DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M5-190

DIST. 4 REGION

W.P. No. 410-85-00 (A)
FORMERLY 114-85-00A)

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 403

LOCATION HWY 403 AT C.N.R. CROSSING
(DETENTION POND)

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ministry
of
Transportation

Ontario

FILE No. _____ **DATE** _____

REMARKS _____

Drane Gibbons 585-6788

Ministry of Transportation
Ministère des Transports
Ontario

Engineering Materials Office
Foundation Design Section
Room 315, Central Bldg.
1201 Wilson Avenue
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October 12, 1993

T. H. McColm, P. Eng.
R.V. Anderson Associates
2001 Sheppard Ave., East
Suite 400
Willowdale, Ontario
M2J 4Z8

Re: Highway 403 Advance Structure Approaches
Highway 25 to Walkers Line
Draft Non-Standard Special Provisions (NSSP)
W.P. 410-85-00

We have reviewed the non-standard Special Provisions pertaining to the pressure relief wells and the earth excavation for the above mentioned project. The earth excavation NSSP is considered acceptable as written but the Contractor shall be also similarly notified that the heterogeneous mixture of silt, sand and gravel deposit submerged below the groundwater table is subjected to unbalanced head conditions and hence can slough and cave-in in the hole during the relief well installation.

T. Sangiuliano, P. Eng.
Foundation Engineer

for

P. Payer, P. Eng.
Senior Foundation Engineer

PP/TS/jb

memorandum

Ontario

To: E. Salva
Senior Project Manager
Planning & Design, Central Region
5th Floor, Atrium Tower

Date: 93 04 06

From: Foundation Design Section
Room 315, Central Building

Re: Detention Pond at Hwy 403
Between Bronte Creek and CNR Subway
WP 410 85-00

Further to our meeting at R.V. Anderson Associates Ltd. conducted on March 24, 1993 pertaining to the detention pond design methodology, this office has undertaken an additional examination of all geotechnical considerations and their influence on the overall design. The review has also resulted in reevaluating specific geotechnical aspects for adjacent projects.

This memorandum summarizes the findings of these reviews and provides recommendations for the design and construction of relevant geotechnical aspects of the projects. The following projects have been included in the review.

1) Detention Pond

2) CNR Subway & Diversion

3) Hwy 403 Excavation Cut

In addition, comments have been provided regarding temporary excavation cuts and geotechnical/foundation implications of the deep shaft and tunnel adjacent to the Bronte Creek/Hwy 403 Crossing structure are also addressed.

1) DETENTION POND

(i) Rate of seepage of groundwater

(a) As mentioned at the meeting, the rate of groundwater seepage into the pond is expected to be very small in view of the relatively impervious nature of the surficial cohesive heterogeneous mixture of clayey silt, sand and gravel and the underlying cohesionless heterogeneous mixture of silt, sand and gravel. Although the seepage rates are expected to yield greater flows within the underlying heterogeneous mixture

of silt, sand and gravel deposit, this seepage can be effectively controlled by employing a 0.6 m granular 'A' blanket on the slope surface of this deposit and a toe trench drain that extends for the thickness of the deposit to the bedrock surface. A trench drain is also recommended at the mid-depth bench to intercept the groundwater at the higher elevation. The trench drain-granular 'A' blanket drainage scheme will allow for groundwater drainage and simultaneously prevent slope instabilities.

The slope protection scheme shall also include rip rap or rock protection to the anticipated impounded pond high water level with the granular 'A' filter blanket between the native soil and the outer rock shell as described on page 12 of the Foundation Report (WP 410-85-00A). The granular 'A' blanket shall extend to the high pond water level or upper limit of the cohesionless heterogeneous mixture of silt, sand and gravel, whichever is greater.

Details of the recommended drainage scheme are provided on Figure 1 attached. The drainage scheme is applicable to all four(4) sides of the detention pond.

(b) It is recommended that any pond water be prevented from egressing into the groundwater drainage system. This can be achieved by constructing an impervious seal as illustrated in detail 1 in Figure 1. The impervious seal shall consist of a clay seal as defined in OPSS 1205 series.

(ii) Subexcavation

The original Foundation Report emphasized the potential for hydrostatic uplift and recommended the excavation of the heterogeneous mixture of silt, sand and gravel to avoid potential "boiling" conditions within this material. These recommendations had been based on the presumption that the pond would be a retention "wet" pond. Having been informed at the meeting that the design would be a "dry" pond, it is hereby informed that subexcavation is **NOT** required. Alternatively, hydrostatic uplift can abe controlled by the "relief" toe drains that were mentioned in (i) above. The toe drains are required throughout the excavation perimeter.

Installation of the toe drains will necessitate an additional excavation trench at the toe of the slope. A dewatering scheme will be required to facilitate the excavation of the trench within the heterogeneous mixture of silt, sand and gravel deposit. This can be achieved by conducting the excavation using an oversized excavation with perimeter ditches and sump pumping to discharge the groundwater.

To reduce the possibility of slope instability caused by toe excavation, it is

recommended that the work be completed in lengths not exceeding 5 m. This should be specified in a Non-standard special provision in the contract documents. It is also suggested that the excavation take place within a trench box to ensure the safety of personnel and also to prevent toe slope instability.

The design, installation and maintenance of the temporary dewatering system should be the responsibility of the contractor. The contractor shall be notified of the potential hydrostatic uplift condition and the susceptibility of the heterogeneous mixture of silt, sand and gravel to conditions of unbalanced head.

(iii) Effect of Railway Loading

A further slope stability analyses was conducted to determine the minimum edge distance between the CNR detour railway loading and the crest of the adjacent excavation cut slope. An effective stress analysis was conducted incorporating the slope geometries as summarized in Table 2 of the report (WP 410-85-00A) and using an external railway loading of 120 kN/m (American Railroad Engineering Association). Based on the results, it can be concluded that the centre-line of the railroad tracks shall be a minimum of five(5) metres from the crest of the slope. The slope shall be in accordance to the geometries recommended in the Foundation Report.

A review of the CNR detour drawings attached to R.V. Anderson Associates Ltd letter dated April 2, 1993 reveals that this minimum edge distance will be satisfied.

(iv) Excavation Drainage System

An excavation and dewatering scheme has been proposed and is provided on page 13 of the Foundation Report (WP 410-85-00A). It is believed that this procedure will adequately facilitate the excavation.

2) CNR SUBWAY & DIVERSION

The CNR diversion will be located in a temporary cut approximately 3 m to 4 m deep. No dewatering or hydrostatic uplift problems are anticipated for the temporary excavation cut.

In the construction of the two span CNR Subway structure, however, excavations to

elevations of approximately 151.8 m and 150.35 m have been shown at the abutment and centre pier locations respectively (see Drawing 19 - WP 408-85-01). These excavations appear to penetrate the cohesionless heterogeneous mixture of silt, sand and gravel and hence a temporary and permanent dewatering scheme will be necessary as indicated in the Foundation Report (pg 12, WP 408-85-01) and then reinforced in preliminary design drawing reviews conducted by this office. An oversized excavation with perimeter ditches may be one method of unwatering the excavation to facilitate the foundation construction. A permanent dewatering scheme will also be required for the Hwy 403 excavation cuts at and adjacent to the abutment locations. Permanent dewatering scheme alternatives are described below.

3) HWY 403 EXCAVATION CUT

A review of the subsurface conditions within the proposed Hwy 403 excavation cut between Bronte Creek and the CNR was implemented to determine whether hydrostatic uplift is a concern within this area. The conditions examined reveal that there is indeed a long term potential for hydrostatic uplift of the cohesionless heterogeneous mixture of silt, sand and gravel as a result of the excavation of the surficial overlying heterogeneous mixture of clayey silt, sand and gravel between Stations 26+650 and 27+190. One method to control this condition is to modify the recommended drainage system illustrated on Figure 4 of the Bronte Creek/Hwy 403 Crossing Report (WP 410-85-01/02) such that the toe drain is extended to bedrock. This measure will intercept water flow and provide the hydrostatic relief required to prevent uplift boiling conditions below the proposed Hwy 403 grade. A revised Figure 4 reflecting this specification is attached. To ensure adequate dewatering to facilitate the trench drain installation, trench excavation can be carried out within an oversized excavation restricted to lengths of 5 m as previously discussed.

An examination of the Hwy 403 profile grade elevation in relation to the depth and thickness of the cohesionless heterogeneous mixture of silt, sand and gravel reveals that the trench drain installation within the cohesionless stratum will require excessive non pragmatic excavation cuts as the profile grade increases in the easterly direction. Therefore, a more feasible method of hydrostatic uplift relief is the installation of vertical relief wells in the cohesionless till deposit. The spacing of the relief wells depends on the efficiency of the well, the hydraulic conductivity of the cohesionless till deposit and the amount of drawdown required. It is suggested that the relief wells be installed on 30 metre centres in a staggered pattern along the north and south roadway ditches. In view of the fact that a trench drain system will be installed on the north side of the detention pond parallel to the Hwy 403 excavation cut, vertical relief wells are **NOT** required along the south roadway ditch of the Hwy 403 adjacent to the detention pond.

Relief wells should consist of a minimum 100 mm diameter, PVC plastic screen extending for the **FULL** depth through the cohesionless till deposit. A typical generic pressure relief well is shown on Figure 6 in the Appendix (taken from WP 146-74-00-3). The relief well system must be connected to a permanent discharge system.

The relief wells can be installed in augured holes using conventional drilling equipment. Temporary casing may be needed to prevent soil sloughing from the shaft of the hole and enable the PVC plastic screen installation.

Temporary Excavation Cuts

Any temporary excavation cut that is susceptible to hydrostatic uplift shall be safeguarded accordingly. This can be achieved by installing the permanent drainage design scheme such that it also performs as a temporary scheme or alternatively employing deep wells or well points within the underlying cohesionless till deposit. The temporary or temporary/permanent scheme shall be installed when the excavation reaches the threshold elevation that will initiate the hydrostatic uplift imbalance. These elevations are summarized in Table 1 below and the excavation should be staged accordingly. There are no major dewatering difficulties anticipated above these elevations.

TABLE 1 - STAGE EXCAVATION ELEVATIONS

Chainage	Elevation(m)
26+650 - 27+100	156
27+100 - 27+190	159

As mentioned earlier, the design, installation and maintenance of the temporary dewatering system should be the responsibility of the contractor. The contractor shall be notified of the potential uplift condition and the susceptibility of the heterogeneous mixture of silt, sand and gravel to conditions of unbalanced head.

PROXIMITY OF TUNNEL STRUCTURE TO EAST ABUTMENT OF EASTBOUND STRUCTURE

Having reviewed the mutual influences of the proposed location of the drop shaft and the tunnel structure and the east abutment of the eastbound structure, it can be concluded that no influence exists between the structures.

If you have any questions regarding the above comments or require additional information, please do not hesitate to contact this office.

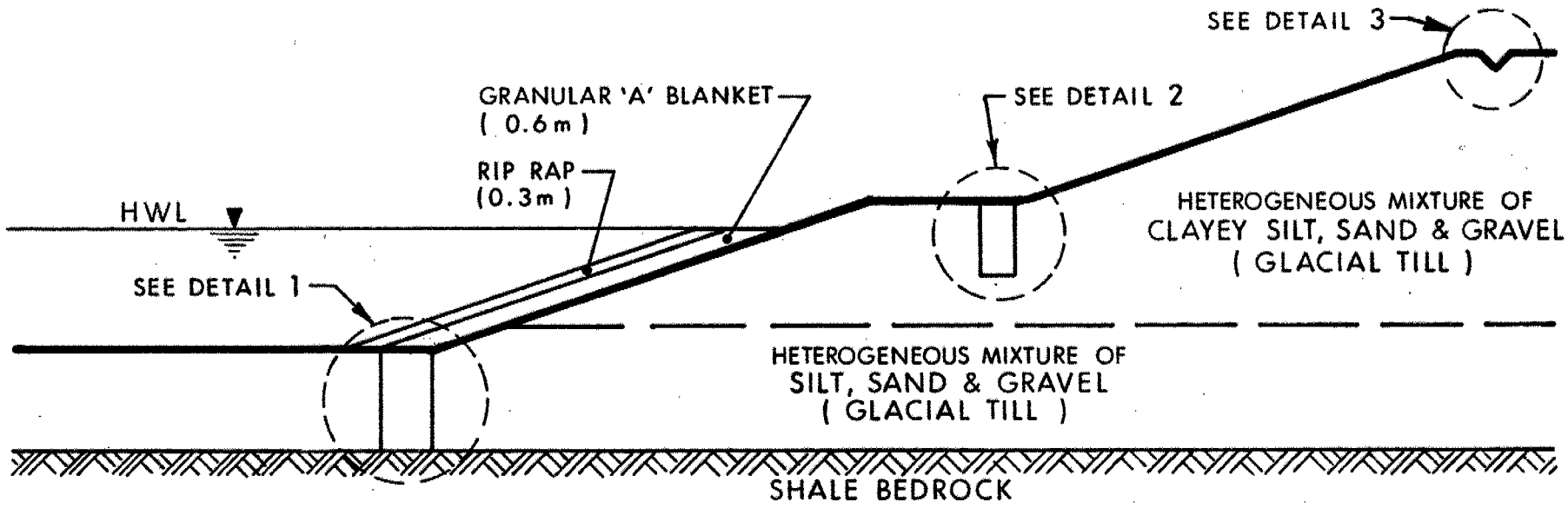
T. Sangiuliano, P. Eng.
Foundation Engineer

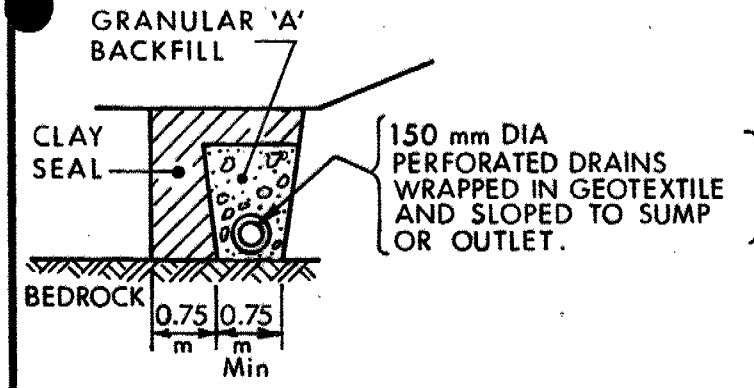
for

P. Payer, P. Eng.
Senior Foundation Engineer

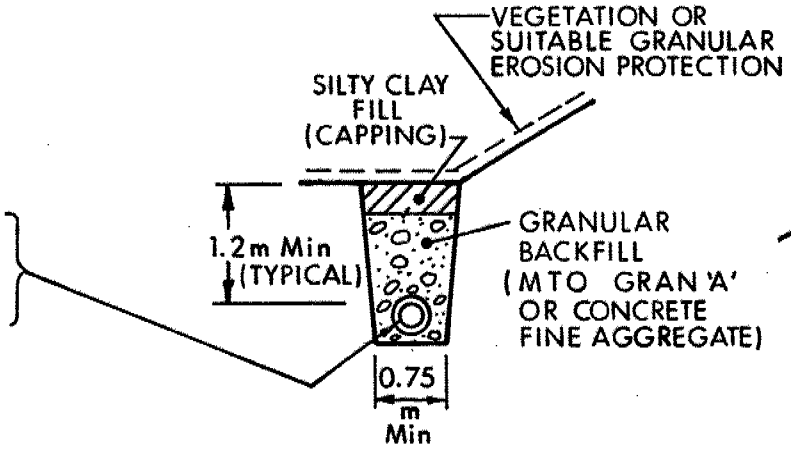
Figure 1 - DETENTION POND DRAINAGE/SLOPE PROTECTION SCHEME

NOT TO SCALE





DETAIL 1



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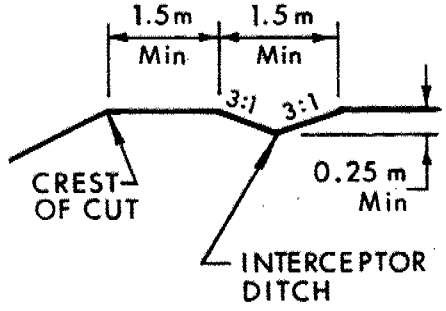
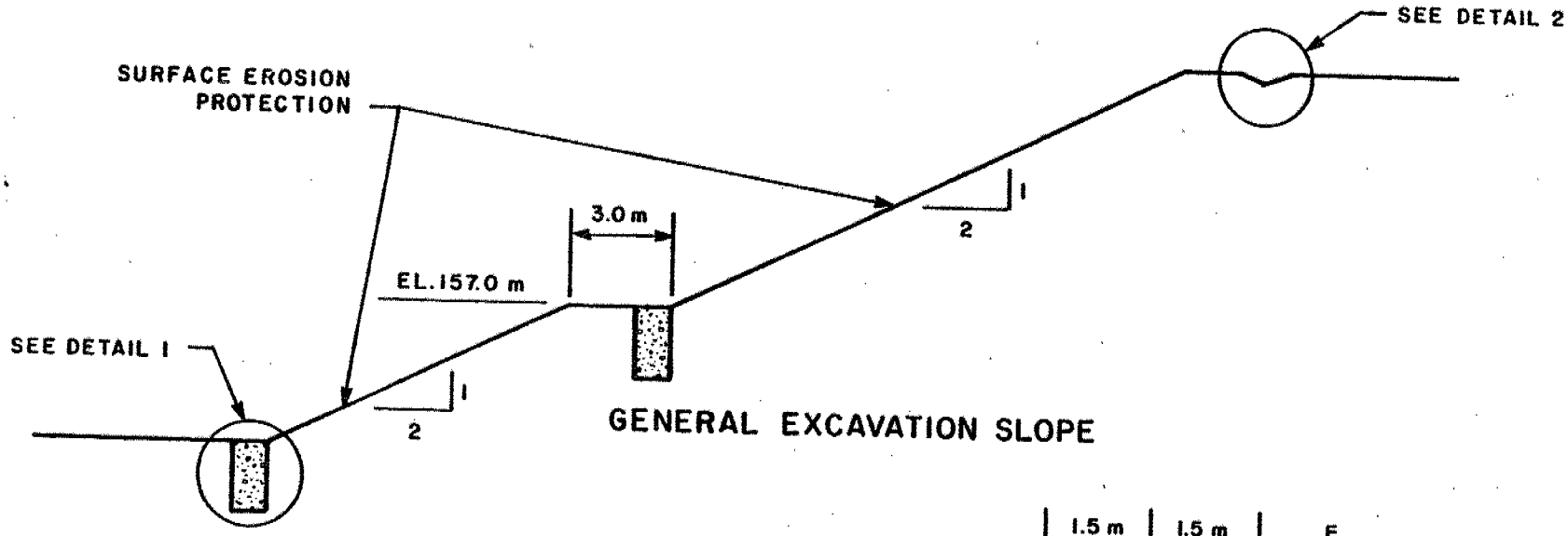
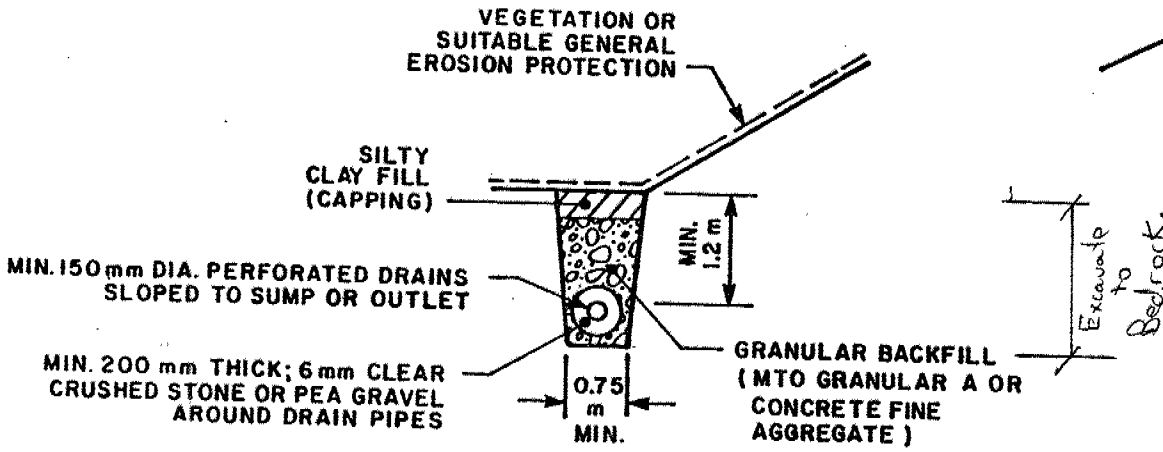


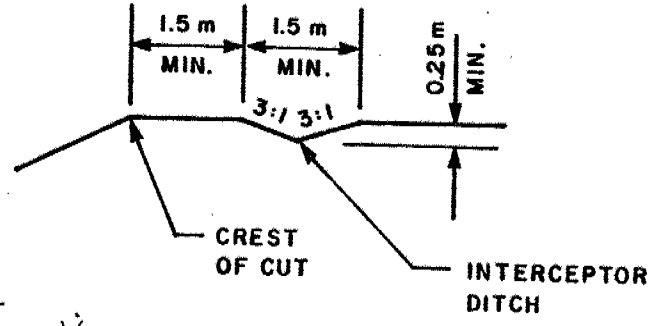
DETAIL 3



GENERAL EXCAVATION SLOPE



DETAIL 1

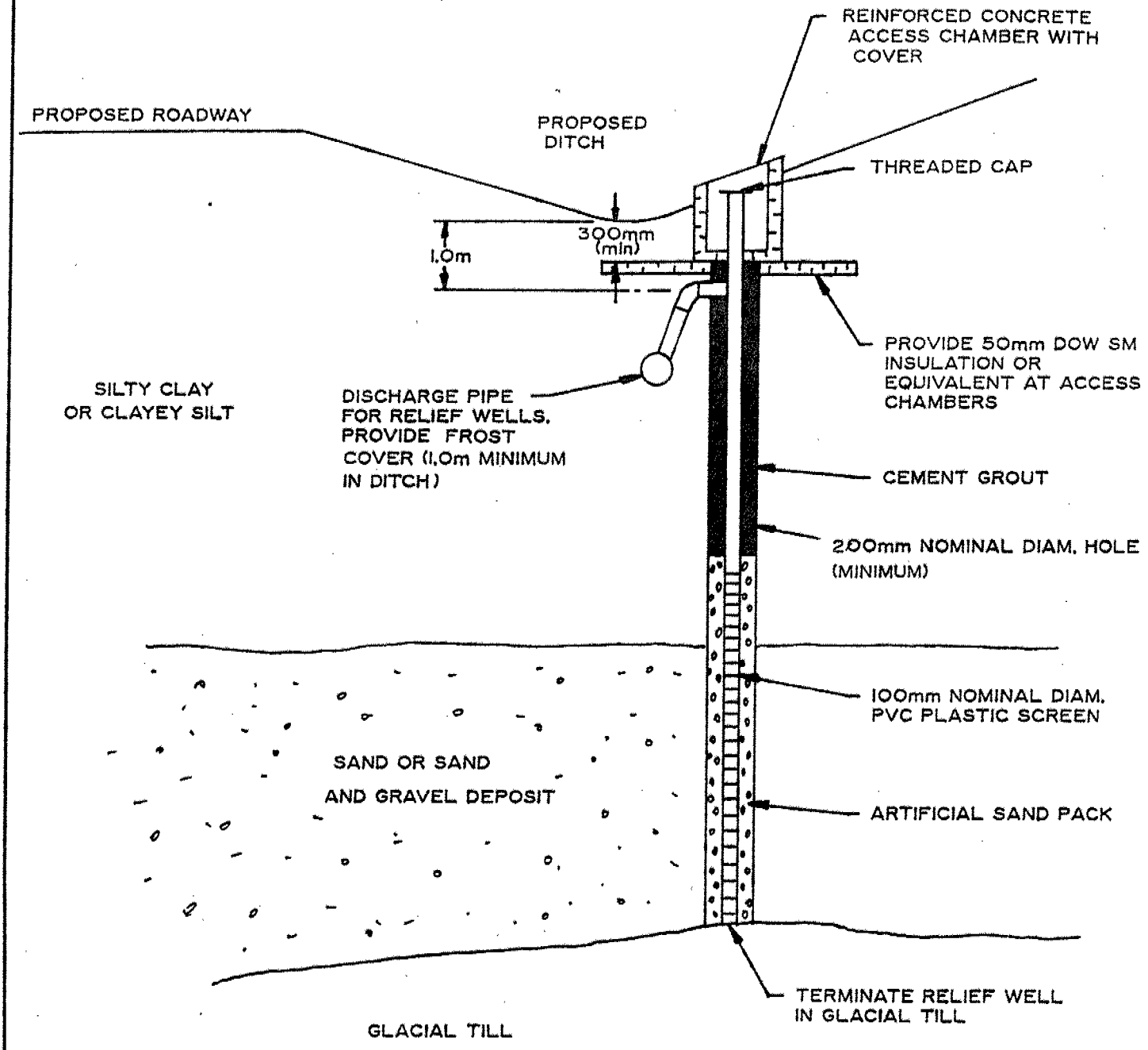


DETAIL 2

Ministry of Transportation, Ontario	RECOMMENDED DRAINAGE SYSTEM EAST APPROACH CUT	FIG No 4 WP 410-85-01/02

TYPICAL PRESSURE RELIEF WELL DETAIL
— SAND —

FIGURE 6
WP 146-74-00-3



NOT TO SCALE

SPECIAL NOTE
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

Date OCT. 4, 1990
Project 901-2115

Golder Associates

Drawn S.L
Chkd. MC