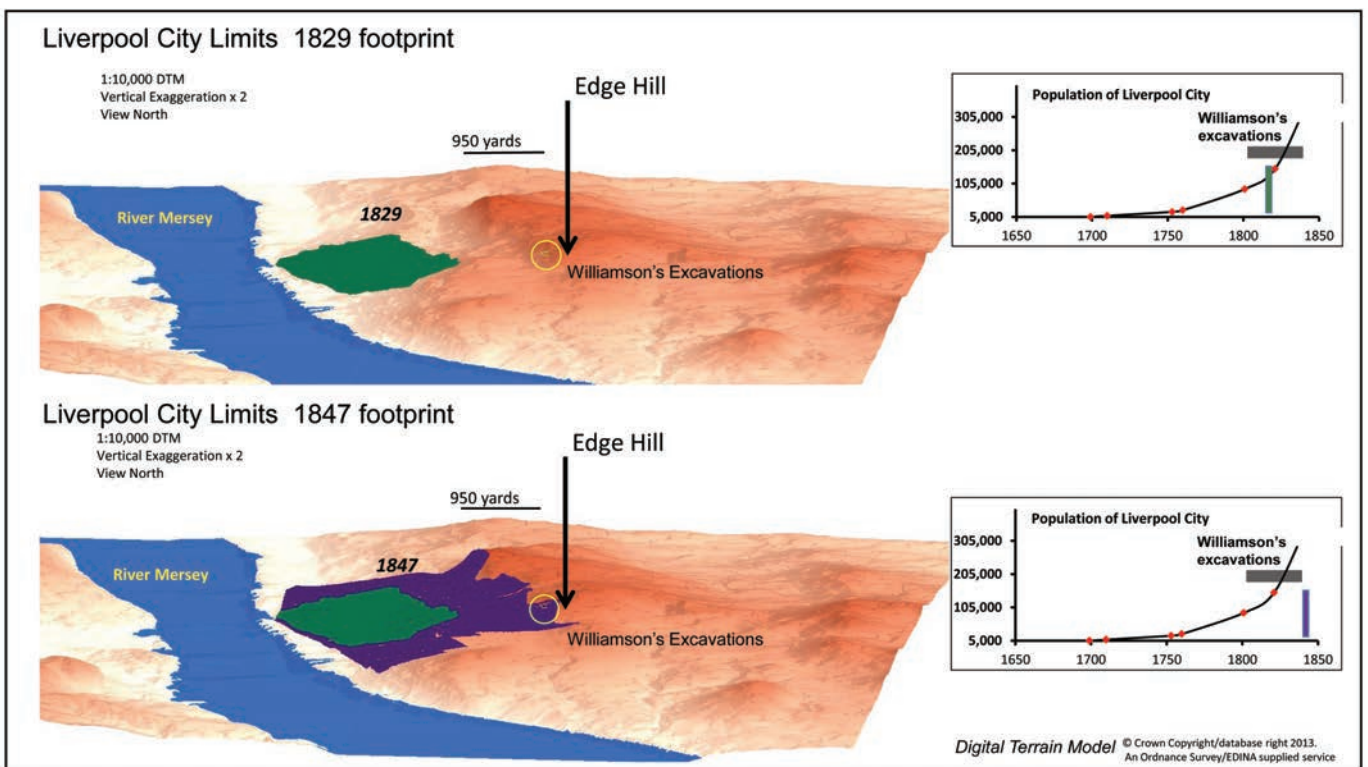


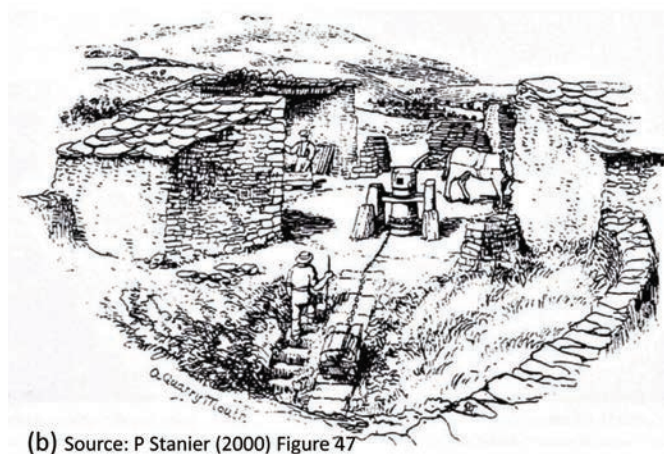
Figure 11. Digital Terrain Model (DTM) and Liverpool City growth overlays.

for foundations for the considerable construction of the period. There are no apparent spoil tips in the Edge Hill area that could amount to waste from the excavations although it is quite possible they could have been moved in the intervening 170 years.

During 2010 and 2011 the area adjacent to the Williamson Tunnels Heritage Centre was subject to a detailed archaeological investigation and a ground investigation in advance of the construction of a complex of student flats. Data from the ground investigation included ground penetrating radar, dynamic probes and window samples. The archaeologist conducted a traditional hand excavation. The ground investigation confirmed made ground overlying sandstone bedrock which had the appearance of series of flat benches and steps typical of building stone extraction over a sizeable area. The archaeological excavation uncovered confirmation of the above (Figure 12a, Label A) as well as the presence of a polished cobble lined roadway (Figure 12a, Label B). This has the appearance of a “quarr road” typical of 19th century quarries. Quarr roads connected a working quarry with the surface works where the stone was often dressed before dispatch. Stone was hauled up the road on a quarr cart by a chain and capstan powered by horses. Stanier (2000) describes a



Photograph: D Bridson



(b) Source: P Stanier (2000) Figure 47

Figure 12. 12a. View west to Smithdown Lane of the archaeological excavations in the Yard at the Williamson Heritage Centre showing quarry levels and benches and remains of a quarr road. 12b. An artists impression of a quarr road and haulage from Stanier (2000).

similar situation from the Purbeck quarries (Figure 12b) and Wilding (1888) explains that the same procedure was used at Woolton Quarry, Liverpool (also extracting the Pebble Beds). Here the quarry was “approached by a long inclined road, the hill being attacked from the front and the posse worked down 50 feet or so below the level of the roadway” (Wilding, 1988:33).

Further pictorial evidence can be provided studying paintings of the period in particular those of W. G. Herdman (1805-1882) a painter who documented the city of Liverpool with over 2000 watercolours. Figure 13 shows an extract of his painting entitled “Williamson Tunnels and Edge Hill 1858”. The ‘tunnels’ are clearly visible within a retaining wall to the Mason Street properties. The arched ‘tunnels’ had been constructed over or within sandstone slot type voids, to the level of Mason Street. The extrados of the arches were then covered with soil to make the gardens at the rear of Mason Street. To the right of the painting there appears to be a series of buildings typical of masons sheds which may be associated with a large stockpile of lintel sized and shaped red sandstone.



Figure 13. Extract from a W.G. Herdman watercolour painting ‘Williamson Tunnels and Edge Hill 1858’. View east from Smithdown Lane towards the terraced housing of Mason Street. Courtesy of Liverpool City Libraries.

Within the Williamson Tunnels Heritage Centre a 200m section of a tunnel is open to the general public. Numerous artifacts from the stone quarrying are readily visible. If as suggested in some accounts Williamson had put men to work digging ‘tunnels’ with no purpose “these works were carried on for the sole purpose of employing men in times of great need and depression” (Stonehouse, 1863:63) there would not have been any need to extract blocks of stone using traditional quarrying techniques. If the purpose had been simply to extract rock it would have been hewn from the rock face with picks demonstrating no skill other than the brute force needed to release the rock. Instead, rectangular blocks were delineated by excising deep channels with picks to a depth of 0.5m or so. The repetitive swing marks of the picks are visible on the slot walls. They are typically two pick depths deep, and often resemble cross bedding in appearance. The blocks would then have been levered from underlying bedding planes by using a long iron bar and lifted onto carts by scotch derrick type cranes. These simple wooden or metal cranes consisted of a single jib supported by a square floor base and sometimes stabilised with wall supports. Figure 14 shows some of the building stone quarry features found in the ‘tunnels’ at the centre.



Figure 14. Building stone extraction features in the Williamson Tunnels Heritage Centre, Liverpool.

RESTORATION OF THE QUARRIES

Although the excavations as they are seen today appear to be 'tunnels', at the time of Williamson they were quarries. According to Stonehouse's plan of 1846 there appears to have been one, possibly two, large square based quarries situated in the area between Smithdown Lane and Mason Street. They would have coincided with the scarp slope of Edge Hill and were classic hill side quarries where ingress is simply made by quarrying into the rock face. The western edge of their footprint coincided with the 'quarr road' and the masons sheds. The offshoot slots made into the faces of the main sites presumably followed good seams of rock (good colours, zones devoid of joints/faults etc.). At that time quarriers were most likely paid by piecework for the stone delivered so quarry design let alone safety would have been ignored to a large extent. The term Williamson 'tunnels' is an accurate term following the restoration of the site but at the time of their origin they were excavations in the forms of slot quarries. There is not a single example of the existing 'tunnels' that is solely hewn out of sandstone in the form of a conduit. The 'tunnels' or slots as they were originally cut have been roofed in three different styles with brick and/or red sandstone blocks. Figure 15a shows an aerial view of a mixed brick/sandstone tunnel roof taken during the archaeological excavations. The adjacent blocks represent the range of typical blocks released from the excavations and abandoned after the enterprise

The vaults themselves are sprung from recesses cut into the quarry walls. Some of the slots were over 30m

deep and in order to bridge the voids arches were piggybacked to make double or triple decker 'tunnels'. Figure 15b shows an example of a double decker tunnel. In large open quarry sections the vaults were constructed laterally and sprung on brick or sandstone pillars. In this way the voids were effectively bridged and by piggybacking arches they raised the restoration to a level at which they could be topped with soil to make ground. In this way the quarry site was restored without the need for infilling. At that time fill was in short supply being in much demand for the foundations of the buildings in the growing city.

Figure 16 is an early photograph taken by the accomplished Victorian photographer James Mudd and shows a void bridged by arches to make 'tunnels' and a retaining wall for the gardens created on top at the rear of Mason Street.

Once the ground had been raised and effectively stabilised it could now be built upon, or gardens laid, and must have been premium land for properties as urban Liverpool pressed on the perimeter of Williamson's leasehold. More value was added to this made ground because it had an elevation that allowed the residents to gain both logistical and aesthetic views over the port (for observing the arrival of ships and perspectives of the Wirral peninsula and the Welsh Mountains). Williamson constructed gardens behind the houses on Mason Street using this technique making them even more desirable properties. The residents made use of the subterranean caverns as cellars primarily for the disposal of their night soils and household rubbish. Some of the disposed artefacts (oyster shells, clay pipes, bottles, crockery etc)



uncovered by the current excavations are on display at the Williamson Tunnels Heritage Centre and provide a fascinating window into the past.

The *modus operandi* of the Williamson's restoration of the slots is shown in Figure 17. The retaining wall constructed to hold back made ground on top of the 'tunnels' after they had formed level ground and gardens to the back of Mason Street is visible in Figure 16.

It is quite possible that Williamson was aware of similar ways of making ground, allowing urban construction on top. South Bridge in Edinburgh was constructed in 1788 by way of 120 lateral and piggy-backed arches topped by a viaduct making the bridge across a valley (Royal-Mile.com, 2013) and would have proven to be a valuable precursory model to Williamson's later restorative engineering.

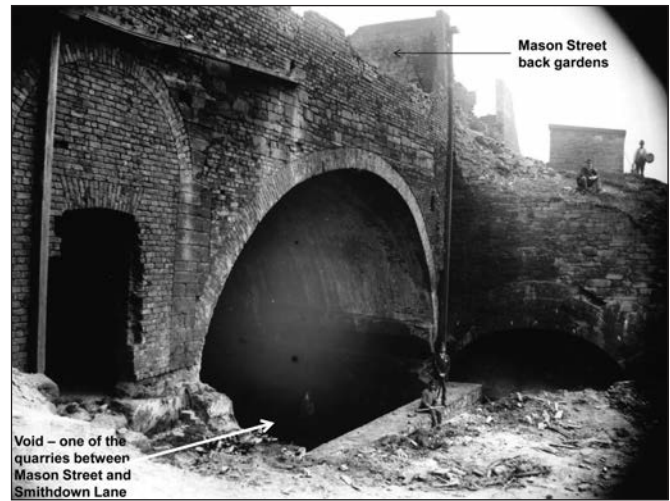


Figure 15. 15a. View of a tunnel roof uncovered during the archaeological investigations. 15b. Double decker tunnel. Williamson Tunnels Heritage Centre.

Figure 16. Quarry void bridged by arches to make 'tunnels' with a retaining wall holding back the fill on arch extrados. View to Mason Street.

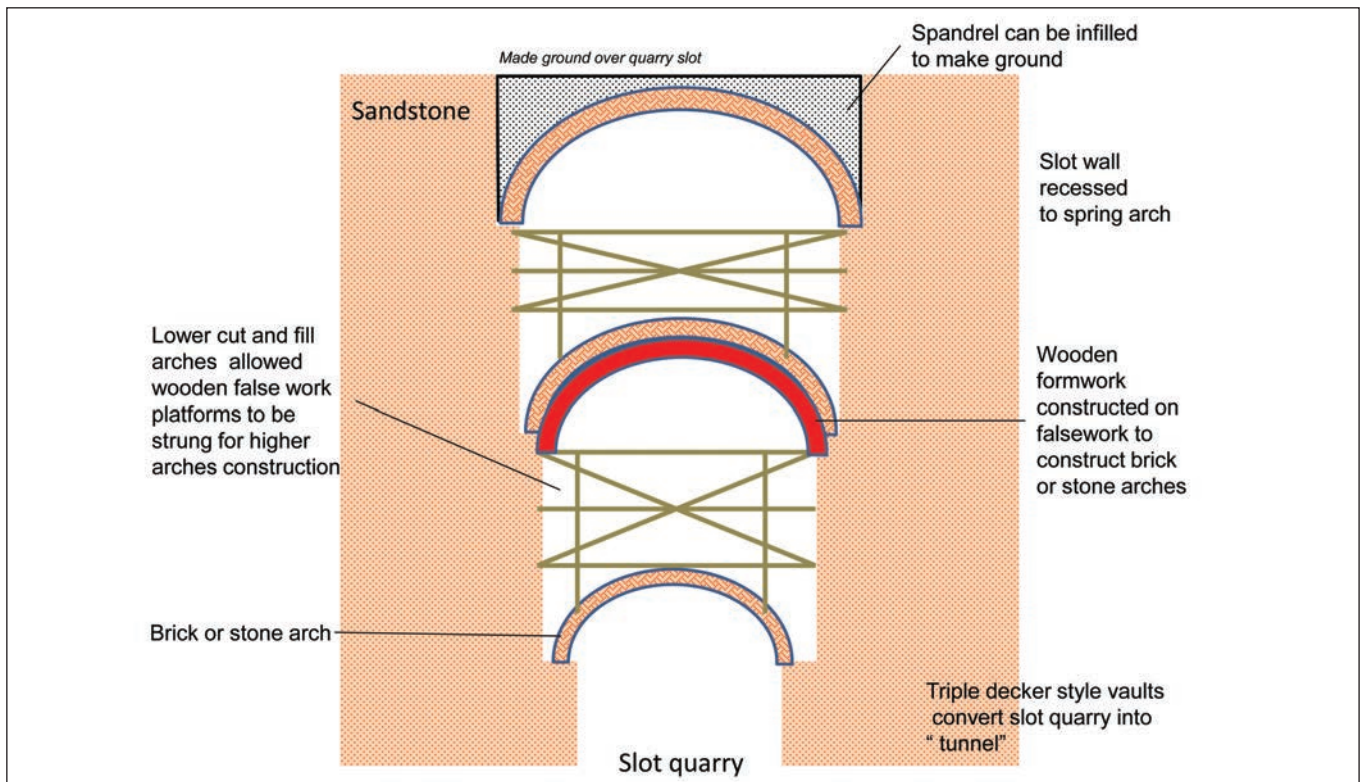


Figure 17. Williamson's Tunnel construction by piggybacking arches designed to convert quarry voids into made ground.

Using the GIS some estimates of the volume of stone extracted from Williamson's excavations have been prepared. Assuming a conservative and average depth of excavation of 7m the authors have arrived at a figure of nearly 123,000 tonnes of sandstone removed over a period of 30-35 years. Depending on the factor used to calculate waste materials derived from such stone extraction operations which may amount to as much as 70% waste in production (Godden, M., 2012 personal communication) we estimate that some 36-86,000 tonnes of building stone was released with the remaining waste being used as fill aggregate, a commodity very much in demand at the time for building foundations.

Williamson died in 1840 with an estate valued at £40,000 (Whittington-Egan, 1952:11) which at today's equivalent is approximately £45 million (National Archives, 2013). He was a wealthy man before moving to Edge Hill having married into the prosperous Tate tobacco family. He retired from that enterprise in 1818 yet it seems he was able to maintain and enhance his wealth from the subsequent business activities related to the Williamson excavations.

LATER USE OF THE 'TUNNELS'

After the death of Williamson all 'tunnelling' works stopped and by 1857 the lease reverted to West Derby Waste Lands Commission. By 1867 Liverpool Corporation had built stabling for 50 horses for its scavenging (street cleaning) department. At times the excavations proved problematic for Liverpool City Council often filling with putrid water. In order to alleviate this, and probably because they were in a convenient location, many of the 'tunnels' were infilled with demolition rubble. In later years the complex was occupied by the Liverpool City Cleansing and City Engineers departments and some of the 'tunnels' were used for storage. By 1968 Liverpool Corporation had left the site and some of the buildings were demolished. In 2002 the Williamson Tunnels Heritage Centre opened to preserve part of the complex, provide an opportunity for the public to visit and to engage in further research.

CONCLUSION

In Edge Hill, Liverpool a series of Williamson 'tunnels' are known to exist. The use of a retro GIS to analyse the spatial context of the excavations has provided a new perspective to the debate about their purpose. In addition consideration of the geological characteristics of the stone and the diggings has pointed to their purpose being largely part of a profitable extractive stone industry to supply a demanding urban market. Much of the published literature has suggested they were constructed out of some idiosyncratic philanthropy for unemployed demobbed Napoleonic war veterans. These men were undoubtedly a source of good labour at the time. However, the 'tunnels' are not true 'tunnels' in the sense of conduits hewn into the sandstone rock. Today they have the appearance of bedrock slots with arched roofs constructed from sandstone and/or bricks. Evidence from within the excavations today as well as ancillary sources indicate that building stones were being released rather than rock being hacked out. A ready and profitable market existed on the doorstep of the site.

As a keen businessman Williamson took the opportunity to remediate the sandstone slot excavations in a novel way to create land that was much in demand at the time in a prosperous and growing mercantile port city. In this way Williamson was also a pioneer of quarry restoration.

ACKNOWLEDGMENTS

Liverpool Museums and Liverpool Record Office for access to documents and general assistance. Goldcrest Finance for access to engineering geology reports. Kathryn Coffey for proof reading.

REFERENCES

- Anon. 1827., Poor Rate Book 2 Mar 1826 – 1 Mar 1827. Liverpool Record Office. 354 WES/1/1
- Anon. 1881., Excursion to Liverpool. Transactions of the North Staffordshire Institute of Mining and Mechanical Engineers. Vol. VI. p258.
- British History Online., 2013. www.british-history.ac.uk [Accessed 17 July 2013].
- Clensy, D., 2006. The Mole of Edge Hill. Morrisville. Lulu.
- Cuss, R.J. and Styles, P., 1999. The application of microgravity in industrial archaeology: an example from the Williamson 'tunnels', Edge Hill, Liverpool. Geological Society, London, Special Publications, 165: pp.41-59.
- Hand, C.R., 1916. Joseph Williamson: The king of Edge Hill. Transactions of the Historical Society of Lancashire and Cheshire, 79, pp. 86-111.
- Herdman, W. G., 1857. Pictorial Relics of Ancient Liverpool. Published by the author.
- Kaye, T. 1812. The stranger in Liverpool; or an historical and descriptive view of the town of Liverpool and its environs. 3rd Ed, Thomas Kaye, Liverpool.
- LK Consult Ltd., 2010. Land at Smithdown Lane. Preliminary Risk Assessment. (Phase 1 Desk Study). Ref CL1657.
- Moore, J., 1998. Underground Liverpool: Joseph Williamson - The King of Edge Hill The Bluecoat Press, Liverpool.
- Moorhead, C., 2009. The labyrinth of Edge Hill. 'Context' – Journal of the Institute of Historic Building Conservation. 109. 25-27.
- Morton, G.H., 1861. Geology of the Country around Liverpool. A lecture to the Liverpool Naturalists Field Club. November 1861. Geo Smith, Watts and Co.
- Morton, G.H., 1863. The Geology of the Country around Liverpool. Smith. Liverpool.
- Morton, G.H., 1887. Local historical, post-glacial and pre-glacial geology. Presidents Address. Proceedings of the Liverpool Geological Society. Session Twenty-Ninth.
- Morton, G.H., 1891. The Geology of the Country around Liverpool, including the North of Flintshire. George Philip & Son: London 2nd Edition.
- National Archives. 2013. <http://www.nationalarchives.gov.uk/currency> [accessed 18th July 2013].
- Oxford Archaeology North., 2011. Smithdown Lane, Corporation Stable Yards. Building Survey Report. OA North Job No: L10321.
- West Lancashire Territorial Forces., 1907. Survey map of the Williamson Tunnels.
- Royal-mile.com, 2013. <http://www.edinburgh-royalmile.com/interest/south-bridge.html> [accessed 18th July 2013].

- Savill, R., 2009. England's oldest allotments celebrate 200 years. The Daily Telegraph [accessed 18th July 2013].
- Spiegel, F., 1966. Liverpool Packet: Maps and Plans of Liverpool from Earliest Times to 1830 No. 2. Scouse Press, Liverpool.
- Spiegel, F., 1978. Liverpool Packet: Maps and Plans of Liverpool from 1830's to Present Day No. 2: The Growth of Merseyside No 2. Scouse Press, Liverpool.
- Stanier, P., 2000 Stone quarry landscapes. Tempus Publishing, Stroud.
- Stonehouse, J., 1846. In a brief notice of the excavations at Edge Hill, near Liverpool. Handwritten notebook. Liverpool Record Office. H 942 5701/3.
- Stonehouse, J., 1863. A Nonagenarian: Recollections of Old Liverpool. J. F. Hughes Liverpool.
- Whittington-Egan, R., 1952. Joseph Williamson- maker of catacombs. Chambers Journal of Literature, Science and Arts.
- Wilding, J., 1888. The building stones used in Liverpool. Journal of the Liverpool Geological Association. Vol IX.

Appendix 1. Maps used in the Retro GIS

- 1725 Chadwick's Map of Liverpool.
- 1768 Yates, W. & Parry, G. A Map of the environs of Liverpool.
- 1785 Eyes, C. Plan of the Town and Township of Liverpool.
- 1796 Gore, J. Plan of the Town of Liverpool.
- 1805 Plan of the Town of Harrington (Toxteth).
- 1807 Cole, G. & Roper, J. Liverpool.
1824. West Derby Wasteland Ledger date 1849. Map of the Mason Street area dated 1824.
- 1828 Gage, M. A. Map of Liverpool.
- 1829 Kaye, T. Plan of Liverpool.
- 1831 Taylor, T. Picture of Liverpool: A Strangers Guide.
- 1836 Gage, M. Liverpool.
- 1847 Ordnance Survey. Liverpool. 60 inch town plan.
- 1851 Ordnance Survey.1:10,560. County Series. Liverpool.
- 1855 Davies Map of Liverpool.
- 1860 Benson's Map of Liverpool.