NRA ~~THAMES~~
~~HYDRAULIC MODELLING~~

NO

Flynn & Rothwell

CONSULTING ENGINEERS

NATIONAL RIVERS AUTHORITY
(THAMES REGION)

BRIDGE MILL - WHEATHAMPSTEAD

SURVEY AND ANALYSIS OF CULVERTS

45/47 South Street,
Bishop's Stortford,
Herts. CM23 3AG,
England.

~~625.745.2 FLY~~ NRA - Thames 312

X

NATIONAL RIVERS AUTHORITY
(THAMES REGION)

BRIDGE MILL - WHEATHAMPSTEAD

SURVEY AND ANALYSIS OF CULVERTS

February 1990

FLYNN AND ROTHWELL
Consulting Engineers
45-47 South Street
Bishop's Stortford
Herts. CM23 3AG

NRA (THAMES REGION)
Aspen House
Crossbrook Street
Waltham Cross
Herts. EN8 8LX

CONDITION SURVEY - WHEATHAMPSTEAD MILL CULVERTS

CONTENTS

1. SURVEY REPORT (MILL CULVERT)

1.1 Procedure

All relevant parts of the culvert were inspected for structural defects above and below water by a Chartered Civil Engineer. The stream bed upstream and downstream of the culvert was inspected for scour and the nature of the bed materials was noted. Invert levels were taken upstream and downstream. The dimensions of typical cross-sections and any obstructions were measured to provide a basis for estimation of the hydraulic capacity. Still photographs were taken of any defects or other points of interest, and the whole length of the culvert was surveyed by CCTV and video-taped.

The survey was carried out on 7th November 1989 during a period of low flow, but underwater visibility within the culvert was nil due to silt in suspension. Underwater inspection was therefore carried out by touch.

Chainages through the culvert are in metres from the downstream end of the culvert. The results of the inspection are shown on Drawing No. 236/03 in Appendix A. Photographs with explanatory captions, are included in Appendix B 1.

1.2 Downstream Bed

There are no signs of erosion or undermining to the downstream bed, which consists of rubble.

1.3 Downstream Exit

The downstream exit consists of a brick arch, headwall and parapet. There are no cracks in the arch ring or headwall, and the pointing is fair (photograph 1). The culvert opening is 2950 mm wide by 1200 mm high. The arch springing points are 1000 mm below the arch soffit and 200 mm below the downstream water level (77.80 m AOD at the time of the survey).

1.4 Culvert

The culvert runs under the Mill House and the High Street (B651). It is constructed of brickwork and consists of a vertical sided wheel chamber, 3150 mm wide, with a 2950 mm wide arched-roof tail culvert. The tail culvert opening is 1200 mm high at the downstream exit (chainage 0 m), 2950 mm wide, and the height of the arch from springing point to soffit is 1000 mm. The depth of water was 400 mm at the time of the survey. At chainage 4.4 m, there is a transverse joint, indicating that the culvert has at some time been extended to allow the road above to be widened (photograph 2). The invert is covered with a layer of silt, gravel and rubble, which rises to within 1000 mm of the arch soffit at chainage 7 m. There is a 300 mm diameter steel pipe which crosses the culvert at chainage 8.5 m; it intrudes 200 mm into the culvert, the bottom of the pipe being only 800 mm above the rubble-covered culvert invert (photograph 3). At chainage 10.5 m, the water depth was 400 mm, giving a clear height from the rubble invert to the arch soffit of 1200 mm.

At chainage 10.8 m, the tail culvert opens into the wheel chamber, which is 3150 mm wide (photograph 4). The depth of water over the brick invert is 500 mm. The mill wheel is no longer in place. The resulting hole in the floor above has been closed with wooden floorboards on concrete-cased steel joists, which span between the side walls of the chamber. Joists Nos. 2, 5, 6, 7 and 8 (numbered from the downstream end) are in poor condition, with varying degrees of corrosion to the steel and spalling of the concrete casings (photographs 5, 6, 7,10 and 11).

From chainage 14.0 m, the brick invert of the wheel chamber curves upwards (photograph 8), reaching the water level at chainage 15.6 m. On the right-hand side (facing downstream) of the wheel chamber, from chainage 13.1 m to 15.3 m, there is a substantial void through and under the invert brickwork. The hole in the 300 mm thick brickwork measures approximately 2200 mm long by 1500 mm wide. The void extends to a maximum depth 1000 mm below the invert and penetrates up to 2000 mm under the invert and the right-hand side wall. There is no evidence of subsidence due to undermining of the culvert wall foundation, but the subjective assessment of the diving inspector is that the void is already large enough to threaten the stability of the wheel chamber invert and the side wall.

At chainage 16.4 m, the upstream entrance to the wheel chamber consists of an opening at high level, 2800 mm wide by 550 mm high. The sill of the opening is constructed of brickwork, with timber facings upstream and downstream (photographs 8, 9, 10 and 11). Under low-flow conditions, this sill is 250 mm above the upstream water level (79.10 m AOD), all flow being diverted through a sluice to the by-pass culvert.

1.5 Upstream Entrance

The stream enters the mill culvert under a timber footbridge (photograph 12). The right-hand upstream bank is retained by a brickwork wing wall, which is in very poor condition (photograph 13). On the left-hand side, there is a brick and concrete sluice which is in fair condition (photograph 14). Under low flow conditions, such as on the day of this survey, all river flow is diverted via this sluice and through a by-pass culvert.

1.6 Upstream Bed

The upstream bed consists of rubble and is approximately 1.1 metres below the level of the surrounding ground. The bed material appears to be stable and there is no evidence of scour.

2. REMEDIAL WORKS (MILL CULVERT)

2.1 Introduction

The remedial works for this culvert divide into the short term need to ensure the structural stability of the mill culvert (and mill buildings) as a whole along with some minor repairs, and the longer term need to implement the remedial works to the culvert invert.

A large void was found in the brick invert. The hole measures approximately 2200mm long by 1500mm wide. The depth of the void is approximately 1000mm. Although there is no evidence of subsidence due to undermining of the wall foundation, it is thought probable that the void will threaten the stability of the wheel chamber invert and side wall.

The timber coping at the weir has deteriorated and some boltheads are projecting. The pointing to the brickwork apron and the sides is in bad condition and needs to be repaired.

The beam casing is cracked and spalled in many places and this concrete should be reinstated and repaired. When the damaged concrete has been broken out, the beams should be inspected for decay and their residual life and strength estimated.

It appears that the moisture content in the floorboards approaches a level where biodegradation can occur and this should be monitored.

The right hand brickwork wing wall is in very poor condition and needs to be restored.

Note: A separate summary of the superstructure has been carried out and appears in Appendix D.

2.2 Short-Term Works

- Remove all rubble prior to work

- Break back overhanging brick invert to expose void and refill using dense concrete

- Restore brickwork invert

- Repair/reconstruct right-hand upstream brickwork wing wall at the entrance to the culvert.

- Restore the timber coping and secure with new bolts. Make good all defective pointing in the brickwork apron and side walls.

- Break out casing around roof members and examine the steel sections to determine their structural condition. Replace I beams where necessary and reconstruct concrete casing.

2.3 Long-Term Works

- Further monitoring of the moisture content of the floorboards, and replace them if and when deemed necessary.

3. SURVEY REPORT (BY PASS CULVERT)

3.1 Procedure

All relevant parts of the culvert were inspected for structural defects above and below water, by a Chartered Civil Engineer. The stream bed upstream and downstream of the culvert was inspected for scour and the nature of the bed materials was noted. Invert levels were taken upstream and downstream. The dimensions of typical cross-sections and any obstructions were measured to provide a basis for estimation of the hydraulic capacity. Still photographs were taken of any defects or other points of interest, and the whole length of the culvert was surveyed by CCTV and video-taped.

The survey was carried out on 7th November 1989 during a period of low flow. The water in the culvert was clear but fast-flowing, and generally not more than 300 mm deep. Underwater inspection was therefore carried out by touch and sight.

Chainages through the culvert are in metres from the downstream end of the culvert, measured along the left-hand wall (viewed downstream).

The results of the inspection are shown on drawing No. 236/04 in Appendix A. Photographs with explanatory captions, are included in Appendix B.

3.2 Downstream Bed

There are no signs of erosion or undermining to the downstream bed, which consists of rubble.

3.3 Downstream Exit

At the downstream exit, the culvert consists of a reinforced concrete roof and walls, with a brick headwall/parapet above (photograph 1). The bottom 400 mm of the culvert walls and the culvert invert are brickwork, as are the side walls downstream of the exit. The reinforced concrete and brickwork are in fair condition, except for the right-hand wall 1500 mm downstream of the culvert exit, where poor pointing has resulted in the loss of a brick 300 mm above water level (photograph 2). The downstream exit measures 1800 mm wide by 1100 mm high, and the water depth at the time of the survey was 500 mm.

3.4 Culvert

The culvert by-passes the mill culvert, running under the High Street (B651) at the northern end of the mill buildings. It has a rectangular cross-section and is constructed of reinforced concrete and brickwork.

From chainage 0 m (the downstream exit) to chainage 13 m, the culvert is straight and measures 1800 mm wide by 1100 mm high. The water depth varies from 500 mm at chainage 0 m to 200 mm at chainage 6 m and beyond. The pre-cast concrete slab roof and in-situ concrete walls are in good condition. The invert and the lower 400 mm of the wall are of brickwork, which is in fair condition. There are no obstructions in this section of the culvert, but there are two 650 mm diameter pipe outlets in the right-hand wall at chainages 10 m and 11 m. These two pipes run nearly straight under the High Street from the upstream entrance to the culvert (photographs 3, 4, 5, 13 and 14).

From chainage 12 m, the culvert roof is constructed of in-situ reinforced concrete, as are the invert and the whole of the walls. The finish to the in-situ concrete is fair and the overall condition is good (photograph 6). From chainage 13.5 m to chainage 17m, the culvert bends through approximately 70 degrees. At chainage 15.5 m, there are three pipe outlets in the left-hand wall measuring 200 mm, 100 mm and 150 mm in diameter (photograph 7).

At chainage 18 m, the culvert measures 1800 mm wide by 1200 mm high. From chainage 19.2 m to chainage 22 m, the invert is lowered to provide 1000 mm clearance below two pipes which cross the culvert 500 mm below soffit level (photographs 8 and 9). From chainage 24 m to the upstream entrance, the height of the culvert is 1050 mm. At chainage 26.7m, there is a scaffolding board jammed between the walls of the culvert, obstructing the top 250 mm; at chainage 27 m, a 150 mm diameter steel pipe intrudes 100 mm below the soffit (photograph 10).

From chainage 28.4 m to the upstream entrance at chainage 31.5 m, the culvert bends through approximately 80 degrees. There is a curved concrete cutwater at this bend (photographs 11, 12 and 14).

3.5 Upstream Entrance

The stream enters the by-pass culvert from a brick and concrete channel (photograph 14). The left-hand upstream bank is retained by a brickwork wall, which is in fair condition (photograph 14). On the right-hand side, there are two 650 mm diameter pipe entrances (photographs 13 and 14).

3.6 Upstream Bed

The upstream bed consists of an open brick and concrete channel measuring 2700 mm wide by 1400 mm high. Under low flow conditions, such as on the day of this survey, all river flow is diverted via this channel and through the by-pass culvert.

4. REMEDIAL WORK (BY-PASS CULVERT)

4.1 Introduction

The culvert itself appears to be in very good condition. Concrete finishings are in good condition throughout. It is not considered necessary to undertake any internal works assuming the culvert is inspected in 3-5 years time.

4.2 Short-Term Works

- Repoint and repair damaged brickwork on the right-hand wall 1500mm downstream of exit.

- Repair the right hand side of the upstream entrance where there is evidence of damage at the entrance to the two 650mm pipes.

4.3 Long-Term Works

There are none required at this time.

5. HYDRAULIC ANALYSIS

5.1 General Hydraulic Features:

The Hydraulic System consists of two culverts namely the Mill culvert and the By-Pass culvert. The Mill culvert underlies the mill buildings and the High Street. The by-pass culvert takes a much longer tortuous route to discharge into the River Lee. A plan of the overall configuration is as shown on Drawing No. 236/02.

The Mill culvert changes in its cross-section reducing in height from 1.8 m to 1.2 m. Losses included are sudden contraction, exit & friction in addition to energy dissipated at the weir. The By-Pass culvert itself is at the end of a 35 m by-pass channel. The end of this channel consists of an entrance to the rectangular culvert and on the right-hand side two 650 mm diameter pipelines which takes some of the flow.

Hydraulically, the most significant feature of the system is that the outlets of the culverts are sudden expansions and drowned for all flows greater than 6.0cu m/sec. This leads to substantial losses at the exits.

The two 650 mm diameter pipelines have significant exit and entry losses at higher flow rates due to the orientation of the pipe entrances, and similarly rapid dissipation of the exit velocity head.

The By-Pass culvert gives significant form losses due to bends and local accelerations. The losses due to pipe crossings inducing blockage effects are not as significant, as the bend losses. The loss at the cutwater is less significant than would be anticipated.

5.2 Hydraulic Performance of the Culvert

Flows considered for these culverts vary from 1 - 10cu m/sec representing all flows up to the 100 year return period event. On the basis of undrowned flow at the weir structures upstream the flows were split into that going into the By-pass system and that passing through the Mill culvert.

The flows into the By-pass culvert were further split into that going into the pipes and that going into the actual culvert. The pipes take 25% of the By-pass flow and this is much smaller than was expected initially. Despite the fact that these pipes were short the total head loss across the pipes was 0.45 m for a flow of 1.65cu m/sec.

The By-pass system runs full, as pipe flow, at flows above about 3.5 - 4cu m/sec. The weir structures at the channel entrance were drowned for flows in excess of 6cu m/sec in the By-pass.

The Mill weir is undrowned, even at the highest flows. It is interesting to note that only for total discharges in excess of 9.0cu m/sec, is the upstream water level governed by the effects of the tailwater, due to drowning of the broad crested weir at the Mill.

5.3 Stage Discharge Relationship

The rating curve is given on Drawing No. 236/05. It is noticeable that the ustream head rises rapidly as the upstream structures are drowned out. This only occurs at very high flows.

6. PROPOSED MEASURES TO INCREASE HYDRAULIC CAPACITY

6.1 Flood levels

In considering a definition of serviceability/failure for the system the following parameters have been established:

Primary: The upstream level of 80.3m AOD in a 1:100 year event must not be exceeded.

Secondary:

1. The flow level in the rectangular culvert downstream of the Mill weir shall be no higher than 100mm below the soffit of concrete encased joists that support the floor within the shop.

2. The flow level upstream of the weir shall not exceed the defence level. In particular, the flood protection around the bridge and the walkways shall ensure that no overbank flow can take place.

6.2 Opportunities for Improvements

Although some increase in efficiency can be achieved by improvements within the by-pass, ie. by removing the cut-water and by streamlining at the pipe crossings, the performance of the system is controlled by:

1. The weir levels at upstream end. These are undrowned (with the exception of the sharp crested weir at the entrance to the by-pass) even at higher flows.

2. The tailwater level will determine the water level under the floor in the Mill.

Hence any improvement scheme must, in addressing the parameters laid down in 6.1, seek to set the weir crests at the correct level to avoid flooding upstream, whilst apportioning flow to the by-pass and Mill culverts so that no flooding occurs at the by-pass and so that the water level under the floor in the Mill is not excessive. This balance is further complicated by the need for the fish-pass to be below the adjacent weir-crest levels and by the problems at the footbridge where, under the present layout, flow will 'leak' around the bridge via the two footpaths.

6.3 Proposals (Option 1, Option 2)

Both options outlined below include reconstruction of the existing arched culvert as a concrete box culvert with dimensions the same as the existing maximums.

Option 1: This has been developed on the basis of improvements within the Mill culvert, so that the water level under the floor (and also under the upper floors and footbridge) is kept acceptably low.

In reality, the only way that this could be achieved would be to build concrete floors to withstand uplift forces during an extreme flood. However, although this could be done within the building, it would not be acceptable to rebuild the footbridge as a culvert with headwall. Hence, it has been necessary to design this option to give an upstream water level just below the soffit of the existing bridge.

The proposals are shown on drawing. no. 236/05 attached.

Option 2: The existing position of the weir is far from ideal. Whilst it is possible to deal with uplift pressures under the lower floor, the head loss at the weir means that in its present position, there are potential uplift pressures under the upper floor and bridge, as discussed in Option 1.

This option allows for the weir to be relocated upstream of the existing footbridge (to be retained). This new weir will then become a focus for people crossing the bridge, and will enhance the attractiveness of the area.

The maximum discharge that can be accommodated through the Mill culvert occurs, in accordance with the first of the secondary parameters listed in item 6.1, when the maximum acceptable uplift occurs in the box culvert under the existing low level floor. The weir has been set to give this flow at the design event.

By setting the weir upstream, the head loss occurs outside the building, and hence there is no uplift on the upper floors.

Moving the Mill weir upstream requires that the weirs at the head of the by-pass are to be repositioned upstream and the by-pass channel re-aligned. This will result in the formation of a small triangle of land, potentially on the 'flood-plain', adjacent to the existing walkway. This would be a considerable enhancement to the area if properly laid out as a sitting area. Access would be via steps over the flood defence wall.

The layout of Option 2 is shown on drawing no. 236/06 attached.

6.4 Recommendation

It is recommended that Option 2 be considered further, subject to outline design and costing. This option would not require weir levels to be dropped significantly (Option 1 would) and making the weir external to the building, and providing a seating place, would give considerable enhancement to the local environment.

7. LIFE EXPECTANCY AND MAINTENANCE

The By-pass structure is generally in good condition and needs only repair works outside of the culvert itself. Future monitoring must be planned for 5 years time when another diving survey will be required. With regular monitoring and remedial work, the life expectancy should exceed 50 years. The radical alterations proposed to the Mill Culvert are likely to require full reconstruction of the Culvert. The life expectancy of these new works would be about 60 - 80 years and will need to be determined at design. However, the Mill Culvert will continue to require inspection at periods of no more than 5 years.

8. Existing Services

✓ 27 FEB 1990

British Gas Eastern

Regional Chairman
G Eccles OBE

Please reply to: Area Engineer

Your Ref: DMcD/JA.
Our Ref: DD/SL/JG/0.58
Please ask for: MR. GILL.

British Gas plc (Eastern)
London Road
Hemel Hempstead
Hertfordshire HP3 9AW

Telephone Hemel Hempstead(0442)3233

26 FEB 1990

FLYNN & ROTHWELL
CONSULTING ENGINEERS.
45-47 SOUTH STREET.
BISHOPS STORTFORD.
HERTS.
CM 23 3AG.

Dear Sir,

MILL AREA, HIGH STREET.
WHEATHAMPSTEAD

Thank you for your letter dated 16 FEB 1990 concerning the above.

I attach a copy ~~of your plans/copies~~ of our records, showing the approximate position of our mains in the Area. Individual customers' services are not shown.

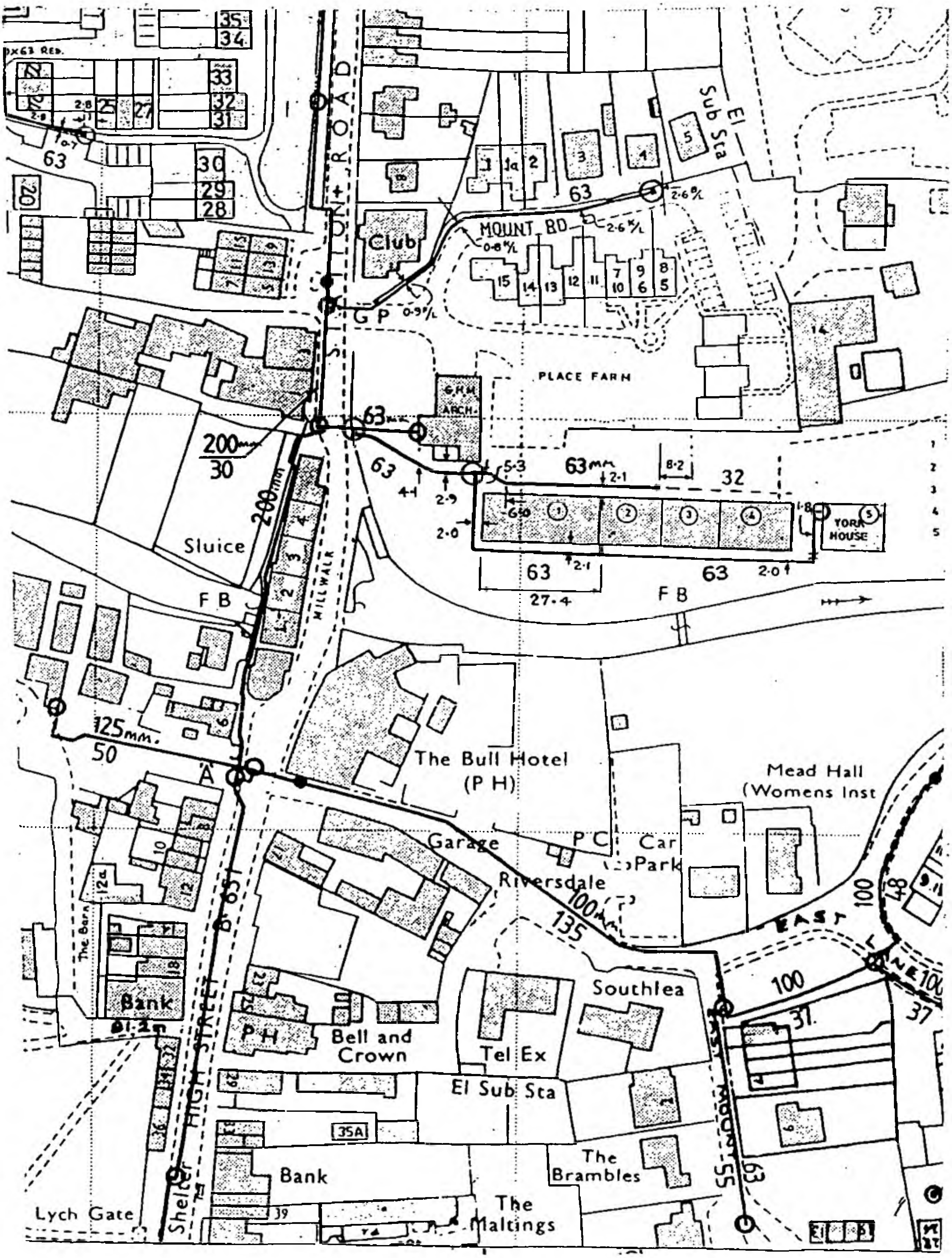
British Gas plc Eastern reserves the right of access to the mains and services as shown for maintenance and replacement purposes.

Should you require any further information, please contact the above member of my staff.

Yours faithfully,

G. White

G. White
Area Engineer



MOUNT RD
Club
G P
PLACE FARM
G.H.M. ARCH.
YORK HOUSE
Sluice
F B
MILLWALK
The Bull Hotel
(P H)
Mead Hall
(Womens Inst
Garage
P C
Car Park
Riversdale
EAST
Southlea
Bank
P H
Bell and Crown
Tel Ex
El Sub Sta
Bank
The Brambles
The Maltings
Lych Gate
Shelter
HIGH STREET
The Barn
Sub Sta
200mm
125mm
100mm

British Gas plc
Eastern
South Herts. Area
Distribution Department

EXISTING MAINS ————
~~PROPOSED MAINS~~
~~EXISTING SERVICES~~
~~PROPOSED SERVICES~~
DEPTHS THUS 0.75m

IMPORTANT NOTICE:

"The information shown on this plan is given without obligation, or warranty. The accuracy thereof cannot be guaranteed. Service pipes are not known but their presence should be anticipated. No liability of any kind whatsoever is accepted by British Gas, its agents or servants for any error or omission. The actual position of mains and services must be verified and established on site before any mechanical plant is used."

DATE 25 FEB [illegible]

District

WHEATHAMPSTEAD

Scale

1:1250

Map Ref. No.

TL 1714 SE

Map reproduced by Trident Associates

Date	Revision
MAR '83	LOWER LUTON RD. SOCIAL CLUB KS.
DEC 1983	CREST HOMES: LOWER LUTON RD. KS
JUN 1984	CODICOTE RD. 63mm. KS.

LEGEND

(SIZE E.G. 125mm.) DIAMETER

Low pressure up to 75 mbar	————	Governor	△
Medium pressure 75 mbar to 2 bar	—— - —— - ——	Dia. change Cap & Junction	○
Intermediate Pressure 2 bar to 7 bar	- ··· - ··· -	Syphon	—●—
High pressure 7 bar to 24 bar	——···——	Valve	—▷◁—
High pressure 24 bar to 70 bar	——····——···——	Purge point	—◇—
		Press. rec. pt.	—□—

2 8 FEB 19

The Colne Valley Water Company

Blackwell House, Aldenham Road, Watford, Hertfordshire WD2 2EY
Telephone Watford (0923) 223333.
Facsimile No. 0923 249395.

Your Ref DMcD/JA
Our Ref JANL/RHB/JF
Please ask for Mr Bates 0923 814311

Flynn & Rothwell
45-47 South Street
Bishops Stortford
Herts CM23 3AG

23 February 1990

Dear Sirs

We thank you for your letter dated 16 February 1990 with two copies of your site location drawing.

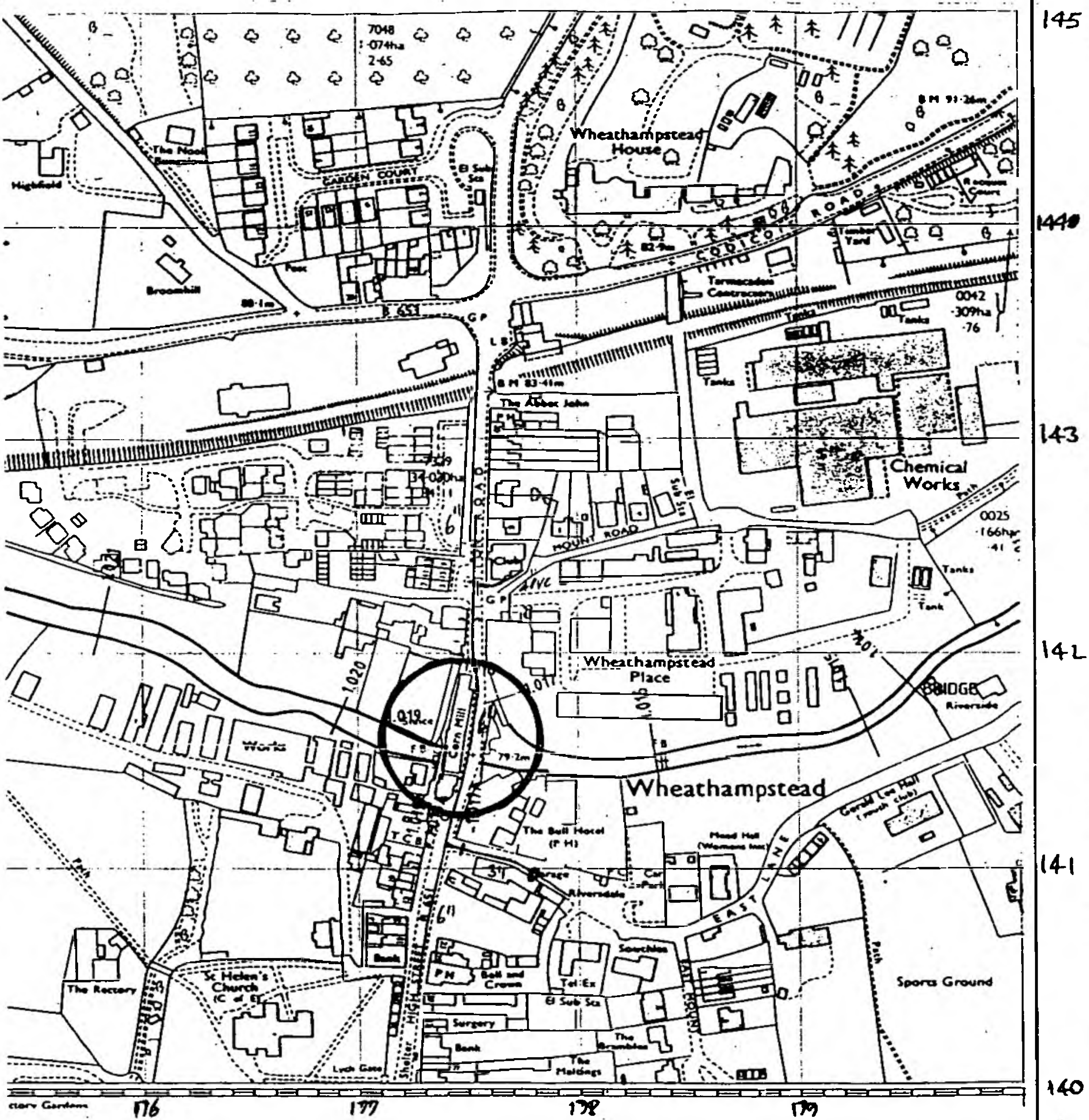
We are returning one copy of your drawing on which we have indicated what we believe to be the positions of our existing mains which were originally laid with an approximate cover of 900mm.

Reference points existing at the time of installation of our mains or when they were last exposed may have been altered subsequently as a result of highway or other works and the information given should, therefore, be regarded as approximate only. We cannot accept responsibility for loss or damage that may occur as a result of error in the particulars supplied.

Yours faithfully

J A N Lang
Managing Engineer - Operations

Incorporated with limited liability by Act of Parliament. No. Z22 (England)
Principal Office: Blackwell House, Aldenham Road, Watford, Hertfordshire WD2 2EY



COLNE VALLEY WATER COMPANY

TL1714S

EXISTING MAINS TQ1714S

EXISTING SERVICE CONNECTIONS

PROPOSED MAINS 22/2/90

PROPOSED SERVICE CONNECTIONS ....

MAINS TO BE ABANDONED

Wheathampstead Main Culvert Survey

Location Plan

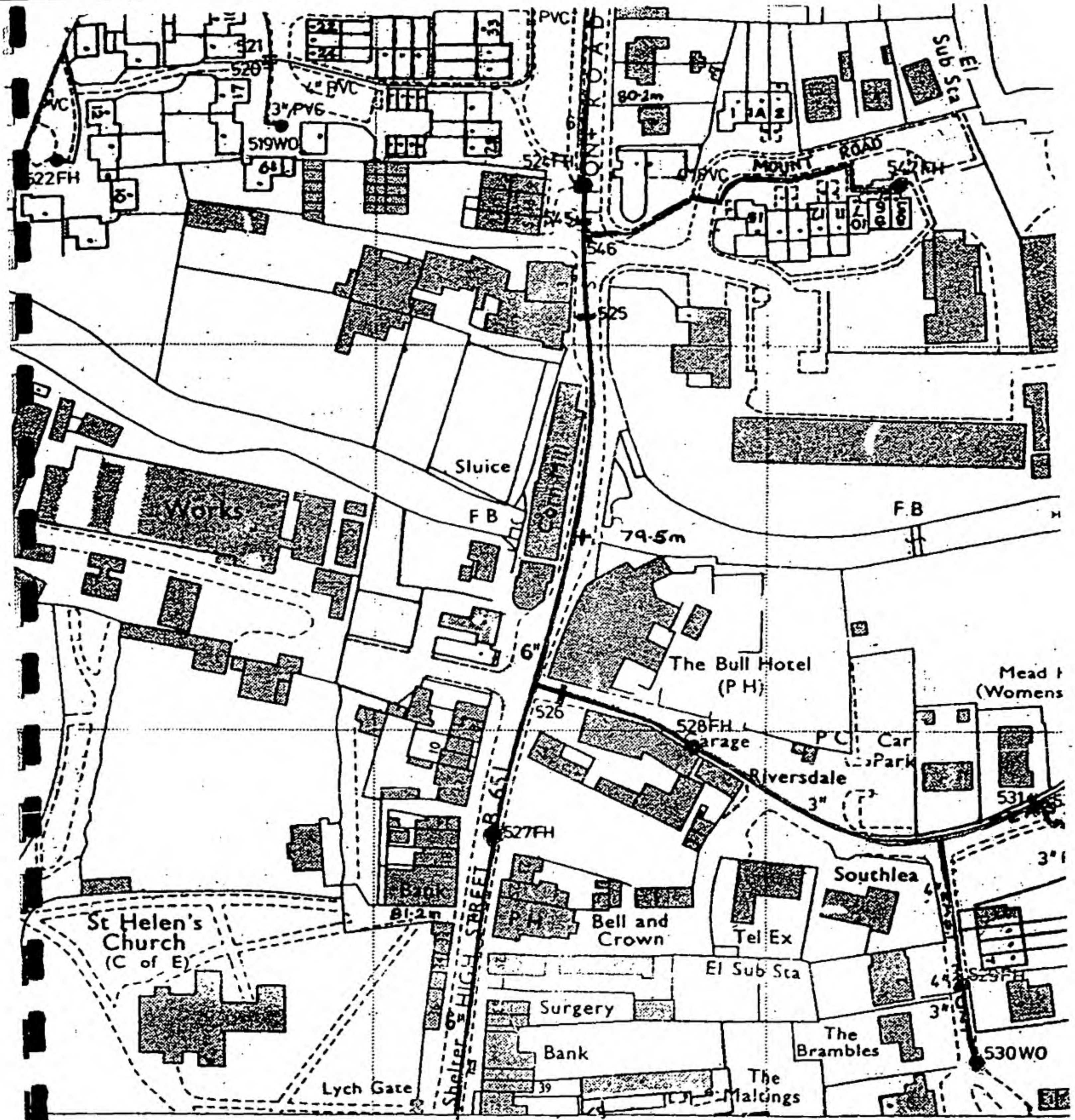
Flynn & Rothwell

CONSULTING ENGINEERS

45-47 South Street.,

Bishops Stortford Herts.

Job No 6/236	Drawing No 236/01
Drawn by T.E.T.	Approved
Scale 1:2500	Date Jan 90



MMM

1:1250 Enlargement fro

COLNE VALLEY WATER COMPANY

EXISTING MAINS ——— TQ 1714S

EXISTING SERVICE CONNECTIONS ....

PROPOSED MAINS ....

PROPOSED SERVICE CONNECTIONS..................

MAINS TO BE ABANDONED ....

DATE 22/2/90

EASTERN
ELECTRICITY

Hemel Hempstead Office
Chilterns Area
P.O. Box 3
Hemel Hempstead, Herts, HP3 9AD
Tel: Luton (0582) 585555 Ext.
Fax: Hemel (0442) 219595

28 FEB 1990

Our Ref: 302/3147

Your Ref:

Glynn & Rothwell.
Consulting Engineers
45-47 South St.
Bishop Stortford
Herts.
CM23 3AQ.

Dear Sirs

PUBLIC UTILITIES STREET WORKS ACT 1950

Your reference. DMcD/JA .... Date. 23.2.90 ....

Description/Location. Mill / By-pass culverts ......
.... Wheathampstead. ....

Thank you for your letter informing us of your intention to carry out works at the above location.

Please have regard to paragraphs indicated

- [x] The Board's High Voltage and Low Voltage cables are present within the limits of the proposed work. You are requested to take precautions to avoid damage to this apparatus. You are also requested to bear in mind the presence of SERVICE CABLES in this locality.

****

- [ ] The Board's High Voltage and Low Voltage cables are not present within the limits of the proposed works, but you are requested to bear in mind the presence of SERVICE CABLES in this locality.

****

- [ ] CAUTION High Voltage/Low Voltage overhead lines in the proximity of the above works.

****

- [ ] Microfilm copies of our cable records are in your possession.

For your information I enclose:

1. A copy of our Mains Plans and Section Sheets, showing our cables in the vicinity of the proposed works.

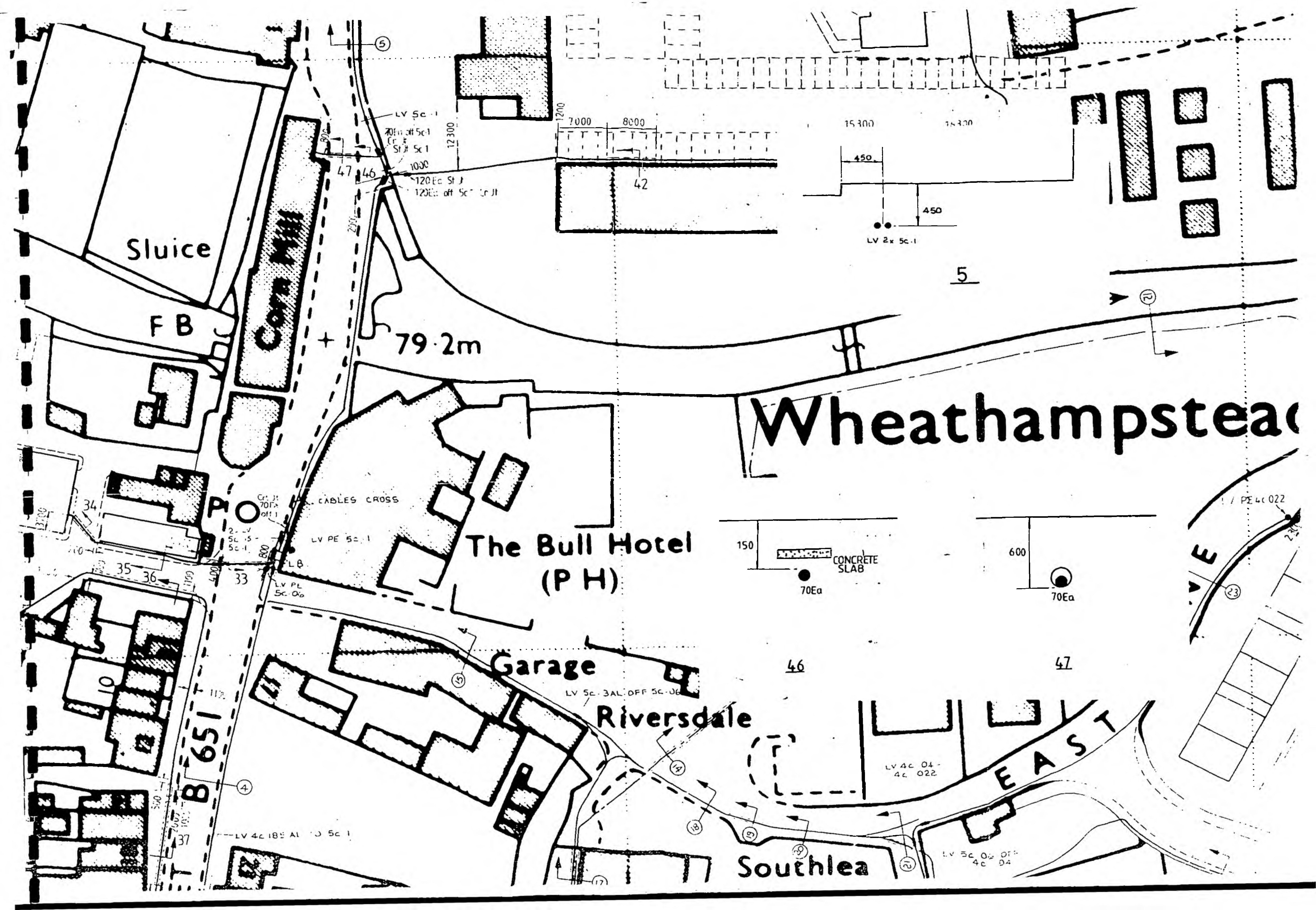
2. ~~A copy of our plans showing overhead lines.~~

Please be aware of the information overleaf and on all Plans.

Yours faithfully,

[signature]

for DISTRIBUTION ENGINEER


Sluice
Corn Mill
F B
79·2m
Wheathampstead
P O
The Bull Hotel
(P H)
CABLES CROSS
L B
Garage
Riversdale
Southlea
B 651
E A S T
CONCRETE SLAB
70Ea
70Ea
150
600
450
450
LV 2x 5c·1
7000
8000
12300
1000
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46
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35
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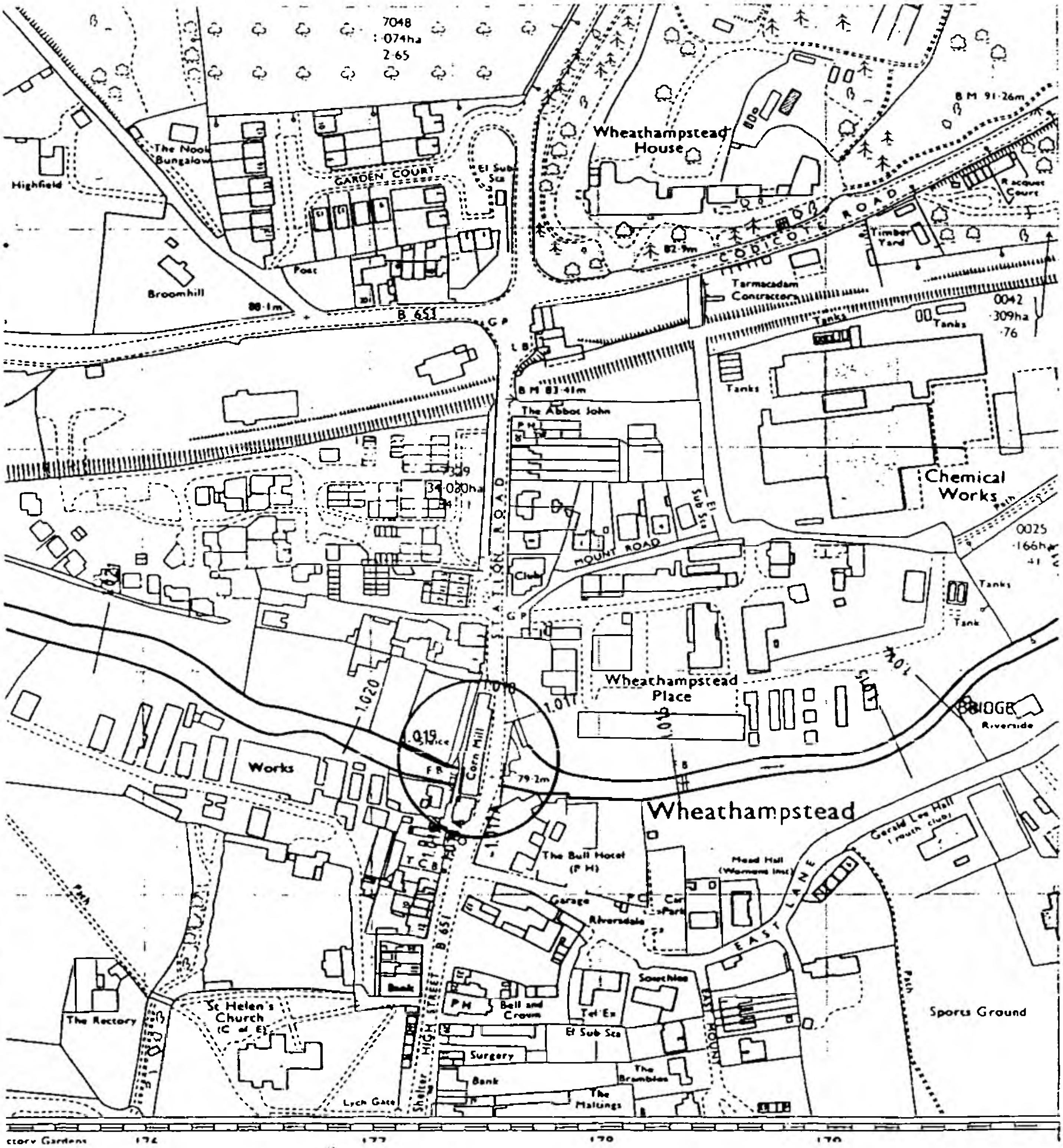
37

APPENDIX A —	Drawings:	Location Plan	Drg. 236/01
		General Arrangement	02
		Mill Culvert Plan and Section	03
		By Pass Culvert Plan and Section	04
		Outline Modifications Option 1	05
		Outline Modifications Option 2	06

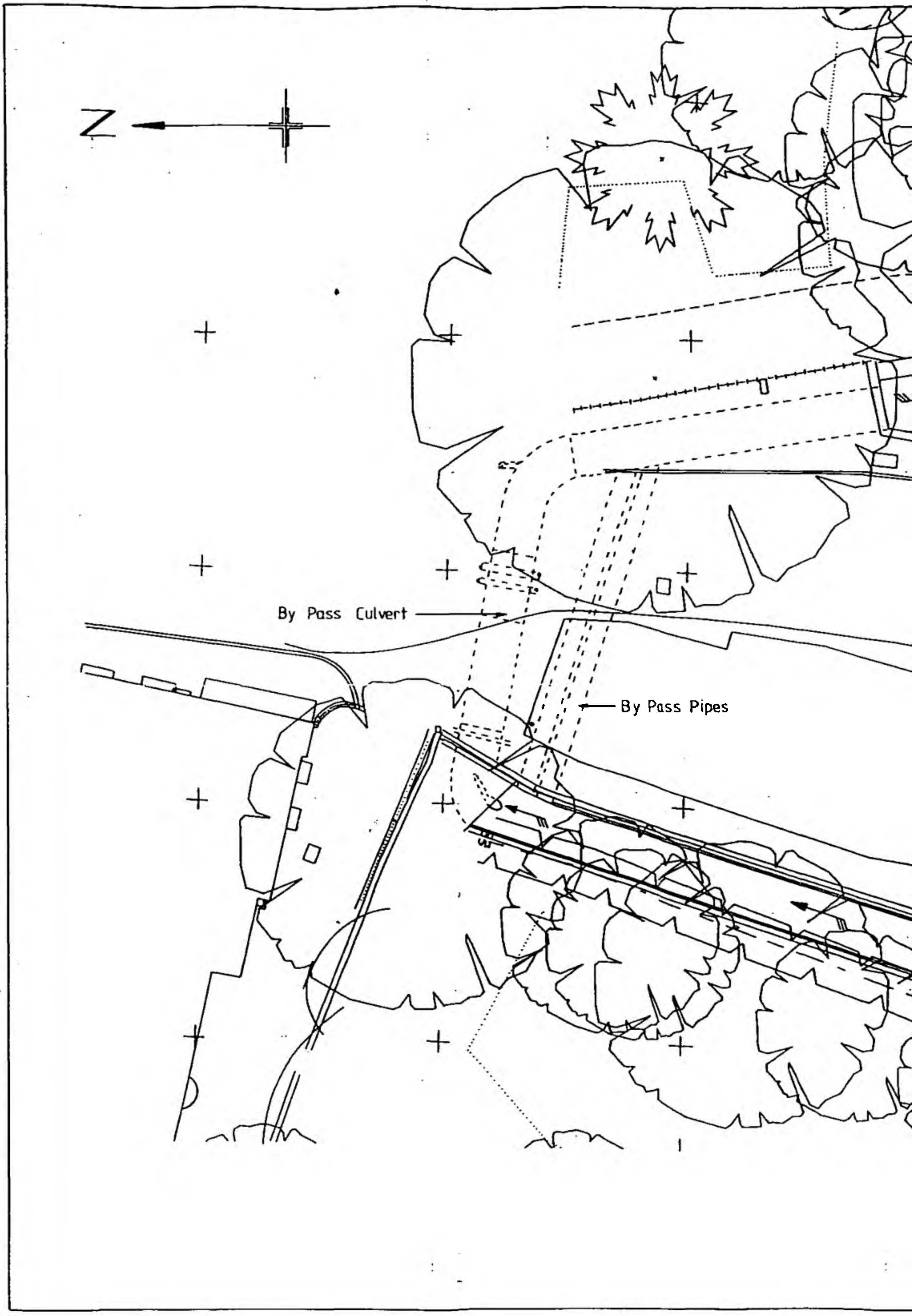


Flynn & Rothwell

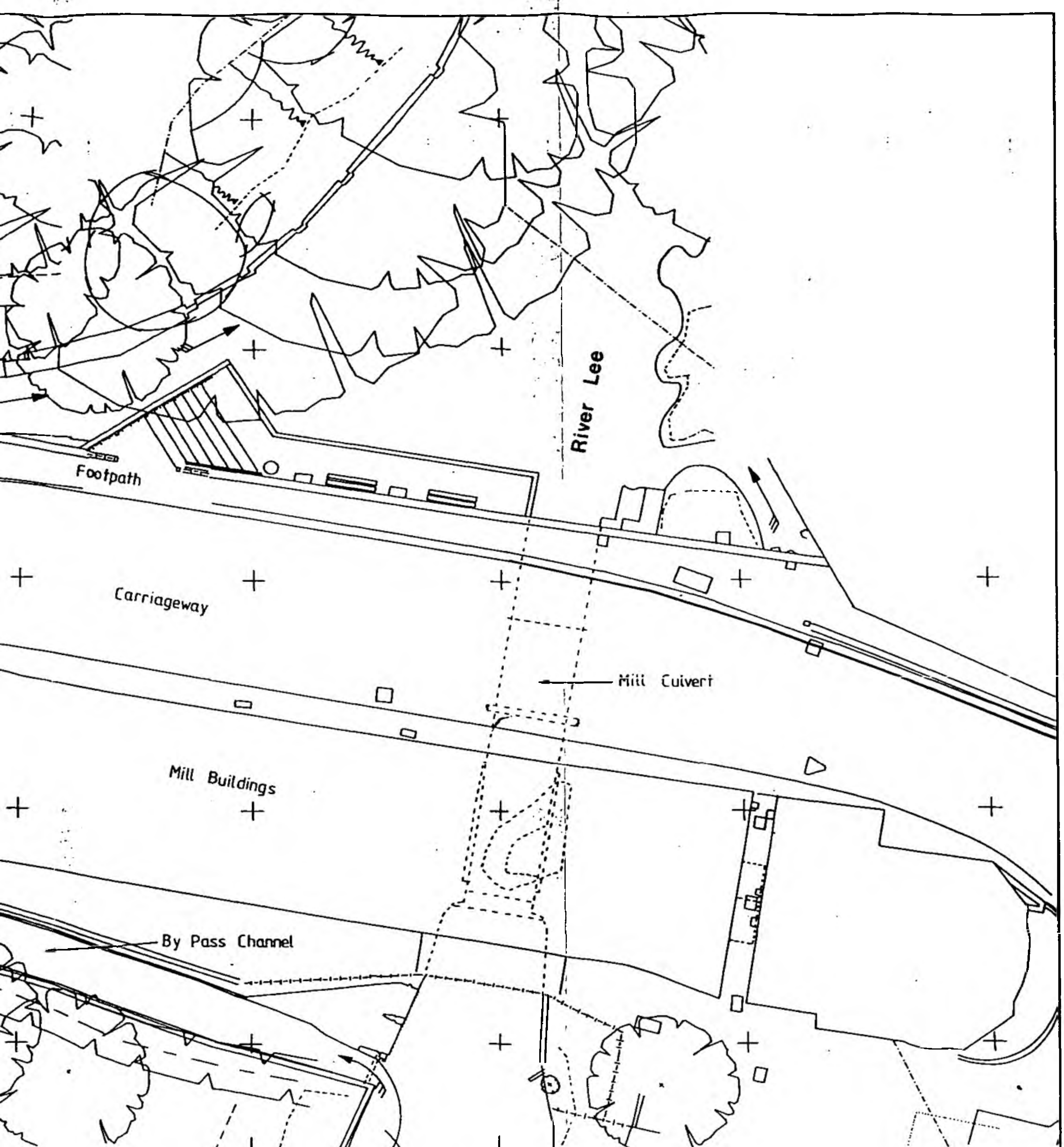
CONSULTING ENGINEERS

45-47 South Street.,
Bishops Stortford Herts.

Wheathampstead Main Culvert Survey Location Plan	
Job No 6/236	Drawing No 236/01
Drawn by T.E.T.	Approved RT
Scale 1:2500	Date Jan 90



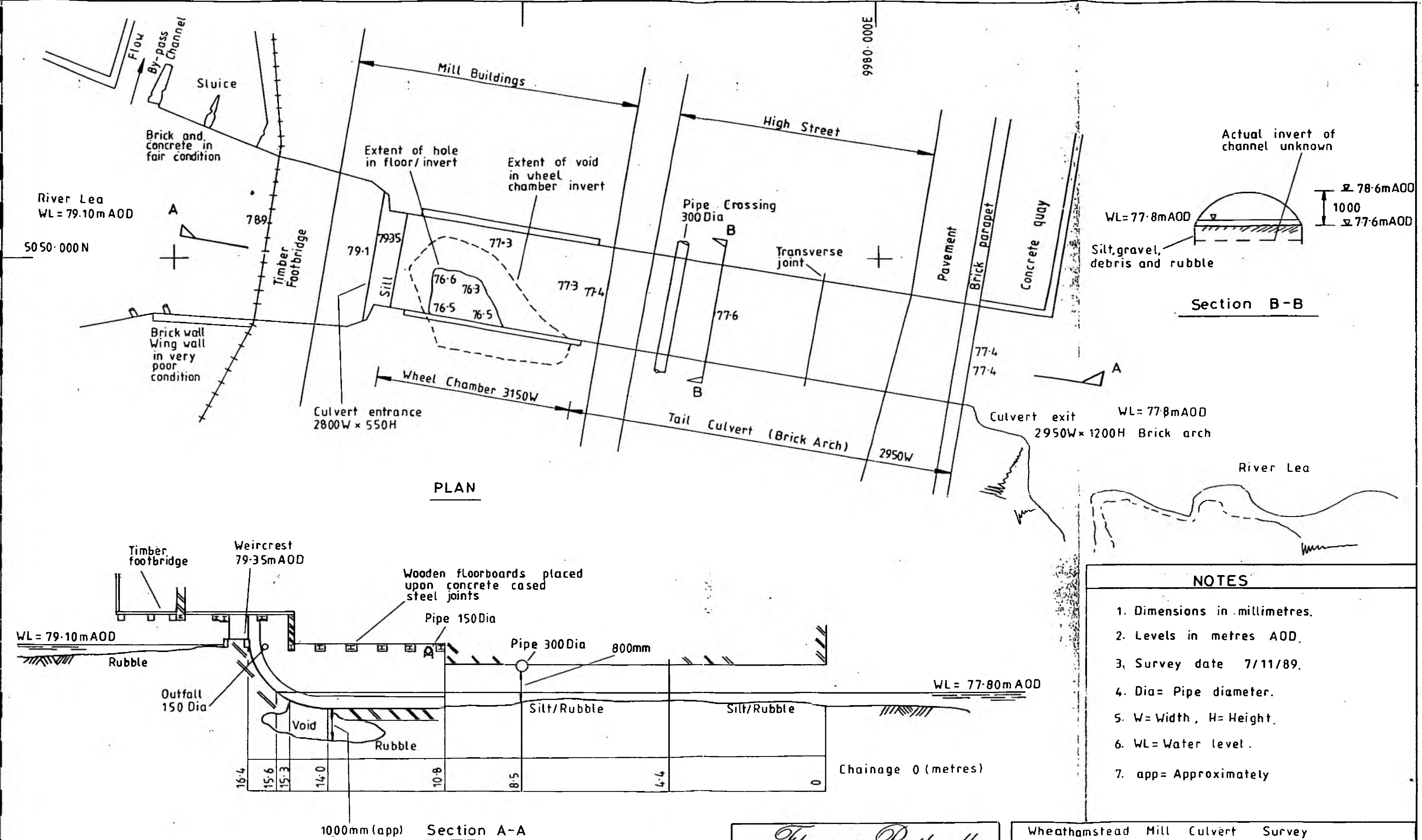
Z
By Pass Culvert
By Pass Pipes



Flynn & Rothwell
CONSULTING ENGINEERS
45 – 47 South Street., Bishops Stortford Herts.

Wheathampstead Main Culvert Survey
General Arrangement

Job No	6/236	Drawing No	236/02
Drawn by	T.E.T.	Approved	
Scale	1:200	Date	Jan 90



NOTES

1. Dimensions in millimetres.
2. Levels in metres AOD.
3. Survey date 7/11/89.
4. Dia = Pipe diameter.
5. W = Width, H = Height.
6. WL = Water level.
7. app = Approximately.

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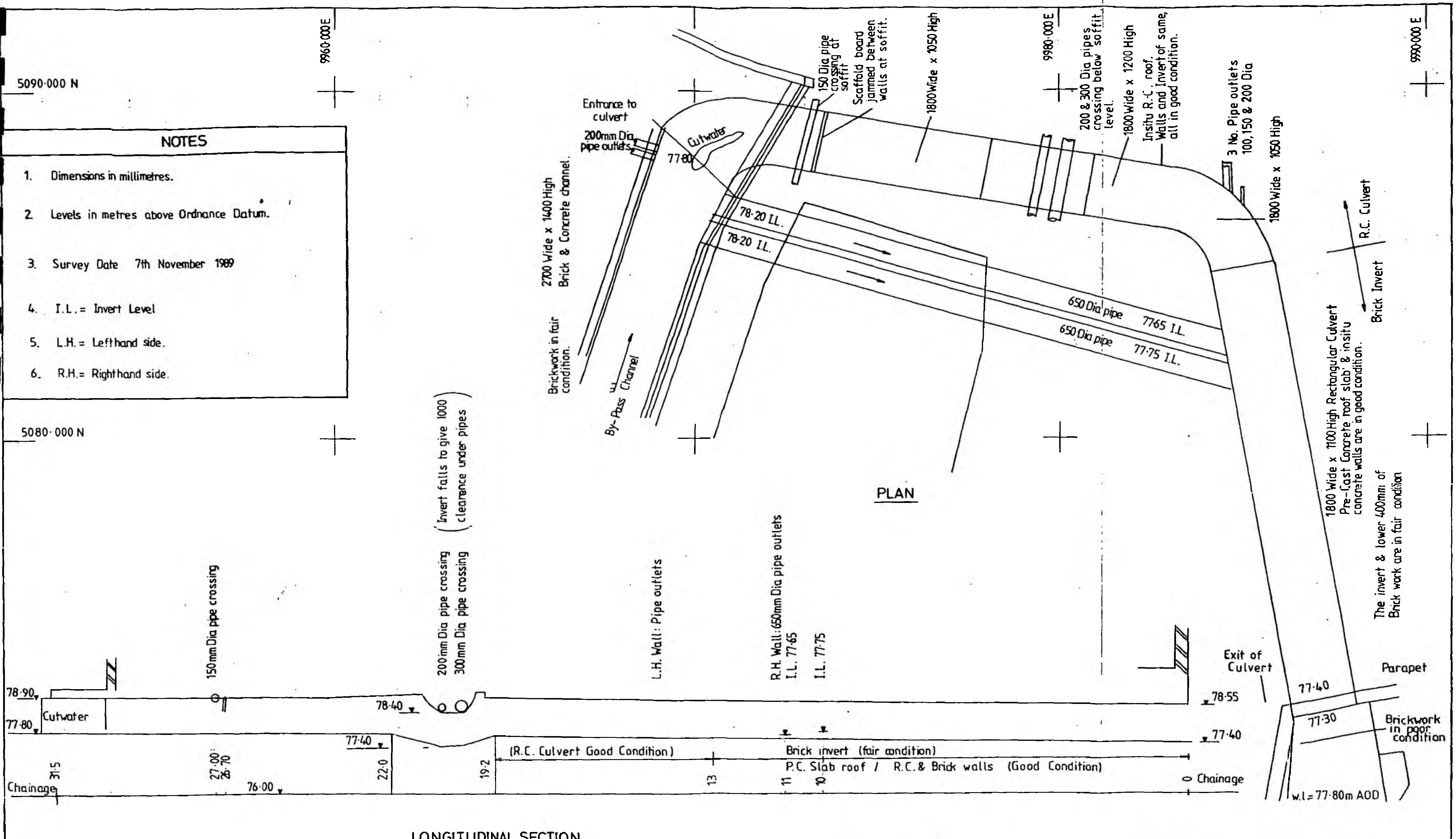
45-47 South Street., Bishops Stortford Herts.

Wheathamstead Mill Culvert Survey Mill Culvert Plan and Structures	
Job No 6/236	Drawing No 236/03
Drawn by SDC	Approved RT
Scale 1:100	Date JANUARY 90

NOTES

1. Dimensions in millimetres.
2. Levels in metres above Ordnance Datum.
3. Survey Date 7th November 1989
4. I.L. = Invert Level
5. L.H. = Lefthand side.
6. R.H. = Righthand side.



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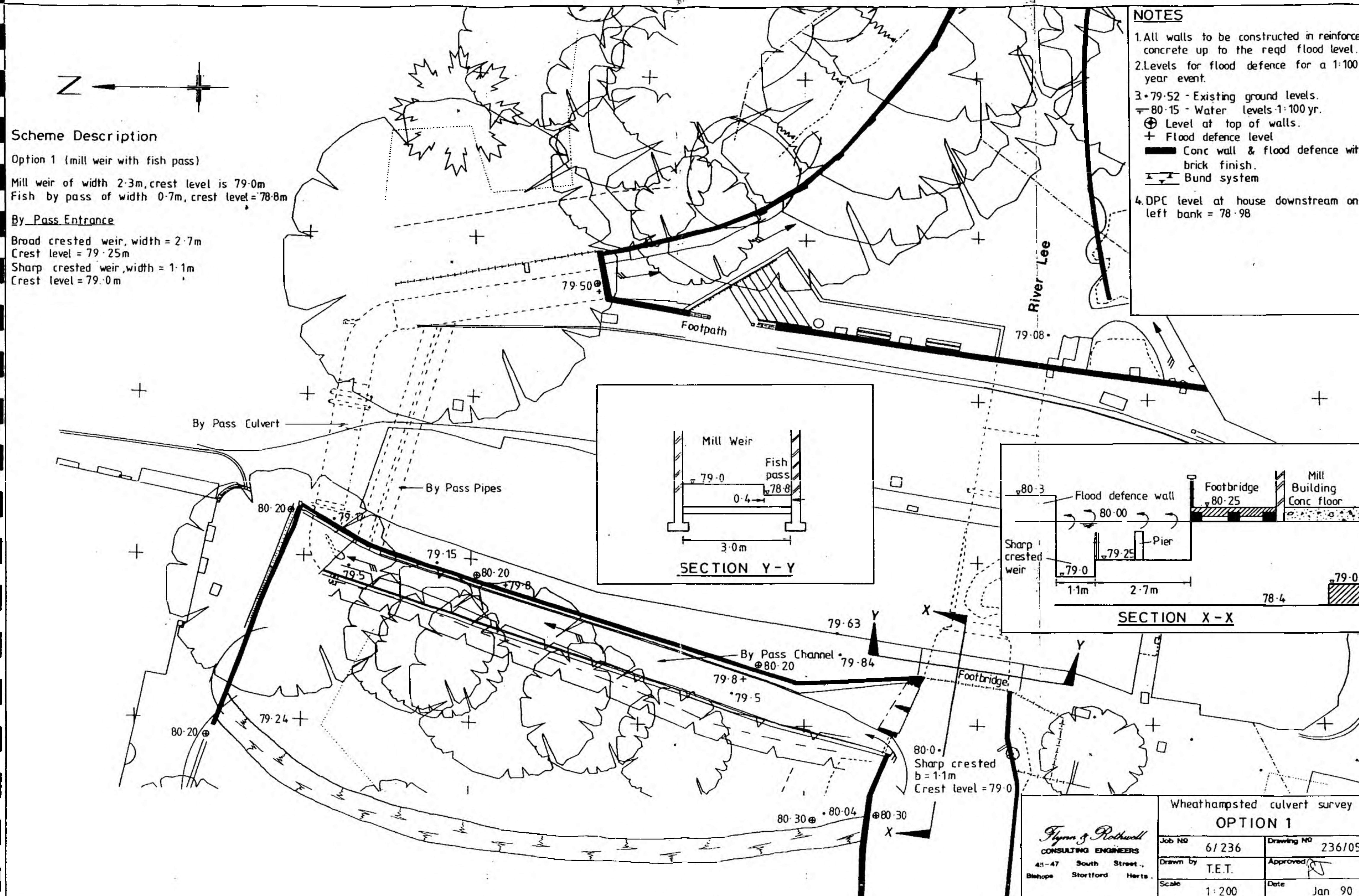
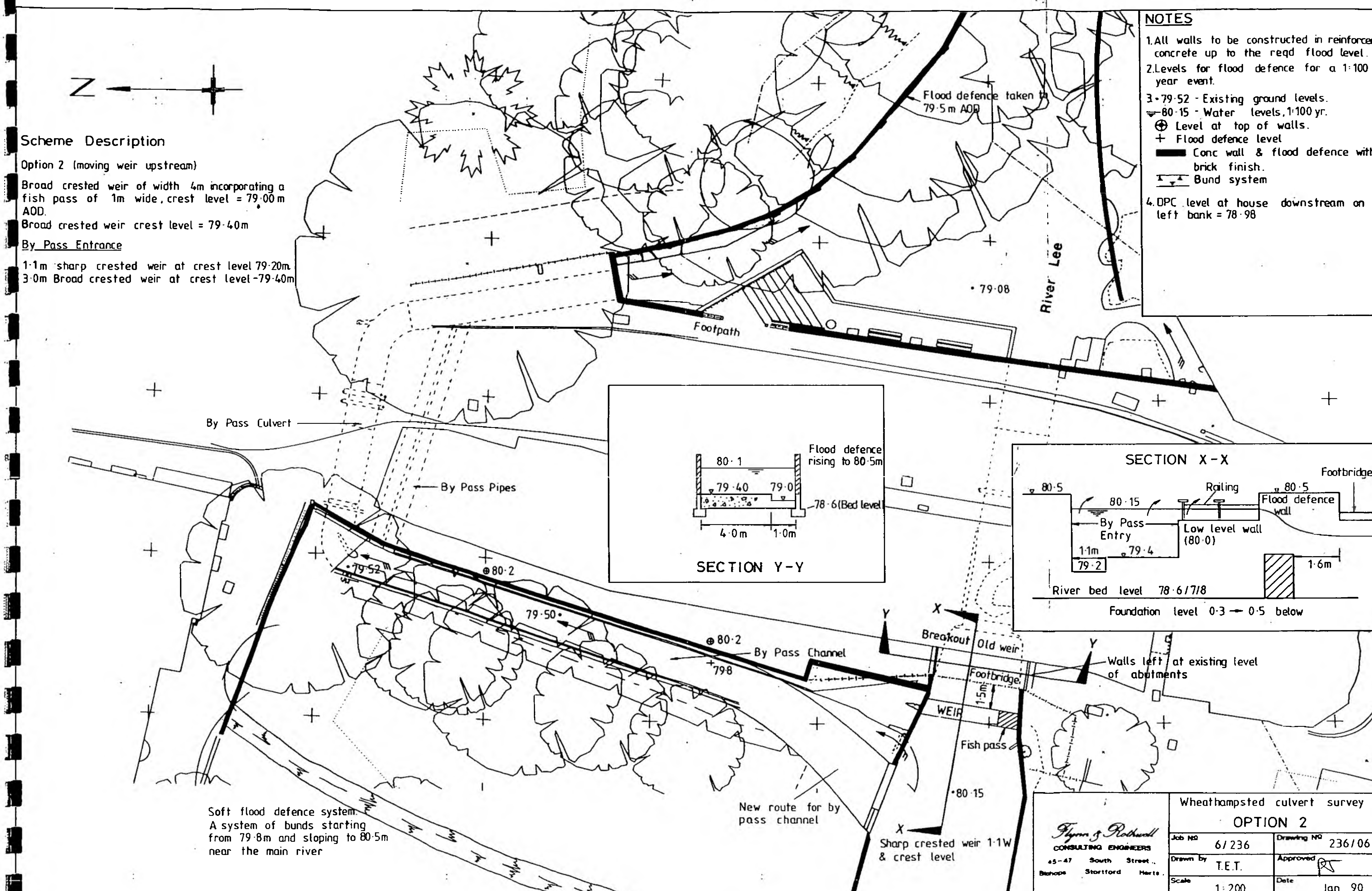
CONSULTING ENGINEERS
45-47 South Street., Bishops Stortford Herts.

Wheathampstead Mill Culvert Survey By Pass Culvert Plan & Section	
Job NO 6/236	Drawing NO 236/04
Drawn by MRA	Approved
Scale 1:100	Date January 1990

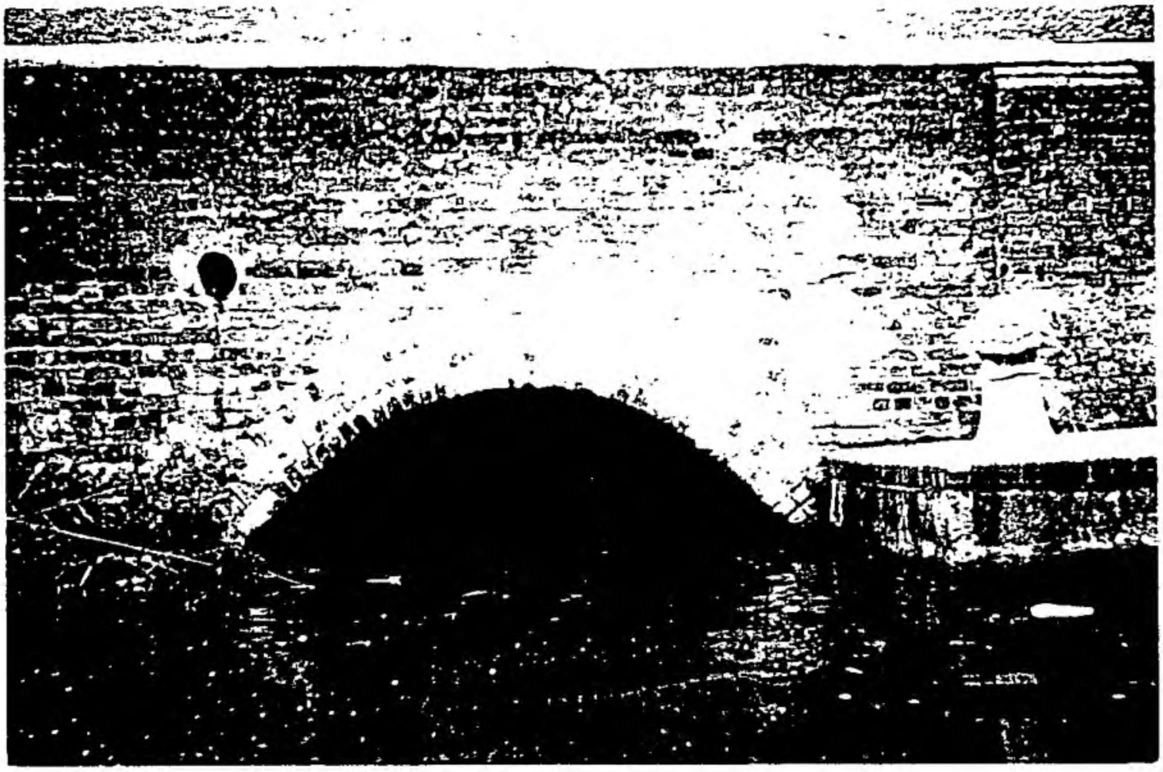

Z
Scheme Description
Option 1 (mill weir with fish pass)
Mill weir of width 2·3m, crest level is 79·0m
Fish by pass of width 0·7m, crest level = 78·8m
By Pass Entrance
Broad crested weir, width = 2·7m
Crest level = 79·25m
Sharp crested weir, width = 1·1m
Crest level = 79·0m
NOTES
1. All walls to be constructed in reinforced concrete up to the reqd flood level.
2. Levels for flood defence for a 1:100 year event.
3. • 79·52 - Existing ground levels.
80·15 - Water levels 1:100 yr.
⊕ Level at top of walls.
+ Flood defence level
Conc wall & flood defence with brick finish.
Bund system
4. DPC level at house downstream on left bank = 78·98
River Lee
Footpath
79·50
79·08
By Pass Culvert
By Pass Pipes
By Pass Channel
Footbridge
80·20
79·77
79·15
80·20
79·5
79·8
79·63
79·84
80·20
79·8
79·5
79·24
80·20
80·0
Sharp crested
b = 1·1m
Crest level = 79·0
80·30
80·04
80·30
X
Y
Mill Weir
Fish pass
79·0
78·8
0·4
3·0m
SECTION Y-Y
80·3
Flood defence wall
Footbridge
80·25
Mill Building Conc floor
80·00
Pier
Sharp crested weir
79·0
79·25
1·1m
2·7m
79·0
78·4
SECTION X-X
Flynn & Rothwell
CONSULTING ENGINEERS
45-47 South Street, Bishops Stortford Herts.
Wheathampsted culvert survey
OPTION 1
Job No 6/236
Drawing No 236/05
Drawn by T.E.T.
Approved
Scale 1:200
Date Jan 90



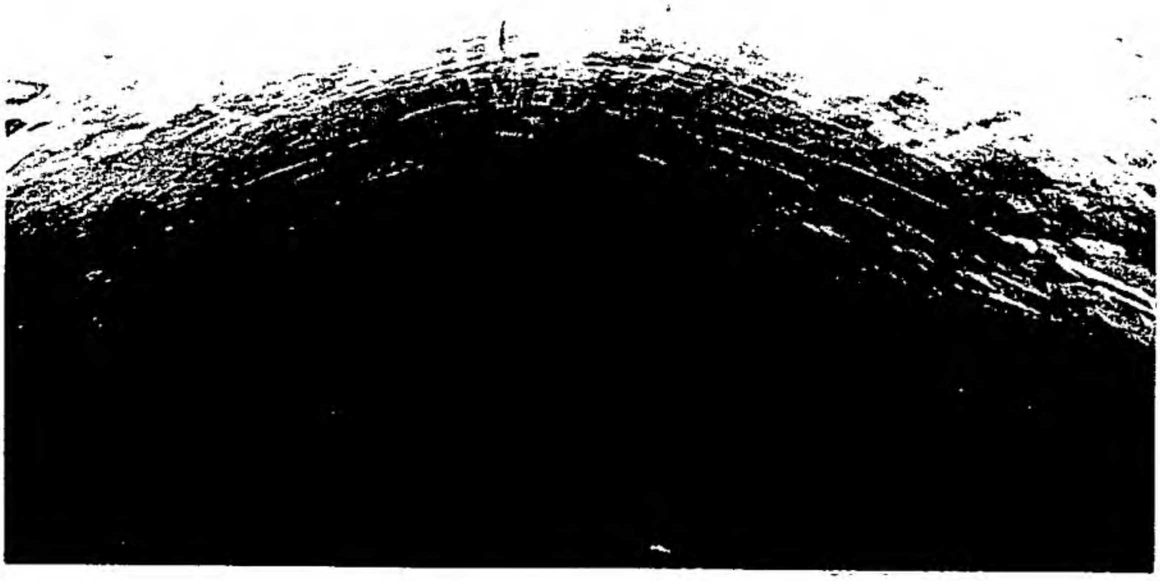
Z
Scheme Description
Option 2 (moving weir upstream)
Broad crested weir of width 4m incorporating a fish pass of 1m wide, crest level = 79·00 m AOD.
Broad crested weir crest level = 79·40m
By Pass Entrance
1·1m sharp crested weir at crest level 79·20m
3·0m Broad crested weir at crest level-79·40m
NOTES
1. All walls to be constructed in reinforced concrete up to the reqd flood level.
2. Levels for flood defence for a 1:100 year event.
3. • 79·52 - Existing ground levels.
80·15 - Water levels, 1:100 yr.
Level at top of walls.
Flood defence level
Conc wall & flood defence with brick finish.
Bund system
4. DPC level at house downstream on left bank = 78·98
Flood defence taken to 79·5 m AOD
79·08
River Lee
Footpath
By Pass Culvert
By Pass Pipes
Flood defence rising to 80·5m
80·1
79·40
79·0
78·6 (Bed level)
4·0m
1·0m
SECTION Y-Y
SECTION X-X
Footbridge
80·5
Railing
80·5
80·15
By Pass Entry
Flood defence wall
Low level wall (80·0)
1·1m
79·4
79·2
1·6m
River bed level 78·6/7/8
Foundation level 0·3 → 0·5 below
79·52
80·2
79·50
80·2
By Pass Channel
79·8
Breakout
Old weir
Y
X
Y
Walls left at existing level of abutments
Footbridge
1·5m
WEIR
Fish pass
80·15
X
Soft flood defence system.
A system of bunds starting from 79·8m and sloping to 80·5m near the main river
New route for by pass channel
Sharp crested weir 1·1W & crest level
Flynn & Rothwell
CONSULTING ENGINEERS
45-47 South Street, Bishops Stortford Herts.
Wheathampsted culvert survey
OPTION 2
Job No 6/236
Drawing No 236/06
Drawn by T.E.T.
Approved
Scale 1:200
Date Jan 90

APPENDIX B - Photographs:

B1 Mill Culvert

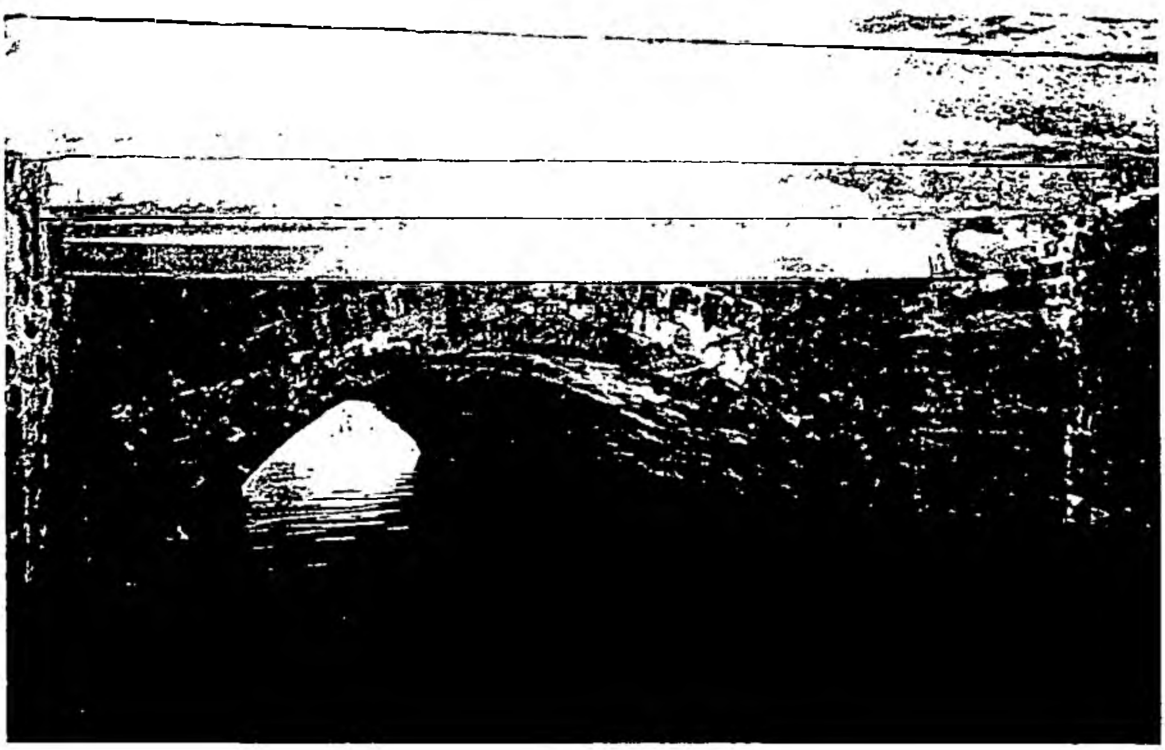


Photograph No. 1. A chainage 0 m. Downstream exit of tail culvert, showing brick headwall and parapet in fair condition.



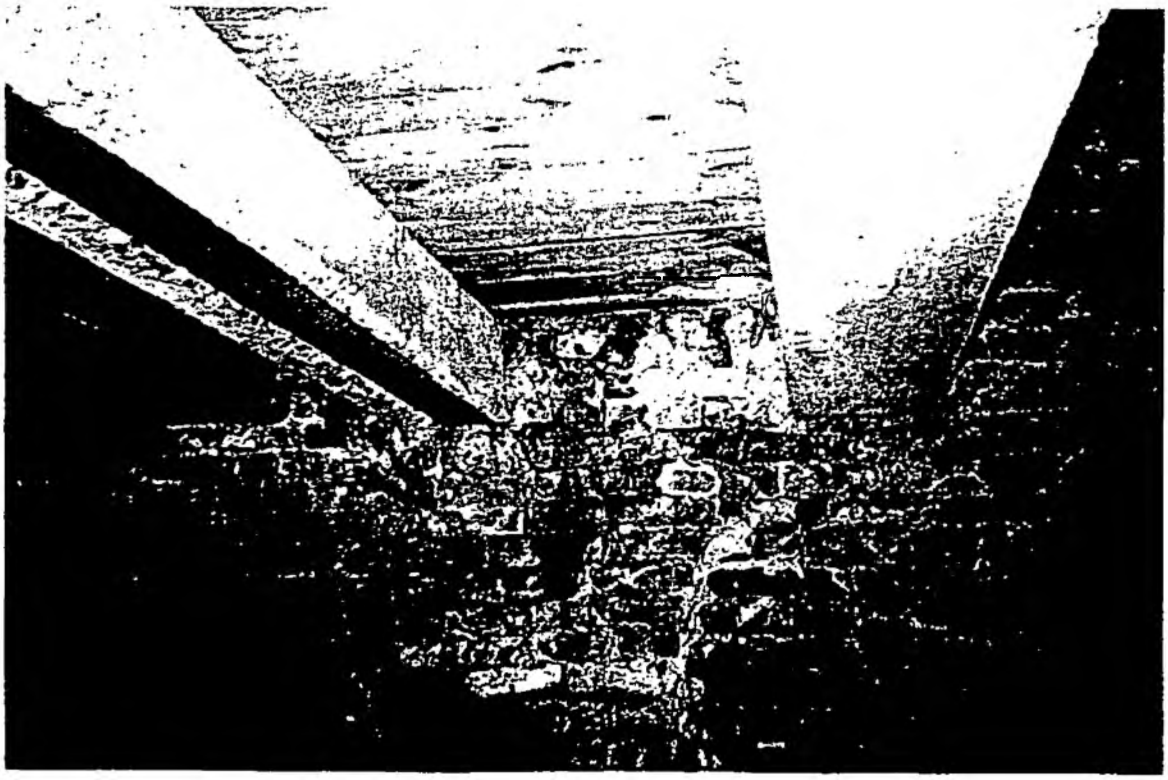
Photograph No. 2. View upstream in tail culvert, showing joint at chainage 4.4 m with 20 mm step in arch soffit.

Photograph No. 3. View upstream, showing 300 mm diameter steel pipe at chainage 8.5 m crossing tail culvert at arch soffit level.



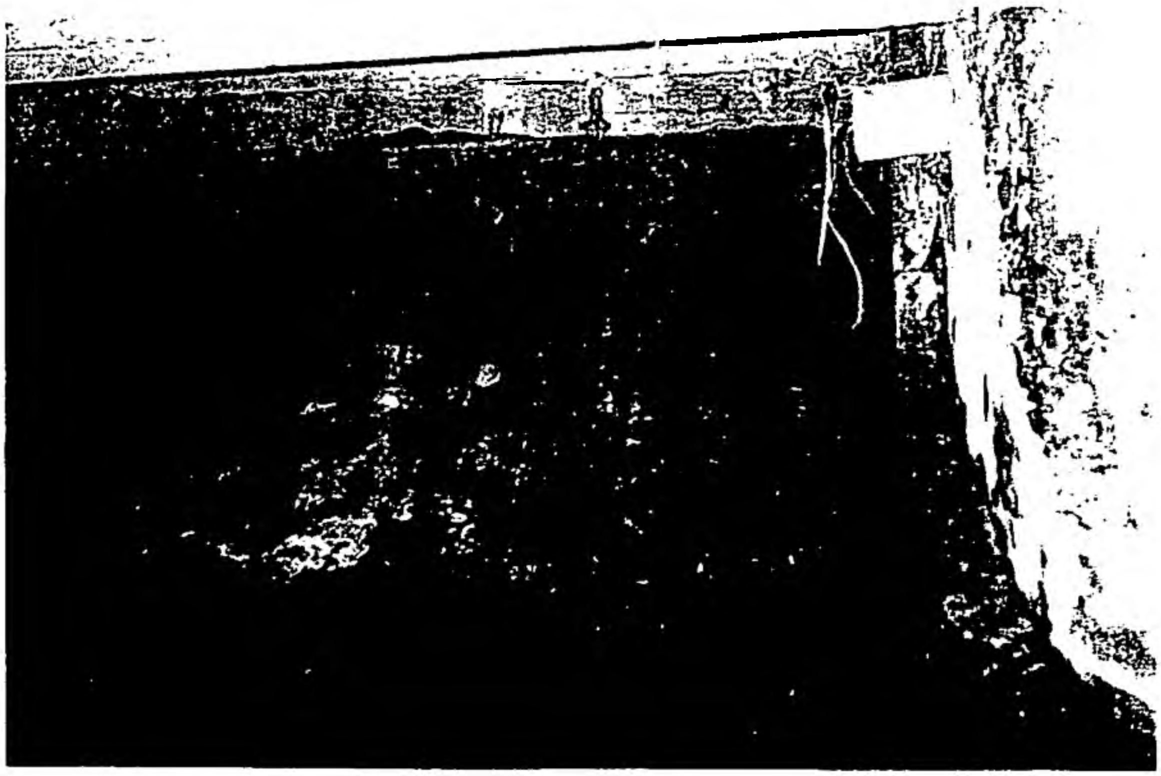
Photograph No. 4. View downstream, showing transition at chainage 10.8 m from arched-roof tail culvert to wheel chamber, with concrete-cased steel joists supporting floor above.

Photograph No. 5. Right-hand end of joist No. 2 (numbered from downstream), showing spalling concrete.



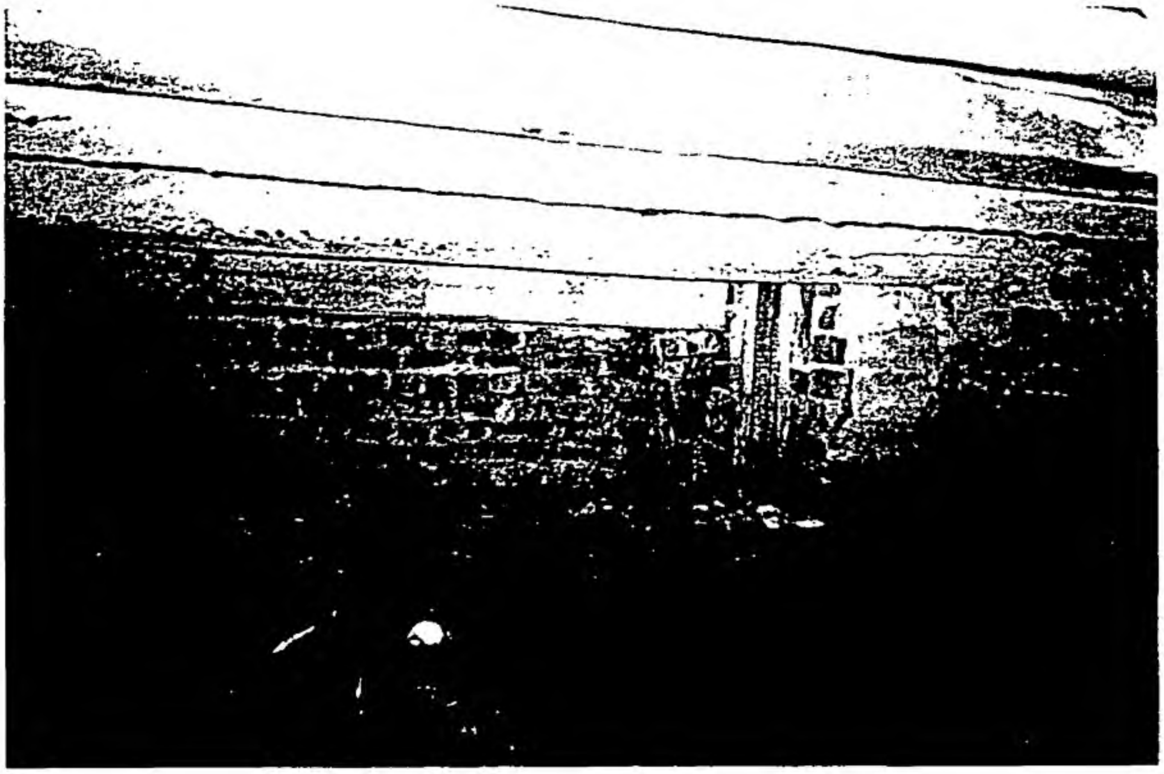
Photograph No. 6. At chainage 15 m. View of right-hand end of Nos. 5 and 6 joists (numbered from downstream), showing spalling concrete.

Photograph No. 7. At chainage 15 m. View of right-hand ends of joist No. 6 (low level) and Nos. 7 and 8 (high level). Also shown is right-hand end of timber facing to sill across entrance to wheel chamber at chainage 16.4 m.

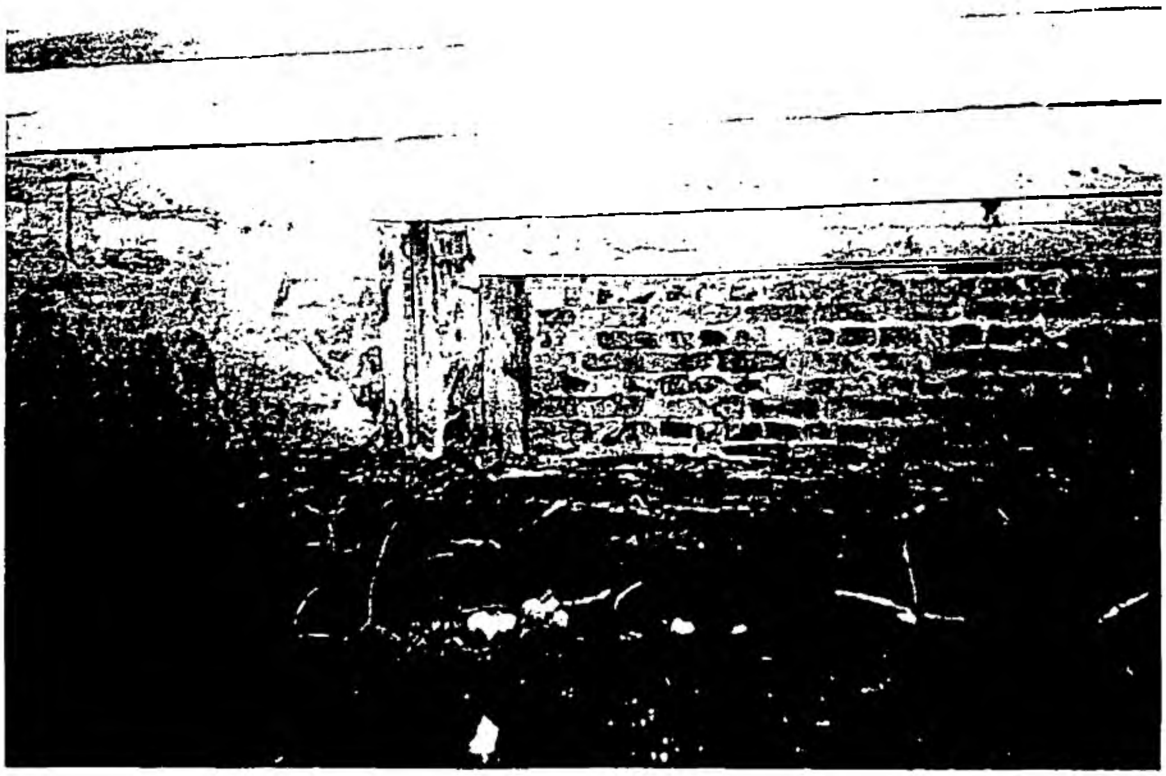


Photograph No. 8. Curved brick upstream wall of wheel chamber, left-hand side of culvert.

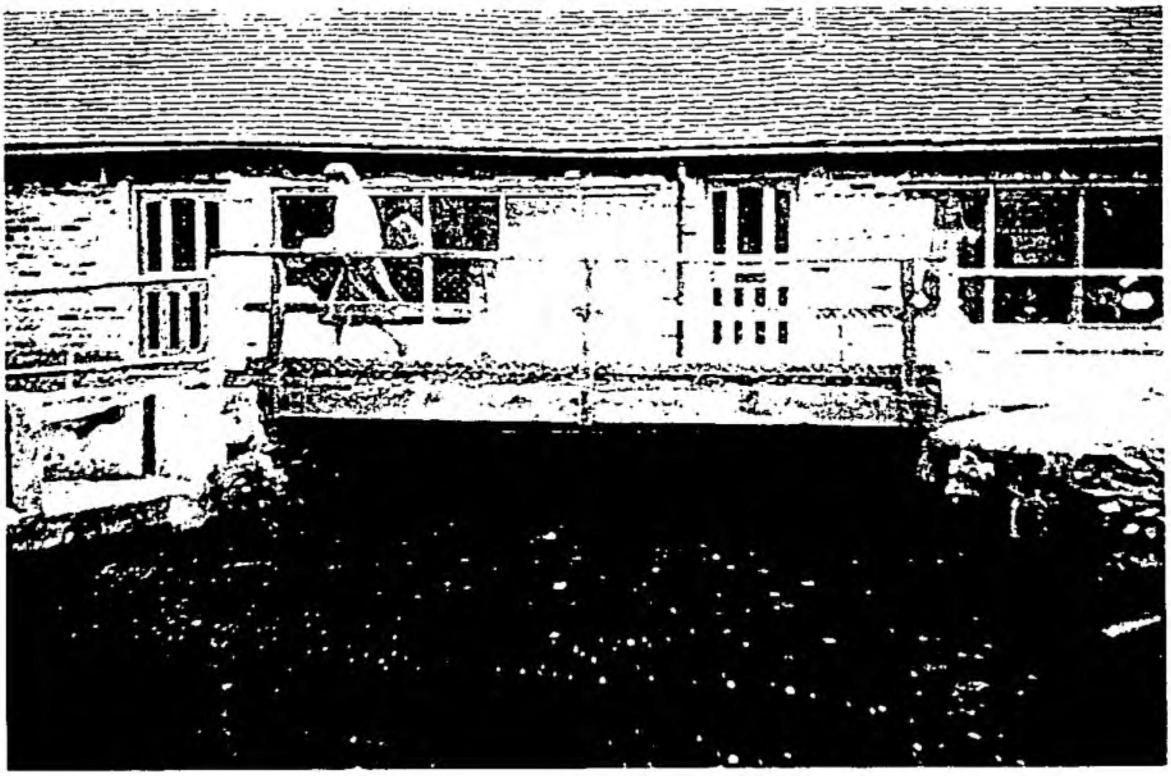
Photograph No. 9. View along timber facing to downstream side of entrance sill.



Photograph No. 10. Right-hand end of entrance sill, showing spalling concrete-cased joist (No. 8) above.



Photograph No. 11. Left-hand end of entrance sill, showing spalling beam No. 7 above.



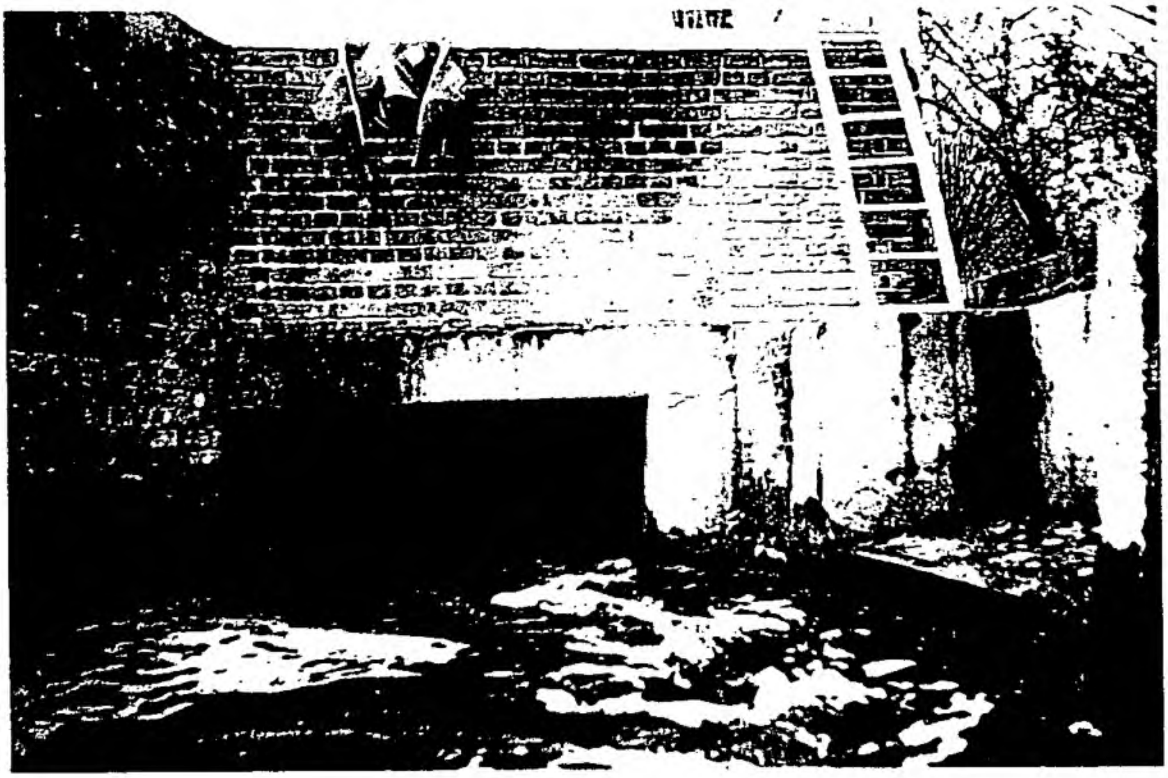
Photograph No. 12. View of upstream entrance to mill culvert, showing timber footbridge.

Photograph No. 13. Right-hand upstream bank, showing brick wall in poor condition.

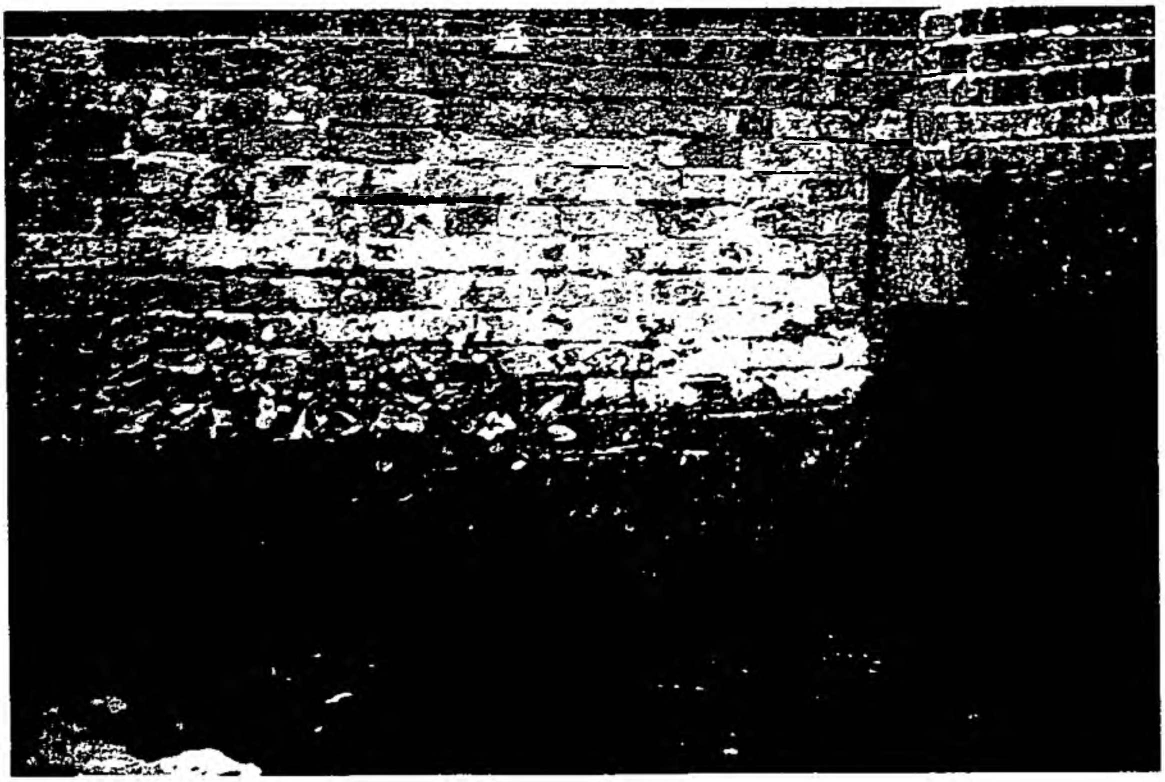
Photograph No. 14. Left-hand upstream bank, showing sluices to by-pass channel.

APPENDIX B - Photographs

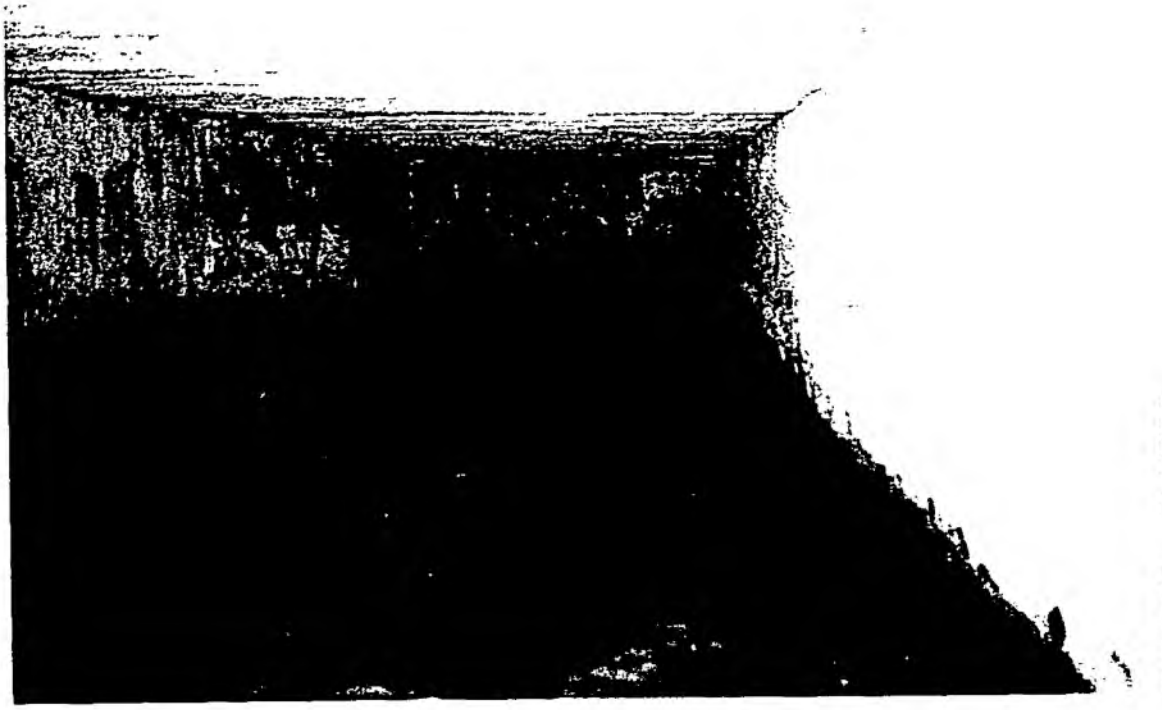
B2 By Pass Culvert



Photograph No. 1. By-pass culvert downstream exit.



Photograph No. 2. At chainage 0 m. Right-hand side wall at downstream exit, showing poor condition of brickwork.



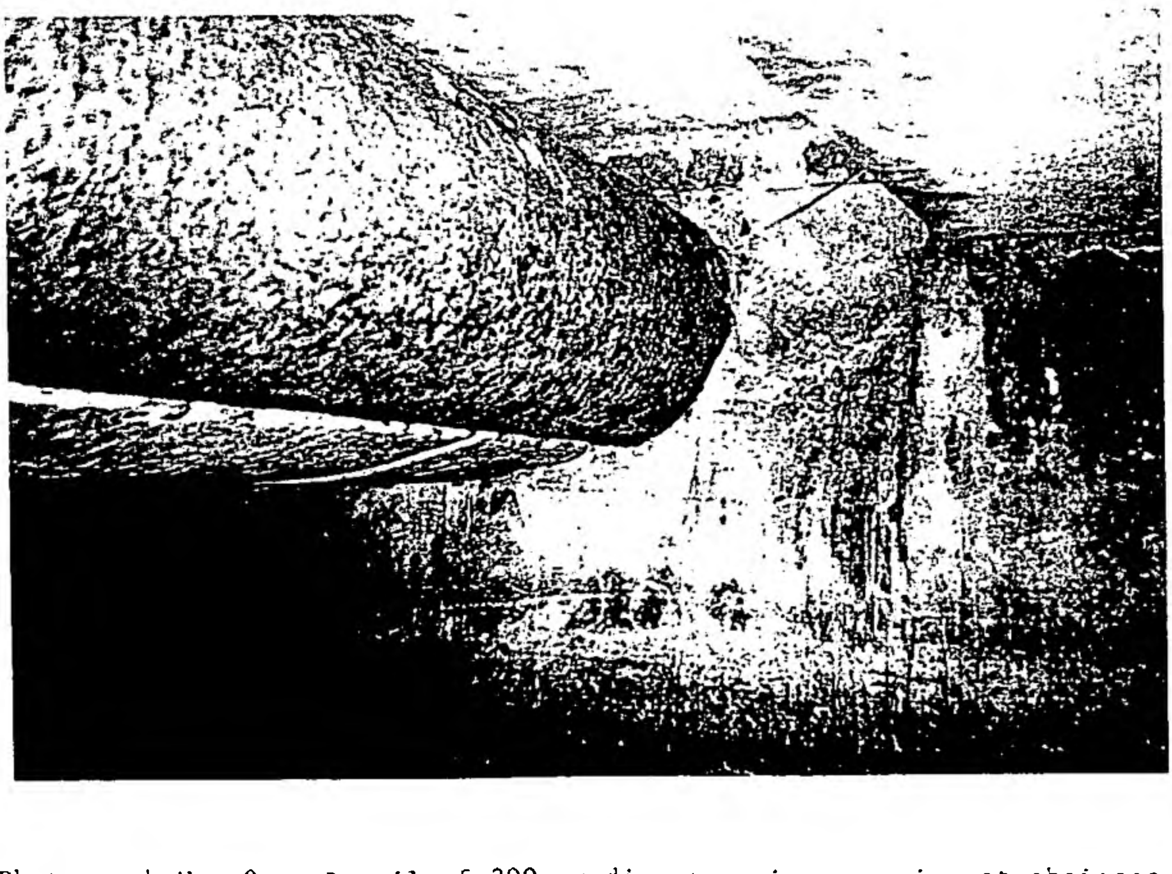
Photograph No. 3. At chainage 6 m. Downstream end of culvert.

Photograph No. 4. At chainage 10 m. View up 650 mm pipe. Upstream entrance of pipe is visible.

Photograph No. 5. Right-hand side wall, showing two 650 mm diameter pipe outlets at chainage 11 m and chainage 10 m.

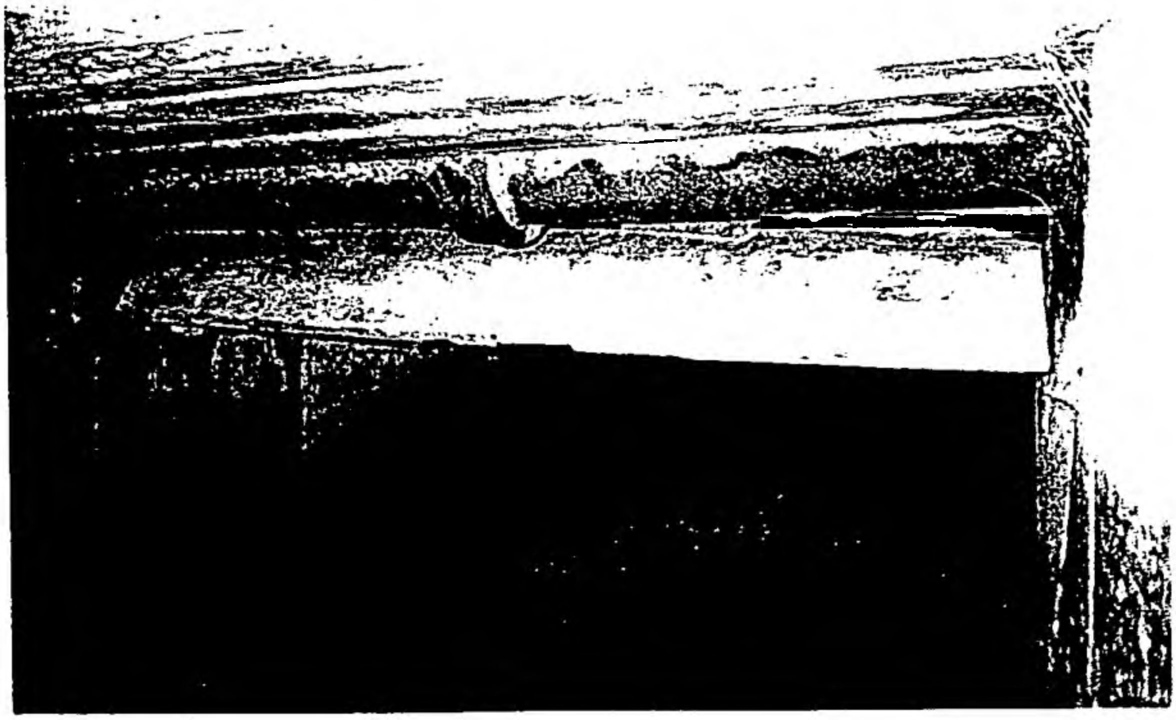
Photograph No. 6. Bend in culvert, showing transition to pre-cast slab roof at chainage 13 m, viewed from upstream.

Photograph No. 7. Bend in culvert at chainage 15 m, viewed from upstream.

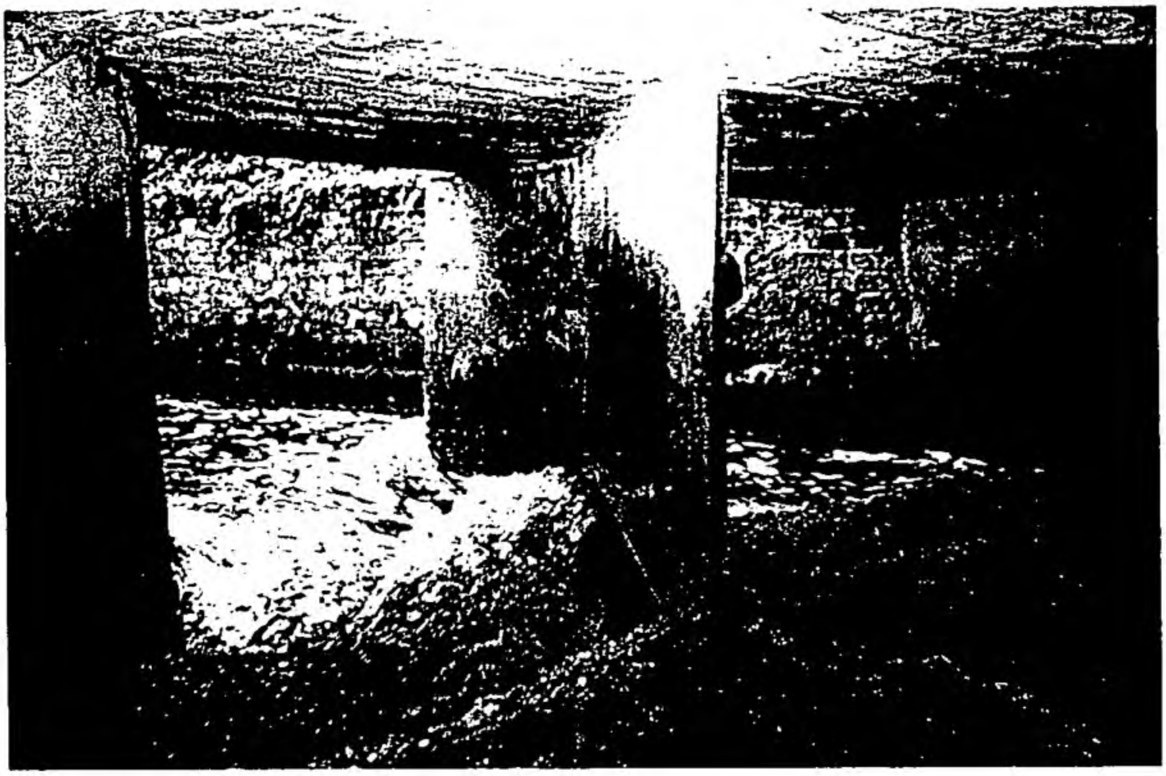


Photograph No. 8. Detail of 300 mm diameter pipe crossing at chainage 20 m.

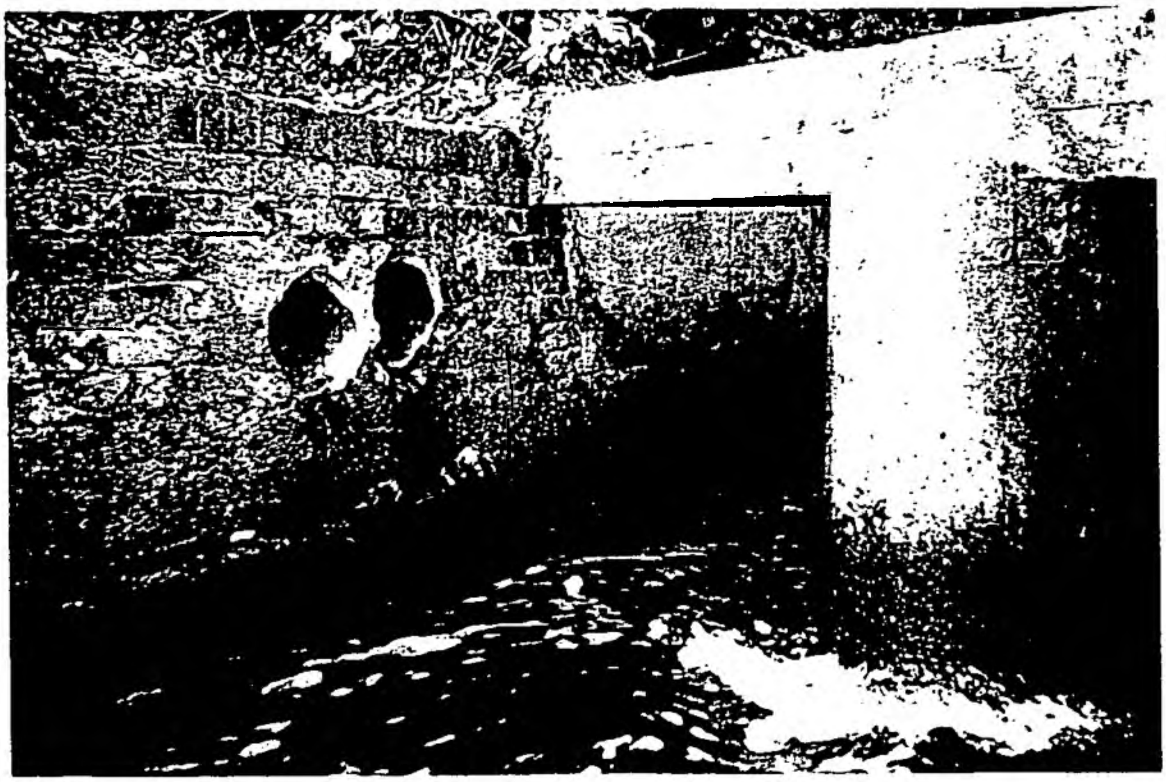
Photograph No. 9. 200 mm and 300 mm diameter pipes crossing at chainage 20.6 m and 20.0 m, with concrete part-surround, viewed from upstream.



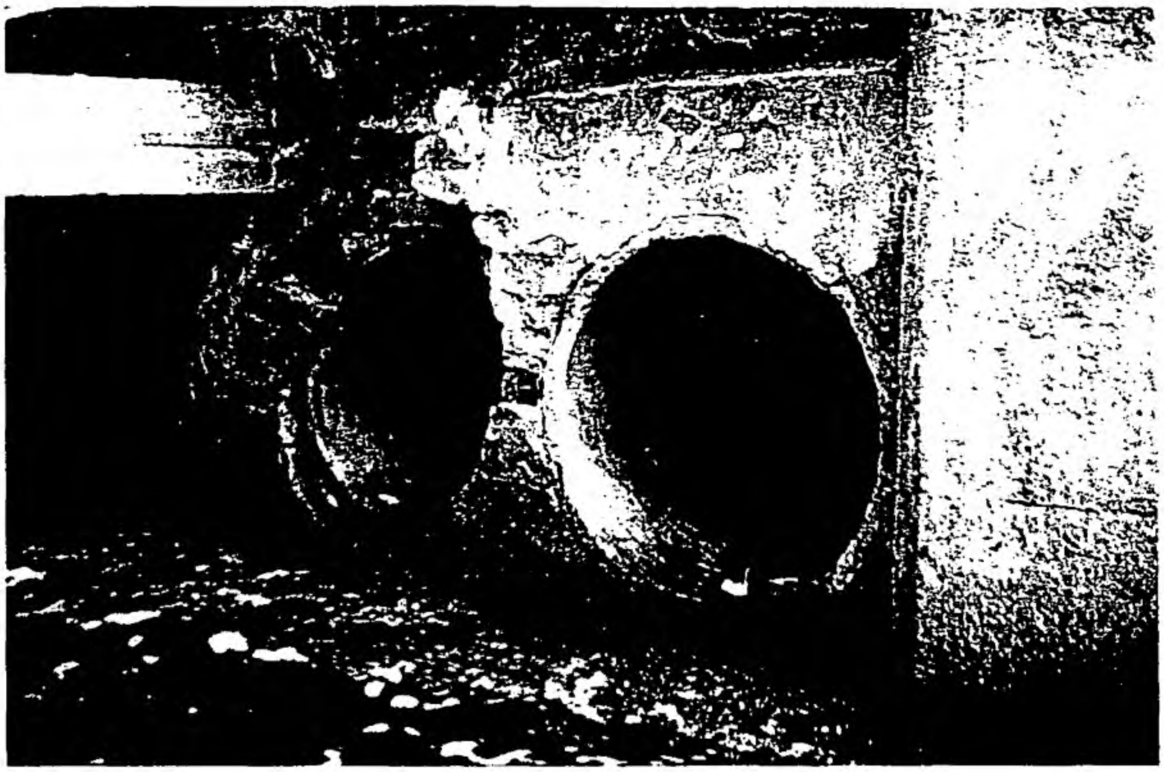
Photograph No. 10. 100 mm diameter pipe crossing at chainage 27 m and scaffold board jammed between walls at chainage 26.7 m, viewed from upstream.



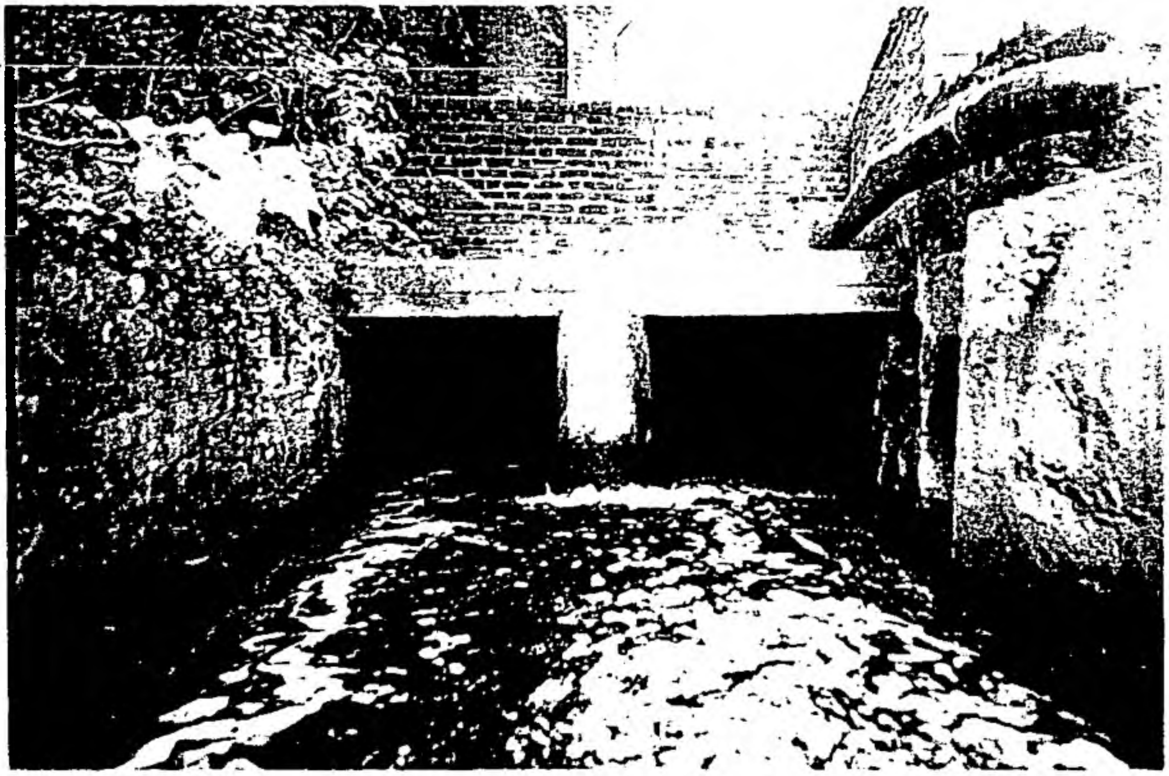
Photograph No. 11. View of culvert entrance from downstream, showing curved cutwater.



Photograph No. 12. Left-hand side wall, showing two 200 mm diameter pipe outlets in left-hand wall of by-pass channel at chainage 32 m.

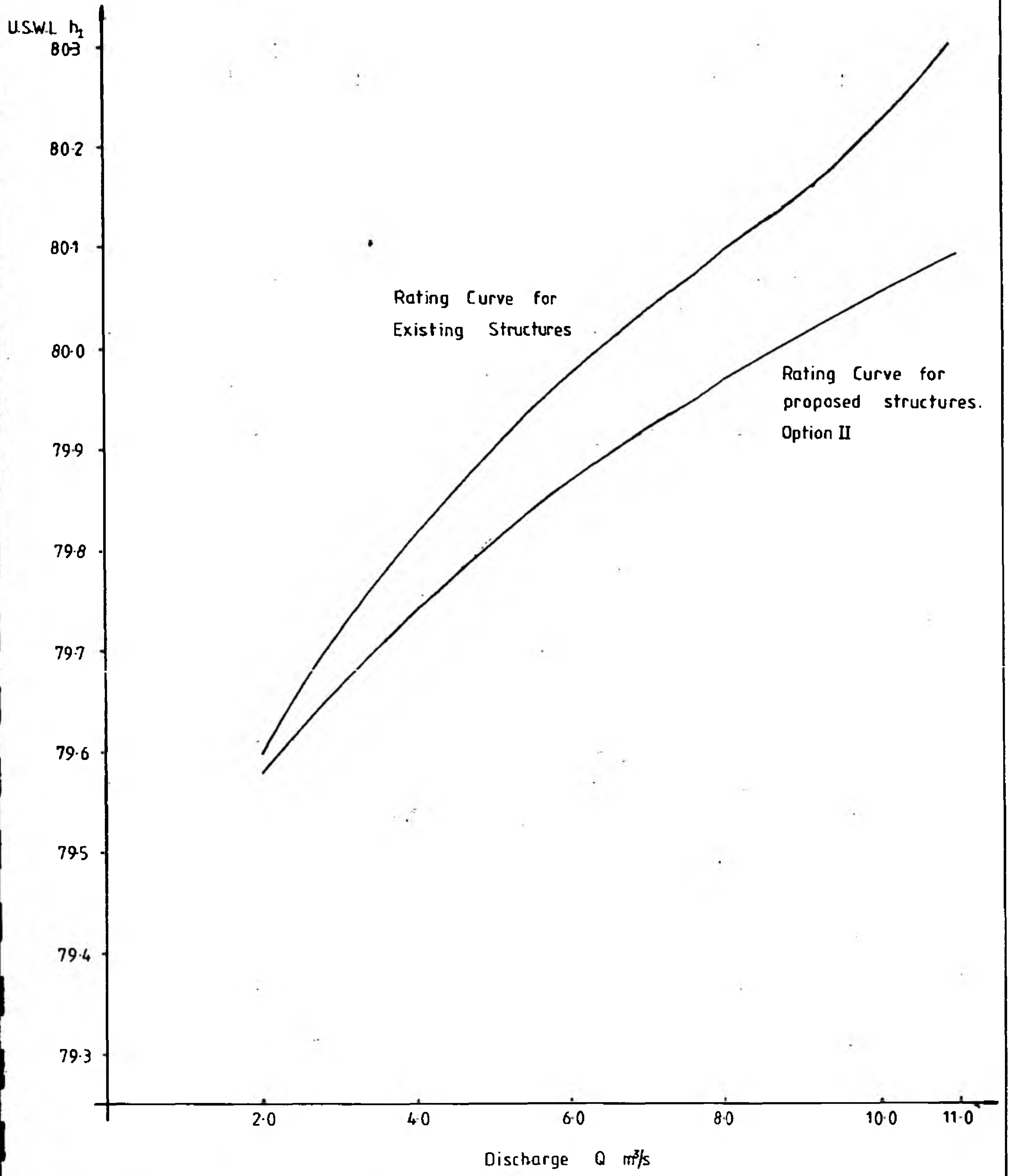


Photograph No. 13. Detail of 650 mm diameter pipe entrances at chainages 32 m and 33 m.



Photograph No. 14. View down by-pass channel, showing upstream culvert entrance at chainage 31.5 m and two 650 mm diameter pipe entrances in right-hand wall of channel.

APPENDIX C - Rating Curves



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CONSULTING -ENGINEERS
45–47 South Street.,
Bishop's Stortford, Herts.

Wheathampstead Mill Culverts Survey Combined Rating Curve.			
Job Nº	6/236	Drawing Nº	236/09
Drawn by	D.MC.D	Approved	AT
Scale	N.T.S	Date	February 90

APPENDIX D - Report by SLS on Preliminary Structural Inspection of the Bridge Mill

REPORT ON THE PRELIMINARY INSPECTION

OF

BRIDGE MILL

WHEATHAMPSTEAD, HERTFORDSHIRE

Derrick Beckett, M Phil (Surrey), BSc Eng (London), DIC, C Eng MICE, MICT

Structural & Literary Services
Downings Cottage
Egloskerry
Nr Launceston
Cornwall PL15 8RU

Tel/Fax : (056685) 443

November 1989

1.00 INTRODUCTION

1.01 On the instructions of Flynn & Rothwell, a preliminary structural inspection of Bridge Mill, Wheathampstead, Hertfordshire was undertaken on 7 November 1989.

1.02 The mill straddles the River Lee and is situated on the B651 at the north end of the village.

1.03 The structure, in part, has undergone extensive renovation to a high standard and the roof space is occupied by an architectural practice. There is a range of shops at ground floor level, the north end being used for storage purposes.

1.04 A general view of the building looking along the B651 from north to south is shown in FIG. 1. It is not possible to be precise about the date of construction, with the exception of the east face adjacent to the B651. The 18 inch (450 mm) brick wall is dated 1895, see FIG. 2.

1.05 The structural fabric has been extensively modified over the centuries and part of the internal timber framing is possibly medieval. The external brick walls have been rebuilt at a much later date (late 19th century).

2.00 SITE INSPECTION

2.01 EXTERNAL

2.01.1 The general condition of the roof is good, typically shown in FIGS. 3 & 4. There is no evidence of sagging or displacement of the tiles.

2.01.2 The general condition of the external brick walls is also good and there is no evidence of cracking. However, it can be seen from FIG. 5 that the east wall adjacent to the B651 is tied back by means of wall plates to the internal framework, FIG. 6.

2.01.3 The structure is subject to road traffic induced vibration, but there is no apparent evidence that this has resulted in movement of the fabric which would have manifested itself in cracking.

2.01.4 There is, however, evidence of rising damp in the east wall, see FIG. 7. This has been exacerbated by lack of provision of drainage for roof drainpipes and the flow of surface water from the crown of the road, see FIG. 8.

2.02 INTERNAL

2.02.1 The internal inspection of the building concentrated on the section which straddles the River Lee. The condition of the sub-structure is the subject of a separate report, but the observations made by Peter Jackson were :

(i) there is spalling of the concrete casing to the steel beams spanning the river;

(ii) there are significant scour holes.

2.02.2 A number of moisture content readings were taken from timbers in the rooms over the River Lee and the values averaged about 20 percent. This is at the level at which some biodegredation could be expected. However, this area has been unoccupied for some time and current renovation involves wet trades.

3.00 CONCLUSIONS

3.01 Considering the age of the structure, and the extensive renovation work that has been undertaken, the Bridge Mill is in a satisfactory condition for medium term occupation without the need for significant repair work, with the exception of the east face wall.

3.02 Although the damp wall on the east face is separated from the shops and offices by a 1.0 m wide corridor, provision for remedial treatment is recommended for other than short term (up to two years) occupation.

FIG. (1) General view of Bridge Mill looking along the B651 from North to South

FIG. (2) The wall on the east face is dated 1895

FIG. (3) The roof structure, east face (1)

FIG. (4) The roof structure, east face (2)

FIG. (5) East face of building with wall plates

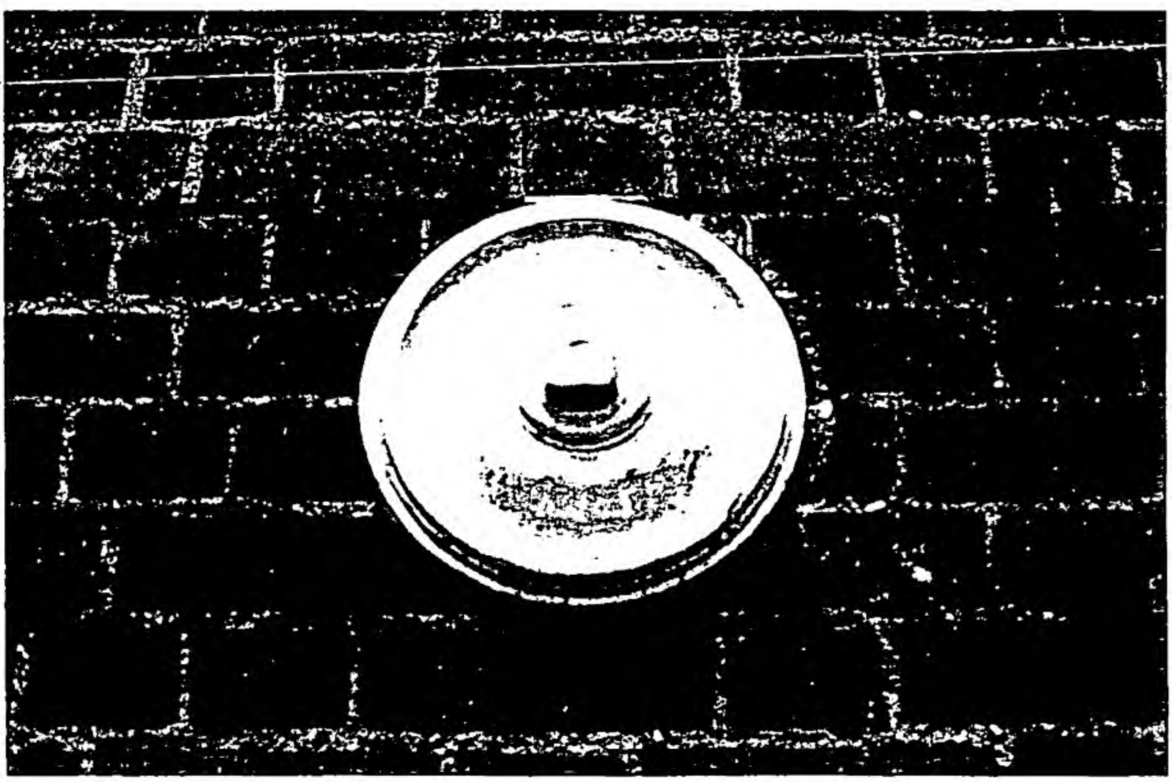


FIG. (6) Close-up of wall plates

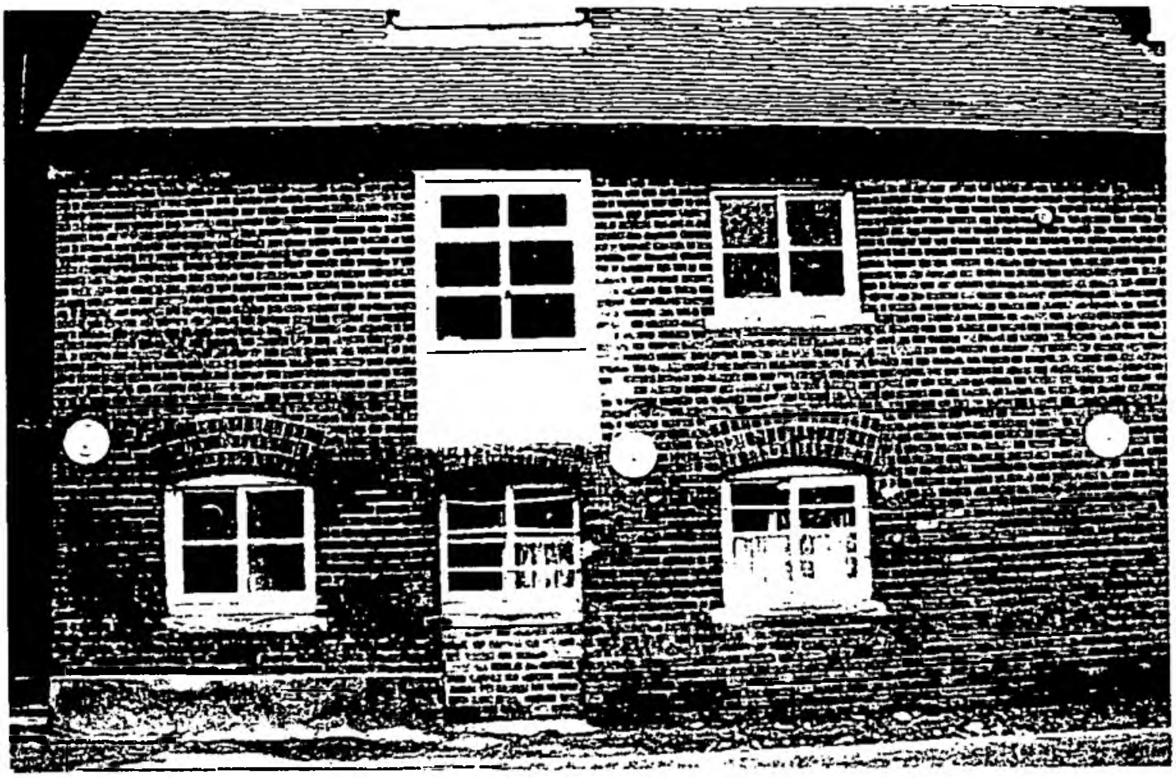


FIG. (7) Rising damp on east wall

FIG. (8) Lack of provision for drainage, east wall

APPENDIX E – Summary Calculations
AE1 Existing Situation and Drawing 236/07
AE2 Proposed Modifications and Drawing 236/08

Flynn & Rothwell

Calculation Sheet

CONSULTING ENGINEERS 45/47 SOUTH STREET, BISHOP'S STORTFORD, HERTS. CM20 3AG.

Project	Wheathampstead Mill Culverts			Reference drawing number	
Subject	Final Summary Calcs (Unmodified)			236/03 236/09	
Prepared by DMcD	Checked by RT	Approved by RT		Job number	6/236
Date 20.2.90	Date Feb 90	Date Feb 90		Sheet number 1 of 2 sheets	

The losses occuring in the system are as follows.

Mill Culvert

Area = $2.40m^2$
Losses = $0.043V^2$

By-Pass (0-11m from downstream end)

Area = $2.00m^2$
Losses = $0.011V^2$ = QBy-pass/2.0

By-Pass □ (11.0 - 31.5) from d/s end

Area = $2.00m^2$
Losses = $0.075V_{cul}^2$, V_{Cul} = Q□,cul/2.00

By-Pass Pipes

Area = $0.665m^2$
Losses = $0.0735V^2$ pipes pipes = Qpipes/0.665

Procedure:

Derive the stage discharge curve for the upstream structures. Using $10.9m^3/s$ as first flow, estimate from the stage discharge of the individual structures, assuming modular flow, Qby-pass and Qmill. i.e. Qby-pass = Q for sharp and broad crested weirs. Proceeding from the d/s end compute the total energy at 11m. Divide the Qby-pass into Qpipes and Q□ by-pass until the energy balances at upstream end. Then with this value of energy derive the specific energy.

Flynn & Rothwell

Calculation Sheet

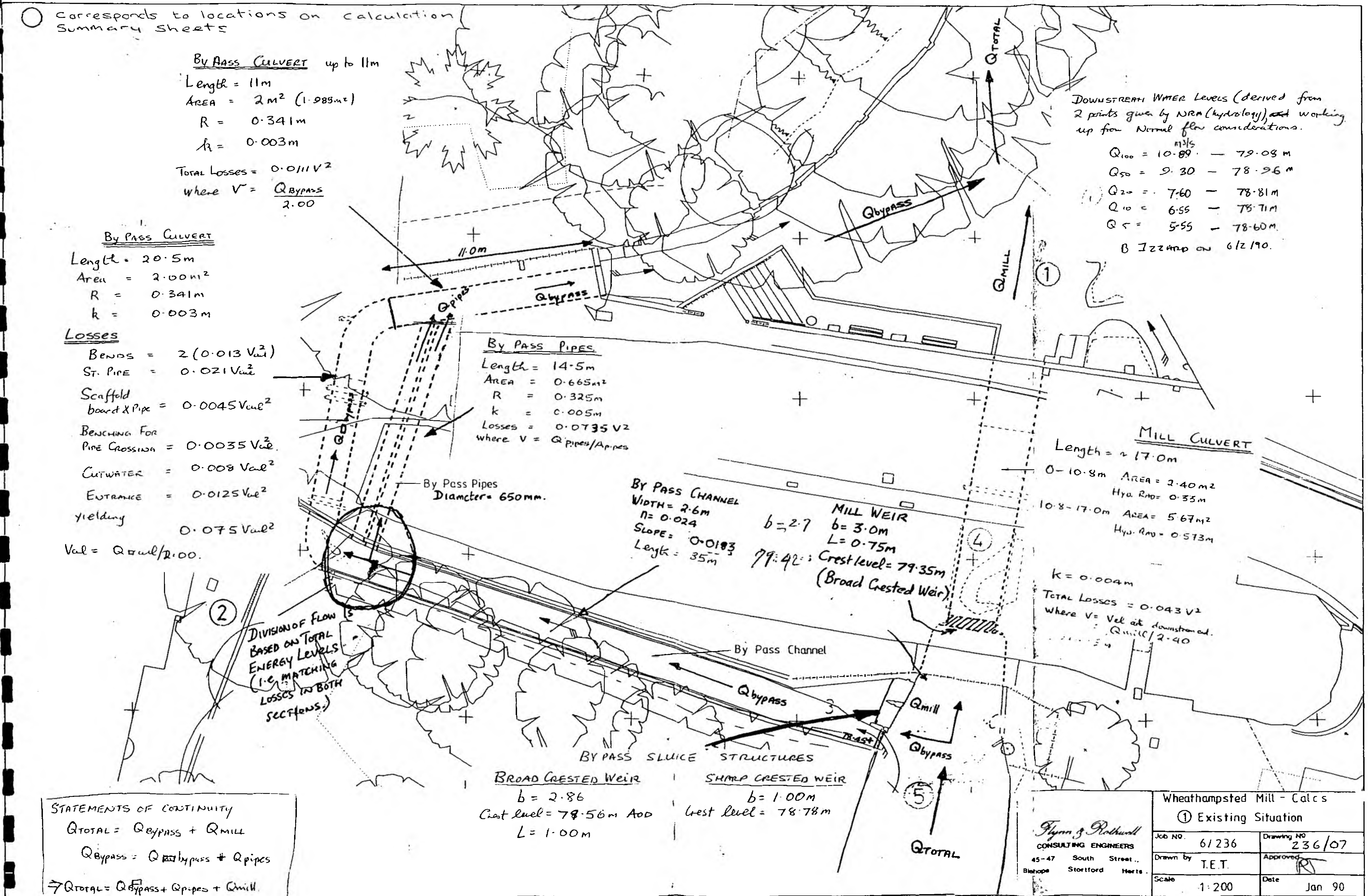
CONSULTING ENGINEERS 45/47 SOUTH STREET, BISHOP'S STORTFORD, HERTS. CM20 3AG

Project			Reference drawing number
Subject		Unmodified	
Prepared by	Checked by	Approved by	Job number
Date	Date	Date	Sheet number 2 of 2 sheets

Use $E = D+V^2/2g$ to get the water depth. With this water depth, find the depth just below the sluice structure, using a backwater analysis. Calculate the head loss in the mill weir using the formulae above. If no drowning occurs the first guess was correct. If drowned, iterate to solve.

SUMMARY TABLE

Return Period Years	Q cu m/s	D.S.W.L. (m)	Level at Ent.to By-Pass Cul.	Level d/s of sluice Structure(m)	Max.Water Levels in Mill (m)	U.S.W.L. (m)
100	10.89	79.08	79.96	79.93	79.34	80.30
50	9.30	78.96	79.67	79.65	79.07	80.17
30/35	8.50	78.89	79.47	79.44	78.98	80.12
20	7.60	78.81	79.29	79.24	78.88	80.07
10	6.55	78.71	79.04	79.00	78.76	80.00
5	5.55	78.60	78.80	78.93	78.64	79.94
5	4.00	78.43	78.50	78.86	78.45	79.82
5	3.00	78.31	78.29	78.80	78.32	79.72
5	2.00	78.17	78.16	78.73	78.17	79.61



○ Corresponds to locations on calculation Summary sheets
By Pass Culvert up to 11m
Length = 11m
Area = 2m² (1.989m²)
R = 0.341m
k = 0.003m
Total Losses = 0.0111 V²
where V = Q bypass / 2.00
By Pass Culvert
Length = 20.5m
Area = 2.00m²
R = 0.341m
k = 0.003m
Losses
Bends = 2(0.013 Vcul²)
St. Pipe = 0.021 Vcul²
Scaffold board & Pipe = 0.0045 Vcul²
Benching For Pipe Crossing = 0.0035 Vcul²
Cutwater = 0.008 Vcul²
Entrance = 0.0125 Vcul²
yielding 0.075 Vcul²
Vcul = Q cul / 2.00
11.0m
Q pipes
Q bypass
Q bypass
Q TOTAL
Q bypass
Q MILL
1
Downstream Water Levels (derived from 2 points given by NRA (hydrology), and working up from Normal flow considerations.
Q100 = 10.89 m³/s — 79.08 m
Q50 = 9.30 — 78.96 m
Q20 = 7.60 — 78.81 m
Q10 = 6.55 — 78.71 m
Q5 = 5.55 — 78.60 m
B Izzard on 6/2/90.
By Pass Pipes
Length = 14.5m
Area = 0.665m²
R = 0.325m
k = 0.005m
Losses = 0.0735 V²
where V = Q pipes / A pipes
By Pass Pipes
Diameter = 650mm.
By Pass Channel
Width = 2.6m
n = 0.024
Slope = 0.0183
Length = 35m
b = 2.7
79.42
Mill Weir
b = 3.0m
L = 0.75m
Crest level = 79.35m
(Broad Crested Weir)
Mill Culvert
Length = ~17.0m
0 – 10.8m Area = 2.40m² Hyd. Rad = 0.33m
10.8 – 17.0m Area = 5.67m² Hyd. Rad = 0.573m
k = 0.004m
Total Losses = 0.043 V²
Where V = Vel at downstream end. Q mill / 2.40
4
2
Division of Flow Based on Total Energy Levels (i.e. matching losses in both sections.)
3
By Pass Channel
Q bypass
Q mill
Q bypass
78.45
5
Q TOTAL
By Pass Sluice Structures
Broad Crested Weir
b = 2.86
Crest level = 78.56m AOD
L = 1.00m
Sharp Crested Weir
b = 1.00m
Crest level = 78.78m
Statements of Continuity
Q TOTAL = Q Bypass + Q MILL
Q Bypass = Q bypass + Q pipes
→ Q TOTAL = Q Bypass + Q pipes + Q mill
Flynn & Rothwell
CONSULTING ENGINEERS
45-47 South Street, Bishops Stortford Herts.
Wheathampsted Mill - Calcs
① Existing Situation
Job No. 6/236
Drawing No 236/07
Drawn by T.E.T.
Approved
Scale 1:200
Date Jan 90

Flynn & Rothwell
CONSULTING ENGINEERS 45/47 SOUTH STREET, BISHOP'S STORTFORD, HERTS. CM20 3AG

Calculation Sheet

Project: Wheathampsted Mill Culverts			Reference drawing number
Subject: Final Summary Calcs - Option 2			236/03 236/04
Prepared by: D McD	Checked by: RT	Approved by: RT	Job number: 6/236
Date: 19.2.90	Date: Feb 90	Date: Feb 90	Sheet number 1 of 2 sheets

The Losses occuring in the system are as follows, the areas are also given.

Mill Culvert

Area = $3.54 m^2$
Losses = $0.028 V^2$

= Q Mill/3.54

By-Pass (0-11m from downstream end)

Area = $2.00 m^2$
Losses = 0.011 V2 = Q By-pass/2.00

By-Pass □ (11-31.5m from d/s end)

Area = $2.00 m^2$
Losses = $0.049 V_{cul}^2$ V_{cul} = Q□ cul/2.00

By-Pass Pipes

Area = $0.665 m^2$
Losses = $0.0735 V_{pipes}^2$ Vpipes = Qpipes/0.665

Procedure:

Derive the stage discharge curve for the upstream structures. Using $10.9 m^3/s$ as first flow, estimate from the stage discharge of the individual structures, assuming modular flow, Qby-pass and Qmill. i.e. Qby-pass = Q for sharp and broad crested weirs. Proceeding from the d/s end compute the total energy at 11m. Divide the Qby-pass into Qpipes and Q □ bypass until the energy balances at upstream end. Then with this value of energy derive the specific energy.

Flynn & Rothwell

Calculation Sheet

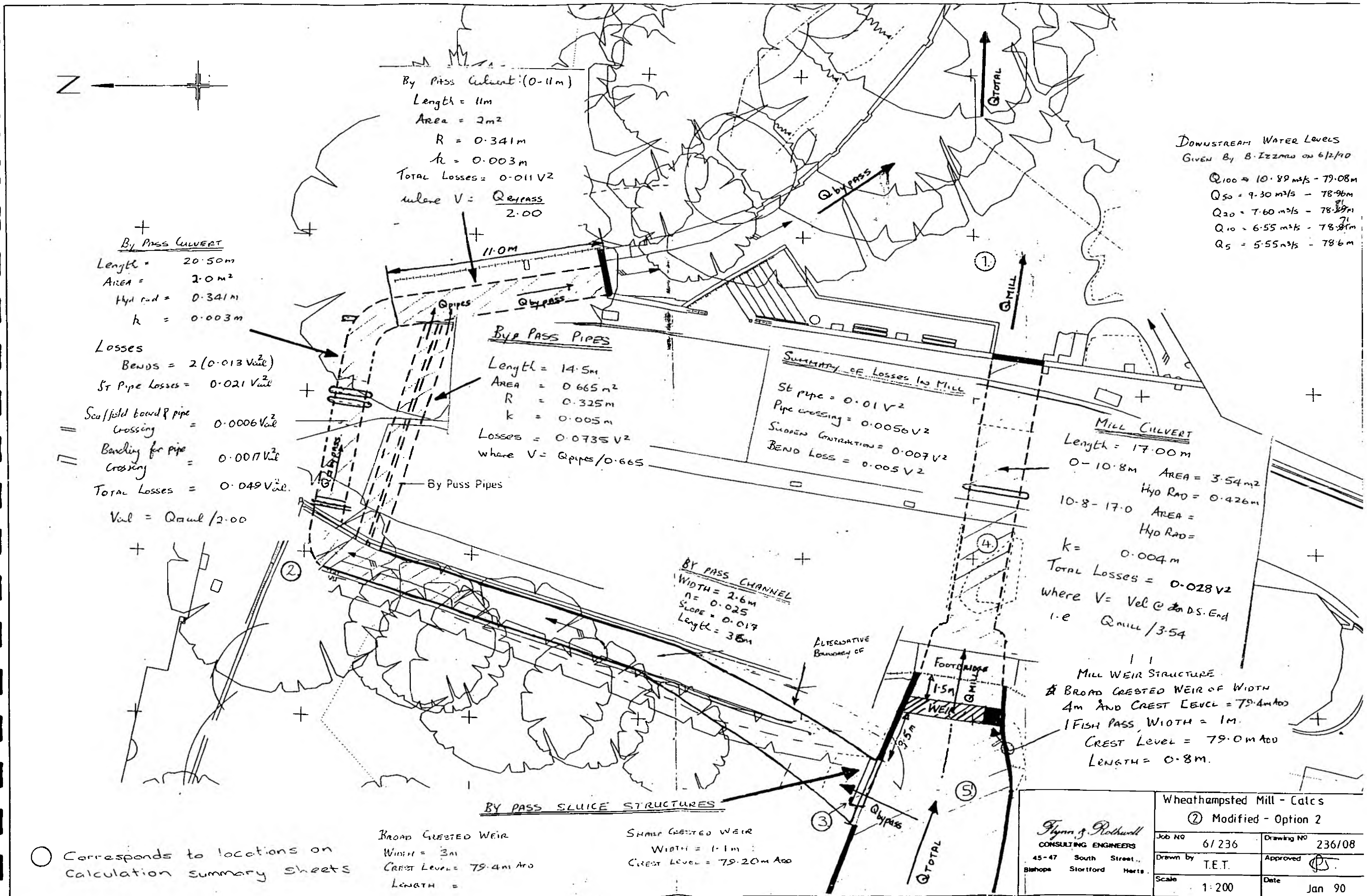
CONSULTING ENGINEERS 45/47 SOUTH STREET, BISHOP'S STORTFORD, HERTS. CM20 3AG

Project			Reference drawing number
Subject – Option 2			
Prepared by	Checked by	Approved by	Job number
Date	Date	Date	Sheet number 2 of 2 sheets

Use $E = D + V^2/2g$ to get the water depth. With this water depth, find the depth just below the sluice structure, using a backwater analysis. Check for drowning of the sluice structure. Calculate the head loss in the mill weir using the formulae above. If no drowning occurs the first guess was correct. If drowned, iterate to solve.

SUMMARY TABLE

Return Period Years	Q cu m/s	D.S.W.L. (m)	Level at Ent. to By-pass(m)	Level d/s of sluice Structure(m)	Water Level in Mill(m)	U.S.W.L. (m)
100	10.89	79.08	79.51	79.50	79.17	80.09
50	9.30	78.96	79.28	79.26	79.02	80.02
30/35	8.50	78.89	79.17	79.15	78.94	79.98
20	7.60	78.81	79.00	79.95	78.85	79.94
10	6.54	78.71	78.82	78.89	78.74	7$\overset{9}{8}$.89
5	5.55	78.60	78.60	78.85	78.62	79.84
5	4.00	78.43	78.50	78.77	78.45	79.74
5	3.00	78.31	78.40	78.71	78.32	79.66
5	2.00	78.17	78.32	78.64	78.17	79.58



Z
By Pass Culvert (0-11m)
Length = 11m
Area = 2m²
R = 0.341m
k = 0.003m
Total Losses = 0.011 V²
where V = Qbypass / 2.00
QTOTAL
Qbypass
11.0m
Qpipes
Qbypass
Downstream Water Levels
Given By B. Izzard on 6/2/90
Q100 = 10.89 m³/s - 79.08m
Q50 = 9.30 m³/s - 78.96m
Q20 = 7.60 m³/s - 78.81m
Q10 = 6.55 m³/s - 78.71m
Q5 = 5.55 m³/s - 78.6m
1
QMILL
By Pass Culvert
Length = 20.50m
Area = 2.0 m²
Hyd rad = 0.341m
k = 0.003m
Losses
Bends = 2 (0.013 V²cul)
St Pipe Losses = 0.021 V²cul
Scaffold board & pipe crossing = 0.0006 V²cul
Bending for pipe crossing = 0.0017 V²cul
Total Losses = 0.049 V²cul
Vcul = Qcul / 2.00
Byp Pass Pipes
Length = 14.5m
Area = 0.665 m²
R = 0.325m
k = 0.005m
Losses = 0.0735 V²
where V = Qpipes / 0.665
By Puss Pipes
Qbypass
Summary of Losses In Mill
St pipe = 0.01 V²
Pipe crossing = 0.0056 V²
Sudden Contraction = 0.007 V²
Bend Loss = 0.005 V²
Mill Culvert
Length = 17.00m
0 - 10.8m Area = 3.54 m²
Hyd Rad = 0.426m
10.8 - 17.0 Area =
Hyd Rad =
k = 0.004m
Total Losses = 0.028 V²
where V = Vel @ DS. End
i.e Qmill / 3.54
2
4
By Pass Channel
Width = 2.6m
n = 0.025
Slope = 0.017
Length = 35m
Alternative Boundary of
Footbridge
1.5m
QMILL
WEIR
9.5m
Mill Weir Structure
Broad Crested Weir of Width 4m And Crest Level = 79.4m AOD
1 Fish Pass, Width = 1m.
Crest Level = 79.0m AOD
Length = 0.8m.
5
3
Qbypass
QTOTAL
By Pass Sluice Structures
Broad Crested Weir
Width = 3m
Crest Level = 79.4m AOD
Length =
Sharp Crested Weir
Width = 1.1m
Crest Level = 79.20m AOD
◯ Corresponds to locations on Calculation summary sheets
Flynn & Rothwell
CONSULTING ENGINEERS
45-47 South Street, Bishops Stortford Herts
Wheathampsted Mill - Calcs
② Modified - Option 2
Job No 6/236
Drawing No 236/08
Drawn by T.E.T.
Approved
Scale 1:200
Date Jan 90