Jacobs

CCT/23 CS 454 Assessment and Inspection Report

A675 Bolton Road Bridge, Lancashire

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National Highways – Historical Railways Estate
VAR9/7070

HRE Assessment Programme
April 2023

CCT/23 CS 454 Assessment and Inspection Report

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Revision	Issue approved	Date issued	Issued to	Comments

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Executive Summary

Structure Type: Skewed single span overbridge

Superstructure Form: Cast iron girders with brick jack arches

Substructure Form: Stone abutments and wingwalls

Span: Skew Span: 10.18m; Square Span: 8.44m

Assessment Code: CS 454

Capacity Factor: 0.7

Capacity Critical Element: Internal carriageways girders, mid-span bending

Restriction: 7.5T ALL

Condition: Poor

Local Authority: Lancashire

OS Reference: SD 639 228

This report presents the load carrying capacity for the bridge and identifies the data used to derive the assessment. The load carrying capacity of the bridge is based only on the assessment of visible spans that were amenable to inspection. It has been prepared by Jacobs for the exclusive use by HRE and should not be relied on by third parties. It has been based on site measurements and investigation by Jacobs or historical information provided by HRE, as appropriate.

The description of condition does not represent a principal inspection, nor should it be relied on for the development of maintenance works. Close inspection of members was limited by the constraints of safe access possible within the site visits described.

Identification of defects is principally based on ground level observation of visible members. The structural arrangement of the bridge meant that the following elements were not examined as part of the inspection for assessment:

- Tie bars are located above the jack arch extrados level and were not visible for inspection. The tie bars were assumed to be competent owing to their protection by the deck construction.
- Internal girders - due to the jack arch construction, only the underside of the bottom flanges of the internal girders were visible. Therefore, the internal girders' webs and top flanges are considered built-in parts protected by the deck construction and not amenable for inspection.
- Edge girders – the parapet screens fixed to the top of the edge girders restricted the inspection of the top flanges. The internal face of the flange outstands and web were considered to be built-in parts and therefore not amenable to inspection. Unexposed surfaces were assumed to be competent owing to their protection by the deck construction.

Contents

Appendices

1. General Description and Structural Details

1.1 Introduction

Jacobs was appointed by National Highways Historical Railways Estate (HRE) to undertake a CS 454 assessment of structure CCT/23, Bolton Road Bridge. The bridge was highlighted in an Abnormal Load appraisal based on the 2001 BD21/97 assessment which had rated the bridge at 40T ALL and 45 units of HB load. A rating of 45 units HB loading for a quite delicate cast iron bridge aroused suspicion. It appeared that only the total tensile stress limit had been evaluated but the live load tensile stress limit ignored. Consequently, a new assessment was recommended. Abnormal load movements have been refused in the interim period.

Structural Soils Ltd. provided a scaffold tower for high level access to the superstructure soffit.

1.2 Location and General Description

Bridge CCT/23 'Bolton Road Bridge' carries the A675, Bolton Road, over the former Chorley - Cherry Tree railway line in Abbey Village, Lancashire.

The road is a single lane carriageway with a width of 7.15m at the centre of the span. On the east side of the road there is a 2.81m wide grass verge and to the south a 1.02m wide footpath. The overall width between the parapets is 10.99m. Refer to the plan at road level in Appendix F for dimensions.

The OS Grid reference is SD 639 228.

The former Chorley - Cherry Tree railway line was opened circa 1869. From its structural form, materials, and indications from historic mapping it is probable that the bridge dates from this time. The railway below the bridge was closed to passengers in 1960 and to all through traffic in 1966 with the tracks removed some time later.

1.3 Construction Type

The dimensions recorded during the survey correspond with those detailed in the existing drawings provided by HRE and are as detailed below.

The structure is a skewed, single span bridge with cast iron girders and brick jack arches. The clear square span is 8.44m and the clear skew span is 10.18m giving a skew angle of 33°.

The bridge comprises 13 cast iron internal girders. Five girders span between the abutments and four on each side span between an abutment and a cast iron edge girder. Brick jack arches spring from the bottom flanges of the internal girders. 28.56mm diameter tie bars are located above the extrados of each of the jack arches spaced equally across the span.

Cast iron edge girders

The bridge has two cast iron edge girders with a total depth of 762mm (2'6"). The bottom flange is 508mm wide with a thickness of 63.5mm. The upper flange is 228.6 (9") wide and 47.6mm thick. The web has a thickness of 50.8mm at the bottom flange tapering to 38.1mm at the top.

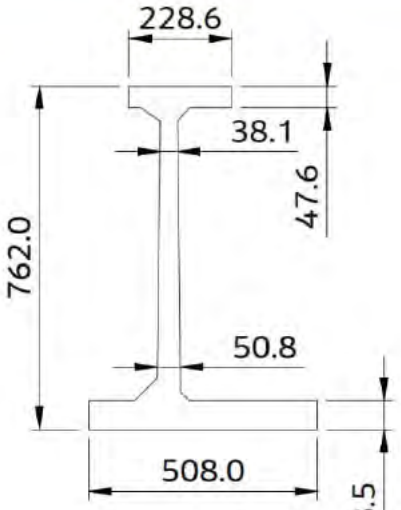


Figure 1: Edge girder

Cast iron internal girders

The full length internal girders are recorded as having a total depth of 609.6mm at midspan tapering to 457.2mm at supports. The shorter girders spanning between the abutments and edge girders appear to be cut from full length girders on the required skew.

The top flange is 152.4mm wide with a thickness of 50.8mm. The web has a thickness of 50.8mm at the bottom flange and tapers to 38.1mm at the top flange. The bottom flange was measured as 457.2mm wide with a thickness of 57.2mm.

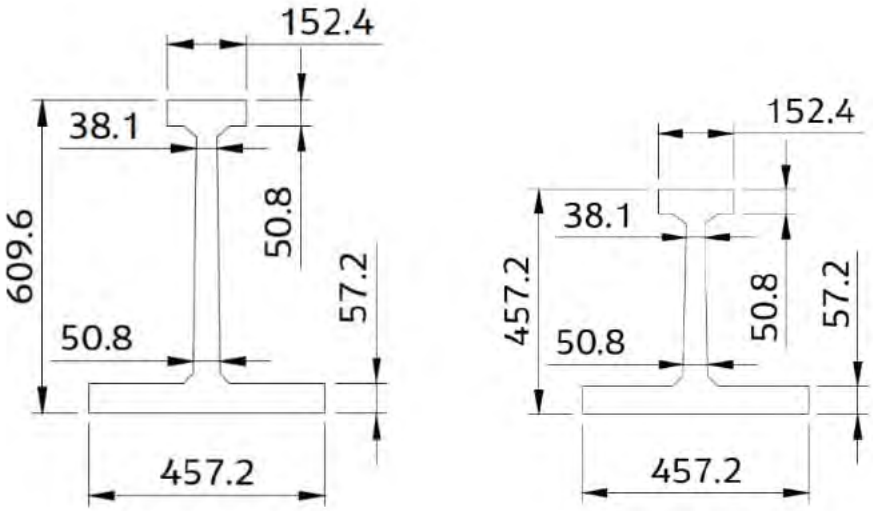


Figure 2: Internal girder at support (left) and midspan (right)

Original L&YR drawings show that concrete infill is present up to the underside of the top flange of the internal girders after which there is a layer of ashalt overlain by hardcore filling and a layer of tarmac. URS Thorburn Colquhoun confirmed this arrangement in trial pits excavated as part of their 1999 inspection for assessment. Refer to the section drawing of the deck in Appendix F for details.

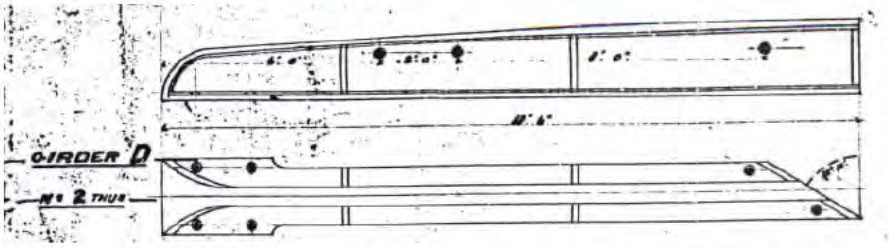


Figure 3: Shorter girder from L&YR General Arrangement Drawing, 1935

Jack arches

The jack arches have a thickness of 228.6mm (9") with a measured average rise of 89mm and a clear span of 838.2mm between internal girders. Tie bars are located above the jack arch extrados level, they are recorded as having a diameter of 28.56mm and are spaced at 3m centres.

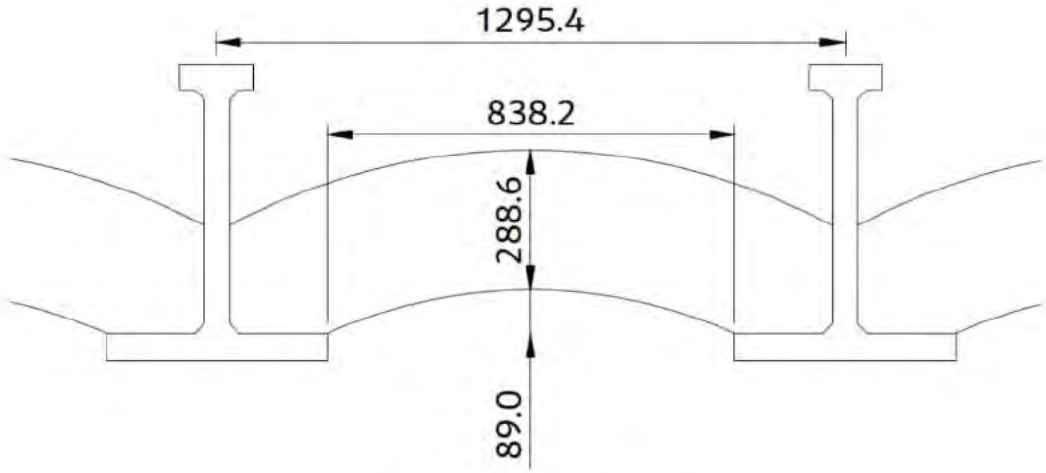


Figure 4: Jack arches

Parapet

The parapets are formed from cast iron panelling fixed to the top flange of the edge girders by 22mm (⅞") shaft diameter rivets spaced at 685.8mm centres (2'3"). The cast iron panels are topped with a 385mm high timber boarded fence.

Substructure

The abutments and wingwalls comprise regularly coursed squared masonry.

Sketches of the plan at road level, elevation and sections of the deck are included in Appendix F.

2. Information Search

2.1 Services Search

A services search was carried out by Jacobs in April 2022. Information is supplied in Appendix D.

2.2 Site Investigation Description and Results

Undated general arrangement drawings produced by Lancashire and Yorkshire Railway were provided by HRE. The drawings provided were considered sufficient to obtain the details of the hidden elements therefore an intrusive survey was not required for CCT/23.

2.3 Existing Drawings

Existing sketches from a Thorburn Colquhoun inspection and assessment report, dated June 1998, contain cross section, elevation, and a plan of the structure. These drawings have been used to compare with dimensions taken during the survey. The dimensions taken during the site survey are consistent with the dimensions given in the existing information. Refer to Appendix E for details.

3. Structure Condition

3.1 General

The survey and inspection for a CS 454 assessment were undertaken on Wednesday 31st August 2022. Weather conditions were dry and bright with a temperature of 19°C.

During the inspection the superstructure was felt to vibrate under heavy vehicle loading. A condition factor of 0.90 shall be applied to the live load modulus to account for the amplification of live load stresses due to the vibration of the deck. The value of the condition factor is based on an appraisal of the degree of vibration observed and is considered equivalent to a 'poor' road surface factor.

Parking was available in the road off the A675 to the south east of the bridge. Access to the formation was gained through private land (former Withnell Station) down the south west embankment.

3.2 Structure Condition

3.2.1 Edge Girders

The edge girders are in a fair condition (Photograph 6 and 18). There is paint loss to the outer face of the webs with the exposed cast iron exhibiting minor corrosion.

There is full paint loss to the bottom flanges with moderate lamination and pitting corrosion to the underside. Corrosion was observed along the full length of the girder. Section loss up to 2mm deep was recorded at midspan.

The upper flanges are obscured by the cast iron plate casting that clamps the parapet panels to the girders. Due to their protection by the plate casting, the top flanges are assumed to be in a good condition. There are several large fractures to the underside of the plate casting with iron shards hanging down on both elevations (Photograph 22). All connection bolts with internal girders exhibit moderate corrosion.

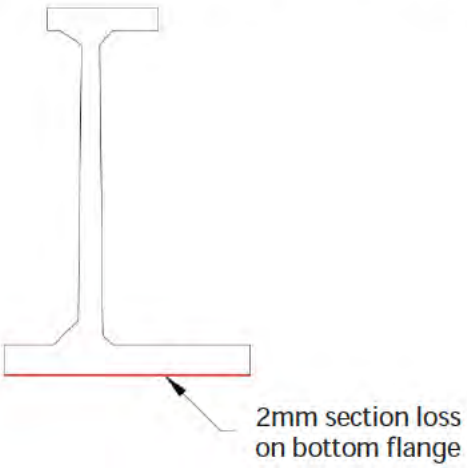


Figure 5: Section loss on edge girder

3.2.2 Internal Girders

The internal girders are in a fair condition (Photograph 6, 18 and 19) though there is moderate corrosion along the underside of the bottom flanges. De-lamination and pitting corrosion are evident along the full length of the girders. Section loss up to 1mm was recorded.

Calcite deposits and stalactite formations are visible below the steel and jack arch interface (Photograph 16). This suggests the bridge waterproofing has been locally compromised with active seepage occurring through the bridge deck.

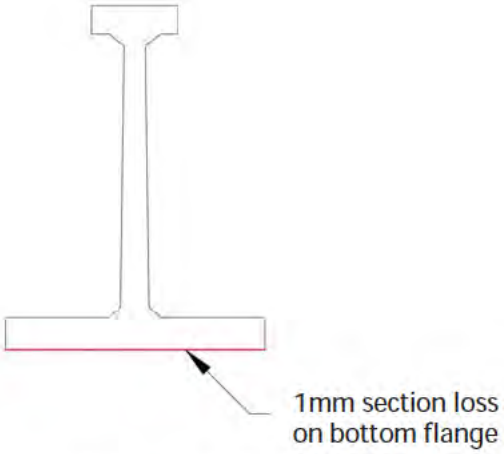


Figure 6: Section loss on internal girder

3.2.3 Jack Arches

The jack arches located below the carriageway are in a fair condition. Several of the jack arches display a distorted profile with two courses out of line at the most severe location (Photograph 17). In a number of bays, the jack arch rise appears flattened. Isolated areas of displaced brickwork were noted.

Spalling was visible across 50% of the arches with a depth of up to 10mm. Individual spalled bricks were observed with a depth of 50mm. There are isolated recessed and open joints primarily located within the damp areas of the jack arches.

Water staining and calcite deposits are visible, most notably at the interface between the jack arch and cast iron girders. Water was found to be actively dripping from several locations throughout the bridge soffit.

Several missing bricks were noted in the skewed corner of the north east end jack arch at the connection between the jack arch and edge girder. The arch has partially collapsed with the fill below the verge visible through the hole in the arch (Photograph 21). This jack arch is in a poor condition.

3.2.4 Abutments

Both abutments are in a fair condition (Photograph 7 and 8). The western half of the north abutment is not visible due to the horse stable which has been built in the formation. Water staining and damp areas are present throughout the visible areas of both abutments and is concentrated around the bearing stones. The walls exhibit isolated areas of calcite staining.

3.2.5 Wingwalls

The wingwalls are in a fair condition (Photograph 9 to 12).

The north east wingwall is partially obscured by vegetation. There is light vegetation growth on the bearing shelf. Joints are well filled throughout the wall. There is a crack through a mortar tab located on the pilaster return dated 31.10.09 (Photograph 15).

The north west wingwall is only partially visible due to vegetation and tree growth. Ivy growth covers the bottom two courses of the wall. The visible areas of the wall are in a fair condition.

On the south east wingwall there is an individual brick spalled to a depth of 200mm located above string course (Photograph 13). There is widespread moss growth and algal staining across the wall. Joints are well filled though there are isolated areas of vegetation growth in some joints (Photograph 14).

Joints are well filled across the face of the south west wingwall. There is light vegetation growth visible on the bearing shelf.

3.2.6 Parapets

The cast iron parapets exhibit paint loss and minor corrosion throughout (Photograph 25 and 26). There are displaced panels on both the east and west parapets (Photograph 23 and 24).

3.2.7 Formation

The formation to the west has been developed into a private residence (Photograph 29). A timber fence and gate run between the north and south abutments. A horse stable is located beneath the structure and the formation has been paved in flagstones (Photograph 28). The formation to the east is farmland (Photograph 27).

3.2.8 Road Surface and Traffic Flow

The road over the structure is in fair condition with no signs of settlement or tracking. There is some minor degradation to the surface. The road surface shall be taken as “good” for the purpose of this assessment.

DfT road traffic statistics suggests the Annual Average Hourly HGV Flow (AAHHGVF) over the structure is “Medium” in accordance with CS 454 cl.5.5.

4. Assessment to CS 454

4.1 Methodology

Capacities of the elements were calculated using estimates of reduced section sizes where corrosion is present.

Resistance capacities of the cast iron girders were determined in accordance with CS 454 Clause 8. The capacity of the internal girders was not enhanced using the section modulus factor F_I, as there is discontinuity in the material encasing the girders at the level of the top flange.

The deck was checked using ALL model 1 (Appendix B vehicle loads), applied using a simple "2D" grillage model. The edge girders were checked for the effects of accidental vehicle loads utilising ALL model 1 applied using the same grillage.

A condition factor of 0.90 has been applied to the live load modulus to account for the vibration of the deck felt under heavy vehicle loading.

Determination of the adequacy of the jack arches was based upon the empirical method as described in Bridgeguard 3 Current Information Sheet No. 22 (Pro-forma for the empirical assessment of brick, masonry and concrete jack arches and associated ties).

The substructure was assessed qualitatively.

4.2 Results

Element: Internal girders – ALL Model 1 in accordance with CS 454 Cl.5.8

Action	Location	DL & SDL Effect	ALL Model 1 loading	Total Load Effect	Assessed Resistance	Live Load Capacity
Bending 40T	Mid-span	324.2 kNm	202.2 kNm	526.4 kNm	466.9 kNm	Fail
Bending 26T	Mid-span	324.2 kNm	195.7 kNm	519.9 kNm	466.9 kNm	Fail
Bending 18T	Mid-span	324.2 kNm	159.4 kNm	483.6 kNm	466.9 kNm	Fail
Bending 7.5T	Mid-span	324.2 kNm	81.89 kNm	406.1 kNm	466.9 kNm	7.5T ALL
Shear 40T	Support	7.3 kN	4.6 kN	11.9 kN	149.2 kN	Normal Traffic

If the 0.9 condition factor is not applied on the live load modulus, the assessed bending resistance increases to 482.8 kN.m, but this value still a marginal failure for 18T GVW loading.

Element: Edge girders – ALL Model 1 (AVL) in accordance with CS 454 Cl.5.8

Action	Location	DL & SDL Effect	ALL Model 1 Accidental Vehicle Loading*	Total Load Effect	Assessed Resistance	Live Load Capacity
Bending 40T	Mid-span	83.0 kNm	359.9 kNm	442.9 kNm	491.7 kNm	40/44T AVL
Shear 40T	Support	31.1 kN	93.8 kN	124.9 kN	779.7 kN	40/44T AVL

* Accidental Vehicle Loading is the critical load effect on the edge girders. Normal Traffic Loading on the carriageway need not be considered in this instance.

Element: Jack Arches

Bridgeguard 3 CIS 22 does not explicitly deal with the skewed arrangement of the jack arches on this bridge, being intermediate between longitudinally spanning where no tie bars are required and transverse spanning where the specified provision of tie bars is required. The tie bars have insufficient cross-sectional area and are spaced too far apart to comply with the transverse spanning requirements, but the bolted connection between the internal girders and the edge girders may be considered to provide a 'hard edge' and hence compliance with the CIS 22 section 2 type 5 check. The east jack arch fails due to the partially collapsed arch in the north skewed corner, but this would only be applicable in the case of Accidental Vehicle Loading.

Element: Substructure

The visible areas of the substructure above ground level show no significant defects or signs of structural distress. The substructure was deemed suitable to support normal traffic loading by qualitative assessment to CS 459.

The wingwalls and abutments appear to be sound and are accordingly rated as adequate for normal traffic loading.

5. Conclusions and Recommendations

The internal girders have been found to be suitable for 7.5T GVW only in mid-span bending under two-lane loading. A weight restriction of 7.5 tonnes GVW loading is therefore indicated. The assessment applied a 0.9 general condition factor to account for the amplification of live load stresses due to deck vibration felt under heavy vehicle loading. It is appreciated that evaluation and application of condition factors is somewhat subjective, though the calculation indicates that even if the factor is not applied, there is still a marginal failure at 18T GVW and hence the same 7.5T GVW limit is indicated.

The assessment demonstrates that the edge girders have sufficient capacity to support 40/44 tonnes assessment live loading applied to the carriageway and Accidental Vehicle Loading up to 40/44T applied close to the edge.

The jack arch in the skewed north east corner has partially collapsed. There is a wide verge at this point, so the damaged section would only be affected by extreme positioning of accidental vehicle loading.

By qualitative assessment, the substructure appears to be satisfactory to support normal traffic loading in line with CS454.

With cast iron susceptible to sudden brittle failure, the consequence of carriageway girder failure being potentially catastrophic and the bridge carrying a classified 'A' road, it must be regarded as a high-risk structure. Temporary measures could include: restriction of the carriageway width to less than 6m obviating the need to apply two lane loading with impact or propping the bridge.

Repairs involving extensive plate bonding would be expensive and may not negate all the potential problems with the bridge. As the land in the formation on either side of the bridge seems to be in private ownership, infilling seems to be a viable permanent solution.

Appendix A. Photographs

1. East elevation

2. West elevation

3. South approach

4.Road over deck

5. North approach

6. General soffit view

7. North abutment

8. South abutment

9. North east wingwall

10. South east wingwall

11. North west wingwall

12. South west wingwall

13. Spalling to south east wingwall

14. Vegetation in joints on south east wingwall

15. Fracture through mortar tab on north east pilaster return

16. Calcite deposits and stalactite formations on jack arches

17. Jack arch profile distortion

18. Corrosion to edge and internal girders

19. Corrosion to internal girders

20. Damp on padstones

21. Partially collapsed jack arch at north east corner of bridge soffit

22. Fracture to top flange of edge girder

23. Displaced parapet panels

24. Displaced parapet panels

25. East parapet

26. West parapet

27. View along formation looking east

28. Formation below span

29. View along formation looking west

Appendix B. Form AA

FORM 'AA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No CCT/23 Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Bridge/Line Name: Bolton Road Bridge / Chorley to Cherry Tree

ELR/Bridge No. CCT/23

Brief Description of Existing Bridge:

(a) Span Arrangement

The structure is a skewed, single span bridge with cast iron girders and brick jack arches. The clear square span is 8.44m and the clear skew span is 10.18m giving a skew angle of 33°.

(b) Superstructure Type

The bridge comprises 13 cast iron internal girders which span between abutments and cast iron edge girders. Brick jack arches spring from the bottom flanges of the internal girders. 28.56mm diameter tie bars are located above the extrados of each of the jack arches spaced equally across the span.

Cast iron edge girders

The bridge has two cast iron edge girders with a total depth of 762mm (2'-6"). The bottom flange is 508mm wide with a thickness of 63.5mm. The upper flange is 228.6 (9") wide and 47.6mm thick. The web has a thickness of 50.8mm at the bottom flange tapering to 38.1mm at the top.

Cast iron internal girders

The internal girders are recorded as having a total depth of 609.6mm at midspan tapering to 457.2mm at supports. The top flange is 152.4mm wide with a thickness of 50.8mm. The web has a thickness of 50.8mm at the bottom flange and tapers to 38.1mm at the top flange. The bottom flange was measured as 457.2mm wide with a thickness of 57.2mm.

Existing drawings show that concrete infill is present up to the underside of the top flange of the internal girders after which there is a layer of asphalt overlain by hardcore filling and a layer of 'tarmac'.

Jack arches

The jack arches have a thickness of 228.6mm (9") with a measured average rise of 89mm and a clear span of 838.2mm between internal girders. Tie bars are located above the jack arch extrados level, they are recorded as having a diameter of 28.56mm and are spaced at 3m centres.

(c) Substructure Type

The substructure comprises gravity type abutments and wingwalls constructed from regularly coursed squared masonry. The edge girders rest on stone bearing pads.

FORM 'AA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No CCT/23 Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

The parapets are formed from cast iron panelling fixed to the top flange of the edge girders by 22mm (⅞") shaft diameter rivets spaced at 685.8mm centres (2' - 3"). The cast iron panels are topped with a 385mm high timber boarded fence.

(d) Planned highway works/modifications at this site

None.

(e) Road designation class and whether classed as a heavy load route

CCT/23 carries the A675, Bolton Road, over the dismantled track bed. The road is a single lane carriageway with a width of 7.15m at the centre of the span. On the east side of the road there is a 2.81m wide grass verge and to the south a 1.02m wide footpath. The overall width between the parapets is 10.99m.

The traffic flow category has been taken as 'Medium (M)'. The road surface category has been taken as 'good' for the purpose of this assessment.

(f) Any other requirements

None

Assessment Criteria

(a) Loadings and Speed

Dimensions and conditions are obtained from site measurements and inspection (See Jacobs report "VAR9/7070 Assessment Programme – Assessment and Inspection Report – Bridge Ref.: CCT/23 September 2022").

The bridge is to be assessed for normal traffic, with a restricted traffic level being determined where this capacity is not reached.

(b) Codes to be used

CS 454 – Assessment of highway bridges and structures

(c) Proposed Method of Structural Analysis

Capacities of the elements will be calculated using estimates of reduced section sizes where corrosion is present. A general condition factor will not be applied.

Resistance capacities will be determined in accordance with CS454 Clause 8. The capacity of the internal girders will not be enhanced using

the section modulus factor, F_I, as there is a discontinuity in the encasing material.

The deck comprises cast iron girders and brick jack arches between which there will be some lateral interaction. The deck will be checked for normal traffic loading using CS 454 ALL model 1. The loading will be applied using a simple "2D" grillage model. The girders beneath the footpath and verge will be checked for the effects of accidental vehicle loads. The girders below the footpath and verge will also be analysed utilising ALL model 1 applied using a simple "2D" grillage.

A condition factor of 0.90 shall be applied to the live load modulus to account for the vibration of the deck felt under heavy vehicle loading.

Determination of the adequacy of the jack arches will be based upon the empirical method as described in Bridgeguard 3 Current Information Sheet No. 22 (Pro-forma for the empirical assessment of brick, masonry and concrete jack arches and associated ties).

The substructure will be assessed qualitatively.

FORM 'AA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No CCT/23 Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Senior Civil Engineer's Comments

None

Proposed Category for Independent Check 1

Superstructure 1

Substructure 1

Name of Checker suggested if Cat 2 or 3 Not applicable

Category 1

The above assessment, with amendments [redacted]

FORM 'AA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No CCT/23 Issue: 1

Revision: B (Nov 2000)

APPROVAL IN PRINCIPLE FOR ASSESSMENT

Category 2 and 3

The above assessment, with amendments shown, is approved in principle:

Signed [redacted]

Title [redacted]

Date [redacted]

Signed [redacted]

[redacted]

[redacted]

Appendix C. Form BA

FORM 'BA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No CCT/23 Issue: 1

Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK

Assessment Group: **Jacobs UK Ltd**

Bridge/Line Name: **Bolton Road Bridge / Chorley to Cherry tree**

Category of Check: **1**

ELR/ Bridge No: **CCT/23**

We certify that reasonable professional skill and care have been used in the assessment of the above structure with a view to securing that:

(1) It has been assessed in accordance with the Approval in Principle as recorded on Form AA approved on 1st November 2022.

(2) It has been checked for compliance with the following principal British Standards, Codes of Practice, BRB (Residuary) Limited technical notes and Assessment standards:

- CS 454 – Assessment of highway bridges and structures

List any departures from the above and additional methods or criteria adopted, with reference and justification for their acceptance.

None

Category 1

Name	Signature	Date
[redacted]	[redacted]	[redacted]

FORM 'BA' (BRIDGES)

GC/TP0356
Appendix: 4
Issue: 1
Revision: A (Dec 2005)

ELR/ Bridge No CCT/23

CERTIFICATION FOR ASSESSMENT CHECK

Category 2 and 3 (Note: Category 1 check must also be signed)

(a) Assessment

Name	Signature	Date	
			Assessor
			Assessment Checker
			Authorised signatory of the firm of Consulting Engineers to whom Assessor/Checker is responsible.

Checker is responsible.

(b) Check

Name	Signature	Date	
			Assessor
			Assessment Checker
			[redacted]

[redacted]

FORM 'BAA' (BRIDGES)

ELR/ Bridge No CCT/23

CERTIFICATION FOR ASSESSMENT CHECK

Notification of Assessment Check

Assessment Group	**Jacobs UK Ltd**
Bridge Name/Road No.	**Bolton Road Bridge / A675**
Line Name	**Chorley to Cherry Tree**
ELR Code/Structure No.	**CCT/23**

The above bridge has been assessed and checked in accordance with Standards which are listed on the appended Form BA. A summary of the results of the assessment in terms of capacity and restrictions is as follows: -

STATEMENT OF CAPACITY

Internal Girders (carriageway):	**7.5T GVW loading**
Edge Girder	40/44T Accidental Vehicle Loading
Jack Arches (carriageway):	Normal Traffic Loading
Jack arch (NE corner under verge)	No AVL capacity
Substructure:	Normal Traffic Loading (by qualitative assessment)

Recommended Loading Restrictions

7.5 tonnes GVW loading.

Description of Structural Deficiencies and Recommended Strengthening

With cast iron susceptible to sudden brittle failure, the consequence of carriageway girder failure being potentially catastrophic and the bridge carrying a classified 'A' road, it must be regarded as a high-risk structure. Temporary measures could include: restriction of the carriageway width to less than 6m obviating the need to apply two lane loading with impact, or propping the bridge.

Repairs involving extensive plate bonding would be expensive and may not negate all the potential problems with the bridge. As the land in the formation on either side of the bridge seems to be in private ownership, infilling seems to be a viable permanent solution.

FORM 'BAA' (BRIDGES) **GC/TP0356**

Appendix: 4

ELR/ Bridge No CCT/23 Issue: 1

Revision: A (Dec 2005)

CERTIFICATION FOR ASSESSMENT CHECK

Name	Signature	Date	
[redacted]			Assessor
		3	
			Assessment Checker
		.....	
			Authorised signatory of
[redacted]			g
			s
..			
Th			....

Appendix D. Services Search Results

National One Call
Protecting People and Services in the UK

Online: www.national-one-call.co.uk
Call us: 0800 0853 865 (Mon-Fri, 9am-5pm)

Retriever Planning Pack

Jacobs UK Ltd

Enquiry Date	[redacted]	**Enquiry**	NOC/RRQVJ382
Contact		**Service**	Retriever
Asset Owners		**Enquiry Status**	Complete
Price Status	Actual	**Payment Status**	Paid

Enquiry Specification		
Option	**What is it?**	**Selected**
Enquiry Type	Enquiry by National One Call	✔
Express	Emailing of Plans as they arrive	✖
Fusion Plan	Compile Plans into 1 Drawing	✖
Delivery	Delivery of Completed Pack by Email	✔

Enquiry Documentation		
Document	**What is it?**	**Included**
PlanToDig Enquiry	Details of Enquiry	✔
Asset Owner Contacts	List of Selected Asset Owners	✔
Text Responses	Instructions from Asset Owners	✔
CoRE	Certificate of Registered Enquiry	✔
Appendix A: Asset Owner Plans		
See Plans section Cover Page for Details		
Appendix B: Enquiry Accounting		
Invoice	Invoice for Enquiry	✔
For Guidance on PlanToDig		
View / download our PlanToDig Guide		

PlanToDig Enquiry			
Jacobs UK Ltd			
Date	29/04/22	**Enquiry**	NOC/RRQVJ382
Contact	[redacted]	**Status**	Complete

Enquiry Site
Bolton Road Abbey Village, Chorley PR6 8DA
DISUSED RAILWAY BRIDGE **(Public Street / Road)**
OS Centre(Approx):363948,422899 (@2229 sq.mtrs)

Work Intentions		
Intention	**Start**	**Duration**
Works Intended	2022-05-09	1 Day
Please send client waiver letter to all known service providers		

Enquiry is Complete
Status: This Enquiry has Completed; you should now have all Responses from Asset Owners.
Asset Owners: Charges from 17 Asset Owners have been Confirmed
Timing: As Asset Owner Areas of Interest and Plans change frequently, please do not rely on Enquiries or Responses that are more than 30 days old.
Content: Asset Owner responses should be considered `indicative only` until physically verified. Follow guidance in HSG(47)/NRSWA/CDM etc relating to services verification and excavation methods.

Summary of Asset Owner Contacts for NOC/RRQVJ382			
Enquiry Date	29/04/22	**Enquiry**	NOC/RRQVJ382
Selected Contacts	[redacted]	**Closed**	[redacted]
Est. Charges	[redacted]	**Act. Charges**	[redacted]

Contact List				
Asset Owner	**Status**	**Txt**	**Est.**	**Act.**
Affected by Enquiry				
Electricity				
Electricity North West Limited	losed	[redacted]		
Gas				
Cadent (National Grid Gas)	Closed		-	-
Pipeline				
Linesearch (Pipeline search service)	Closed	T	-	-
Telecommunications				
BT Openreach	Closed		-	-
Vodafone Limited	Closed	T	[redacted]	-
Water / Sewerage				
United Utilities Water Limited	losed	[redacted]		
See Response Text				
Electricity				
Utility Assets Ltd	Closed	T	-	-
Not Affected				
Electricity				
National Grid Transmission Electricity	Closed			-
SSE Networks (Electricity)	lose	[redacted]		-
Gas				
National Grid Transmission (Gas)	Closed		-	-
Multi-utility				
Brookfield Utilities UK (was GTC	Closed	T	-	-
Telecommunications				
BSkyB Telecommunications Services Ltd	Closed	T	-	-
CityFibre	Closed	T	-	-
Colt Telecoms	Closed	T	-	-
Instalcom	Closed	T	-	-
Verizon Business	Closed	T		
Virgin Media	losed	[redacted]		

Contact Comments

Some Asset Owners provide guidance / notes when making their Response - in the interests of safety, these should be provided to any Site Operatives along with any Plans.

Asset Owner	Comments
Affected by Enquiry	
Pipeline	
Linesearch (Pipeline search service)	Cadent Gas and Electricity NW in Zone of Interest
Telecommunications	
Vodafone Limited	Please accept this email as confirmation that Vodafone: Fixed does have apparatus within the vicinity of your proposed works detailed below.
See Response Text	
Electricity	
Utility Assets Ltd	We will check whether we have any plant present at your site and contact you within 5 - 7 working days ONLY if we own any plant in the vicinity. If we do not reply, we do not have any apparatus in the area of your works. However, PLEASE TAKE CARE when excavating around electricity cables in the event that not all cables present may be accurately shown. We recommend you use detecting equipment to map the site before excavating and fully comply with HSG47. DO NOT assume that a cable is dead if you don`t have a record of its presence. The cable must be treated as live unless PROVEN DEAD by the cable owner. In case of emergency please contact your local electricity distribution company.
Not Affected	
Multi-utility	
Brookfield Utilities UK (was GTC	GTC Apparatus Not Found In Search AreaOur Plant Enquiry Service Ref: 2483603Your Enquiry Ref: NOC/RRQVJ382
Telecommunications	
BSkyB Telecommunications Services Ltd	Please be advised that Sky Telecommunications Services Ltd will not be affected by your proposal.
CityFibre	Title: NOC/RRQVJ382Comment:Please find attached a plan of the area of your interest that may contain plant which may be affected by your proposed works.The validity of this response is 6 weeks, after such time a new enquiry would need to be made.
Colt Telecoms	We can confirm that Colt Technology Services do not have apparatus near the above location as presented on your submitted plan

Instalcom	We can confirm that Lumen Technologies (formerly CenturyLink Communications UK Limited, Level 3, Global Crossing (Uk) Ltd, Global Crossing PEC, Fibernet UK Ltd and Fibrespan Ltd) do not have any apparatus within the indicated works area. Please note that this response is only valid for 3 months.
Verizon Business	We have reviewed your plans and have determined that Verizon (Formally known as MCI WorldCom, MFS) has no apparatus in the areas concerned.

Asset Owner Plans Cover

Plans received from Asset Owners will be sent to you by email; these may require specialist printers, sometimes up to A0.

Plans may be accompanied by Disclaimers / Instructions etc. which will be contained in the Asset Owner Comments document. These Comments are often as important as the plans themselves as they give direction and context to the plan.

Treat All Plans as `Indicative` until physically verified.

Sometimes an Asset Owner may have provided a Plan even if they considered that they are `Not Affected`.

It is also possible that an Asset Owner has responded as `Affected` but is unable to provide a Plan of their services; this will be stated in the Asset Owner Comments.

Ensure that Asset Owner Comments accompany Plans

Certificate of Registered Enquiry (CoRE)

Enquiry Date	29/04/22	**Enquiry**	NOC/RRQVJ382
Work Intention	Works Intended	**Site Type**	Public Street / Road

Asset Owners Contacted

A CoRE is issued on completion of a PlanToDig Enquiry, when all Responses have been received from the selected Asset Owners. Due to risk of changes to Asset Owner presences / their Area of Interest (AoI), and the probability of changes to plans and service presences, an Enquiry should only be considered `good` for 30 days following Enquiry Date.

Asset Owner	Comments
Affected by Enquiry	
Electricity	
Electricity North West Limited	
Gas	
Cadent (National Grid Gas)	
Pipeline	
Linesearch (Pipeline search service)	✔
Telecommunications	
BT Openreach	
Vodafone Limited	✔
Water / Sewerage	
United Utilities Water Limited	
See Response Text	
Electricity	
Utility Assets Ltd	✔
Not Affected	
Electricity	
National Grid Transmission Electricity	
SSE Networks (Electricity)	
Gas	
National Grid Transmission (Gas)	
Multi-utility	
Brookfield Utilities UK (was GTC	✔
Telecommunications	
BSkyB Telecommunications Services Ltd	✔
CityFibre	✔
Colt Telecoms	✔
Instalcom	✔

Verizon Business	✔
Virgin Media	

openreach

Our Ref: Ref shown on map

Date of issue: shown on map

email: nnhc@openreach.co.uk

Dear Customer,

NR & SW ACT 1991 – PROPOSED WORKS AT: Bolton Rd, Abbey Village, Chorley.

Prior to commencement of work: For free onsite guidance and accurate up to date location of BT Apparatus please contact our Plant Protection Service by the following methods:-

Email the Click Before You Dig Team CBYD@openreach.co.uk
Visit the Click Before You Dig Website www.openreach.co.uk/cbyd

Thank you for your request of **NOC/RRQVJ382** describing the above proposals.

Enclosed are copies of our drawings marked up to show the approximate locations of BT apparatus in the immediate vicinity of your works. It is intended for general guidance only. No guarantee is given of its accuracy.

The drawings are valid for 90 days from the date of issue and should not be relied upon after this time period has expired.

When planning excavation work or other works near to BT apparatus, please be mindful our apparatus may exist at various depths and may deviate from the marked route.

To avoid damage it is recommended that mechanical excavators or borers are not used within 600mm of BT apparatus. If scaffolding is erected, please ensure that our equipment is not enclosed, blocked, covered or otherwise obstructed by the scaffolding.

In the event of BT apparatus being in the area of your works we recommend that your plant/vehicle crossing is either resited, or apply for a budget estimate by submitting detailed plans to our Network Relocation Team at https://www.ournetwork.openreach.co.uk/altering-our-network.aspx

Yours faithfully,

[redacted]

Maps by email Plant Information Reply

IMPORTANT WARNING

Information regarding the location of BT apparatus is given for your assistance and is intended for general guidance only. No guarantee is given of its accuracy. It should not be relied upon in the event of excavations or other works being made near to BT apparatus which may exist at various depths and may deviate from the marked route.

openreach

CLICK BEFORE YOU DIG

FOR PROFESSIONAL FREE ON SITE ASSISTANCE PRIOR TO COMMENCEMENT OF EXCAVATION WORKS INCLUDING LOCATE AND MARKING SERVICE

email cbyd@openreach.co.uk

ADVANCE NOTICE REQUIRED
(Office hours: Monday - Friday 08.00 to 17.00)
www.openreach.co.uk/cbyd

Accidents happen

If you do damage any Openreach equipment please let us know by calling 0800 023 2023 (opt 1 + opt 1) and we can get it fixed ASAP

KEY TO BT SYMBOLS

	Planned	Live
PCP		
Pole		
Box		
Manhole		
Cabinet		

Change Of State	+	Hatchings	
Split Coupling	×	Built	
Duct Tee	▲	Planned	
Building		Inferred	
Kiosk	K	Duct	

Other proposed plant is shown using dashed lines.
BT Symbols not listed above may be disregarded.
Existing BT Plant may not be recorded.
Information valid at time of preparation. Maps are only valid for 90 days after the date of publication.

	Pending Add	In Place	Pending Remove	Not In Use
Power Cable				
Power Duct				N/A

BT Ref : KAT10181O
Map Reference : (centre) SD6393422886
Easting/Northing : (centre) 363934,422886
Issued : 03/05/2022 10:18:55

WARNING: IF PLANNED WORKS FALL INSIDE HATCHED AREA IT IS ESSENTIAL BEFORE PROCEEDING THAT YOU CONTACT THE NATIONAL NOTICE HANDLING CENTRE. PLEASE SEND E-MAIL TO: nnhc@openreach.co.uk

Date: 03/05/2022
LinesearchbeforeUdig ref: 25502303
Your ref: NOC/RRQVJ382

Dear Sir/Madam,

Please submit a planned works enquiry for your project

We have received a notification from the LinesearchbeforeUdig (LSBUD) platform regarding your initial enquiry to undertake works. As this is an initial enquiry, we haven't undertaken an assessment into the impact and risk posed to our assets. We need more information from you to do so.

You must not start any work until we confirm it is safe to do so after submission of a planned works enquiry. There are Cadent gas pipes in the area you're planning to work. These pipes may impact and possibly prevent your work for safety or legal reasons.

If your works are proposed to be undertaken in an easement, please note any auto-response from our enquiry system does not constitute written consent and formal, signed written consent which will only be provided following consultation with our plant protection team.

What you need to do

To help develop your initial enquiry into a planned works enquiry, please review our attached plans, which detail the Cadent gas assets in the area along with our key guidance document Specification for Safe Working in the Vicinity of Cadent Assets.

Once you have a plan for review by our engineering teams, please submit a "Planned Works" enquiry via LSBUD. In the meantime, if you want to discuss specifics associated with your initial enquiry please contact us at plantprotection@cadentgas.com or on 0800 688 588 quoting your reference at the top of this letter.

Your responsibilities and obligations

It is your responsibility to ensure that the information you have given us is accurate, therefore you must not undertake any works until a planned works enquiry has been submitted for assessment. You must also share all relevant documents, including the guidance notes, with anyone who carries out work on your behalf.

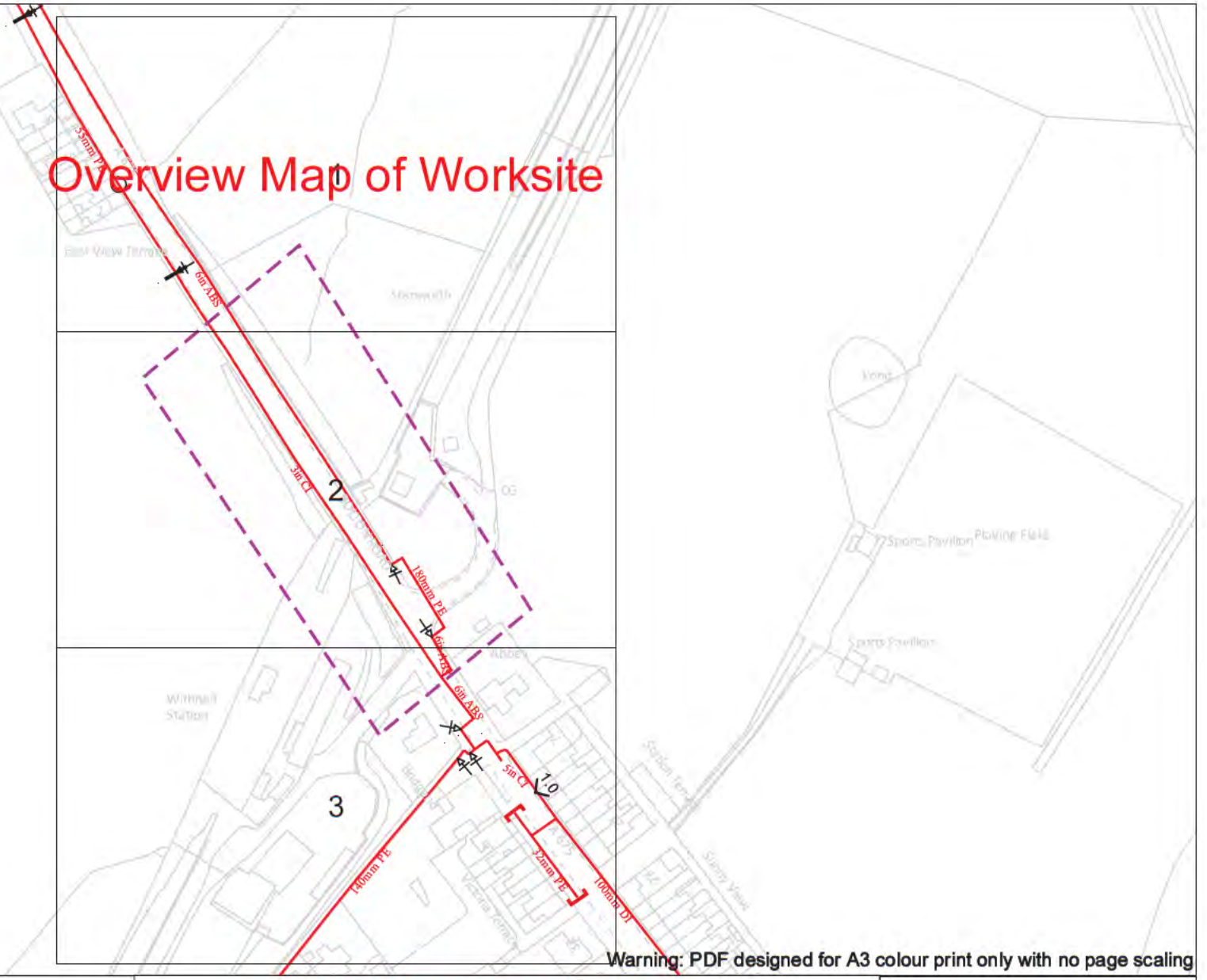
Cadent may have a Deed of Easement on the pipeline, which provides us with a right of access for a number of functions and prevents change to existing ground levels and storage of materials. It also prevents the erection of permanent/temporary buildings, or structures. If necessary Cadent will take action to legally enforce the terms of the easement.

This letter does not constitute any formal agreement or consent for any proposed development work either generally or related to Cadent's easements or other rights, or any planning or building regulations applications.

Cadent Gas Ltd or their agents, servants or contractors do not accept any liability for any losses arising under or in connection with this information. This limit on liability applies to all and any claims in contract, tort (including negligence), misrepresentation (excluding fraudulent misrepresentation), breach of statutory duty or otherwise. This limit on liability does not exclude or restrict liability where prohibited by the law nor does it supersede the express terms of any related agreements.

Kind Regards,
Plant Protection Team

Overview Map of Worksite



Warning: PDF designed for A3 colour print only with no page scaling

Date Requested: 03/05/2022
Job Reference: 25502303
Site Location: 363934 422886
Requested by:
Mr Brian McMaster
Your Scheme/Reference:
NOC/RRQVJ382

Scale: 1:1537 (When plotted at A3)

View extent 200m, 115m

IMPORTANT NOTICES

This plan shows these pipes owned by Cadent Gas Limited in its role as a Licensed Gas Transporter (GT). Gas pipes owned by other GT's or otherwise privately owned may be present in this area. Information with regards to such pipes should be obtained from the relevant owners. The information shown on this plan is given without warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections etc. are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Cadent Gas Limited or their agents, servants or contractors for any errors or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

In case of an emergency call 0800 111 999

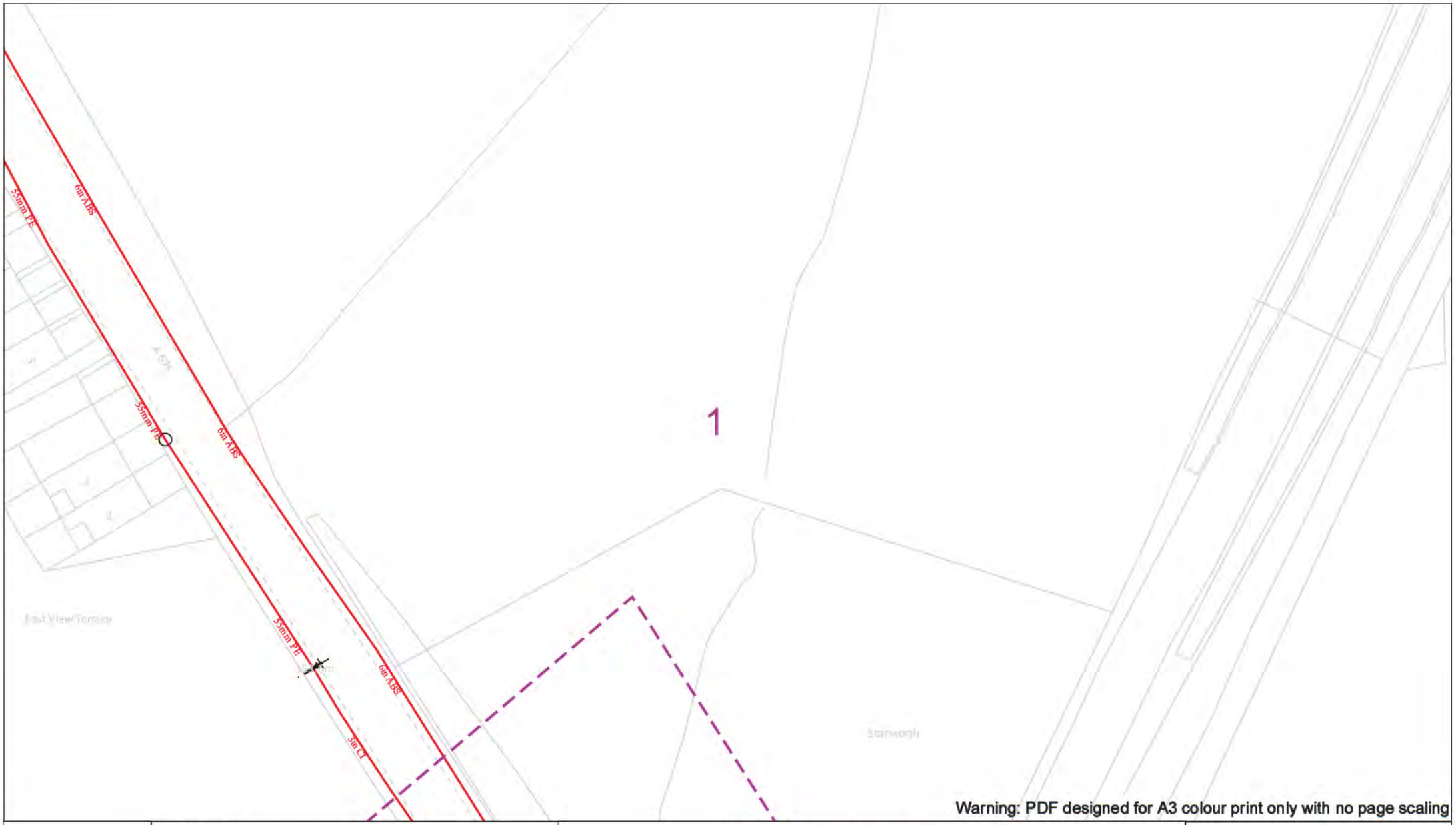
Dig Sites

Area: Line:

LP Mains
MP Mains
IP Mains
LHP Mains

Valve
Depth of cover
Syphon
Diameter Change
Material Change
Out of Standard Service

Cadent
Your Gas Network



Warning: PDF designed for A3 colour print only with no page scaling

Date Requested: 03/05/2022
Job Reference: 25502303
Site Location: 363934 422886
Requested by:
Mr Brian McMaster
Your Scheme/Reference:
NOC/RRQVJ382

Scale: 1:500 (When plotted at A3)

View extent 200m, 115m

IMPORTANT NOTICES

This plan shows these pipes owned by Cadent Gas Limited in its role as a Licensed Gas Transporter (GT). Gas pipes owned by other GT's or otherwise privately owned may be present in this area. Information with regards to such pipes should be obtained from the relevant owners. The information shown on this plan is given without warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections etc. are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Cadent Gas Limited or their agents, servants or contractors for any errors or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

In case of an emergency call 0800 111 999

50m

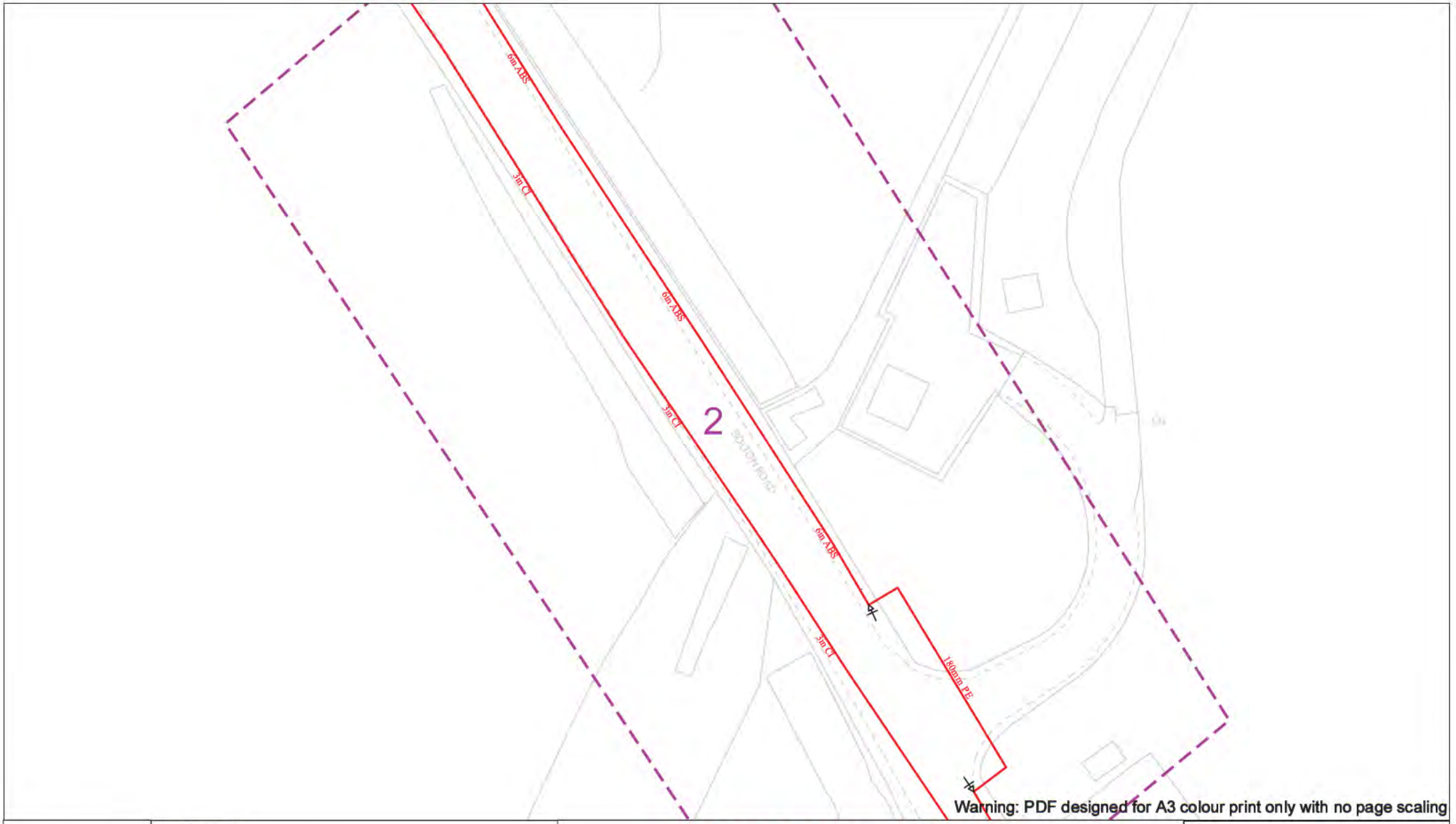
Dig Sites

Area:

Line:

- LP Mains
- MP Mains
- IP Mains
- LHP Mains
- Valve
- Depth of cover
- Syphon
- Diameter Change
- Material Change
- Out of Standard Service

Cadent
Your Gas Network



Warning: PDF designed for A3 colour print only with no page scaling

Date Requested: 03/05/2022
Job Reference: 25502303
Site Location: 363934 422886
Requested by:
Mr Brian McMaster
Your Scheme/Reference:
NOC/RRQVJ382

Scale: 1:500 (When plotted at A3)

View extent 200m, 115m

IMPORTANT NOTICES

This plan shows these pipes owned by Cadent Gas Limited in its role as a Licensed Gas Transporter (GT). Gas pipes owned by other GT's or otherwise privately owned may be present in this area. Information with regards to such pipes should be obtained from the relevant owners. The information shown on this plan is given without warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections etc. are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Cadent Gas Limited or their agents, servants or contractors for any errors or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

In case of an emergency call 0800 111 999

50m

Dig Sites

Area:

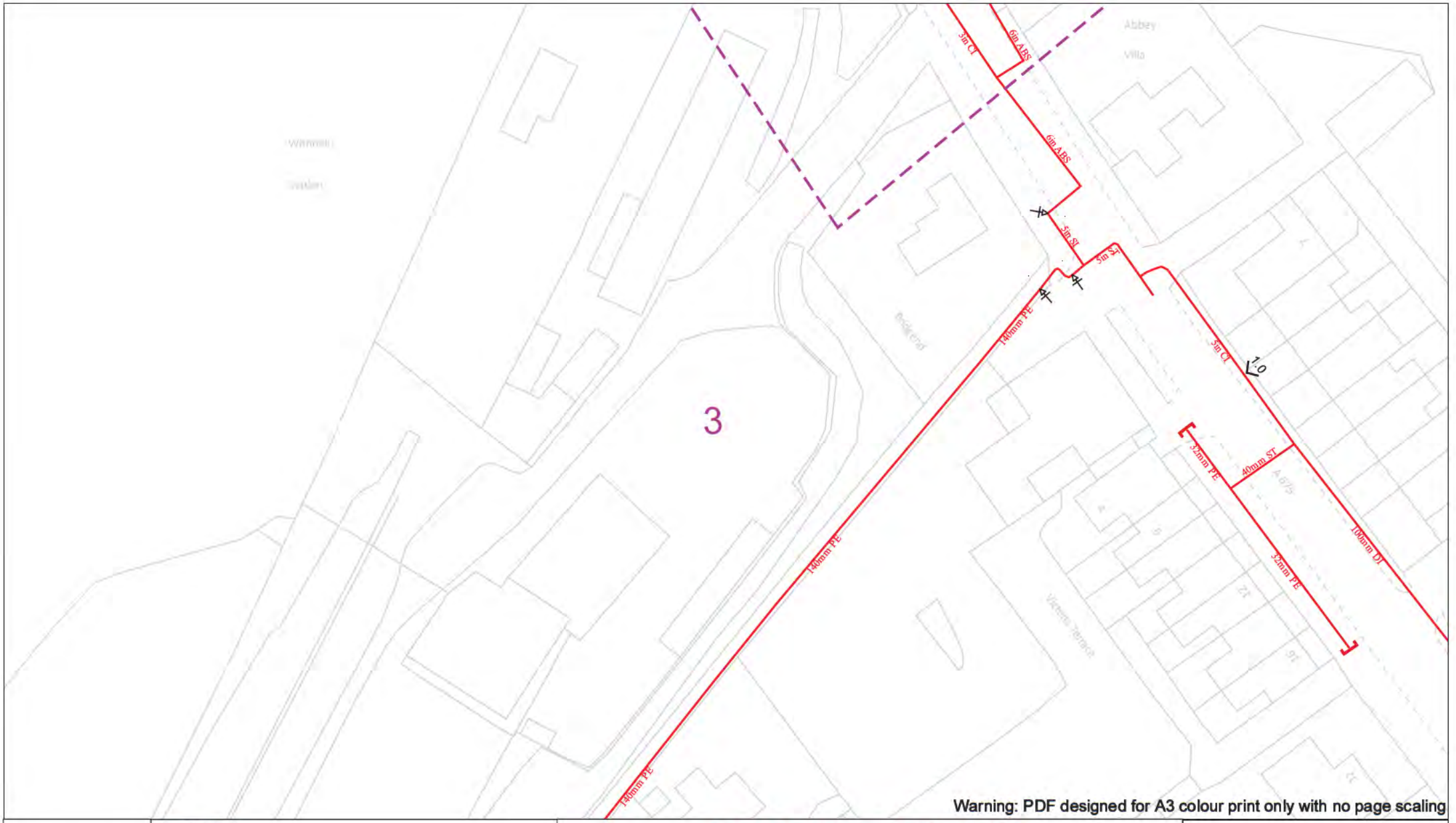
Line:

LP Mains
MP Mains
IP Mains
LHP Mains

Valve
Depth of cover
Syphon

Diameter Change
Material Change
Out of Standard Service

Cadent
Your Gas Network



Warning: PDF designed for A3 colour print only with no page scaling

Date Requested: 03/05/2022
Job Reference: 25502303
Site Location: 363934 422886
Requested by:
Mr Brian McMaster
Your Scheme/Reference:
NOC/RRQVJ382

Scale: 1:500 (When plotted at A3)

View extent 200m, 115m

IMPORTANT NOTICES

This plan shows these pipes owned by Cadent Gas Limited in its role as a Licensed Gas Transporter (GT). Gas pipes owned by other GT's or otherwise privately owned may be present in this area. Information with regards to such pipes should be obtained from the relevant owners. The information shown on this plan is given without warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections etc. are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Cadent Gas Limited or their agents, servants or contractors for any errors or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

In case of an emergency call 0800 111 999

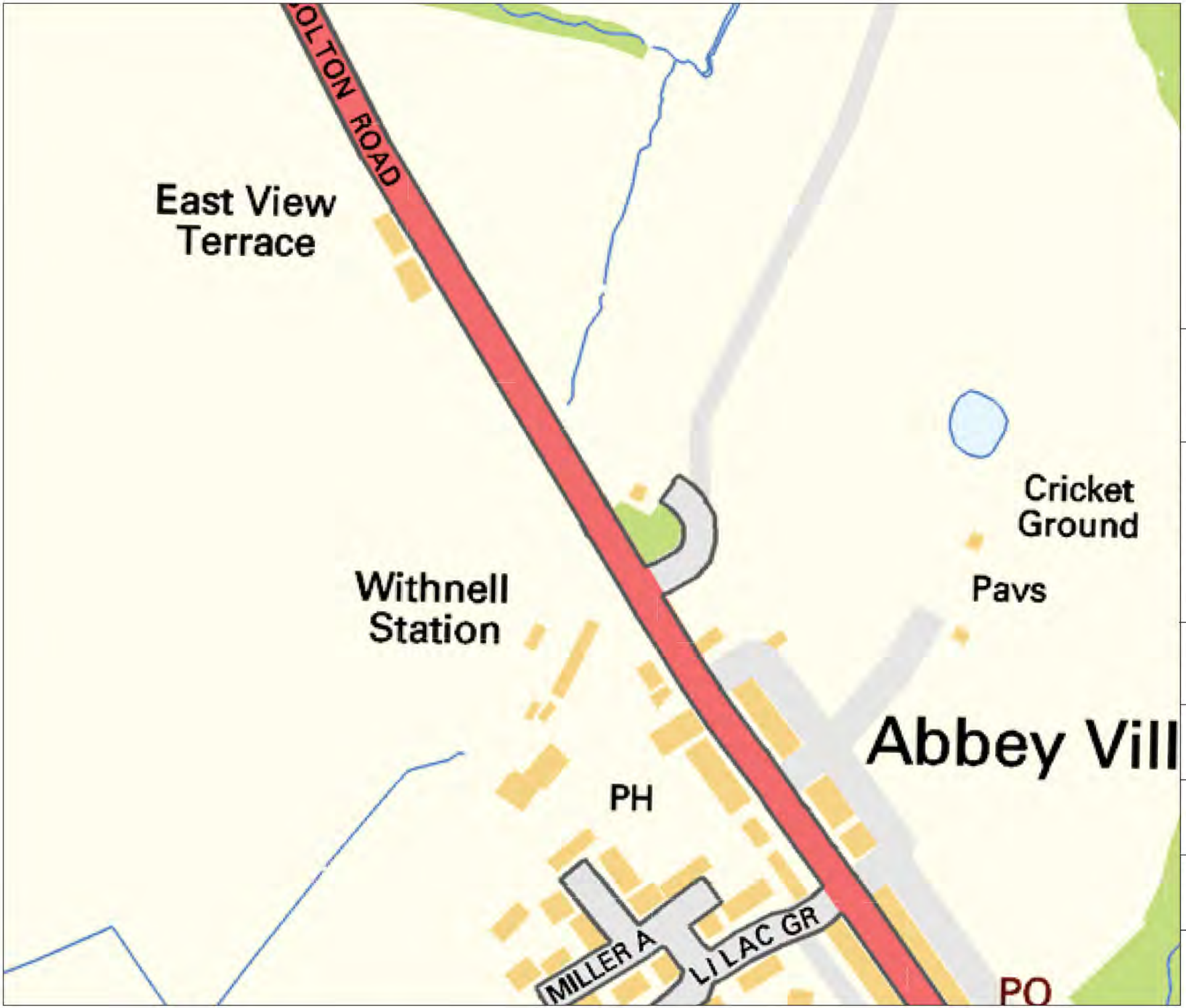
50m

Dig Sites

Area: Line:

- LP Mains
- MP Mains
- IP Mains
- LHP Mains
- Valve
- Depth of cover
- Syphon
- Diameter Change
- Material Change
- Out of Standard Service

Cadent
Your Gas Network



bitmap_layout select_raster

LEGEND

EXISTING PLANT

EXISTING PLANT

bitmap_layout select_raster

Head Office
CityFibre Holdings Ltd
15 Bedford Street,
London,
WC2E 9HE

Tel: 0845 293 0774
Web: www.cityfibre.com

Asset Office
CityFibre Holdings Ltd,
Rutherford House,
Birchwood,
Warrington,
WA3 6ZH

Email: asset.team@cityfibre.com

Project

Plant Enquiry

Drawing

Existing Plant

Drawn by:

smallworld

Date: 03/05/2022

Drawing No.

CFH_EP_000001

Revision

001

Scale: 1:2500

A4

0m 20m 40m 60m 80m 100m

N

Electricity North West
Data Management,
Electricity North West
Linley House
Dickinson Street
Manchester, M1 4LF
Phone: 0800 195 4141
Email: planrequest@enwl.co.uk
Web: www.enwl.co.uk

[redacted]
PlanToDig
[redacted]
Linlithgow West Lothian
[redacted]

Our Reference: 25502303

Your Reference: NOC/RRQVJ382

Dear Mr [redacted]

Electricity Network Plans

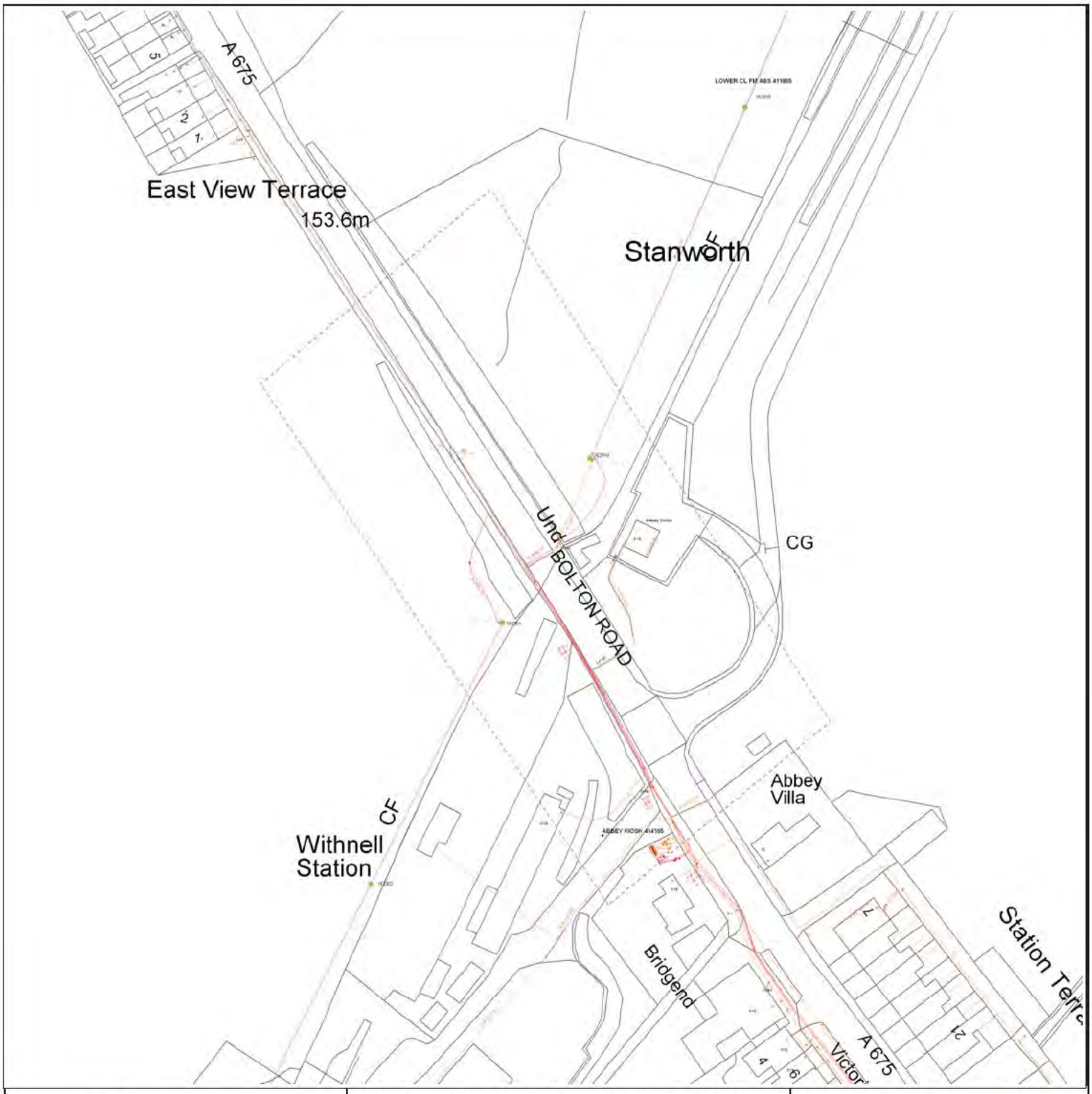
I acknowledge with thanks your request dated 03/05/2022 09:19:51 AM for information on the location of our services.

Please find enclosed plan(s) showing the approximate position of our apparatus known to be in the vicinity of this site.

I attach Conditions and information regarding electricity mains, which details contact numbers for additional services (i.e. new supplies, connections, diversion). In addition you should ensure they are made available to anyone carrying out any works which may affect our apparatus.

Yours sincerely,

Data Management



Requested by: Brian McMaster
Company: PlanToDig
Date Requested: 03/05/2022
Job Reference: 25502303
Your Scheme/Reference: NOC/RRQVJ382

Dig Sites:
Area Line

Operating Voltage	Colour Code	Line Colour
132kV	Black	
33kV	Green	
22kV-25kV	Yellow	
11kV	Red	
6kV-6.6kV	Blue	
1kV-6kV	Violet	
LV	Orange	
Unknown Voltage	Brown	

electricity north west

Data Management
Electricity North West
Linley House
Dickinson Street
Manchester, M1 4LF
Phone: 0800 195 4141
Email: planrequest@enwl.co.uk

Scales on A4 paper:
1:1250 Area dig site
1:250 Line dig site

United Utilities
Water for the North West

How to contact us:

United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

National One Call

1
Mill Place, Mill Road Ind Est
Linlithgow Bridge, West Lothian
EH49 7TL

FAO:

Your Ref: NOC/RRQVJ382
Our Ref: UUPS-ORD-390786
Date: 04/05/2022

Dear Sirs

Location: Disused Bridge

I acknowledge with thanks your request dated 03/05/2022 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. http://www.unitedutilities.com/work-near-asset.aspx .

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please contact us .

Yours Faithfully,

[redacted]

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

United Utilities
Water for the North West

TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

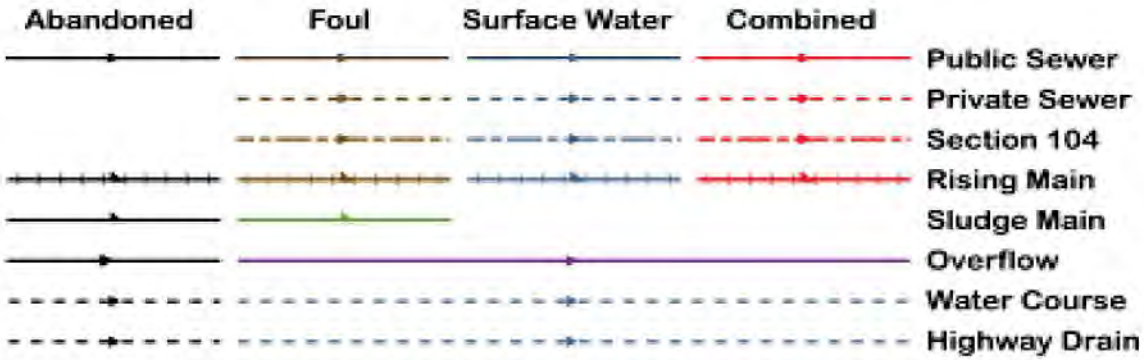
TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distr bution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

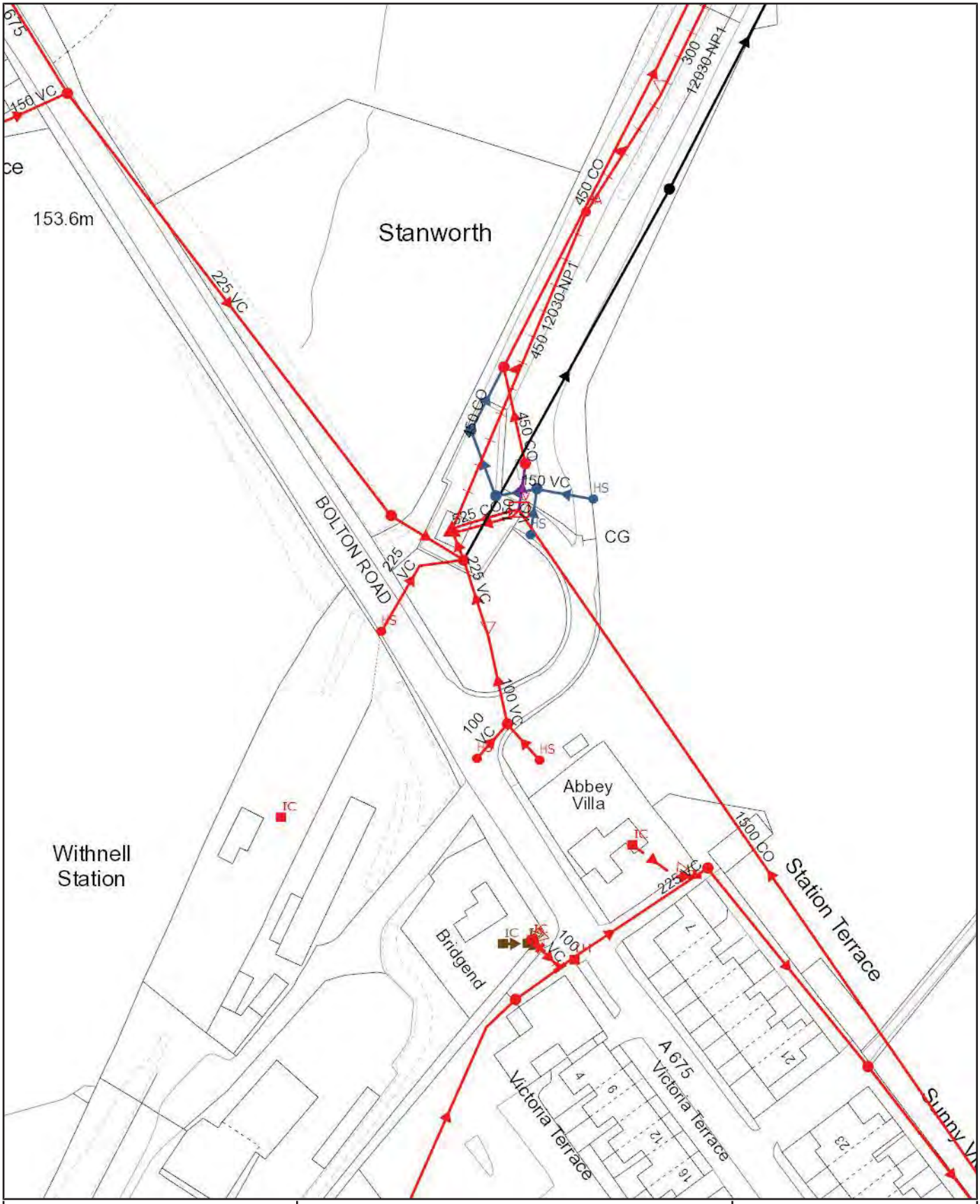
United Utilities
Water for the North West

Wastewater Symbology



All point assets follow the standard colour convention: red – combined, brown - foul, blue – surface water, purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

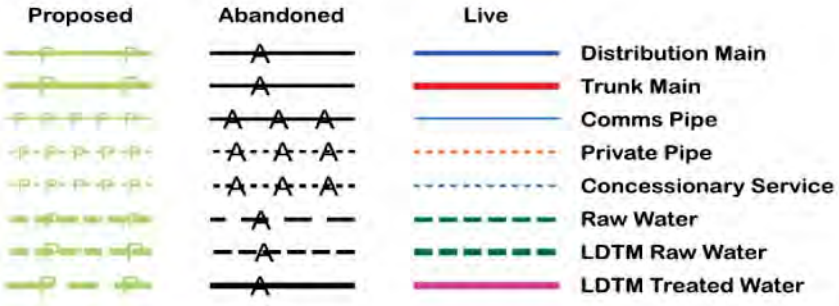


Scale:	1:1250	**SEWER RECORDS**	United Utilities Water for the North West
Date:	04/05/2022		
Address or Site Reference:	Disused Bridge		
Printed by:	Property Searches		

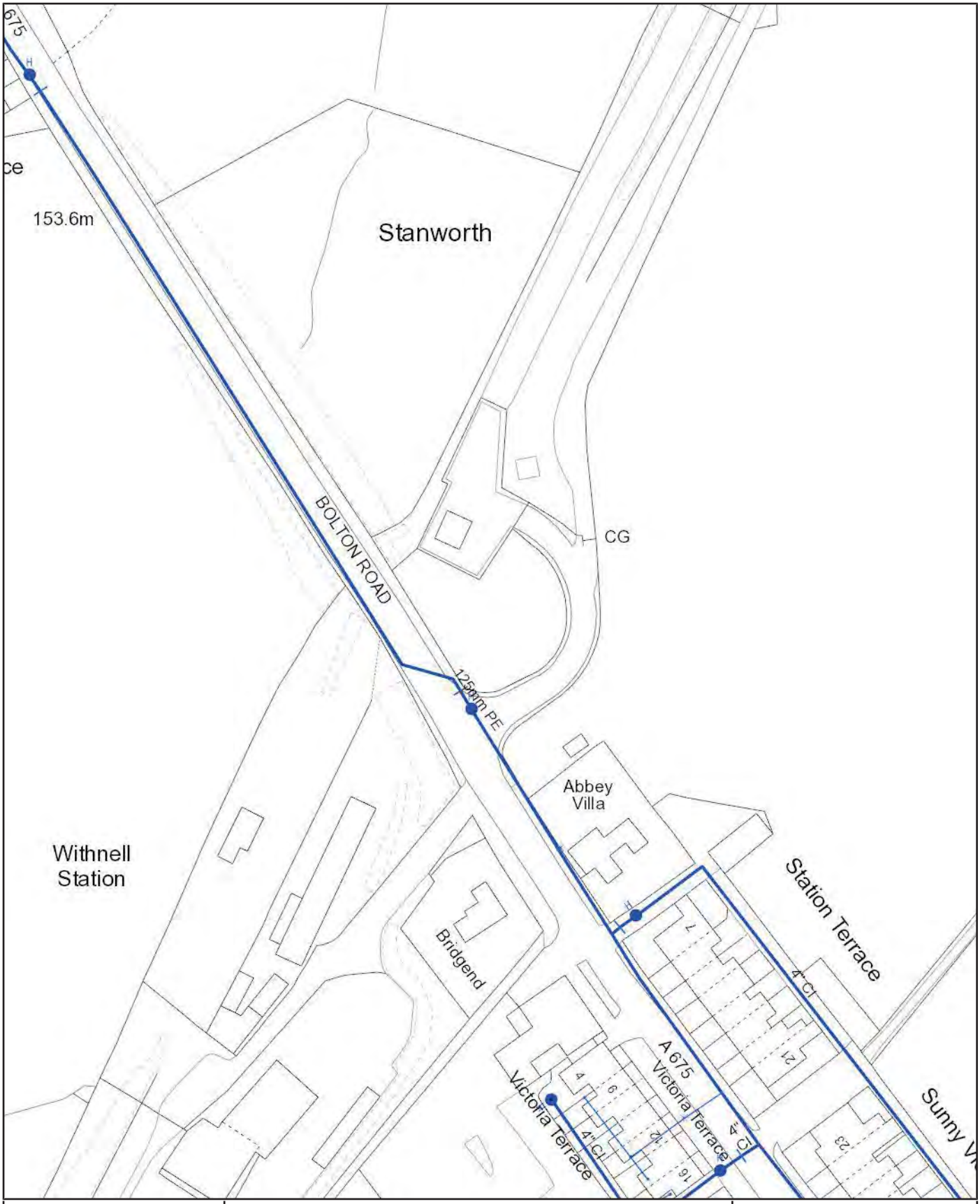
The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

United Utilities
Water for the North West

Clean Water Symbology



Symbology for proposed assets is the same as above, but shown in green
Symbology for abandoned assets is the same as above, but shown in black



Scale: 1:1250
Date: 04/05/2022

WATER MAINS RECORDS

United Utilities
Water for the North West

Address or Site Reference: Disused Bridge
Printed by: Property Searches

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

(c) Crown copyright and database rights 2022 Ordnance Survey 100019209	Scale: 1:1250	Date: 03/05/22	Telecoms Plan A4
Data updated: 24/03/22	Map Centre: 363938,422859	Our Ref: 845681 - 2	Powered by digdat

Duct, Trench | Chamber / Pole | Cabinet

brian.mcmaster@national-one-call.co.uk

NOC/RRQVJ382

Important Information - please read The purpose of this plan is to identify Virgin Media apparatus. We have tried to make it as accurate as possible but we cannot warrant its accuracy. In addition, we caution that within Virgin Media apparatus there may be instances where mains voltage power cables have been placed inside green, rather than black ducting. Further details can be found using the "Affected Postcodes.pdf", which can be downloaded from this website. Therefore, you must not rely solely on this plan if you are carrying out any excavation or other works in the vicinity of Virgin Media apparatus. The actual position of any underground service must be verified by cable detection equipment, etc. and established on site before any mechanical plant is used. Accordingly, unless it is due to the negligence of Virgin Media, its employees or agents, Virgin Media will not have any liability for any omissions or inaccuracies in the plan or for any loss or damage caused or arising from the use of and/or any reliance on this plan. This plan is produced by Virgin Media Limited (c) Crown copyright and database rights 2022 Ordnance Survey 100019209.

Legend

- Access Chamber.Location Active Footway Chamber
- Underground Route.Route Act. - Owned

vodafone

Vodafone Limited (No01471587) registered office is at Vodafone House, The Connection, Newbury, Berkshire, RG142FN

Plot Date : 09/05/2022	Scale : 1:1250

This plan shows apparatus owned by members of the Vodafone Group of companies (including legacy telecommunication companies currently within the group)

Information with regard to such apparatus should always be obtained from Vodafone or its appointed agents.

Special Requirements relating to the External Plant Network of Vodafone

Contents

1. Introduction

This document sets out the procedure that will apply when Other Parties intend or are undertaking works in the vicinity of Vodafone apparatus (see Appendix B for further information on what constitutes Vodafone apparatus).

2. Purpose of document

This document provides a means by which the Vodafone specific special requirements relating to their apparatus, regardless of it being situated in the public highway / road, private street, land or any other areas, is made aware to Other Parties.

3. Scope

This document will be presented to Other Parties or Contractors to encourage those undertaking works within the vicinity of Vodafone apparatus to refer to and comply with. This is in order to protect where necessary the Vodafone apparatus and to avoid damage to the apparatus and loss of service.

A National Joint Utilities Group (NJUG) document NJUG Volume 3 Guidelines on the Management of Third Party Cable Ducting provides useful reference material.

It should be noted that, where appropriate, additional information on avoiding danger from underground apparatus is contained within the HSG47 guidance book titled "Avoiding Danger from Underground Services."

4. Vodafone Network and Apparatus

Damage to Vodafone apparatus is extremely disruptive and can be expensive to repair, especially where long lengths of cable have to be replaced.

In order to maintain the network integrity and minimise disruption to service, it is essential that disturbances are absolutely minimal. When working within the vicinity of Vodafone apparatus, extreme care is necessary in order to avoid costly repairs. The Other Parties / Contractor shall make every effort to ensure that disturbance of Vodafone apparatus is no more than is absolutely necessary for the completion of the works in accordance with their contract. It should be noted that it is an offence to interfere with Vodafone apparatus without first contacting the company for advice.

5. Plant records

It is the responsibility of the Other Parties undertaking works which may affect Vodafone apparatus to obtain all relevant Vodafone plant records from our agent Atkins Global prior to works commencing. This may be done by contacting the Atkins Global Plant Enquiries Team listed in Appendix B.

Plant records for such enquiries will generally be provided within 10 working days of receipt and in compliance with the New Roads and Street Works Act 1991 [NRSWA] requirements.

6. Definitions

The following definitions are applicable in this document:

a) **Apparatus -** means all surface or sub-surface equipment and plant used by Vodafone including any associated cables or ducts owned, leased or rented by Vodafone.

b) **Cable** - means any polythene or other sheath containing optical fibres or metallic conductors.

c) **Depth of cover** - means the depth from the surface to the topmost barrel of the duct nest, in the case of ducts encased in concrete, to the top of the concrete, and in the case of directly buried cable, the top of the cable.

d) **Jointing chamber** - means any manhole, surface box or other chamber giving access to Vodafone apparatus or their network.

e) **Utility** - means an organisation licensed to provide gas, water, electricity, Cable TV or telecommunications services.

f) **Developer** - means an organisation licensed to develop industrial/residential premises or given license to connect to utility apparatus.

g) Contractor - means the individual, firm or company contracted to undertake the work for a Utility or Other Parties.

h) Other Parties - means the Utilities, Highway or Roads Authorities, Developers, Street/Roads Authority Section 50/109 licensees

i) Site - means the location of, or in the vicinity of, the various works.

7. Requirements

Prior to commencing any work or moving heavy plant or equipment over any portion of the site, the Other Parties or Contractor shall notify Vodafone of their intentions. This may be done by contacting Vodafone via the contact list in Appendix B.

Upon receipt of this notification, Vodafone will identify if their apparatus is affected. If any Vodafone apparatus is affected by the works then they will arrange for the necessary records to be provided and confirm details of Vodafone apparatus and network operated within the affected area or adjacent to the proposed work site.

7.1 Location of Plant

It is the responsibility of the Other Parties or Contractors to undertake adequate plant location procedures. These may include searches for metallic cables which must be performed by actively inducing a signal in a cable conductor via a transmitter. A passive search is not considered sufficient.

Before applying a tracing signal to the Vodafone apparatus, the Other Parties or Contractors shall seek confirmation from Atkins Global that the Vodafone apparatus will not suffer any disruption to its networks normal workings as a result of the nature of the signal being induced.

7.2 Trial excavations

Optic fibre cables are very susceptible to damage from excavation tools. They are not electrically conductive and cannot be located by radio induction methods. Once an approximate location is known, the exact location must be ascertained by means of hand dug pilot holes. Where the work to be carried out by the Other Party or Contractor involves excavation in the vicinity of our apparatus, the Other Party or Contractor shall, by trial excavation at his own expense, determine the exact location and depth of the Vodafone apparatus. All excavations adjacent to the Vodafone apparatus are to be carried out by hand until the extent and /or location of the apparatus is known.

All excavation work shall be executed in accordance with the current issue of Health and Safety series booklet HSG47, Avoiding danger from underground services.

8. Depths of cover

The Other Party or Contractor should note that the minimum depths of cover for Vodafone apparatus shall be maintained together with specified separation requirements. Where the minimum depths of cover specified by Vodafone cannot be maintained, the Other Party or Contractor shall at their own expense, carry out the instructions of Vodafone requirements for the protection or diversion of their apparatus.

The Other Party or Contractor should have particular regard to the possibility of encountering Vodafone apparatus (including ducts and cables), at depths of cover other than that reported.

Surface cables (such as cables on bridges or walls) which are liable to be placed in danger from the Other Parties or Contractors works shall be protected, at the Other Parties expense, as directed by the Vodafone representative.

[redacted]

9. Separation

Reference should be made to HSG47 to ensure that adequate separation is achieved. The following details outline the specific requirements of Vodafone and capture the HSG47 requirements.

9.1 High voltage cables

High voltage single core cables of 1000 V and above shall have a minimum clearance from Company Apparatus of 500 mm.

High voltage multi-core cables of 1000 V and above shall have a minimum clearance from Company Apparatus of 350 mm.

In exceptional circumstances where the above clearances cannot be maintained, the separating distance may be reduced to a minimum of 175 mm. In such circumstances, concrete, of a quality as directed by the Company Representative, must be inserted to completely fill the space between the High Voltage cable and the Company Apparatus, in accordance with the requirements of the Company Representative. Any further services must have a minimum clearance of 250 mm from the concrete.

9.2 Low voltage cables

Low voltage cables of less than 1000 V shall have a minimum clearance from Company Apparatus of 180 mm. In exceptional circumstances where the above clearance cannot be maintained, the separating distance may be reduced to a minimum of 75 mm. In such circumstances, concrete, of a quality as directed by the Company Representative, must be inserted to completely fill the space between the services, in accordance with the requirements of the Company Representative. Any further services must have a minimum clearance of 250 mm from the concrete.

9.3 Ancillary electrical apparatus

Street furniture such as lamp posts, traffic posts and other such ancillary electrical apparatus shall have a minimum clearance of 150 mm from underground Company Apparatus and 600mm clearance from above ground Company Apparatus.

9.4 High pressure gas mains and other Undertakers plant/equipment

High pressure gas mains shall have a minimum clearance of 450 mm from Company Apparatus. All other undertakers' plant and equipment, when running in parallel with Company Apparatus, shall have a minimum clearance of 200mm. Where gas mains cross Company Apparatus, the minimum clearance shall be 200mm. All other undertakers' plant and equipment, when running across Company Apparatus, shall have a minimum clearance of 100 mm. NJUG Volume 1, Guidelines on the positioning and colour coding of underground utilities' apparatus refers.

9.5 Other Undertakers plant

Other undertakers' plant and equipment which runs in parallel with Company Apparatus shall have a minimum clearance of 200mm. All other undertakers' plant and equipment when running across Company Apparatus shall have a minimum clearance of 100mm.

9.6 Tramways

Each separating distance shall be individually agreed with the Company Representative.

10. Jointing chambers

10.1 Protection

Footway type jointing chambers are not designed to withstand carriageway loadings.

Where such chambers are liable to be placed at risk, either temporarily or permanently, from vehicular traffic or from the movement of plant and/or equipment, they will need to be adequately protected. Alternatively, they may have to be demolished and rebuilt to carriageway standards, at the Other Parties or Contractors expense under supervision of Vodafone representative.

All Vodafone jointing chambers and / or other access points shall be kept clear and unobstructed. Access for vehicles, winches, cable drums and / or any further equipment required by Vodafone for the maintenance of its apparatus, must be maintained at all reasonable times.

10.2 Access

The covers to Vodafone jointing chambers and / or apparatus shall only be lifted by means of the appropriate keys and under the direct supervision of a Vodafone representative. Other Parties or Contractors shall not enter any Vodafone jointing chamber and / or apparatus unless under the supervision of a Vodafone representative and in any case not before the mandatory gas test has been carried out in the presence of Vodafone representative and such checks have shown it to be safe to enter the Vodafone chamber and / or apparatus. The Other Parties or Contractors shall be given reasonable access to Vodafone apparatus and chambers when required.

11. Notification periods

Where the Other Parties or Contractors works or the movement of plant or equipment may endanger Vodafone apparatus, the Other Party or Contractor shall give **Vodafone at least 7 working days' notice in writing** of the intended date to commence operations.

No excavation should be made without first consulting the relevant Vodafone apparatus layout drawings, which will be made available from the Vodafone agent Atkins Global on request and allowing 28 working days for processing the relevant drawings. However, should this not be possible, direct contact should be made to the Atkins Global Plant Enquiries Team as soon as possible to assess the situation.

When excavating, moving or backfilling (including use of Foamed Concrete for Reinstatements – FCR) around Vodafone apparatus, **Vodafone shall be given adequate prior written notice of the Other Parties or Contractors intentions, in order that the works may be adequately supervised. Such notice shall not be less than 3 working days.**

12. Excavation and backfill

All excavations adjacent to Vodafone apparatus are to be carried out by hand until the extent and or location of the Vodafone apparatus is known.

Use of mechanical borers and / or excavators shall not be used without the supervisory presence of a Vodafone representative or a given exemption.

Shuttering of the excavation or support to Vodafone apparatus, at the Other Parties or Contractors expense, shall be used as directed by the Vodafone representative.

At least 7 working days' notice must be given to Vodafone in order that any special protective measures which may be required to protect Vodafone apparatus, at the Other Parties or Contractors expense, when equipment such as pile driving, explosives, laser cutting high powered RF equipment or RF test gear, is to be used in conjunction with the works.

Other Parties or Contractors are advised to refer to the National Joint Utilities Group publication: NJUG Volume 1- Guidelines on the Positioning and Colour Coding of Underground Utilities' Apparatus

13. Foam concrete

If foam concrete is being used as the backfill material, it shall not be used either above or within 500 mm of any Company Apparatus. A suitable material in accordance with the specification for the Reinstatement of Openings in Highways shall be substituted.

14. Attendance of Company Representative

If a situation requires the attendance on site of a Vodafone representative for a continuous period of more than 6 hours, suitable facilities shall be provided by the Other Party or Contractor, at their expense, to meet the office and ablution requirements. If a situation arises that requires urgent attention Vodafone will endeavour to attend site within 2 hours for all other occasions arising, 24 hours.

15. Damage reports

In the event of any damage whatsoever occurring to Vodafone apparatus, the Other Party or Contractor shall immediately inform Vodafone by contacting their 24/7 number , (for contact details please refer to Appendix A).

All relevant costs of any subsequent repair and / or removal of the Vodafone apparatus shall be charged to the Other Party or Contractor, irrespective of who affects the repair.

The above requirements do not relieve the Other Party or Contractor of any of their obligations under their contract.

16. Appendix A – Street Works Team Contacts for Vodafone

Function	Address	Phone	Email Address
Streetworks Team	Vodafone, Street Works, Faraday House, Ground Floor, The Connection, Newbury, RG14 2FN	0333 304 0759	utilitiescentre@vodafone.com
Customer Complaints	n/a	0333 304 0762	n/a
Liability Claims Or Damage to Vodafone Apparatus	Vodafone Damage Claims, 1-2 Berkeley Square, 99 Berkeley Street Glasgow G3 7HR	0333 304 1104	claims@vodafone.com
Diversionary Works C2/C3	Atkins Global, PO Box 290, 500 Aztec West, Almondsbury, Bristol, BS32 4RZ.	01454 662881	osm.enquiries@atkinsglobal.com
Diversionary Works C4 / Escalations Networks Manager	Vodafone, Diversionary Works, 1-2 Berkeley Square, 99 Berkeley Street Glasgow G3 7HR	0141 303 2855	c3requests@vodafone.com
Emergencies 24 Hour – Defects & Faults	n/a	0333 304 0762	n/a
Vodafone Plant Enquiries includes: Cable & Wireless; Mercury Comms; Thus plc; Scottish Telecoms; Your Comms; Norweb Comms; Energis	Atkins Global PO Box 290 500 Aztec West, Almondsbury, Bristol, BS32 4RZ	01454 662881	osm.enquiries@atkinsglobal.com

[redacted]

17. Appendix B – What constitutes Vodafone Network

Vodafone own fibre network dedicated to business and residential users of telecommunications and has an international cable network that provides connectivity to 153 countries, either directly or indirectly through partners, reaching across the Atlantic Ocean, through Europe and on to India and throughout Asia. Spanning approximately 500,000 km in length, including interests in more than 69 major global cable systems, our next-generation network improves the quality and performance of telecommunications services through our use of advance optical and IP transmission.

In the UK & Ireland Vodafone's overall network includes the following legacy networks now owned through acquisitions or Company name changes.

Below are examples of what you could see on the streets and should be aware of:

vodafone

[redacted]

Cable & Wireless became Cable & Wireless Worldwide in 2010

[redacted]

Mercury Communications – changed its name to Cable & Wireless in 1996

Energis – was acquired by Cable Wireless in 2005

[redacted]

Thus plc was acquired by Cable & Wireless in 2008

Scottish Telecom

Scottish Telecom demerged from its parent company Scottish Power to become Thus plc in 2002

[redacted]

your communications

Your Communications was integrated into Thus plc in 2006

NORWEB COMMS

Norweb Communications became Your Communications in 2000

Our apparatus is installed in roads and streets of UK and Ireland, however in some places is undistinguishable from other operators' apparatus, for example in City Centres where high quality infill modular paving chamber covers are found; some with labels and some without.

See below as examples:

[redacted]

[redacted]

The apparatus shown here is now owned, maintained and still in operation by Vodafone and includes.

Vodafone
Cable & Wireless
Mercury Communications
Energis
Thus plc
Your Communications
Norweb Communications
Scottish Telecom

Please see the Contact Details in Appendix A for Plant Enquiries and help on site.

18. About this Document

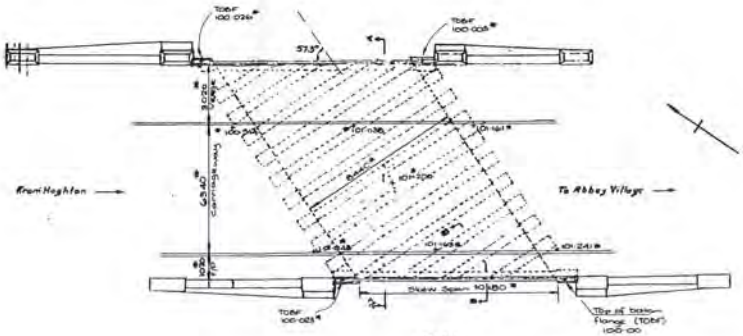
Content Owner
[redacted]

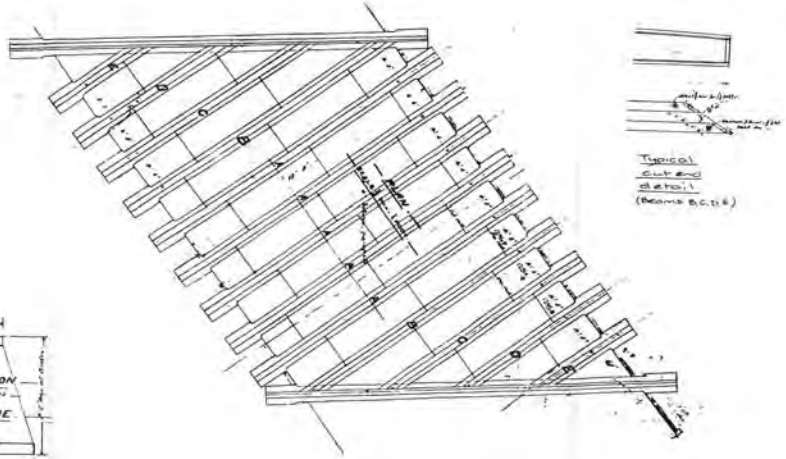
Changes since last version
Reformatted using the current Vodafone template to include updated Contact Details .

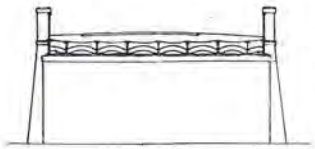
End of Document

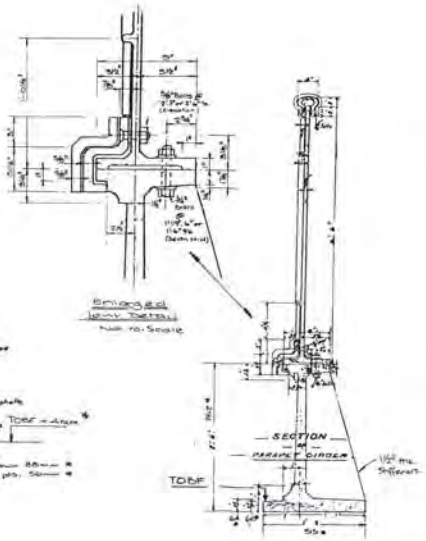
Appendix E. Existing / Historical Information

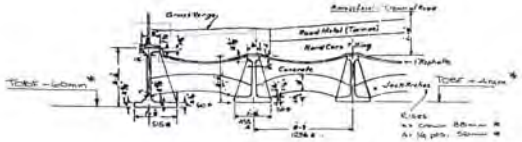
DO NOT SCALE

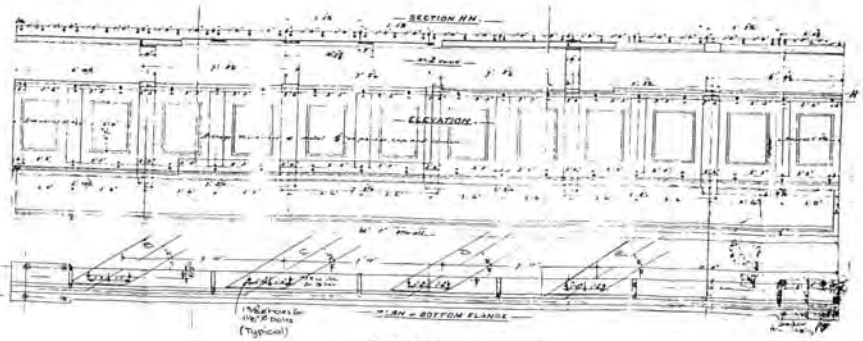












NOTES

1. THIS DRAWING IS BASED UPON AN ORIGINAL DRAWING PROVIDED BY RAIL PROPERTY LIMITED
2. DETAILS MARKED * ESTABLISHED DURING INSPECTION BY TC ON 24/8/98

A	TOBF Clarified	
B	ESDFG	
C		
DATE		

REPORT DRAWING

CONSULTING ENGINEERS

THORBURN COLQUHOUN

ELISABETH HOUSE ST PETERS SQUARE MANCHESTER M2 3DF
TEL 0161-236-4571 FAX 0161-228-2788

CLIENT: RAIL PROPERTY LIMITED

PROJECT: ASSESSMENT OF 29 NO. PUBLIC ROAD BRIDGES IN LANCASHIRE

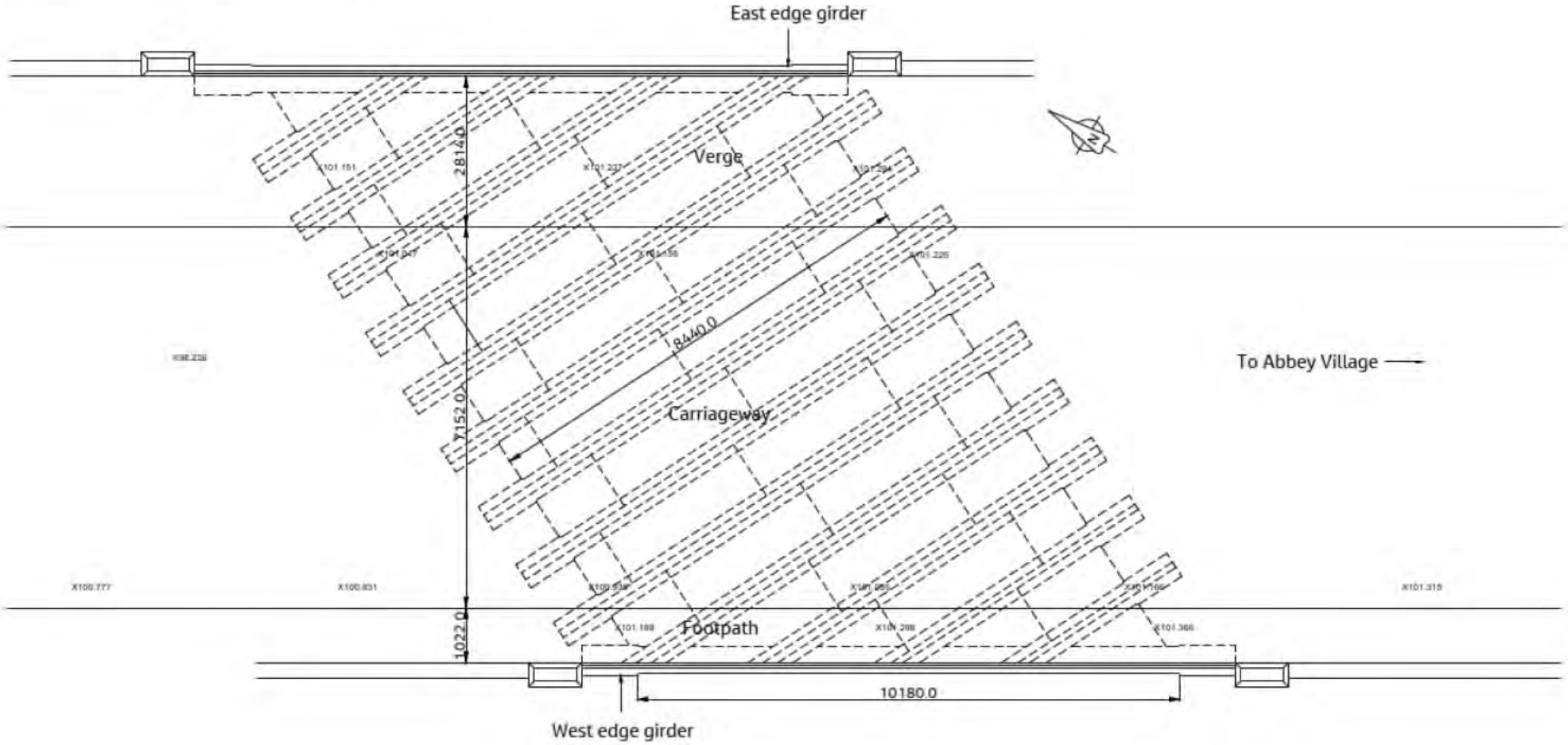
DRAWING TITLE: GENERAL ARRANGEMENT WITHNELL STATION (CCT/23)

DRAWN	TRACED	CHECKED	APPROVED	DATE
		MC	R.A.W	JUNE 1998

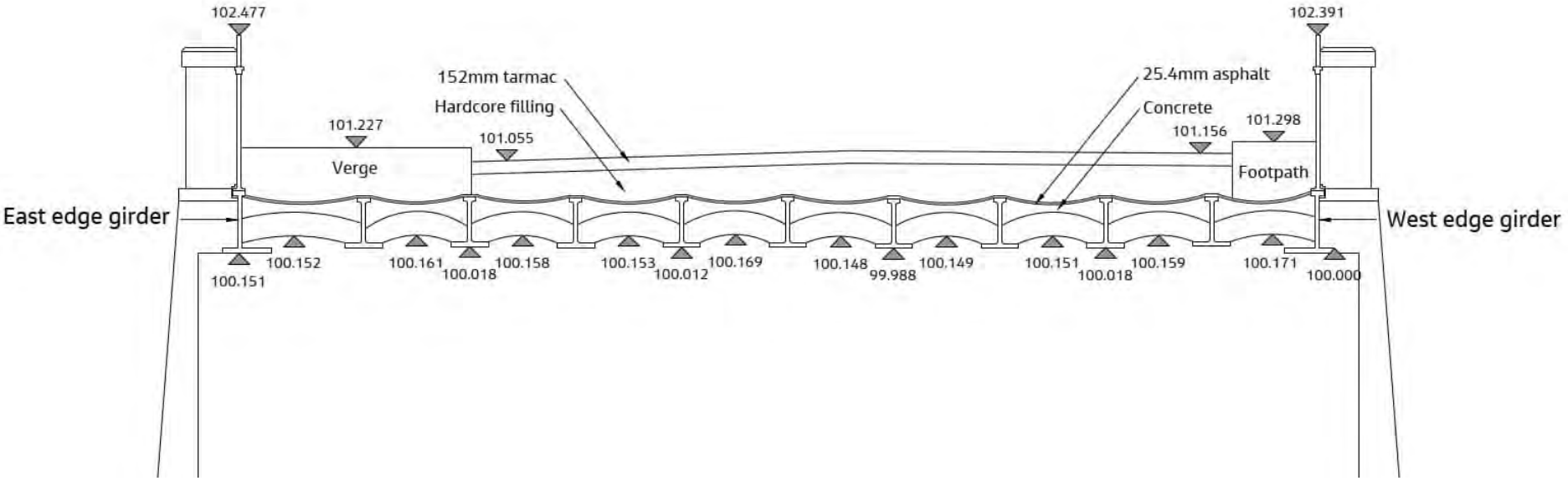
SCALE: AS NOTED | DRG. No. 31279/_/CS/11 | REV. A

ORIGINAL DRAWING A0

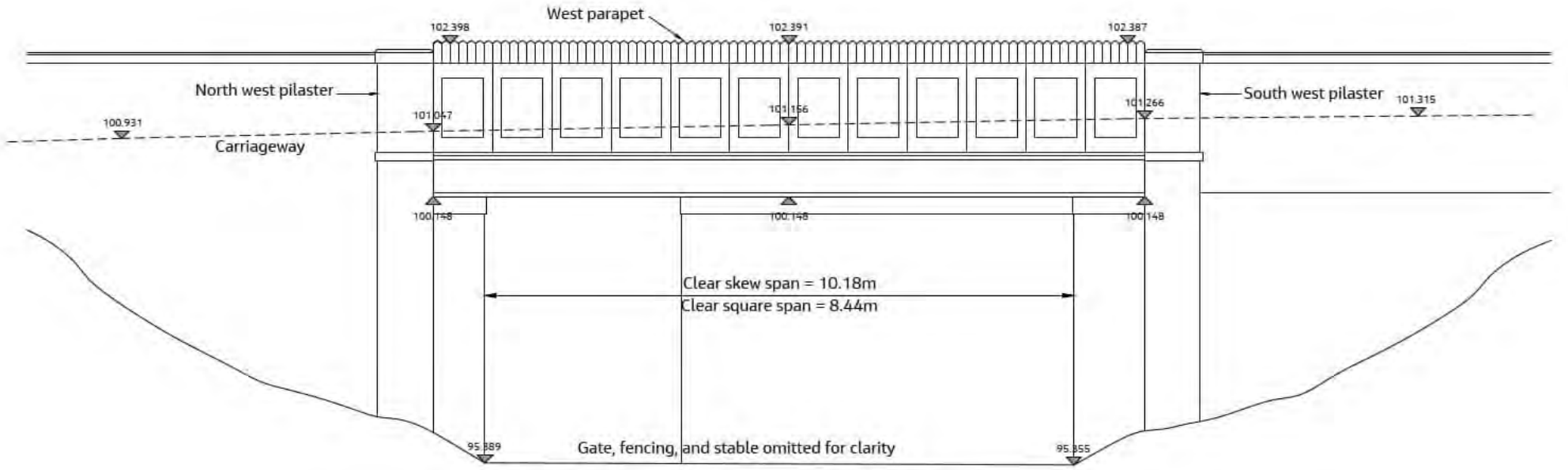
Appendix F. Survey Sketches



Plan at Road Level



Section at Mid Span



West Elevation

Appendix G. Calculations

CALCULATION COVER SHEET

Jacobs

Project Title: HRE Assessment Programme		Calc. No.:	451442
Job No: B38380BA		File:	VAR9/7070
Project Manager [redacted]	Subject: CCT/23		
Assessor [redacted]	Bolton Road Bridge, Lancashire		
Project Group	CS 454 Assessment		

	Total Sheets	Made by	Date	Checked by	Date	Reviewed by	Date		
Original		[redacted]	Mar-23	[redacted]	pr-23	[redacted]	Apr-23		
Rev									
Rev									
Rev									
Rev									
Rev									

Superseded by Calculation No. Date

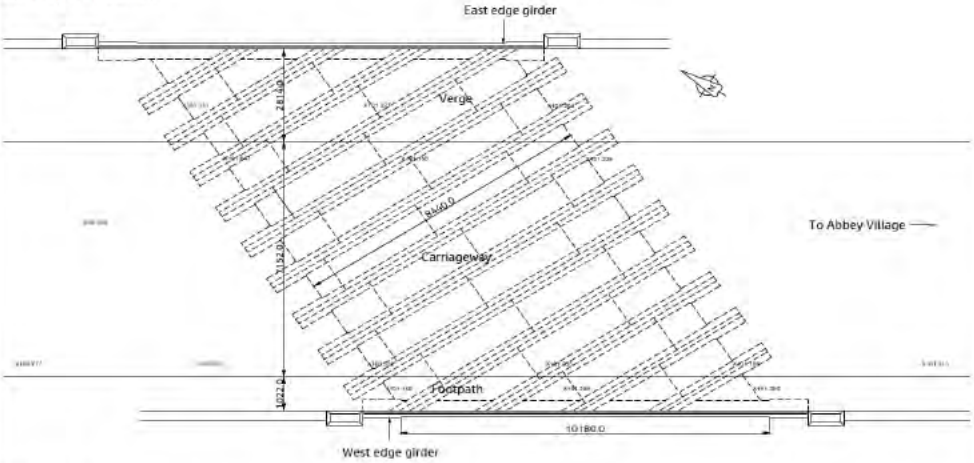
For assessment criteria, refer to Approval in Principle (Form AA) document

Jacobs

CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Effective span	Checker	[redacted]	Date	Apr-23

Survey sketches



Effective span

The effective span shall be calculated based on an assessment of the position of the centroids of the support reactions.

There are no bearing stiffeners and the member rests directly on brick, therefore, the effective span will be taken as the distance between the centroids of bearing pressure diagrams assuming the reaction is linearly distributed from a maximum at the front edge of the support to zero at the back of the bearing area.

As the support is brick, the length of the bearing area should be taken as no greater than the depth of the member.

As the length of the bearing area is not known, it will be taken as the depth of the girder.

Edge Girder

Depth of girder 762.0 mm

Effective Span L_{eff} = span + 2/3 bearing L_{eff} 10688 mm

Internal Girder

The depth of the internal girders (type 'A') close to the support has been used.

Depth of girder 457.0 mm

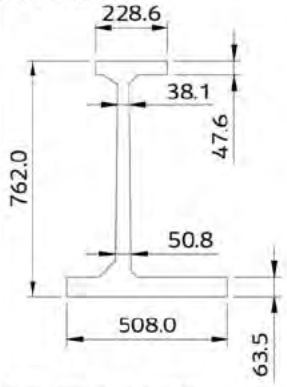
Effective Span L_{eff} = span + 2/3 bearing L_{eff} 8745 mm

Jacobs

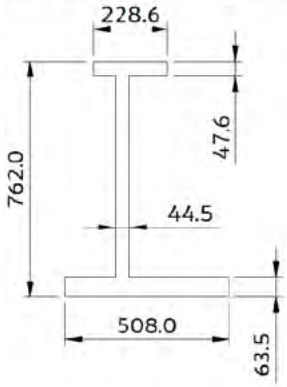
CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Edge Girder Section Properties	Checker	[redacted]	Date	Apr-23

Section sketch:



Idealised section for use in calculation:



r ss Secti n r perties

Gross elastic section properties at midspan about -

Section	b mm	d mm	A mm^2	y mm^3	Ay mm^3	A(y-yt)^2 mm^4	I_{xx} mm^4
pper flange plate	228.6	47.6	10881	23.8	258976	2.3E+09	2054546
eb	44.5	650.9	28965	373.05	1.1E+07	3.3E+08	1E+09
Lower flange plate	508.0	63.5	32258	730.25	2.4E+07	2E+09	1.1E+07
Net area			72104		3.5E+07	4.6E+09	1E+09

Depth of full section		D	762.00 mm
Depth of web		d_w	650.90 mm
Distance to NA from top of section	$\Sigma Ay / \Sigma A$	y_t	480.15 mm
Distance to NA from bottom of section	$D - y_t$	y_b	281.85 mm
Second moment of area of section	$\Sigma I_{xx} + \Sigma A(y-y_t)^2$	I_{xx}	5.7E+09 mm^4
Elastic section modulus (compression flange)	I_{xx}/y_c	xc	1.2E+07 mm
Elastic section modulus (tension flange)	I_{xx}/y_t	xt	2.0E+07 mm

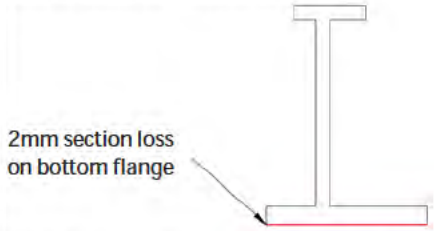
Gross elastic section properties at midspan about -

Section	b mm	d mm	A mm^2	x mm^3	Ax mm^3	A(x-xt)^2 mm^4	I_{yy} mm^4
pper flange plate	47.6	228.6	10881	0	0	0	4.7E+07
eb	650.9	44.5	28965	0	0	0	4779837
Lower flange plate	63.5	508	32258	0	0	0	6.9E+08
Net area			72104		0	0	7.5E+08

idth of full section		B	508.00 mm
Distance to NA from top of section	$\Sigma Ay / \Sigma A$	y_t	0.00 mm
Second moment of area of section	$\Sigma I_{yy} + \Sigma A(x-x_t)^2$	I_{yy}	7.46E+08 mm^4

C rr e Secti n r perties

Sketch of section loss observed at midspan:



Corroded elastic section properties at midspan about -

Section	b mm	d mm	A mm^2	y mm^3	Ay mm^3	A(y-yt)^2 mm^4	I_{xx} mm^4
Beam	-	-	72104	480.15	3.5E+07	1161733	5.7E+09
Lower flange plate	508.0	-2.0	-1016	761	-773176	-8E+07	-338.67
Net area			71088		3.4E+07	-8E+07	5.7E+09

Jacobs

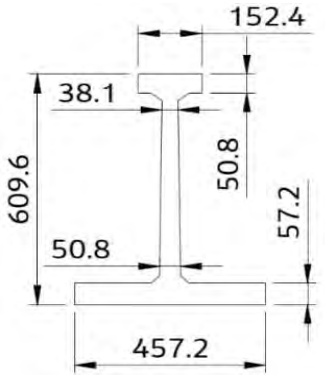
CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Edge Girder Section Properties	Checker	[redacted]	Date	Apr-23

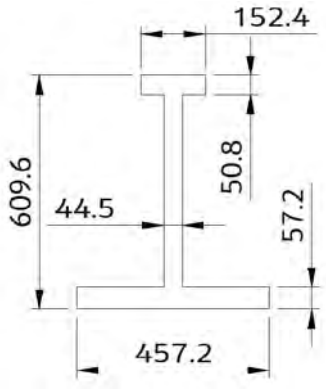
Depth of full section			D	760.00 mm
Depth of web			d_w	650.90 mm
Distance to NA from top of section		$\Sigma Ay / \Sigma A$	y_t	476.13 mm
Distance to NA from bottom of section		$D - y_t$	y_b	283.87 mm
Second moment of area of section		$\Sigma I_{xx} + \Sigma A(y-y_t)^2$	I_{xx}	5.6E+09 mm^4
Elastic section modulus (compression flange)		I_{xx}/y_c	$_{xc}$	1.2E+07 mm
Elastic section modulus (tension flange)		I_{xx}/y_t	$_{xt}$	2.0E+07 mm

Jacobs	CALCULATION SHEET				
Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Internal Girder Section Properties (midspan)	Checker		Date	Apr-23

Section sketch:



Idealised section for use in calculation:



r ss Secti n r perties

Gross elastic section properties at midspan about -

Section	b mm	d mm	A mm^2	y mm^3	Ay mm^3	$A(y-yt)^2$ mm^4	I_{xx} mm^4
pper flange plate	152.4	50.8	7742	25.4	196645	1E+09	1664926
eb	44.5	501.6	22321	301.6	6732074	1.9E+08	4.7E+08
Lower flange plate	457.2	57.2	26152	581	1.5E+07	9.2E+08	7130386
Net area			56215		2.2E+07	2.2E+09	4.8E+08

Depth of full section		D	609.60	mm
Depth of web		d_w	501.60	mm
Distance to NA from top of section	$\Sigma Ay / \Sigma A$	y_t	393.54	mm
Distance to NA from bottom of section	$D - y_t$	y_b	216.06	mm
Second moment of area of section	$\Sigma I_{xx} + \Sigma A(y-y_t)^2$	I_{xx}	2.6E+09	mm^4
Elastic section modulus (compression flange)	I_{xx}/y_c	xc	6.7E+06	mm
Elastic section modulus (tension flange)	I_{xx}/y_t	xt	1.22E+07	mm

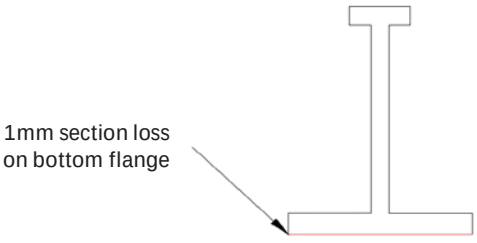
Gross elastic section properties at midspan about -

Section	b mm	d mm	A mm^2	x mm^3	Ax mm^3	$A(x-xt)^2$ mm^4	I_{yy} mm^4
pper flange plate	50.8	152.4	7742	0	0	0	1.5E+07
eb	501.6	44.5	22321	0	0	0	3683463
Lower flange plate	57.2	457.2	26152	0	0	0	4.6E+08
Net area			56215		0	0	4.7E+08

idth of full section		B	457.20	mm
Distance to NA from top of section	$\Sigma Ay / \Sigma A$	y_t	0.00	mm
Second moment of area of section	$\Sigma I_{yy} + \Sigma A(x-x_t)^2$	I_{yy}	4.74E+08	mm^4

C rr e Secti n r perties

Sketch of section loss observed at midspan:



Corroded elastic section properties at midspan about -

Section	b mm	d mm	A mm^2	y mm^3	Ay mm^3	$A(y-yt)^2$ mm^4	I_{xx} mm^4
Beam	-	-	56215	393.54	2.2E+07	175624	2.6E+09
Lower flange plate	457.2	-1.0	-457.2	609.1	-278481	-2E+07	-38.1
Net area			55758		2.2E+07	-2E+07	2.6E+09

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Section	CCT/23 - Internal Girder Section Properties (midspan)	Checker	[redacted]	Date	Apr-23

Depth of full section		D	608.60	mm
Depth of web		d_w	501.60	mm
Distance to NA from top of section	$\Sigma Ay / \Sigma A$	y_t	391.77	mm
Distance to NA from bottom of section	$D - y_t$	y_b	216.83	mm
Second moment of area of section	$\Sigma I_{xx} + \Sigma A(y-y_t)^2$	I_{xx}	2.6E+09	mm^4
Elastic section modulus (compression flange)	I_{xx}/y_c	xc	6.7E+06	mm
Elastic section modulus (tension flange)	I_{xx}/y_t	xt	1.2E+07	mm

Jacobs — CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
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Section	CCT/23 - Dead loads Superimposed Dead Loads		Checker	Date	Apr-23

CS 454 artia act rs f r L a s

Appendix A

Dead	Cast iron dead load	1.00
	Non-metallic dead loads	1.00
Superimposed Dead	Surfacing superimposed dead loads	1.50
	Other superimposed dead loads	1.00

CS 454 Unit ei hts f ateria s

Table 4.1.1a

Cast Iron	7200 kg/m		70.63 kN/m
Brick	2100 kg/m		20.60 kN/m
Timber	720 kg/m		7.06 kN/m
Hardcore fill	1920 kg/m		18.84 kN/m
Asphalt	2300 kg/m		22.56 kN/m
Bituminous macadam (tar)	2400 kg/m		23.54 kN/m
Concrete (plain)	2300 kg/m		22.56 kN/m
Miscellaneous fill	2200 kg/m	*used for verge and footpath*	21.58 kN/m

Se f ei ht

Gross midspan areas used for a conservative assessment

Edge Girder

Area 0.0721 m^2

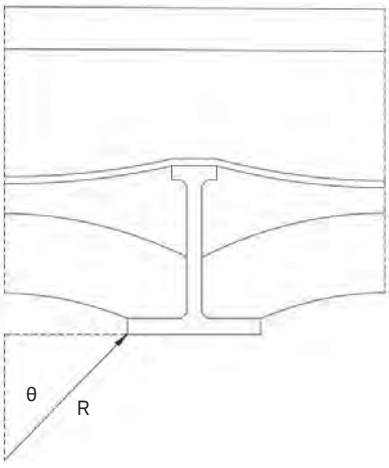
Edge girder DL 1.00 x 70.63 kN/m x 0.07 m^2 = 5.09 kN/m

Internal Girder

Area 0.0562 m^2

Internal girder DL 1.00 x 70.63 kN/m x 0.06 m^2 = 3.97 kN/m

Jack Arch



0.15 m	Tar	
0.429 m	Hardcore fill	
0.025 m	Asphalt	
0.099 m	Concrete	
0.289 m	Brick jack arch, d	
0.089 m	Jack arch rise, r	
0.057 m	Bottom girder flange	
1.138 m	Total	

Jack arch span		s	0.84 mm
Jack arch radius	$R_{in} = (r + (s/4))/2r$	R_{in}	1.03 m
	$R_{ex} = R_{in} + d$	R_{ex}	1.32 m
	$\theta = \sin^{-1}((s/2)/R_{in})$	θ	23.98 °
Arc length	$a = R_{in} \times 2\theta$	a	0.86 m

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Section	CCT/23 - Dead loads Superimposed Dead Loads	Checker		Date	Apr-23

Area of segment under arch — A_s = Area of sector - Area of triangle



$A_s = (2\theta/360)\pi \times R_{in}$ - $(s/2) \times (R_{in}-r)$

A_s = 0.445 - 0.39 A_s 0.05 m^2

Area of jack arch $A_{arch} = (2\theta/360)\pi \times R_{ex} - R_{in}$ A_{arch} 0.28 m^2

Jack arch DL 1.00 x 20.60 kN/m x 0.28 m^2 5.85 kN/m

Concrete

The depth of concrete varies from 332.4mm at the girder to 91.6mm above the jack arch midpoint. The average depth of the concrete will be taken.

Depth of concrete			0.21 m
idth of concrete	taken as girder spacing		1.30 m
Area of concrete			0.28 m^2
Concrete DL	1.00 x 22.56 kN/m x 0.3 m^2		6.26 kN/m

Asphalt

A 25.4mm thick layer of asphalt overlays the concrete.

Depth of asphalt			0.03 m
idth of asphalt	taken as girder spacing		1.30 m
Area of asphalt			0.03 m^2
Aspalt DL	1.00 x 22.56 kN/m x 0.03 m^2		0.74 kN/m

Hardcore fill

Depth of hardcore filling			0.43 m
idth of fill	taken as girder spacing		1.30 m
Area of fill			0.56 m^2
Hardcore fill DL	1.00 x 18.84 kN/m x 0.56 m^2		10.47 kN/m

Surfacing

Depth of surfacing	consider first 100mm depth with 1.50 partial factor applied		0.1 m
idth of surfacing	taken as girder spacing		1.30 m
Area of surfacing			0.13 m^2
Surfacing DL	1.50 x 23.54 kN/m x 0.13 m^2		4.57 kN/m
Remaining depth of surfacing	with 1.00 partial factor applied		0.05 m
Area of surfacing			0.06 m^2
Surfacing DL	1.00 x 23.54 kN/m x 0.06 m^2		1.52 kN/m
Total surfacing DL			6.10 kN/m

Verge Footpath

Average depth of verge and footpath			0.62 m
idth of verge / footpath supported by girder	taken as girder spacing		1.30 m
Area of verge / footpath			0.81 m^2
Verge / footpath DL	1.00 x 21.58 kN/m x 0.81 m^2		17.45 kN/m

Parapets

Area of cast iron parapet	taken from CAD sketch		0.01 m^2
Cast iron parapet DL	1.00 x 70.63 kN/m x 0.01 m^2		0.58 kN/m
Area of timber board parapet			0.02 m^2
Timber parpet DL	1.00 x 7.06 kN/m x 0.02 m^2		0.14 kN/m

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Section	CCT/23 - Dead loads Superimposed Dead Loads	Checker	[redacted]	Date	Apr-23

Total parapet DL 0.72 kN/m

r p rti n f Lan S L Carrie y ri ers

Internal girder type 1 supports a portion of the verge and a portion of carriageway surfacing. The maximum length of verge supported by any of the internal girders as been used. The forth internal girder from the north supports the verge over 60 of its length and carriageway surfacing the remaining 40 . Internal girder type 2 carries only carriageway surfacing.

	Edge Girder	Internal Girder T1	Internal Girder T2
Edge girder	1	0	0
Internal girder	0	1	1
Jack arch	0	1	1
Concrete	0	1	1
Asphalt	0	1	1
Hardcore	0	0.4	1
Surfacing	0	0.4	1
Verge / Footpath	0	0.6	0
Parapet	1	0	0

T ta Lan S L n ir ers

	Edge Girder	Internal Girder T1	Internal Girder T2
Edge girder	5.1	0	0
Internal girder	0	4.0	4.0
Jack arch	0	5.9	5.9
Concrete	0	6.3	6.3
Asphalt	0	0.7	0.7
Hardcore	0	4.2	10.5
Surfacing	0	2.4	6.1
Verge / Footpath	0	10.5	0
Parapet	0.7	0	0

	Edge Girder	Internal Girder T1	Internal Girder T2
Total (kN/m)	5.8	33.9	33.4

E e ir er Resu ts

Maximum moment	$M_{max} = wl^2/8$	M_{DL}	83.03 kNm
Shear at supports	$V_{max} = wl/2$	V_{DL}	31.07 kN

Interna ir er Resu ts

Maximum moment	$M_{max} = wl^2/8$	M_{DL}	324.22 kNm
Shear at supports	$V_{max} = wl/2$	V_{DL}	148.31 kN

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CALCULATION SHEET

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Section	CCT/23 - Live Loading	Checker		Date	Apr-23

The deck will be checked for normal traffic loading using CS 454 ALL model 1. The loading will be applied using a simple 2D grillage model. The girders beneath the footpath and verge will be checked for the effects of accidental vehicle loads. The girders below the footpath and verge will also be analysed utilising ALL model 1 applied using a simple 2D grillage.

ateria r perties

Cast iron

Poisson's ratio for cast iron	v	0.24	
oung's modulus for cast iron	E	130.00	kN/mm^2

Brick

Structural Bridge Design has been used to derive the shear modulus, G, for brick based on the oung's modulus, E_T, for solid brick

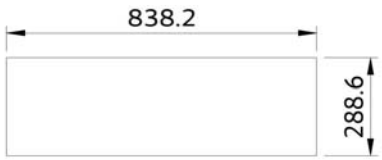
oung's modulus for other solid brick and Type N mortar given in The Brick Industry Association Technical Notes 3A - Brick Masonry Material Properties.

oung's modulus	E_T	15.4	kN/mm^2
Shear modulus	G	6.42	kN/mm^2

L n itu ina e ers

Jack arch thickness		288.60	mm
Jack arch span		838.60	mm

Sketch of jack arch members:



Area	A	242020	mm^2
Second moment of area	I_{yy}	1.7E+09	mm^4
Second moment of area	I_{zz}	1.4E+10	mm^4

Half width sections will be applied to the edge transverse members of the mesh

Area		121010	mm^2
Second moment of area		8.4E+08	mm^4
Second moment of area		7.1E+09	mm^4

Transverse e ers

Edge girder

Area	A	72104	mm^2
Second moment of area	I_{yy}	5.7E+09	mm^4
Second moment of area	I_{zz}	7.5E+08	mm^4

Internal girder

Area	A	56215	mm^2
Second moment of area	I_{yy}	2.6E+09	mm^4
Second moment of area	I_{zz}	4.7E+08	mm^4

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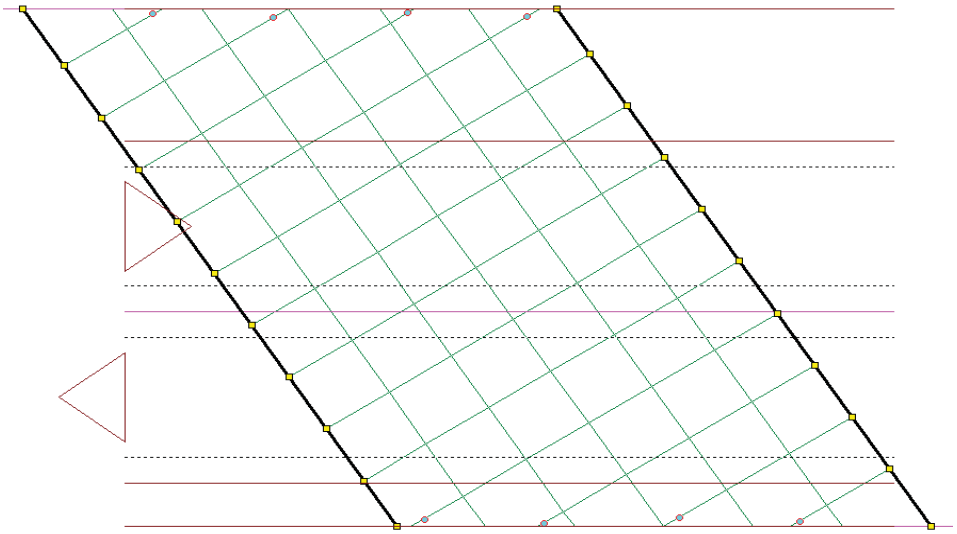
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Live Loading	Checker	[redacted]	Date	Apr-23

Grillage mesh layout from Structural Bridge Design:



Parameters used in live loading:

A traffic flow factor for 'medium' traffic flow category shall be applied to the results	0.95
Notional lane width	3 m
idth of surfaced carriageway	7.51 m
Number of notional lanes	2
Minimum lateral spacing between wheel centres of adjacent vehicles	1.2 m

Interna ir er

Bending Moment

sing the moving loads effects spreadsheet to obtain critical load position:

Maximum bending moment occurs when axle 1 is positioned 7.03 m from the left hand support.

CS 454 Appendix B vehicle load model reference	H1
Factored axle	2
Impact factor (good road surface)	1.62

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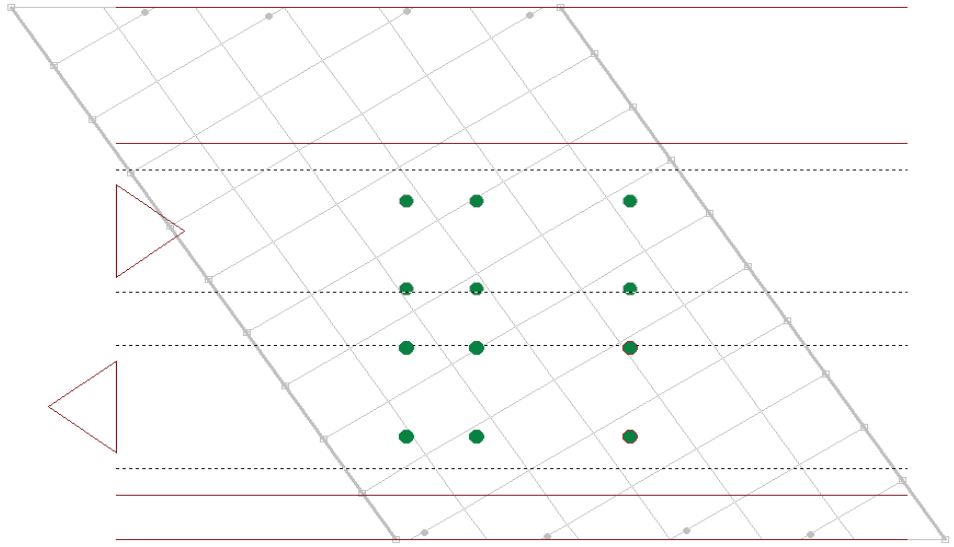
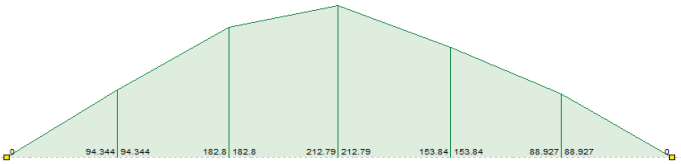
Section	CCT/23 - Live Loading	Checker	[redacted]	Date	Apr-23

Load arrangement in Structural Bridge Design:



Internal girder Structural Bridge Design analysis output:



Internal girder maximum moment 212.8 kNm x 0.95 202.15 kNm

Shear

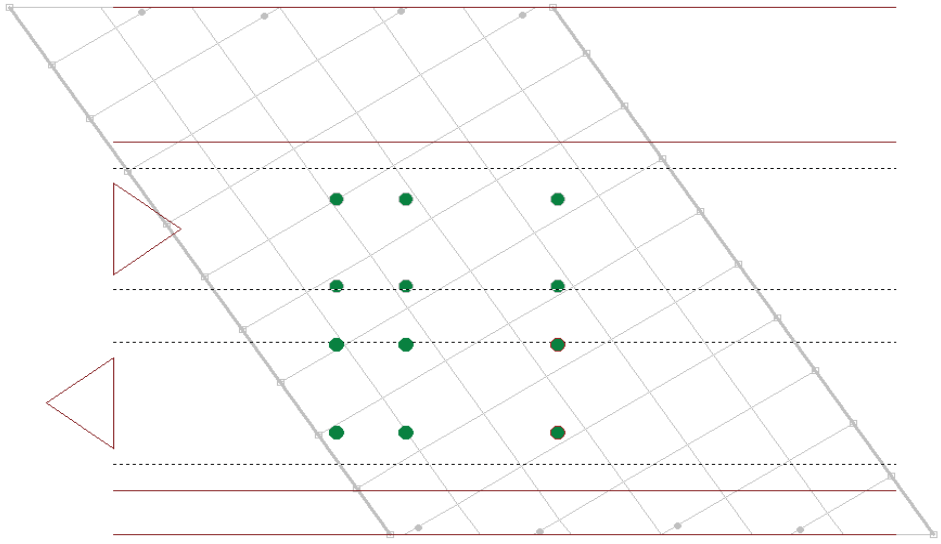
Max shear occurs when axle 1 is positioned 4.101 m from the left hand support

CS 454 Appendix B vehicle load model reference H2

Factored axle 3

Impact factor (good road surface) 1.62

Load arrangement in Structural Bridge Design:



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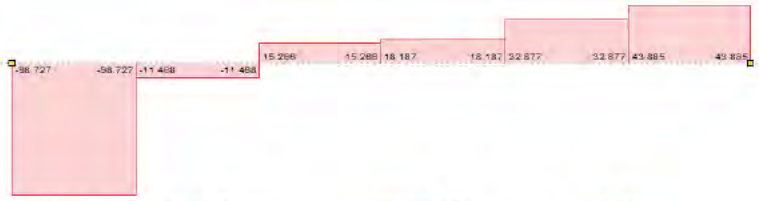
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Live Loading	Checker	[redacted]	Date	Apr-23

Internal girder Structural Bridge Design analysis output:



Internal girder maximum shear 98.73 kN x 0.95 93.79 kN

Acci enta Vehic e L a s

cl 5.27.4 The characteristic vehicle loading arrangement for non-cantilevered members should consist of a single vehicle including impact factor and assuming low traffic flow placed to produce the most adverse effect on the member. The vehicle has been positioned 350mm away from the parapet face.

A traffic flow factor for 'low' traffic flow category shall be applied to the results 0.9

Bending Moment

sing the moving loads effects spreadsheet to obtain critical load position:

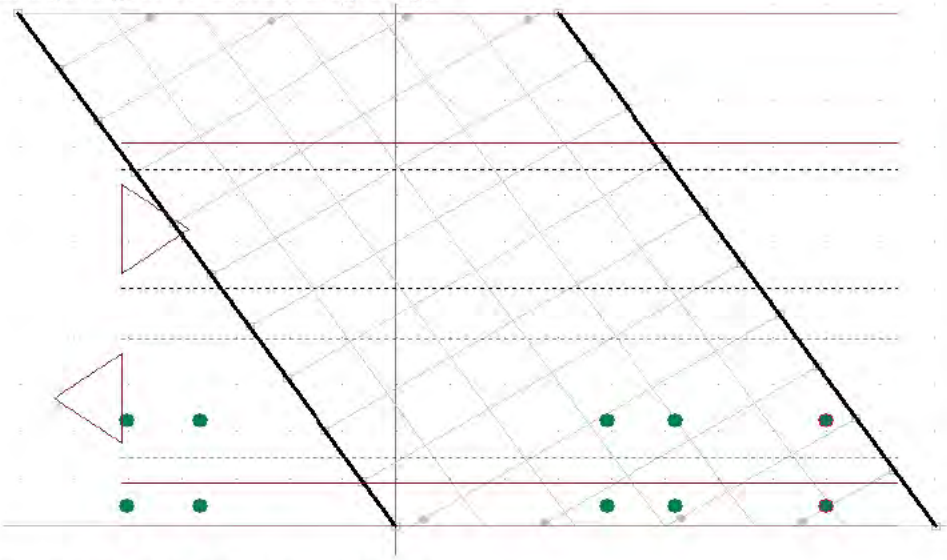
Maximum bending moment occurs when axle 1 is positioned 8.01 m from the left hand support.

CS 454 Appendix B vehicle load model reference H1

Factored axle 2

Impact factor (good road surface) 1.62

Loading arrangement in Structural Bridge Design:



Edge girder Structural Bridge Design analysis output:

Edge girder maximum moment 307.6 kNm x 0.9 276.84 kNm

Shear

Max shear occurs when axle 1 is positioned 4.101 m from the left hand support

CS 454 Appendix B vehicle load model reference H2

Factored axle 3

Impact factor (good road surface) 1.62

Jacobs

CALCULATION SHEET

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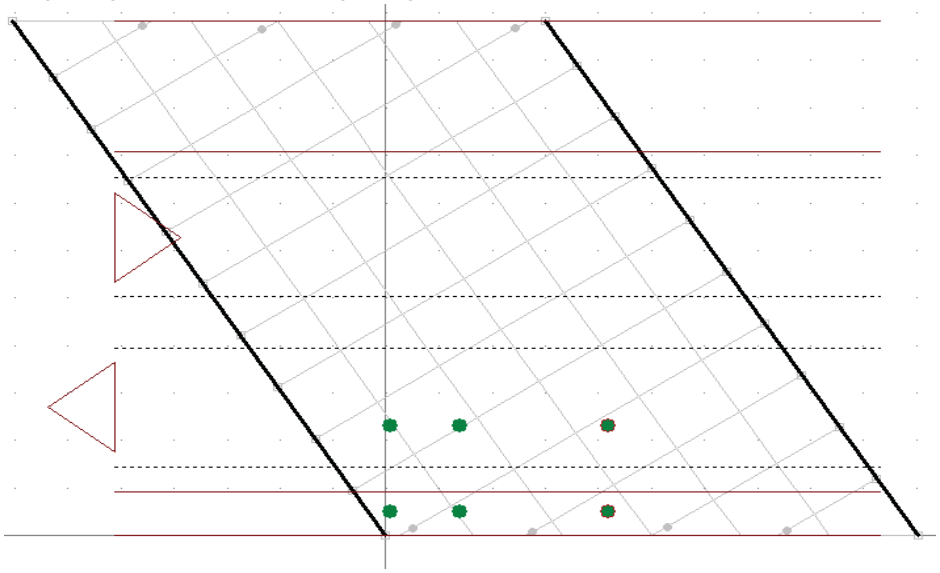
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Live Loading	Checker	[redacted]	Date	Apr-23

Loading arrangement in Structural Bridge Design:



Edge girder Structural Bridge Design analysis output:

Edge girder maximum shear	104.7 kN	x	0.9	94.27 kN

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CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment		Originator	Date	Mar-23
Section	CCT/23 - Load Effect Summary		Checker	Date	Apr-23

Element	DL+SDL		LL		Totals	
	V	M	V	M	V_T	M_T
Edge Girder	31.1	83.0	93.8	276.8	124.9	359.9
Internal Girder	148.3	324.2	94.3	202.2	242.6	526.4

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CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Edge Girder Capacity	Checker	[redacted]	Date	Apr-23

CS 454 — er issi e stresses in cast ir n

Cl. 8.3 — The total compressive stress shall not exceed — 154.00 MPa

Cl. 8.4 — The total tensile stress shall not exceed — 46.00 MPa

Cl. 8.7 — The total shear stress in cast iron shall not exceed — 46.00 MPa

E . 8.5 — Tensile stress limit for traffic loading on cast iron: $\sigma_{tr} \le f_{p1}$

here:

$f_{p1} = 25 - 0.44\sigma_g$ when stresses due to permanent loads, σ_g -16MPa

$f_{p1} = 20 - 0.76\sigma_g$ when stresses due to permanent loads, $\sigma_g \le$ -16MPa

E . 8.6

$f_{p2} = -(44 - 0.79\sigma_g)$ when stresses due to permanent loads, σ_g 16MPa

$f_{p2} = -(81 - 3.15\sigma_g)$ when stresses due to permanent loads, $\sigma_g \le$ 16MPa

E . 8.8 — Shear stress limit for traffic loading in cast iron: $\tau_{tr} \le \min \begin{matrix} 25 - 0.44\tau_g \\ 44 + 0.79\tau_g \end{matrix}$

here:

τ_{tr} = shear stress due to traffic loads only, taken as positive

τ_g = Shear stress due to permanent loads, taken as positive where it acts in the same direction as τ_{tr} and negative when it acts in the opposite direction.

Form AA — The capacity of the internal girders will not be enhanced using the section modulus factor, FI, as there is a discontinuity in the encasing material.

During the inspection the superstructure was felt to vibrate under heavy vehicle loading. A condition factor of 0.90 shall be applied to the live load modulus to account for the amplification of live load stresses due to the vibration of the deck. The value of the condition factor is based on an appraisal of the degree of vibration observed and is considered e uivalent to a poor road surface factor.

Condition factor to account for amplification of live load stresses due to deck vibration — 0.90

E e ir er Capacity

Tension section modulus			1.96E+07 mm^3
Compression section modulus			1.17E+07 mm^3
Moment due to dead load		M_{DL}	83.03 kNm
Moment due to live load		M_{LL}	359.87 kNm
Total applied bending moment	$M_{DL} + M_{LL}$	M_T	442.89 kNm
Tensile stress due to dead loads			4.23 N/mm
Tensile stress due to live loads			18.34 N/mm
Total tensile stress			22.57 N/mm
T ta tensi e stress is accepta e			
Tensile stress limit for traffic loading		f_{p1}	23.14 N/mm
Reduced tensile stress limit	23.14 N/mm x 0.90	f_{p1}	20.82 N/mm
Tensi e stress ue t traffic a s is accepta e			
Girder capacity	$M_{DL} + (\ _{xt} \times f_{p1})$		491.67 kNm
Compressive stress due to dead loads			-7.10 N/mm
Compressive stress due to live loads			-30.76 N/mm
Total imposed compressive stress			-37.86 N/mm
T ta c pressive stress is accepta e			
Compressive stress limit for traffic loading		f_{p2}	-103.35
Reduced compressive stress limit	-103.35 N/mm x 0.90	f_{p2}	-93.02 N/mm
C pressive stress ue t traffic a s is accepta e			

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CALCULATION SHEET

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Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Edge Girder Capacity	Checker	[redacted]	Date	Apr-23

Depth of girder at support (including 2mm section loss to bottom flange)			760.00 mm
eb thickness			44.50 mm
Area of web		A_w	33820 mm^2
Shear due to dead loads		V_{DL}	31.07 kN
Shear due to live loads		V_{LL}	93.79 kN
Total shear		V_T	124.86 kN
Shear stress due to dead loads			0.92 N/mm
Shear stress due to live loads			2.77 N/mm
Total shear stress			3.69 N/mm
T ta shear stress is accepta e			
Shear stress limit for traffic loading		$\tau_{tr} \leq \min\{$	24.60 N/mm
			46.19 N/mm
Reduced tensile stress limit	24.60 N/mm x 0.90	τ_{tr}	22.14 N/mm
Shear stress ue t traffic a s is accepta e			
Girder capacity	$V_{DL} + (A \times \tau_{tr})$		779.72 kN

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CALCULATION SHEET

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Section	CCT/23 - Edge girder capacity	Checker	[redacted]	Date	Apr-23

CS 454 — er issi e stresses in cast ir n

Cl. 8.3 — The total compressive stress shall not exceed — 154.00 MPa

Cl. 8.4 — The total tensile stress shall not exceed — 46.00 MPa

Cl. 8.7 — The total shear stress in cast iron shall not exceed — 46.00 MPa

E . 8.5 — Tensile stress limit for traffic loading on cast iron: $\sigma_{tr} \le f_{p1}$

here:

$f_{p1} = 25 - 0.44\sigma_g$ when stresses due to permanent loads, σ_g -16MPa

$f_{p1} = 20 - 0.76\sigma_g$ when stresses due to permanent loads, $\sigma_g \le$ -16MPa

E . 8.6

$f_{p2} = -(44 - 0.79\sigma_g)$ when stresses due to permanent loads, σ_g 16MPa

$f_{p2} = -(81 - 3.15\sigma_g)$ when stresses due to permanent loads, $\sigma_g \le$ 16MPa

Shear stress limit for traffic loading in cast iron: $\tau_{tr} \le \min \begin{matrix} 25 - 0.44\tau_g \\ 44 + 0.79\tau_g \end{matrix}$

here:

τ_{tr} = shear stress due to traffic loads only, taken as positive

τ_g = Shear stress due to permanent loads, taken as positive where it acts in the same direction as τtr and negative when it acts in the opposite direction.

Form AA — The capacity of the internal girders will not be enhanced using the section modulus factor, Fl, as there is a discontinuity in the encasing material.

Condition factor to account for amplification of live load stresses due to deck vibration — 0.90

Interna ir er Capacity

Tension section modulus			1.2E+07 mm^3
Compression section modulus			6.7E+06 mm^3
Moment due to dead load		M_{DL}	324.22 kNm
Moment due to live load		M_{LL}	202.15 kNm
Total moment		M_T	526.37 kNm
Tensile stress due to dead loads			26.91 N/mm
Tensile stress due to live loads			16.78 N/mm
Total tensile stress			43.69 N/mm
T ta per issi e tensi e stress accepta e			
Tensile stress limit for traffic loading		f_{p1}	13.16 N/mm
Reduced tensile stress limit	13.16 N/mm x 0.90	f_{p1}	11.84 N/mm
Tensi e stress ue t traffic a s e cee s per issi e i it			
Girder capacity	$M_{DL} + (\ _{xt} \times f_{p1})$		466.91 kNm
Compressive stress due to dead loads			-48.62 N/mm
Compressive stress due to live loads			-30.32 N/mm
Total imposed compressive stress			-78.94 N/mm
T ta per issi e c pressive stress accepta e			
Compressive stress limit for traffic loading		f_{p2}	-234.17
Reduced compressive stress limit	-234.17 N/mm x 0.90	f_{p2}	-210.75 N/mm
C pressive stress ue t traffic a s is accepta e			
Depth of girder at support	(smaller height of girder at support used and includes 1mm section loss to bottom flange)		457.10 mm
eb thickness			44.50 mm

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Section	CCT/23 - Edge girder capacity	Checker	[redacted]	Date	Apr-23

Area of web				20341 mm^2
Shear due to dead loads				148.31 kN
Shear due to live loads				94.27 kN
Total shear				242.57 kN
Shear stress due to dead loads			V_{DL}	7.29 N/mm
Shear stress due to live loads			V_{LL}	4.63 N/mm
Total shear stress			V_T	11.93 N/mm
T ta shear stress is accepta e				
Shear stress limit for traffic loading			$\tau_{tr \leq min}$	21.79 N/mm 47.66 N/mm
Reduced shear stress limit	21.79 N/mm	x 0.90	τ_{tr}	19.61 N/mm
Shear stress ue t traffic a s is accepta e				
Girder capacity	V_{DL} + (A x τ_{tr})			149.18 kN

As the girder fails 40/44 tonne GV , the girder will be checked for reduced live loads.

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Section	CCT/23 - Reduced Live Loading	Checker	[redacted]	Date	Apr-23

The tensile stress of the internal girder due to 40/44 tonne GV traffic loads exceeds the permissible limit.
Compressive and shear stresses due to 40/44 tonne GV traffic loads were found to be acceptable.
Therefore the tensile stress due to reduced traffic loads will be checked only.

A traffic flow factor for 'medium' traffic flow category shall be applied to the results 0.95

C nsi er 2 t nne a in

CS 454 Appendix B vehicle load model reference 1

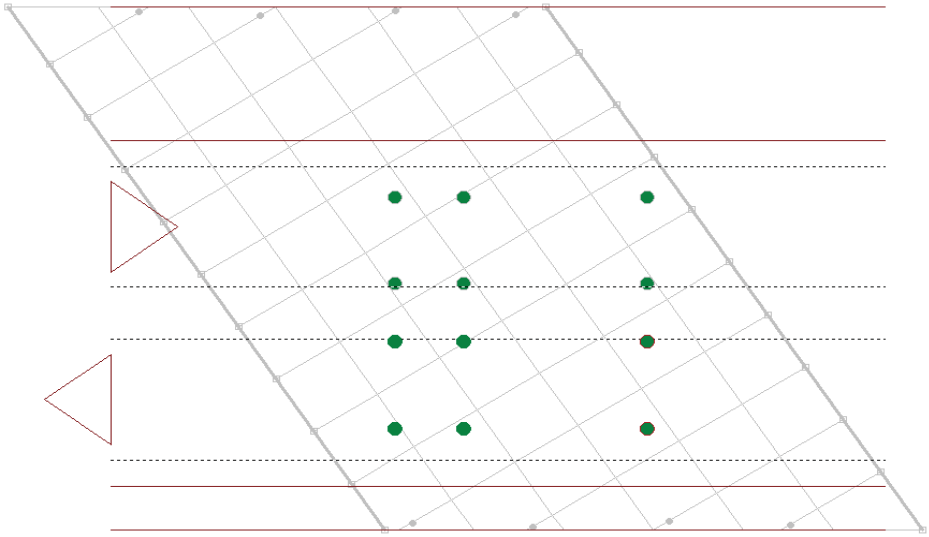
sing the moving loads effects spreadsheet to obtain critical load position:

Maximum bending moment occurs when axle 1 is positioned 7.59 m from the left hand support

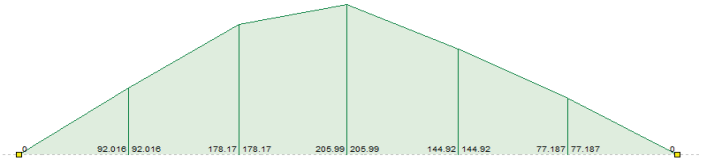
Factored axle 2

Impact factor (good road surface) 1.62

Load arrangement in Structural Bridge Design:



Internal girder Structural Bridge Design analysis output:



Internal girder maximum moment 206 kNm x 0.95 195.69 kNm

ir er Capacity

Tensile stress due to live loads 16.24 N/mm

Reduced tensile stress limit f_{p1} 11.84 N/mm

Tensi e stress ue t traffic a s e cee s per issi e i it

The girder fails 26 tonne GV , the girder will be checked for 18 tonne GV loading.

C nsi er t nne a in

CS 454 Appendix B vehicle load model reference M

sing the moving loads effects spreadsheet to obtain critical load position:

Maximum bending moment occurs when axle 1 is positioned 7.0 m from the left hand support

Factored axle 2

Impact factor (good road surface) 1.62

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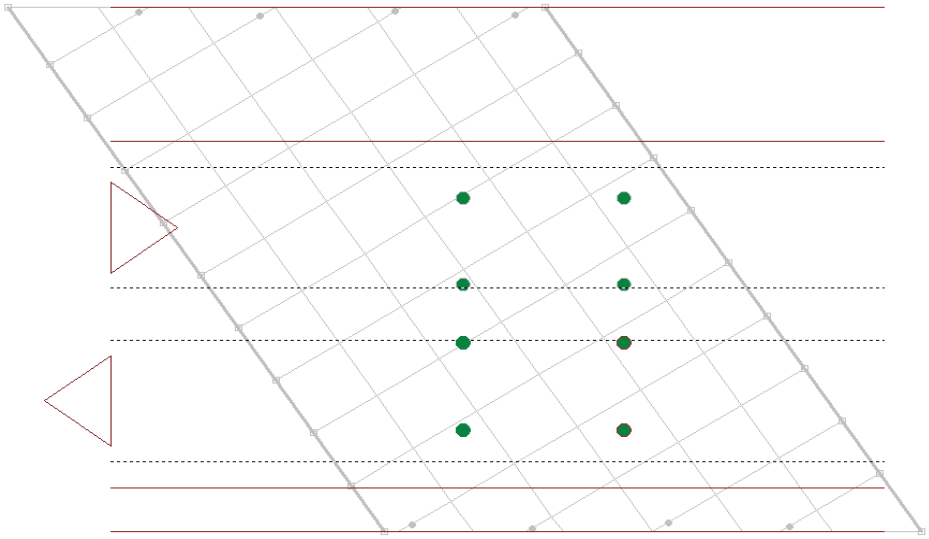
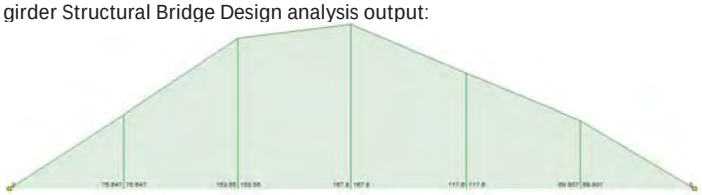
CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Reduced Live Loading	Checker	[redacted]	Date	Apr-23

Load arrangement in Structural Bridge Design:



Internal girder Structural Bridge Design analysis output:



Internal girder maximum moment 167.8 kNm x 0.95 159.41 kNm

Interna ir er Capacity

Tensile stress due to live loads 13.23 N/mm

Reduced tensile stress limit f_{p1} 11.84 N/mm

Tensi e stress ue t traffic a s e cee s per issi e i it

The girder fails 18 tonne GV , the girder will be checked for 7.5 tonne GV loading.

C nsi er t nne a in

CS 454 Appendix B vehicle load model reference N

sing the moving loads effects spreadsheet to obtain critical load position:

Maximum bending moment occurs when axle 1 is positioned 4.5 m from the left hand support

Factored axle 1

Impact factor (good road surface) 1.62

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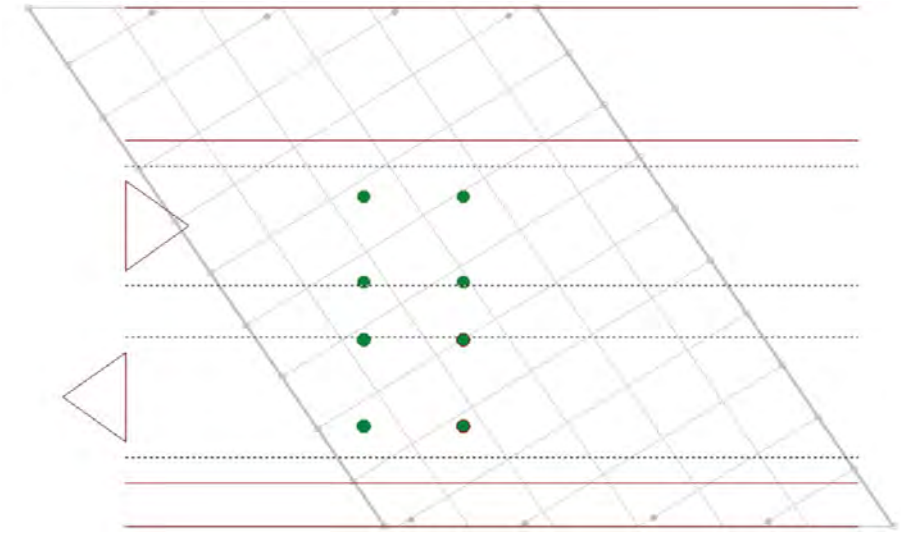
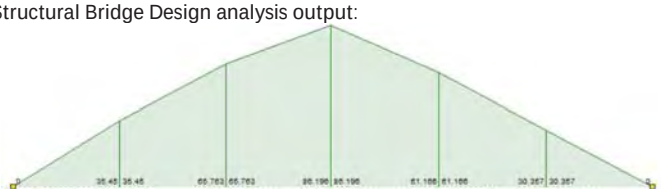
CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Reduced Live Loading	Checker	[redacted]	Date	Apr-23

Load arrangement in Structural Bridge Design:



Internal girder Structural Bridge Design analysis output:



Internal girder maximum moment	86.2 kNm	x	0.95		81.89 kNm

Interna ir er Capacity

Tensile stress due to live loads		6.80 N/mm
Reduced tensile stress limit	f_{p1}	11.84 N/mm
Tensi e stress ue t traffic a s is accepta e		

The girder is suitable for 7.5 tonne GV loading.

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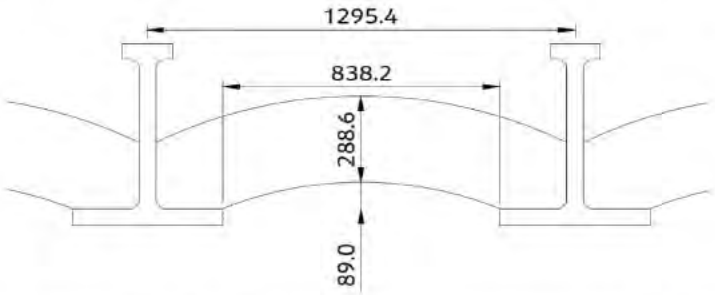
Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]



Review of the ade uacy of the jack arches and tie-rods will be based upon the empirical method described in Bridgeguard 3 Current Information Sheet No 22 (Pro-forma for the empirical assessment of brick, masonry and concrete jack arches and associated ties.)

SECTION Check f r C p iance ith T C nfi urati n Re uire ents

					C p iant es/N
hat is the maximum span of the arch *Non-compliant if greater than 2.0m			0.84	m	es
Do jack arches spring from bottom flanges of beams *If not, non-compliant			es		es
hat is the beam spacing	b	=	1.30	m	
hat is the rise of the arch	r_c	=	0.29	m	
Gross aspect ratio *Non-compliant if b/r_c greater than 10	b/r_c	=	4.5		es
hat is the arch barrel thickness (include concrete fill above)	d	=	420.0	mm	
How is thickness derived			Site Investigation		
*Non-compliant if thickness is less than 220mm					es

SECTION 2 Check f r eficiency

Type N	eficiency				ass/ ai
	hat is the backing material Is it structural				
	Concrete				
	Does the structural backing extend to at least the crown level of the arch extrados		es		
	*If not, fail				ass
	hat is effective shear depth of deck	D_s =	477.6	mm	
	arch rise		89	mm	
	+ barrel thickness		289	mm	
	+ height of structural fill above crown of extrados		100	mm	
	Is $D_s \geq$ minimum re uirement Fig1.	Fig1. Min =	303.8	mm	
	*Fail if $D_s <$ Fig 1 477.6 > 303.8				ass

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CALCULATION SHEET

Office	Glasgow			Calc No.	0451442
Title	VAR9-7070 HRE CS 454 Assessment	Originator	[redacted]	Date	Mar-23
Section	CCT/23 - Jack arch assessment	Checker	[redacted]	Date	Apr-23

2	Do jack arches span longitudinally or transversely between longitudinal girders						
	The jack arches are skewed so that they are intermediate between longitudinally spanning and transversely spanning.						
	For Longitudinal spanning jack arches, ignore following questions on ties/lateral restraint and state N/A.						
	Are ties provided in edge bays of transverse spanning jack arches						
	Ties are not provided in edge bay, however the bolted connection between the internal girders and the edge girders may be considered to provide a hard edge .						
	*If yes, go to 3a/3b						
	*If not, fail, unless edge bay is 'hard' (see 5)			No			ass
3a	hat is the cross sectional area of one tie	dia	=	28.56	mm		
	(Allowing for corrosion losses)	A	=	641	mm^2		
Cl	hat is the number of ties per beam length	n	=	3			
	hat is the clear skew span	L	=	10.18	m		
	Specific area of tie (A_s) = ((n+1) x A) /L	A_s	=	252	mm^2/m		
	*Non-compliant if less than 260mm^2 /m						ai
	hat is the maximum tie spacing	S	=	3	m		
	*Non compliant if greater than 2.5m for cast iron						ai
	The tie bars have insufficient cross-sectional area and are spaced too far apart to comply with the transverse spanning re uirements, however the 'hard edge' complies with section 2 type 5 check.						
3	hat is the cross sectional area of one tie	dia	=	N/A	mm		
	(Allowing for corrosion losses)	A	=	N/A	mm^2		
I/	hat is the number of ties per beam length	n	=	N/A			
ST	hat is the clear s uare span	L	=	N/A	m		
	Specific area of tie (As) = ((n+1) x A) /L	A_s	=	N/A	mm^2/m		
	*Non-compliant if less than 260mm^2 /m						
	hat is the maximum tie spacing	S	=	N/A	m		
	*Non compliant if greater than 3.0m for wrought iron/steel						
	Are ties located within crown of external arch			No			
	*If so, then fail Cl or possible fail for wrought iron/steel						ass
	Does external bay construction provide alternative lateral restraint (i.e. not soft edge)			es			
	*If so, pass *If not, are ties provided in first Jack Arch bay?			No			ass
	*If yes, treat as 3a (or 3b) Otherwise fail.						

SECTION 3 Checks f r efects

Type N	efect	E pirica Assess ent		ass/ ai
		Cl ecks	I/Stee ecks	
	Rotation of supporting beam	Fail	Fail	Pass
	Horizontal Displacement of supporting beam	Fail	Fail	Pass
	Inade uate support to springers e.g. Corrosion of bottom flange of supporting beam over a significant length, missing bedding mortar	Possible Fail	Possible Fail	Pass
	Transversely bowed bottom flange of supporting beam	Fail	Fail	Pass
	Cracking at crown of arch owing to spreading of springers (other than 12, 13)	Fail	Fail	Pass
	Distortion and any associated cracking of jack	Fail	Fail	Fail

Jacobs	CALCULATION SHEET				
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Section	CCT/23 - Jack arch assessment	Checker	[redacted]	Date	Apr-23

	arch barrel			
2	Arch crack resulting in substructure crack	Fail	Fail (5)	Pass
3	Substructure crack or other distress resulting in crack to jack arch	Possible fail (3)	Possible Fail (3) (5)	Pass

Notes

(3) 'Substructure renovation' or 'Monitoring' as appropriate; 'Repair of arch' (if appropriate)

(5) Not applicable in general to longitudinally spanning arches