South East Rivers Trust, Emm Brook Pipe Bridge Detailed Design report

25/04/2022

GHY-SERT-04-DOC-04 - Detailed Design Document.Docx

This document has been updated from the options appraisal document to record the early design process and the conclusions of the detailed design. Section 4 still contains the options considered, however section 5 (recommendations) has been deleted instead continuing with section 6 – Design solution.

CONTENTS

Issue Ref	Date	Author	Check	Review	Description
A	16-02-22	AMH			Draft issue
B	25-04-22	AMH	AMT	AMH	Updated from options appraisal into detailed design document.

1 INTRODUCTION

Ghyston Engineering Ltd has been employed by South East Rivers Trust to consider an existing foul sewer pipe in Wokingham and how this should be amended and supported in order to cross the restored channel of the Emm Brook as part of the proposed scheme.

The larger scheme describes the development of a river restoration design for a reach of the Emm Brook, South of Wokingham, Berkshire. The brook is a tributary of the River Loddon, itself part of the wider River Thames catchment.

Restoration Reach: OS NGR SU 79910 68889 to SU 79824 69269. The ultimate aim of the project was to develop a design to re-instate a historic channel located to the east of the current course of the Emm Brook, bypassing the existing channel and an associated weir structure at the downstream end of the site.

2 LOCATION

The proposed project is contained within the public green space (Woosehill Meadows) located to the east of Woosehill spine road and south of Reading Road along the river corridor. The green space is located adjacent to commercial units (supermarket) and residential housing, as such it has a mixture of uses, but a relatively high footfall.

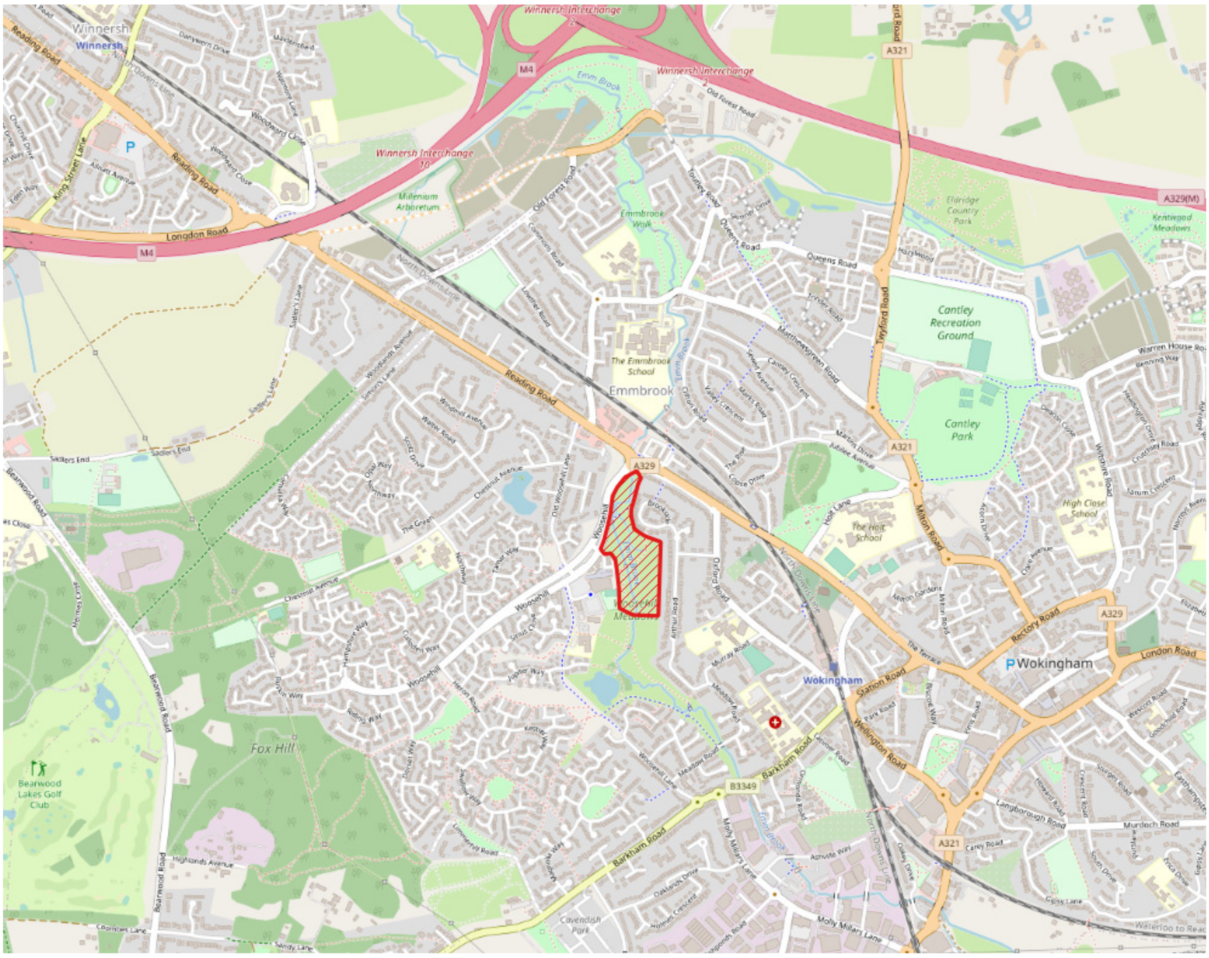


Figure 1 - Location plan

3 Scheme Background

3.1 Scheme proposals

The proposed scheme has been developed by South East Rivers Trust and CBEC Eco Engineering. Their designs were based upon a topo survey dated February 2019 "Emm Brook - Existing Conditions - Updated cbec - February2019" which also corresponds with the survey "M&P - Emm Brook -5006_comb 2017". This survey has been the basis of the following options appraisal in order to maintain a consistent set of levels throughout the scheme. The proposal is to reinstate the paleochannel of the Emm brook which lies just to the East of the existing watercourse. This will require a new off-take structure to divert flows, but will avoid a number of structures that are impassable to fish and will present an opportunity to increase the biodiversity of the reach, creating additional habitat along this watercourse.

Near the point at which the new channel is to diverge from the existing, the route of the channel passes over an existing foul water sewer which will need to be arranged so that the pipe freely spans the channel in its new arrangement.

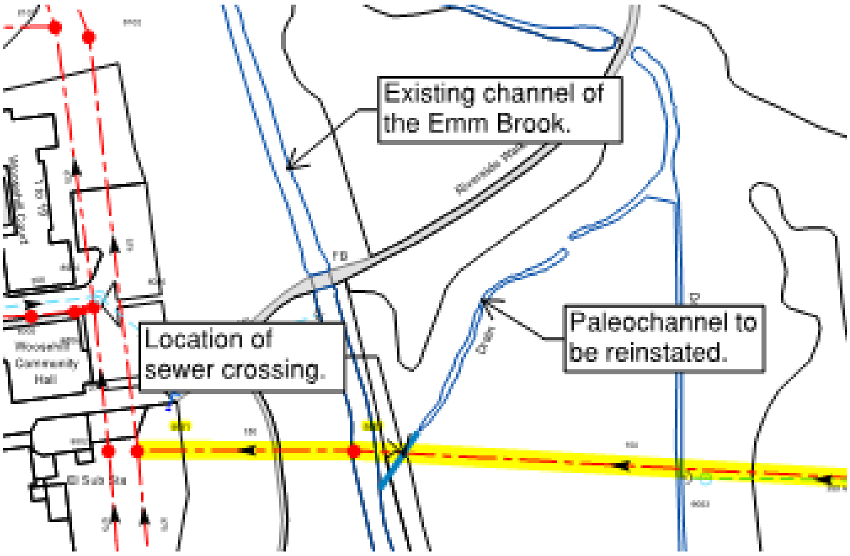


Figure 2 - Location of sewer crossing

3.2 Existing sewer

The site investigations that exposed the existing foul sewer discovered that the pipe is bedded onto concrete. It is supposed that this was done due to the poor ground conditions to provide additional support, however it is currently not known whether this has taken the form of concrete beams under the pipe between manholes or concrete pads to help spread the load and reduce the amount of settlement the pipes would experience.

Beams between the manholes seem unlikely due to the distance between manholes (40m and 80m). Also the concrete supports did not appear to be cast in shutters which would be expected for reinforced concrete structures. It is therefore supposed that the concrete was poured under the pipes to provide a wider footing and spread the load, therefore increasing the contact area of the pipes, which increases support to the pipes in the attempt to reduce settlement. This rationale has been expressed to Thames Water who has agreed that this is the most likely reason for this installation detail.

The underside of the sewer pipe is positioned at a level some 330mm above the base of the currently proposed channel. There are concerns that this would easily become blocked / obstructed with debris considering the nature of the wooded area within which this pipe cross is set. It is therefore recommended that the channel be widened and deepened into a pool at this location to increase the flow area, reduce the velocity of the water around the pipe and provide a greater flow area which may then be more resistant to blockages. However due to the decrease velocity in the channel at this location, deposition of silt is probable over time, so there may be a requirement for regular maintenance to clear silt from this area.

3.3 Location of manhole vs. proposed channel

The existing manhole serving the foul sewer is located near the centre of the proposed channel alignment and would significantly obstruct flows should the scheme be constructed as currently proposed. The two solutions at hand are to adjust the channel profile to avoid the manhole or to move the manhole. These options are discussed in section 4.

3.4 Modelling

CBEC have completed hydraulic modelling of the existing and proposed conditions in order to establish the effects on flood risk, flow depths, and velocities for the consideration of fish passage. Generally their target was to retain a flow velocity under 1.3m/s for flow volumes upto 1.5m^3/s. At the sewer crossing, the calculated water level is 44.275mAOD, with the underside of the pipe set at a level between 44.16 - 44.23mAOD. This would then require the channel to be enlarged at this location to increase the flow area as mentioned in 3.2 above. Considering the maximum velocity for the predicted flow volume above this gives a minimum flow area of 1.15m^2 at this water level.

4 OPTIONS DISCUSSION

The three main arrangements being considered are utilising a standard ductile iron pipe length (6m for a spigot socket or 5.5m for a flanged pipe), to have a steel pipe specially fabricated for this purpose in order to extend the free span of the pipe and whether to adjust the channel profile or move the manhole. These options are shown in drawings GHY-SERT-04-DWG-11-A.1 and GHY-SERT-04-DWG-13-A

4.1 Standard pipe length – OPTION 1

Utilising the standard pipe length is likely to result in a more cost effective solution, and to be more favourable with Thames Water (the sewerage undertaker) as standard pipes require standard maintenance and no special ongoing considerations (this has been confirmed as their preference within an email received from developer services on 14th February 2022). A standard 150mm pipe has a effective length of 5.5m. This would therefore represent the span for a single pipe length, however Saint Gobain (a well know industry standard supplier of ductile iron pipe) provides technical literature describing how bridges can be formed with standard lengths of pipe upto a length of 11m with spigot-socket joints or 10m with flanged joints as shown in Figure 3 below.

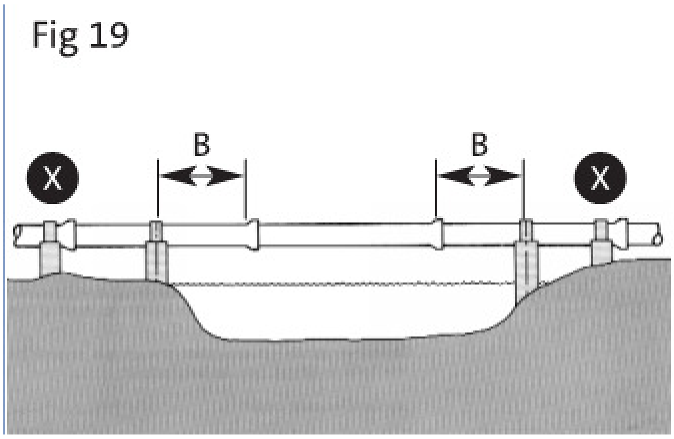


Figure 3 - Saint Gobain pipe bridge arrangement

It is noted that this may be undesirable as this would leave pipe joints over the watercourse. From a technical perspective this risk could be mitigated by ensuring that the pipe was air tested before completing the diversion in order to prove the efficacy of the installation and that the pipe did not leak on completion of the installation.

Even if a joint over the watercourse was deemed unacceptable, the use of standard pipes would leave pipe joints in close proximity to the water course, either side of the crossing location – it is noted that flexible joints are required in order to accommodate differential settlement between new and existing parts of the pipeline.

The arrangement showing the enlarged channel (option 1 shown within Appendix B) provides a flow area under the pipe of 1.52m^2 (sufficient to keep the flow velocity within the designed parameters). This profile also provides a pipe span of 4.1m at the predicted mean daily flow water level (the CBEC profile was previously only providing 2.4m span length). This span length could potentially be increased further and the channel could be further deepened should the project team feel that additional redundancy is required within the design.

A potential risk to the arrangement is the erosion of the banks of this arrangement especially around the manhole, which could be undermined by hydraulic action. It is therefore proposed to line the southern embankment of the channel with the Flex MSE stabilisation system. This is system of soil filled bags that are installed with interlocking plates that bind the system together. Once installed they can be seeded and can form a vegetated bank whilst providing protection from scour.

4.2 Fabricated pipe – OPTION 2

It has been confirmed by Thames water that they would prefer a design that used a standard ductile iron pipe rather than a specially fabricated steel pipe. This is so that it can be maintained in a regular manner (and if necessary replaced with regular pipe and fittings rather than having to wait for a specially fabricated piece to be made). The onus would therefore be on us / the design team to prove that a longer section of pipe is absolutely required, and the same design could not be delivered with standard pipe lengths. Considering that a free span of 4-5m can already be achieved with the standard ductile iron pipe which appears to achieve the requirements of the scheme (sufficient depth of flow for fish passage and cross sectional area for flow velocity) I do not believe that further consideration of a steel special pipe is necessary.

4.3 Re-locate manhole – OPTION 3

The third consideration is to re-locate the manhole in order to achieve the channel alignment as currently designed rather than amend the channel profile within this area. Replacement of a manhole will require over pumping for a longer period of time and a larger construction activity than re-profiling the channel to fit around the existing constraints. The level of the pipe would be unaffected, such that a larger cross section would still be required in this area (to protect the pipe crossing from a build-up of debris and reduce the anticipated flow velocity). There are considerations regarding the trees and their root balls to be considered, how the proposed alignment and resultant excavations might affect them, however the re-establishment of the channel will have to consider this implication in which-ever location the channel is excavated.

5 RECOMMENDATIONS

Text from options appraisal has been deleted. The design narrative is now continued within section 6.

6 DESIGN SOLUTION

Through discussions with South East Rivers Trust and Thames water option 1 has been chosen as the most favourable. Thames Water were opposed to the use of a steel special pipe, as this will complicate maintenance requirements for this crossing, and it was shown that sufficient cross sectional area could be made available to flows to adequately decrease the risk of blockages at this location. Moving the manhole was shown to be the most expensive option and was seen as unfavourable due to construction considerations such as increased over-pumping, risk associated with settlement of a new manhole, and increased works next to the watercourse.

Due to difficulties with the ground conditions (high water table, presence of peat etc) it was decided to opt for a shallow raft foundation instead of a deep excavation reaching down to the firm / stiff clays some 3.5m below. The ground investigations undertaken by RSK were used to determine the potential settlement of a pad foundation to support the east end of the pipework. These calculations are included within appendix D and determine the settlement as less than 5mm. This was submitted to Thames water for their consideration, who returned a positive verdict, agreeing that this level of settlement would be acceptable and could be accommodated within the pipeline.

It is noted that the pipe gradient at the crossing location has been measured on site as 1:50 (measurement by GD Contracting Ltd 12-08-2021 – supplied by SERT). This gradient would provide 110mm of fall per pipe length, therefore a 5mm settlement would be inconsequential to the operation of the gravity sewer.

Consideration has been given to the lateral forces on the exposed pipe from the water within the channel during flood conditions and support provided to the pipeline by the proposed foundation. CBEC Eco Engineering has produced the report document “U20-1057 Emm_Brook_Model_Update_Report_23_12_20” in which table 3 displays the anticipated water velocity for the 100 year flood event, showing that at the southern bridge (inlet control located adjacent to the pipe crossing position) the anticipated flow velocity is 1.08m/s.

Table 3 Velocity peaks at key structures during the 100 year return period hydrograph.

Bridge Name	Peak 100 y RP velocity [m/s]
Kingfisher	1.06
Un-named, existing channel north	0.40
South Bridge/control	1.08
Upstream of pond	0.46
Northern bridge, design channel	0.33
Between Alder tree trunks	0.86

Considering that within the proposed arrangement, 4.57m of the pipe will be exposed, this would give rise to an exposed face of 0.777m^2 (150mm ductile pipe with outside diameter of 170mm). This would give rise to a force of 0.84kN (0.42kN per end of pipe) to be resisted. The manhole is of sufficient bulk to resist such a force without consideration. However the new pad foundation is considered in the *Figure 4* below.

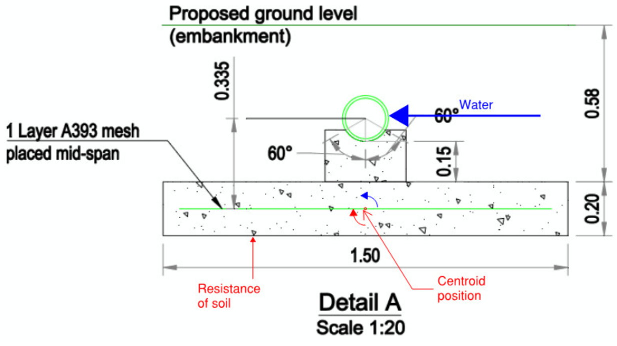
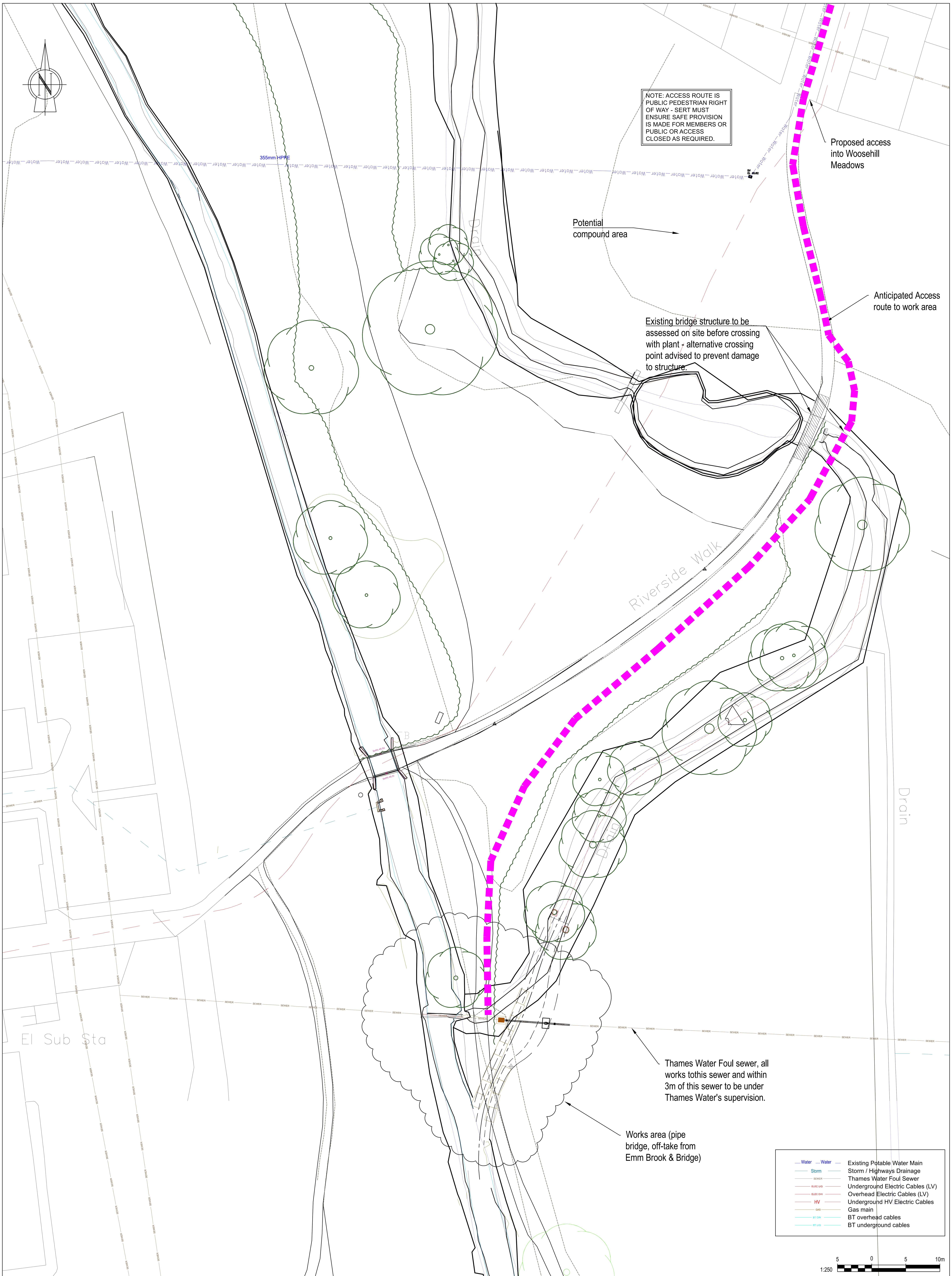


Figure 4 - Overturning forces

The force of water would act with a lever of 0.335m giving a total moment of (0.42*0.335) 0.14kNm. The resisting force would be the resistance of the soil under the opposite side of the pad foundation (the weight of the pad and soil above would equalise on either side of the centroid). The pad foundation is 1.5m x 1.0m, giving a half area of 0.75m^2 and a lever arm of 1.5m/4 = 0.375m. The resisting capacity (shear strength) of the soil would therefore need to be a minimum of 0.5kN/m^2. The soil testing from Windows Sample hole 2 (next to the proposed bridge location) gave a peak shear strength 18 kN/m^2 and in trial pit 1 (same location) the shear strength was 10kN/m^2. This shows ample capacity to resist the overturning forces applied by the force of water passing down the watercourse.

The final consideration was in regards to the embankment protection. It is anticipated that the force of water being directed down the new channel would give rise to a scouring action especially on the west bank of the new arrangement. It is therefore proposed to install a series of gabion baskets along this length to protect the embankment. Different protection methods were discussed and gabions was chosen as the favoured solution by SERT (see appendix E for the embankment options considered).

APPENDIX A – CONSTRAINTS PLAN



NOTES:

1. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialists drawings together with the specification.

IF YOU HAVE A QUERY CALL US

SCALING FROM THIS DRAWING OR OBTAINING DIMENSIONS ELECTRONICALLY MAY NOT PROVIDE ACCURATE INFORMATION AND SHOULD BE AVOIDED. WORK ONLY FROM FIGURED DIMENSIONS.

REV	REVISION DETAILS	DATE
B	EMBANKMENT PROTECTION CHANGED TO SINGLE GABION BASKET	27-04-22
A	1ST ISSUE	25-04-22

Ghyston Engineering Ltd

5 FURZE ROAD, FISHPONDS, BRISTOL, BS16 4HR
TEL : 0117 325 0745
email : Alex@GhystonEngineering.co.uk

PROJECT TITLE
EMM BROOK
PIPE BRIDGE

DRAWING TITLE
CONSTRAINTS PLAN

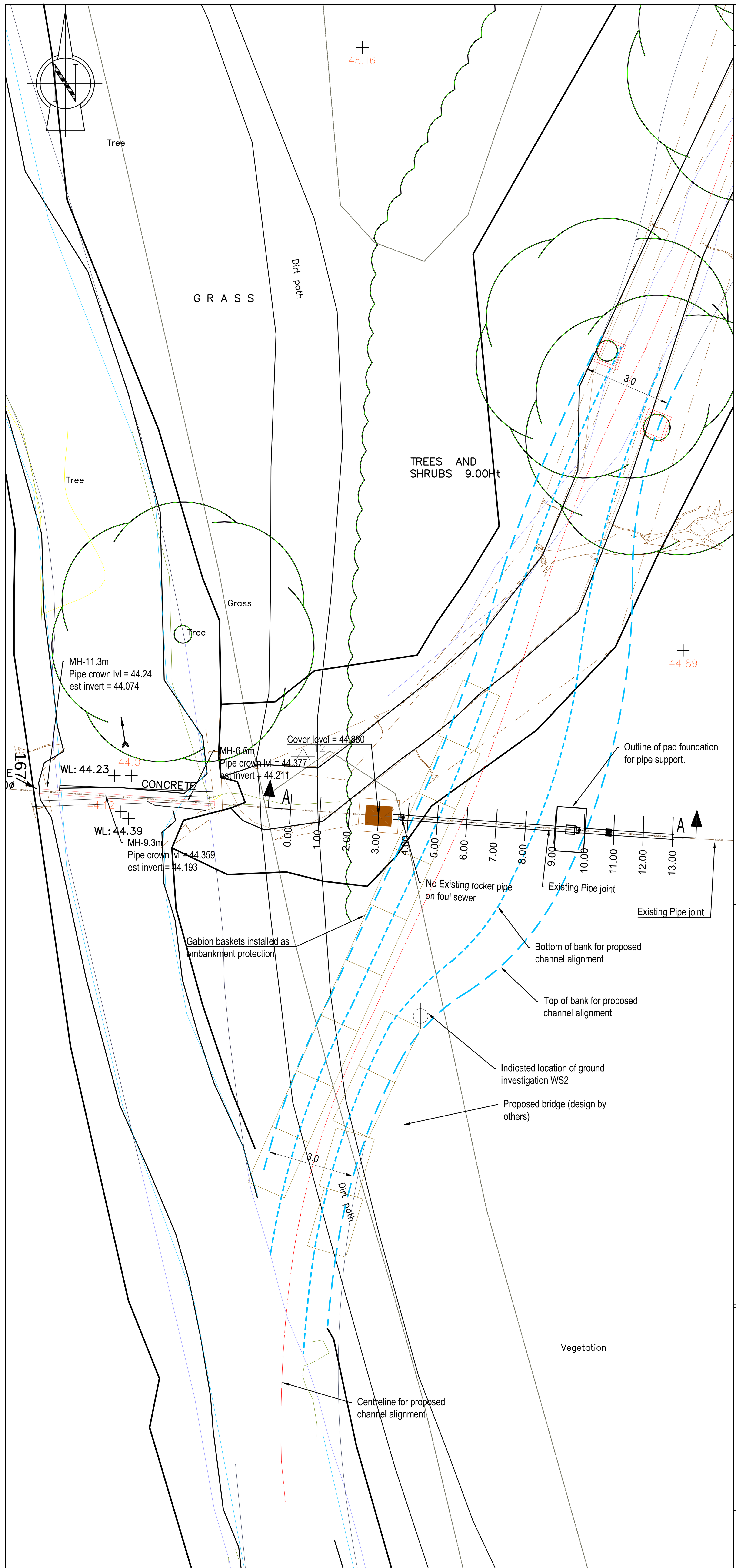
CLIENT
SOUTH EAST RIVERS TRUST

STATUS
INFORMATION

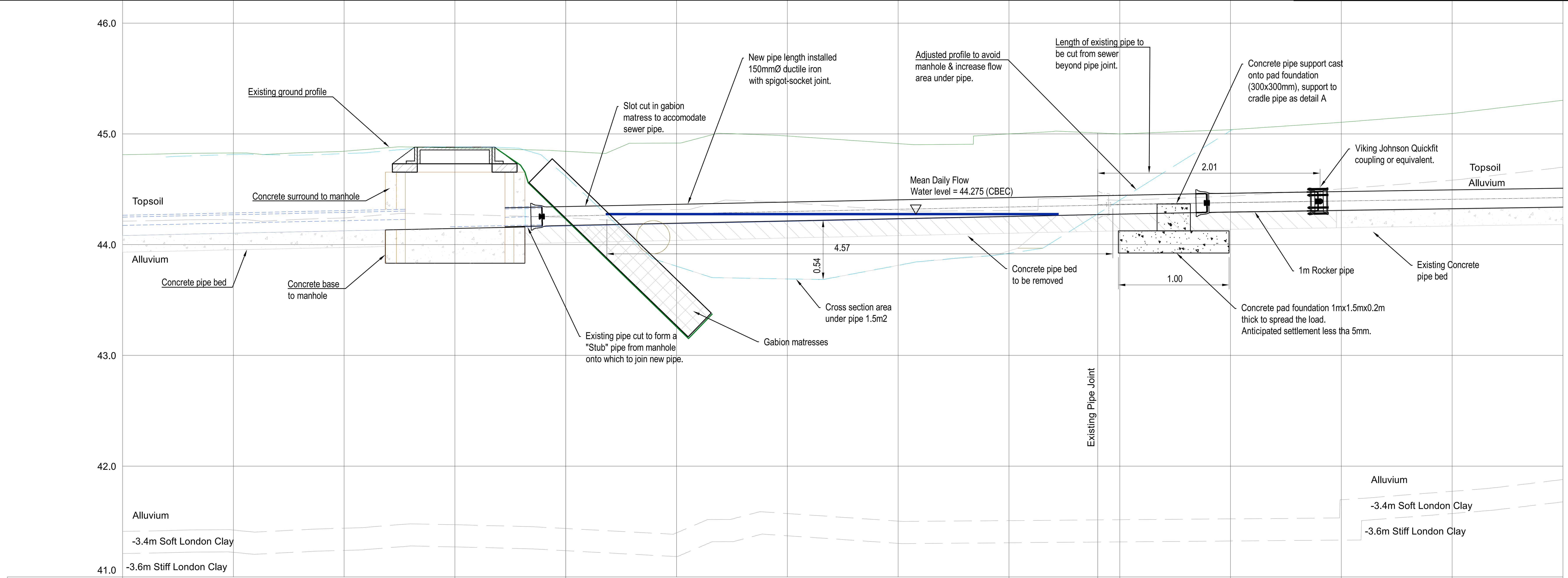
SCALE	DRAWN	CHECKED	APPROVED
1:250 AT A1	A.HUGHES	AMT	AMH

DRG SIZE	DRAWING NUMBER	REV
A1	GHY-SERT-04-DWG-13	B

APPENDIX B – LAYOUT PLAN

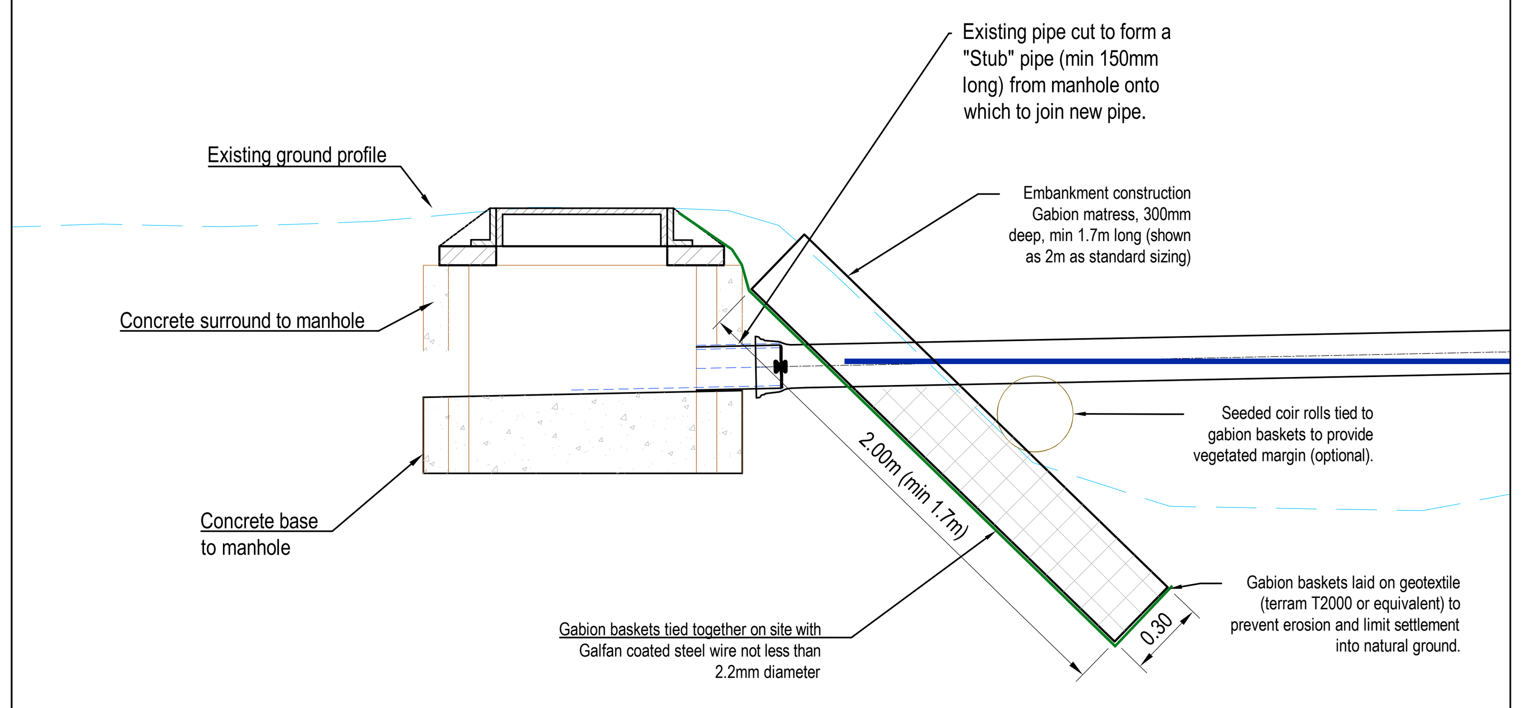


Plan Layout
Scale 1:100

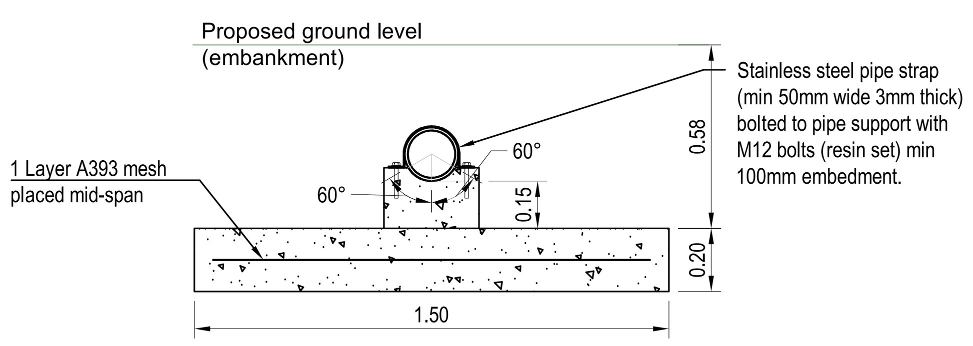


Chainage	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	8.80	9.00	10.00	11.00	12.00	12.00
Existing Ground Level				44.88	44.84				45.00	45.01					45.30
Proposed Level				44.12	43.84				45.00	45.01					45.30
Underside of pipe				44.15	44.17				44.25	44.27					44.34

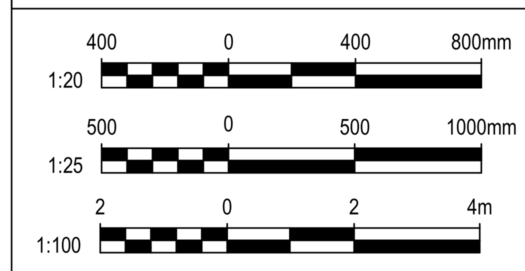
Section A-A
Proposed Arrangement
Option 1
Scale 1:25



Proposed Embankment Construction
Option 1
Scale 1:25



Detail A
Scale 1:20



1. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialists drawings together with the specification.
2. All dimensions are in m. Levels are shown in m AOD
3. Design of the proposed channel has been undertaken by CBEC. The details shown on the proposed channel are inferred from their designs, but should not be relied upon for construction purposes.
4. Design of bridges has been undertaken by another consultant. The details shown on this drawings in inferred from their designs, but should not be relied upon for construction purposes.
5. Ground information at this location has been based upon the investigations carried out by RSK in their report reference 1921661 R01(01) dated 29.06.2021, and specifically the window sampling hole WS2.
6. The proposed arrangements contained within these drawings are for discussion purposes only and should not be used for construction.
7. The design has been based upon the assumption that the existing manhole has settled to its full potential (has been in place for decades) and that the pipe runs are supported on concrete ground beams to reduce their relative settlement.
8. The gabion baskets shall have hexagonal woven mesh with a maximum size of 8 cm x 8 cm, formed of steel wire min diameter 3mm, treated with Galfan or quivalent protection (to EN 10244:2).
9. The gabion baskets shall be filled with a hard and durable angular stone 100-200mm in size (grading 6G) placed and lightly compacted to minimise the amount of voids present.
10. Concrete for the pad foundation and pipe support shall be C35 mix or equivalent approved.

Safety Health and Environmental information

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:

Construction:
S.1 - Access through public areas - conflict with members of public
S.2 - Works within watercourse - flooding of works
S.3 - High Ground water
S.4 - Interface with foul sewer
S.5 - Falls from height
S.6 - Working next to watercourse - drowning & Weils disease

Maintenance/Cleaning/Operation.
S.1 - Access through public areas - conflict with members of public
S.4 - Interface with foul sewer - Weils disease
S.6 - Working next to watercourse - drowning & Weils disease

Decommissioning/Demolition.
S.1 - Access through public areas - conflict with members of public
S.2 - Works within watercourse - flooding of works
S.3 - High Ground water
S.4 - Interface with foul sewer
S.6 - Working next to watercourse - drowning & Weils disease

REV	REVISION DETAILS	DATE
B	GABIONS CHANGED TO SINGLE BASKET, NOTE ADDED TO CLARIFY CUT-OUT FOR SEWER	27-04-22
A	1ST ISSUE	25-04-22

Ghyston Engineering Ltd
5 FURZE ROAD, FISHPONDS, BRISTOL, BS16 4HR
TEL : 0117 325 0745
email : Alex@GhystonEngineering.co.uk

PROJECT TITLE
EMM BROOK
PIPE BRIDGE

DRAWING TITLE
PROPOSED ARRANGEMENT
OPTION 1
STANDARD PIPE LENGTH

CLIENT
SOUTH EAST RIVERS TRUST

STATUS
CONSTRUCTION

SCALE		DRAWN	CHECKED	APPROVED
AS SHOWN	AT A1	AM HUGHES	AMT	AMH

DRG SIZE	DRAWING NUMBER	REV
A1	GHY-SERT-04-DWG-11	B

APPENDIX C – THAMES WATER CORRESPONDENCE

Alex Hughes

From:	DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
Sent:	31 March 2022 14:15
To:	Alex Hughes
Subject:	RE: RE: RE: Emm Brook Pipe Bridge Proposal. Red:DS6091513

Dear Alex,

Thank you for your email and I hope you are well. I looked over your design along with some colleagues. From the calculations, the settlement looks to be minor at 3.2mm. Your preferred solution to support the pipeline seems it may work. I can confirm this would be acceptable for Thames Water.

Warm regards,

Long Tran
Developer Services – Adoptions Engineer
Mobile: 0774 764 6498
Office: 0800 009 3921
developer.services@thameswater.co.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk

Get advice on making your sewer connection correctly at connectright.org.uk

Original Text

From:
To: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
CC:
Sent: 24.03.22 14:38:28
Subject: RE: RE: Emm Brook Pipe Bridge Proposal. Red:DS6091513

Good Afternoon Long,

Having considered options for supporting the pipeline further and looking at the practicalities of excavating deep pits etc for the foundations where there is high ground water, we have been exploring the option of casting a high level slab / pad onto which the pipe can be supported in order to reduce the potential long term settlement. We have undertaken calculations (as attached) to show that the anticipated settlement will be less than 5mm. This would be our preferred solution for to support the pipeline, please can you confirm whether it would be acceptable to Thames Water?

thanks

Kind regards

Alex Hughes
Beng Ceng MICE MCIWEM

Director

From: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>
Sent: 22 February 2022 10:23
To:
Cc:
Subject: RE: RE: Emm Brook Pipe Bridge Proposal. Red:DS6091513

Hello Alex,

Thanks for your email and no need to be sorry. I appreciate you working so diligently on this project. I can see how it is plausible for concrete to be poured under the pipe and not cast in shutters, so it must have reduced settlement in some way as you mentioned. Will this be your proposal or will the concrete supports be cast in shutters? The preference I think might be best would be cast in shutters unless you think otherwise. Please do let me know what you think.

Kind regards,

Long Tran
Developer Services – Adoptions Engineer
Mobile: 0774 764 6498
Office: 0800 009 3921
developer.services@thameswater.co.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk

Original Text

From:
To: DEVELOPER.SERVICES@THAMESWATER.CO.UK>
CC:
Sent: 16.02.22 07:43:51
Subject: RE: Emm Brook Pipe Bridge Proposal. Red:DS6091513

Long,

Sorry to send another email so quickly after the first, but I was considering the concrete supports again last night and have come to the same rationalisation which I hope you agree with:

Beams between the manholes seem unlikely due to the distance between manholes (40m and 80m). Also the concrete supports did not appear to be cast in shutters which would be expected for reinforced concrete structures. It is therefore supposed that the concrete was poured under the pipes to provide a wider footing and spread the load, therefore increasing the contact area of the pipes, which increases support to the pipes in the attempt to reduce settlement.

Kind regards

Alex Hughes
Beng Ceng MICE MCIWEM

Director

Ghyston Engineering Ltd

4HR

From: Alex Hughes
Sent: 15 February 2022 16:53

VICES@THAMESWATER.CO.UK>

Long,

Thank you for your response.

I note your comments in regards to preferring ductile iron pipe to a specially fabricated steel pipe section. The existing manhole adjacent to the proposed pipe bridge is an old square Brick style construction, approximately 450x600 internal dimension and some 0.73m deep (similar to sewers for adoption type "D" / or type 4 from 7th edition). I have attached a screenshot from the CCTV survey carried out on the sewer back in August 2020 by the client. I would note that there is no evidence of rocker pipes outside of the manhole chamber, infact, the chamber could have been formed around the pipe and the soffit of the pipe cut out?

We have ground investigation local to the pipe position, and my intention was to utilise the manhole as the pipe support on one side of the pipe span, and create a second pipe support on the other side with foundations extending to competent ground. As we do not have historic information on how this pipeline was designed for settlement, would you want me to design the interface with the existing pipe section as a beam support (i.e. tie it into the new foundation) or to consider the concrete under the pipe as a "spreader" foundation and therefore include a rocker pipe?

I have attached some work in progress drawings to demonstrate this principal for your consideration. Please note that the profile of the paleochannel has not been confirmed or the "free span" of the pipe (this is currently undergoing discussions with different parts of the design team) but please treat this as indicative of the support arrangements currently being considered for the pipework.

Kind regards

Alex Hughes
Beng Ceng MICE MCIWEM

Director

Ghyston Engineering Ltd

From R.SERVICES@THAMESWATER.CO.UK>
Sent:
To: A
Subject: RE: Emm Brook Pipe Bridge Proposal. Ref:DS6091513

Hello Alex,

Thank you for your email. The input I will give you will be in red.

The concept for the diversion has already been established, that being an online diversion of the foul to create a single span pipe bridge across the channel, with concrete foundations / abutments at either side of the channel. I am currently drawing up initial options for this but would appreciate your input in two respects:

1. One of the options being considered is to us a fabricated steel pipe to cross the channel so that we are not restricted to the standard pipe lengths for ductile iron (6m) this may create a better solution for the river restoration scheme, but I would like Thames Water's input to the acceptability of this proposal. Are there maximum pipe lengths you would accept, and other than the British Standards (BS10224 & 10311) does Thames Water have any specific requirements to have such a proposal accepted?

   Our preference would be to stay with ductile iron. The reason is because ductile would be more readily available compared to a specific fabricated steel. Just in case in the future, if there are remedial works that needed to be done, there wouldn't be a need or any delays to get the fabricated steel to do the work. As for the length, I understand the proposed upstream pipe will have an unsupported span of 4m. I have requested some information with our AM standards team so I will get back to you. At the moment, was thinking 7m span where the joints will be 1.5m from the unsupported section of the beam.

2. From initial trial pitting of the pipe to be diverted, it appears that the pipe was laid on a concrete bed. Please can you confirm if this was a design measure to prevent adverse settlement of the pipeline by forming beams between manholes. If this is the case, please can you confirm the dimensions and make-up of the beams (reinforcement etc) so that it can be incorporated within our design and also the design of the manholes which presumably would have needed to be piled or have their foundation extend to a specific depth. This query is largely informed by ground investigations of the area uncovering a depth of alluvium (associated with the old river bed etc) to a depth of ~3.5-4m.

   Unfortunately, we don't have information on the original design of the concrete bed. A recommendation would be to do a ground investigation and design a concrete bed to prevent adverse settlement. Please provide calculations, that would be great. As for the manhole design, how are the existing manholes nearby? Would you know the type and depth? I reckon following guidance of Design and Construction Guidance page 20-21 Figure B 3.

Kind regards,

Long Tran
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developer.services@thameswater.co.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk

Original Text

From: Alex Hughe

To: developer.services@thameswater.co.u <developer.services@thameswater.co.uk>

CC:

Sent: 07.02.22 13:34:58

Subject: Emm Brook Pipe Bridge Proposal. Red:DS6091513

Good afternoon,

I am working with the South East Rivers Trust (SERT) in respect to the reinstatement of the paleochannel of the Emm Brook in Woosehill Meadows, Wokingham. Nick Hale of SERT contacted you / your department to begin the diversion process of a foul sewer at this location on 10th January 2022 (reference DS6091513). I have been appointed by them to design the “diversion” of this sewer to allow for the reinstatement of this watercourse along its original path in a more ecological form and setting.

The concept for the diversion has already been established, that being an online diversion of the foul to create a single span pipe bridge across the channel, with concrete foundations / abutments at either side of the channel. I am currently drawing up initial options for this but would appreciate your input in two respects:

1) One of the options being considered is to us a fabricated steel pipe to cross the channel so that we are not restricted to the standard pipe lengths for ductile iron (6m) this may create a better solution for the river restoration scheme, but I would like Thames Water’s input to the acceptability of this proposal. Are there maximum pipe lengths you would accept, and other than the British Standards (BS10224 & 10311) does Thames Water have any specific requirements to have such a proposal accepted?
2) From initial trial pitting of the pipe to be diverted, it appears that the pipe was laid on a concrete bed. Please can you confirm if this was a design measure to prevent adverse settlement of the pipeline by forming beams between manholes. If this is the case, please can you confirm the dimensions and make-up of the beams (reinforcement etc) so that it can be incorporated within our design and also the design of the manholes which presumably would have needed to be piled or have their foundation extend to a specific depth. This query is largely informed by ground investigations of the area uncovering a depth of alluvium (associated with the old river bed etc) to a depth of ~3.5-4m.

Thank you in advance for your assistance.

Kind regards

Alex Hughes
Beng Ceng MICE MCIWEM

Director

Ghyston Engineering Ltd

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APPENDIX D – SETTLEMENT CALCULATIONS

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Settlement estimate
Author: RLPH
Date 22/03/22

Project: EMM BROOK PIPE BRIDGE

References: RSK - Ground Investigations - 1921661 R01 (01) Emm Brook Factual Report

A 150mm sewer crosses Emm Brook. This is to be replaced with a new ductile iron crossing. This calculation provides an estimate of the possible long-term settlement of the new crossing. Soil profile is shown on next sheet.

Pipe bridge length		6.000	m, one pipe length
Pipe dimensions:	id=	150.000	mm
and weight	Mass/m	23.800	kg
	volume/m	0.018	m^3
	fluid density	1100.000	kg/m^3
	mass/m	19.439	kg of sewage

Therefore, total mass = 2.545 kN of 6m length

Concrete pad, lxb (m):	l=	0.50	b=	0.50
thickness, t (m)=		0.20		
concrete density =		25.00 kN/m^3		
pad weight =		1.250 kN		

And load on each pad formation =	2.523 kN	at base of organic silt
Therefore, formation pressure =	10.090 kN/m^2	
NET formation pressure increase, p =	6.890 kN/m^2	assumes pad buried

Soil profile assumed:

Depth, m		γb kN/m^3	m_v, m^2/MN	
GL				
	organic silt, to be removed	16	n/a	
0.6				
	Soft brown Clay	17	0.300	estimated
1.6				
	soft blue clay	17	0.120	from RSK report
3				
	London Clay			

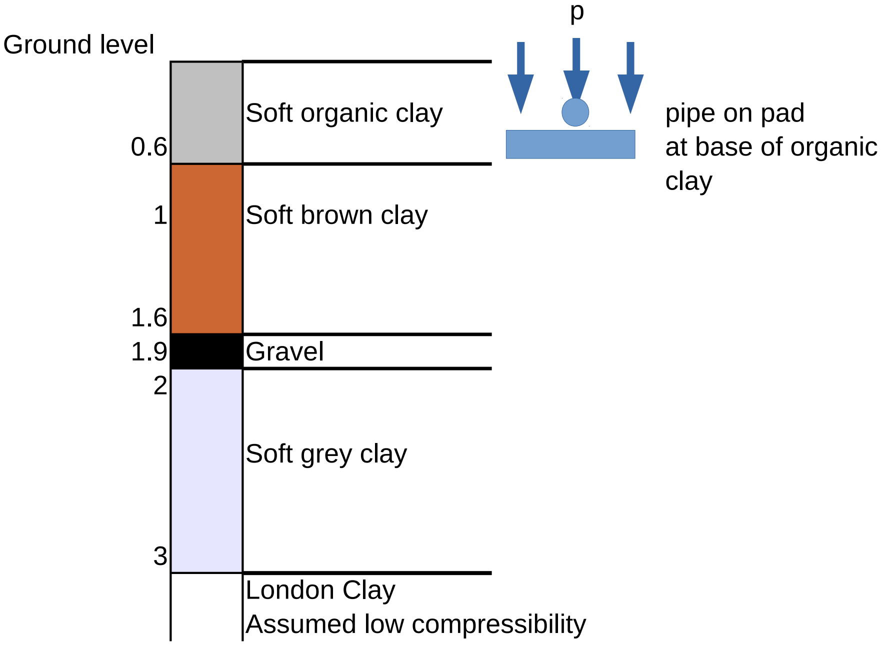
nb. layer of gravel 1.6-1.9m ignored

Settlement, δ = Sum (H x p x m_v) 3.2 mm
where H = thickness of layer

This calculation overestimates settlement because
a. no account taken of dissipation of load with depth and
b. no reduction made for relatively low compressibility of gravel layer.

Soft spots may occur anywhere in alluvial soils and actual settlements can vary significantly.

Ground Profile   From SKS report



p = Net bearing pressure = load from pipe and pad less the displaced soil load.

p would dissipate with depth. Calculation ignores this for simplicity and to allow for ground. variability.

Brown clay assumed to be softer than grey clay. M_v (coefficient of volume compressibility) was measured in a sample of grey clay (value of 0.12m^2/MN determined) and typical value of 0.3m^2/MN assumed for soft alluvium in brown clay.

APPENDIX E – EMBANKMENT OPTIONS

Ghyston Engineering Ltd

EMBANKMENT OPTIONS

To:	Nick Hale (South East Rivers Trust)	Date:	6th April 2022
From:	Alex Hughes	Subject:	Emm Brook Pipe Bridge

This note has been prepared in order to evaluate and present the options for embankment protection at Emm Brook, following on from our previous discussions on the subject.

1) Flex MSE

Description:
Flex MSE is a Geomodular building technology consisting of two components, the Flex MSE Bag and Interlocking Plate. These are assembled to create a soft solution that can vegetate finishing with a result similar to a natural embankment but reinforced and able to be constructed to a steeper slope.
https://www.flexmse.com/

Pros
Relatively cheap, simple installation with little training required, and does not require mechanical plant for installation. This solution can take an organic form / layout and results in a natural vegetated embankment. Stated design life of 120 years (life span of the UV stabilised synthetic bag).

Cons
Not as robust as other solutions and could be subject to vandalism (bags can feasibly be picked up and the wall de-constructed, or bags slit leading to loss of material and loss of support to embankment).

2) Concrete filled bags

Description:
Similar to the Flex MSE bag solution, this consists of individually places bags filled with a dry mixed concrete, which will naturally absorb moisture from the surroundings & the atmosphere to set in its final location. These bags come in 2 forms, sealed – for use below the water line and unsealed for use elsewhere. The bags are placed and pierced with metal bars at given intervals to provide an interlock and in the case of the sealed bag, to rupture the seal and allow water ingress to set the concrete whilst preventing contamination to the wetland environment. The life span of the structure is then similar to other concrete structures.
https://www.soluform.co.uk/concrete-filled-bagwork/

Pros
More robust solution than Flex MSE bags, creating a system of set concrete units. These units will be heavier than the vegetated bags and less likely to be moved / vandalised. Can still form organic shapes, embankment gradients and can be placed by hand.

Cons
Will not vegetate and bags will rot away leaving exposed concrete finish (aesthetic consideration only). Although heavier than Flex MSE it is still conceivable that the bags could be moved after the scheme is finished (vandalism).

3) Rock Rolls

Description

Large net bags made from UV stabilised braided polyethylene filled with stone, used as an alternative to gabion baskets. These bags can be placed and fixed together to create semi organic shapes (sweeping curves).

https://www.salixrw.com/product/rock-rolls/

Pros

Robust solution, too heavy to be moved by hand (vandalism). Easy to construct on site and quick to form a structure. The rock material contained by the net accretes silt and fine particles such that over time it can develop a partially vegetated look and helps to stabilise the embankment long-term.

Cons

Heavy bags – would require mechanical plant to place them on site. The net container is made of Polypropylene twine which can be cut leading to loss of stone (vandalism). Would require additional materials (coir rolls) to provide a natural vegetated finish quickly.

4) Gabion Baskets

Description

Traditional stone filled galvanised steel baskets with a long service life (typically 50 years+)

https://www.gabionbaskets.co.uk/

Pros

Well established solution, very robust with little / no chance of vandalism affecting the installation.

Cons

Very heavy and typically wide may lead to settlement. Regular, square shape – will not easily conform to an organic shape / form on site. Will not vegetate over time, will require mechanical plant for placement. Likely to be a more costly solution.

5) Geotextile Embankment

Description

It is possible to create a reinforced embankment purely with the use of geotextiles (Geoweb + Vmax for example) however this would be a very soft solution and in my experience can be susceptible to being moved by hydraulic action. It is also not very robust when considering interaction with the public for the first season. However after the first season it is sufficiently vegetated to not longer be a target for vandalism and is also tied together to withstand most instances of hydraulic action. It would present a low cost solution but exposes the site to an increased degree of risk.

Pros

Low cost solution, very natural and self-reinforcing long term. Very flexible and light weight solution, no plant required and no additional skill-set required for installation.

Cons

Least robust solution, site exposed to risk of erosion and vandalism during establishment phase (typically 1st year). Has potential to move around long term, may not establish a suitable fixed hydraulic control for flow splits.

6) Concrete block revetment

Description

A system of pre-cast concrete blocks fixed together with wire to form a flexible mattress. The blocks typically have holes in them to allow vegetation to take root.

http://www.armortec.co.uk/armorflex.htm

Pros

Very robust, will allow a degree of vegetation, blocks are tied together such that they cannot be individually be moved (vandalism), will conform to site shapes / profiles. Low skill set required for installation.

Cons

Usually used in larger schemes, small quantities may be problematic. Will require mechanical plant for installation.

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EMBANKMENT OPTIONS

	Solution	Appearance (vegetation etc)	Robustness	Susceptible to vandalism	Cost	Score
1	Flex MSE	5	2	1	4	12
2	Concrete filled bags	2	3	2	4	11
3	Rock Rolls	3	4	4	3	14
4	Gabion Baskets	1	5	5	1	12
5	Geotextile	5	1	1	5	12
6	Concrete block revetment	2	5	4	2	13

Note the above is scored based on 1 being least positive and 5 being most positive

Based on the above (no weighting to any category) Rock rolls would be the recommended solution.