



Tier Environmental Ltd

Chadwick House, Warrington Road,
Birchwood, Warrington WA3 6AE
01925 818388

TECHNICAL LETTER REPORT FOR GROUND INVESTIGATION

TATTENHALL WAR MEMORIAL, HIGH STREET, TATTENHALL CHESHIRE, CH3 9PT

Client:	Tattenhall Parish Council	Version:	Final
Reference:	TE1579-TE-00-XX-RP-GE-001-V01	Author:	Eve Rowland
		Reviewed:	Steve Millar
Date:	02/06/21	Approved:	Sean Lee

1. Introduction

Tier Environmental was commissioned by Tattenhall Parish Council to undertake a ground investigation for the Tattenhall War Memorial located on High Street, Tattenhall, West Cheshire, CH3 9PX ("the Site").

This short technical letter report forms a summary of the ground investigation works and geotechnical testing conducted at Tattenhall War Memorial on 23rd April 2021.

The main objective of this ground investigation was to inspect the small sink holes that have appeared in front of the memorial recently.

The Client provided the following information to supplement this report:

- Graham Holland Associates Report 2004 – previous structural issues at the Memorial
- Email from Iain Keeping 09:46hrs 29/4/21 – on the extent of the flooding at the Memorial in January 2021
- Email from Parish Clerk 15:40hrs 28/4/21 – the EA map of flooding in Tattenhall

2. Site Description and History

The site is currently consists of the War Memorial, sandstone hard standing, gravelled area, a wall and vegetation beyond the wall. The Site sits within the Mill Field area of Tattenhall. North of the site is the Barbour Institute, east of the site is the Mill Brook Field and beyond is the earth embankment mill pond, west is High Street. To the south of the site is Mill Brook river and overflow chamber/tunnel beneath the road.

Tattenhall War memorial appears on records from 1921. Prior to the construction of the Memorial the site was part of the Mill Field area with the Mill Brook 5-10m south of the Memorial.

3. Fieldwork Scope

The ground investigation works and geotechnical testing conducted at Tattenhall War Memorial was undertaken on 23rd April 2021. The fieldwork consisted of 5 No. Window Sample boreholes (WS01 to WS05) and 5 No. hand dug foundation inspection/trial pits (HDP01 to HDP05). These were advanced to determine the nature and extent of shallow soils and construction of the War Memorial beneath the Site. In addition it was essential to



determine the nature of groundwater beneath the Site (if any) and allow for *in situ* geotechnical testing and to obtain samples for laboratory geotechnical testing.

This information along with data provided by the Parish Council would form part of the analysis and interpretation of the causes of the sinkholes and the settlement issues observed during the site walkover around the Memorial. This assessment would then inform the potential options for remedial works to preserve the Memorial for posterity.

4. Ground Conditions

Exploratory holes and hand dug pits (logs are in Appendix B) were advanced in targeted locations to investigate the sink holes and surrounding ground conditions as shown on TE1456-TE-GE-00-XX-DR-003-V01-Exploratory Hole Location Plan (in Appendix A). A summary of the ground conditions encountered is presented below:

- Granular MADE GROUND was encountered in HDP01 to HDP05, WS04 and WS05. These locations are all in front of the memorial. Made Ground consisted of GRAVEL (ground surface) overlaying a black or blackish brown, fine to coarse, gravelly SAND. The gravel was angular to subrounded, fine to coarse of brick.
- Two superficial deposits were encountered on Site:
 - Spongy, pseudo-fibrous to fibrous, black slightly clayey and slightly sandy PEAT was encountered in all exploratory hole locations.
 - Orangish brown, slightly gravelly, fine to coarse SAND. The gravel is fine to coarse, angular to subangular of quartz and sandstone.
- Bedrock was encountered in WS01 to WS05 as orange, extremely weathered, extremely weak SANDSTONE. This was at depths of between 1.90m bgl and 3.10m bgl to the base of all boreholes, however the base of this borehole was not encountered.

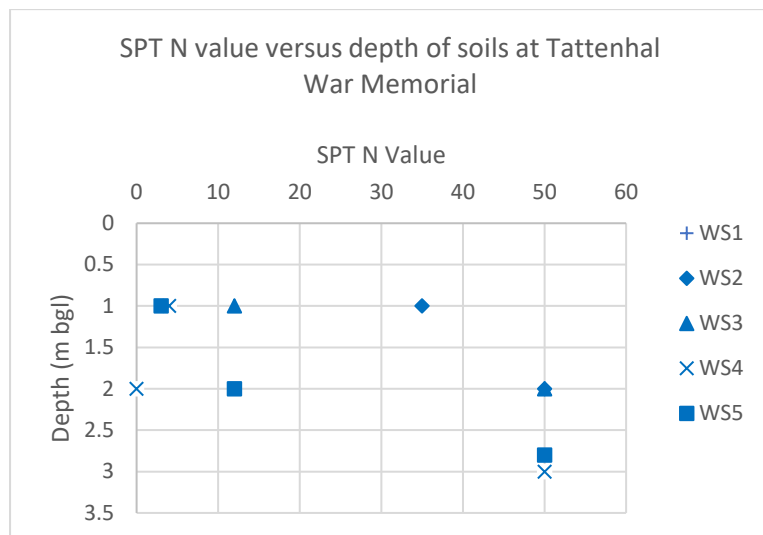
Groundwater was encountered in all window sample locations at depths between 0.70m bgl and 2.30m bgl and was perched within the superficial Peat deposits.

Hand dug pits were targeted along the front of the memorial to investigate the sinkholes which have appeared and the foundations of the memorial. Significant voids were encountered in the hand dug pits, specifically in HDP1 and HDP2 extending from the pit beneath the concrete slab foundation of the memorial. A Schematic cross section of HDP is attached in Appendix A (TE1579-TE-00-XX-DR-GE-001-V01-Foundation Inspection Pit (HDP1)) which highlights the void space underneath the memorial.

5. Geotechnical Testing

In situ Geotechnical testing was conducted in all Window Sample boreholes. SPT tests were conducted every meter in the borehole. Figure 5.1 below outlines SPT results versus depth.

Figure 5.2. SPT N Value versus depth



4 No. soil samples were submitted for Atterberg testing and 7 No. separate moisture content tests were conducted. A summary of the results is shown in table 3.1 below.

Table 3.1. Atterberg test results

Parameter	No. of Tests	Minimum	Maximum	Average
Natural MC (PEAT) %	3	85	284	195.6
Natural MC (SAND) %	9	10	139	30.5
Plastic Limit %	4	ALL TESTS RETURNED A NON-PLASTIC CLASSIFICATION		
Liquid Limit %	4			
Plasticity Index %	4			

1 No. sample (WS04 at 3.00m bgl) was submitted for Particle Size Distribution testing. The PSD testing classified the soil as a silty SAND with rare gravels. The results of the geotechnical testing are including in Appendix C.

6. Analysis and Interpretation

Following on from the review of the information provided by the Parish Council, a detailed site walkover, the ground investigation and geotechnical testing conducted at Tattenhall War Memorial it has been concluded that there are a number of contributing factors that have potentially been affecting the War Memorial and these are listed below in the following sub-sections.



Peat

The ground conditions encountered at the Site showed the presence of Peat beneath and in the land around the Memorial. Peat was identified in all exploratory hole locations (WS1-WS5 and HDP1-HDP5) and was identified at minimum depths between 0.20m bgl and 0.75m bgl and was proven to maximum depths between 1.05m bgl and 2.50m bgl.

The peat overlies a medium dense to dense SAND directly above the bedrock of the Chester Sandstone Formation. The peat is of an extremely low to negligible strength and therefore not suitable as a founding stratum.

This is shown as the footings of the Memorial are not level and are dipping towards the road and towards the Mill Brook. There is evidence that there are a number of cracks within the mortar of the surrounding wall of the Memorial have been identified (See photograph 10 in Appendix E).

Due to the extremely low strength of the Peat, this is deemed the primary driver for the differential settlement seen historically in 2004 with Graham Holland Associates Report and the recent issues with the Memorial.

Groundwater

Groundwater was encountered in all window sample boreholes; at depths between 0.70m bgl and 2.30m bgl. The groundwater was perched within the Peat itself or directly at the base of the Peat within the SAND. The high groundwater table means that the Peat deposits are saturated. The water table is likely to be sensitive to changes in seasonal variations is likely to rise and fall significantly, this process could contribute to partial washout to the Made Ground over time.

Located approximately 30m east of the Site (to the rear of the Barbour Institute) is a groundwater borehole. This borehole is at a lower elevation (approximately 1.00m) than the Site itself but shows evidence of sub-artesian groundwater leaking through the brick surroundings. The car park in which this borehole is located had water covering it; the caretaker of The Barbour Institute has informed Tier Environmental (conversation had whilst on Site) that this car park has not fully dried out for approximately 9 months, and the borehole has been leaking at least since then. This is another line of evidence showing the high groundwater levels are potentially affecting the War Memorial.

Historic Vegetation

Tier Environmental has obtained a 3rd party report of the Site conducted by Graham Holland Associates in February 2004. Photographs included within the report show that 2 no. Trees and 2 No. small shrubs were present on Site in front of the Memorial. The presence of the trees and shrubs will most likely have had an impact on the moisture content of the soils beneath Site; as the roots of the plants will draw out water from the soils. Removal of the vegetation is likely to have contributed to a change in conditions of the soil and likely contributed to localised subsidence.

A review of the Graham Holland report shows photographs which are located in the same location in which the two of the small sinkholes have appeared which Tier Environmental were instructed to investigate as shown in the photographs included within Appendix E. The following two scenarios are likely to have influenced and contributed to the settlement issues in and around the Memorial;

- a) The roots of the shrubs have impacted the integrity of the concrete slab foundation of the memorial in this area (identified by the void spaces underneath the memorial in the area of the sinkholes).

And/or

- b) When the shrubs were removed, the void left by the roots was not appropriately backfilled and/or compacted, this would allow for differential settlement in these areas. In addition this could potentially



create pathway for surface water runoff and groundwater to percolate through and causing partial washout of the soils.

Drainage

Directly adjacent to the south of the Site is an overflow drain which assists the Mill Brook during flood events. This drain runs northwest underneath the road parallel to the Mill Brook (drains into the Brook) and was installed circa 2003. During the site walkover, the drain shows evidence of seepage of water coming through the concrete structure in the northern face, adjacent to the Site (see Photograph 6 in Appendix E). During the walkover it was evident that the wall above the diversion drain is also showing evidence of differential settlement, this would be in keeping with the current ground conditions and groundwater level.

The construction of this diversion drain could potentially create a preferential pathway for sediment to be partially washed out.

Immediately to the north of the Memorial is a potential soakaway or drain (see photograph 5 in Appendix E), it is unclear at what its function is into the surrounding area. The groundwater within it was approximately 0.80m below ground level at the time of the site walkover.

Flooding of the area

There has been three flood events have affected Tattenhall in recent years; 2000, 2020 and 2021. The extent of flooding in all three years have flooded the Site. It is likely that flood events have potentially contributed to the differential settlement as the flood waters recede. The Parish Council have provided a flooding map which is presented in Appendix D.

Foundations of the Memorial

The ground investigation demonstrated that the foundation of the Memorial is a thin concrete ground bearing slab as shown in Photographs 1 to 4 within Appendix E.

It was evident during the hand pitting that there was a void beneath the foundation, this could have been due to long term settlement of the construction layer into the Peat and/or partial washout of soil over time due to high groundwater levels and flooding events.

7. Conclusions

The objectives of the ground investigation at Tattenhall War Memorial were to identify the ground conditions beneath the Site, obtain soil samples to undergo geotechnical testing and to explore the potential cause(s) of the sinkholes that have appeared in front of the Memorial, and the subsidence of the Memorial itself.

Shallow soils encountered at the site comprised Granular Made Ground in front of the memorial (WS04 and WS05) and Topsoil behind the memorial (WS01, WS02 and WS03) underlain by superficial deposits of Peat and Sand. Directly underlaying the superficial deposits in all exploratory hole locations was Sandstone of the Chester Formation at shallow depths between 1.90m bgl (WS01 and WS02) to 3.10m bgl (WS04) .

Geotechnical testing on soil samples obtained during the investigation revealed soils of extremely varying moisture contents. Atterberg tests conducted on samples all returned a non-plastic result. Additionally, 1 No. Particle Size Distribution test was conducted in the SAND from WS04 at 3.00m bgl classifying the soils as a silty Sand with rare gravels.



It is concluded that there are a number of potential differing factors that have contributed to the appearance of the sinkholes and the history of subsidence at the Memorial. These are summarised below:

- The Peat identified in the ground beneath and surrounding the Memorial is an extremely low strength soil and not a suitable founding strata.
- High groundwater table potentially contributing to the differential settlement due to seasonal variations and flooding events.
- Historical trees and shrubs in the front of the Memorial and poor backfilling of the holes could be a contributing factor to the sinkholes and differential settlement.
- An unknown drain to the north of the Memorial and the Mill Brook diversion drain could be contributing to potential pathways for partial sediment washout or movement. Which is supported in part by the partial void beneath the Memorial slab.
- The Mill Brook diversion drain could be contributing to the consolidation of the Peat to the south of the Memorial (this concurs with the visible evidence that the wall is showing signs of differential settlement).
- It is possible that potential impact from passing traffic could contribute to the differential settlement and damage to the Memorial.
- The foundation slab is thin (0.07m) and not sufficient to effectively deal with the Peat ground conditions it was constructed on. Previous evidence in 2004 of the wall being repaired contributes to this with the current evidence of cracking of mortar joints on the Memorial and wall.

In conclusion the ground conditions are believed to be the primary driver to the causes of the differential settlement with potential contributory factors including foundation construction, groundwater, flooding events, drainage, traffic and previous vegetation.

8. Recommendations

The following recommendations are being made and it is essential each option is appraised and costed to provide a long-term solution to the poor ground conditions in which the Memorial is constructed upon.

Option 1 – Stabilisation of the Memorial

Tier Environmental has considered three possible stabilisation methods, outlined below:

Option 1A – Underpinning of the Memorial

The first stabilisation method for the memorial would be to underpin the Memorial itself and support the existing structure. This option could prove potentially difficult due to the road, the diversion drain and access.

Option 1B – Removal of Peat

The second stabilisation method involves temporarily disassembling the Memorial to allow access to the ground beneath it. All the Peat underlying the Memorial should be dug out and the void replaced with suitably engineered granular fill to provide a foundation layer for a ground bearing slab. This option could prove expensive and potentially need shoring to avoid influx of groundwater and potential instability of the adjacent highway.



Option 1C – Geo Grid

The third stabilisation method is to dismantle the Memorial, excavate down to circa 1.00m bgl and install a geo-grid and suitable granular fill to provide a foundation layer. This option reduces disposal costs for the peat, the need for shoring and to provide a suitable base for the Memorial foundations.

Option 1D – New Foundations

The fourth stabilisation method is to implement a new foundation option for the Memorial. Temporary disassembly and removal of the Memorial would allow for the new foundations to be installed. A potential foundation option would be to undertake mini-piles to be driven into the underlying shallow bedrock beneath the Site with a suspended slab for the Memorial and wall to avoid any long term differential settlement issues. This could prove the easiest option as less consideration is required for the diversion drain and road. It would not require shoring, specialist piling advice should be sorted during the appraisal and costing exercise.

Option 2 – Relocation

The second remedial option is to identify and relocate a location within Tattenhall for the Memorial to be relocated. However, if the Memorial is to be moved; the new chosen location should be assessed to ensure the ground conditions at the new location are suitable for founding on with a ground bearing slab and to prevent similar long term issues.

It is recommended that a detailed appraisal, design and costing exercise is undertaken to assess the viability of each option, taking into consideration factors such as the sensitivity and history of the Memorial, the services and utilities within close proximity to the Site (i.e. the overflow bridge) and the main Road (High Street).

For and on behalf of Tier Environmental Ltd

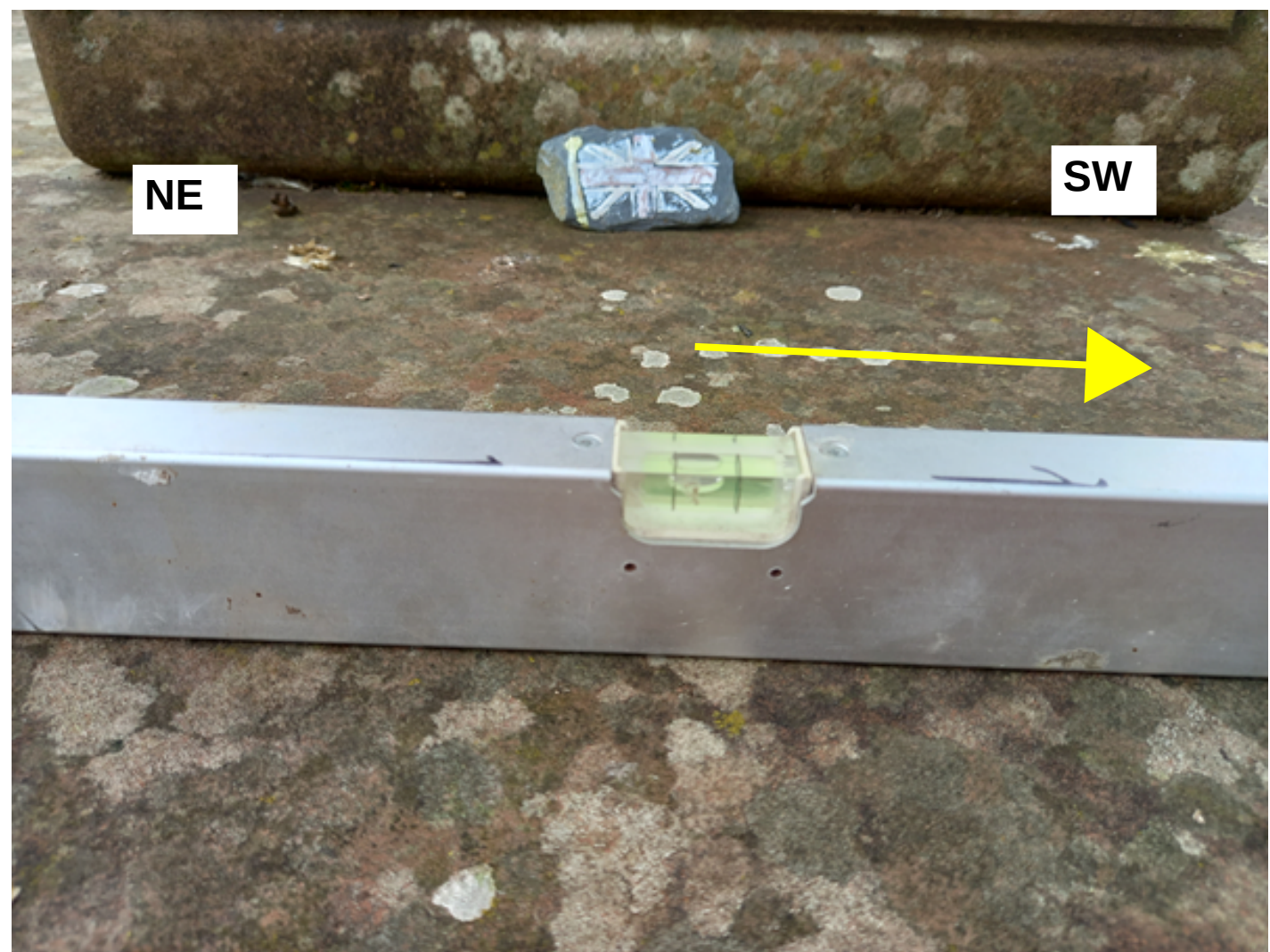
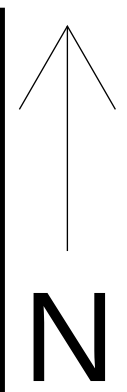
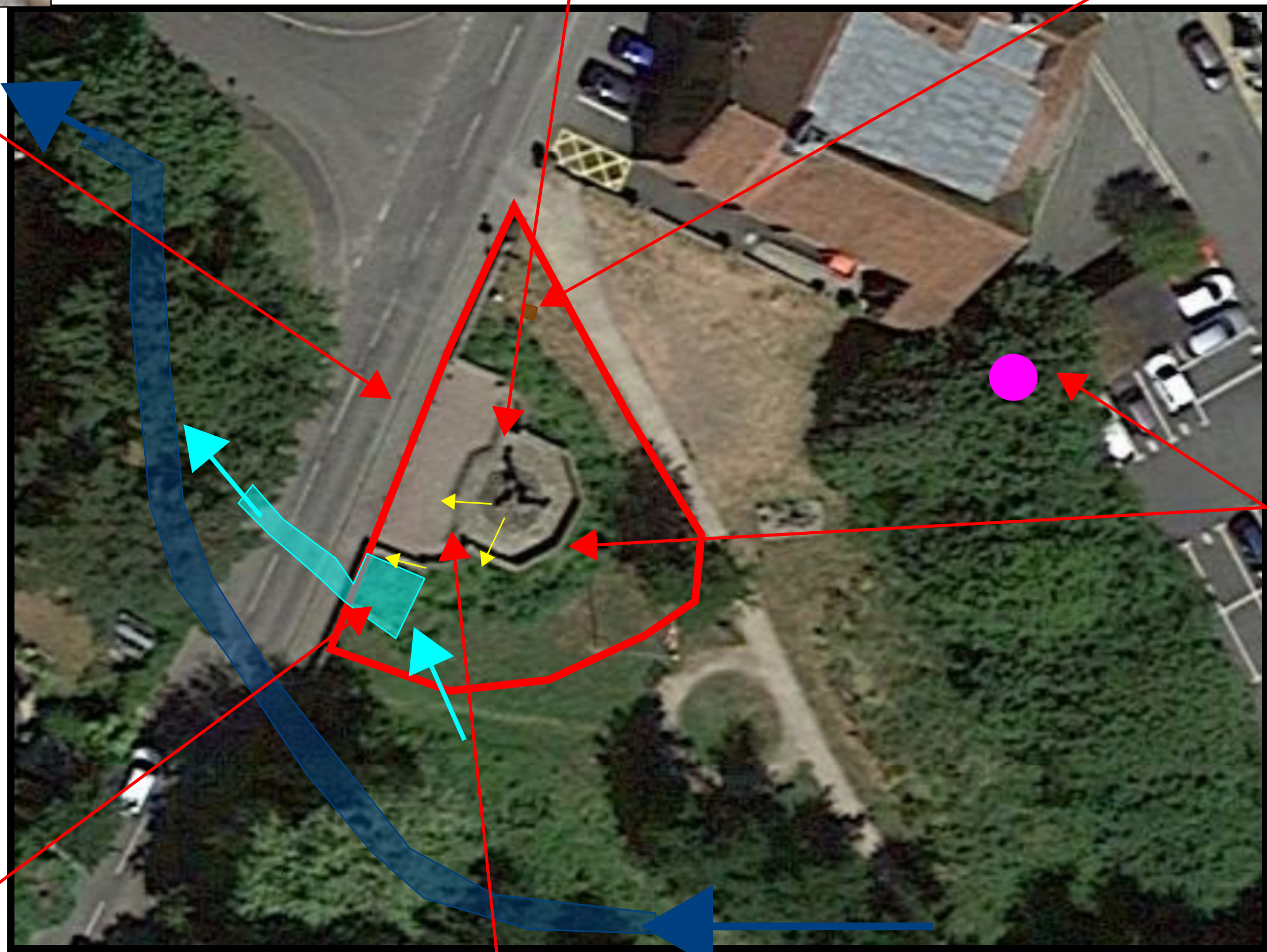
A handwritten signature in black ink, appearing to read "E. Rowland", written over a light blue background.

Eve Rowland MEng (Hons)

Assistant Geoenvironmental Engineer



APPENDIX A – FIGURES AND DRAWINGS



LEGEND

Proposed Working Area

Location of Proposed Exploratory Hole

WS03

Location of Proposed Hand Pits

Electrical Sub-Station

Possible Electrical Box for War Memorial Lights

Spot Lights for War Memorial Lights

Rev:

Description:

Date:

By:

Chkd:

TIER

CONSULT

TIER ENVIRONMENTAL LTD
Bromsgrove - Chester - Manchester - London - Sheffield - Warrington

Status:

DRAFT

Project:

GROUND INVESTIGATION AT TATTENHALL WAR MEMORIAL

Orig Title:

PRELIMINARY EXPLORATORY HOLE LOCATION PLAN AND SITE CONSTRAINTS AND HAZARDS

Size:

A1

Date:

APR 2021

Drawn By:

SM

Designed By:

SM

Checked By:

ER

Scale:

NTS

Project Reference - TE-1579-GE-DR-00002-V01

TE1579: Tattenhall War Memorial – HDP1 (foundation inspection pit)

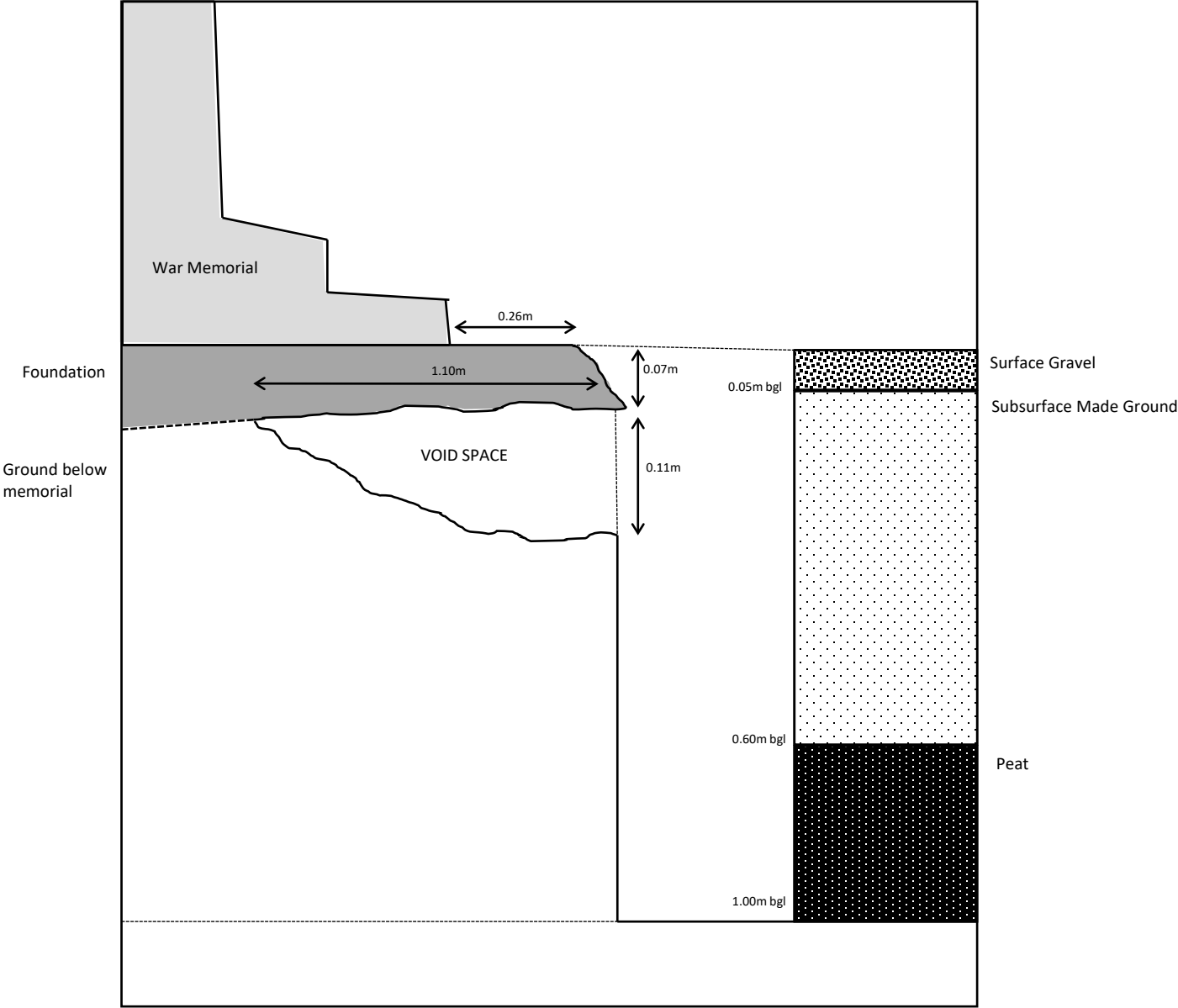


Photo 1. "Sinkhole" at surface before excavation



Photo 2. Hand Dug Pit 1



Photo 3. Pinch Bar positioned at the edge of foundation



Photo 4. Pinch Bar positioned 1.10m into void space under foundation



Drawing Number: TE1579FIP1
Date: 26.04.2021
Drawn By: ER
Approved By: SM
Authorised By: SL



APPENDIX B – EXPLORATORY HOLE LOGS



Trial Pit Log

Trialpit No

HDP1

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579Co-ords: -
Level:Date
23/04/2021

Location: Tattenhall, Cheshire

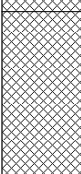
Dimensions
(m):

0.4

0.4

Depth
1.00Scale
1:25Logged
ER

Client: Tattenhall Parish Council

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05			MADE GROUND: Loose, light brown and grey, fine to coarse, angular GRAVEL MADE GROUND MADE GROUND: Black, peaty, gravelly, fine to coarse SAND. Gravel is fine to coarse, angular of brick MADE GROUND
				0.60			Spongy, pseudo-fibrous to fibrous, black, slightly clayey PEAT
				1.00			
							End of pit at 1.00 m

1

2

3

4

5

Remarks: 1) Hand dug pit for Geoenvironmental purposes and foundation inspection 2) No Groundwater ingress encountered 3) Split scissors, Pinch Bar and shovel used to excavate pit 4) Terminated at target depth.

Stability: Stable





Trial Pit Log

Trialpit No

HDP3

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579Co-ords: -
Level:Date
23/04/2021

Location: Tattenhall, Cheshire

Dimensions
(m):

0.4

0.4

Depth
1.00Scale
1:25Logged
ER

Client: Tattenhall Parish Council

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.07			MADE GROUND: Loose, light brown and grey. fine to coarse, angular GRAVEL.
				0.20			MADE GROUND MADE GROUND: Orange, fine to coarse, cobbly, angular GRAVEL of brick. Cobbles are angular of brick and while brick
				1.00			MADE GROUND Spongy, pseudo-fibrous to fibrous, black, slightly clayey PEAT
							End of pit at 1.00 m

1

2

3

4

5

Remarks: 1) Hand dug pit for Geoenvironmental purposes and foundation inspection 2) No Groundwater ingress encountered 3) Split scissiors, Pinch Bar and shovel used to excavate pit 4) Terminated at target depth.

Stability: Stable







Trial Pit Log

Trialpit No

HDP5

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579Co-ords: -
Level:Date
23/04/2021

Location: Tattenhall, Cheshire

Dimensions
(m):

0.4

0.4

Depth
1.20Scale
1:25Logged
ER

Client: Tattenhall Parish Council

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05			MADE GROUND: Loose, light brown and grey, fine to coarse, angular GRAVEL MADE GROUND
				0.45			MADE GROUND: Brown, slightly gravelly, fine to coarse SAND. Gravel is fine to coarse, angular to subangular of mixed natural lithologies and bricks MADE GROUND Spongy, pseudo-fibrous, black PEAT
				1.20			End of pit at 1.20 m

1

2

3

4

5

Remarks: 1) Hand dug pit for Geoenvironmental purposes and foundation inspection 2) No Groundwater ingress encountered 3) Split scissiors, Pinch Bar and shovel used to excavate pit 4) Terminated at target depth.

Stability: Stable





Borehole Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579

Co-ords: -

Hole Type
WS

Location: Tattenhall, Cheshire

Level:

Scale
1:50

Client: Tattenhall Parish Council

Dates: 23/04/2021 -

Logged By
ER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.60			Grass over, slightly sandy, slightly gravelly TOPSOIL. Gravel is fine to coarse, angular to subangular of mixed natural lithologies	
		1.00	SPTL S	N=4 (1,0/1,1,1,1)				TOPSOIL	
		1.20						Low strength, spongy, fibrous, black, slightly sandy PEAT	1
		2.00	SPTL S	N=50 (4,7/11,12,17,10)	1.90			Very dense, extremely weathered, extremely weak, orange SANDSTONE	2
		2.00			2.20			End of borehole at 2.20 m	
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes 2) Groundwater strike at 1.0m bgl 3) Terminated at refusal





Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579

Co-ords: -

Hole Type
WS

Location: Tattenhall, Cheshire

Level:

Scale
1:50

Client: Tattenhall Parish Council

Dates: 23/04/2021 -

Logged By
ER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			Grass over, slightly gravelly, sandy TOPSOIL. Gravel is fine to medium, angular to subangular of mixed natural lithologies	
					0.70			TOPSOIL	
		1.20	SPTL S	N=35 (5,7/7,8,10,10)	1.25			Orangish brown, slightly gravelly, fine to coarse SAND. Gravel is fine to coarse, angular to subrounded of mixed natural lithologies	1
		1.20						Soft, spongy, fibrous, black slightly sandy PEAT	
		2.00	SPTL S	40 (25 for 115mm/27,13,,)	1.90			Dense, orangish brown, slightly gravelly, fine to coarse SAND. Gravel is fine to medium, angular of quartz	
		2.00			2.90			Very dense, orange, extremely weathered, extremely weak SANDSTONE	2
								End of borehole at 2.90 m	3
									4
									5
									6
									7
									8
									9
									10

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes 2) Groundwater strike at 0.70m bgl 3) Terminated at refusal





Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579

Co-ords: -

Hole Type
WS

Location: Tattenhall, Cheshire

Level:

Scale
1:50

Client: Tattenhall Parish Council

Dates: 23/04/2021 -

Logged By
ER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.12			Grass over, clayey, sandy, slightly gravelly TOPSOIL. Gravel is fine to medium of mixed natural lithologies TOPSOIL	
					0.75			Loose, orangish brown, slightly gravelly, fine to coarse SAND. Gravel is fine to coarse, angular to subrounded of mixed natural lithologies	1
		1.20	SPTL		1.05			Soft, spongy, pseudo-fibrous to fibrous, black, slightly clayey PEAT	
		1.20	S	N=12 (2,2/3,3,3,3)				Medium dense, orange and greyish brown, gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies	2
		2.00	SPTL		2.10			Orange, extremely weathered, extremely weak SANDSTONE	
		2.00	S	50 (25 for 70mm/50 for 115mm)	2.20			End of borehole at 2.20 m	
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes 2) Groundwater strike at 0.95m bgl 3) Terminated at refusal





Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579

Co-ords: -

Hole Type
WS

Location: Tattenhall, Cheshire

Level:

Scale
1:50

Client: Tattenhall Parish Council

Dates: 24/04/2021 -

Logged By
ER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.07			MADE GROUND: Loose, lightly brown and grey, fine to coarse, angular GRAVEL	
					0.45			MADE GROUND	
		1.00	B					MADE GROUND: Black, slightly gravelly, fine to coarse SAND with a moderate proportion of ash. Gravel is fine to coarse, angular of brick	1
		1.20	SPTL					MADE GROUND	
		1.20	S	N=4 (1,1/1,1,1,1)				Extremely low to very low strength, spongy, pseudo-fibrous to fibrous, black, slightly clayey PEAT	
		2.00	SPTL						2
		2.00	S	N=0 (1,0/0,0,0,0)					
					2.50			Medium dense, orangish brown, slightly gravelly, fine to coarse SAND. Gravel is fine to medium, angular of quartz	3
		3.00	SPTL						
		3.00	S	50 (25 for 30mm/50 for 40mm)	3.10			Very dense, orange, extremely weathered, extremely weak SANDSTONE	
					3.30			End of borehole at 3.30 m	
									4
									5
									6
									7
									8
									9
									10

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes 2) Groundwater strike at 2.30m bgl 3) Slight organic odour in peat 4) Terminated at refusal





Borehole Log

Borehole No.

WS05

Sheet 1 of 1

Project Name: Tattenhall War Memorial

Project No.
TE1579

Co-ords: -

Hole Type
WS

Location: Tattenhall, Cheshire

Level:

Scale
1:50

Client: Tattenhall Parish Council

Dates: 23/04/2021 -

Logged By
ER

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.05			MADE GROUND: Loose, light brown and grey, fine to coarse, angular GRAVEL	
					0.80			MADE GROUND: Blackish brown, clayey, fine to coarse SAND	
		1.20 1.20	SPTL S	N=3 (1,0/1,0,1,1)				Very low strength, spongy, pseudo-fibrous to fibrous, black, slightly clayey PEAT	1
		2.00 2.00	SPTL S	N=12 (3,3/3,3,3,3)	2.10			Medium dense, orangish brown, slightly gravelly, fine to coarse SAND. Gravel is fine to medium, angular of quartz	2
		2.50	D		2.50			Very dense, orange, extremely weathered, extremely weak SANDSTONE	
		2.80 2.80	SPTL S	50 (25 for 105mm/50 for 115mm)	2.90			End of borehole at 2.90 m	3
									4
									5
									6
									7
									8
									9
									10

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes 2) Groundwater strike at 210m bgl 3) Slight organic odour in peat 4) Terminated at refusal





APPENDIX C – GEOTECHNICAL TESTING RESULTS



TEST REPORT

Client Tier Environmental Ltd

Address Suite 513, Chadwick House
Warrington Road
Birchwood Park
WA3 6AE

Contract TE1579 –
Tattenhall War Memorial

Job Number MRN 4144/22
Date of Issue 12 May 2021
Page 1 of 7

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted. This does not, however, guarantee the balance of the materials from which the tested samples have been taken to be of equal quality.



Andrew House, Hadfield Street, Dukinfield, Cheshire SK16 4QX Tel: 0161 475 0870
Email: enquiries@murrayrix.com Website: www.murrayrix.com

Also at: London: 020 8523 1999

Murray Rix is the trading name of Murray Rix (Northern) Limited, Registered in England 2878361

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

**TEST CERTIFICATE****MOISTURE CONTENT DETERMINATION
BS 1377 : PART 2 : 1990 (OVEN DRY)**

CLIENT	Tier Environmental Ltd
SITE	TE1579 – Tattenhall War Memorial
JOB NUMBER	MRN 4144/22

DATE SAMPLED	Not advised	SAMPLED BY	Client
DATE TESTED	01 May 2021	DATE RECEIVED	27 April 2021

Sample No	Site Reference	Material	Sample Location	Moisture Content %
98352	WS01 1.2	Soft black ORGANIC MATTER	As site reference	284
98355	WS02 2	Red brown silty SAND	As site reference	10
98354	WS02 1.2	Red brown silty SAND	As site reference	15
98357	WS03 2	Grey silty SAND	As site reference	20
98359	WS04 2	Black silty SAND with organic matter	As site reference	20
98362	WS05 1.2	Black silty SAND with organic matter	As site reference	19
98356	WS03 1.2	Red brown silty SAND	As site reference	139
98360	WS04 1	Soft black ORGANIC MATTER	As site reference	218
98365	WS05 2.8	Red brown silty SAND	As site reference	14

REMARKS

SIGNED

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 12 May 2021

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3

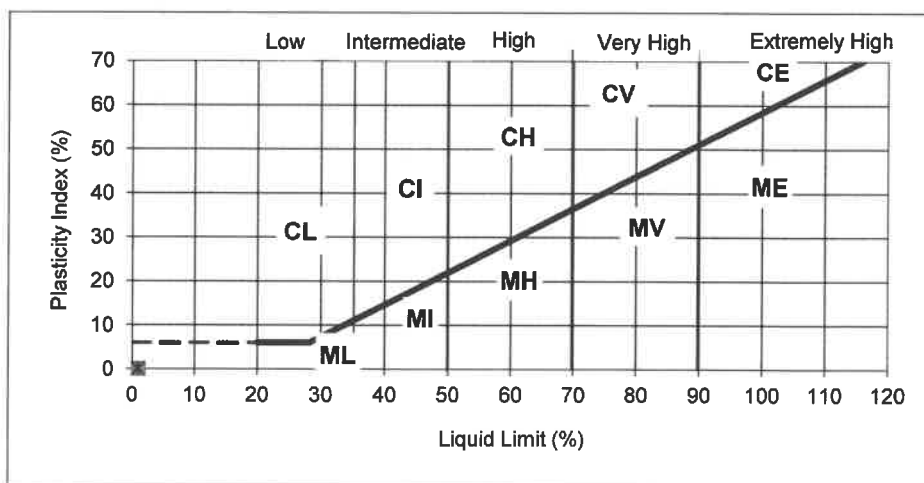
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	Tier Environmental Ltd
SITE	TE1579 - Tattenhall War Memorial
JOB NUMBER	MRN 4144/22

SAMPLE LABEL	WS01 1.2	DATE SAMPLED	Not advised
SAMPLE No.	98352	DATE RECEIVED	27-Apr-21
DATE TESTED	01-May-21	SAMPLED BY	Client

MATERIAL	Soft black ORGANIC MATTER
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
284	N/A	Non Plastic	N/A	85



REMARKS

Sample tested after wet sieving

SIGNED

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 12-May-21

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3

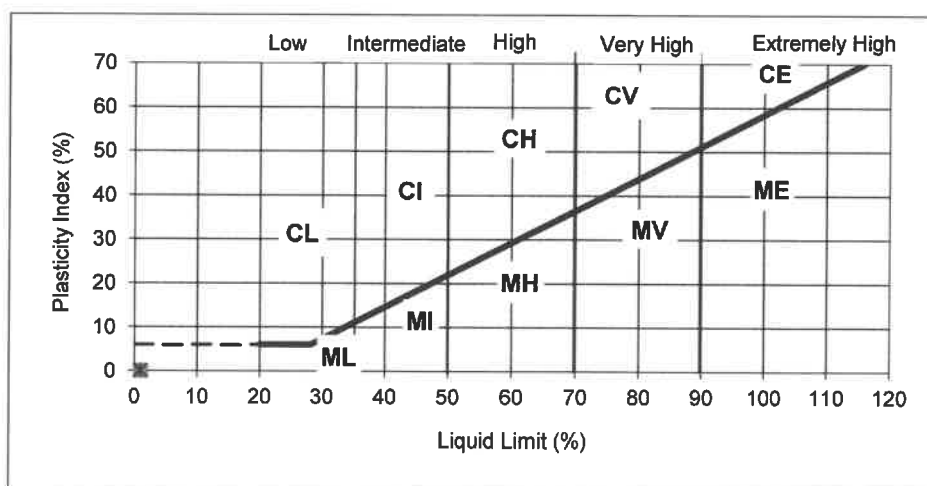
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	Tier Environmental Ltd
SITE	TE1579 - Tattenhall War Memorial
JOB NUMBER	MRN 4144/22

SAMPLE LABEL	WS02 2	DATE SAMPLED	Not advised
SAMPLE No.	98355	DATE RECEIVED	27-Apr-21
DATE TESTED	01-May-21	SAMPLED BY	Client

MATERIAL	Red brown silty SAND
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
10	N/A	Non Plastic	N/A	80



REMARKS

Sample tested after wet sieving

SIGNED

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 12-May-21

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3

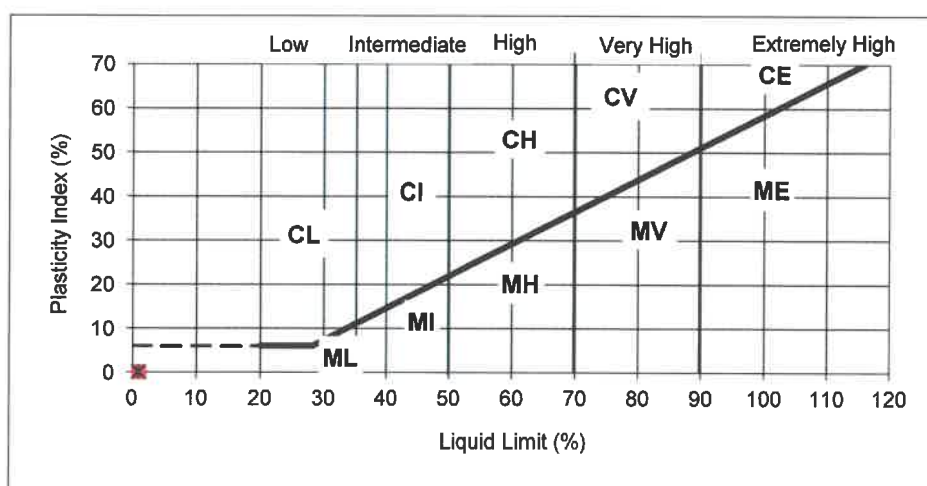
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	Tier Environmental Ltd
SITE	TE1579 - Tattenhall War Memorial
JOB NUMBER	MRN 4144/22

SAMPLE LABEL	WS04 1.2	DATE SAMPLED	Not advised
SAMPLE No.	98355	DATE RECEIVED	27-Apr-21
DATE TESTED	01-May-21	SAMPLED BY	Client

MATERIAL	Soft black ORGANIC MATTER
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
213	N/A	Non Plastic	N/A	92



REMARKS

Sample tested after wet sieving

SIGNED

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 12-May-21

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID AND PLASTIC LIMIT

BS 1377: PART 2: 1990 Clause 4.4 ONE POINT METHOD & Clause 5.3

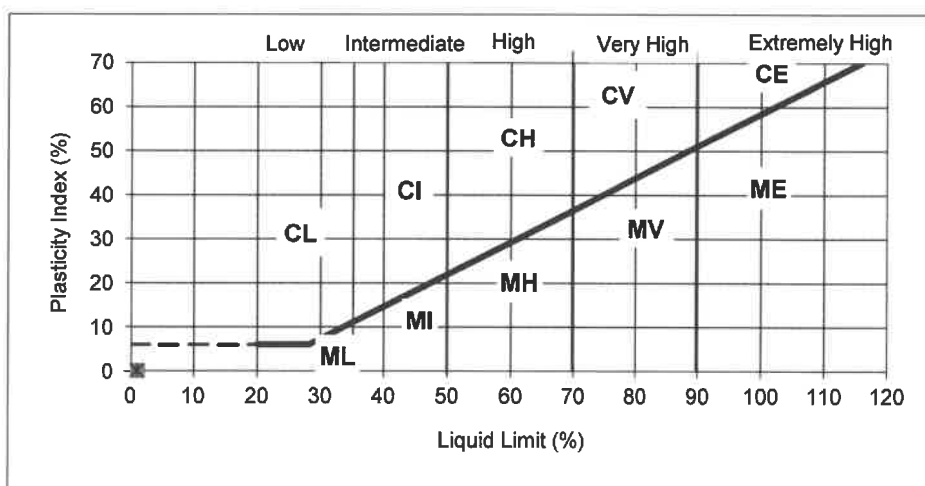
MOISTURE CONTENT METHOD BS 1377: PART 2: 1990 Clause 3.2

CLIENT	Tier Environmental Ltd
SITE	TE1579 - Tattenhall War Memorial
JOB NUMBER	MRN 4144/22

SAMPLE LABEL	WS05 2	DATE SAMPLED	Not advised
SAMPLE No.	98363	DATE RECEIVED	27-Apr-21
DATE TESTED	01-May-21	SAMPLED BY	Client

MATERIAL	Red brown silty SAND
ADVISED SOURCE	Site Investigation Sample

Moisture Content (Natural) (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
28	N/A	Non Plastic	N/A	82



REMARKS

Sample tested after wet sieving

SIGNED

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 12-May-21

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS 1377: PART 2: Clause 9.2: 1990

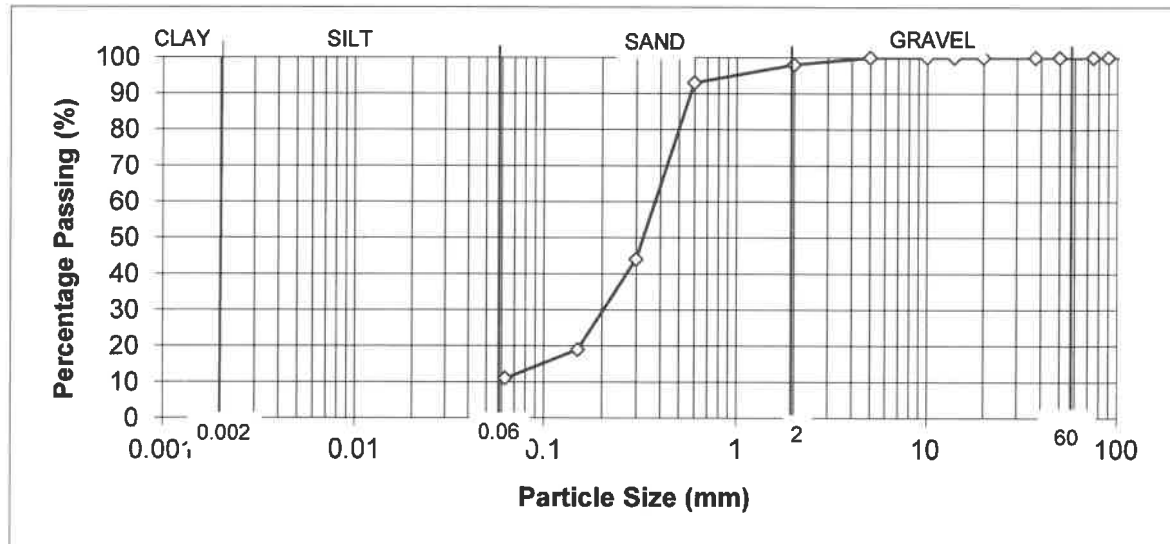
Determination of Moisture Content in accordance with BS 1377: PART 2: Clause 3: 1990 (Oven Dry)

CLIENT	Tier Environmental Ltd
SITE	TE1579 - Tattenhall War Memorial
JOB NUMBER	MRN 4144/22

SAMPLE LABEL	WS04 3	DATE SAMPLED	Not advised
LAB SAMPLE No	98361	DATE RECEIVED	27-Apr-21
DATE TESTED	01-May-21	SAMPLED BY	Client

MATERIAL	Red brown silty SAND with rare gravel
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		10	100	
90	100		5	100	
75	100		2	98	
50	100		0.6	93	
37.5	100		0.3	44	
20	100		0.15	19	
14	100		0.063	11	



REMARKS

SIGNED

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

DATE 12-May-21



APPENDIX D – CLIENT PROVIDED INFORMATION

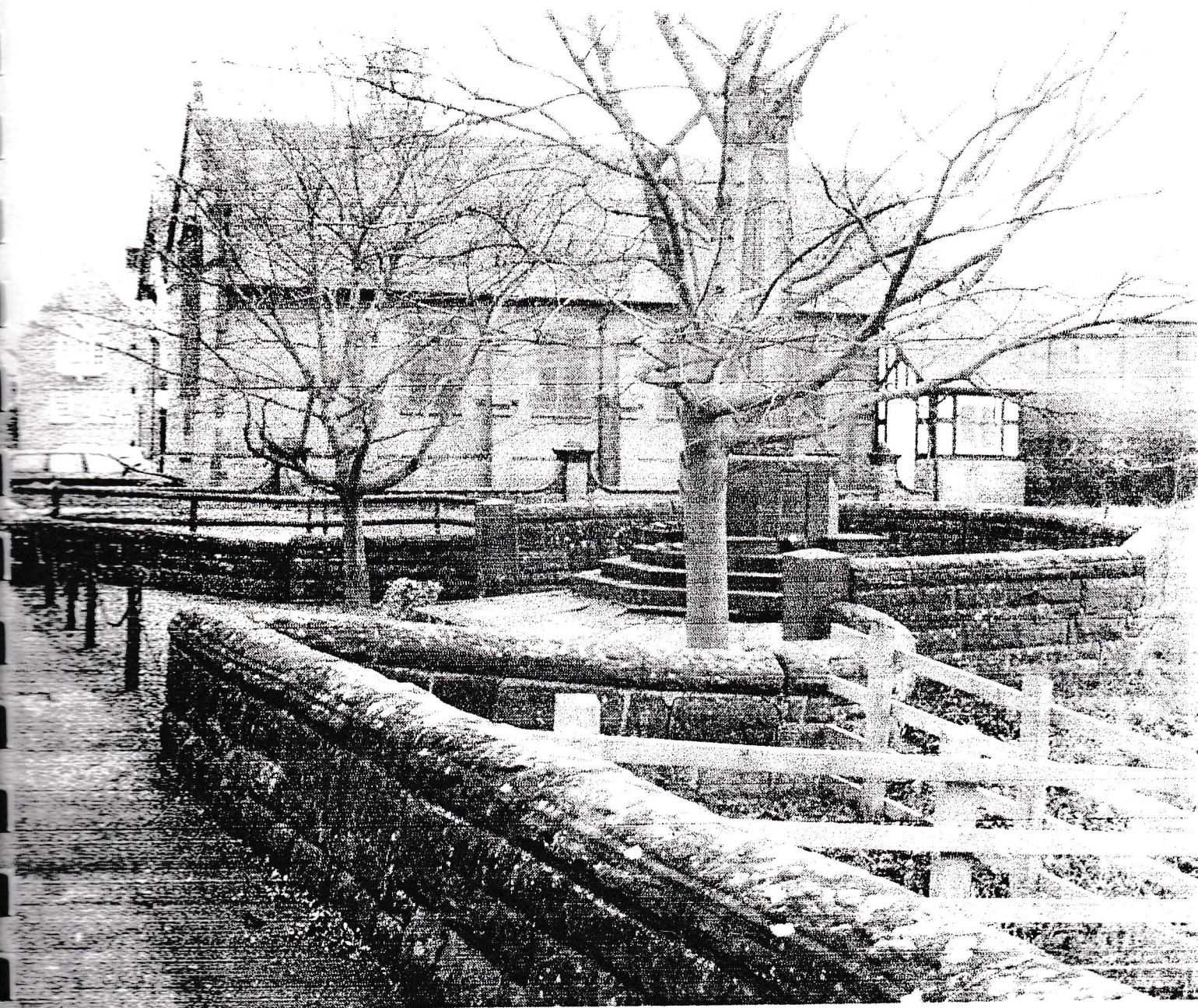
February 2004

GRAHAM HOLLAND ASSOCIATES

Architects & Historic Buildings Consultants

4 King Street, Knutsford, Cheshire WA16 6DL
tel: 01565 651066 fax: 01565 755265
mobile: 07885 224256

Plas Draw, Ruthin, Denbighshire LL15 1RT
tel: 01824 704709 fax: 01824 704912



TATTENHALL WAR MEMORIAL

CONDITION REPORT

Prepared for the Parish Council

Graham D. Holland, DipArch DipArchConsv RIBA, Cathedral Architect, Bangor
Associates: Nigel H. Lea, BA(Hons)Arch DipArch RIBA, Carl S. Thorgaard, BA(Hons) DipArch RIBA, Chris Wilson, DipBld Cons(RICS) MBIAT.

Distribution

Two copies of this report have been sent each to:

Clerk to the Parish Council

Mrs. J. Dutton,
Hill Farm,
Burwardsley,
Tattenhall,
Cheshire, CH3 9PF

English Heritage – Ref. P/C 112695

Attn. Cindy Molenaar, War Memorial Grant Scheme Co-ordination,
23 Savile Row,
London, W15 2ET

Contents

Description, Condition, Investigation Analysis & Proposals
Drawing 1151.A.1 (revision A)
Photographs Nos. 1 – 7 inclusive

Signed.....



Date.....

12 February 04

The Survey was carried out with the benefit of fine weather on Friday 23rd January 2004 & followed a preliminary survey prepared in May 2002.

Description

The memorial is situated to the south-west of the village in the High Street. A unified composition of red sandstone consisting of a central cross set onto a stepped base & surrounded with a stone pavement, a gravelled forecourt to the road. All is enclosed within a low random coursed sandstone wall which retains the higher area of the site above the surrounding field to the south; the site is roughly level with the roadway to the north.

There is a deep culvert immediately to the west, surrounded with concrete and an open ditch beyond.

The forecourt contains two trees – a gift of the Women's Institute – see drawing 1 & photograph 1. The cover

Condition

The central cross & steps remain firm with little evidence of any movement, a few open joints to the steps otherwise all is sound. See photo 2 - & note the paving settling away from the steps.

The surrounding pavement has settled & now falls steeply away from the centre towards the outer wall; many of the stones are loose making access hazardous – see photo 3.

The surrounding walls and foundations have settled both vertically downwards & outwards (see photos 4,5 & 6 & adjacent to the trees, photo 7. There are severe splits to the angles & within the short lengths of wall between.

The sections of wall have separated and the 'lengths' broken through joints. The walls have remained in sections with little disturbance to the opened horizontal bed joints indicating that the foundation slabs have also settled with the wall and rotated.

The cracks are extensive & noticeably worse since the previous inspection. A number of stones are loose & the sections of the wall are now unstable.

The settlement appears to be progressive – note the previous joint filling & open cracks adjacent on the photographs 3,4, 5 & 6.

Investigation Work

Ground conditions were investigated in 2002 & the report is attached. This advised of very poor ground below the paving, forecourt & wall & continuing in the adjacent field.

Local investigation indicates simple stone slab footings.

Over the last two years the wall has been monitored, significant movement has been noted & last year the areas was cordoned off for public safety: crack widths have more than doubled in the period of recording.

The area was reportedly flooded in 1999.

Analysis

It must be assumed that the principal memorial is built of a 'column of firm structure' whilst the surrounding walls slab footings are built directly onto the unstable peat, which is now 'sagging away' from the centre column out towards the lower ground – weight of stonework & recent wet/dry conditions.

The cracks are far too wide to be the result of 'thermal' movement.

The 'wall retains higher ground to the memorial site & this is likely to be adding thrust causing the footings to 'rotate' & the wall to lean outwards.

The two trees, planted within the forecourt may also be contributing to the outward movement both have now grown to semi-maturity & are obscuring the monument – see photo 7. Their absorption of ground water and likely undermining of the adjacent wall may be contributing to movement.

There would appear to have been some work carried out in the recent past to the culvert along the west side – this is of concrete.

Options

The whole wall and contained platform is unstable at present; progressive settlement is obvious.

It is, therefore not considered practical to try and stabilize the present situation as continuing movement would result in failure. Ties across the corners would transfer problems into the lengths of wall adjacent. A rebuild would seem to be essential.

Another option for foundations was to use piles and a table raft for the pavement. Verbal cost advice suggests that this would be more expensive and possibly need intervention into the Memorial base for support.

Excavation of the problem area to a sound base is preferred.

Proposals

See drawing no. 1 (revision A)

The cross, base & steps are stable, local repointing only is proposed.

There is comprehensive failure of the surrounding pavement & enclosing wall. The proposal shown on drawing 1 (revision A) is suggested.

Removal of the two trees – to be replaced with new trees outside the enclosure – at a safe distance, (the landowner has agreed).

Recording & taking down the perimeter wall, preparing & laying sside the stonework for reuse.

Ditto the pavement & ditto.

Excavating the 'peaty' soil from below the pavement area down to identified firm bearing & clearing from site.

Providing new concrete footings to the perimeter wall & building-up to just below ground level with brickwork; thence reconstructing the stone wall to the original profile.

Filling the 'area with suitable compacted graded hardcore, gravel & sand.

Resetting the pavement in a weak concrete bed.

Making good to the gravel forecourt.

GRAHAM HOLLAND ASSOCIATES

Architects & Historic Buildings Consultants

4 King Street, Knutsford, Cheshire WA16 6DL

tel: 01565 651066

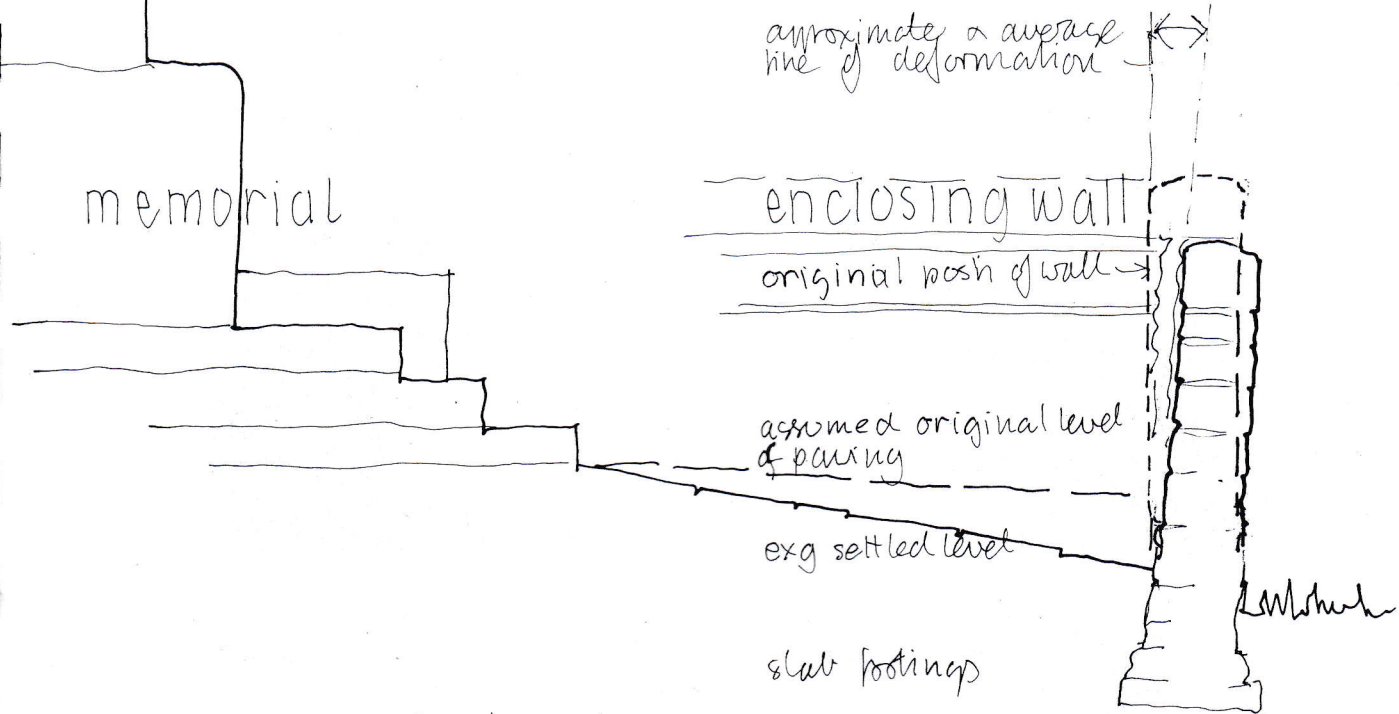
fax: 01565 755265

mobile: 07885 224256

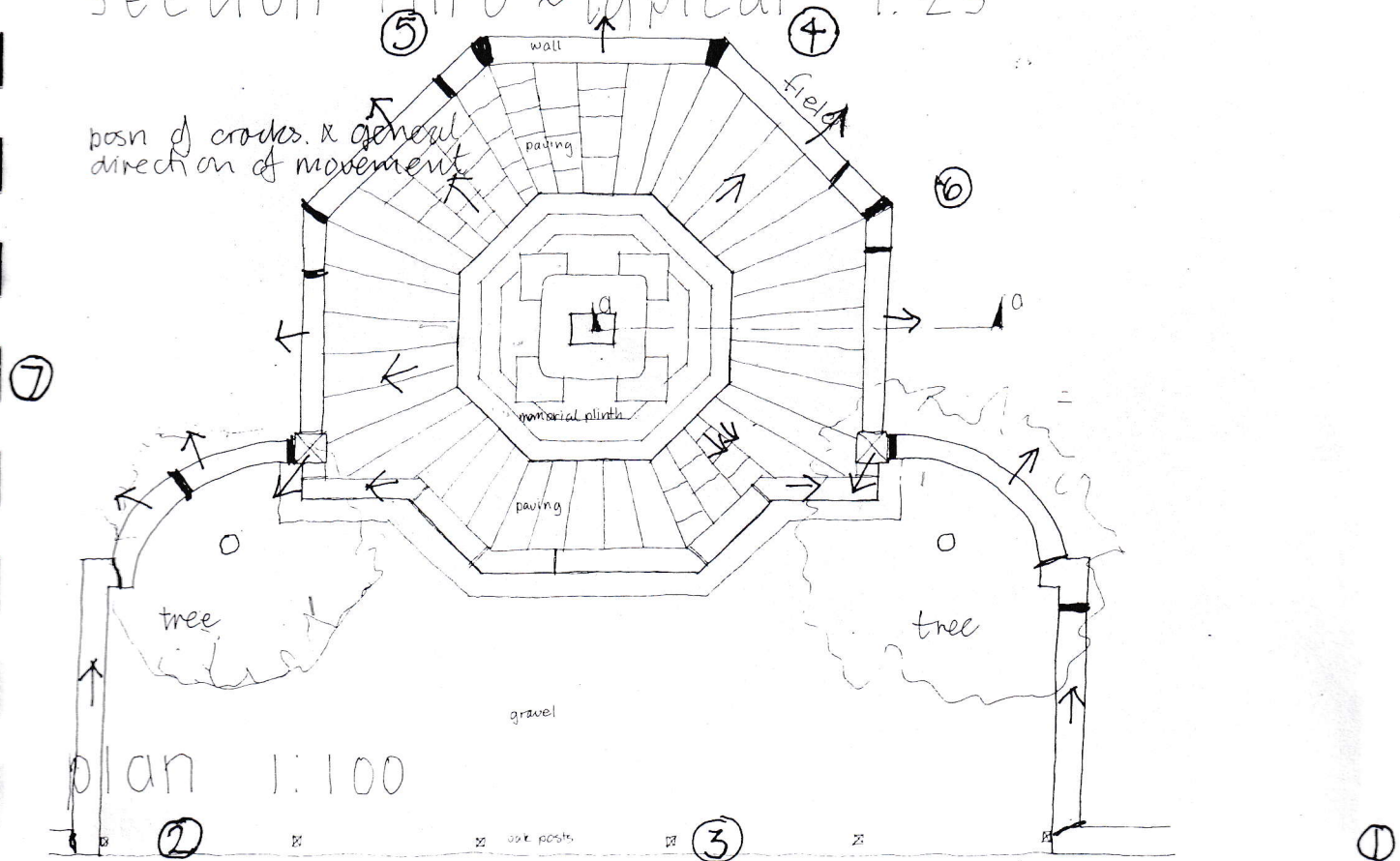
Plas Draw, Ruthin, Denbighshire LL15 1RT

tel: 01824 704709

fax: 01824 704912

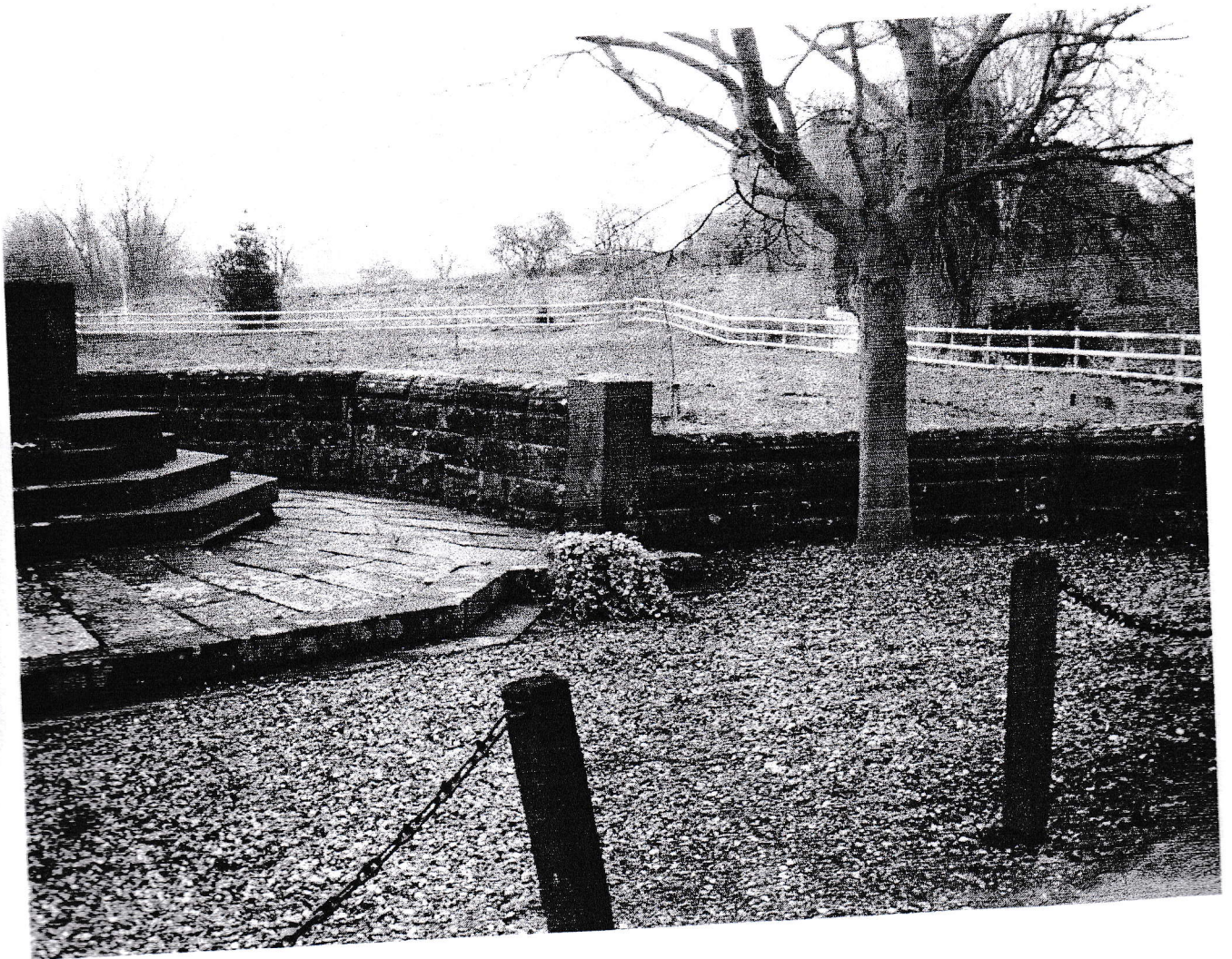


section thro ~ typical 1:25





②



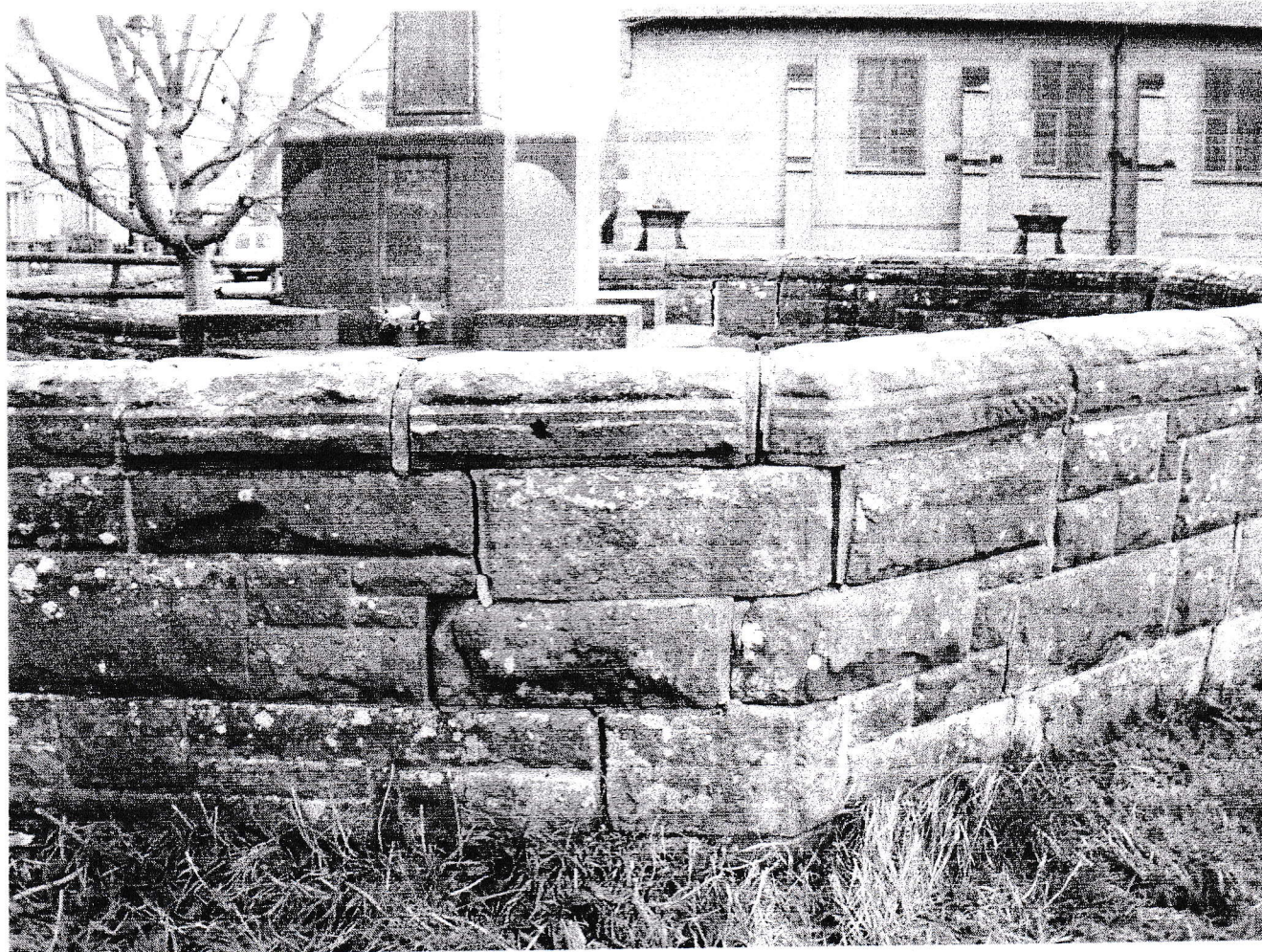
③



④



⑤



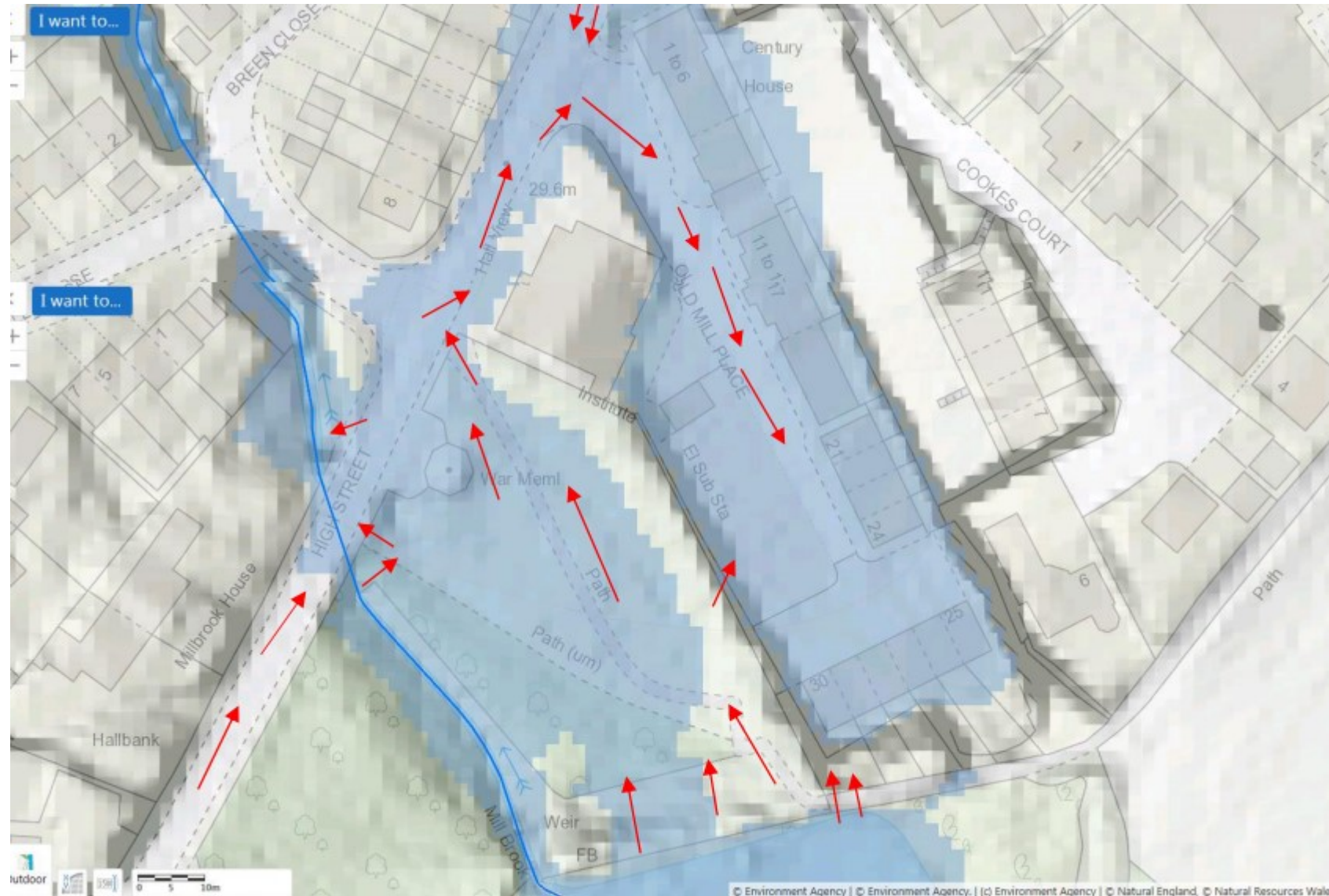
6



7

Steven Millar

From: Parish Clerk <tattenhallpc@outlook.com>
Sent: 28 April 2021 15:40
To: Steven Millar
Subject: RE: Flooding Tattenhall



From: Steven Millar <steven.millar@tieruk.com>
Sent: 26 April 2021 15:28
To: Parish Clerk <tattenhallpc@outlook.com>
Subject: Flooding Tattenhall
Importance: High

Hi Ann,

Do you have a map showing the extent of the flooding in the Tattenhall area in recent years, in particularly last year. It would be good to get the relationship of this in respect to the memorial. Did the Mill Brook flood and if so how extensively?

Can you confirm how many times work has occurred on the memorial in the last 100 years or so, you did mention the wall being rebuilt?

We have an internal meeting tomorrow and it would be good to get an idea of the flooding to help us interpret the data.

Kind Regards



Steven Millar BSc (Hons) MSc MCIWEM C.WEM FGS C.Geol

Principal Geo-Environmental Engineer | Tier Environmental

Suite 513, Chadwick House, Warrington Road, Birchwood Park, WA3 6AE

t: [01925 818 388](tel:01925818388) | m: [07867 497 480](tel:07867497480) | e: steven.millar@tieruk.com | w: tierconsult.com



This email is confidential and intended solely for the use of the individual to whom it is addressed. Any views or opinions presented are solely those of the author and do not necessarily represent those of Tier Consult Ltd. If you are not the intended recipient, be advised that you have received this email in error and that any use, dissemination, forwarding, printing, or copying of this email is strictly prohibited. If you have received this email in error please notify the sender by telephone shown above.

Steven Millar

From: Iain Keeping <iain.keeping@gmail.com>
Sent: 29 April 2021 09:46
To: Steven Millar
Cc: Parish Clerk
Subject: Re: War memorial floods and drains

.jpg images attached.

Iain K







APPENDIX E – SITE PHOTOGRAPHS

Project Name	Tattenhall War Memorial	Walkover Photographic Record	
Project No.	TE1579		
Engineer	Eve Rowland		
Client	Tattenhall Parish Council		
<i>Photograph 1 - Sinkhole present at the front of the Memorial</i>			
<i>Photograph 2 - Void under existing foundations at a sinkhole (HDP02)</i>			
Photographed By	Eve Rowland	Date	28.05.21
			

Project Name		Tattenhall War Memorial		Walkover Photographic Record	
Project No.		TE1579			
Engineer		Eve Rowland			
Client		Tattenhall Parish Council			
<i>Photograph 3 - HDP01 with Pinch Bar placed at the edge of existing foundation</i>					
<i>Photograph 4 - HDP01 with Pinch Bar inserted into void beneath the foundations (1.10m)</i>					
Photographed By		Eve Rowland		Date	28.05.21
					

Project Name	Tattenhall War Memorial	Walkover Photographic Record	
Project No.	TE1579		
Engineer	Eve Rowland		
Client	Tattenhall Parish Council		
Photograph 5 - Groundwater level at 0.80m bgl shown by existing potential soakaway/drain in close proximity to the Site (off- Site between the drainage ditch and brook)			
Photograph 6 - Diversion drain adjacent to Site			
Photographed By	Steve Millar	Date	28.05.21
			

Project Name	Tattenhall War Memorial	Walkover Photographic Record	
Project No.	TE1579		
Engineer	Eve Rowland		
Client	Tattenhall Parish Council		
Photograph 7 - Surrounding wall of memorial dipping towards the road due to subsidence			
Photograph 8 - Overview of Site showing proximity to the road			
Photographed By	Steve Millar	Date	28.05.21
			

Project Name	Tattenhall War Memorial	Walkover Photographic Record		
Project No.	TE1579			
Engineer	Eve Rowland			
Client	Tattenhall Parish Council			
Photograph 9 - Dip of the memorial towards the road and drain due to subsidence				
Photograph 10 - Damage to surrounding walls of the Site due to subsidence				
Photographed By	Steve Millar		Date	28.05.21

Project Name	Tattenhall War Memorial	Walkover Photographic Record	
Project No.	TE1579		
Engineer	Eve Rowland		
Client	Tattenhall Parish Council		
<i>Photograph 11 - Water seeping from well behind the Barbour Institute due to high groundwater</i>			
<i>Photograph 12 - Well behind the Barbour Institute</i>			
Photographed By	Eve Rowland	Date	28.05.21
			