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Your reference:
Our reference: AQW10021 17-22
Date: Tuesday 24 September 2020

AQW 10021/17-22 – INFORMATION TO BE PLACED IN THE ASSEMBLY LIBRARY

In answer to AQW 10021/17-22, the information attached at Annex A has been placed in the Assembly Library.

NICHOLA MALLON MLA
Minister for Infrastructure

AQW 10021/17-22

DATE FOR ANSWER: WEDNESDAY 25 NOVEMBER 2020

Jim Allister MLA (North Antrim)

To ask the Minister for Infrastructure (i) whether her Department holds a copy of an archaeological evaluation of the Boyne Bridge, South Belfast; and (ii) if so, whether she would lay a copy of the same in the Assembly Library.

ANSWER

I can confirm that my Department holds a copy of an Archaeological Evaluation and Bridge Coring preliminary Report, which discusses the coring of the south end of the Boyne Bridge in Sandy Row, Belfast in order to establish whether or not the 17th century Saltwater Bridge over the Blackstaff River still exists in a buried state at its south end.

A copy of this report will be provided to the Assembly Library. This report is also available to view on the planning portal using the reference number LA04/2020/0223/DC.

Signed: _____

NICHOLA MALLON MLA
Minister for Infrastructure

Date: _____20/11/2020_____

IAC Archaeology

ARCHAEOLOGICAL EVALUATION & BRIDGE CORING
AT
BELFAST TRANSPORT HUB

LICENCE NUMBER: AE/19/86

ON BEHALF OF: TRANSLINK

PLANNING REFERENCE: LA04/2017/1388/F
I.N.G. 333198, 373834

LICENCEE: CHRISTINA O'REGAN
AUTHOR(S): CHRISTINA O'REGAN, FRED HAMOND & TOM MEHARG

REPORT STATUS: PRELIMINARY REPORT
DATE: 14/01/2020

IAC PROJECT REF.: NJ0051

ABSTRACT

Irish Archaeological Consultancy Ltd has prepared this report on behalf of Translink, to study the impact, if any, on the archaeological and historical resource of the Belfast Transport Hub, which is located on the western side of Belfast City Centre on the site of the existing Europa Bus Centre and Great Victoria Street Railway Station. The report was undertaken by Christina O'Regan and Tom Meharg of IAC Ltd under licence AE/19/86 and in response to planning conditions attached to the development (LA04/2017/1388/F). It follows a previous archaeological desk top assessment carried out by Northern Archaeological Consultancy LTD on the 24th June 2015.

Archaeological testing was carried out over the course of five days from 2nd September 2019 using a mechanical excavator fitted with a flat grading bucket. Seven trenches were opened throughout the northern portion of the development area targeting an area known as *Brick Hall* on Williamson's map of 1791, to fully investigate the archaeological potential of the site.

A possible robbed-out foundation trench was uncovered in Trench 1. Brick and pottery recovered from the material within the trench dates to the late 18th century. Two deposits of brick were noted within the northwestern section of Trench 2. The brick was the same type as that found in Trench 1. A possible sandstone wall was noted at the southeastern end of Trench 3. The remains of late 19th/early 20th century brick buildings were recorded in Trench 7.

The material uncovered in Trenches 1, 2 and 3 may pertain to the building *Rose Lodge*, recorded on the 2nd Edition OS map. This building is likely a replacement of the *Brick Hall* noted on the Williamson map of 1791. Further displaced and possible *in situ* archaeological remains may exist within the development area which may relate to these buildings. It is therefore recommended that any invasive groundworks within the northern part of the development area are subject to archaeological monitoring.

The 17th-century Saltwater Bridge is encapsulated within the Boyne Bridge. The proposed development will involve the re-profiling of the Boyne Bridge. In order to ascertain the potential impact upon the Saltwater Bridge a programme of coring was devised. A total of five cores were drilled through the modern road deck to a depth of c. 4.5m. The results indicate that there will be no negative impact from the proposed development to the Saltwater Bridge.

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1 INTRODUCTION

1.1 GENERAL

The following report details the results of a programme of archaeological testing undertaken at the site of the existing Europa Bus Centre Depot prior to the development of The Belfast Transport Hub (Figure 1; Planning Ref.: LA04/2017/1388/F). This evaluation has been carried out to ascertain the potential impact of the development on the archaeological resource that may exist within the development area. The evaluation (Licence Ref.: AE/19/86) was undertaken by Christina O'Regan and Tom Meharg of Irish Archaeological Consultancy Ltd (IAC), on behalf of Translink.

Test trenching commenced at the site on 2nd September 2019 and continued for five days. This was carried out using a 13 tonne 360 degree tracked excavator, equipped with a flat, toothless bucket, under strict archaeological supervision. A total of seven trenches were mechanically investigated across the test area which measured 190 linear metres. This report follows on from an archaeological desk top assessment carried out by Northern Archaeological Consultancy Ltd (NAC) on the 24th June 2015.

The assessment by NAC concluded that there was potential for the remains of an 18th-century building (Brick Hall) to survive beneath the current ground surface.

1.2 THE DEVELOPMENT

The development (Planning Ref.: LA04/2017/1388/F) will provide bus and rail services within a single station (Figure 2). The development is situated on the western side of Belfast City Centre on the site of the existing Europa Bus Centre and Great Victoria Street Railway Station. The site is bounded by the main Belfast–Dublin railway line to the south, the A12 Westlink to the west and the B38 Grosvenor Road to the north.

2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

2.1 SUMMARY OF DESKTOP ASSESSMENT (NAC 2015)

The proposed development is located in the townlands of Town Parks and Malone Lower, Parish of Shankill and Barony of Belfast Upper. The following is a summary of the historic environment chapter taken from the Belfast Transport Hub Environmental Impact Statement (EIS) Vol 1:

> The development is located within an area of deep estuarine alluvium or marine clay close to the intersection of the Blackstaff and Lagan Rivers. The site is located on the outskirts of the Area of Archaeological Potential for the historic settlement of Belfast. Analysis of the available cartographic resources indicate that the area of the proposed development remained greenfield until the 19th Century. There are no known pre-Industrial archaeological remains within the limits of the development area.
>
> The closest recorded archaeological site is a brick chimney stack (ANT060:505) located 144m south of the southern end of the development area. Other recorded sites in the vicinity include a holy well (ANT061:007), a chimney stack (ANT060:500), a fortification (ANT061:012), the 17th-century town ditch (ANT061:022) and the site of the 17th-century Belfast castle (ANT061:005). A review of the Listed Buildings database revealed there are no listed buildings within the limits of the development area though several occur in close proximity. A single building will be bounded by the development area, the Grand Opera House (HB26/29/001). A review of the Industrial Heritage Record revealed there are three recorded sites within the limits of the development area. These are the (now demolished) GNR Goods Shed (IHR0062:213) within the centre of the development area, the Boyne Bridge (IHR0062:214) and the Saltwater Bridge (IHR10121:000).

Prehistoric Period

Although very recent discoveries may push back the date of human activity by a number of millennia (Dowd and Carden 2016), the Mesolithic Period is the earliest time for which there is clear evidence of prehistoric activity in Ireland. During this period people hunted, foraged and gathered food and appear to have had a mobile lifestyle. The most common evidence indicative of Mesolithic activity at a site comprises scatters of worked flint material; a by-product from the production of flint implements (Stout and Stout 1997). There are no known Mesolithic sites within the vicinity of the development area, although several have been identified within the wider landscape (Ó Baoill 2011, 23).

During the Neolithic period (4000–2500 BC) communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. There was a greater concern for territory, which saw the construction of large communal ritual

monuments called megalithic tombs, which are characteristic of the period. Although there are no known Neolithic sites within the vicinity of the development, evidence for Neolithic occupation has been discovered at several locations including the Belfast Hills and along the Malone Ridge.

The Bronze Age was marked by the widespread use of metal for the first time in Ireland. As with the transition from Mesolithic to Neolithic, the transition into the early Bronze Age was accompanied by changes in society. Megalithic tombs were no longer constructed and the burial of the individual became typical. Cremated or inhumed bodies were often placed in a cist, which is a stone-lined grave, usually built of slabs set upright to form a box-like construction and capped by a large slab or several smaller lintels (Buckley and Sweetman 1991, 63). There are no known Bronze Age sites within the vicinity of the development.

Compared to the rest of Irish prehistory there is relatively little evidence in Ireland, as a whole, to represent the Iron Age (*c.* 500BC – *c.* AD500). As in Europe, there are two phases of the Iron Age in Ireland; the Hallstatt and the La Tène. The Hallstatt period generally dates from 700BC onwards and spread rapidly from Austria, across Europe, and then into Ireland. The later Iron Age or La Tène culture also originated in Europe during the middle of the 5th century BC. For several centuries the La Tène Celts were the dominant people in Europe, until they were finally overcome by the Roman Empire. There are no known Iron Age sites within the vicinity of the development.

Early Medieval Period (AD400–1100)

The early medieval period is depicted in the surviving sources as entirely rural characterised by the basic territorial unit known as *túath*. Byrne (1973) estimates that there were probably at least one hundred and fifty kings in Ireland at any given time during this period, each ruling over his own *túath*. The first written reference to Belfast dates to 665 AD, in the Annals of the Four Masters, where reference is made to 'The battle of the Fearsat [Farset]...'.

During this, sometimes violent period, roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. Although most of the ringforts that have been excavated are shown to date to this period, some have earlier origins and may have been originally constructed during the Iron Age, or even earlier. The ringfort or rath is considered to be the most common indicator of settlement during the early medieval period. A recent study of the ringfort (Stout 1997) has suggested that there are a total of 45,119 potential ringforts or enclosure sites throughout Ireland. They are typically enclosed by an earthen bank and exterior ditch, and range from 25m to 50m in diameter. The smaller sized and single banked type (univallate) were more likely to be home to the lower ranks of society while larger examples with more than one bank (bivallate / trivallate) housed the more powerful kings and lords.

The site of a possible early medieval occupation site (ANT 061:014) is located 1.2km south of the development site while a ringfort (ANT 061:013) is located 1.3km north of the development. It was shown as an enclosure on the 1st Edition 6-inch OS map (1832– 3) and described as a *rath* by Bigger. The site had disappeared by the time of

the 2nd Edition OS map (1858). Other early medieval sites in the wider landscape include a horizontal water mill (ANT060:066), discovered in a clay pit close to the Springfield Road, located 2km west; platform rath ANT060:033, located 2.2km southwest, and The Chapel of the Ford (ANT061:004), located 1.16km northeast.

Medieval Period (AD1100–1600)

The first of the Irish Anglo-Norman landings and invasions took place in County Wexford, at the invitation of the former king of Leinster, Dermot MacMurrough Kavanagh. The Anglo-Normans, joined by 500 *Uí Chennselaig* men, took the Viking town of Wexford. Through a policy of military force and integration, the Anglo Normans colonised much of the country. In 1177, John de Courcy led a small army from Dublin into Ulster, arriving at Carrickfergus in the late 1170s (Ó Baoill 2011, 70).

A small borough town was established at Belfast, defended on all sides by a series of motte and bailey structures, many of which are still extant. It is presumed that the Anglo-Norman castle was constructed on the site of what would become Sir Arthur Chichester's manor house, at the western end of High Street. The Chapel of the Ford is presumed to have been located at the opposite end of High Street, under what is now St George's Church. The medieval town is likely to have been confined between these two points.

Evidence for medieval settlement and activity in Belfast is limited. A curving gully containing sherds of medieval coarseware, was discovered during excavations at the Woolworth's and Burton building in 2003 (Moore, Licence Ref.: AE/03/95) while human burials were discovered between Castle Place and Cornmarket, one of which was radiocarbon dated to the 15th century (Ó Baoill 2011, 88).

A number of medieval ecclesiastical sites occur within a 2.5km radius of the development. These include the church site at Friar's Bush (ANT061:006) located 1.4km SSE and an unlocated church site (ANT061:008), 2.05km southwest;

Post-medieval Period (AD1600-1900)

In the years leading up to AD 1600, the lands around Belfast were under the control of the Clandeboye O'Neills, whose seat of power was in the Castlereagh Hills. Following the conclusion of the Nine Years' War in 1603, these lands were granted to Sir Arthur Chichester. He constructed a manor house on the site of the Anglo-Norman castle in 1610–11 and encouraged settlers from England and Scotland to the lands around Belfast, Carrickfergus and Malone (McLaughlin & Lyttleton 2016). In 1613 the small town was incorporated by royal charter becoming the city of Belfast. By the 1640s, Belfast had acquired defences, taking the form of an external ditch and associated bank. Evidence for these defences has been encountered at several locations including Queens Street (Dunlop 2005, Licence Ref.: AE/05/021), Donegall Street (Brannon 1990) and Gordon Street (McConway 2001, Licence Ref.: AE/01/12).

By 1660, Belfast was comprised of five main streets, High Street, Bridge Street, Waring Street, North Street and Skipper Street. This would remain the hub of the city for the next couple of centuries.

By the late 17th century Belfast was an industrial hub, with beef, hide, butter, tallow and corn being exported. There is also evidence for the beginnings of the shipbuilding industry at this time (Ó Baoill 2011). Much of the industry and expansion of the city was centred around the existing city centre and west of the River Lagan but the construction of the Long Bridge in 1682 encouraged developed in Ballymacarrett, in what is now east Belfast.

The lands around the development area were dominated by brick fields and kilns. Brick from this area was used to construct Belfast Castle in the 17th Century.

A programme of land reclamation began in the early decades on the 18th century, following the construction of the Hanover and George Quays, allowing further expansion of the city of Belfast. Other major industries to become established in the city included paper mills, linen and cotton production. By the late 19th century Belfast was the largest linen-producer in the world but this industry went into decline soon after, paving the way for ship-building as the primary industry of the city.

2.2 SUMMARY OF PREVIOUS ARCHAEOLOGICAL FIELDWORK

A review of the excavations.ie has revealed that while several investigations have taken place within the heart of Belfast city, just two have been undertaken within the immediate vicinity of the development area. In 2005 excavations at Queen Street, c. 180m north of the development area, uncovered a portion of the 17th-century town ditch as well as 19th-century foundations (Dunlop; Licence Ref.: AE/05/021). In 2007, the remains of late 19th-century foundations were uncovered at a site on Grosvenor Road, which is bounded by the development area to the east (O'Regan 2007; Licence Ref.: AE/07/116).

In addition, three investigations have taken place within the immediate vicinity of the development area where nothing of archaeological significance was encountered. These include College Square North, 190m north (Heaney 2003; Licence Ref.: AE/03/85), Bedford St, 150m east, (Gahan 2006; Licence Ref.: AE/04/43) and Clarence Street West, 160m east, (Long 2007; Licence Ref.: AE/07/110).

2.3 CARTOGRAPHIC ANALYSIS

A summary of the cartographic analysis taken from NAC 2015, shows that the development area was first mapped in 1791 by James Williamson. The map shows the Saltwater Bridge which allowed what is now Durham Street to traverse the river in the southeast of the development area. The construction of the Saltwater Bridge was undertaken by Sir Arthur Chichester in 1642 and was originally called the Great Bridge of Belfast. It was also known as the Brickle or Brick Kiln Bridge owing to the brick kilns in the area which produced the materials for the 17th-century castle at Castle Lane. The Williamson map shows the Blackstaff River passing through the development area. To the north of the development area a lane is showing leading to a building annotated as *Brick Hall*, perhaps belonging to an individual known as 'Mr Simpson'

which is also recorded on the map. A wide straight road lined with trees passes north–south through the development area, today's Durham Street. A road, roughly corresponding to today's Hope Street, runs east–west to meet with this road. It is at this junction that the Saltwater Bridge is located, in association with some buildings, possibly houses. Further buildings are recorded to the west of the Durham Street, within the northern limits of the development area. The area to the south of the development area is annotated as *Brick Fields* while the area to the north is annotated as *Brick Yards*.

The development area continued to remain unmapped until parts of the eastern side were included on maps in the second half of the 18th Century. During this time, the development area was far beyond the limits of the main settlement of Belfast though new development was slowly encroaching. Throughout the 18th Century and into the 19th Century, the development area remained peripheral to the settlement of Belfast in undeveloped ground.

First Edition Ordnance Survey Map, 1832–33, scale 1:10560

This is the first accurate historic mapping coverage of the area containing the scheme. The map depicts the southern area of the development area as undeveloped ground that is bounded by the Blackstaff River along its northern limit. The extreme southern end of the development area includes a section of a small road that travels north–south across the area. An oval pond is located along the eastern edge of the development area, within what appears to be an area of landscaped ground associated with a dwelling to the east of the development area. The River cuts the main body of the development area in two. To the north of the river are located a group of small buildings associated with two access trackways and an area of rough ground. To the northeast of the River, fronting onto what is labelled Durham place, is a group of industrial buildings relating to a Linen Mill located just outside the development area to the south. A number of other buildings are recorded on the east side of Durham Place.

Second Edition Ordnance Survey Map, 1858 scale 1:10560

Prior to the second Edition Ordnance Survey Map a small portion of the development area is covered by O'Hagan's map of 1858, this map records the first appearance of the railway line. It notes the appearance of the line, a large shed 'luggage station' and another smaller building to the north, west of Durham Street, and the Ulster Railway Station/Terminus to the east of Durham Street.

The Second Edition OS map (1858) shows the full development of the railway line. The southern end of the development area is dominated by the railway line but also a rectangular area, possibly denoting a garden. The Blackstaff River continues to cut the development area in two. To the south of the river is an area annotated as Coke Ovens, associated with a cluster of rectangular buildings that are bounded by the river to the north and the railway to the south. A small group of buildings with an associated garden annotated as *Rose Lodge* and accessed off Grosvenor Street is recorded to the north. It is likely that this is a continuation of Brick Hall from the 1791 map. A large Goods Shed is recorded to the south of the development area, within

the bend of the Blackstaff. Several groups of buildings, possibly terraced houses, annotated as *Masseys Court* and *Stormont Court* are located to the west of Durham Street. The Saltwater Bridge is noted to the south of the development area.

Third Edition Ordnance Survey Map, 1902, scale 1:2500

By the time of the 3rd Edition OS map (1902) the development area has become highly developed. Rose Lodge is no longer visible, having been replaced by two rectangular Goods Sheds and a yard. Several smaller buildings associated with the railway line are noted to the north of the main line. The area previously annotated as Coke Ovens has been re-labelled as a Reservoir. The rectangular area of planting to the southwest is now recorded as a graveyard. It is truncated by a new railway line that travels eastwards towards the area of Botanic. By the time of the 4th Edition OS map (1931), there is little change to the cartographic resource that relates to the development area. The smaller buildings to the north of the main line have been replaced by a single large square building.

Aerial Photography

A review of the available aerial photographic evidence (Google Earth 2001, 2005, 2006, 2007, 2009, 2010, 2015 & 2016, Bing and OSNI) shows the large Goods Sheds to the north of the development area were demolished between 2015 and 2016. No structures or features of archaeological significance were identified.

3 ARCHAEOLOGICAL TESTING

3.1 GENERAL

Test trenching took place between the 2nd September 2019 and the 6th September 2019, using a 13 tonne 360 degree tracked excavator equipped with a flat, toothless bucket under strict archaeological supervision. A total of seven trenches measuring c. 190 linear metres were excavated across the northern portion of the development area, targeting the area known as 'Brick Hall' on Williamson's map of 1791. A number of environmental and infrastructural constraints were identified across the development area. The trenching layout was designed to avoid these constraints. Any investigated deposits were preserved by record. This was by means of written, drawn and photographic records.

The test trenches were excavated to determine, as far as reasonably possible, the location, extent, date, character, condition, significance and quality of any surviving archaeological remains threatened by the development. Test trenching was also carried out to clarify the nature and extent of existing disturbance and intrusions and to assess the degree of archaeological survival in order to formulate further mitigation strategies. These are designed to reduce or offset the impact of the development scheme.

3.2 TESTING RESULTS

A total of seven trenches measuring c.190 linear metres were excavated across the site (Figure 3, Plates 1–13). The site is predominantly covered in tarmac hardstanding while rubble spoil heaps are piled upon a spread rubble surface to the southeast. Only the southeast end of Trench 6 was excavated through this material. A rigid mesh fence ran in a northwest–southeast orientation dividing the development area. This fence crossed Trenches 1, 2, 3, and 4. A narrow section of trench remained unexcavated to allow for the preservation of the fence.

Trenches 5 and 6 were targeted at the area known as *Brick Hall*.

Topsoil was a hardstanding surface of tarmac throughout the site. The southern half of Trench 6 extended into the area where the Goods Sheds had been demolished and through a surface of hardcore and rubble. Subsoil varied throughout the site, typically appearing as grey to black silty clay deposits.

3.3 MODERN CONSTRAINTS

As a site used for numerous industrial purposes in modern times, there were concerns over encountering any hazardous contaminants or dangerous subsurface utilities. The layout of the trenches avoided seriously contaminated hotspots, identified by comprehensive ground investigations. In addition to this, Translink provided a utilities map, and a cable avoidance tool was regularly used during the excavations. However, some modern features and constraints were encountered

throughout the excavation and occasionally prevented the complete excavation of certain areas. These are identified below.

In Trenches 1 and 2 concrete piles spaced along the base of the trench prevented the full excavation of these trenches in some areas (Plate 1).

In the middle portion of Trench 3 the presence of an electrical cable prevented the excavation of the trench to natural deposits. A layer of granite square sets was present beneath the concrete in some areas of the trench.

In Trench 4, the southern extent of the trench could not be excavated due to the presence of a weighbridge, composed of thick concrete and iron rails. In the northern part of the trench a pressurised water pipe (identified by blue plastic mesh fencing) interrupted excavation.

In Trench 5, beneath the hardcore, a surface of large rounded cobbles and square sets was present. Along the northern trench face two grey plastic pipes were encountered, one of which was damaged (Plate 8). Although some water flowed out of the pipe it was not pressurised and dissipated very quickly. At the northeastern end a ceramic drain and metal pipe were encountered at a depth of 1.2m. These same pipes and plastic ducting were also encountered during the excavation of Trench 6.

Trench 7 contained the highest volume of modern features, all of which were brick walls (Plates 10–13). At c. 5m from the southwestern edge of the trench a brick wall (C8) ran south–north through the trench at a depth of 0.45m (Plate 11). It measured 1.8m in length and 0.63m in width. The eastern face was exposed to a depth of 0.8m from topsoil surface. At the base of this wall was a layer of granite square sets.

To the northeast of C8, c. 10m from the southwestern edge of the trench, was brick wall (C9). It was orientated south–north through the trench at a depth of 0.75m. It measured 1.8m in length and 0.35m in width.

Northeast of this, c. 11m from the southwest edge of trench, was wall (C10). Between C9 and C10 was a spread of degraded mortar rubble with numerous brick inclusions. C10 was orientated south–north through the trench at a depth of 0.58m and measured 2m in length and 0.65m in width (Plate 12).

Northeast of C10 was a spread of yellow sand with a ceramic drain running north–south between C10 and brick wall C11. C11 was located c. 13.2m from the southwest edge of trench. It was orientated south–north and was located at a depth of 0.58m. It measured 1.5m in length and 0.13m in width. Brick wall (C13) abutted C11 at its northern end (Plate 13). It measured 1.7m in length and 0.2m in width, widening to 0.45m at the east. Demolition deposits were noted to the northeast of C11.

Approximately 16m from the southwest edge of the trench, a possible brick foundation wall with slate damp proofing (C12 was located at a depth of 0.52m. It

measured 1.75m in length and extended into the trench 0.56m from the northwest section.

TRENCH 1 (Plates 1 and 2)

LENGTH	50m
DEPTH	2.1m
WIDTH	2m
ORIENTATION	Southwest–northeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil - hardstanding tarmac
0.1–0.5m	Hardcore aggregate
0.5–1m	Brown sandy rubble with inclusions of broken brick.
1.0-1.8m	Dark grey clay silt with inclusions of brick and rubble.
1.8-2.1m	Subsoil - black clayey silt
ARCHAEOLOGICAL FEATURES	
A linear feature (C6), orientated northeast–southwest was noted at the base of the trench. This may be a robbed-out foundation trench, possibly associated with Rose Lodge. Sherds of 19th Century ceramic and brick were noted within the fill of the feature.	

TRENCH 2 (Plates 3 and 4)

LENGTH	42m
DEPTH	1.95.m
WIDTH	2m
ORIENTATION	Southwest–northeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil - hardstanding tarmac
0.1–0.45m	Hardcore aggregate
0.45–0.85m	Dark grey clay layer with mottled patches of brown sandy grit and rubble. Inclusions of brick rubble and stones.
0.85–1.8m	Subsoil - grey silty clay grading to yellow silty clay at the west
ARCHAEOLOGICAL FEATURES	
Two deposits of brick and rubble were identified in the northwestern section face. The brick was the same type recovered from Trench 1.	

TRENCH 3 (Plates 5 and 6)

LENGTH	28m
DEPTH	2.1m
WIDTH	2m
ORIENTATION	Northwest–southeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil - hardstanding tarmac
0.1–0.2m	Hardcore aggregate
0.2–0.46m	Concrete throughout much of southern end of trench
0.2–0.6m	Grey rubble with boulder inclusions
0.6–1.2m	Brown gritty sandy rubble

1.2–2.1m	Subsoil - dark grey silty clay
ARCHAEOLOGICAL FEATURES	
Possible wall foundation (C7) and a red brick drain (C14) located at southeast end of trench.	

TRENCH 4 (Plate 7)

LENGTH	12m
DEPTH	1.75m
WIDTH	2m
ORIENTATION	Northwest–southeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil - hardstanding tarmac
0.1–0.12m	Hardcore aggregate
0.12–0.15m	Concrete
0.15–0.06m	Rubble with modern brick
0.06–1.75m	Subsoil - grey silt
ARCHAEOLOGICAL FEATURES	
No archaeological features present	

TRENCH 5 (Plate 8)

LENGTH	25m
DEPTH	2.4m
WIDTH	2m
ORIENTATION	Southwest–northeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil - hardstanding tarmac
0.1–0.65m	Hardcore aggregate
0.65–0.8m	20th-century surface of stone cobbles and square sets
0.8–1.2m	Mixture of red brick dust with spreads of coal dust throughout
1.2–2.4m	Subsoil - grey silty clay
ARCHAEOLOGICAL FEATURES	
No archaeological features present	

TRENCH 6 (Plate 9)

LENGTH	8m
DEPTH	2.4m
WIDTH	2m
ORIENTATION	Southwest–northeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil - hardstanding tarmac
0.1–0.8m	Hardcore and rubble
0.8–1.2m	Blackish silty grit
1.2–2.4m	Subsoil - grey silty clay
ARCHAEOLOGICAL FEATURES	
No archaeological features present	

TRENCH 7 (Plates 10–13)

LENGTH	24m
DEPTH	1.55m
WIDTH	2m
ORIENTATION	Southwest–northeast
STRATIGRAPHY FROM PRESENT GROUND LEVEL	
0.0–0.1m	Topsoil- (hardstanding tarmac
0.1–0.6m	Hardcore aggregate
0.6–0.9m	Black gritty rubble
0.9–1.25m	Brown rubble
1.25–1.55m	Subsoil - dark grey silty clay
ARCHAEOLOGICAL FEATURES	
Six mortared brick walls were discovered in this trench (C8, C9, C10, C11, C12, and C13). These are likely associated with a building recorded on the 3rd Edition OS map (1900). Removal of these walls was not possible due to their extensive depth. Removal of material in between revealed no buried archaeological material.	

TABLE 1: Test Trench Results

TRENCH	LENGTH (m)	WIDTH (m)	DEPTH (m)	ORIENTATION	DETAILS
1	50	2	2.1	Southwest–northeast	Linear feature, possible foundation cut (C6).
2	42	2	1.95	Southwest–northeast	Two brick and rubble deposits.
3	28	2	2.1	Northwest–southeast	Possible wall foundation (C7) and brick drain (C14).
4	12	2	1.75	Northwest–southeast	No archaeology found.
5	25	2	2.4	Southwest–northeast	No archaeology found.
6	8	2	2.4	Northwest–southeast	No archaeology found.
7	24	2	1.55	Southwest–northeast	Six mortared brick walls (C8, C9, C10, C11, C12, C13).

Archaeological Features

Trenches 1 and 3 contained features of archaeological interest.

In Trench 1, a linear feature (C6) was identified at a depth of 1.9m (Plate 2). It measured c. 0.8m in width and c. 6m in length (min). The feature was orientated northeast–southwest and appeared to be filled with a mix of rubble, black silt and pottery sherds. From the spoil, sherds of late 18th/19th-century ceramic were recovered along with bricks, which, based on their dimensions, also appeared to be late 18th century in date. It is possible that this foundation relates to the building recorded on the 1st Edition OS map, later known as Rose Lodge. The feature was

preserved *in situ* and covered with a layer of geotextile (terram) before the trench was backfilled.

In Trench 2, two deposits of brick rubble were visible in the northwest section face. The first was located c.17.8m from the southwest end of the trench at a depth of 0.5–0.85m (Plate 3) while the second was present c.21.9m from the southwest end of the trench at a depth of 0.65m–1.5m. It is likely that these deposits relate to the destruction of the 18th-century building(s) in the immediate vicinity and possibly relate directly to the feature identified in Trench 1.

Towards the southwest end of Trench 3, a red brick drain (C14) was identified at a depth of 1.6m (Plate 5). The drain measured 0.3m in width and was orientated northwest–southeast. Its depth was unknown as it contained a reservoir of water that repeatedly filled the base of the trench. The brick appeared to be of the same type recovered from Trenches 1 & 2 and it is likely to be a feature contemporary to the other archaeological activity noted on site.

A possible wall foundation (C7) was identified at the southeastern end of Trench 3 at a depth of 0.46–0.88m (Plate 6). The feature was composed of mortared sandstone with degraded sandstone around the edges. Beneath was a deposit of mortar with brick fragments contained within a matric of fine grained dark grey silty clay. This feature was preserved *in situ* and covered with a layer of geotextile (terram) before the trench was backfilled. A large piece of struck flint was recovered in association with the wall.

4 CONCLUSIONS

Archaeological testing was carried out over the course of five days from 2nd September 2019 using a mechanical excavator fitted with a flat grading bucket. The trenches were designed to investigate the archaeological potential of the site, in particular the area around the building noted as *Brick Hall*. Testing revealed two areas of archaeological potential. These comprise a foundation cut in Trench 1, to the northwest of the development area, dumps of brick in Trench 2 and a brick drain and possible sandstone wall at the southern end of Trench 3.

The test area is to be developed as part of the new Belfast Transport Hub. New rail lines and station will be constructed within the test area. In the immediate future however, temporary bus washing facilities will be constructed within the test area. The construction method for these works is to be decided. However, if deep invasive works are required there may be a negative impact on buried archaeological remains which have the potential to exist within the site.

5 CORING OF SALTWATER BRIDGE, SANDY ROW BELFAST

FRED HAMOND

NOVEMBER 2019

CONTENTS

PREFACE

Preface This report discusses the coring of the south end of the Boyne Bridge in Sandy Row, Belfast in order to establish whether or not the 17th century Saltwater Bridge over the Blackstaff River still existed in a buried state at its south end. The Boyne Bridge is to be demolished as part of the development of a new bus and rail transport hub and the results of this exercise will inform the design of the new roadway which will connect Durham Street with Sandy Row. I should like to thank Neil Haggan (Causeway Geotech), Christina O'Regan (Irish Archaeological Consultancy) and Brian Devlin (Arup) for their assistance in the preparation of this report.

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November 2019

5.1 INTRODUCTION

Saltwater Bridge is located under the south end of Boyne Bridge, just north of the junction of Sandy Row with Linfield Road and Hope Street (fig.1; National Grid 33340 373676).

The objective of this project was to take a number of cores through this end of the Boyne Bridge to verify whether or not the Saltwater Bridge still existed below the present-day road, and if so, to establish its depth relative to the surface of the road.

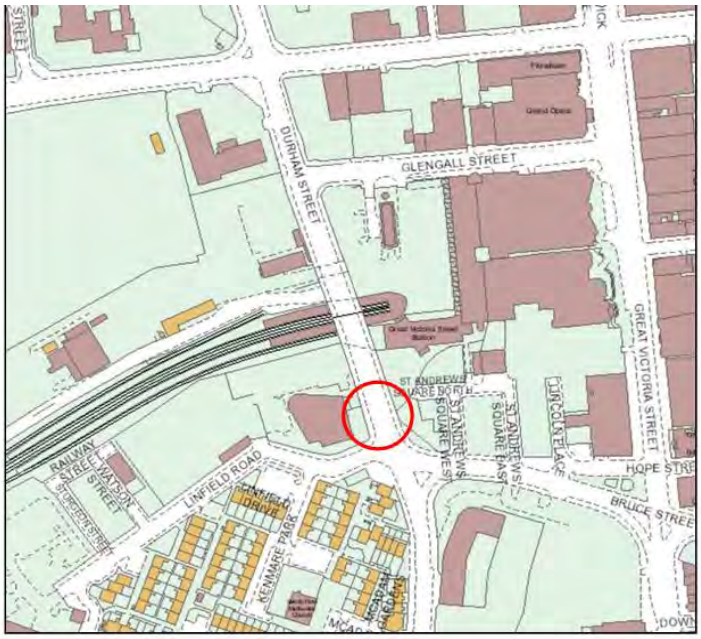


Fig.1 Location of Saltwater Bridge and area of proposed test coring *(OSNI)*.

5.2 BRIDGE HISTORY

A road bridge over the River Blackstaff is documented hereabouts in 1611. It was rebuilt or extensively repaired in the early 1640s and by 1689 was known as the 'Great Bridge'. As local folklore attests, it is extremely likely that King William III passed over it en route to the Battle of the Boyne in 1690. By the 1720s, the bridge was known as Saltwater Bridge to reflect the fact that the Blackstaff was tidal up to this point. It is captioned as such on Williamson's 1791 map and is also shown uncaptioned on the 1833 OS six-inch map (fig.2)

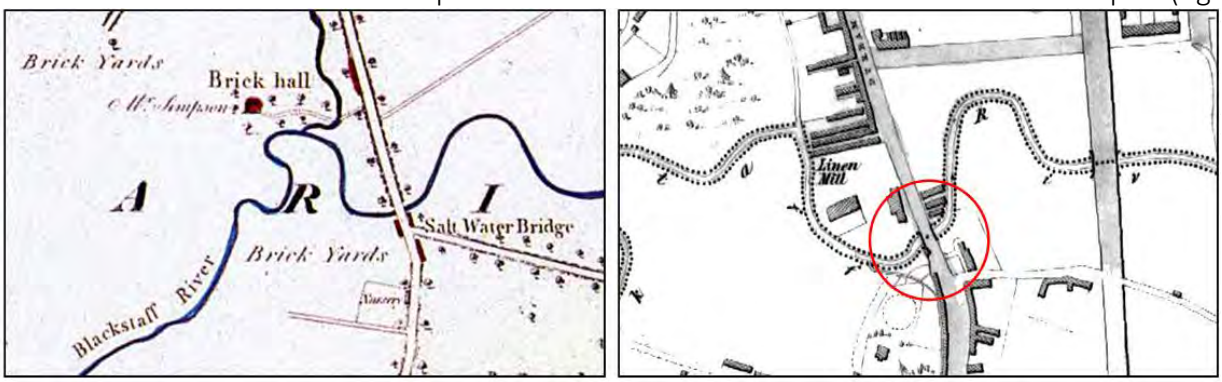


Fig.2 *Left:* Williamson's 1791 map of Belfast and environs showing the location of Salt Water Bridge.
Right: 1833 OS 1:10,560 map *(not to scale)*.

In 1839, the Ulster Railway Company opened a line from its terminus at Great Victoria Street to Lisburn. This entailed the construction of a level crossing at Durham Street, immediately west of the terminus. The 1858 OS map shows three railway tracks crossing the road and also the

Saltwater Bridge with two arches (fig.3). That it had two arches is confirmed by contemporary newspaper reports citing flooding in the locality.

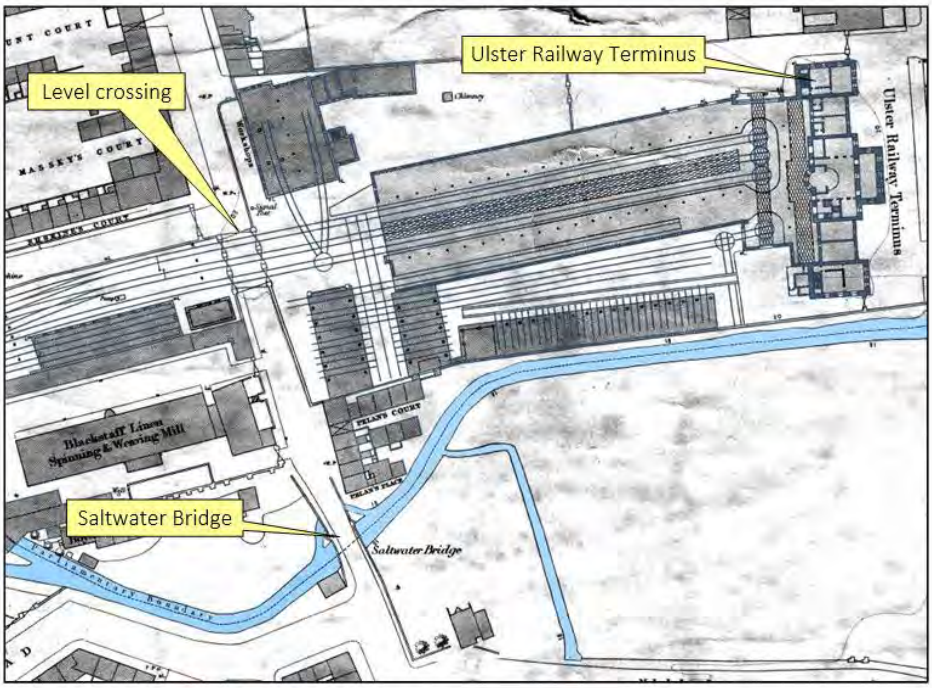


Fig.3 1858 OS 1:1056 map *(not to scale).*

To facilitate an ever increasing volume of road traffic, the level crossing was replaced by a metal girder bridge over the railway in 1863. This new structure quickly became known locally as the 'Boyne Bridge' and separated Durham Street at its north end from Sandy Row to its south. Although Saltwater Bridge was unaffected by the addition of the new bridge, its deck may have been re-graded to tie in with the gradient of its southern approach (fig.4).

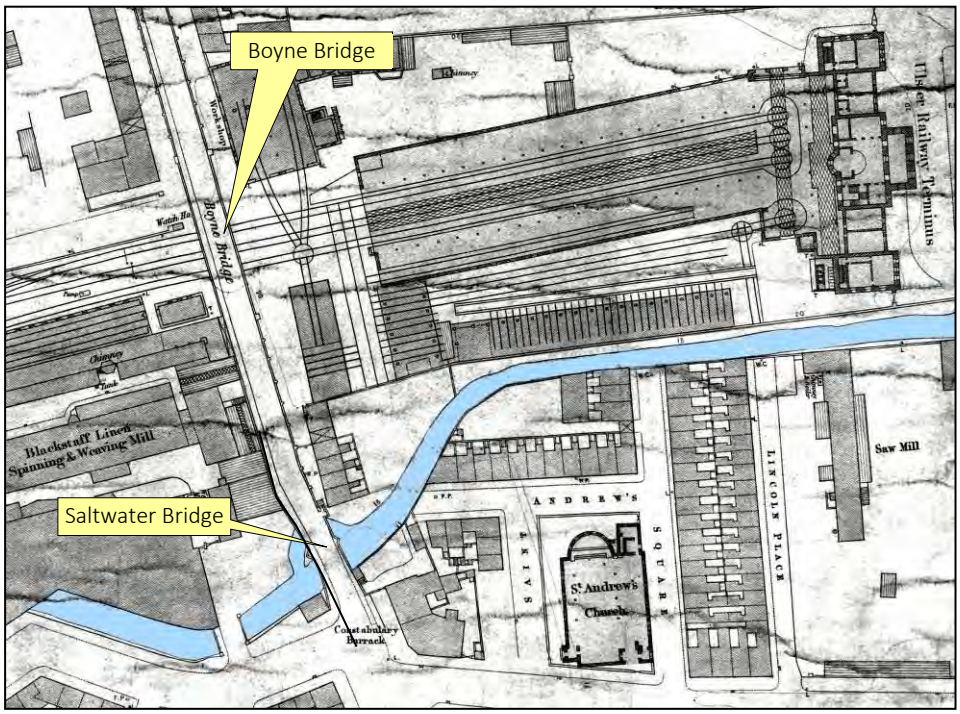


Fig.4 1872 OS 1:1056 map *(not to scale).*

In 1900-01, Murray's Whitehall Tobacco Works was built at the south end of Boyne Bridge, on the west side. At the same time, the road was realigned slightly by widening the Saltwater Bridge to fill in the gap between its west face and the new factory, under which the Blackstaff was also culverted (fig.5).

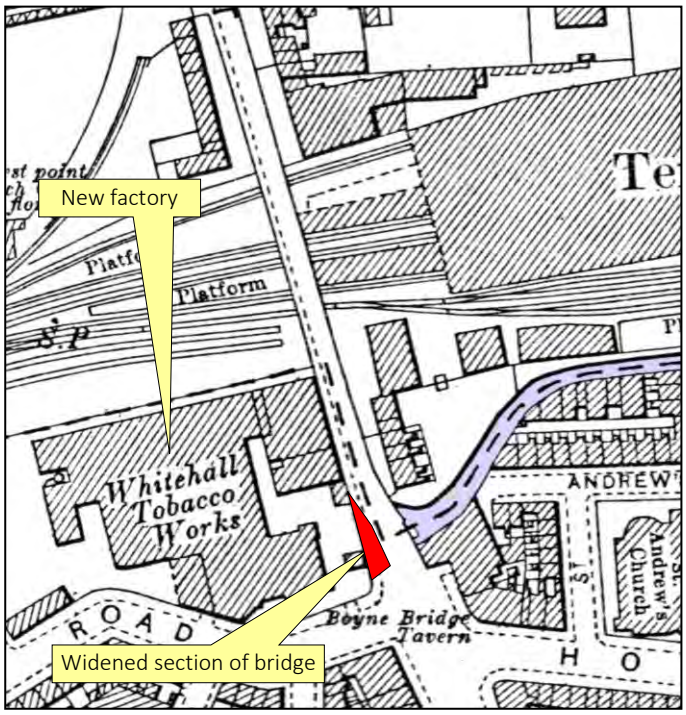


Fig.5 1902 OS 25-inch map (not to scale) showing Whitehall Tobacco Works and realignment of road at SW end of Saltwater Bridge.

In 1934-36, the 1860s Boyne Bridge was replaced with a new reinforced-concrete bridge. Rather than demolish Saltwater Bridge, it was decided to incorporate it into the south end of the new bridge's approach road. Harry Martin, senior director of H & J Martin, the scheme's contractors, noted that it was "constructed of local blue whinstone, [and] is still good and sound".

A photograph taken around that time shows the Saltwater Bridge's east (downstream) face (fig.6). It also shows the downstream face of the main archway (at left in the photograph) had been extended outwards from its original line to accommodate an open brick urinal, the floor of which was carried on metal girders between the abutment and pier.

Fig.6: View of east face of Salt-water Bridge, c.1934 *(Millin, 1938).*

A 1936 drawing of the bridge shows the two semicircular arches of approximately the same height but slightly different widths (fig.7). The south arch spanned 19ft 0in (5.8m) and the north one 17ft 3in (5.3m) and both were 24ft 6in (7.5m) deep. Their rings were 14-inch (36cm) thick, but the exact profiles of their outer surfaces was uncertain.

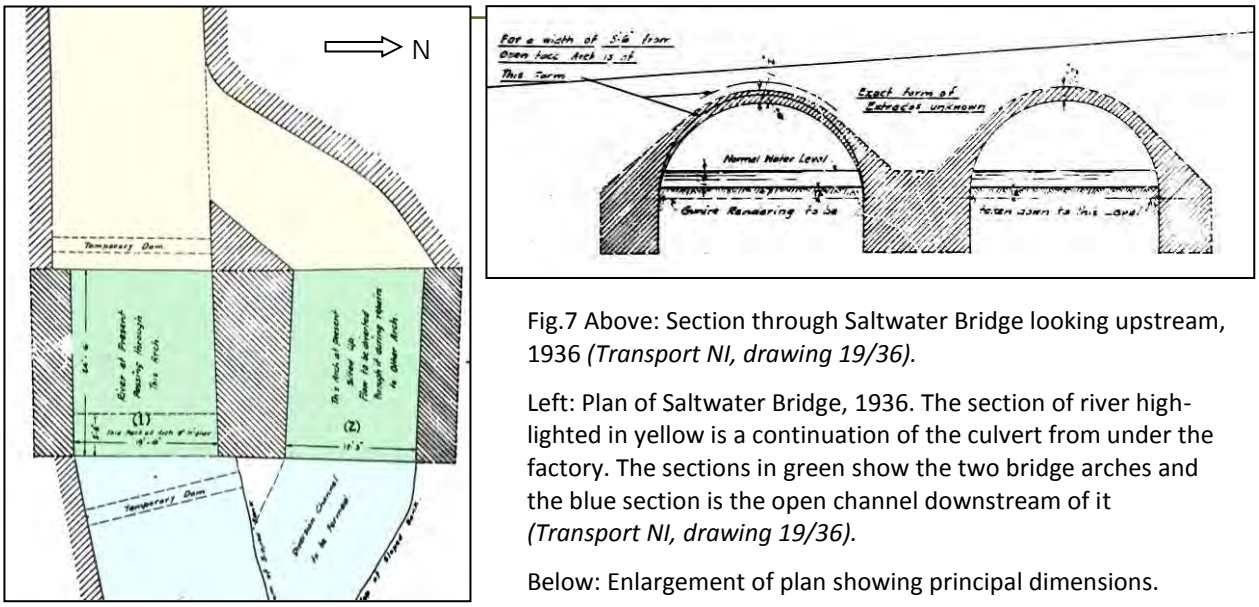
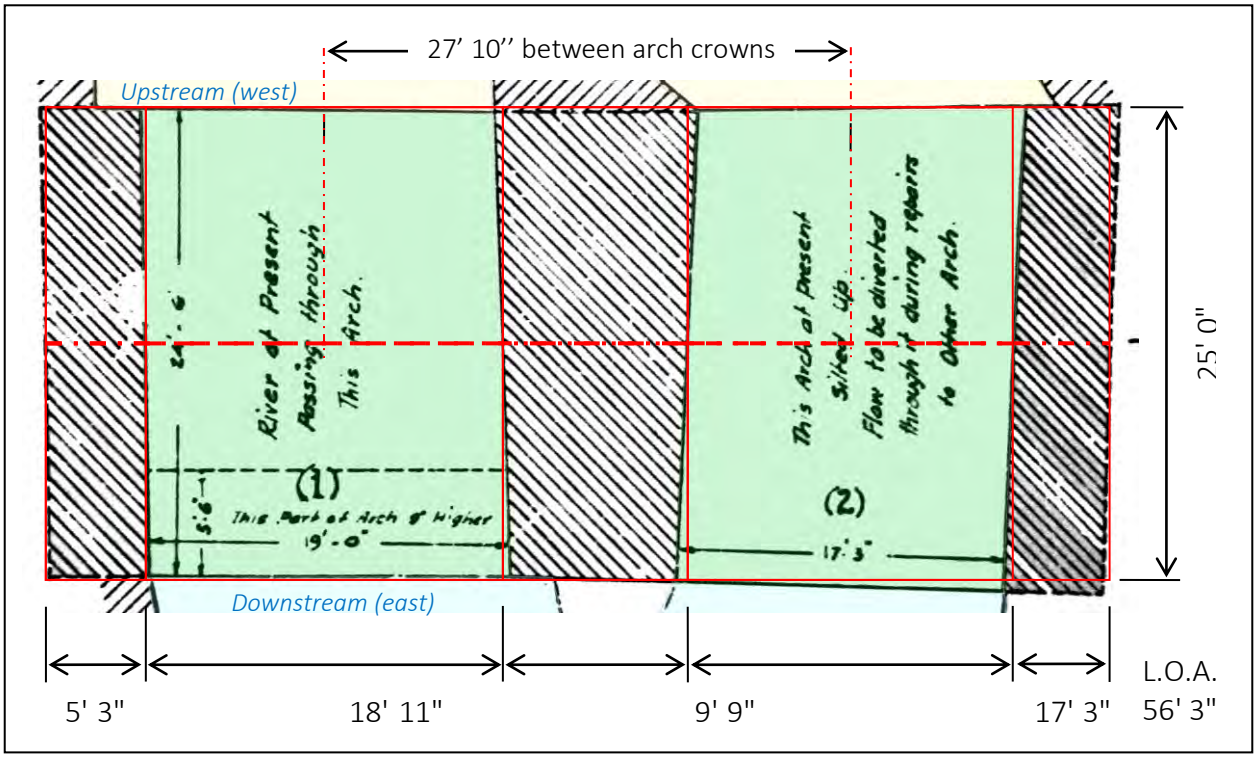


Fig.7 Above: Section through Saltwater Bridge looking upstream, 1936 *(Transport NI, drawing 19/36).*

Left: Plan of Saltwater Bridge, 1936. The section of river highlighted in yellow is a continuation of the culvert from under the factory. The sections in green show the two bridge arches and the blue section is the open channel downstream of it *(Transport NI, drawing 19/36).*

Below: Enlargement of plan showing principal dimensions.



To strengthen the bridge, the insides of the arches were pneumatically sprayed with gunite (a dry concrete mix of cement, sand and fine stones), steel reinforcing mesh embedded in it, and then more gunite applied, thus creating reinforced-concrete arches under the existing stone

Fig.8 Photograph of widened downstream elevation of Saltwater Bridge, 1936 *(Millin 1938).*

ones. The eastern face of the bridge was also widened with two reinforced-concrete beam-and-slab spans supported on concrete abutments and piers to give a straight run for the new 60ft wide Boyne Bridge (fig.8).

Figure 9 shows the position of the encapsulated Saltwater Bridge at the south end of the new Boyne Bridge. Because the new approach road was much wider than the previous one, the Saltwater Bridge is now offset to the west of, and at an angle to, the line of the new road.

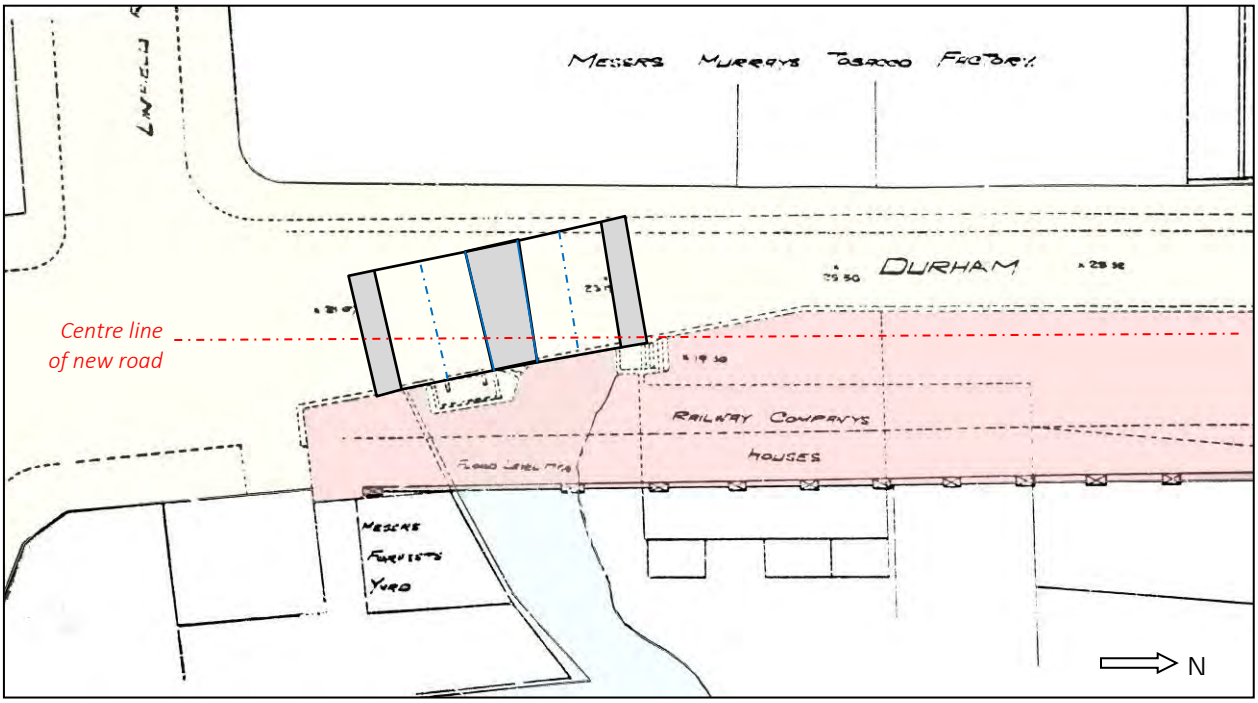
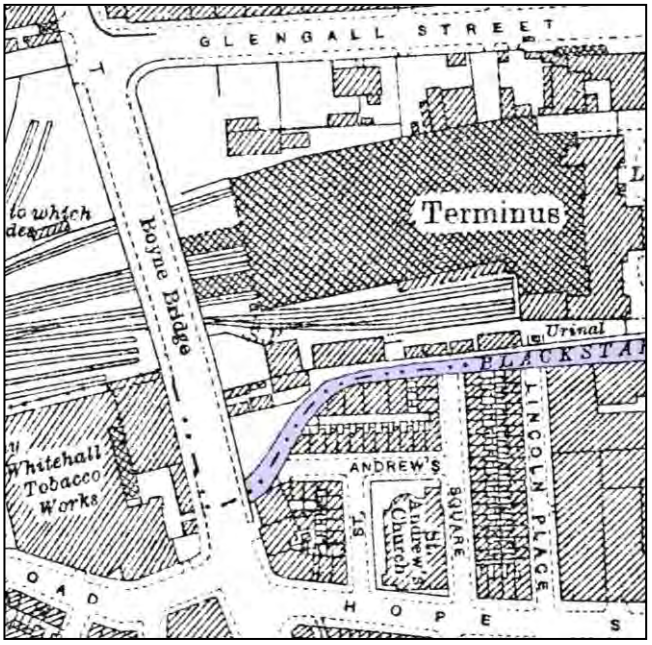


Fig.9 Saltwater Bridge superimposed over c.1936 plan of new Boyne Bridge. The bridge's abutments and piers are shaded in grey, the previous road in yellow and its widened section in pink (Transport NI, drawing 00/33).



The 1938 OS map shows the line of the new bridge (fig.10). West of the bridge, the Blackstaff remains culverted, but is still an open channel to the east.

Fig.10 1938 OS 25-inch map (not to scale) showing new wider bridge.

The last development in the history of the Saltwater Bridge was the diversion of the Blackstaff through two reinforced-concrete box culverts towards the northern end of the Boyne Bridge in 1990. Its original course under the Saltwater Bridge was thus bypassed and abandoned (fig.11).

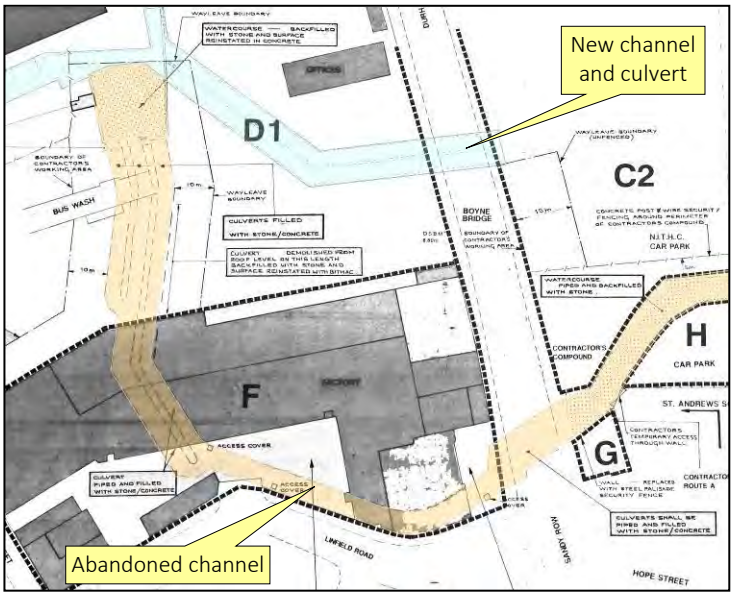


Fig.11 Diverted course of Blackstaff River (Transport NI, drawing 225-30-L100R).

5.3 CORING STRATEGY

The replacement of Great Victoria Street Railway Station and Europa Bus Centre with a new integrated transport hub to the west of the existing Boyne Bridge will do away with the need for a road-over-railway crossing between Sandy Row and Durham Street. Accordingly, the Boyne Bridge is to be demolished so that the two roads connect with one another on the level. However, from the above historical review, it would appear that the 17th century Saltwater Bridge still survives in an encapsulated state at the south end of the 1930s Boyne Bridge. The demolition works and levelling of the road will therefore potentially impact upon the earlier bridge.

In order to devise a mitigation strategy to minimise any negative impacts of these works, it is essential to quantify how deep the extradoses of the bridge's two arches are below the present road surface. The most straightforward method of ascertaining their positions is to drill a series of cores down though the road surface where the buried bridge is believed to exist so that its existence can be verified and its depth below the present road surface ascertained.

Armed with this information, it should then be possible to ascertain (1) whether the new road deck can be constructed as currently proposed without disturbing the Saltwater Bridge, (2) if the proposed new deck is too low, whether it could be raised slightly to avoid the old bridge, or (3) if it will be necessary to demolish the old bridge if the new deck cannot be raised to avoid it.

5.4 CORING METHODOLOGY

On the basis of the measured drawings of the Saltwater and Boyne Bridges from the 1930s onwards, it was possible to gauge its approximate position on a modern-day map. It was evident that the bridge lies mostly under the western half of the present road and also at an angle to the latter's alignment. From a practical point of view, however, the cores were taken along the line of the present road rather than along the longitudinal axis of the Saltwater Bridge. So that the cores would, in theory, hit the old bridge's abutments, pier and arch crowns, five cores would be necessary.

The carriageway hereabouts is divided into four lanes. The optimal traverse is along the west outer lane as this maximises the chances of the cores hitting their targets. To access this lane, the entire west half of the carriageway was closed to traffic and a two-way system set up along its east half. To ensure the drilling rig did not interfere with the live traffic, the line of the cores was marked out 80cm east of the white road strip between the 'west inner' and 'west outer' lanes. The concrete pier at the end of the Boyne Bridge's south parapet is a constant feature of all the overlaid maps and the cores' positions were set out from a baseline at right angles from the end of this pier (fig.12).

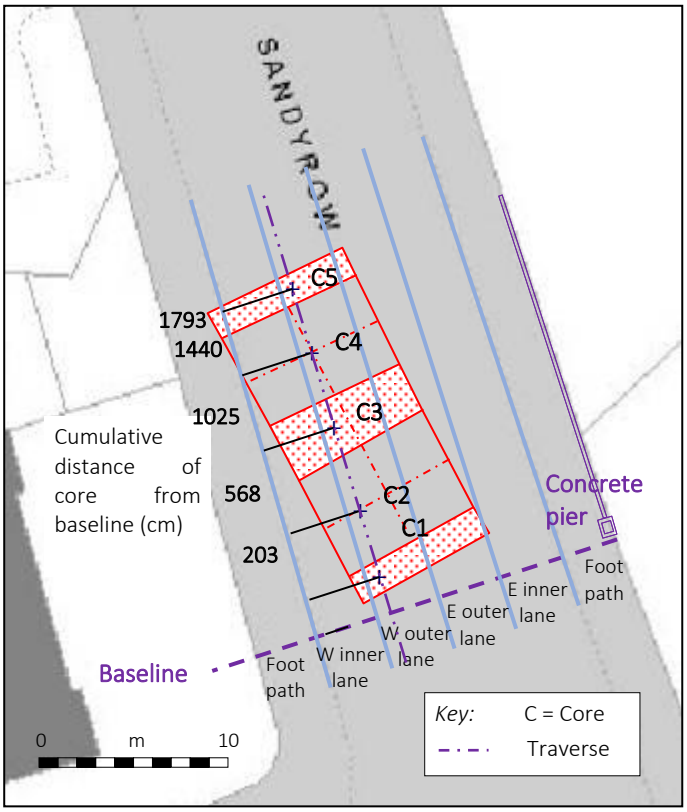


Fig.12 Marking out positions of cores along west outer lane.

The coring was carried out by Causeway Geotech Ltd over a three day period from 26th to 28th August 2019 (fig.13). At each location, the concrete road deck was removed to a depth of c.40cm using a hand-held 30cm diameter rotary corer. This was followed by a drilling rig which took 10cm diameter cores up to a maximum depth of 450cm. Each core was split up between several boxes, each of which was labelled and dispatched to Causeway Geotech's Ballymoney headquarters for detailed examination.

Fig.13 Coring procedures.
Far left: Boxed core.
Middle top: Surface coring.
Middle bottom: Deep coring.
Above: Making good core hole.

After the completion of drilling at each point, the holes were backfilled with clay and capped with quick-drying concrete and bitmac. Finally, the grid coordinates of all the points was determined by IAC using the OSGM15 Geoid model and TM75 Irish Grid zone (fig.14).

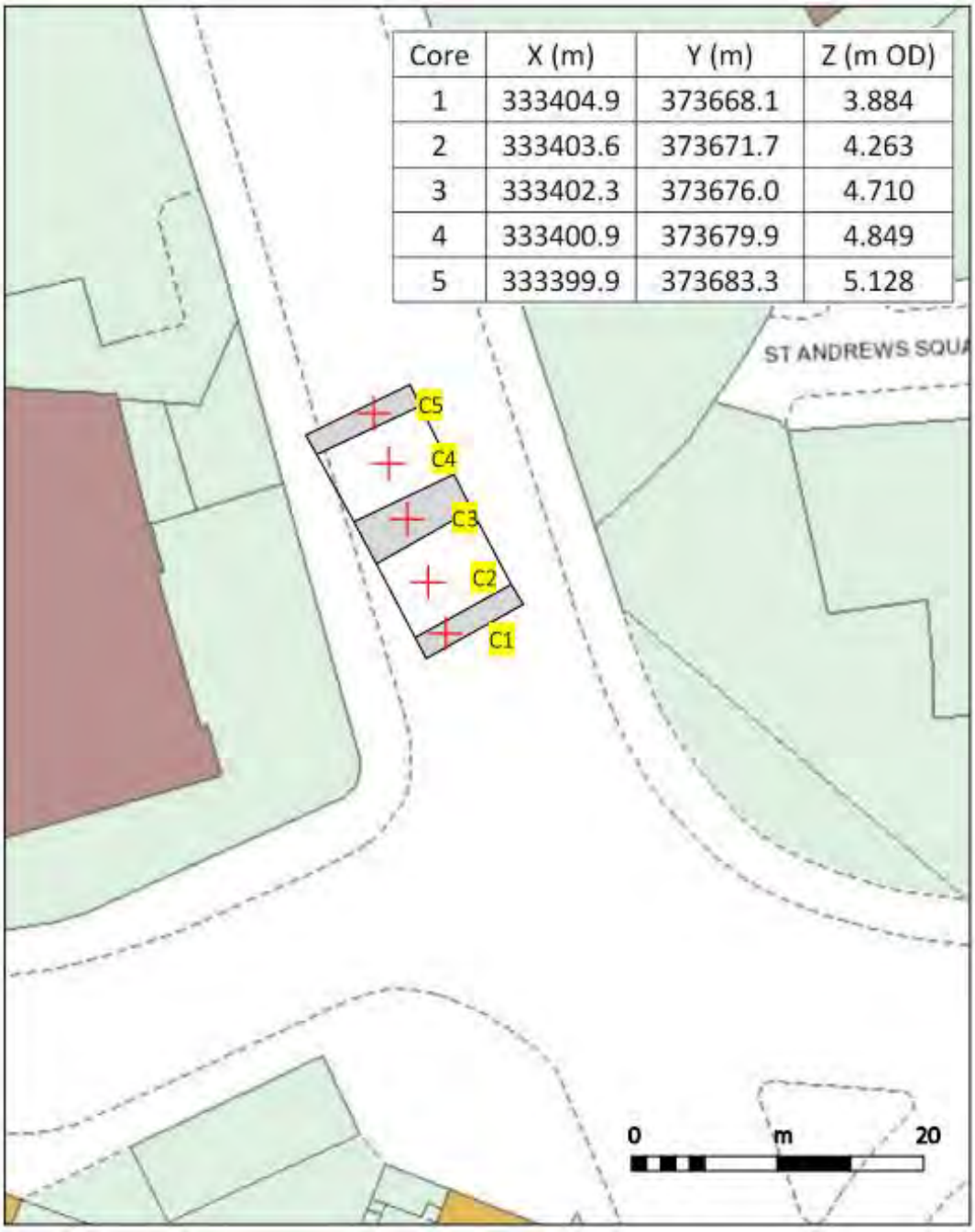


Fig.14 Irish Grid co-ordinates for the five core locations (courtesy IAC).

5.5 RESULTS

This chapter summarises the main findings of the coring with special reference to Saltwater Bridge. Additional photographs taken by the author are presented in Appendix 1. Causeway Geotech's detailed description of their coring procedure, core logs and photographs are reproduced in Appendix 2.

Topmost cores

A 30cm diameter x 40cm deep core was recovered from the surface layer at each location in preparation for the drilling rig. These cores revealed up to three layers of bitmac some 10-15cm in depth. Under this wearing surface was a 25-30cm thick layer of concrete in which two sub-layers were evident: a 5-10cm thick horizon of fine concrete on top of a 15-20cm thick layer of much coarser material. Cores 3 and 5 also contained pieces of 6mm square (¼ inch) steel reinforcing bar in this lower concrete horizon.

Interpretation

The coarser concrete horizon undoubtedly dates from the present Boyne Bridge's construction in the 1930s. The finer concrete layer on top of it is probably the deck's original wearing surface rather than a later addition. The bitmac layers reflects this surface's subsequent renewal from time to time up to the present day.

Fig.15 Basalt - gunite plug at bottom of core 1.

Core 1

Directly below the topmost core at this location is a layer of clay and gravel. Most of its finer material, mostly silt and sand, was flushed away in the water used to cool the drill bit. This resulted in a recovery rate of only c.45% for this layer.

Below this layer, at a depth of 180-295cm below the present-day road surface, was a 115cm thick solid layer of large basalt fragments firmly bound with gunite (fig.15). In contrast to the other cores, where washout created uncertainty as to the precise depth of each layer, one can be confident that this horizon of basalt was at the bottom end of the 3m core.

A second core was taken, between 300 and 450cm below the surface. In contrast to the first one, it contained looser material, much of which was missing; the recovery rate was only c.50%. What remained mostly comprised fragments of basalt and gunite. One of the latter pieces was 8cm thick and had a piece of steel embedded in its matrix. Its bottom surface was also steeply angled and appears to be a finished face. Several fragments of gunite were also recovered from the bottom of the second core.

Interpretation

The basalt towards the bottom of the same core is probably the south end of the south arch of the Saltwater Bridge. The steel bar embedded in the gunite in the second core is probably the reinforcing which was placed around the inside of the arch during the gunite's application. Moreover, this fragment's steeply angled outside face suggests that it probably came from the sloping inner surface (intrados) of the arch, probably near its junction with the top of the abutment. The overall thickness of this bridge fragment (i.e. basalt and gunite) is 170cm.

The low recovery rate from the second core suggests that it missed the abutment but, rather, continued through into the void underneath the arch. Whatever loose material was inside this void had mostly been washed away. The gunite found in this core possibly derives from a build-up on the bed of the channel as the arch was being sprayed.

Core 2

The upper part of the core comprised gravel and clay similar to that in core 1. Again, there was considerable wash-out of the finer material so it is difficult to ascertain its actual thickness. It overlays a layer of basalt fragments interspersed with gunite. Below it is a 10cm thick horizon of layered gunite and then uniform gunite down to a depth of 300cm (fig.16).

Fig.16 Gunite horizons at bottom of core 2.

The core between 300cm and 450cm depth had a recovery rate of only 30% and comprised loose fragments of gravel.

Interpretation

As anticipated, this core appears to have cut through the arch itself. The arch ring is c.60cm thick and is of basalt bound with gunite. Its intrados appears to have been sprayed with a 10cm thick layer of gunite. There is no evidence of any brickwork. It is difficult, however, to determine the exact depth of the arch due to the considerable wash-out in the made-up gravel and clay above.

The 75cm thick gunite layer below the intrados cannot be explained other than as a build-up on the bed of the channel whilst the arch was being sprayed. The 30% recovery rate in the 300-450cm core below the gunite suggests natural sediment from which most of the finer component had been washed out during coring.

Core 3

The recovery rate for the core below the road deck was only 27% and comprised mostly fragments of medium-sized gravel from which the finer material had evidently been washed out (fig.17). There were also some fragments of basalt with lime mortar attached, but their precise depths could not be ascertained due to the wash-out.

The second core, between 300cm and 450cm contained a 40cm thick lens of basalt but its precise depth is uncertain due to the wash-out of material from above and below it. As before, the low recovery rate indicates that the core had largely cut down through natural sand and gravel. Interestingly, no gunite whatsoever was observed.

Fig.17 Washed out gravel in core 3.

Interpretation

The relative paucity of basalt and absence of gunite at this location suggests that the core had probably cut through the fill of the pier between the arches rather than through solid masonry.

Core 4

As before, made-up ground comprising clay and gravel was encountered directly below the road deck. At the bottom of this layer was a small fragment of brick, followed by fragmentary basalt.

Fig.18 Steel bar *(circled)* embedded in gunite in core 4.

A second core, taken from 150cm to 300cm below the surface, contained a c.15cm thick layer of basalt at its top end. Below it was a c.15cm thick horizon of sprayed gunite containing at least one piece of steel bar (fig.18). Under this gunite was a 55cm layer of finer gunite, at the bottom end of which gravel fragments were embedded. Again, it is difficult to be sure as to the exact depths of these various layers.

There was zero recovery from a third core taken between 300cm and 450cm below the road surface.

Interpretation

The small piece of brick was much too small to have been other than a constituent of the material gathered up from elsewhere to build up the ground on which to place the concrete deck.

The c.35cm thick layer of basalt at the bottom of the first core and top of the second one was undoubtedly part of the north arch ring. Its intrados was evidently sprayed with a 15cm thick layer of gunite reinforced with steel bar. The fact that the layers are

angled rather than horizontal indicates the core did not run directly through the crown, but to one or other side of it.

The gunite under the arch probably built up as the arch was being sprayed. The gravel embedded at its bottom end is probably indicative of the bed of the channel.

The total absence of material in the third core indicates natural sediment, all of which was washed away during drilling.

Core 5

Although cored to a depth of 450cm, this location had the lowest recovery rate of the five cores. The upper part of the core mostly comprised gravel from which the finer sediments had been washed out. Some fragments of brick were recovered, but no significant quantities of basalt other than small fragments. Nothing was recovered in the core between 300 and 450cm deep.

Interpretation

It would appear that this core missed the north abutment of the north arch entirely. The pieces of brick were probably in the made-up ground laid around the bridge.

5.6 SALTWATER BRIDGE SURVIVAL

The presence of basalt interspersed with gunite in some of the cores suggests that the bridge is still extant under the present carriageway. Core 1 appears to have hit the arch ring of the south arch at its junction with the top of the south abutment. Cores 2 and 4 appear to have gone through the arches of the south and north arch respectively. Core 3 has probably cut through the middle of the pier between the arches, but core 5 has completely missed the north abutment of the north arch.

Less certain is the depth at which the bridge is buried. The recovery rate varied enormously between cores and also between the different layers within each core. A layer of solid basalt will have upwards of 100% recovery rate, whereas a horizon of fine silt and gravel could be up to 0% (i.e. no recovery). Different layers on top of one another will have different recovery rates, making it virtually impossible to determine their thicknesses and absolute depths with any degree of certainly.

The size and profile of the two arches was recorded in the 1936 drawings (fig.7 above). It should be noted that only the inside profiles of the two arches, the thicknesses of their crowns, the width of the pier between them, and bed level of the channel are depicted with certainty in these drawings. The widths and heights of the abutments and profile of the arches' outer surfaces are all conjectural. These profiles can then be superimposed on the five Causeway Geotech core profiles in order to gauge the depths of their crowns below the present road surface. There are three possible scenarios:

1. The soffit of the south arch is approximately aligned to the gunite in Core 1 and, at the same time, just misses its abutment (fig.19a)
2. The soffit of the south arch is aligned with the gunite in Core 2 (fig 19b).

3. The soffit of the north arch is aligned with the gunite in Core 4 (fig 19c).

It is then possible to determine the depth of the outsides of the arches below the existing road level as follows:

	South arch	North arch
Scenario 1	235 cm	310 cm
Scenario 2	175 cm	253 cm
Scenario 3	85 cm	160 cm

Given that each arch is probably of randomly-sized rather than regular squared basalt rubble and could be up to 60cm thick in places rather than the 36cm assumed in the 1936 drawing, the above depths are probably somewhat less in reality than those calculated here. But which of the above scenarios is the most likely?

As noted earlier, the depths of the gunite layers in cores 2 and 3 is very uncertain due to the loss of material above and below. The large plug of basalt in core 1 is probably at the correct depth in this core due to its solidity, so scenario 1 is probably the most likely of the three.

On the basis of the present evidence, it would thus appear that the depth of the south arch is probably somewhere between scenarios 1 and 2,ie between 1.75 and 2.35m below the present road deck. Moreover, the north arch will be c.75cm deeper than the south arch due to the rising slope of the road surface.

5.7 SALTWATER BRIDGE IN RELATION TO THE PROPOSED NEW ROAD

Figure 20 shows the position of the core locations in relation to the proposed new road alignment. It is not completely level along its longitudinal section as it has to rise over the existing Blackstaff Culvert towards the north end of the Boyne Bridge.

Figures supplied by Arup indicated that the new deck will be 32cm above its present level at core point 1, and 3cm below it at point 5. Note that because of the camber of the existing deck, these figures may vary slightly across the width of both the existing and proposed decks, but probably not significantly.

Even in the worst-case scenario (3) discussed above, the extrados of the south arch will be over 1m below the existing road, and that of the north arch 1.60m deep.

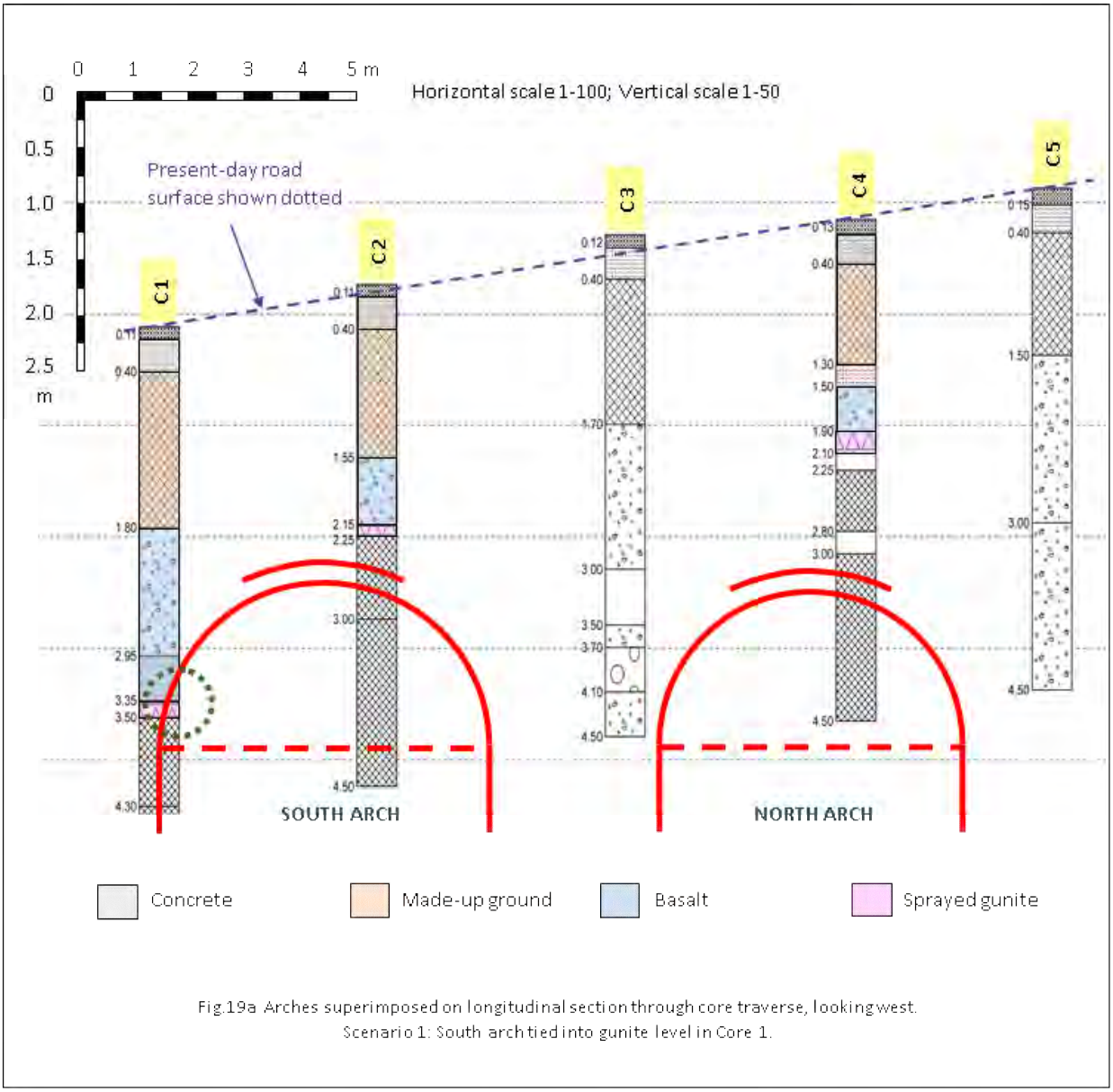


Fig.19a Arches superimposed on longitudinal section through core traverse, looking west.
Scenario 1: South arch tied into gunite level in Core 1.

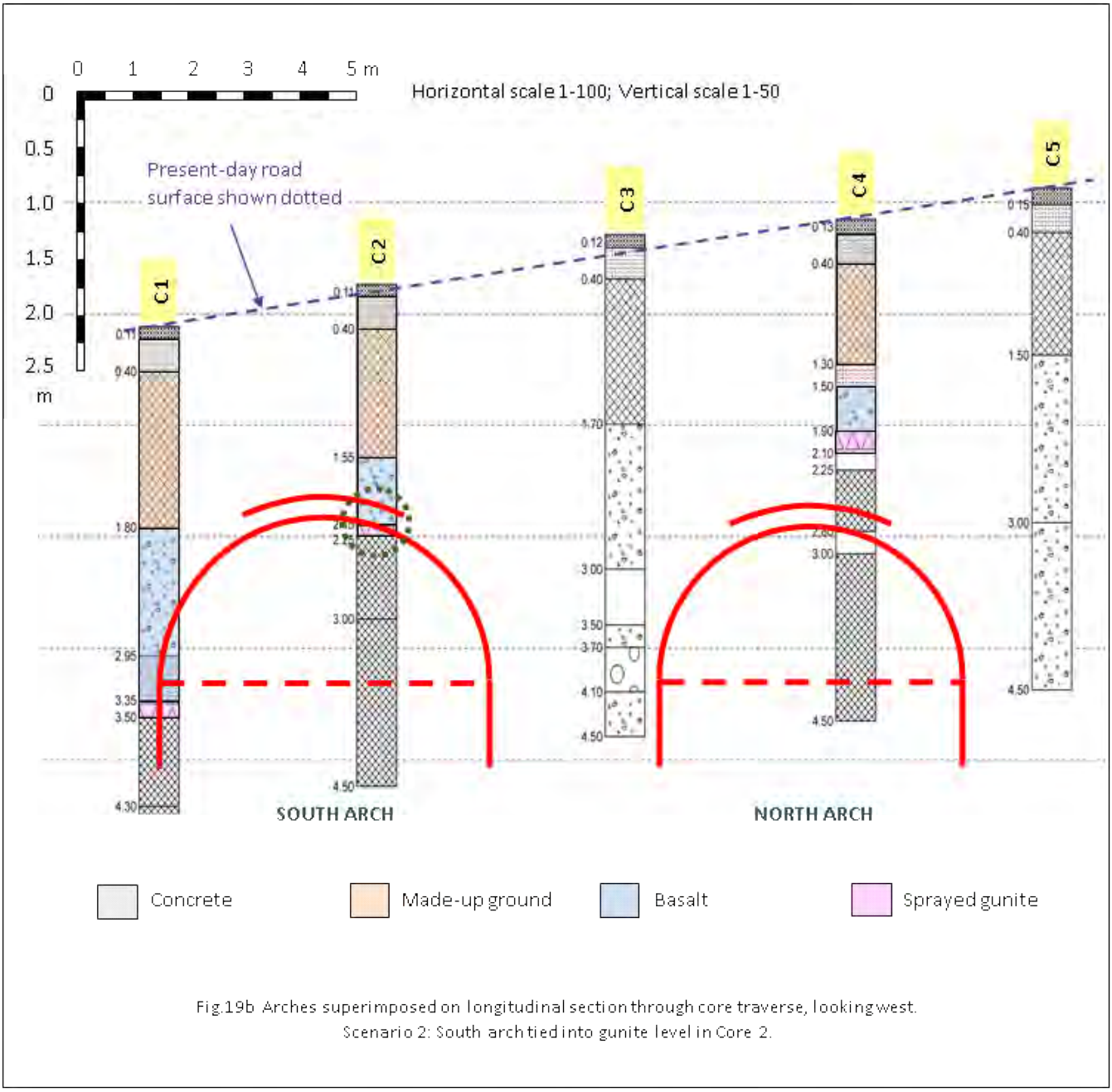


Fig.19b Arches superimposed on longitudinal section through core traverse, looking west.
Scenario 2: South arch tied into gunite level in Core 2.

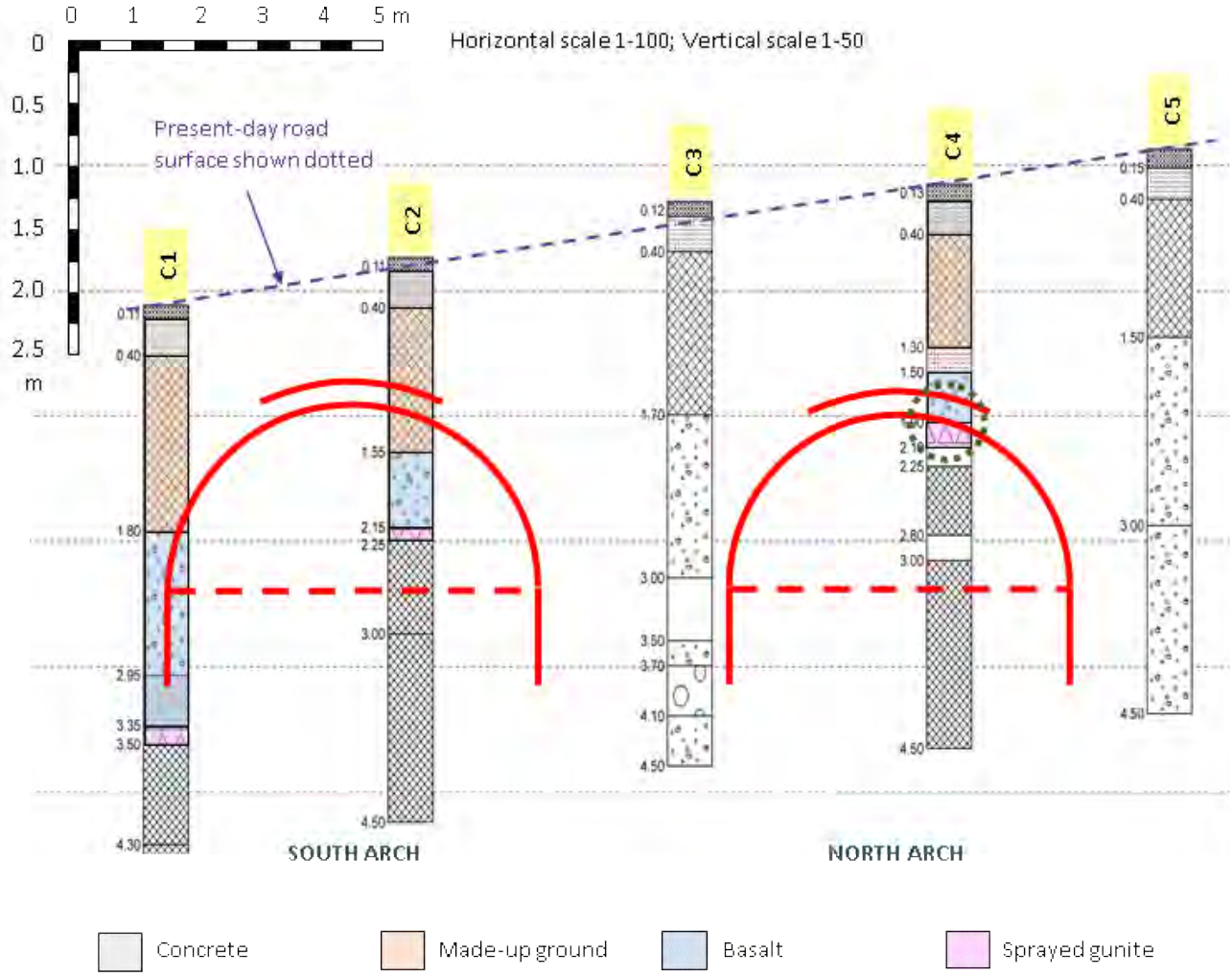
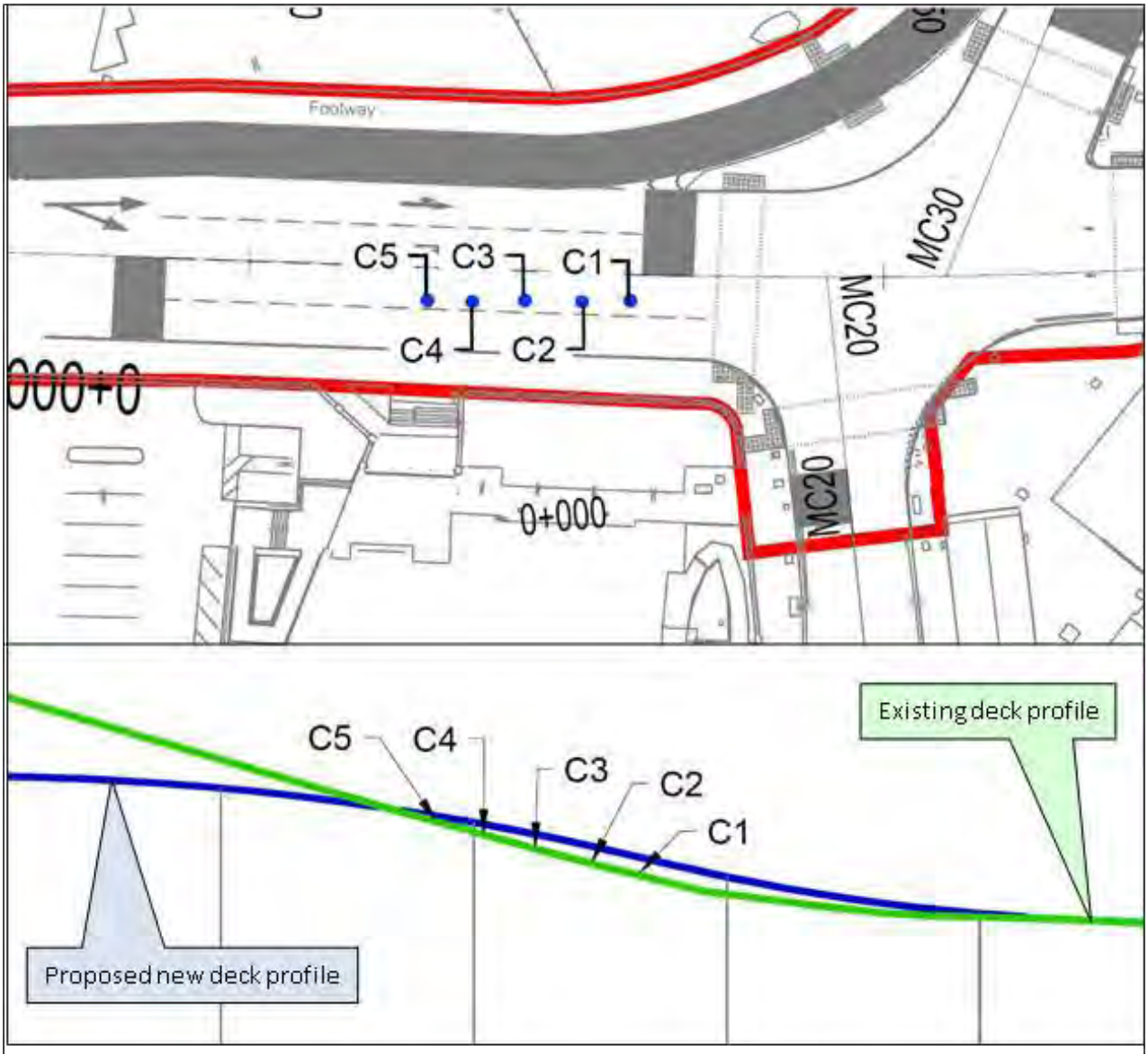


Fig.19c Arches superimposed on longitudinal section through core traverse, looking west.
Scenario 3: North arch tied into gunite level in Core 4.



Core	Height of new deck relative to existing deck (m)
1	+0.321
2	+0.268
3	+0.179
4	+0.073
5	-0.033

Fig.20 Comparison of existing and proposed new road decks based on Arup drawing C0423-ARP-XX-W8-DR-CH-0004 (28/11/2019).

Top: Proposed new road alignment with core locations superimposed.

Middle: Sections through existing and proposed decks at core points.

Left: Relative heights of new deck compared with existing deck levels.

5.8 CONCLUSIONS

The coring confirms the presence of the Saltwater Bridge under the present road. Its precise depth is uncertain but the south arch is probably at a depth of between 1.5 and 2.5m below the present-day road surface at a point approximately mid-way between cores 1 and 2.

Based on the available evidence and levels of the proposed new deck in relation to the present one, it would appear that the Saltwater Bridge can be wholly incorporated within the new road without raising the proposed new road deck.

Having said that, it cannot be emphasised too strongly that great care should be exercised to mitigate any negative impacts which may potentially arise during demolition and reconstruction, for example through vehicle overloading and vibrations. Archaeological monitoring of this end of the Boyne Bridge is strongly recommended to ensure that the Saltwater Bridge remains intact.

APPENDIX 1: PHOTOGRAPHS

Taken on 26 - 28 August: Cores 1, 2 and 4 by Fred Hamond and cores 3 and 5 by Christina O'Regan (IAC).

101-102	Core 1: Deck plug.
103-105	Drilling core 1.
106-107	Infilling of hole after drilling.
111-117	Core 1.1 (0.4 - 3.0m).
121-129	Core 1.2 (3.0 - 4.5m). Note the steel bar in the gunite in photos 125-127.
201-205	Core 2: Deck plug.
206-207	Drilling core 2.
208	Infilling of hole after drilling.
211-219	Core 2.1 (0.4 - 3.0m).
221-228	Core 2.2 (3.0 - 4.5m).
301-302	Core 3: Deck plug.
303	Drilling core 3.
311-312	Core 3.1 (0.4 - 3.0m).
313-314	Core 3.1: Fragments recovered.
321-324	Core 3.2 (3.0 - 4.5m).
401-404	Core 4: Deck plug. Note traces of steel reinforcing bar in photos 403 and 404.
405	Drilling core 4.
411-418	Core 4.1 (0.4 - 1.5m).

421-429	Core 4.2 (1.5 - 3.0m).
501	Core 5: Deck plug.
511-513	Core 5.1 (0.4 - 3.0m).
514	Core 5: Brick fragments.
515	Core 5: Brick-flecked grit.
521	Core 5.2 (3.0 - 4.5m): Empty core tube.

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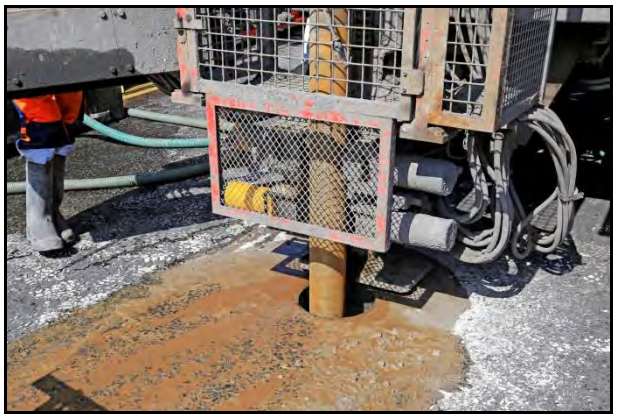

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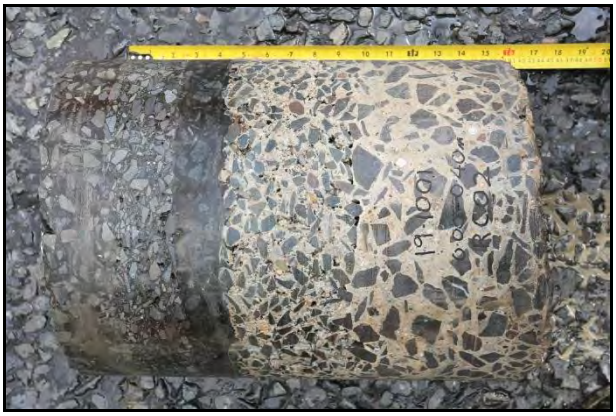

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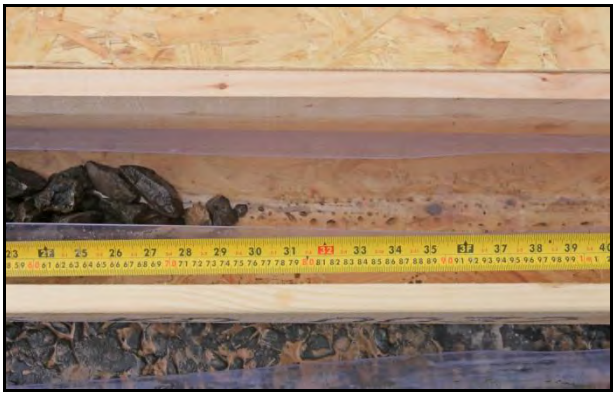

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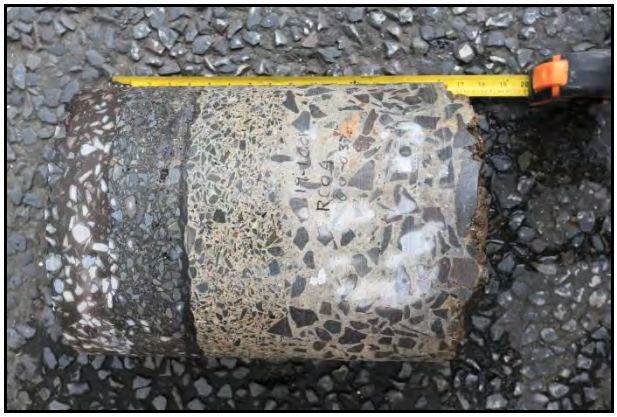

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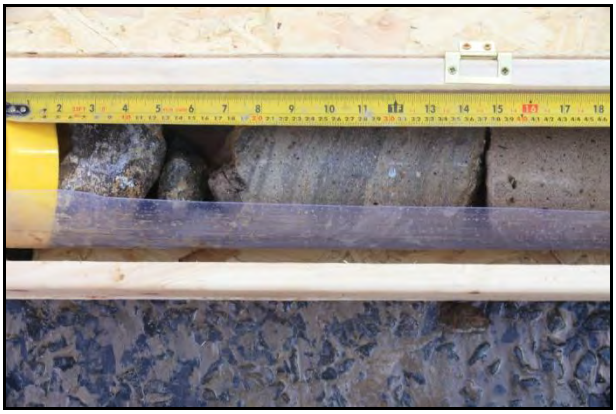

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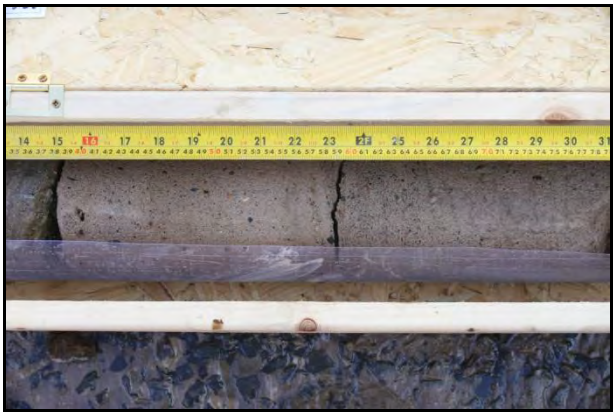

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6 IMPACT ASSESSMENT AND MITIGATION STRATEGY

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological resources potentially affected. Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping; disturbance by vehicles working in unsuitable conditions; and burial of sites, limiting access for future archaeological investigation.

6.1 IMPACT ASSESSMENT

- The remains of a foundation trench, brick deposits, a brick drain and a stone wall have been uncovered within the development area. These features likely date to the late 18th/early 19th century, and may overlie earlier structural remains.
- There may be an adverse impact on additional previously unrecorded archaeological feature or deposits that have the potential to survive beneath the current ground level. This will be caused by ground disturbances associated with the proposed development.
- Coring of the Boyne Bridge has determined the approximate depth of the Saltwater Bridge beneath the current road deck level.
- There may be an adverse impact on the Saltwater Bridge caused by the reprofiling of the Boyne Bridge during the development.

6.2 MITIGATION

We recommend the following actions in mitigation of the impacts above.

- It is recommended that invasive ground disturbances (not including rotary drilling for piles) in the northern section of the development area are subject to archaeological monitoring. This is to identify any further structural remains associated with Brick hall or Rose Lodge which may exist below the current ground surface. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation *in-situ* or by record. Any further mitigation will require approval from the Historic Environment Division.
- It is recommended that all invasive works associated with the re-profiling of the Boyne Bridge, in the vicinity of the Saltwater Bridge, are subject to archaeological monitoring. This is to identify and record any remnants of the Saltwater Bridge which may be exposed during the works.

It is the developer's responsibility to ensure full provision is made available for the resolution of any archaeological remains, both on site and during the post excavation process, should that be deemed the appropriate manner in which to proceed.

Please note that all recommendations are subject to approval by the Historic Environment Division, Department for Communities

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www.googleearth.com – Aerial photographs of the development area.

APPENDICES

APPENDIX 1 CONTEXTS

CONTEXT NO.	TRENCH NO.	DESCRIPTION
1	–	Topsoil - Tarmac
2	–	Hardcore
3	–	Concrete
4	–	Light grey silty clay subsoil
5	–	General rubble
6	1	Cut for possible foundation trench
7	3	Possible sandstone wall
8	7	Red brick wall with granite square sets at base
9	7	Red brick wall
10	7	Red brick wall
11	7	Red brick wall
12	7	Red brick wall with slate damp proof course
13	7	Red brick wall
14	3	Red brick drain

APPENDIX 2 SMR SITES WITHIN THE SURROUNDING AREA

SMR NO.:	ANT061:012
PROTECTION:	N/A
TOWNLAND:	Town Parks
PARISH:	Shankill
BARONY:	Belfast Upper
I.N.G.:	333292,374275
CLASSIFICATION:	Fortification
DIST. TO SITE:	513m northeast
DESCRIPTION:	Designated 'barracks' on a map reprinted in U.J.A. in 1857 and reported by Bigger. The site is now occupied by a school.
REFERENCE:	NISMR

SMR NO.:	ANT061:009
PROTECTION:	N/A
TOWNLAND:	Woodvale Ward
PARISH:	Shankill
BARONY:	Belfast Upper
I.N.G.:	332998,374499
CLASSIFICATION:	Horizontal Mill
DIST. TO SITE:	731m north
DESCRIPTION:	The exact location of this horizontal mill cannot be determined as the site has been built over. It was reported as a 'wooden house' found in 1867 and embedded in a boulder-clay drift in a brick field on the west side of Dover Street.
REFERENCE:	NISMR

SMR NO.:	ANT060:502
PROTECTION:	Scheduled
TOWNLAND:	Edenderry
PARISH:	Shankill
BARONY:	Belfast Upper
I.N.G.:	332208,374175
CLASSIFICATION:	Chimney Stack
DIST. TO SITE:	984m northwest
DESCRIPTION:	Set centrally in a flax spinning complex, this is an octagonal chimney, tapering towards the top with metal strapping at regular intervals close to the top.
REFERENCE:	NISMR

APPENDIX 3 LEGISLATION PROTECTING THE ARCHAEOLOGICAL RESOURCE

Historic Monuments

The Historic Monuments and Archaeological Objects (NI) Order 1995 is one of the primary pieces of legislation used to protect the built heritage of Northern Ireland. Article 13 of the Order makes it possible to protect monuments by taking them into the ownership or guardianship of the Department, for the purpose of securing their protection and providing public access.

Article 3 of the Order allows for the scheduling of monuments for protection. These monuments remain in their existing ownership, but the Department of Communties can control works through Scheduled Monument consent; help to look after sites through Management Agreements or pursue prosecution where damage has been caused.

The Order also requires the licensing and regulation of excavations on archaeological sites under Article 41. There is also an obligation under Article 42 of the Order for finders of archaeological objects to report these to a relevant authority.

The Historic Monuments Council was established under Article 22 of the Historic Monuments and Archaeological Objects (NI) Order 1995. This body advises the Department on the exercise of its powers under the Order.

Over 14,000 archaeological sites and monuments are currently recorded in Northern Ireland but the actual number of sites which may exist is unknown. Many others undoubtedly exist and will continue to be found as a result of archaeological work and by discoveries made during development or as a result of agricultural activity.

Archaeological sites and monuments may be taken into the care of the Department or scheduled for protection under the Historic Monuments and Archaeological Objects (NI) Order 1995. The fact that a site has not yet received statutory protection does not necessarily diminish its archaeological importance nor its significance as an element in the historic landscape. Any site identified in the NISMR is defined as a site of archaeological interest in the Planning (General Development) Order (NI) 1993.

Historic Buildings

Article 42 of The Planning (NI) Order 1991 places a duty on the Department of the Environment (DoE) to compile lists of buildings of special architectural or historic interest. The order gives the Department powers to influence change to these structures through Listed Building Consent, grant aid and enforcement against unauthorized works.

The listing criterion has been reviewed and new guidance is proposed. Current policy is set out in Annex C of Planning Policy Statement 6 (March 1999). The new proposals are intended to clear up the current process rather than change it.
Two important issues that the new proposals look at are:

1. The criteria letters indicated on listing reports.
2. How the historic interest of structures is valued.

The test for assessing whether a building should be listed or not will remain the same because the legislation is not being changed.

To be listed a building must be of 'special architectural or historic interest'. Buildings of lesser interest which do not make this grade cannot be protected in this way.

Defence Heritage Record

To date over 500 sites have been recorded, although coverage is not yet complete. Inclusion within this record does not necessarily entitle the site to statutory protection, but the most appropriate form of protection is identified on an individual site basis. A number of sites have been Scheduled for protection under the Historic Monuments and Archaeological Objects (NI) Order 1995 whilst other sites have been Listed for protection under the Planning (NI) Order 1991. The Department of Communities: HED also work with the Planning Service to ensure defence heritage sites are given due consideration when dealing with new development applications. It should be noted that the survey is not yet considered to be complete.

Industrial Heritage Record

The Industrial Heritage Record lists more than 16,000 features, but only limited information is currently available for most. Inclusion within this record does not necessarily entitle the site to statutory protection, but the most appropriate form of protection is identified on an individual site basis. A number of sites have been Scheduled for protection under the Historic Monuments and Archaeological Objects (NI) Order 1995 whilst other sites have been Listed for protection under the Planning (NI) Order 1991.

The Register of Historic Parks, Gardens and Demesnes

This record has been established to identify those sites that can be considered of exceptional importance within Northern Ireland. Inclusion is based upon a clear set of criteria, as listed in the Register and 154 sites have been selected to date. A further 150 sites have been identified as having a high level of interest and are included as an appendix to the main Register as designated 'Supplementary' sites. Inclusion in the Register affords these sites protection through Planning Policy Statement 6 (PPS6) which specifies that historic parks and gardens included within the register should be considered in the determination of planning consent. This is further reinforced when a park or garden forms the setting of a building that has been listed for protection under the Planning (NI) Order 1991.

THE PLANNING ACT (NI) 2011 AND BELFAST METROPOLITAN AREA PLAN 2015

Development Area plans are also drawn up for each area. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning Act 2011 recognises that proper planning and sustainable development includes the protection of the architectural heritage. The

Belfast Metropolitan Area Plan 2015 sets policies and objectives for Archaeology and Built Heritage in the developing environment. This will be superseded by the Belfast Local Development Plan (currently at draft stage).

APPENDIX 4 IMPACT ASSESSMENT & THE CULTURAL HERITAGE RESOURCE

POTENTIAL IMPACTS ON ARCHAEOLOGICAL AND HISTORICAL REMAINS

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2003: 31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.

- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.

- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.

- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.

- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.

- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.

- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

PREDICTED IMPACTS

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;
- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;
- Assessment of the levels of noise, visual and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

APPENDIX 5 MITIGATION MEASURES & THE CULTURAL HERITAGE RESOURCE

POTENTIAL MITIGATION STRATEGIES FOR CULTURAL HERITAGE REMAINS

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved *in situ*.

DEFINITION OF MITIGATION STRATEGIES

ARCHAEOLOGICAL RESOURCE

The ideal mitigation for all archaeological sites is preservation *in situ*. This is not always a practical solution, however. Therefore, a series of recommendations are offered to provide ameliorative measures where avoidance and preservation *in situ* are not possible.

Full Archaeological Excavation involves the scientific removal and recording of all archaeological features, deposits and objects to the level of geological strata or the base level of any given development. Full archaeological excavation is recommended where initial investigation has uncovered evidence of archaeologically significant material or structures and where avoidance of the site is not possible (CIfA 2014b).

Archaeological Test Trenching can be defined as 'a limited programme... of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land or underwater. If such archaeological remains are present test trenching defines their character and extent and relative quality' (CIfA 2014a).

Archaeological Monitoring can be defined as a 'formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons within a specified area or site on land or underwater, where there is possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive' (CIfA 2014c).

APPENDIX 6 CAUSEWAY GEOTECH REPORT

CAUSEWAY GEOTECH

HEAD OFFICE
Causeway Geotech Ltd
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Company Number: NI610766

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Registered in Ireland.
Company Number: 633786

www.causewaygeotech.com

Translink
Milewater Service Centre
Belfast
BT3 9BJ

Project:	**19-1042**
Site	**Saltwater Bridge Archaeological Coring**
Report Date	**21st November 2019**
Prepared by	**Carin Cornwall**

Introduction

At the request of Translink, ground investigation works were carried out between 26th and 28th August 2019 to verify the existence and location of the 17th century Saltwater Bridge beneath Durham Street, Belfast and ensure its preservation during future Belfast Transport Hub redevelopment works. The works consisted of five road cores with follow-on coring through man made strata put down by rotary coring methods.

The site location plan and rotary cored exploratory hole plan are presented in Appendix A.

Road Cores

Five cores (RC01 to RC05) were carried out at specified locations as directed by the Client's Representative along Durham Street, Belfast. The road cores were taken in 300mm diameter using hand-held diamond-tipped coring equipment; follow-on rotary coring was then carried out using a Beretta T44 tracked drilling rig.

Photographs of the road cores, together with a log of the material encountered, are presented in Appendix C.

Boreholes

Five boreholes (RC01-RC05) were put to completion by rotary coring techniques using a Beretta T44 rotary drilling rig.

Geobor S Coring was used through made ground and the existing Saltwater Bridge structure; core recovery rates through imported granular (gravel) fill material were low; this is considered normal given the nature of the material encountered. The core was extracted in up to 1.5m lengths using a SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with BS 5930: 2015: Code of practice for ground investigations.

Appendix B presents the borehole logs, with rotary core photographs presented in Appendix C.

Summary of Findings

RC01: Top of Saltwater Bridge structure encountered at approximately 1.80mbgl (2.08mOD), with a section of Gunite injected basalt beneath. This borehole recovered a section of the steel mesh reinforced sprayed gunite lining of the existing Saltwater Bridge southern archway. The steep angle of the face of the sprayed gunite would suggest we are close to the southern abutment structure. Imported void fill was found below the existing structure to the base of the borehole.

RC02: Top of the Saltwater Bridge structure encountered at approximately 1.55mbgl (2.71mOD); straight into the gunite injected basalt. Again, this borehole recovered a section of the steel mesh reinforced sprayed gunite lining of the southern archway; due to the low angle of the sprayed gunite face we can be confident we are close to the centre of the southern archway. Similar void fill encountered as in RC01 beneath the existing arch to the base of the borehole.

RC03: Top of the Saltwater Bridge structure encountered at approximately 1.70mbgl (3.01mOD); this was targeted at the central abutment of the existing structure. The core indicates the central abutment persisted to termination depth of the borehole; absence of injected gunite noted in this borehole suggests the central abutment was wide enough that the gunite did not penetrate to the centre of the structure.

RC04: Top of the Saltwater Bridge structure encountered at approximately 1.30mbgl (3.55mOD) in the form of a suspected old road/bridge surface. Immediately below this we have the basalt structure of the bridge; no injected gunite observed at this location. We do encounter the steel mesh reinforced sprayed gunite lining; again, the face is at a shallow angle suggesting we are near the centre of the northern archway. As with the southern archway we see void fill material beneath the arch extending to the base of the borehole.

RC05: Top of the Saltwater Bridge structure encountered at approximately 1.50mbgl (3.63mOD); this location was targeted at the northern abutment structure. As with the central abutment, no injected gunite was found. The material at the core of the northern abutment seems to be whatever material they had available at the time of the original Saltwater Bridge construction; sand, gravels, cobbles and fragments of red brick all found to be present in this borehole.

Long Sections

Two schematic long sections showing south to north traverses of the five boreholes are presented in Appendix D. The first is a clean section with no interpretation. The second has the existing road levels, proposed finished road level, and annotations based on the findings as interpreted from the recovered core. It should be noted, this is based on all available information to Causeway Geotech at the time of reporting. The proposed road level only accounts for finished road surface level; this does not take into account any proposed excavation of existing carriageway/bridge deck to facilitate the new infrastructure.

The findings of this investigation indicate the smallest offset from the top of the existing Saltwater Bridge structure occur in the location of RC04. An excavation depth of 1300mm below existing road level at this location would encroach on the top of the Saltwater Bridge structure.

REFERENCES

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

CAUSEWAY GEOTECH

Project No.:	19-1042	**Client:**	Translink
Project Name:	Saltwater Bridge Archaeological Coring	**Client's Representative:**	

Legend Key

Title:

Site Location Plan

Last Revised:	**Scale:**
16/10/2019	1:8500

CAUSEWAY GEOTECH

Project No.:	19-1042	**Client:**	Translink
Project Name:	Saltwater Bridge Archaeological Coring	**Client's Representative:**	

Legend Key

Locations By Type - RC

Title:

Exploratory Hole Location Plan

Last Revised:	**Scale:**
16/10/2019	1:500

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.:	Project Name:	Borehole No.:
19-1042	Saltwater Bridge Archaeological Coring	RC01
Coordinates:	**Client:**	Sheet 1 of 1
333404.85 E	Translink	
373668.06 N	**Client's Representative:**	**Scale:** 1:25
Ground Level:	**Date(s):**	**Driller:** GT
3.88 mOD	26/08/2019 - 26/08/2019	**Logger:** CC

Method	Plant Used	Top	Base
Geobor S	Beretta T44	0.00	4.50

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						3.77	(0.11) 0.11		MADE GROUND: Strong black BITMAC with 40-85% angular aggregate of fine gravel. [EXISTING CARRIAGEWAY SURFACING]		
	40						(0.29)		MADE GROUND: Strong white CONCRETE with 65-75% angular aggregate of fine to medium gravel (low recovery). [EXISTING BRIDGE DECK]		
0.40						3.48	0.40		MADE GROUND: Brown sandy subangular fine to coarse GRAVEL with low cobble content and pockets of firm clay. Sand is fine to coarse. Cobbles are subangular (low recovery - approximate depths). [MODERN FILL MATERIAL]		
							(1.40)				
	50					2.08	1.80		BRIDGE STRUCTURE: Black subangular COBBLES of basalt in a matrix of brownish white coarsely crushed concrete (GUNITE) - (low recovery - approximate depths). [START OF SOUTHERN ABUTMENT STRUCTURE] *At 2.00m: driller noted loss of flush - possible void*		
							(1.15)				
3.00						0.93	2.95		BRIDGE STRUCTURE: Weak light grey GUNITE with 60-80% aggregate of fine angular gravel with many cobbles of black basalt (low recovery - approximate depths). [CONTINUATION OF SOUTHERN ABUTMENT STRUCTURE]		
							(0.40)				
						0.53	3.35		BRIDGE STRUCTURE: Sprayed GUNITE lining with 10mm wire mesh visible [INSIDE FACE OF GUNITE REINFORCED SOUTHERN ARCH]		
						0.38	(0.15) 3.50		MADE GROUND: Black angular fine to coarse GRAVEL of basalt. [VOID FILL]		
	50						(0.80)				
						-0.42	4.30		MADE GROUND: Grey CONCRETE with 30-40% aggregate of fine angular gravel. [VOID FILL]		
							(0.20)				
4.50						-0.62	4.50		End of Borehole at 4.50m		
	TCR	SCR	RQD	FI							

Remarks

Core completed to assess depth to southern abutment

Terminated on instruction of Archaeologist

Casing Details		Water Strikes			
To (m)	Diam (mm)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Core Barrel	Flush Type
SK6L	Polymer

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Geobor S	Beretta T44	0.00	4.50

Project No.: 19-1042

Project Name: Saltwater Bridge Archaeological Coring

Borehole No.: RC02

Coordinates: 333403.57 E, 373671.75 N

Client: Translink

Sheet 1 of 1

Client's Representative:

Scale: 1:25

Driller: GT

Ground Level: 4.26 mOD

Date(s): 27/08/2019 - 27/08/2019

Logger: CC

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						4.15	(0.11) 0.11		MADE GROUND: Strong black BITMAC with 40-85% angular aggregate of fine gravel. [EXISTING CARRIAGEWAY SURFACING]		
	100						(0.29)		MADE GROUND: Strong white CONCRETE with 65-75% aggregate of fine to medium gravel. [EXISTING BRIDGE DECK]		
0.40						3.86	0.40		MADE GROUND: Brown sandy subangular fine to coarse GRAVEL with medium cobble content and pockets of clay. Sand is fine to coarse . Cobbles are subangular (low recovery - approximate depths). [MODERN FILL MATERIAL]		
							(1.15)				
						2.71	1.55		BRIDGE STRUCTURE: Black angular COBBLES and BOULDERS of basalt in a matrix of brownish white coarsely crushed concrete (GUNITE). [START OF SOUTHERN BRIDGE ARCH STRUCTURE]		
	57						(0.60)		*At 1.80m: driller noted loss of flush - possible void*		
						2.11	2.15 (0.10)		BRIDGE STRUCTURE: Sprayed GUNITE lining with 10mm wire mesh visible [INSIDE FACE OF GUNITE REINFORCED SOUTHERN ARCH]		
						2.01	2.25		MADE GROUND: Medium strong light grey fine CONCRETE with 30-40% aggregate of fine angular gravel. [VOID FILL]		
							(0.75)				
3.00						1.26	3.00		MADE GROUND: Black angular fine to coarse GRAVEL of basalt. [VOID FILL]		
	30						(1.50)				
4.50						-0.24	4.50		End of Borehole at 4.50m		
	TCR	SCR	RQD	FI							

Remarks

Core completed to assess depth to southern arch

Terminated on instruction of Archaeologist

Casing Details		Water Strikes			
To (m)	Diam (mm)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Core Barrel: SK6L

Flush Type: Polymer

CAUSEWAY GEOTECH

Project No.:	Project Name:	Borehole No.:
19-1042	Saltwater Bridge Archaeological Coring	RC03
Coordinates: 333402.25 E 373676.01 N	**Client:** Translink	Sheet 1 of 1
	Client's Representative:	**Scale:** 1:25
Ground Level: 4.71 mOD	**Date(s):** 27/08/2019 - 27/08/2019	**Driller:** GT
		Logger: CC

Method	Plant Used	Top	Base
Geobor S	Beretta T44	0.00	4.50

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
						4.59	(0.12) 0.12		MADE GROUND: Strong black BITMAC with 40-85% angular aggregate of fine gravel. [EXISTING CARRIAGEWAY SURFACING]		
	100						(0.28)		MADE GROUND: Strong white CONCRETE with 65-75% aggregate of fine to medium gravel. [EXISTING BRIDGE DECK]		
0.40						4.31	0.40		MADE GROUND: Brown sandy subangular fine to coarse GRAVEL with pockets of clay. Sand is fine to coarse. (no recovery - approximate depths). [MODERN FILL MATERIAL]		
							(1.30)				
	27					3.01	1.70		BRIDGE STRUCTURE: Light grey and brown sandy subangular fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subangular (low recovery - approximate depths). Absence of GUNITE noted in this section. [START OF CENTRAL ABUTMENT STRUCTURE]		
							(1.30)				
3.00						1.71	3.00		BRIDGE STRUCTURE: Possible VOID or Potential Zone of Core Loss. [POSSIBLE WEAK FILL MATERIAL IN CORE OF CENTRAL ABUTMENT STRUCTURE]		
							(0.50)				
						1.21	3.50		BRIDGE STRUCTURE: Black and brownish white angular to subangular fine to coarse GRAVEL of basalt and coarsely crushed concrete matrix (low recovery - approximate depth). Absence of GUNITE noted in this section. [CONTINUATION OF CENTRAL ABUTMENT STRUCTURE]		
							(0.20)				
	53					1.01	3.70		BRIDGE STRUCTURE: Medium strong dark grey BASALT (low recovery - approximate depths). Absence of GUNITE noted in this section. [CONTINUATION OF CENTRAL ABUTMENT STRUCTURE]		
							(0.40)				
						0.61	4.10		BRIDGE STRUCTURE: Black angular fine to coarse GRAVEL of basalt (low recovery - approximate depths). Absence of GUNITE noted in this section. [CONTINUATION OF CENTRAL ABUTMENT STRUCTURE]		
							(0.40)				
4.50						0.21	4.50		End of Borehole at 4.50m		

TCR	SCR	RQD	FI

Remarks

Core completed to assess depth to central abutment

Terminated on instruction of Archaeologist

Casing Details		Water Strikes			
To (m)	Diam (mm)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Core Barrel	Flush Type
SK6L	Polymer

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Geobor S	Beretta T44	0.00	4.50

Project No.: 19-1042

Project Name: Saltwater Bridge Archaeological Coring

Borehole No.: RC04

Coordinates: 333400.92 E, 373679.93 N

Client: Translink

Sheet 1 of 1

Client's Representative:

Scale: 1:25

Driller: GT

Ground Level: 4.85 mOD

Date(s): 28/08/2019 - 28/08/2019

Logger: CC

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						4.85	(0.13)		
	100					4.72	0.13		MADE GROUND: Strong black BITMAC with 30-85% of angular aggregate of fine gravel. [EXISTING CARRIAGEWAY SURFACING]
							(0.27)		MADE GROUND: Strong white CONCRETE with 65-75% aggregate of fin to medium gravel. [EXISTING BRIDGE DECK]
0.40						4.45	0.40		MADE GROUND: Light grey and brown sandy subangular fine to coarse GRAVEL with low cobble content, pockets of clay and fragments of red brick. Sand is fine to coarse. Cobbles are subangular (low recovery - approximate depths). [MODERN FILL MATERIAL]
	54						(0.90)		
						3.55	1.30		BRIDGE STRUCTURE: Grey CONCRETE (low recovery - approximate depths). [START OF NORTHERN BRIDGE STRUCTURE - POSSIBLE OLD SURFACE]
1.50						3.35	(0.20) 1.50		BRIDGE STRUCTURE: Black angular fine to coarse GRAVEL of basalt (low recovery - approximate depths). Absence of GUNITE noted in this section. [CONTINUATION OF NORTHERN BRIDGE ARCH STRUCTURE]
							(0.40)		
						2.95	1.90		BRIDGE STRUCTURE: Sprayed GUNITE lining with 10mm wire mesh visible [INSIDE FACE OF GUNITE REINFORCED NORTHERN ARCH]
						2.75	(0.20) 2.10		VOID: Interpreted as void directly beneath the northern arch structure. *At 2.10m: driller noted loss of flush - possible void*
	60					2.60	(0.15) 2.25		MADE GROUND: Medium strong light grey fine CONCRETE with 30-40% aggregate of fine angular gravel. [VOID FILL]
							(0.55)		
						2.05	2.80		Possible VOID or Potential Zone of Core Loss. [VOID FILL]
3.00						1.85	(0.20) 3.00		MADE GROUND: Grey sandy subangular fine to coarse GRAVEL. Sand is fine to coarse. (No recovery) [VOID FILL]
	0						(1.50)		
4.50						0.35	4.50		End of Borehole at 4.50m

Depth (m)	TCR	SCR	RQD	FI

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Remarks

Core completed to assess depth to northern arch

Terminated on instruction of Archaeologist

Casing Details		Water Strikes			
To (m)	Diam (mm)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Core Barrel: SK6L

Flush Type: Polymer

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Geobor S	Beretta T44	0.00	4.50

Project No.: 19-1042

Project Name: Saltwater Bridge Archaeological Coring

Borehole No.: RC05

Coordinates: 333399.88 E, 373683.28 N

Client: Translink

Sheet 1 of 1

Client's Representative:

Scale: 1:25

Driller: GT

Ground Level: 5.13 mOD

Date(s): 28/08/2019 - 28/08/2019

Logger: CC

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
							(0.15)		MADE GROUND: Strong black BITMAC with 40-50% angular aggregate of fine gravel.		
	100					4.98	0.15		[EXISTING CARRIAGEWAY SURFACING]		
							(0.25)		MADE GROUND: Strong white CONCRETE with 65-75% angular aggregate of fine to medium gravel.		
0.40						4.73	0.40		[EXISTING BRIDGE DECK]		
							(1.10)		MADE GROUND: Grey sandy subangular fine to coarse GRAVEL with low cobble content and fragments of red brick. Sand is fine to coarse. Cobbles are subangular (low recovery - approximate depths). Suspected that clay material found in this strata in the other boreholes has been "washed away" by the rotary coring process. [MODERN FILL MATERIAL]		
	15					3.63	1.50		BRIDGE STRUCTURE: Light grey and brown sandy subangular fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subangular (low recovery - approximate depths). Absence of GUNITE noted in this section. [START OF NORTHERN ABUTMENT STRUCTURE]		
							(1.50)		*At 2.50m: driller noted loss of flush - possible void*		
3.00						2.13	3.00		BRIDGE STRUCTURE: Reddish brown fine to coarse SAND and fragments of red brick. (No recovery) [POSSIBLE WEAK FILL MATERIAL IN CORE OF NORTHERN ABUTMENT STRUCTURE]		
	0						(1.50)				
4.50						0.63	4.50		End of Borehole at 4.50m		

TCR	SCR	RQD	FI

Remarks

Core completed to assess depth to northern abutment

Terminated on instruction of Archaeologist

Casing Details		Water Strikes			
To (m)	Diam (mm)	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Core Barrel

Flush Type

Polymer

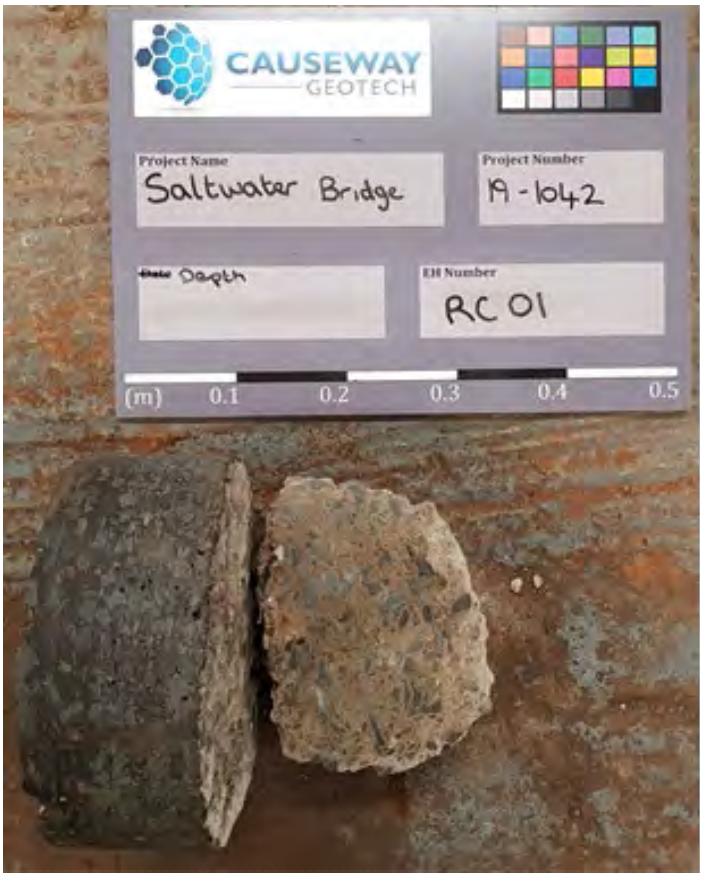
CAUSEWAY GEOTECH

APPENDIX C

ROAD CORE AND ROTARY CORE PHOTOGRAPHS

Road Core -RC01

Layer	Depth (mm)	Thickness (mm)	Description
1	0 – 45	45	Strong dark bluish grey and black BITMAC with coated chippings and high binder content. 40-50% subangular 1-13mm aggregate with <1% small voids. Positive textured surface.
2	45 – 110	65	Strong dark bluish grey and black BITMAC with low binder content. 75-85% subangular 0-10mm aggregate with 2% small to medium voids.
3	110 – 290	180	Strong dark grey and light brown CEMENT with high binder content. 40-50% subangular 1-13mm aggregate with 1% small voids.



RC01 Box 1 – 0.40 - 3.00m

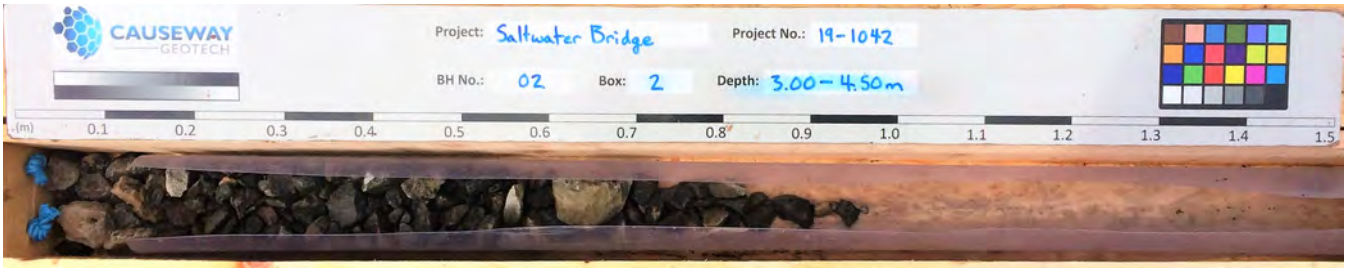
RC01 Box 2 – 3.00 - 4.50m

CAUSEWAY GEOTECH

Road Core -RC02

Layer	Depth (mm)	Thickness (mm)	Description
1	0 – 45	45	Strong dark bluish grey and black BITMAC with coated chippings and medium binder content. 65-75% subangular 1-13mm aggregate with no voids. Positive textured surface.
2	45 – 110	65	Strong dark bluish grey and black BITMAC with low binder content. 75-85% subangular 0-12mm aggregate with 5% small to large voids.
3	110 – 145	35	Strong very dark grey and black BITMAC with high binder content. 40-50% subangular 1-15mm aggregate with no voids.
4	145 – 250	105	Strong very dark grey and light brown CEMENT with medium binder content. 65-75% subangular 0-15mm aggregate with 15% small to large voids.
5	250 – 400	150	Strong very dark grey to light brown CEMENT with high binder content. 40-50% subangular 0-25mm aggregate with 1% small to medium voids.

RC02 Box 1 – 0.40 - 3.00m



RC02 Box 2 – 3.00 - 4.50m

Road Core -RC03

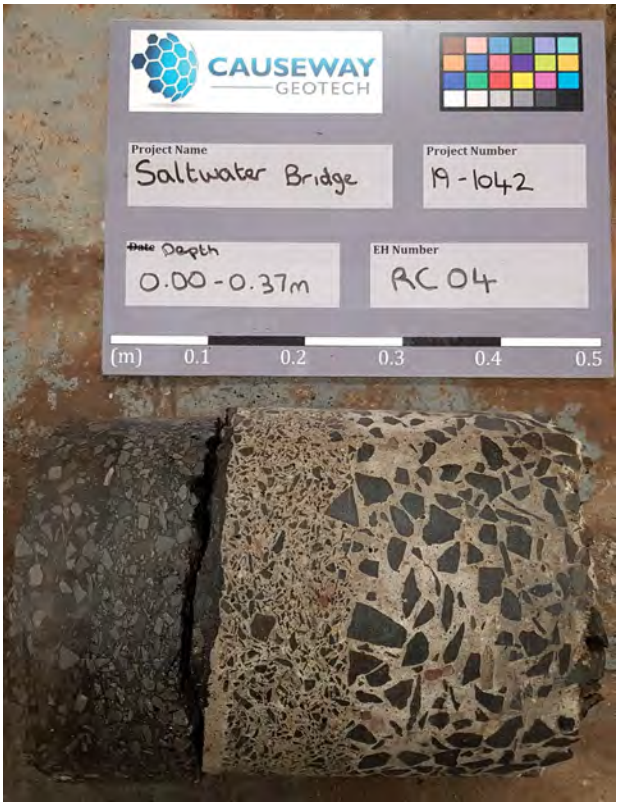
Layer	Depth (mm)	Thickness (mm)	Description
1	0 – 55	55	Strong dark bluish grey and black BITMAC with coated chippings and high binder content. 40-50% subangular 1-14mm aggregate with no voids. Positive textured surface.
2	55 – 123	68	Strong dark bluish grey and black BITMAC with low binder content. 75-85% subangular 0-10mm aggregate with 10% small to large voids.
3	123 – 140	17	Strong very dark grey and black BITMAC with high binder content. 40-50% subangular 1-11mm aggregate with no voids.
4	140 – 195	55	Strong very dark grey and light brown CEMENT with medium binder content. 65-75% subangular 0-12mm aggregate with 5% small to large voids.
5	195 – 400	205	Strong very dark grey and light brown CEMENT with high binder content. 40-50% subangular 1-25mm aggregate with 1% small to medium voids.

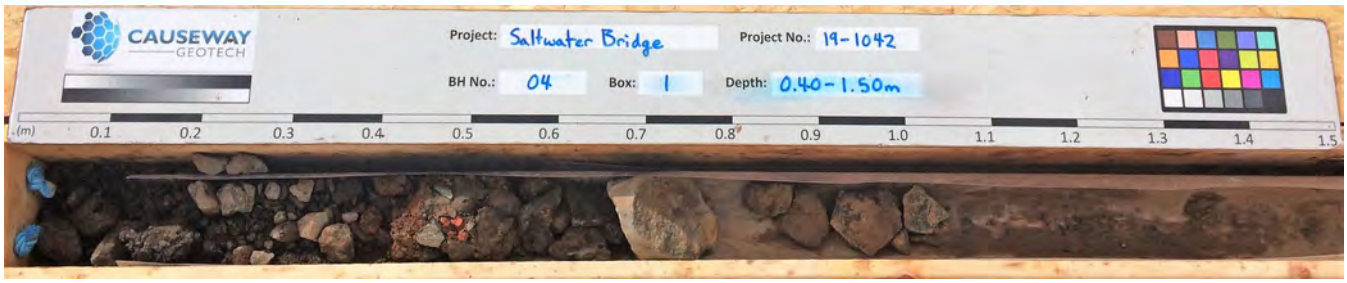
RC03 Box 1 – 0.40 - 3.00m

RC03 Box 1 – 3.00 - 4.50m

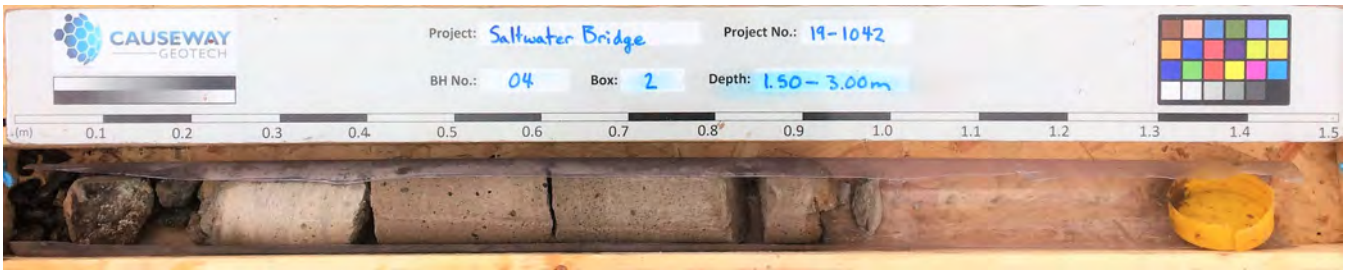
Road Core RC04

Layer	Depth (mm)	Thickness (mm)	Description
1	0 – 60	60	Strong dark bluish grey and black BITMAC with coated chippings and high binder content. 40-50% subangular 1-17mm aggregate with no voids. Positive textured surface.
2	60 – 130	70	Strong dark bluish grey and black BITMAC with low binder content. 75-85% subangular 0-10mm aggregate with 2% small to large voids.
3	130 – 220	90	Strong very dark grey and light brown CEMENT with medium binder content. 65-75% subangular 0-10mm aggregate with 5% small voids.
4	220 – 400	180	Strong very dark grey and light brown CEMENT with high binder content. 40-50% subangular 1-22mm aggregate with 1% small to medium voids.





RC04 Box 1 – 0.40 - 1.50m



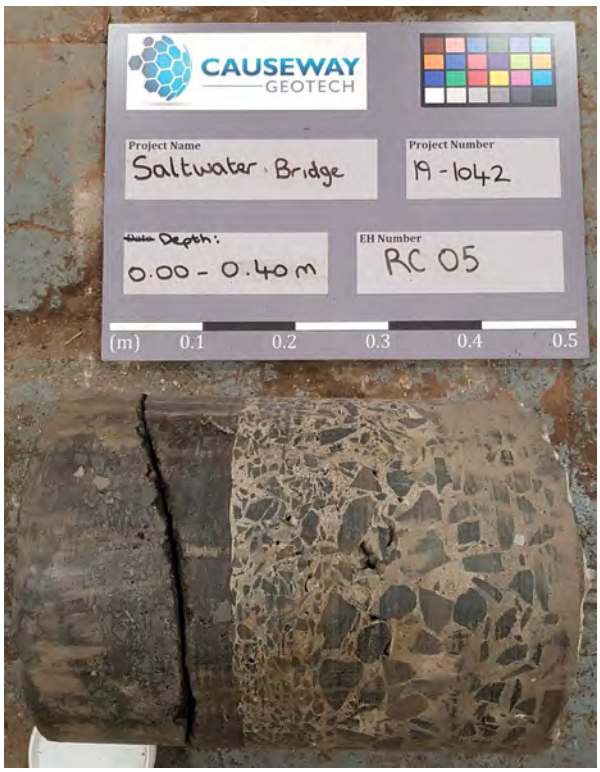
RC04 Box 2 – 1.50 - 3.00m

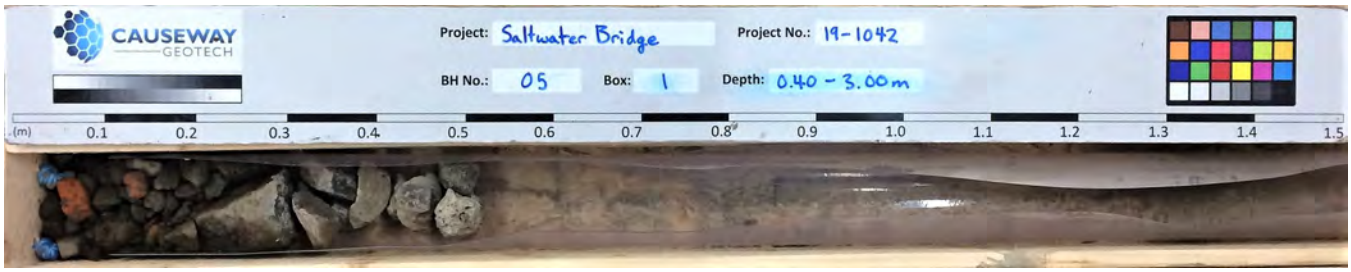
NO RECOVERY (Sands & Gravels)

RC04 Core Run 3 – 3.00 - 4.50m

Road Core RC05

Layer	Depth (mm)	Thickness (mm)	Description
1	0 – 50	50	Strong dark bluish grey and black BITMAC with coated chippings and high binder content. 40-50% subangular 1-15mm aggregate with no voids. Positive textured surface.
2	50 – 110	60	Strong dark bluish grey and black BITMAC with low binder content. 75-85% subangular 0-9mm aggregate with 2% small voids.
3	110 – 150	40	Strong very dark grey and black BITMAC with high binder content. 40-50% subangular 3-15mm aggregate with 1% small voids.
4	150 – 210	60	Strong very dark grey and light brown CEMENT with low binder content. 75-85% subangular 0-10mm aggregate with 5% small to large voids.
5	210 – 400	190	Strong very dark grey and light brown CEMENT with high binder content. 40-50% subangular 1-28mm aggregate with 10% small to large voids.





RC05 Box 1 – 0.40 - 3.00m

NO RECOVERY (Sand & Red brick)

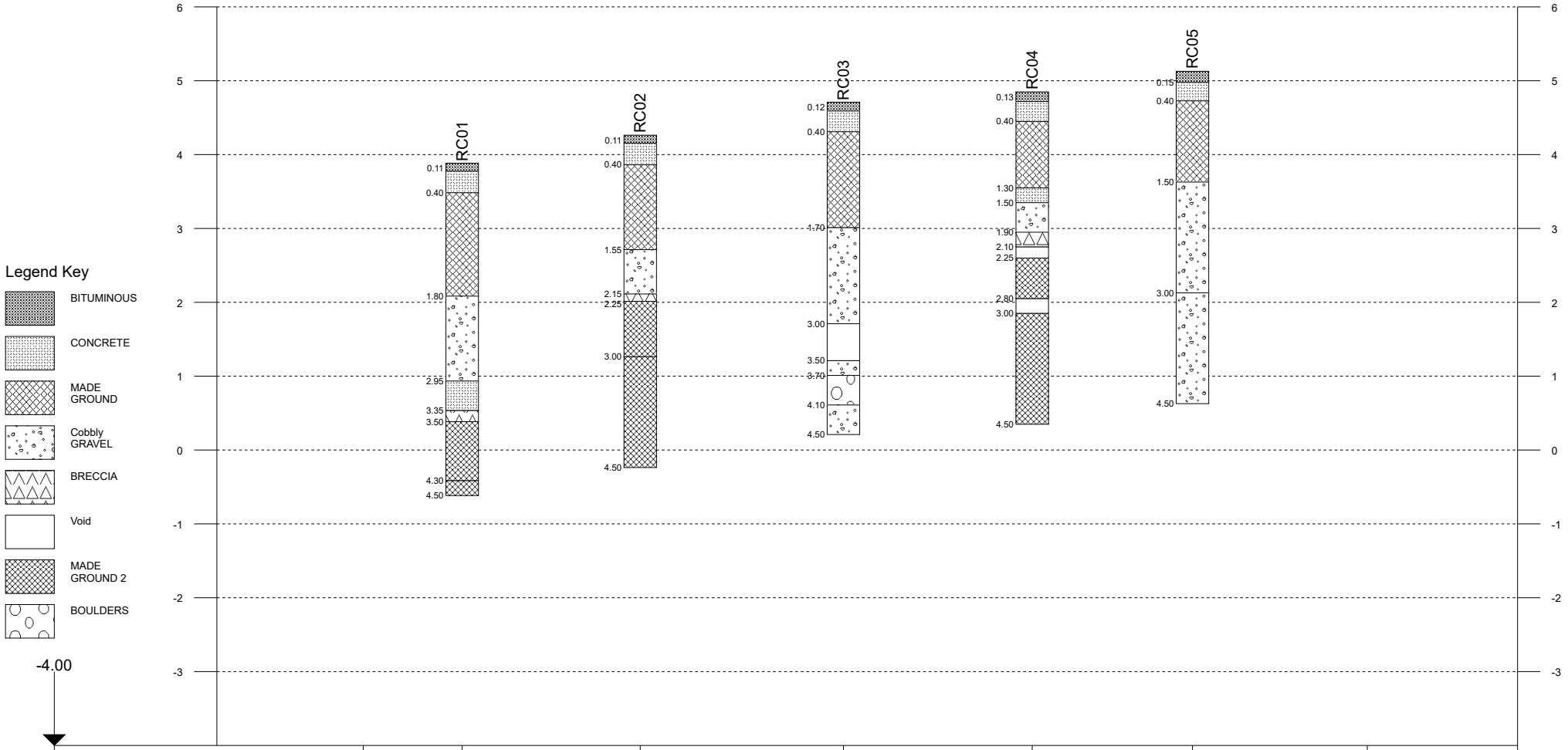
RC05 Core Run 2 – 3.00 - 4.50m

CAUSEWAY GEOTECH

APPENDIX D

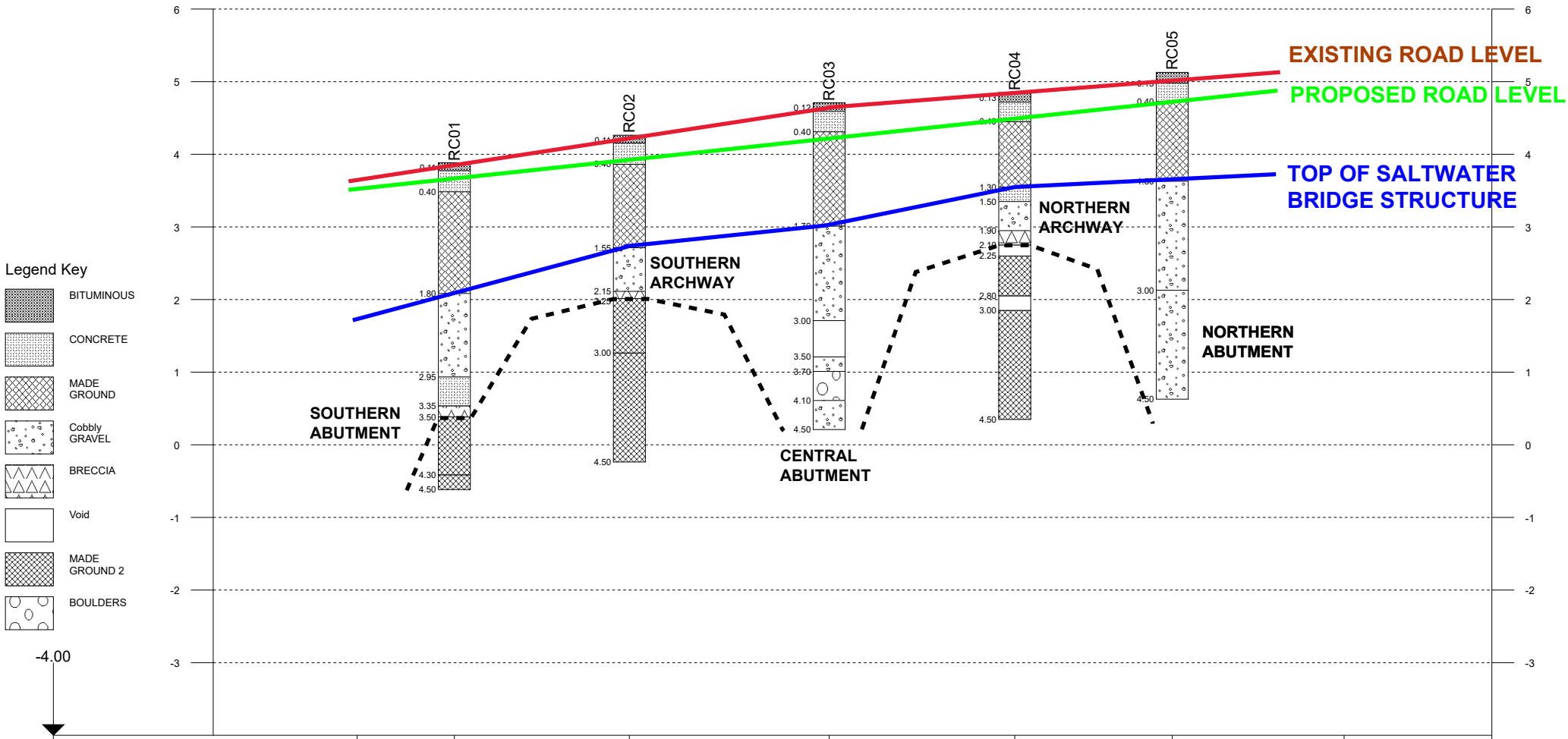
SCHEMATIC LONG SECTIONS

Project Id: 19-1042	Title: Section line 1
Project Title: Saltwater Bridge Archaeological Coring	Vertical Scale: 1:79
Location:	Horizontal Scale: 1:128
Client: Translink	Engineer:



Chainage (m)	0.00	2.17	6.07	10.53	14.67	18.18	22.01
Offset (m)	0.13	0.06	0.13	0.09	0.15		
Elevation (mAOD)	3.88	4.26	4.71	4.85	5.13		

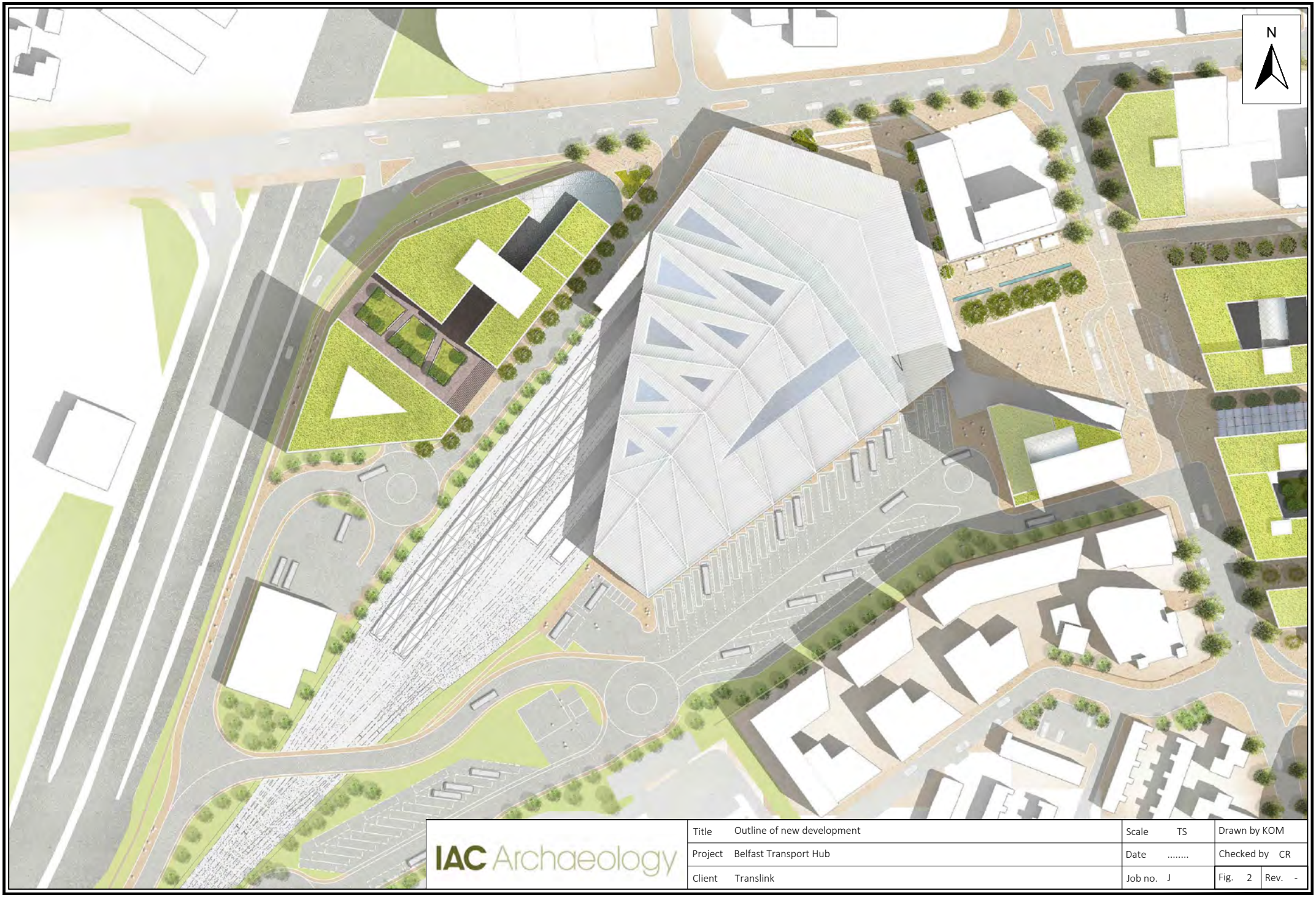
Project Id: 19-1042	Title: Section line 1
Project Title: Saltwater Bridge Archaeological Coring	Vertical Scale: 1:79
Location:	Horizontal Scale: 1:128
Client: Translink	Engineer:



Chainage (m)	0.00	2.17	6.07	10.53	14.67	18.18	22.01
Offset (m)	0.13	0.06	0.13	0.09	0.15		
Elevation (mAOD)	3.88	4.26	4.71	4.85	5.13		

IAC Archaeology

Title	Site location (Google Earth May 2018)	Scale	As hown	Drawn by	KOM
Project	Belfast Transport Hub	Date	.....	Checked by	CR
Client	Translink	Job no.	J	Fig. 1	Rev. -



IAC Archaeology

Title	Outline of new development	Scale TS	Drawn by KOM
Project	Belfast Transport Hub	Date	Checked by CR
Client	Translink	Job no. J	Fig. 2 Rev. -

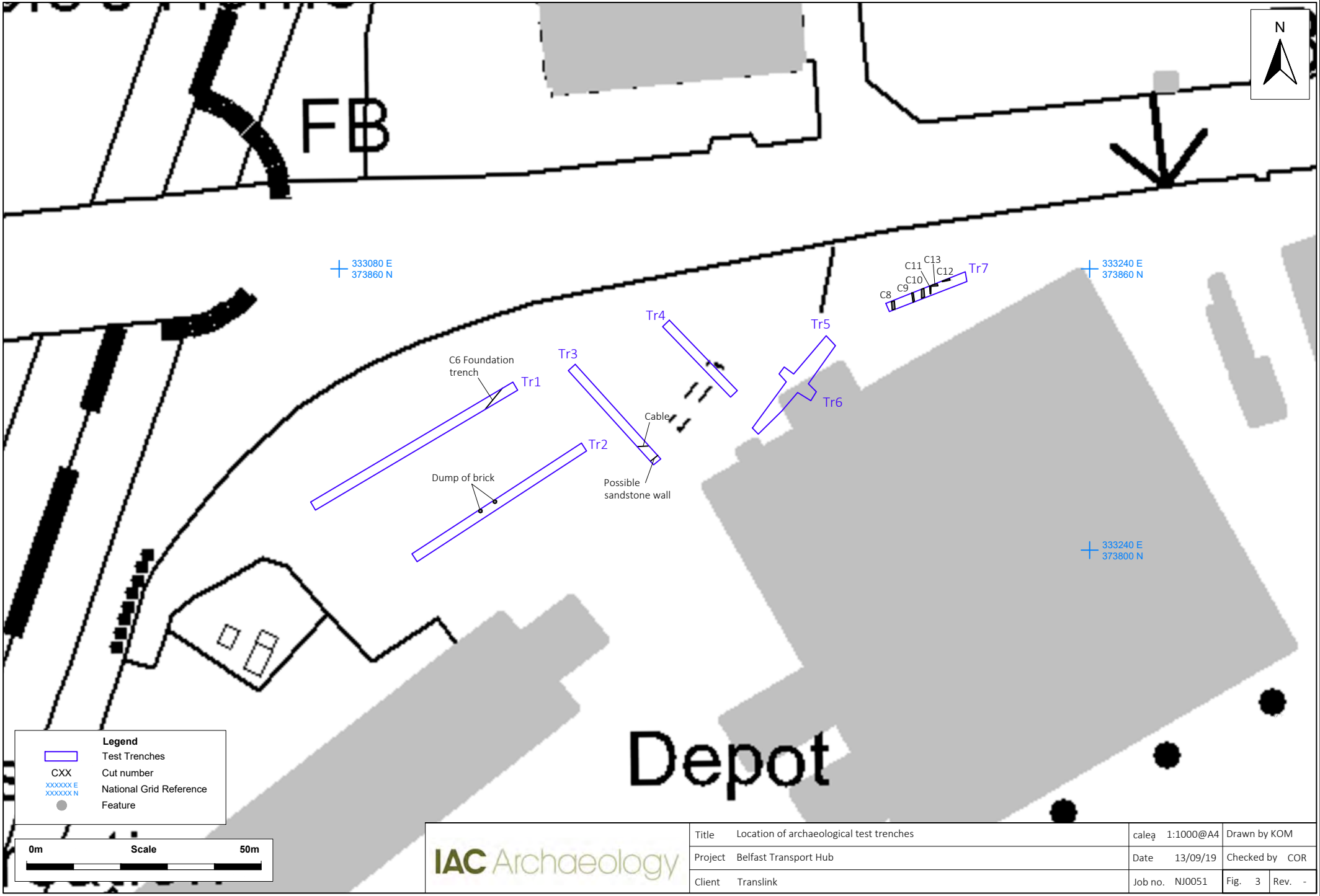

N
FB
333080 E
373860 N
333240 E
373860 N
333240 E
373800 N
Tr1
Tr2
Tr3
Tr4
Tr5
Tr6
Tr7
C6 Foundation trench
Cable
Dump of brick
Possible sandstone wall
C8
C9
C10
C11
C12
C13
Depot
Legend
Test Trenches
CXX
Cut number
XXXXXX E
XXXXXX N
National Grid Reference
Feature
0m
Scale
50m
IAC Archaeology
Title Location of archaeological test trenches
Project Belfast Transport Hub
Client Translink
calea 1:1000@A4
Date 13/09/19
Job no. NJ0051
Drawn by KOM
Checked by COR
Fig. 3
Rev. -

Plate 1 Trench 1, facing northeast.

Plate 2 Trench 1, C6, facing southwest.

Plate 3 Trench 2, brick deposit, facing northwest.

Plate 4 Trench 2, facing southwest.

Plate 5 Trench 3, brick drain C14, facing southwest.

Plate 6 Trench 3, Possible sandstone wall C7, facing southeast

Plate 7 Trench 4, facing northwest.

Plate 8 Trench 5, plastic ducting visible, facing northeast.

Plate 9 Trench 6, facing southeast.

Plate 10 Trench 7, facing northeast.

Plate 11 Trench 7, brick wall C8, facing west.

Plate 12 Trench 7, brick wall C10 (foreground), facing northeast.

Plate 13 Trench 7, brick walls C11 and C13, facing northeast.