G.I.-30 SEPT. 1976

GEOCRES No. _____

DIST. 2 REGION _____

W.P. No. _____

CONT. No. _____

W. O. No. 93-11004

STR. SITE No. _____

HWY. No. 401

LOCATION Fountain St. Watermain / Hwy 401 Crossing, City of Cambridge

No OF PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

memorandum

PAUL PAYER

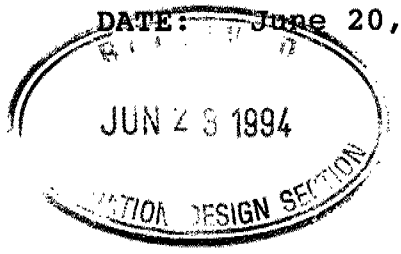
Ontario

(519) 649-3126

COPY

TO: Dennis Macleod
District 2 London /Stratford

DATE: June 20, 1994



RE: Fountain St. Watermain
Region of Waterloo
Highway 401 Crossing

The proposals for the dewatering, soil grouting and tunnelling were forwarded to the Traffic Section, Geotechnical Section and the Foundation Office for review. It was our understanding that only temporary work, minimal in nature would be carried in the median including placement of well points and a small diameter pipe along the ditch line to carry water from the dewatering operations. A 1.5 m Trench, which the contractor proposes, presents a significant change in the nature of the median work however with the appropriate protection of the traffic work within the median will be permitted. Based on our review of the documents we offer the following comments;

1. Our Foundation Design Section has reviewed the dewatering proposal for the median and finds that based on the borehole data from the Geotechnical investigation that the wellpoint lines in the median should be constructed in sections not longer than 8 m and backfilled as much as feasible prior to the excavation of the next section.

2. The temporary concrete barrier length must be increased to cover the hazard or excavation plus an additional 160 m of barrier at each approach end. This is over and above the length of the appropriate end treatment as defined in MTOD 920.02, Concrete Barrier Installation Layout of Temporary End Treatments (attached). It should also be noted that the concrete barrier should be placed in conjunction with appropriate delineation as defined in MUTCD.

   In regard to their question concerning the removal of the CAT end treatment, MTOD 920.20 states that a minimum clearance of 10 m is required for a design speed of 120 km/h. Therefore based on the median conditions an energy attenuating system would be required.

3. If the contractor is entering the median to carry out work the contractor must ensure that vehicular movements are accomplished with minimum interference and interruptions to traffic. This will necessitate vehicles to 'slip on' and 'slip off' in the direction of traffic in order to merge with and thereby avoid crossing traffic lanes.

4. We trust that appropriate environmental protection measures will be employed with respect to loss of sediment and that the site will be restored to existing conditions once work is complete.

Jennifer Graham-Harkness
Project Engineer
For: D. E. Turner
Area Manager
Planning and Design Section
Southwestern Region, London

JGH/sk

Attch.
c: Ken Teasdale
Paul Payer
Dave McLay
Heather Reu

Ministry of Transportation
Ontario

FAXGRAM

PLEASE TYPE

DATE 94 06 21

PAGE 1 OF 1

TO:	FROM:
J.G. Harkness Planning & Design Southwestern Region Fax: (519) 649-3109	P. Payer Foundation Design Section Downsview

SUBJECT: Fountain St. Watermain
District #3
W.O. 93-11004

The Wellpoint Header Lines in the median of Hwy. 401 should be constructed in sections not longer than 8 m and backfilled as much as feasible prior to the excavation of the next section.

P. Payer
Sr. Foundation Engineer

cc. - D. MacLeod
Fax: (519) 271-9009

ADM-S-481 91-05

ENGLAND NAYLOR ENGINEERING LTD.
CONSULTING ENGINEERS

BOREHOLE: 306
Sheet 1 of 1

MEDIAN

PROJECT Fountain Street Trunk Watermain
LOCATION Fountain Street, Cambridge, Ontario
DATE 6 June 1993
JOB NO. 0335G4
FIELD ENG/TECH RM

DEPTH (m)	DESCRIPTION	LEGEND	ELEV.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N-VALUE
	GROUND ELEVATION: 295.72					
0.20	FILL: dark brown silt (topsoil), moist					
0.60	compact brown fine to medium sand, some gravel, damp		295	1	SS	28
1.05	traces of topsoil					
1.85	SAND AND GRAVEL: compact to dense brown fine to coarse sand and gravel, damp		294	2	SS	33
2.45	some silt to silty sand layers, wet			3	SS	21
3.35	SILT TILL: firm to stiff brown silt, some clay and fine gravel and sand, wet		293	4	SS	6
4.25	SAND: compact fine to coarse sand, occasional fine gravel at 4.10 m, occasional 6 mm silt layers		292	5	SS	26
5.35	compact brown fine to coarse sand, wet		291	6	SS	29
6.40	SAND AND GRAVEL: compact brown medium to coarse sand and fine gravel, wet		290	7	SS	17
7.30	SAND: compact brown fine to medium sand, wet		289	8	SS	17
8.55	occasional thin silt layers		288	9	SS	19
9.15	SILT TILL: hard brown silt, some clay, occasional fine gravel, moist		287	10	SS	30
9.30	grey, moist			11	SS	38
	Borehole terminated at 9.30 m			12	SS	89

SHEAR STRENGTH, kPa(ksf)
FV. NAT. ■ REM. □
UC ◆ PP ▲
PENETRATION RESISTANCE
DYNAMIC CONE ×
STANDARD PENETRATION ●
20 40 60 80

WATER CONTENT (%)
wp w wl
10 20 30

GROUNDWATER OBSERVATIONS & PIEZOMETER DETAILS
bentonite seal
13 mm pipe
native backfill
1.2 m slotted filter

NOTES: 1) Elevation of top of pipe = 296.243

DRILLING METHOD: Hollow Stem Augers

ENGINEER: DN

ENGLAND NAYLOR ENGINEERING LTD.
CONSULTING ENGINEERS

BOREHOLE: 307
Sheet 1 of 1
MEDIAN

PROJECT Fountain Street Trunk Watermain
LOCATION Fountain Street, Cambridge, Ontario
DATE 6 June 1993
JOB NO. 0335G4
FIELD ENG/TECH RM

DEPTH (m)	SOIL PROFILE: DESCRIPTION	LEGEND	ELEV.	SAMPLES: NUMBER	TYPE	N-VALUE
	GROUND ELEVATION: 295.49					
0.30	FILL: dark brown silt (topsoil), moist					
	compact brown fine to medium sand, damp		295	1	SS	23
1.20	TOPSOIL: black clayey silt, moist					
1.70	SAND AND GRAVEL: compact brown fine to coarse sand and gravel, occasional cobbles, damp		294	2	SS	9
2.45						
2.75	less gravel to 3.05 m, moist		293	3	SS	28
3.05	wet					
	very dense brown fine to coarse sand and gravel, some cobbles		292	4	SS	53
4.25				5	SS	60
4.70	SAND: compact brown fine to coarse sand, trace silt, some fine gravel, wet		291	6	SS	23
	SAND AND GRAVEL: compact brown fine to coarse sand and gravel, wet			7	SS	30
5.95			290			
	SAND: compact brown fine to medium sand, some coarse sand layers and occasional fine gravel, wet			8	SS	16
			289	9	SS	10
7.30	compact brown fine to coarse sand, some gravel (no large gravel), trace silt, wet		288	10	SS	*
8.25	compact brown fine to medium sand, occasional 6 mm silt layers, wet		287	11	SS	17
9.30				12	SS	37
9.45	SILT: very dense brown silt, wet		286			
	SILT TILL: hard grey silt, some clay, trace sand and occasional fine gravel, moist			13	SS	102
10.35	Borehole terminated at 10.35 m					

SHEAR STRENGTH, kPa (ksf)
FV. NAT. ■ REM. □
UC ✣ PP ▲
PENETRATION RESISTANCE
DYNAMIC CONE ✕
STANDARD PENETRATION ●

WATER CONTENT (%)
wp w wl

GROUNDWATER OBSERVATIONS
PIEZOMETER DETAILS

concrete
bentonite seal
50 mm PVC pip
native backfill
7 mm roundsto
1.5 m slotted fil

NOTES: 1) Elevation of top of pipe - 295.543
* sample disturbed - rods ahead of augers

DRILLING METHOD: Hollow Stem Augers

ENGINEER: DN

ENGLAND NAYLOR ENGINEERING LTD.
CONSULTING ENGINEERS

BOREHOLE: 305
Sheet 1 of 1

PROJECT Fountain Street Trunk Watermain
LOCATION Fountain Street, Cambridge, Ontario
DATE 9 June 1993
JOB NO. 0335G4
FIELD ENG/TECH RM

DEPTH (m)	DESCRIPTION	LEGEND	ELEV.	SAMPLES NUMBER	TYPE	N-VALUE
	GROUND ELEVATION: 294.70					
0	FILL: dark brown/black clayey silt (topsoil), moist		294			
0.90				1	SS	6
1	TOPSOIL: black clayey silt, moist					
1.60						
	SAND: loose grey silty fine sand, moist		293	2	SS	7
2						
2.30						
	compact grey fine to coarse sand, wet			3	SS	24
			292			
3						
3.50						
	some gravel			4	SS	20
			291			
3.95						
4	SILT TILL: very stiff grey silt, some clay, occasional fine gravel, wet			5	SS	22
4.55						
	firm grey silt, some sand, clay and fine gravel, saturated		290	6	SS	5
5						
			289	7	SS	5
6						
6.10						
	stiff			8	SS	12
6.70						
	Borehole terminated at 6.70 m					

SHEAR STRENGTH, kPa(ksf)
FV. NAT. ■ REM. □
UC ◇ PP ▲
50(1) 100(2) 150(3) 200(4)
PENETRATION RESISTANCE
DYNAMIC CONE ×
STANDARD PENETRATION ●
20 40 60 80

WATER CONTENT (%)
wp w wl
10 20 30

GROUNDWATER OBSERVATIONS & PIEZOMETER DETAILS

bentonite seal

50 mm PVC pipe

native backfill

7 mm roundstone
1.5 m slotted filter

At drilling completi
wet cave at 1.85 m

NOTES: 1) Elevation of top of pipe = 294.703

DRILLING METHOD: Hollow Stem Augers

ENGINEER: DN

ENGLAND NAYLOR ENGINEERING LTD.
CONSULTING ENGINEERS

BOREHOLE: 308
Sheet 1 of 1

PROJECT Fountain Street Trunk Watermain DATE 9 June 1993 JOB NO. 0335G4
LOCATION Fountain Street, Cambridge, Ontario FIELD ENG/TECH RM

DEPTH (m)	DESCRIPTION	LEGEND	ELEV.	NUMBER	TYPE	N-VALUE
	GROUND ELEVATION: 294.46					
0	FILL: brown/dark brown clayey silt (topsoil), wet		294			
0.75	PEAT: soft black amorphous peat, wood, saturated			1	SS	2
1.50	frequent pieces of wood		293	2	SS	8
1.85	SAND: compact grey silty sand, wet					
2.15	CLAY: soft grey silty clay, WTPL		292	3	SS	5
2.80	SAND AND GRAVEL: compact to dense brown fine to coarse sand and gravel, occasional cobbles, saturated		291	4	SS	26
4.55	larger gravel and frequent cobbles		290	5	SS	36
5.50	dense brown silty fine sand, some silt layers to 6.10 m		289	6	SS	49
6.10	compact brown medium to coarse sand and gravel, saturated			7	SS	43
6.70	brown silty fine sand, some gravel, saturated		288	8	SS	12
7.60	SILT TILL: compact brown sandy silt, some fine gravel, some sand layers, wet		287	9	SS	8/50 mm
8.40	hard brown clayey silt, DTPL			10	SS	24
8.70	grey, DTPL		286	11	SS	36
8.85	Borehole terminated at 8.85 m					

SHEAR STRENGTH, kPa (ksf)
FV. NAT. ■ REM. □
UC ⊕ PP ▲
50(1) 100(2) 150(3) 200(4)
PENETRATION RESISTANCE
DYNAMIC CONE ×
STANDARD PENETRATION ●
20 40 60 80

WATER CONTENT (%)
wp w wl
10 20 30
74.45
225.2

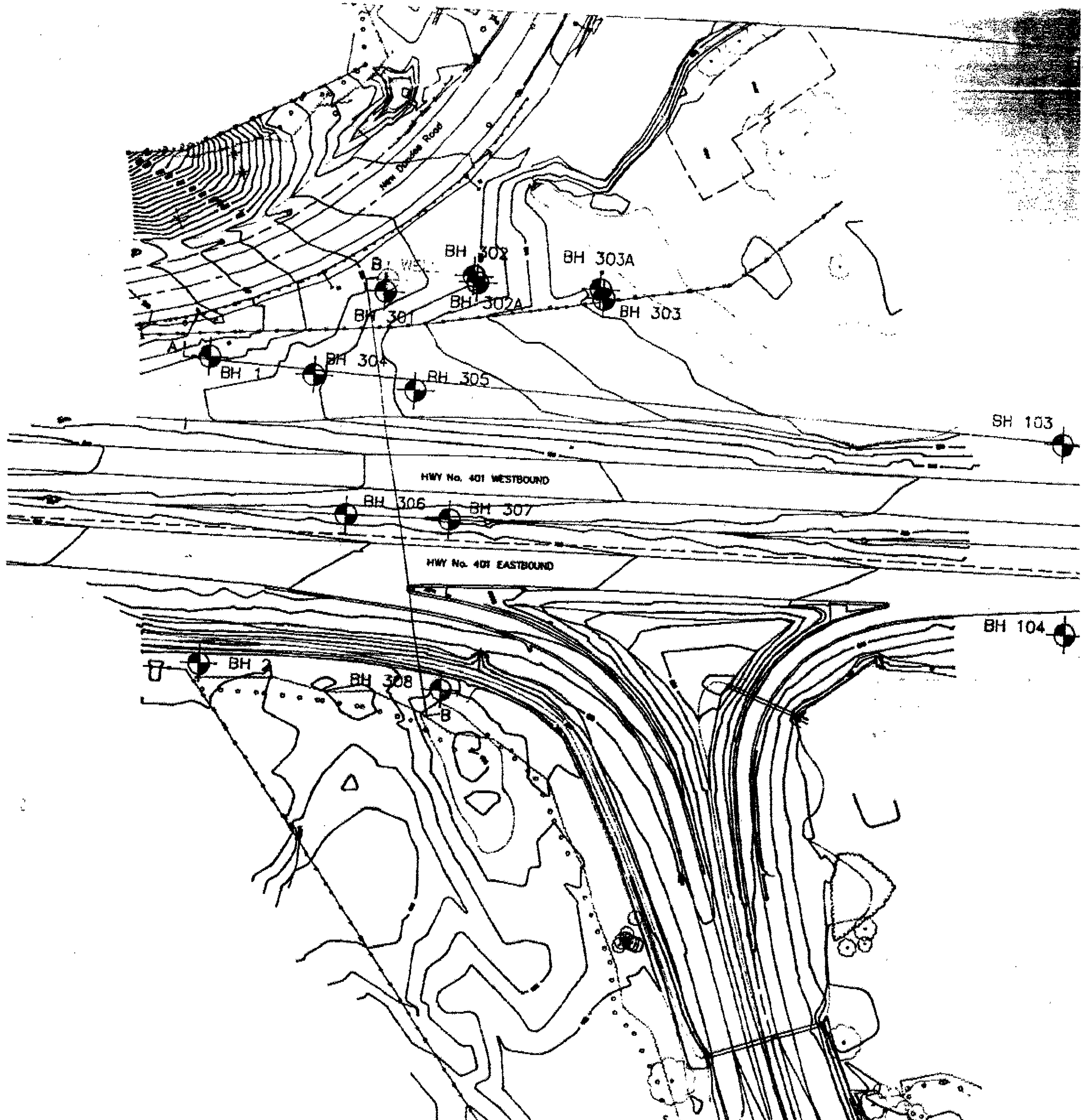
GROUNDWATER OBSERVATIONS & PIEZOMETER DETAILS
bentonite seal
50 mm PVC pipe
native backfill
1.5 m slotted filter
7 mm roundstone
At drilling completion wet cave at 1.85 m

NOTES: 1) Elevation of top of pipe = 294.518

DRILLING METHOD: Hollow Stem Augers

ENGINEER: DN

06-21-94 02:28PM TO 8-1-4162355240 P002 JUN 21 '94 01:25PM



MEMORANDUM

Ontario

To: D.E. Turner
Area Manager
Planning and Design
Southwestern Region

Date: March 9, 1994

Attn: J. Graham Harkness

From: Foundation Design Section
Room 315, Central Building
Downsview

Re: Fountain St. Watermain
City of Cambridge
Hwy 401 and Homer Watson Interchange
W.O. 93-11004
District 3, (Stratford)

The procedures for the construction of a watermain crossing proposed by the Regional Municipality are in accordance with our recommendations. We are pointing out however, that the Regional Municipality of Waterloo is responsible for the integrity of the underpass structure and Hwy 401. Therefore, the municipality should establish proper monitoring systems.

P. Payer

P. Payer, P. Eng.
Senior Foundation Engineer

PP/jb

cc: C. Brickman
D. McLay

memorandum

Ontario

(519) 649-3126

TO: C. Brickman
Stratford District

DATE: September 27, 1993

RE: Fountain Street Watermain
Highway 401 Crossing

The aquifer pumping test and geotechnical investigation report was forwarded to the Foundation Design Section for review. They found that the effect of the drawdown on the structure could not be determined as the groundwater was not lowered to the proposed invert level. They also believe that the dewatering will cause the highway to settle (see attached memo).

Therefore a scheme which requires dewatering would not be acceptable at this location.

Jennifer Graham-Harkness
Project Engineer
For: D. E. Turner
Area Manager
Planning and Design Section
Southwestern Region, London

JGH/hb
Attachment

c: D. McLay
P. Payer

ENGLAND NAYLOR ENGINEERING LTD.

CONSULTING ENGINEERS
353 Bridge Street East
Kitchener, Ontario N2K 2Y5
519-741-1313
FAX 519-741-5422

October 22, 1993

0335G5.L01

Regional Municipality of Waterloo
150 Frederick Street, 7th Floor
Kitchener, Ontario
N2G 4J3

Attention: Mr. Ed Shaniawski, C.E.T.

Dear Sir:

Re: Fountain Street Trunk Watermain
Highway 401 Crossing
Cambridge, Ontario

I have reviewed the recent letter and memorandum from the Ministry of Transportation of Ontario with their review of our aquifer pumping test and geotechnical investigation report. Please forward copies of this response letter for their review so that they may reconsider their position prior to our upcoming meeting.

The Regional Municipality of Waterloo is proposing to install a 450 mm diameter trunk watermain beneath Highway 401 approximately 200 m west of the Homer Watson Boulevard/Fountain Street bridge. The watermain pipe will be installed in a continuous steel casing approximately 1.2 m in diameter with the invert at about Elevation 291, some 5 m below the highway. The required length of casing installation below Highway 401 will be approximately 70 m.

Subsurface soil conditions at the proposed Highway 401 crossing comprise outwash sand and sand and gravel deposits overlying silt and silt till. Typically the elevation of the base of the outwash deposit/top of the underlying silt/till is about Elevation 285 to 287 in this area. The outwash granular deposit ranges in texture from a fine sand to a sand and gravel, and at the proposed watermain crossing, fine to coarse sand predominates.

Groundwater at the Highway 401 crossing location is contained within the outwash granular deposit perched on the less permeable underlying silt/silt till. The static water level is typically at about Elevation 293 to 294 at the crossing location with a horizontal gradient in a northeasterly direction towards the Grand River. An extensive aquifer pumping test was carried out using a 150 mm diameter 11 m deep pumping well. Following a step drawdown test to establish the pumping rate, a constant rate test was conducted for a total of 72 hours. The purpose of the aquifer pumping test was to permit calculation of the aquifer parameters in order to allow evaluation of dewatering for the trunk watermain and steel liner casing installation below Highway 401. Various dewatering schemes were analyzed analytically using the aquifer geometry and parameters, and computer modelling carried out in order to assess the effects of the dewatering.

The September 20, 1993 memo from Mr. Paul Payer, a Senior Foundation Engineer with the Foundation Design section of MTO indicated that the purpose of the pumping test was to evaluate the effect of groundwater lowering on the existing bridge structure and on Highway 401. He states that since the groundwater was not lowered to the invert level, the effect of drawdown on the structure foundation cannot be determined. The aquifer pumping test was not carried out with the purpose of completely lowering the groundwater to the level required during construction, as this would require numerous large diameter wells as discussed in our report and would in essence be construction dewatering. The pumping test was carried out to allow calculation of the pertinent aquifer parameters and then to analytically assess the construction dewatering effect on the structure and Highway 401.

I would like to clarify that there is a constant head barrier between the proposed crossing location and the bridge structure 200 m to the east. The shallow aquifer in question intersects ponded surface water to the west of the bridge and the presence of this ponded water would absolutely ensure no groundwater lowering in this area. Also, as discussed in our report, the construction dewatering scheme would involve discharge of the pumped groundwater to this constant head barrier/surface ponding in order to ensure that the groundwater is not lowered between the crossing location and the bridge structure.

During construction, the groundwater lowering would be continuously monitored using the existing and probably some supplementary monitoring wells in order to ensure that the constant head barrier between the crossing location and the bridge structure is not influenced. However, in our opinion, the presence of the ponded water as a constant head

barrier is sufficient to ensure that the dewatering does not lower the existing groundwater level at the bridge structure.

The last sentence in Mr. Payer's memo states that he also believes that the dewatering will cause the highway to settle. During our aquifer pumping test, we surveyed pavement elevations along a 100 m stretch of Highway 401 adjacent to the test well. The surveying data was not included as part of the report, as stated on Page 10, because absolutely no settlement was taking place, otherwise the pumping test would have been terminated.

The granular deposit which underlies this section of Highway 401 is predominantly compact to dense sand. The average standard penetration N-value in all of the boreholes at this location is approximately 30 blows per 0.30 m. Therefore this material can support an allowable bearing pressure of 300 kPa, assuming the usual 25 mm of settlement for foundations. At the invert level at Elevation 291 the actual existing effective vertical stress including a uniform traffic loading of 10 kPa, as per the Ontario Highway Bridge Design Code, is approximately 100 kPa. The 3.5 m of drawdown required for dewatering increases the effective vertical stress at the invert level by approximately 25 kPa, in other words, after drawdown the effective stress at invert would be approximately 125 kPa, or less than half of the allowable soil bearing pressure for 25 mm of settlement. In our opinion, the dewatering absolutely cannot cause Highway 401 to settle.

I trust that this letter sufficiently addresses the concerns expressed by Mr. Payer in his memo, and look forward to further discussing my position in our upcoming meeting. If you have any questions, please feel free to give me a call.

Yours very truly,

Dave S. Naylor, P.Eng.

km

MEMORANDUM

Ontario

To: J. Graham Harkness
Project Engineer
Planning and Design
Southwestern Region

Date: September 20, 1993

From: Foundation Design Section
Room 315, Central Building

Re: Pumping Test for
Watermain Installation
Hwy 401 at Homer Watson Interchange
W.O. 93-11004
District 3, (Stratford)

It is proposed to install a 1.2 m dia. casing (owner: Regional Municipality of Waterloo) to carry a 0.45 m dia. watermain below Hwy 401 some 200 m west of the interchange structure. The invert level is set between El. 291.0 and El. 291.5, about 4 m below the pavement level. The groundwater level in the test holes varied between El. 294.1 to El. 292.6. In order to construct in dry condition, temporary lowering of the groundwater was recommended by the owner's consultant (England Naylor Engineering Ltd.).

A pumping test was carried out by the consultant to evaluate the effect of the groundwater lowering on the existing structure (founded on spread footings) and on Hwy 401.

After about 24 hours of pumping, the groundwater was lowered to levels as indicated in the table below:

BH. No.	Original G.W.L.	G.W.L. After Pumping
304	El. 293.2	El. 292.3
301	El. 292.6	El. 290.8
308	El. 294.1	El. 293.3

With the exception of BH. 301, the groundwater was not lowered to the invert level, therefore, the effect of the drawdown on the structure foundation can not be determined.

We also believe that the dewatering will cause the highway to settle.

P. Payer

P. Payer, P. Eng.
Senior Foundation Engineer