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GEOCRES No. 31F-118

DIST. 9 REGION

W.P. No. 127-92-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 417

LOCATION Proposed Culverts  
& High Embankments

(From Regional Rd 20 to 22)

No of Pages -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

# memorandum

Ontario

To: Distribution

Date: February 25, 2000

From: Planning and Design Section  
Eastern Region Kingston

Re: Contract 2000-0008, W.P. 127-92-00 Technical Review Meeting Minutes  
Highway 417, From Regional Road 22 to Regional Road 20, 6.2 km

Attached for your information are the minutes of the Technical Review Meeting (held on November 30, 1999) for the above project.



Louis Tay, P.Eng  
Senior Project Engineer



Distribution:

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✓ T. Sanguiliano	S. Ng



**Ministry of Transportation of Ontario  
Technical Review Meeting**

**Project:** W.P. 127-92-00- Highway 417 - Regional Road 22 to Regional Road 20

**MH Project No.:** 2994028.00

**Place:** MTO Eastern Region – Kingston - Boardroom 5

**Date:** November 30, 1999

**Time:** 10:00 am

<b>Present:</b>	Louis Tay	MTO Planning & Design (Sr. Project Engineer)
	Dave McAvoy	MTO Planning & Design - Environmental
	Phil Pawliuk	MTO Planning & Design
	Mike deLugt	MTO Planning & Design
	Chris Kardassis	MTO Planning & Design
	Barry McQuay	MTO Planning & Design
	Ken Polson	MTO Ottawa District & Construction
	David Levere	MTO Ottawa District
	Chris McShane	MTO Construction
	John Blaikie	MTO Traffic
	Doug Gorrill	Golder
	Michael Maher	Golder
	Kevin Tribble	Heartland Environmental (HE)
	Andrew Harkness	Morrison Hershfield (MH)
	Bill Kirby	Morrison Hershfield (MH)
<b>Comments Sent</b>	Sam Ng	MTO Landscaping
<b>But Not In</b>	T. Sangiuliano	MTO Pavement & Foundations
<b>Attendance:</b>	Barry Letang	MTO QA Soils (comments on 2nd package)

**Please Note:** These Meeting Minutes reflect comments provided by Ministry staff on both the original Technical Review package submitted by MH on November 4, 1999 (See Sections 1.0 through 18.0) as well as on a subsequent revised Technical Review package submitted by MH on December 8, 1999 (See Sections 19.0 through 22.0).

A teleconference was held on December 14, 1999 to discuss the second package with Louis Tay and Mike deLugt from MTO and Bill Kirby and Andrew Harkness from MH in attendance. Additional review comments provided prior or subsequent to the December 14, 1999 meeting by fax, mail, etc. have also been documented and responded to as part of these Minutes.

<b>ITEM</b>	<b>MINUTES</b>	<b>ACTION BY</b>
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<b>1.0</b>	<b>INTRODUCTION</b>	
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L. Tay and A. Harkness introduced the project noting that the Technical Review package contained details that will be incorporated into (at least) 3 different contracts. It was noted that the existing Bell cable crossing of the proposed right-of-way west at approx. Sta. 17+000 to Sta. 17+200 is to be relocated this Fall/Winter to avoid a Constructor issue.

The Ministry requested that the package be resubmitted with more detail and including only the work that will be done under Contract #2000-0008. Concerns were noted about the level of completeness of the submission.

**(Response: MH agreed to revise and resubmit the package for further review by December 8, 1999. MH noted that details of work to be undertaken subsequent to Contract #2000-0008 had been included for technical review at the Ministry's request. MH also noted that certain design or contract document elements that were not yet available from the Ministry were not included in the package with MTO's concurrence due to the priority given to adhering to the project schedule. These items included: geotechnical/foundations design details for the Mississippi River approach embankments, staging requirements for the Bridge project which would help establish the highway grading limits west and east of the River, and current ERS/New Initiative NSSP's.)**

**MH**

Phil Pawliuk asked whether the QC Plan had been completed to this stage of the project. MH advised that some but not all QC elements had been completed. Phil advised that the project would be evaluated based on the package that was submitted for the 90% conformance meeting.

<b>2.0</b>	<b>Construction</b>	
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2.1	Construction provided comments in advance of the meeting which MH responded to with a memo and which are documented in the Drawing and Document comments below.	
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2.2	Construction requested that the package be resubmitted with more detail and including only the work that will be done under Contract #2000-0008.	
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**MH**

**MH**

ITEM	MINUTES	ACTION BY
2.3	Construction recommended that the Mississippi River approach fills, pre-loading and the detention pond east of the River not be constructed as part of Contract #2000-0008. (Note: Decision was subsequently changed.)	MH
2.4	Construction requested that the Agricultural Field Tile cutting, capping, realignment and removals be included in Contract #2000-0008. (Response: MH/AgroDrain to include.)	MH/AgroDrain
2.5	Construction would like to undertake an advance contract to install temporary culverts at the Mississippi Drain & Tributary crossings to avoid delays due to 'in-water' work restrictions. (Response: L.Tay to coordinate with C.McShane. MH to revise drawings if required.)	LT/CM/MH
2.6	Construction asked why there are no removal drawings. (Response: Contract removal drawings not included in project scope - working removals drawings will be available.)	MH
3.0	<b>Landscaping</b>  Sam Ng did not attend the meeting but provided comments in advance that (along with other comments) are addressed in Section 18 below. It was agreed that the Landscaping design would be tendered as a separate 'stand-alone' contract subsequent to the Mississippi River Bridge contract.	
4.0	<b>Structural</b>  Weiling Kong did not attend the meeting. Comments provided subsequent to the meeting are addressed below.	
5.0	<b>Traffic</b>  Traffic asked if Permanent Signage would be included in this project. L.Tay responded that it would be included in the assignment for the Reg. Rd. 20 interchange. Other comments are addressed below.	
6.0	<b>Environmental</b>  Various comments were provided by the Environmental Section which are addressed below. Environmental recommended that all affected topsoil be stripped so as to maximize reuse of this resource. It was decided not to adopt this recommendation.	

ITEM	MINUTES	ACTION BY
7.0	<b>Planning &amp; Design</b>  Various comments were provided by Planning & Design which are addressed below.	
8.0	<b>Geotechnical</b>  Various comments were provided by Golder who were representing the Geotechnical Section which are addressed below.	
9.0	<b>Foundations</b>  Foundations did not attend the meeting but comments were provided in advance by T. Sangiuliano for D. Dundas.	
9.1	Embankments at the Mississippi River structure are to be constructed employing lightweight fill material and wick drains. Have the embankment fills beyond the immediate approaches to the structure been designed according to the subsurface conditions? <b>(Response: Yes, in accordance with geotechnical/foundations recommendations provided.)</b>	
9.2	The lightweight fill embankment on the wick drain foundation shall be designed at the approaches to the Mississippi River. The limits of the design needs to be delineated. A NSSP specifying the material and placement of the expanded palletized blast furnace slag can be obtained from our office. Preloading and surcharging of the embankments shall be specified as required. <b>(Response: On November 30, 1999 MTO stated that the embankments would not be included in Contract #2000-0008. Subsequently, the decision was made to include this work in the contract.)</b>	MH

#### DRAWING & CONTRACT DOCUMENT REVIEW

10.0	<b>D-4</b>	
10.1	Proposed Work - List individual W.P.'s. Add contract #. Check length. Revise description to exclude landscaping. Add salaries & wages & construction estimate. Confirm Aggregate sources to be provided. <b>(Response: Will revise.)</b>	MH

**MH**

ITEM	MINUTES	ACTION BY
10.2	Sundry - The \$2,000.00 set-up under Services (4) for Contract Identification signs is not required. Add total potential bonus payments (e.g. concrete). <b>(Response: Will review/revise.)</b>	MH
10.3	Acquisition/Construction of Physical Assets - The Bell crossing is the WBL and EBL not just WBL as listed. <b>(Response: Will clarify text.)</b>	
	Acq./Con. of Physical Assets - Why are we paying for gating on Hanson Side Road? <b>(Response: Gating is close to Reg. Rd. 3 per request of West Carleton.)</b>	MH
	Acq./Con. of Physical Assets - Add clean-out of strawbale or rock flow checks at \$100/installation. <b>(Response: Will revise.)</b>	MH
11.0	<b>Tender for Contract</b>	
11.1	Items not in Contract #2000-0008 to be deleted. <b>(Response: These were provided for review purposes. Will delete Items 7 - 10, 13 - 19, 26, 31 - 35, 48 - 50.)</b>	MH
11.2	Item 4 - Earth Exc. Grading - What stripping depth was used? <b>(Response: 200 mm. Golder to confirm.)</b>	Golder
	Item 4 - Earth Exc. Grading - Have all slope flattening opportunities been explored? <b>(Response: Will review.)</b>	MH
11.3	Item 9 - DFC - Should this be HL1-Mod.? <b>(Response: Will review with QA for later contract.)</b>	MH/L.Tay
11.4	Item 31 - Recent Regional practice has been to use SBGR instead of 3CGR. If 3CGR is used, ensure there is space behind for deflection. <b>(Response: Will review. L.Tay to check current Regional policy.)</b>	MH
11.5	Items 35 - If eccentric loaders are used, ensure there is adequate space behind. Consider extruders & include SP 559S01 if used. <b>(Response: Will review.)</b>	MH
11.6	Item 37 - Topsoil - This should be a PQP item by the m2 not a measured item by m3. <b>(Response: This has been requested as a non-standard item.)</b>	MH

ITEM	MINUTES	ACTION BY
11.7	Item 38 - Seeding and Cover – This should be a PQP item by the m2. <b>(Response: This has been requested as a non-standard item.)</b>	MH
11.8	Items 44a, 44b, 48 & 48a - Non-Standard items required. Eliminate letters. Dollar value reqd. for 44a. Dwgs. reqd. for 48. <b>(Response: Items have been requested. Dollar value to be inserted by CPCS.)</b>	MH/CPCS
11.9	Items 49 & 50 - Q-sheets reqd. <b>(Response: Will provide.)</b>	MH
11.10	RAP is referenced in the typical but there is no item listed. <b>(Response: Will review for Bridge contract.)</b>	MH
11.11	Preservation, Protection & Reconstruction of Existing Utilities - Item - Consider inclusion. <b>(Response: Will review.)</b>	MH
11.12	OPSD's, SP's & OPSS's - Missing rev. #'s & dates. <b>(Response: CPS 'patch' not provided. Will resolve.)</b>	MH
11.13	MTOD's - Reference applicable MTOD's & include in drawings. <b>(Response: Will include.)</b>	MH
11.14	List of General SP's - Add 'M' to modified SP's (e.g. 102F02M); delete SP's for items to be removed from Contract #2000-0008 (103S21, 103F31, 103S33, 103F34, 105S12); 168S06 is N/A; and, add 100S07, 100S25, 100S29 & 101S18 per Regional practice. <b>(Response: Non-Contract #2000-0008 SP's were included for review purposes. Will revise.)</b>	MH
11.15	List of Item Specific SP's - Delete SP's for items to be removed from Contract #2000-0008 (i.e. SP's 305F01, 313F02, 313F11, 313F17, 313S23, 313S24, 313S25, 353S02, 406S02, 406S03, 407S06, 532S02, 552S01, 552S02, 555S01); and 212F01 & 904S10 are N/A. <b>(Response: Non-Contract #2000-0008 SP's were included for review purposes. Will revise.)</b>	MH
11.16	MTO Specs - 407 not referenced. <b>(Response: Reference to MTO 407 is included.)</b>	
11.17	Additional Documentation - No reference to Supplemental Specifications – 1992 or General Conditions. <b>(Response: Will add.)</b>	MH



ITEM	MINUTES	ACTION BY
12.0	<b>Standard Special Provisions - Fill-ins</b>	
12.1	Delete "Note to designer" notes and "Warrant" notes. Complete fill-ins. Delete Fill-in SP's for items to be removed from Contract #2000-0008 (i.e. SP's 103F31, 103F34, 305F01, 313F02, 313F11, 313F17). 212F02 is canceled. <b>(Response: Non-Contract #2000-0008 SP's were included for review purposes. Fill-ins were not to have been completed for asphalt SP's since they will likely change - other remaining fill-ins will be completed. Will delete SP's not in C. #2000-0008.)</b>	MH
12.2	SP 100F08M - Fill-in's not complete. Contact the Region of Ottawa-Carleton for traffic restrictions on Reg. Rds. 20 & 22. Modify SP to delete N/A portions. <b>(Response: Will follow-up/modify.)</b>	MH
12.3	SP 100F30 Release of holdback is missing. <b>(Response: Now addressed under SP 100F37 which is included.)</b>	
12.4	SP 100F36 - Is Feb 1999 the newest version? Is it going to change shortly? <b>(Response: Will review.)</b>	MH
12.5	SP 102F02M - Borehole, soils profile data, field tile drain drawings should be included in contract. <b>(Response: Inclusion of these were not part of MH's scope of work. Will review with L. Tay)</b>	MH/LT
12.6	SP 110F10 - Generally not being used in Eastern Region. <b>(Response: Will review.)</b>	MH/DM
12.7	SP 110F13 - Has this been updated? <b>(Response: Will review.)</b>	MH
12.8	SP 110F14 - Confirm aggregate lists to be provided & modify. <b>(Response: Granular &amp; concrete aggregate sources lists will be provided. Will revise.)</b>	MH
12.9	SP 199F31 - Are there additional obligations on the Contractor w.r.t. the DFO C of A? Should have written agreement in principle on Authorization from DFO to obtain sign-off at Executive Review. <b>(Response: Will review with Environmental.)</b>	MH/DM
12.10	SP 199F06 - Clarify wording to ensure entire trees salvaged. Add topsoil berms for later landscaping contract. <b>(Response: Will revise.)</b>	MH

ITEM	MINUTES	ACTION BY
12.11	SP 201F01 - Complete fill-in. <b>(Response: Three properties are affected. Will revise.)</b>	MH
12.12	SP 543F01 - Confirm choice of sign wording. <b>(Response: Will review with District/Traffic.)</b>	MH
13.0	<b>Non-Standard Special Provisions</b>	
13.1	Many Special Provisions are missing. The list includes: Conflict GC, CVOR, Certificate of Conformance, ChangeSp., Progree.Pay, QCP-COMP Sp., Issue Resolution Sp., OPSS 206, 314, 501 SP's, MIN-FREQ Sp & Traffic Control Plan. <b>(Response: All of the above former NSSP's are now addressed under standard SP's: 100S13, 100S35, 100F36, 199S42, 100S12, 599S20, 100S05, 102S08, 103S36, 105S10, 103S37 and 543S02, respectively - all of which are included.)</b>	
13.2	All ERS SP's. missing. <b>(Response: Standard ERS SP's are included. Will add ERS NSSP's ERS-STR.905, .919, &amp; AIRVOID.353 (bridge contract) &amp; .904. Will add RAT-BID NSSP.)</b>	MH
13.3	Request inclusion of a completion date incentive/disincentive SP similar to Contract 98-74 given intention to commence bridge contract in Fall 2000. <b>(Response: Will prepare.)</b>	MH
13.4	Information to Bidders - Change Proposals - Suggest add concrete box culvert design & type of other culverts (concrete) to exclusions. <b>(Response: Will revise.)</b>	MH
13.5	Operational Constraint - Construction Access - Suggest modifications. <b>(Response: Will revise.)</b>	MH
13.6	Operational Constraint - Agricultural Field Tile Drains - Review need for/wording since Tile Drain work to be included in contract. <b>(Response: Will review.)</b>	MH
13.7	Operational Constraints - Discovery of Fossils SP is missing. <b>(Response: Considered N/A since no rock identified on project. Will add as contingency.)</b>	MH
	Operational Constraints - Crossing of Existing Hwy. 17 SP is missing. <b>(Response: Considered N/A since construction</b>	

ITEM	MINUTES	ACTION BY
	is on new alignment. Will include/modify as contingency.)	MH
13.8	Erosion and Sedimentation Control - Remove Table M. Time interval for cover after the earth is disturbed is 45 days. (Response: Will leave 'as is' per Environmental Section's input.)	
13.9	Watercourse/Fisheries Protection - General - Can 'in water' timing restrictions (15 June to 15 March) be relaxed? (Response: Will review with MNR/DFO.)	MH/DM
13.10	Watercourse/Fisheries Protection During Work in Watercourses & On Watercourse Banks - Suggest delete culvert length; add Tributary culvert size; and, review dates. (Response: Will review/revise.)	MH/DM
13.11	Watercourse/Fisheries Protection During Watercourse Relocation - Suggest review need for. (Response: Will review.)	MH
13.12	SP should be added to detail the requirement for flushing/cleaning/sweeping of the side roads at the construction access points to Hwy. 417 on a daily basis by the contractor. (Response: Will include.)	MH
13.13	No item numbers associated with Item Specific SP's. (Response: Will add.)	MH
13.14	Delete SP's for items/work not in Contract #2000-0008 (1800 mm x 900 mm Precast Concrete Box Culvert, Geotextile, Pavement Markings, Traffic Control Signing (related to snowmobile crossing to go in bridge contract), Extended Detention Outlet Device. (Response: Will delete.)	MH
13.15	Grubbing - Item 3- Should have an SP for shredding of stumps. (Response: Will add an NSSP.)	MH
13.16	Topsoil From Stockpiles - Item - Include other special depth areas (e.g. berm). (Response: Will review.)	MH
13.17	Erosion Control Blanket - Item - An NSSP is required to specify that the product selected from the DSM List must be acceptable for 'Permanent Installation'. (Response: Will add an NSSP.)	MH

ITEM	MINUTES	ACTION BY
13.18	Removal of Tile Drain - Item - Review wording given changes to work. <b>(Response: Will review/revise.)</b>	MH
13.19	Concrete in Culverts- Item - Add Pit Run Cobble to list of work paid under this item for Culvert #2. <b>(Response: Will revise.)</b>	MH
13.20	Review NSSP requirements related to sub-excavation of material at Tributary. Will dewatering be a concern? <b>(Response: Will review.)</b>	MH
14.0	<b>Grading Drawings</b>	
14.1	Cover - Missing names of ADM and Director. <b>(Response: Will revise.)</b>	MH
14.2	Title Sheet - Names of ADM and Director missing; Township & County not shown; project length and description to be revised; show existing roads; show future construction as dashed; note scale as NTS. <b>(Response: Will revise.)</b>	MH
	L. Tay to confirm reqt. for 1 vs. 2 P.Eng. stamps on Title Sheet.	L.Tay
14.3	Sheet 6 - Revise culvert location & show utilities crossing. <b>(Response: Will revise.)</b>	MH
14.4	Sheet 8 - What is happening with the run-off EBL @ 15+340 Rt.? <b>(Response: Ditch drainage outlets to an existing swale.)</b> Is there a culvert at approx. Sta. 15+390 WBL? <b>(Response: A culvert is not reqd.)</b> Is there a need for ditch protection in this area? <b>(Response: Will review.)</b>	MH
14.5	Sheet 9 - Is there enough property to construct culvert # 2 on the north-side? <b>(Response: Culvert # 2 can be constructed within 35 m offset from WBL centreline to limit of RoW. ETR Sheet shows incorrect property. Will revise ETR Sheet.)</b>	MH
	Sheet 9 - Show the TLI on plan @ Sta. 16+257. <b>(Response: Will revise once limits are confirmed &amp;/or decision to purchase confirmed with Property)</b>	MH/LT

ITEM	MINUTES	ACTION BY
	Sheet 9 - Clarify presentation of existing/new stream channels; add detail at confluence with stream crossings (erosion protection?). Heavy-duty sediment barrier across MMD not recommended. More detail suggested for new channel of Tributary. High fills adjacent to major ditch sections may warrant the installation of silt fence at toe of slope. <b>(Response: Will review/revise.)</b>	MH
	Sheet 9 - MH noted potential concern with regard to cattle movement through the box culvert. It was decided that District Maintenance would address subsequent to construction if a problem arose.	
14.6	Sheet 10 - Bell Crossing on Sheet # 10 should be clearly marked. <b>(Response: Bell to be relocated by others prior to construction. Will revise to show proposed location as 'as built' &amp; mark clearly.)</b>	MH
	Sheet 10 - Similar Environmental comments as per Sheet 9. <b>(Response: Will review/revise.)</b>	MH
14.7	Sheet 11 - Do we have the property to build the cattle access on sheet # 11? <b>(Response: Easement has been acquired for access to river and will be fenced.)</b>	
	Sheet 11 - OPSD 911.011 on the WBL leaving end is not required. What type of guiderail connection will be used at the structure. <b>(Response: Will review/revise.)</b>	MH
	Sheet 11 - Suggest review limits of grading @ west abutments. Revise grading limits to 17+730 WBL & 17+730 EBL for Contract #2000-0008 and extend ditching as required if embankments eliminated. Request more detail on ditch approach to River bank. Why fence installation parallel to River? Suggest review extent of Rip Rap in median ditch approach to River. <b>(Response: Will review/revise.)</b>	MH
	Sheet 11 - Sheet 12 - OPSD 911.011 on EBL leaving end not required. Show guiderail connection at the structure. Flow arrows for culvert 6 and 7 needed. <b>(Response: Sheet will be removed from Contract #2000-0008. Will review/revise for later contract.)</b>	MH

**MH**

ITEM	MINUTES	ACTION BY
14.8	Sheet 12 - Review limits of grading in vicinity of east structure abutments. Revise grading limits to 18+700 (based on 18+430 WBL & 18+380 EBL lightweight fill limits) for Contract #2000-0008 and extend ditching as required if embankments eliminated. Review location of heavy duty sediment barrier west of pier #5 and farm fence east of pier #5. <b>(Response: Will review/revise.)</b>	MH
	Sheet 12 - Review culvert 5 need. <b>(Response: Will review/revise.)</b>	MH
14.9	Sheet 13 - Culvert 8 & 9 - Which way is the drainage flowing? <b>(Response: Will add flow direction arrows)</b>	MH
	Sheet 13 - Suggest replace all SBFC with RFC. <b>(Response: Will review/revise.)</b>	MH
14.10	Sheet 14 - Is noise berm a road hazard? Show berm quantity & materials in q-sheets. How does the water drain 20+100 - 20+400 Hwy 417 EBL Lt. Ditch? <b>(Response: Revised non-standard X/S shows berm beyond clear zone but within 0.5 m of R.o.W. Berm to be constructed of surplus unsuitable material at required slopes to attain minimum height. Erosion control blanket to be used to stabilize side slopes. Culvert required to drain left ditch to median. Quantity will be labeled.)</b>	MH
	Sheet 14 - Suggest show height of noise berm 1.5m as a minimum. Should consider building as high as space allows. Add silt fence along property line. The EBL appears to be the higher of the two - Why is the height of the berm set to the WBL? <b>(Response: Will revise.)</b>	MH
	Sheet 14 - Check shoulder/rounding dimensions vs. Sheet 15. Show shoulder detail @ Sta. 19+939. <b>(Response: Will review/revise.)</b>	MH
14.11	Sheet 15 - Sta. 20+440 WBL and Sta. 20+432 EBL backslopes very close to R.o.W. Show Limit of Grading on ramps. <b>(Response: Will review/revise.)</b>	MH
14.12	Sheet 16 - Clarify dimensions on EBL/WBL; linework at east limit of EBL; &, add note w.r.t. extension of interchange fencing. <b>(Response: Will review/revise.)</b>	MH

ITEM	MINUTES	ACTION BY
14.13	Sheet 17 - Suggest revise EBL Limit of Contract to Sta. 20+870. Is clearing included. Review need for ditching & include quantities. <b>(Response: Will review/revise.)</b>	MH
14.14	Sheets 18 to 30 - Change Top of Gran. 'A' to 'O'. <b>(Response: Will revise.)</b>	MH
14.15	Sheet 19 - Delete "PROFILE TOP OF SUBGRADE" on the EBL profile. <b>(Response: Will delete.)</b>	MH
14.16	Sheets 20 & 21 - MH advised that excavation for removal of organic material is to be added. Excavation quantity will be included in Item #4. Golder read recommendation from Foundations Report. MH noted that estimated quantity for Gran. B backfill will be to establish a working platform and not to original ground.	MH
14.17	Sheet 21 - Clearly label Bell crossing & show depth. <b>(Will revise to show proposed location as 'as built' &amp; mark clearly.)</b>	MH
14.18	Sheets 22 & 23 - Change limits of embankments for Contract #2000-0008 to Sta. 17+730. <b>(Response: Will revise.)</b>	MH
14.19	Sheets 24 & 25 - Remove from Contract #2000-0008. For subsequent work review need for sub-drain along sewers & item for 'Breaking Into MH's, C.B.'s. <b>(Response: Will delete sheets &amp; review additional work for later contract.)</b>	MH
14.20	Sheet 26 - Change limit of embankments for Contract #2000-0008 to Sta. 18+700. Review locations of culverts 8 & 9. <b>(Response: Will revise.)</b>	MH
14.21	Sheet 27 - O.g. is not labeled. <b>(Response: Will label.)</b>	MH
14.22	Sheet 30 - Suggest revise EBL Limit of Contract to Sta. 20+870. <b>(Response: Will revise.)</b>	MH
14.23	Sheet 31 - Revise Note 1. No pavement details needed. The typical for the high fills indicate 1:1 slopes for the earth borrow. Is this a standard? <b>(Response: Will revise Note 1. Although the 1:1 slopes for high fills are not standard, the Pavement Design Report requires a 1:1 core of Earth Borrow material.)</b>	MH

ITEM	MINUTES	ACTION BY
	Sheet 31 - Change 1.00 SHLD to 1.00 PAVED SHLD. Label left side ditch "Earth Cut" on typical for "Tangent section Hwy 417 Low Fill sub-excavation". Show stripping on all typicals. Clarify note in bottom typical w.r.t. 'surplus or unsuitable material or earth fill'. <b>(Response: Will revise/clarify.)</b>	MH
	Sheets 31 to 33 - Clarify that work in Contract #2000-0008 does not include asphalt or shouldering. <b>(Response: Will clarify typical cross-sections.)</b>	MH
14.24	Sheet 32 - Is fill lightweight fill or earth borrow? What type of lightweight fill is being considered? "Air Cooled" blast furnace slag likely not acceptable since it is below the subgrade. Typical indicates a note 7 but none detailed. Label 1.0 m pvd. shoulder. <b>(Response: This typical will be removed from Contract #2000-0008. Blast furnace slag has been recommended. Note 7 should read Note 6. Will label pvd. shoulder.)</b>	MH
14.25	Sheet 33 - Typical indicates a note 7 but none detailed. Revise median dimension. <b>(Response: Note 7 should read Note 2. Will revise median dimension.)</b>	MH
14.26	Sheet 34 - Same comments as for Sheet 12. What is involved in snowmobile crossing? <b>(Response: Sheet will be removed from Contract #2000-0008. Will review/revise for later contract. Once W.C. Snowmobile Association's route relocation plans are confirmed, access will be provided under either west or east side of bridges.)</b>	MH
14.27	Sheet 35 - Is grate to be provided in Extended Detention Outlet Structure 1200mm x 1200mm ditch inlet? Is geotextile required under rip rap? What types of geotextile? Check Stas. given in Note 1. <b>(Response: Will review/revise.)</b>	MH
14.28	Sheet 36 - Review rock flow details vs. OPSD's. <b>(Response: Will review/revise.)</b>	MH
14.29	Sheet 41 - MTO usually does not provide a construction staging plan but rather requires the contractor to develop one and submit for review prior to activity. <b>(Response: Will delete.)</b>	MH



ITEM	MINUTES	ACTION BY
15.0	<b>Natural Channel Design Drawings</b>	
15.1	Sheet 37 - Reference to "Proposed" should be deleted. Reference to "Straw Erosion Control Mattress" should be replaced with "Erosion Control Blanket". Suggest that the species name be used to identify "pussy willow" or "sandbar willow". Where along the banks should the rows of willows be placed? (Reference to the downstream end of the culvert should be included.) Suggest show the erosion control blanket on the typical for the soil bioengineering. Recommend that the "Construction Procedures" section be carefully compared with the relevant environmental NSSP's so as to avoid conflicts. <b>(Response: Will review/revise.)</b>	MH
15.2	Sheet 39 - Why is there a separate Q-Sheet? Sheet refers to 15 "Flow Breakers" while Sheet 41A specifies 18. <b>(Response: Quantity details are also provided in the Q-Sheets but are shown here for reference. Will check 'Flow Breaker' quantities.)</b>	MH
16.0	<b>Structural Drawings</b>	
16.1	Sheet 41A - Eliminate 'A' sheet numbers for final submission. <b>(Response: Will revise.)</b>	MH
	Sheet 41A - Where is pit run material in Note 5 to be placed? Note 6 requires the boulders to be placed on top of pit run, but the cobbles only extend 30m from each end. Does this mean that the boulders are only in the 30m end sections or does it mean that each boulder has its own pad of cobble? <b>(Response: Cobble is inside the culvert &amp; boulders on top of pit run or bottom of culvert. Will clarify Notes 5 &amp; 6.)</b>	MH
	Sheet 41A - Do the expansion joints in the large culvert mean that pre-cast culverts can't be used? If so, then SP 109S31 should be deleted. <b>(Response: Agreed.)</b>	MH
	Sheet 41A - Heavy duty sediment barrier should not be placed across the watercourse as shown on the plan view. Consider Erosion Control Blanket on cut area slopes at upstream end of culvert. Extend rip rap along north side ditch. <b>(Response: Will review/revise.)</b>	MH
	Sheet 41A - Are different lengths of cut-off walls on downstream end of culvert required? <b>(Response: Extra 5 m of property allows equivalent lengths. Will revise.)</b>	MH

ITEM	MINUTES	ACTION BY
	Sheet 41A - Note 2 should not refer to approval by the 'Engineer'. An NSSP should require the Contractor to provide their own Foundations Quality Verification Engineer. <b>(Response: Will revise note and prepare NSSP.)</b>	MH
	Sheet 41A - What is Rip Rap elevation in relation to culvert inverts? <b>(Response: Will extend pit run cobble to limit of Rip Rap.)</b>	MH
	Sheets 41A & 42 - Various clarifications were requested which have been addressed.	
	Sheets 41A & 42 - Concern noted w.r.t. waterproofing of expansion joints. <b>(Response: Will add membrane along top and sides of culvert.)</b>	MH
	Sheets 41A & 42 - Two P.Eng. are to be shown. <b>(Response: Will add stamps.)</b>	MH
16.2	Sheet 42 - Revise wing wall lengths in typical section. <b>(Response: Will review.)</b>	MH
17.0	<b>Quantity Sheets</b>	
17.1	General - Ensure that items are in order & quantities properly totaled on form of tender. <b>(Response: Will review.)</b>	MH
17.2	On Sheet 44, 45, 46, 47 & 48 the column titled "Earth Required" should be changed to Slope Flattening Required using Unsuitable Earth. Minor quantity discrepancies to be corrected. <b>(Response: All "Earth Required" is used outside the 1:1 core of "Earth Borrow" and not just for slope flattening. Will revise.)</b>	MH
17.3	Sheet 45 - Quantities not provided for Noise Berm. <b>(Response: Will revise.)</b>	MH
17.4	Sheets 46 & 48 - Hwy 417 WBL & EBL - The cut stripping and fill stripping not included in HDS is detailed in one breakdown for 6.0 km which is unacceptable. <b>(Response: Agree - The HDS run did not correctly identify Stripping. This is being corrected and upon completion the Q-Sheet will be corrected. An estimate of the correct quantity was made and shown for the purpose of Topsoil and Earth Excavation quantity calculation.)</b>	MH

ITEM	MINUTES	ACTION BY
17.5	Sheet 48 - Municipal Drain Diversion - Earth Available (unsuitable) should be 10,000 not 0. Totals at bottom of Page: Earth Available (unsuitable) should be 131,001 not 121,002. Total Stripping should be 57330 not 53967. Stripping available should be 45864 not 43174. Stripping balance should be 32202 not 29515. <b>(Response: Will review/revise.)</b>	MH
17.6	Sheets 49 to 51 - Ramps are not shown. Are they included in roadway? Should they be separated? Granular 'M' should read Granular 'O'. <b>(Response: Will review/revise.)</b>	MH
17.7	Sheets 52 to 54 - Ramps & paved shoulders not shown. Are they included in roadway? Should they be separated? <b>(Response: These Q-sheets will be removed from Contract #2000-0008 but will be reviewed/revised for later contract.)</b>	MH
17.8	Sheet 56 - The quantity for the 500 mm pipe sewers from # 13-15 of 100 metres should be entered on the line below. <b>(Response: Agreed)</b>	MH
17.9	Sheet 58 - Why is work for maintenance holes/outlets/ grating, etc. detailed as both LS/EA. Is this work paid under the MH items? <b>(Response: The Outlet Device is a separate Item (# 48a) the others are included with other items. This will be revised to show the Outlet Device Item #.)</b>	MH
17.10	Sheet 59 - Culverts on Hwy 417 should be all concrete due to the depth of the fills. Change Proposal SP should note no change to the concrete culverts. <b>(Response: Subsequent to further review it was agreed to change the 2 remaining pipe culvert items to rigid (concrete) pipe.)</b>	MH/LT
17.11	Sheet 67 - Should we have a Granular Sealing item for 3 cable guiderail? <b>(Response: Granular Sealing quantities are shown on Sheet 69.)</b>	MH
17.12	Sheets 70 and 78 - Sheet 70 calls Item 38a "Straw Erosion Control Blanket" with a quantity of 1840 m2. The Tender item calls Item 38a "Seeding and Erosion Control Blanket". Sheet 78 lists "Seeding and Erosion Control Blanket" with a quantity of 1840 m2 with no item number? <b>(Response: This will be corrected to show Seeding and Erosion Control Blanket as the Item on Sheet 70.)</b>	MH

ITEM	MINUTES	ACTION BY
17.13	Sheet 75 – Topsoil should be a PQP item by the m2. (Response: Non-standard item requested.)	MH
17.14	Sheet 77 – Don't need item # 26. (Response: Agreed)	MH
17.15	Sheet 79 - The quantity for reinforcing steel should be shown as 100% rather providing a tonnage. Check totals on Q-sheets vs. totals in tender. (Response: Will review/revise.)	MH
18.0	<b>Landscaping Package</b>  <b>Head Office Landscaping Comment:</b> The cover sheet shows the work as a stand-alone landscape contract. This is not consistent with the original assignment of including landscape planting items in the grading contract.  <b>District/Construction Comment:</b> This work should be a separate contract after the Mississippi Structure Contract is completed. Due to the amount of plantings and landscape work around the Structure approaches and the drainage detention pond the landscaping work would be damaged by work that is required with the structure.  <b>It was agreed that the Landscaping design would be tendered as a separate 'stand-alone' contract subsequent to the Mississippi River Bridge contract.</b>	
18.1	Package is incomplete and not up to MTO Standards. No NSSP's were provided. (Will provide for review as part of finalization of stand-alone landscaping contract.)	MH/Heartland
18.2	Title Sheet - The chainage is run in the easterly direction. The project location should be identified as from Regional Road 22 easterly to Regional Road 20. Details required. (Response: Will review/revise.)	MH/Heartland
18.3	Sheet L-1 - S.Ng.: All the deciduous material has been specified bare root (only coniferous plant material is container grown). This means the bulk of the planting will have to conform to the spring planting time constraints (frost-free to June 7). If these bare root landscape planting items are included as part of the overall grading contract, this operational constraint may have an impact on the substantial completion date of the grading contract. If this is indeed a concern, I have no problem with having the landscape planting items separated out as a follow-up contract.	

ITEM	MINUTES	ACTION BY
	Sheet L-1 - Totals need to be filled-in and graphic symbols added. (Response: Will revise.)	MH/Heartland
18.4	Sheet L-2 -Planting Details - Has the depth of mulch (75mm) been reviewed with Sam Ng or Nick Close? (Response: Will review.)	MH/Heartland
18.5	Sheet L-4 - The Straw Bale Bio-filter detailed here is not shown on the landscape plans. The only indication is on the preliminary Quantities Sheet which shows 120 of these Bio-filter units, from Sta. 17+300 - Sta. 18+000 Rt. Please note this particular item (minus the planting) should be included in the grading contract regardless, because of the earth work involved. Clarify Rip Rap/Rock Protection note. Detail bio-filter dimensions, sub-drain outlet material including geotextile, topsoil & 'pit run' granular type on sectional view. Without an NSSP, the unit of measurement for, and basis of payment are also unknown at this time. Will need to review/approve NSSP prior to approval of non-standard item. (Response: Will review/revise.)	MH/Heartland
18.6	Sheet L-5 - The work is not Construction as indicated in the title block. The "Limit of Landscape Contract" as shown is applicable only if this is a stand-alone landscape contract. Hwy 417 is an east-west oriented highway. The left side of the right-of-way should be referred to as the North side or WB, and the right side as the South side or EB. (Response: Will review/revise.)	MH/Heartland
	Sheet L-5 - Review sight lines & clear zone requirements - especially for median plantings. (Response: Will review/revise.)	MH/Heartland
18.7	Sheet L-6 - Some of the proposed planting is in the ditch. (Response: Will review/revise.)	MH/Heartland
18.8	Sheet L-16 - Need to review implications of lightweight fill (slag), high water levels in detention pond & maintenance concerns. (Response: Will review/revise.)	MH/Heartland
18.9	Sheets L5 to L16 - All work is hand-drawn and hard to read. Pages don't have a symbol index. All planting areas are hand-drawn and you can't distinguish one type of plant from the other. Plant quantities on each page are hand written. Should be typed in a labeled chart. Overall the quality of drawings (Sheets L5 -L16) are poor.	

ITEM	MINUTES	ACTION BY
	Handwork should be changed. <b>(Response: Drawing format was as requested by MTO in accordance with previous submissions. L.Tay/D.McAvoy to review format &amp; confirm direction to MH/Heartland.)</b>	MTO
18.10	Quantities - Quantities should be been done with Standard "Quantities - Miscellaneous 1" sheets. <b>(Response: Will revise.)</b>	MH/Heartland
18.11	Preliminary Quantities Sheet - Item 1 - Traffic Control does not apply if planting is included in grading contract. It won't apply even if the work is a follow-up landscape contract as the follow-up landscape work would be completed before the adjacent interchanges. <b>It was agreed to keep item as a contingency.</b>	
18.12	Preliminary Quantities Sheet - Item 2 - S. Ng.:The supply of topsoil is normally included in bed prep, trees and shrubs planting items. <b>D. McAvoy:</b> Planting testing for impacts of atrazine or other chemicals that may exist in the native topsoil will be coordinated by MTO if required. <b>(Response: Heartland to provide landscaping topsoil requirements to MH for consideration in placement of surplus topsoil berms.)</b>	MH/Heartland
18.13	Preliminary Quantities Sheet - Item 3 - There are no reforestation beds on the landscape plans. <b>(Response: Will review/revise.)</b>	MH/Heartland
18.14	Preliminary Quantities Sheet - Item 6 - Is this item PQP? <b>(Response: Yes will make PQP.)</b>	MH/Heartland
18.15	Preliminary Quantities Sheet - Item 17 - There are no Coniferous Trees, 2.0 m height on the plans. <b>(Response: Will review/revise.)</b>	MH/Heartland
18.16	Preliminary Quantities Sheet - Item 18 - Without an NSSP, the unit of measurement for, and basis of payment are also unknown at this time. Will need to review/approve NSSP prior to approval of non-standard item. <b>(Response: Will prepare NSSP &amp; submit.)</b>	MH/Heartland

ITEM

MINUTES

ACTION BY

**DECEMBER 8, 1999 PACKAGE RESUBMISSION**

**COMMENTS (provided by Mike deLugt (P&D), Chris McShane (Construction), Ken Polson (District Construction/Maintenance), Louis Tay (P&D), Barry Letang (Q/A Soils)**

- |       |  |        |
|-------|--|--------|
| 19.0  | D-4 & Tender for Contract  |        |
| 19.1  | D-4 - Remove 'tile drains' from project description & review salaries & wages. (Response: Will review/revise.)   | MH/MTO |
| 19.2  | Item 5 - What is the SP against this item. (Response: SP canceled. Will delete SP reference.)  | MH     |
| 19.3  | Item 12 - 1800 mm x 900 mm Precast Concrete Box Culvert For Culverts 8 & 9, Gran. B - Type I bedding & backfill should be paid under the item. There is no item for Gran. B - Type I. (Response: Will revise.) | MH     |
| 19.4  | Items 13a, 23a, 23b, 23c should be given individual item numbers. (Response: Will revise.)   | MH     |
| 19.5  | Item 15 - Why is there a separate item for geotextile? (Response: Separate item required for geotextile at Cattle Access path.)  | MH     |
| 19.6  | Item 24 - Should Heavy Duty Sediment Barrier be called Silt Fence Barrier in the first place? (Response: NSSP specifies Silt Fence Barrier.)   |        |
| 19.7  | Item 25 - Straw Bale Flow Checks - NSSP required for payment (70% installation, 30% removal if required by CA.) (Response: Will include.)  | MH     |
| 19.8  | Item 29 Quality Control Plan Compliance - Need to insert the dollar value for this item. (Response: CPCS to insert.)   | MH     |
| 19.9  | Are any MTOD's required. (Response: No.)   |        |
| 19.10 | Is SP 109S312 allowing pre-cast culvert substitution for cast-in place culvert required? (Response: No. Do not want to use pre-cast culverts given performance concerns.)                                      |        |
| 19.11 | Included SP's - Add 100S07, 100S25, 100S29 & 101S18. Delete 110F10. (Response: Will review/revise.)  | MH     |
| 19.12 | Does former SP QCP-COMP now have a number instead? (Response: SP now addressed under 599S20)   |        |

ITEM	MINUTES	ACTION BY
20.0	<b>Standard and Non-Standard Special Provisions</b>	
20.1	General Comment - Delete revision dates from modified SP's. Also, delete references to OPSS dates. (Response: Will revise.)	MH
20.2	SP 100F08M - Crossing Hwy. 17 - Although SP was included, the contract has no time restrictions on when this may occur. This should be added to 100F08M Protection of Public Traffic. (Response: Will add per Contract 98-74.)	MH
20.3	SP 102F02M - Remove borehole data. Add full size tile drain design & removal drawings. (Response: Will revise.)	MH
20.4	SP 199F06 - Clarify that entire intact trees are to be salvaged. (Response: Will revise.)	MH
20.5	SP 543F01M - Insert missing section. Contact MTO - District (J. Blaikie) with regard to inclusion of Contract Information signs. (Response: Will revise. Subsequently it was agreed to leave out the Contract Info signs)	MH
20.6	SP 572S01M - Update item numbers & clarify Measurement for Payment section. (Response: Will revise.)	MH
20.7	On the SP Information to Bidders, Change Proposal need to insert the culvert #'s. 1, 3, 4 & 10. P&D also requested that median width, lane & shoulder widths be added to exclusions. (Response: Will revise.)	MH
20.8	Need to rewrite operational constraint SP for construction access to cover off all areas of 20 and 22. An example maybe " All areas of Regional Roads 20 and 22 affected by construction accesses shall be flushed, ... etc." (Response: Will review/revise.)	MH
20.9	Utilities Operational Constraint SP - Revise stations to agree with D-4. (Response: Will review/revise.)	MH
20.10	Crossing Existing Hwy. 17 SP - Revise wording. (Response: Will review/revise.)	MH
20.11	Environmental Operational Constraints - Revise timing restrictions to read: Between June 1 and March 15 only. (Response: Will revise.)	MH



ITEM	MINUTES	ACTION BY
20.12	Highway Fence SP - Add length of fence requiring barbed wire. <b>(Response: Will revise.)</b>	MH
20.13	Live Willow Stakes/Cuttings SP - Revise Measurement for Payment. <b>(Response: Will revise.)</b>	MH
20.14	SP's for Topsoil from Stockpiles, Heavy Duty Sediment Barriers and Earth Excavation for Structures should include 1. Scope, 2. Measurement of Payment and 3. Basis of Payment. Also clarify wording. <b>(Response: Will review/revise.)</b>	MH
20.15	Temporary Rock Flow Checks SP - Payment under the item reads that the cost includes maintenance (25%) and 15% for removal. Acquisition/Construction of Physical Assets shows clean out of rock flow checks and straw bale flow checks paid for at \$100.00 unit price for removal. Also clarify Payment section. <b>(Response: Will review.)</b>	MH
20.16	Concrete in Culverts SP - Revise wording & include Measurement for Payment. MH noted that the SP would be expanded & forwarded to MTO for review based on comments from MTO Structures related to joint waterproofing requirements. <b>(Response: Will revise/resubmit.)</b>	MH
21.0	<b>Contract Drawings</b>	
21.1	MTO confirmed their intention to undertake an advance contract for the placement of temporary culverts at the Municipal Drain & Tributary pending approval of project funding. If the work proceeds, an Addendum can be issued detailing the existing conditions & requirement for removal of the temporary culverts as part of Contract #2000-0008.	
21.2	Title Sheet - Revisions still required per Nov. 30 comments. <b>(Response: Will revise.)</b>	MH
21.3	Sheets 7 & 15 - Review berm locations. <b>(Response: Will review/revise.)</b>	MH
21.4	Sheet 7 - Change note to read " Work under this contract includes work up to profile grade and does not include paving and granular shoulders. <b>(Response: Will revise.)</b>	MH
21.5	Sheet 11 - Do we have property clearance for Cattle Access (T.L.I.)? <b>(Response: L. Tay to confirm.)</b>	MTO/L.Tay

ITEM	MINUTES	ACTION BY
21.6	Sheet 14 - New culvert should be labeled # 10. (Response: Will revise.)	MH
21.7	Sheet 17 to 27 - Make WBL & EBL labels bolder. (Response: Will revise.)	MH
21.8	Sheet 28 - Typical should not reference paved shoulders or pps. (Response: Will revise.)	MH
21.9	MTO requested MH to add borehole & augerhole data to drawings. (Response: Will include.)	MH
22.0	<b>Quantity Sheets</b>	
22.1	Stockpiling of materials for future uses by the MTO - The SP indicates that two stockpiles are to be built from the salvaged material but quantities are not given for each location. Breakdowns indicate there is no excess topsoil. On Sheet # 48 the total stripping is 53967. The stripping available is now calculated using only 50% instead of 80% previously. Once the required topsoil material is removed, the balance is only 8466, but this balance is detailed on the top of the sheet as material available for slope flattening. Where is the material for the stockpiles? (Response: The quantities for the Topsoil stockpiles are currently included in the Stripping Required. MH will break them out and show them on the final GRADING quantity sheet. To clarify the stripping for slope flattening, will relabel it as "Surplus stripping available for slope flattening." Will revise stripping available to 80% since there is very little clearing and grubbing and much of the area is either pasture or cultivated fields.)	MH
22.2	What was the depth of topsoil used after Golder reviewed the depths? (Response: 200 mm.)	
22.3	Sheet 49 -51 Gran M should read Gran O. (Response: Will revise.)	MH
22.4	Sheet 52 - Delete reference to property owner. (Response: Will revise.)	MH
22.5	Sheet 57 - Item 14 - Rip Rap - Sheet 57 indicates that Class I geotextile will be used. Class II is required under OPSS 511. F.O.S. not specified on Q-sheet. (Response: Will revise.)	MH

ITEM	MINUTES	ACTION BY
22.6	On Sheet 62 Removal of tile drain, there is no item # listed. Should also be labeled PQP. <b>(Response: Will revise.)</b>	MH
22.7	On Sheet # 62, 63, and 64 Topsoil from Stockpiles should be listed as m2 not m3. Should also be labeled PQP. <b>(Response: Will revise.)</b>	MH
22.8	On Sheet # 62 - 64 the seeding and cover item should be labeled PQP. <b>(Response: Will revise.)</b>	MH
22.9	On sheet # 65 Item # 23c should be labeled PQP. <b>(Response: Will revise.)</b>	MH

Minutes Prepared by Morrison Hershfield. Please advise A. Harkness of any errors or omissions at (613) 739-2910 Ext. 258 / fax: 739-4926 / e-mail: [aharknes@mhgroup.ca](mailto:aharknes@mhgroup.ca).

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February 8, 2000

**TO:** E.C. Lane  
Head, Structural Section  
Eastern Region  
Kingston  
Attention: S.N. Chen

**DATE:** May 29, 1995

**FROM:** Geotechnical Section  
Eastern Region

(613) 545-4859

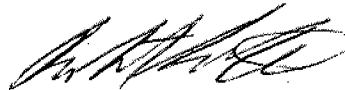
**RE:** W.P. 127-92-00, Highway 417 (New Facility)  
Foundation Investigation Report

---

Per your request (meeting May 25, 1994) attached are four (4) copies of the final Golder Report for the above project.

The Draft Report was circulated to Planning and Design, Construction, Structural and Foundation Design sections in March of 1995. Comments were reviewed and incorporated in this report where applicable.

By way of this memorandum we are also forwarding two copies of the report to Construction, Foundations and Planning and Design.

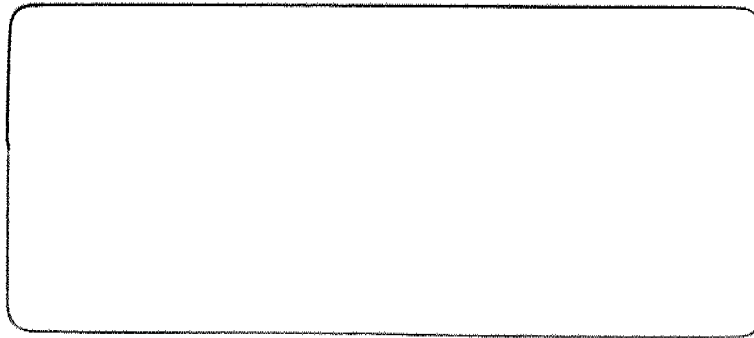


R. Scott  
Soils Unit Supervisor

**Copy:** D. Kimmett  
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GEOCRES No 31F-118

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*GEOCRES No 31F-118*

**FOUNDATION INVESTIGATION REPORT  
PROPOSED CULVERT AND HIGH EMBANKMENTS  
W.P. 127-92-00, HIGHWAY 417(NEW FACILITY)  
FROM REGIONAL ROAD 20 TO 22  
TOWNSHIP OF WEST CARLETON,  
DISTRICT 9, OTTAWA**

Submitted to:

**Ministry of Transportation  
Eastern Region  
355 Counter Street  
Kingston, Ontario  
K7L 5A3**

**Distribution:**

12 copies - Ministry of Transportation  
2 copies - Golder Associates Ltd.

**May, 1995**

**941-8059**

# **FOUNDATION INVESTIGATION REPORT PROPOSED CULVERT AND HIGH EMBANKMENTS**

## **EASTERN REGION**

**W.P. 127-92-00 HWY. 417 DISTRICT 9**

**W. TYPE New Facility LENGTH 6.15 km**

**LOCATION From Regional Road 20 Westerly to Regional  
Road 22, Township of West Carleton**

**CONTRACT NO. \_\_\_\_\_**

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## PROJECT DESIGN SUMMARY

The report presents the results of a foundation investigation carried out within the limits of W.P. 127-92-00 (Hwy 417, New Facility) at the site of the proposed high fill embankments (> 4 m in height) and new culvert which will carry the Mississippi Municipal Diversion Drain beneath the new highway. The field work for this investigation was carried out in late November, 1994 and consisted of five sampled boreholes, drilled to depths ranging from 4 to 19 m below the existing ground surface. The subsurface conditions encountered generally consist of shallow crustal layers of clayey silt and silty sand, underlain by an extensive stratum of saturated, firm to stiff, blue-grey sensitive silty clay.

Based on the results of the investigation at the culvert location, bearing capacities of 100 kPa (ULS) and 65 kPa (SLS) are recommended for the design of the culvert foundation. Particular care will be required during construction to maintain the integrity of the sensitive silty clay material as a bearing stratum. In this regard, the approved bearing stratum should be covered with a working mat of granular material as soon as practical to facilitate construction and minimize disturbance. Differential settlement, in the order of 50 mm, is anticipated along the length of the culvert and should be taken into account for the structural design. The proposed culvert will be below the frost line and the backfill against the culvert should consist of granular material placed in accordance with OPSD 803.01. Rip-rap scour protection should be provided at both ends of the culvert.

Based on the results of the investigation at the high embankment locations, embankments up to 7 m in height with standard 2 horizontal to 1 vertical (2:1) side slopes are considered to be stable without any deep seated failure potential. The sensitive silty clay stratum will undergo some settlement, in the order of 100 to 150 mm for 7 m high embankments and 75 mm for 6 m high embankments. If scheduling permits, a preloading period of at least 9 months is recommended. Final paving should be delayed as long as possible.

For embankment construction, earth cut materials generated from the site are considered to be unacceptable for reuse, except outside of a 1:1 line projected downward from the outside edge of the rounding breakpoint. In addition, unacceptable earth cut material may be reused to backfill the abandoned portions of the municipal drain outside of the new road embankments. However, acceptable earth borrow should be used to backfill portions of the abandoned drain beneath the new road embankments, and over and adjacent to the new concrete culvert.

**FOUNDATION INVESTIGATION REPORT**  
**PROPOSED CULVERT AND HIGH EMBANKMENTS**

**Highway 417 (New Facility) District 9, Region of Ottawa-Carleton**

**From Regional Road 20 Westerly to Regional Road 22  
Township of West Carleton**

**W.P. 127-92-00, Project Length 6.15 km**

<u>Component</u>	<u>Station-to-Station</u>
Culvert	16+200
High Embankments	15+900 to 16+700

## **1.0 INTRODUCTION**

Highway 17, between the current westerly limit of Highway 417 and Arnprior, is presently a two lane, undivided rural highway. Increased traffic volumes and accident rates have warranted the extension of the four lane divided Highway 417 westward along this route. The overall project (G.W.P. 170-88-00) involves the design and construction of a four lane, divided Controlled Access Highway along this route. Golder Associates Ltd. has previously prepared the Pavement Design Report for W.P. 127-92-00, which involves the central section of the new alignment between Regional Road 20 (Kinburn Side Road) and Regional Road 22 (Galletta Side Road). In that report, we concluded that embankments up to 4 m in height at the site can be constructed with sandy earth borrow and standard side slopes (2 horizontal to 1 vertical) in accordance with OPSD 200.01. No stability problems are anticipated for embankments constructed in this manner. In addition, embankments of this magnitude should not experience any excessive long term settlements. However, for embankments greater than 4 m in height, further more detailed subsurface investigation was recommended prior to finalizing the design of these high embankments.

This current report presents the results of a geotechnical investigation carried out at the site of the proposed high fill embankments (> 4 m in height) within the limits of W.P. 127-92-00, as shown on the Key Plan, Figure 1. This report also presents the results of a geotechnical investigation carried out at the proposed culvert location, which will carry the Mississippi Municipal Diversion Drain beneath the new highway. The purpose of these investigations was to determine the subsurface soil and shallow groundwater conditions at the sites by means of a limited number of boreholes and, based on our interpretation of the borehole and laboratory data, to provide geotechnical engineering information for the design of the proposed high fill embankments and culvert foundation. Authorization to process with this investigation was given by Mr. D. F. Barnes, Regional Director (A), in a letter dated October 25, 1994.

It should be noted that this report does not address the high approach embankments to the dual structure crossings at the Mississippi River. It is understood that the associated detailed investigation and design for these embankments will be carried out by MTO Structural Section.

The factual data, interpretations and recommendations contained in this report pertain to the specific projects as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within eighteen months of the date of the report, Golder Associates Ltd. should be given an opportunity to confirm that the recommendations are still valid.

## 2.0 SITE DESCRIPTION

The site of the proposed high fill embankments (> 4 m in height) is located between about Stations 15+900 and 16+700. The land in this area is low lying and gently rolling with occasional stands of trees and swampy areas. The proposed culvert, which will carry the Mississippi Municipal Diversion Drain beneath the new highway, is located at about Station 16+200. This drain flows to the southeast and is a grass covered channel with steep banks and an invert at about 3 m (approx. el. 84.5 m) below the existing ground surface.

### 3.0 PHYSIOGRAPHY AND GEOLOGY

The proposed Highway 417 (new alignment) lies in the physiographic region of Ontario known the Ottawa Valley Clay Plains. This region is characterized by clay plains interrupted by ridges of rock or sand. The section of new alignment covered by this assignment lies predominantly within a silt and clay plain, deposited in deep water during the Champlain Sea era, overlain in the central portion by a shallow fluvial terrace consisting of silty sand, as shown on Figure 2, Surficial Geology.

The surficial clayey deposits are generally mottled greyish-brown in color and form a weathered, desiccated "crust" to a depth of about 1.5 to 2 m. The weathered crust is underlain by a blue-grey, relatively soft, sensitive silty clay deposit, known locally as "Leda Clay". The local bedrock in the project area is relatively deep and was not encountered during this investigation. It reportedly consists of limestone bedrock of Trenton and Black River Groups, Ordovician Period and is located some 40 to 45 m below the existing Mississippi River water level.

### 4.0 INVESTIGATION PROCEDURE

The field work for this investigation was carried out from November 22 to November 24, 1994, at which time five boreholes (Nos. 201 to 205) were drilled at the locations shown on the Location Plan, Figure 3 using a bombardier mounted drillrig supplied and operated by a specialist drilling contractor under our supervision. Standard penetration testing and sampling was carried out at regular intervals of depth in each of the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. In-situ vane shear strength testing was carried out in the relatively soft clayey silt and silty clay soils at selected depths. In addition, thin walled 75 mm diameter shelly tube samples were taken selectively within the underlying sensitive silty clay.

All of the samples obtained were brought to our Whitby laboratory for further examination and representative classification testing. In addition, three laboratory unconfined compressive strength tests (U) and one consolidation test (C) were carried out on samples of the sensitive silty clay extracted from the shelly tubes.

The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were loosely backfilled upon completion of sampling. Standpipes were installed in four of the five boreholes to permit further monitoring of the groundwater levels.

The field work for this investigation was directed by a member of our technical staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The ground surface elevations at the borehole locations were inferred from the project profile drawings provided by the Ministry and should therefore be considered to be approximate only. It is understood that the elevations are referenced to geodetic datum.

## 5.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes as well as the results of the field and laboratory testing are shown in detail on the Record of Borehole sheets and on Figures 4 to 12, following the text of this report. Simplified soil profile sections are shown on Figures 4A and 4B. Lists of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 100 to 150 mm of topsoil (Boreholes 201 to 204) and 1.4 m of organic soil cover (Borehole 205), the subsurface soil conditions encountered generally consist shallow surficial layers of very stiff to stiff clayey silt and/or loose silty sand, extending to depths of 1.4 to 2.8 m below the existing ground surface. These surficial strata are underlain by an extensive stratum of firm to stiff, blue-grey sensitive silty clay. All of the boreholes were terminated within the silty clay stratum. Groundwater levels were measured in the standpipes at depths ranging from 1.0 to 3.5 m below the existing ground surface at the time of the field investigation.

### 5.1 Topsoil

Topsoil was encountered at the surface of Boreholes 201 to 204 and ranged in thickness from 100 to 150 mm. The topsoil was dark brown in color and was clayey or silty in composition.

### 5.2 Organic Silt With Sand

Borehole 205, drilled in the low lying swampy area adjacent to a small tributary creek, encountered a layer of organic silt at the surface. This organic layer extended to a depth of 1.4 m below the existing ground surface. The organic silt was black in color and contained some sand and numerous fibres, roots and organics. Two standard penetration tests carried out within the organic silt gave N values of WH (weight of hammer) per 0.3 m and one in-situ vane shear test gave an undrained shear strength of 48 kPa. This value may not be representative of the strength of the deposit due to the fibrous nature of the material. In addition, this material is considered to be highly compressible. The natural water content of the two organic silt samples were 54 and 62 per cent.

### 5.3 Silty Sand

Layers of silty sand were encountered in Boreholes 204 and 205 directly underlying the topsoil or organic silt. The sand material varies in color from brown (Borehole 204) to grey (Borehole 205) and contained traces of organic material. Standard penetration tests carried out within the silty sand gave N values ranging from WH to 5 blows per 0.3 m indicating a very loose to loose relative density. The natural water content of the silty sand samples ranged from 18 to 22 per cent. One grain size distribution curve for the silty sand is shown on Figure 5.

### 5.4 Clayey Silt

Shallow layers of clayey silt were encountered directly underlying the topsoil in Boreholes 201 to 203 and underlying the surficial silty sand in Borehole 204. The clayey silt was mottled greyish-brown in color and forms a weathered, desiccated "crust" to depths of about 1.4 to 2.9 m below the existing ground surface. Standard penetration tests carried out within the clayey silt gave N values ranging from 2 to 6 blows per 0.3 m and two in-situ vane shear tests gave undrained shear

strengths of greater than 100 kPa. The overall data suggests that the consistency of the clayey silt crust varies from stiff to very stiff. The natural water content of the clayey silt samples ranged from 20 to 35 per cent. One grain size distribution curve for the clayey silt is shown on Figure 6. The liquid and plastic limits of the clayey silt were 28 and 18 per cent, respectively, indicating an inorganic clayey silt of low plasticity, as shown on the Plasticity Chart, Figure 10.

### 5.5 Silty Clay

The surficial clayey silt crust was underlain by an extensive stratum of blue-grey silty clay with small organic inclusions, known locally as "Leda Clay". The boreholes, which were extended to depths up to 19 m below the existing ground surface, were terminated within this silty clay stratum. Standard penetration tests carried out within the silty clay gave N values of WH (weight of hammer) per 0.3 m and twenty-eight in-situ vane shear tests gave undrained shear strengths ranging from 28 to 72 kPa. In addition, three laboratory unconfined compressive strength tests (refer to Figure 11) gave undrained shear strengths ranging from 32 to 47 kPa. The corresponding laboratory vane undrained shear strength values ranged from 32 to 41 kPa. The undrained shear strengths obtained from the laboratory testing generally gave lower values than those obtained from the vane shear tests carried out in the field. It is considered that this is primarily due to unavoidable sample disturbance caused by the field and laboratory handling and subsequent testing of the sensitive silty clay. However, the overall data suggests that the consistency of the silty clay deposit varies from firm to stiff.

The sensitivity of the blue-grey silty clay, determined by the ratio of the undrained shear strength to the remoulded shear strength values obtained from the field vane testing, was in the range of 3 to 8. This indicates that the blue-grey silty clay underlying the crust at the site is considered to be "sensitive".

The natural water content of the silty clay samples generally ranged from 50 to 95 per cent. Three grain distribution curves for the silty clay are shown on Figures 7 to 9. The liquid and plastic limits of the silty clay were in the ranges of 66 to 74 per cent and 29 to 30 per cent, respectively, indicating an inorganic clay of high plasticity, as shown on the Plasticity Chart, Figure 10.

The results of a laboratory consolidation test performed on a sample of the silty clay from Borehole 204 are shown on Figure 12. The consolidation characteristics of the silty clay obtained from the test are summarized as follows:

Initial void ratio	=	$e_o$	=	2.3
Compression index	=	$C_c$	=	1.0
Preconsolidation pressure	=	$P_c$	=	200 kPa
Effective Overburden Pressure	=	$P'_o$	=	80 kPa

These results indicate that the silty clay is preconsolidated by about 120 kPa in excess of the existing overburden.

## 5.6 Shallow Groundwater

The shallow groundwater levels measured within the standpipes on November 25, 1994 were found to be at depths ranging from 1.0 to 3.5 m below the existing ground surface, or between elevations 84.0 and 87.1 m. It should be noted that these observations reflect the shallow groundwater conditions encountered in the boreholes at the time of the field investigation and some seasonal fluctuations should be anticipated.

## 6.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides engineering information for the geotechnical design aspects of the proposed culvert and high embankments, based on our interpretation of the borehole and laboratory information and on our understanding of the project requirements. The information in this portion of the report is provided for the guidance of the design engineers. Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.



Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at the site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this report and have not been investigated or addressed.

## **6.1 Culvert Design**

### **6.1.1 General**

It is understood that a concrete box culvert is proposed to be constructed at about Station 16+200 to carry the Mississippi Municipal Diversion Drain underneath the new highway. A simplified section at the proposed culvert is shown on Figure 4A. The culvert is anticipated to have an opening about 3 m in width and 3 m in height, with an overall length of about 130 m. The proposed top of the culvert varies from about elevation 87.9 m at the west end to 87.4 m at the east end. The proposed base slab of the culvert varies from elevation 84.3 m at the west end to 83.8 m at the east end. The land in this area is gently sloping downward to the east, with existing ground surface elevations ranging from about 88 m (west) to 87.5 m (east). The proposed highway embankments above the culvert are about 4.3 m (EBL) and 4.2 m (WBL) in height.

### **6.1.2 Subsurface Conditions**

Boreholes 202 and 203 were drilled at the west and east ends of the proposed culvert, respectively. The subsurface soil conditions encountered in these boreholes generally consisted of a mottled, greyish-brown, stiff to very stiff clayey silt crust, which extended to elevations 85.5 m (BH 202) and 85.9 m (BH 203). The clayey silt crust was underlain by an extensive stratum of blue-grey, sensitive, firm silty clay, which extended to the investigated depths at elevation 77.7 m (BH 202) and elevation 73.1 m (BH 203). The shallow groundwater levels measured in the standpipes were at elevations 85.6 m (BH 202) and 84.0 m (BH 203) on November 25, 1994.

### 6.1.3 Culvert Foundation

Based on the results of this investigation, the subsoil at the proposed culvert founding elevations will consist of the blue-grey, sensitive, firm silty clay. Measured undrained shear strengths within the silty clay stratum at these elevations range from about 34 to 38 kPa. Based on this, a factored bearing capacity at Ultimate Limit States (ULS) of 100 kPa and at Serviceability Limit States (SLS) of 65 kPa may be used for the design of the culvert footings at the proposed founding elevations.

The founding material is below the local water table and is extremely susceptible to disturbance by construction activities due to its sensitive nature. Particular care will be required during construction to maintain the integrity of this material as a bearing stratum. In this regard, heavy construction equipment should be restricted from travelling on the exposed bearing stratum. In addition, the exposed bearing stratum should be covered with a working mat of granular material as soon as practical to facilitate construction and minimize disturbance to the material. The granular mat should consist of well compacted OPSS Granular A and should be at least 450 mm in thickness and extend horizontally outward from the outside footing edges for at least 1 m. Prior to constructing the granular mat, the foundation excavation should be inspected by the geotechnical engineer to confirm that the founding stratum is native, competent, undisturbed and sufficiently cleaned of ponded water and disturbed material. The granular material for the mat should be on site and ready to be placed immediately following approval of the founding stratum by the geotechnical engineer. Delay in placing the granular material could result in damage to the founding stratum.

### 6.1.4 Settlement Considerations

The sensitive silty clay stratum beneath the culvert will undergo some settlement due to the weight of the culvert and/or overlying road embankments. The maximum settlement will occur under the centrelines of the road embankments where the fill heights are greatest. However, as shown on Figure 4A, the existing ground varies considerably from the EBL to the WBL. As such, differential settlement, in the order of 50 mm, should be anticipated within the length of the culvert. Since the settlement will be greater under the WBL embankment as compared to that under the EBL embankment, the hydraulic gradient of the culvert should not be adversely effected by the

anticipated differential settlement. However, this differential settlement should be taken into account for the structural design of the culvert.

Since is anticipated that the culvert would be constructed prior to the road embankments, it may not be practical to reduce the magnitude of the anticipated settlement by preloading, given the probable construction sequencing.

#### **6.1.5 Culvert Excavation and Groundwater Control**

All excavations at the site should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. Excavation for the culvert will be up to about 4 m in depth below the existing ground surface. Based on the results of the boreholes, the excavation will encounter about 1.4 to 2.1 m of the very stiff to stiff clayey silt crust, underlain by the sensitive, firm silty clay deposit. It is anticipated that the excavation could be carried out using temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical (1:1). However, depending upon the method of construction and groundwater control procedures adopted by the contractor and the weather conditions at the time of construction, some local flattening of the cut slopes may be required. In addition, the excavated material should not be stockpiled adjacent to the excavation where it could lead to instability of the excavation slopes.

Some groundwater seepage within the excavation is expected but can be readily handled by pumping from properly constructed and filtered sumps located within the excavation, but outside of the areas required for foundation support. Care should be taken to direct surface water away from the open excavations. In addition, some form of diversion of the existing municipal drain flow around the work area may be necessary to facilitate the construction, depending upon the staging and other construction considerations.

### **6.1.6 Backfill**

The culvert should be backfilled with a free draining, non-frost susceptible granular material conforming to OPSS Granular B, Type I or Type II. This material should be placed in maximum 300 mm loose lifts and be uniformly compacted to 95 per cent of standard Proctor maximum dry density. Heavy compaction equipment should not be used immediately adjacent to the structure. The proposed culvert will be below the frostline and the granular backfill should be constructed in accordance with OPSD 803.01. The remainder of the backfill in the excavation (i.e., outside the controlled granular zone) may consist of acceptable earth borrow materials.

Assuming that the backfill against the culvert is free draining so hydrostatic forces are not developed and the backfill is placed as described above, the new culvert may be designed using lateral earth pressure coefficients of 0.5 (ULS) and 0.4 (SLS) and a total unit weight of granular backfill of 21 kN/m<sup>3</sup>. The culvert structure should be designed to withstand the full weight of the road embankment loadings.

### **6.1.7 Erosion Protection and Scour**

Based on the results of this investigation, the sensitive silty clay encountered at the anticipated founding elevations is considered to have a high scourability. Adequate rip-rap scour protection should be provided at both ends of the culvert, consistent with the stream flow volume and velocity.

## **6.2 Road Embankment Design**

### **6.2.1 General**

It is understood that the highway between Stations 15+900 and 16+700 will be supported on high embankments with heights up to about 7 m. A simplified section through the site is shown on Figure 4B.

### 6.2.2 Subsurface Conditions

The subsurface conditions encountered in this section generally consist of a mottled, greyish-brown, stiff to very stiff clayey silt crust and/or loose silty sand, extending to depths of 1.4 to 2.8 m below the existing ground surface. These surficial strata are underlain by an extensive stratum of firm to stiff blue-grey, sensitive silty clay. Measure in-situ field vane and laboratory undrained shear strengths of the silty clay were in the range of 29 to 72 kPa, generally increasing with depth. In addition, a surficial layer of organic silt (1.4 m in thickness) was encountered in the swampy area in the vicinity of Borehole 205. Groundwater levels were measured in the standpipes at depths ranging from 1.0 to 3.5 m below the existing ground surface at the time of the field investigation.

### 6.2.3 Embankment Stability

The critical condition for stability of an embankment on normally or slightly overconsolidated clays, as is the case with this clay stratum, generally occurs during or immediately after construction. This being the case, a total stress analysis provides a suitable means of assessing the stability of the proposed high embankments. In this method of analysis, stability is governed by the applied loads and by the stress-strain and undrained shear strength properties of the founding and embankment soils. Analyses have been carried out, therefore, in terms of total stress, both manually and by the use of the computer, to determine the stability of the proposed high embankments.

The geometry of the embankments and the properties of the fill and native subsoils assumed for stability analyses are given in Appendix A (Results of Stability Analyses). The results of the stability analyses are summarized as follows:

Vicinity of Borehole No.	Maximum Embankment Height (m)	Embankment Side Slopes	Factor of Safety
201	7	2:1	1.44
202, 203	7	2:1	1.41
204, 205	7	2:1	1.52

As shown above, embankments up to 7 m in height with 2:1 side slopes have factors of safety greater than 1.4 with respect to overall stability. Based on this, it is concluded that embankments up to 7 m in height with standard 2 horizontal to 1 vertical (2:1) side slopes are considered to be stable without any deep seated failure potential.

#### **6.2.4 Settlement Considerations**

The sensitive silty clay stratum will undergo settlement, over some period of time, under the surcharge loading of the road embankments. For embankments up to 6 m in height, the induced stress will be less than the estimated preconsolidation pressure of the silty clay. This settlement will primarily be due to re-compression of the silty clay structure, rather than "virgin" compression, and will thus be elastic in nature with a minor magnitude. However, for embankments up to 7 m in height, the induced stress will be slightly beyond the estimated preconsolidation pressure which will locally increase the magnitude of the settlement.

In the 7 m high embankment areas, the predicted total settlement will be in the order of 100 to 150 mm. Elsewhere, for embankments up to 6 m in height, the predicted total settlement will be in the order of 75 mm.

In the majority of this section, the embankments heights are 6 m or less and thus the imposed surcharge loading will be in the re-compression, elastic range. Consequently, the predicted settlements will take place during the construction period. However, in the higher 7 m embankment areas, the total amount of the predicted settlement will take place within a period of about 24 to 30 months, with only about 50 per cent of this occurring within the first 6 to 8 months. In view of this, in order to minimize post-construction differential settlements and associated maintenance costs, it would be desirable to construct the high embankments as early as possible. If scheduling permits, a preloading period of at least 9 months is recommended for this purpose. In any event, final paving should be delayed as long as possible.

### 6.2.5 Embankment Construction

The material used to construct the embankments should consist of an approved sandy earth borrow material. The material should be placed in thin lifts and be well compacted according to Ministry standards. Prior to placing any fill, the exposed subgrade should be heavily proofrolled in conjunction with an inspection by a qualified geotechnical person. This procedure typically involves driving a heavy roller across the exposed subgrade under the careful observation of the inspector. Any soft areas identified during the proofroll inspection should be sub-excavated and replaced with well compacted approved sandy earth borrow.

The surficial organic deposit encountered in the swampy area in the vicinity of Borehole 205 should be sub-excavated to its full depth within the entire plan limits of the proposed embankments. The sub-excavation should be backfilled to the original ground surface with a well compacted granular material such as OPSS Granular B, Type I or Type II material.

The final embankment side slopes should be provided with a vegetative cover as per Ministry standards to prevent erosion and local instability of the side slopes. This will require some maintenance over the first few years until the vegetative cover is established.

### 6.2.6 Earth Cut Material Available For Reuse

The relevant properties of the native soils at the site are summarized as follows:

Soil Type	% < 75 $\mu$ m	P.I. %	F.M.C. %	Opt. M.C. %	Comment
Silty Clay	96-98	17-18	29-34	22	> 5% above opt. therefore unacceptable
Clayey Silt	80-98	12-16	22-43	19	> 5% above opt. therefore unacceptable
Sandy Silt	71-73	non-plastic	21-36	16	> 1% above opt. therefore unacceptable
Fine Sand & Silt	52-54	non-plastic	21-23	15	> 1% above opt. therefore unacceptable

Although most of the cuts at the site are skim cuts which will generate mainly topsoil, some earth materials will be generated from deeper cuts and from the new culvert and drain realignment

excavations. Due to relatively high moisture contents, the earth cut materials are considered to be unacceptable for reuse. They may, however, be reused on embankment side slopes (of any height) outside of a 1:1 line projected downward from the outside edge of the rounding breakpoint. However, acceptable earth borrow should be used over and adjacent to the new concrete culvert. In addition, unacceptable earth cut material may be reused to backfill the abandoned portions of the municipal drain outside of the road embankments. However, acceptable earth borrow should be used to backfill portions of the abandoned drain beneath the new road embankments.

#### **6.2.7 Other Considerations**

It should be noted that the alignment crosses a small tributary creek of the Mississippi River at about Station 16+540 (EBL) and 16+605 (WBL). It is not known at this time whether this creek will be diverted or a culvert installed to carry the creek under the new highway.

### **7.0 DESIGN REVIEW, INSPECTION AND TESTING**

Prior to construction, the geotechnical aspects of the final design drawings and specifications should be reviewed by this office in order to confirm that the intent of this report has been met.

During construction, sufficient foundation inspection, in situ density tests and materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes and to monitor conformance to the pertinent project specifications.



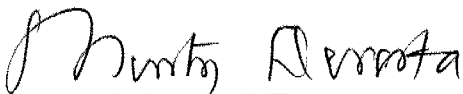
We trust that this report contains sufficient geotechnical information for you to proceed with the design of this project. If there is any point which requires clarification, please do not hesitate to contact our office.

Yours truly,

GOLDER ASSOCIATES LTD.



Doug G. Gorrill, P. Eng.  
Geotechnical Engineer



Murty S. Devata, P.Eng.  
Specialist Consultant

DGG:MSD:sr

## LIST OF ABBREVIATIONS

The abbreviation commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

### I. SAMPLE TYPES

*AS* auger sample  
*CS* chunk sample  
*DO* drive open  
*DS* Denison type sample  
*FS* foil sample  
*RC* rock core  
*ST* slotted tube  
*TO* thin-walled, open  
*TP* thin-walled, piston  
*WS* wash sample

### II. PENETRATION RESISTANCES

#### Dynamic Penetration Resistance:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 0.3 m (12 in.).

#### Standard Penetration Resistance, *N*:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 0.3 m (12 in.).

*WH* sampler advanced by static weight—weight, hammer

*PH* sampler advanced by pressure—pressure, hydraulic

*PM* sampler advanced by pressure—pressure, manual

### III. SOIL DESCRIPTION

(a) <i>Cohesionless Soils</i>	
	' <i>N</i> ' Blows/0.30m or Blows/ft.
Relative Density	
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

#### (b) *Cohesive Soils*

Consistency	kPa	' <i>Cu</i> ' psf.
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000

### IV. SOIL TESTS

*C* consolidation test  
*H* hydrometer analysis  
*M* sieve analysis  
*MH* combined analysis, sieve and hydrometer<sup>1</sup>  
*Q* undrained triaxial<sup>2</sup>  
*R* consolidated undrained triaxial<sup>2</sup>  
*S* drained triaxial  
*U* unconfined compression  
*V* field vane test

#### NOTES:

<sup>1</sup>Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

<sup>2</sup>Undrained triaxial tests in which pore pressures are measured are shown as  $\bar{Q}$  or  $\bar{R}$ .

## LIST OF SYMBOLS

### I. GENERAL

$\tau$	= 3.1416
$e$	= base of natural logarithms 2.7183
$\log_e a$ or $\ln a$	natural logarithm of $a$
$\log_{10} a$ or $\log a$	logarithm of $a$ to base 10
$t$	time
$g$	acceleration due to gravity
$V$	volume
$W$	weight
$M$	moment
$F$	factor of safety

### II. STRESS AND STRAIN

$u$	pore pressure
$\sigma$	normal stress
$\sigma'$	normal effective stress ( $\bar{\sigma}$ is also used)
$\tau$	shear stress
$\epsilon$	linear strain
$\epsilon_{xy}$	shear strain
$\nu$	Poisson's ratio ( $\mu$ is also used)
$E$	modulus of linear deformation (Young's modulus)
$G$	modulus of shear deformation
$K$	modulus of compressibility
$\eta$	coefficient of viscosity

### III. SOIL PROPERTIES

#### (a) Unit weight

$\gamma$	unit weight of soil (bulk density)
$\gamma_s$	unit weight of solid particles
$\gamma_w$	unit weight of water
$\gamma_d$	unit dry weight of soil (dry density)
$\gamma'$	unit weight of submerged soil
$G_s$	specific gravity of solid particles $G_s = \gamma_s / \gamma_w$
$e$	void ratio
$n$	porosity
$w$	water content
$S_r$	degree of saturation

#### (b) Consistency

$w_L$	liquid limit
$w_P$	plastic limit
$I_P$	plasticity index
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_P) / I_P$
$I_C$	consistency index = $(w_L - w) / I_P$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$D_r$	relative density = $(e_{max} - e) / (e_{max} - e_{min})$

#### (c) Permeability

$h$	hydraulic head or potential
$q$	rate of discharge
$v$	velocity of flow
$i$	hydraulic gradient
$k$	coefficient of permeability
$j$	seepage force per unit volume

#### (d) Consolidation (one-dimensional)

$m_v$	coefficient of volume change = $-\Delta e / (1 + e) \Delta \sigma'$
$C_c$	compression index = $-\Delta e / \Delta \log_{10} \sigma'$
$c_c$	coefficient of consolidation
$T_v$	time factor = $c_v t / d^2$ ( $d$ , drainage path)
$U$	degree of consolidation

#### (e) Shear strength

$\tau_f$	shear strength
$c'$	effective cohesion
$\phi'$	effective angle of shearing resistance, or friction
$c_u$	apparent cohesion*
$\phi_u$	apparent angle of shearing resistance, or friction
$\mu$	coefficient of friction
$S_t$	sensitivity

in terms of effective stress  
 $\tau_f = c' + \sigma' \tan \phi'$

in terms of total stress  
 $\tau_f = c_u + \sigma \tan \phi_u$

\*For the case of a saturated cohesive soil,  $\phi_u = 0$  and the undrained shear strength  $\tau_f = c_u$  is taken as half the undrained compressive strength.

PROJECT: 941-8059

## RECORD OF BOREHOLE 201

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 22, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, K, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa	D.P. - + Q - ● rem. V - ● U - O			WATER CONTENT, PERCENT Wp — W — Wl
0		GROUND SURFACE		87.70								
		TOPSOIL		0.00								
		Stiff to very stiff mottled greyish-brown CLAYEY SILT, trace fine sand		0.15								
1				88.25	1	50 DO	3					
		Firm grey SILTY CLAY, trace fine sand		1.45	2	50 DO	WH					
2					3	50 DO	WH					
3					4	50 DO	WH					
4					5	50 DO	WH					
5					6	50 DO	WH					
6					7	50 DO	WH					
7					8	50 TO	PM					
8												
9												
10												

BACKFILL

BENTONITE  
SEAL

BACKFILL

Nov. 25/94

U, MH

CONTINUED ON NEXT PAGE

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.K.

CHECKED: *[Signature]*

PROJECT: 841-8059

## RECORD OF BOREHOLE 201

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 22, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH		WATER CONTENT, PERCENT					
								Cu, kPa	rem. V - $\oplus$	nat. V - $\oplus$	U - $\oplus$	Wp	W		
10	POWER AUGER 200 mm DIA. HOLLOW STEM AUGERS	CONTINUED FROM PREVIOUS PAGE													
		Firm grey SILTY CLAY, trace fine sand													
11															
12															
13															
14															
15															
16															
17															
18															
19															
20		END OF BOREHOLE													

DATA INPUT:

88.65  
19.05

BACKFILL

Water level in open borehole at a depth of 8.10 m (El. 81.80 m) upon completion of drilling, Nov. 22/94

Water level in standpipe at a depth of 3.5 m (El. 84.20 m) on Nov. 25/94

DEPTH SCALE  
1 to 50

Golder Associates

LOGGED: C.K.  
CHECKED: *[Signature]*

PROJECT: 941-8059

## RECORD OF BOREHOLE 202

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 23, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT				
								Cu, kPa	nat. V - +	rem. V - ●	Q - ●	U - ○	Wp	W		WI
0		GROUND SURFACE		87.60												
		TOPSOIL		0.00												
		Very stiff to stiff mottled greyish-brown CLAYEY SILT, trace fine sand		0.15												
1			1	50 DO	4											
			2	50 DO	2											
2			3	50 DO	WH											
		Firm grey SILTY CLAY, trace fine sand		85.47 2.13												
			4	50 DO	WH											
3			5	50 DO	WH											
			6	50 DO	WH											
4			7	50 DO	WH											
			8	50 DO	WH											
5			9	50 DO	WH											
			10	50 DO	WH											
6																
7																
8																
9																
10		END OF BOREHOLE		78.00 9.60												

POWER AUGER  
200 mm DIA. HOLLOW STEM AUGERS

BACKFILL

BENTONITE SEAL

Nov. 25/84

BACKFILL

Water level  
in open  
borehole at  
a depth of  
0.81 m  
(El. 88.89 m)  
upon  
completion  
of drilling,  
Nov. 23/84

Water level  
in standpipe  
at a depth  
of 2.0 m  
(El. 85.60 m)  
Nov. 25/84

BACKFILL

BENTONITE  
SEAL

Nov. 25/94

BACKFILL

Water level  
in open  
borehole at  
a depth of  
0.91 m  
(El. 86.69 m)  
upon  
completion  
of drilling,  
Nov. 23/94

Water level  
in standpipe  
at a depth  
of 2.0 m  
(El. 85.60 m)  
Nov. 25/94

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.K.

CHECKED: *adp*

PROJECT: 941-8059

## RECORD OF BOREHOLE 203

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 23, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		ELEV. DEPTH (m)	SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, K, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT		NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa	nat. V - + rem. V - ● O - ● U - O	WATER CONTENT, PERCENT Wp — W — Wi		
0		GROUND SURFACE		87.30								
		TOPSOIL		0.00								
		Stiff to very stiff mottled greyish brown CLAYEY SILT, trace fine sand		0.10								
1					1	50 DO	8					BACKFILL
				85.93								
		Firm grey SILTY CLAY, trace fine sand		1.37								
2					2	50 DO	WH					BENTONITE SEAL
3					3	50 DO	WH					
4					4	50 DO	WH					
5					5	50 DO	WH					
6					6	50 TO	PM					BACKFILL
7					7	50 DO	WH					
8					8	50 DO	WH					
9												
10												

CONTINUED ON NEXT PAGE

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.K.

CHECKED: *SLH*

PROJECT: 941-8059

## RECORD OF BOREHOLE 203

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 23, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, K, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	SHEAR STRENGTH		WATER CONTENT, PERCENT				
							Cu, kPa	na.V. + rem.V. •	Q - • U - O			Wp	W
10	POWER AUGER 200 mm DIA. HOLLOW STEM AUGERS	CONTINUED FROM PREVIOUS PAGE									BACKFILL 		
		Firm grey SILTY CLAY, trace fine sand											
11				9	50 DO	WH							
12													
13				10	50 DO	WH							
14													
		END OF BOREHOLE		73.13 14.17	11	50 DO	WH						
15													
16													
17													
18													
19													
20													

Water level in open borehole at a depth of 4.8 m (El. 82.70 m) upon completion of drilling, Nov. 23/94

Water level in standpipe at a depth of 3.3 m (El. 84.0 m), Nov. 25/94

DATA INPUT:

DEPTH SCALE  
1 to 50

LOGGED: C.K.  
CHECKED: *[Signature]*

Golder Associates



PROJECT: 941-8059

## RECORD OF BOREHOLE 204

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 24, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		STRATA PLOT	ELEV. DEPTH (m)	SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, K, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	NUMBER			TYPE	BLOWS/0.3m	SHEAR STRENGTH		WATER CONTENT, PERCENT			
								Cu, kPa	rem. V -	Wp	W		
0		GROUND SURFACE			88.10								
		TOPSOIL			0.00								
		Very loose to loose brown SILTY SAND, trace organics			0.10								
1						1	50 DO	3					
2						2	50 DO	5					
		Stiff mottled greyish-brown CLAYEY SILT, trace fine sand			85.97 2.13								
3						3	50 DO	2					
		Firm to stiff grey SILTY CLAY, trace fine sand			85.21 2.89								
4						4	50 TO	PM					
5						5	50 DO	WH					
6						6	50 DO	WH					
7						7	50 DO	WH					
8						8	50 DO	WH					
9													
10													

POWER AUGER  
200 mm DIA. HOLLOW STEM AUGERS

DATA INPUT:

CONTINUED ON NEXT PAGE

BACKFILL

BENTONITE SEAL

Nov. 25/94  
BACKFILL

MH

CAVED MATERIAL

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.K.

CHECKED: *[Signature]*

PROJECT: 941-8059

## RECORD OF BOREHOLE 204

SHEET 2 OF 2

LOCATION: SEE FIGURE 2


BORING DATE: NOV. 24, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, k, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER TYPE BLOWS/0.3m	SHEAR STRENGTH		WATER CONTENT, PERCENT				
						Cu, kPa	rem. V - U - O	Wp	W			
10	POWER AUGER 200 mm DIA. HOLLOW STEM AUGERS	CONTINUED FROM PREVIOUS PAGE										
11		Firm to stiff grey SILTY CLAY, trace fine sand			9 DO WH							
12												
13					10 SO TO PM							
14												
15												
16					11 DO WH							
17												
18												
19					12 DO WH							
20		END OF BOREHOLE		69.05 19.05								

CAVED MATERIAL

Borehole  
caved to  
a depth of  
2.1 m upon  
completion  
of drillingWater level  
in open  
borehole at  
a depth  
of 0.9 m  
(El. 87.20 m)  
upon  
completion  
of drilling,  
Nov. 24/94Water level  
in standpipe  
at a depth  
of 1.0 m,  
(El. 87.10 m)  
Nov. 25/94

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: C.K.

CHECKED: *289*

PROJECT: 941-8059

## RECORD OF BOREHOLE 205

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: NOV. 24, 1994

DATUM: GEODETIC

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m		HYDRAULIC CONDUCTIVITY, k, cm/s		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT, PERCENT	
								Cu, kPa	rem. V -			nat. V -	Wp
0	POWER AUGER 200 mm DIA. HOLLOW STEM AUGERS	GROUND SURFACE		85.80									
		Black ORGANIC SILT, with sand, fibers and roots		0.00	1	50 DO	WH						
1					2	50 DO	WH						
		Very loose grey SILTY SAND, trace clay, trace organics		84.43									
				1.37	3	50 DO	WH						
2		Firm grey SILTY CLAY, trace fine sand		83.67									
				2.13	4	50 DO	WH						
3					5	50 DO	WH						
4		END OF BOREHOLE		81.99									
				3.81									
5													
6													
7													
8													
9													
10													

Water level in open borehole at a depth of 1.2 m (El. 84.6 m) upon completion of drilling, Nov. 24/94

DEPTH SCALE

1 to 50

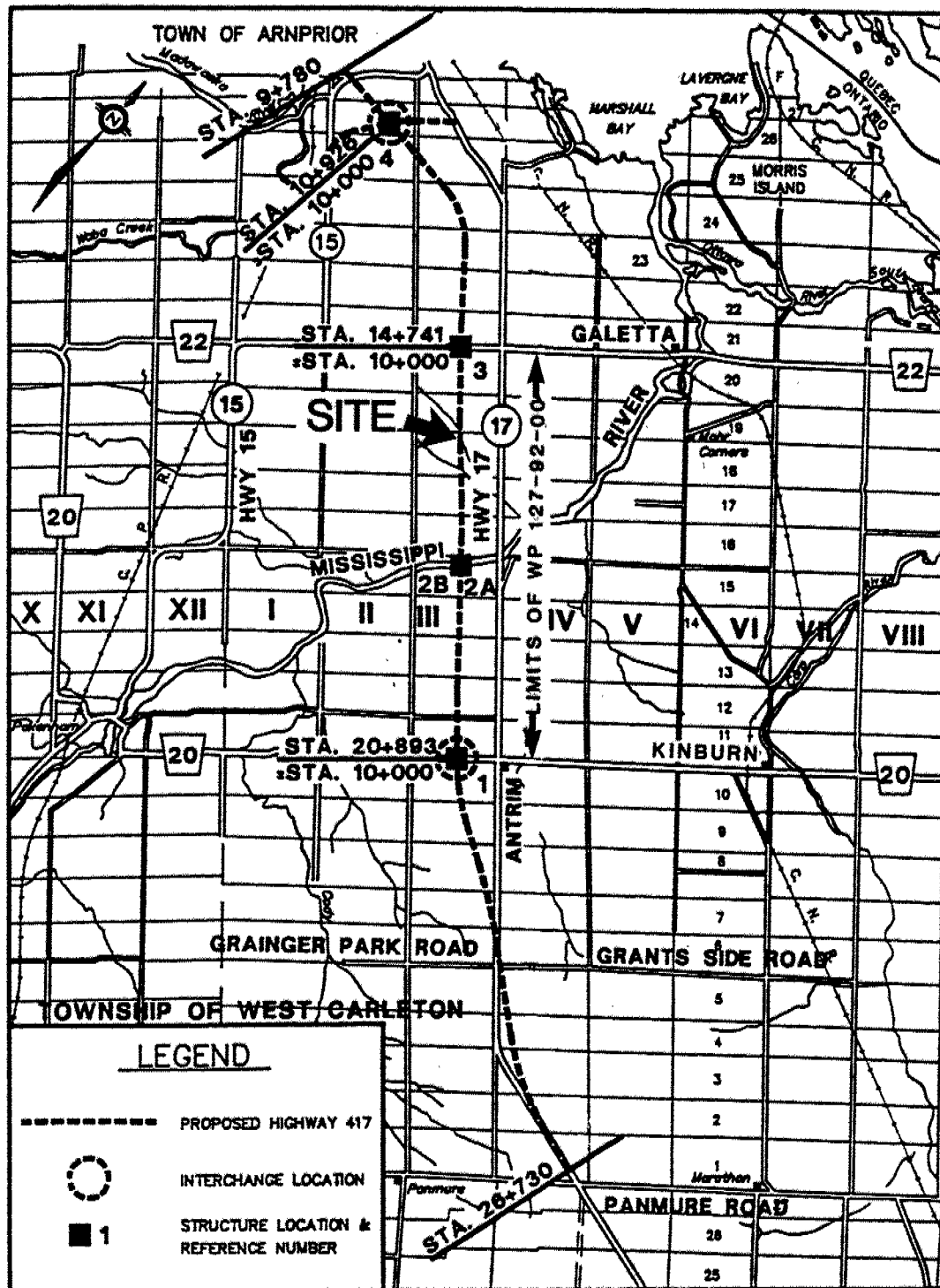
Golder Associates

LOGGED: C.K.

CHECKED: *CK*

# KEY PLAN

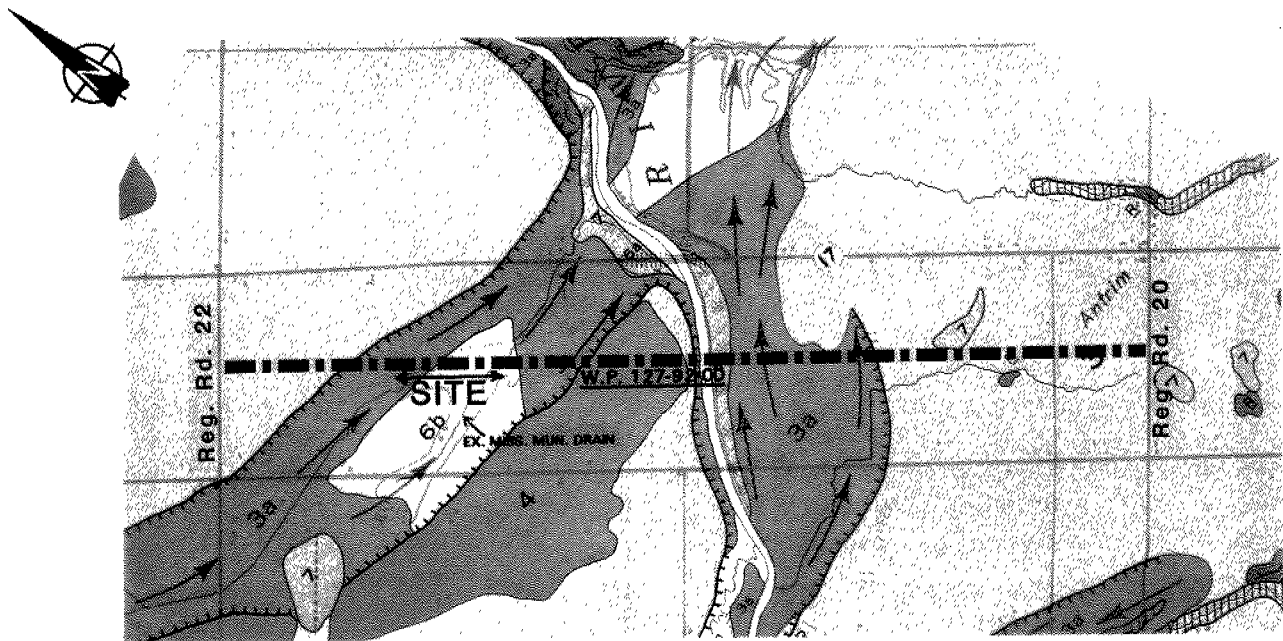
FIGURE 1



Date Feb. 8, 1995  
Project 941-8059

Golder Associates

Drawn DW  
Chkd *[Signature]*



## LEGEND

## CHAMPLAIN SEA SEDIMENTS

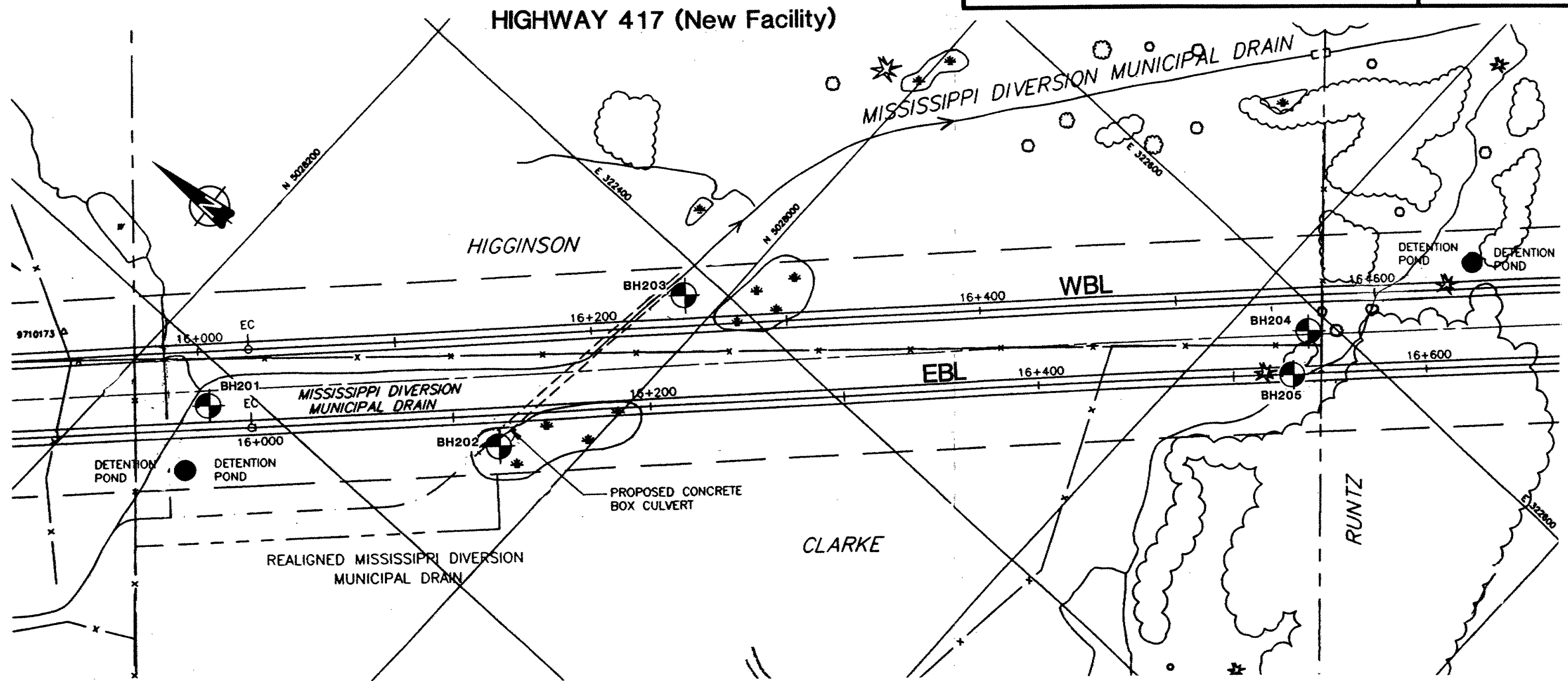
- 3** OFFSHORE MARINE DEPOSITS: clay, silty clay and silt, commonly calcareous and fossiliferous, locally overlain by thin sands. Upper parts are generally mottled or laminated reddish brown and bluish grey and may contain lenses and pockets of sand, but at depth the clay is uniform and blue-grey
- 3a** Clay and silt underlying erosional terraces; upper part of marine deposits removed to variable depths by fluvial erosion so in places clay is uniform blue-grey; unit includes lenses, bars and channel fills of sand and pockets of nonmarine silt that were formed during terrace (or channel) cutting
- 4** DELTAIC AND ESTUARINE DEPOSITS: medium to fine grained sand; in some places fossiliferous, lies outside abandoned channels; most common deposit is a combined strip delta-sand plain that developed as water levels fell

## POST-CHAMPLAIN SEA DEPOSITS

- 6b** Medium grained stratified sand with some silt; in the form of fluvial terraces and channels cut in marine clay, and bars and spits within abandoned channels
- 7** ORGANIC DEPOSITS: mainly muck and peat in bogs, fens, swamps and poorly drained areas

## REFERENCE

Map 1599A, Surficial Geology, Arnprior, Ontario, Geological Survey of Canada, S.H. Richard 1984



## LEGEND



Borehole Location in Plan

SCALE 1:2000

## REFERENCE

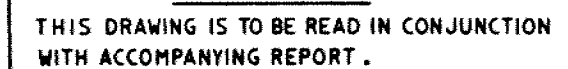
Photocopy of project plan drawing prepared by the Ministry of Transportation

Date: February 8, 1995  
Project: 941-8059

**Golder Associates**

Drawn: DW  
Chkd: [Signature]

## FIGURE 4A



Drawn.....DW.....  
Chkd.....*[Signature]*.....

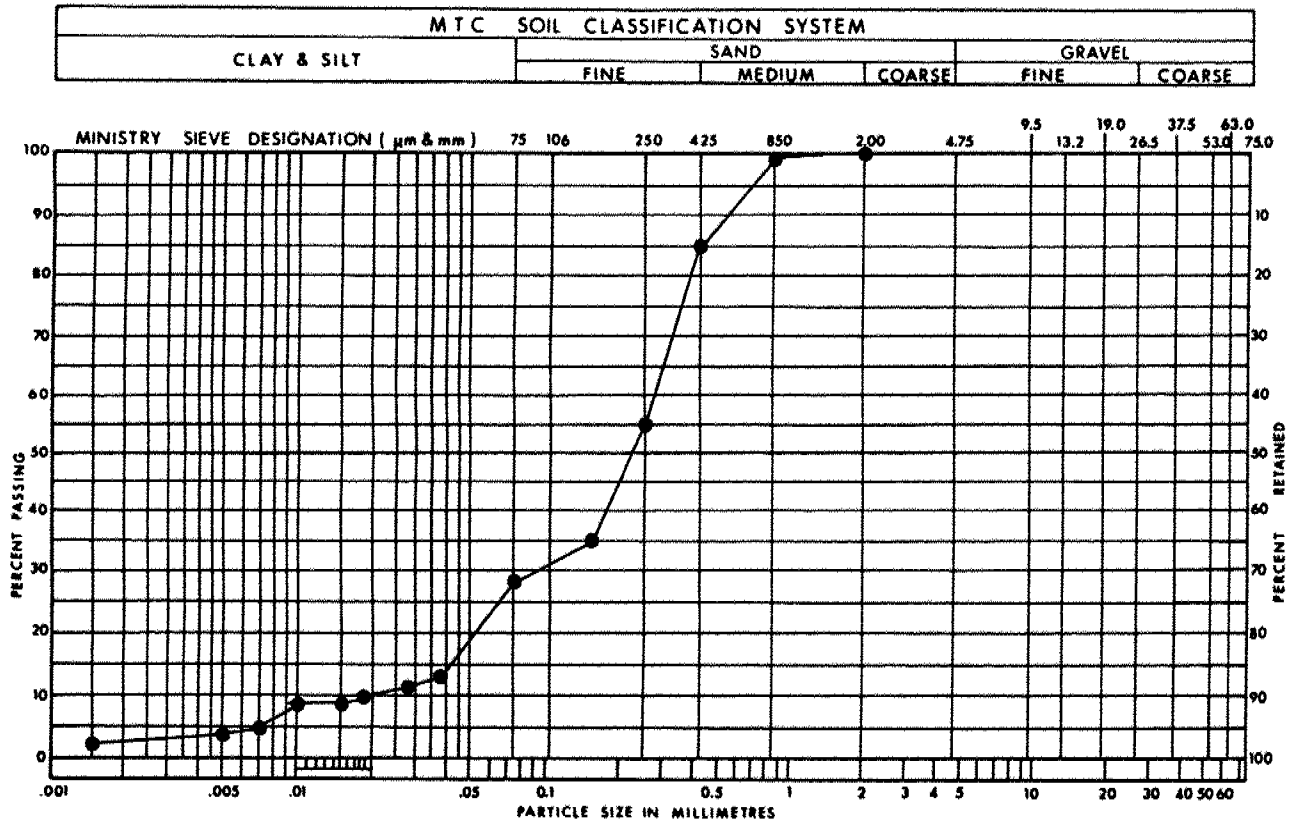
# OVERSIZE DRAWING(S)



# GRAIN SIZE DISTRIBUTION

FIGURE 5

## SILTY SAND



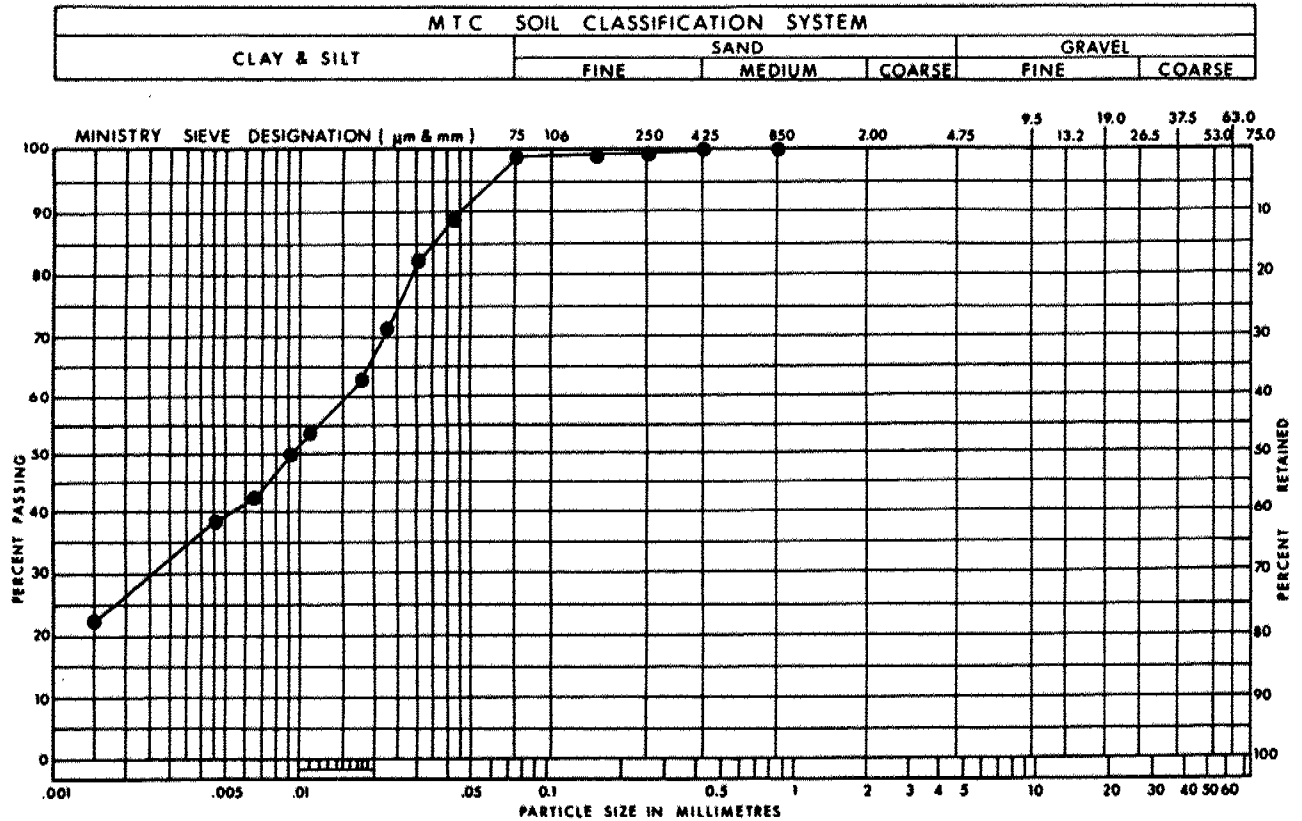
### LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	205	3	1.5-2.0

# GRAIN SIZE DISTRIBUTION

FIGURE 6

## CLAYEY SILT



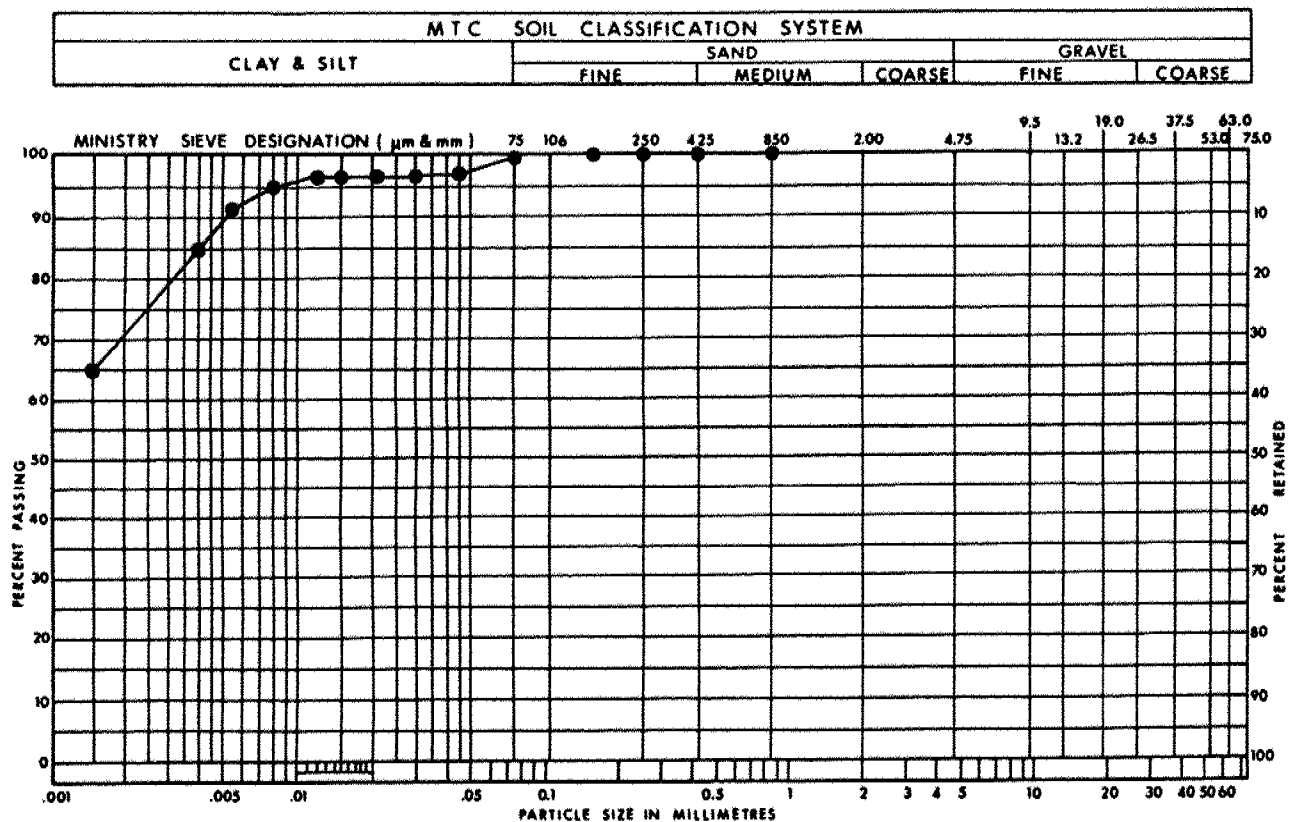
### LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	204	3	2.3-2.8

# GRAIN SIZE DISTRIBUTION

FIGURE 7

## SILTY CLAY



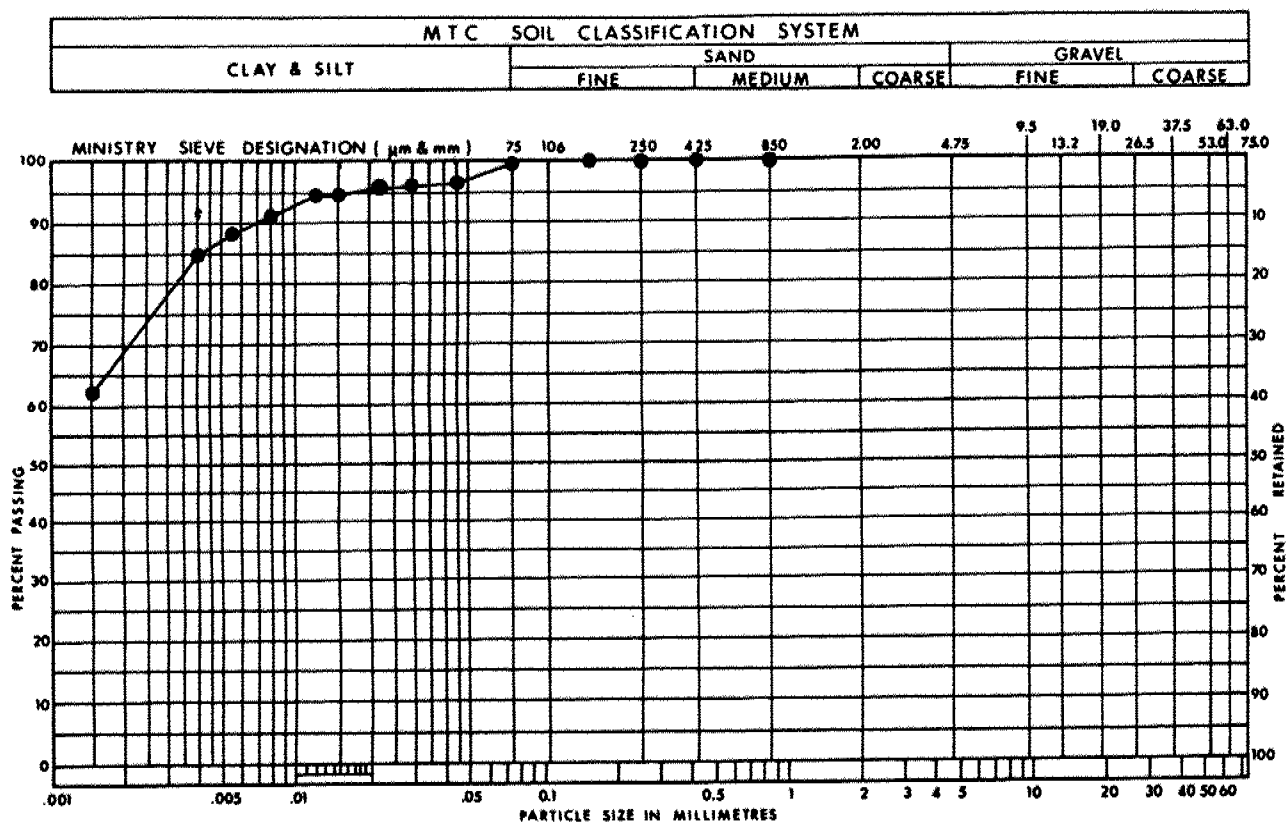
### LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	201	8	9.2-9.6

# GRAIN SIZE DISTRIBUTION

FIGURE 8

## SILTY CLAY



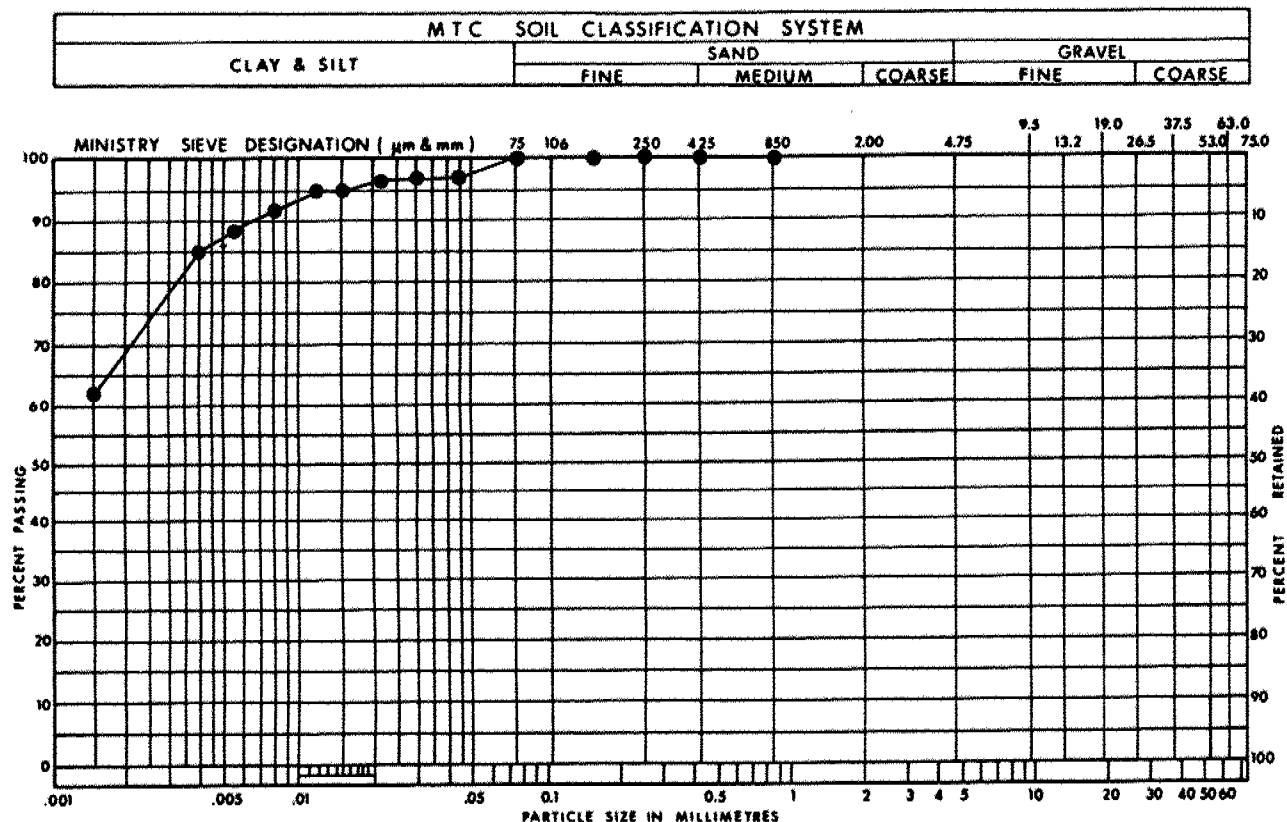
### LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	203	6	6.1-6.5

# GRAIN SIZE DISTRIBUTION

FIGURE 9

## SILTY CLAY

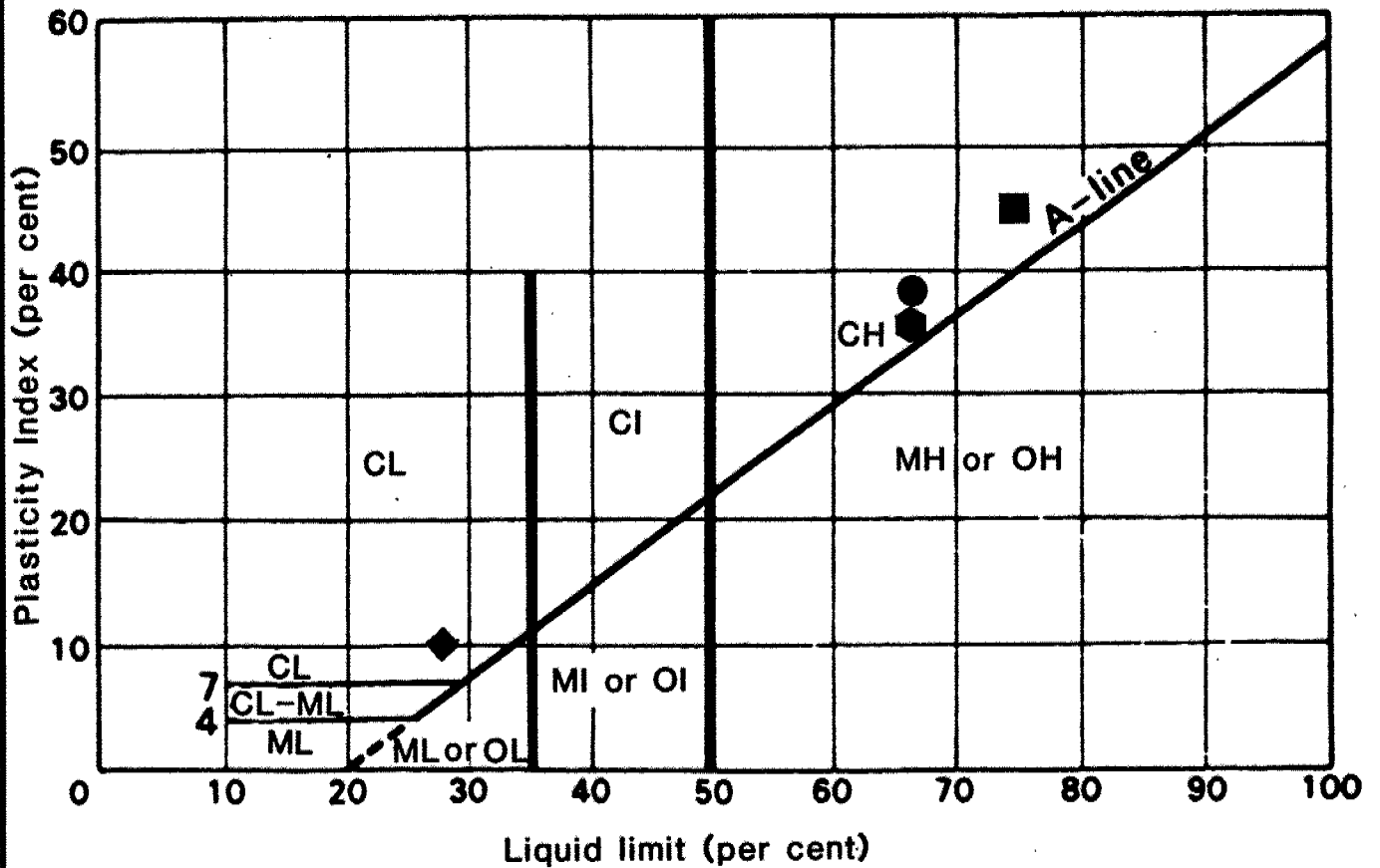


### LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	204	10	12.2-12.6

# PLASTICITY CHART

FIGURE 10



SOIL TYPE	PLASTICITY
C Clay	L Low
M Silt	I Intermediate
O Organic	H High

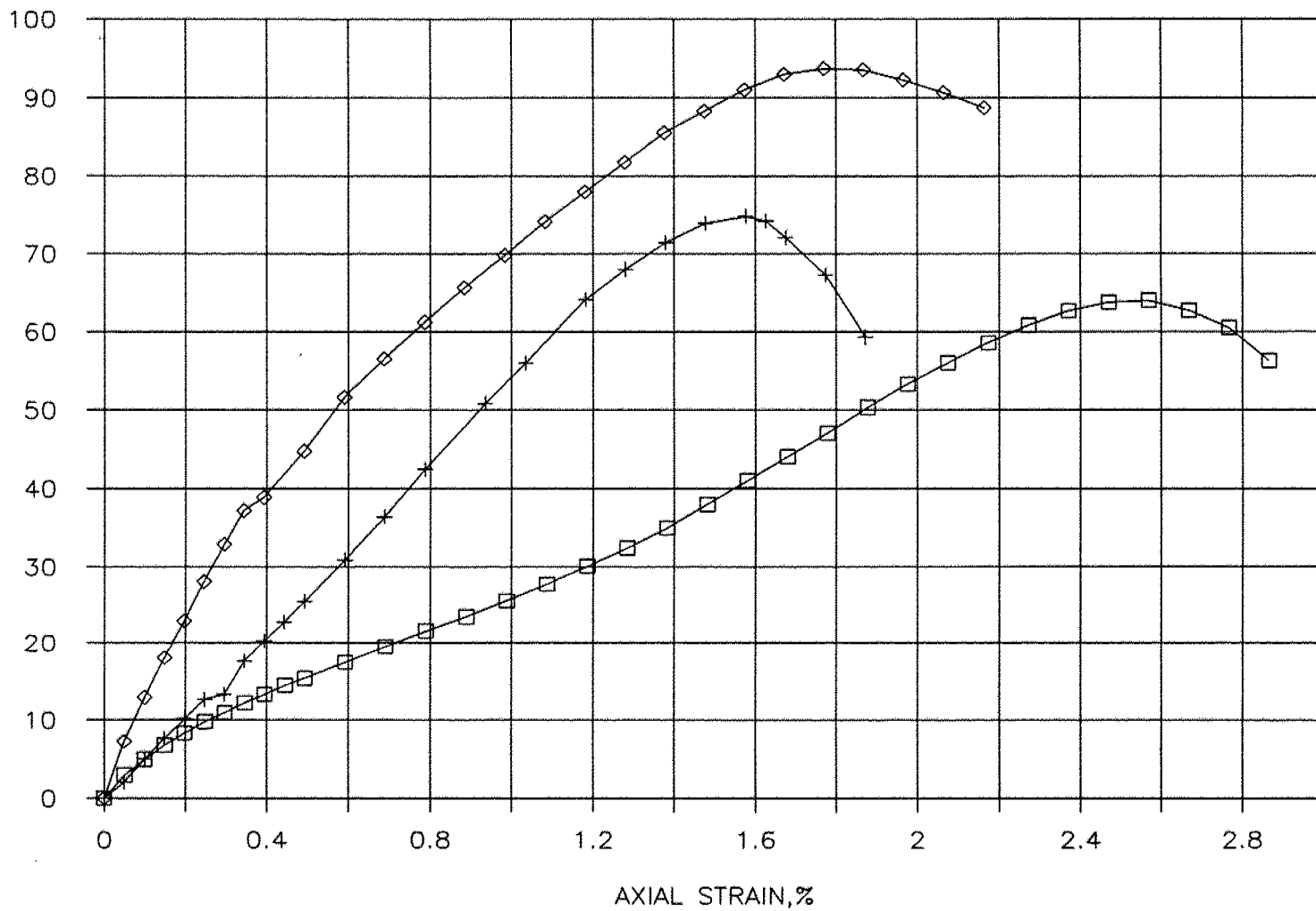
	BOREHOLE	SAMPLE	SAMPLE DESCRIPTION
●	201	8	SILTY CLAY
■	203	6	SILTY CLAY
◆	204	3	CLAYEY SILT
◆	204	10	SILTY CLAY

Date 941-8059  
Project 941-8059

Golder Associates

Drawn DW  
Chkd. *[Signature]*

DEVIATOR STRESS, kPa

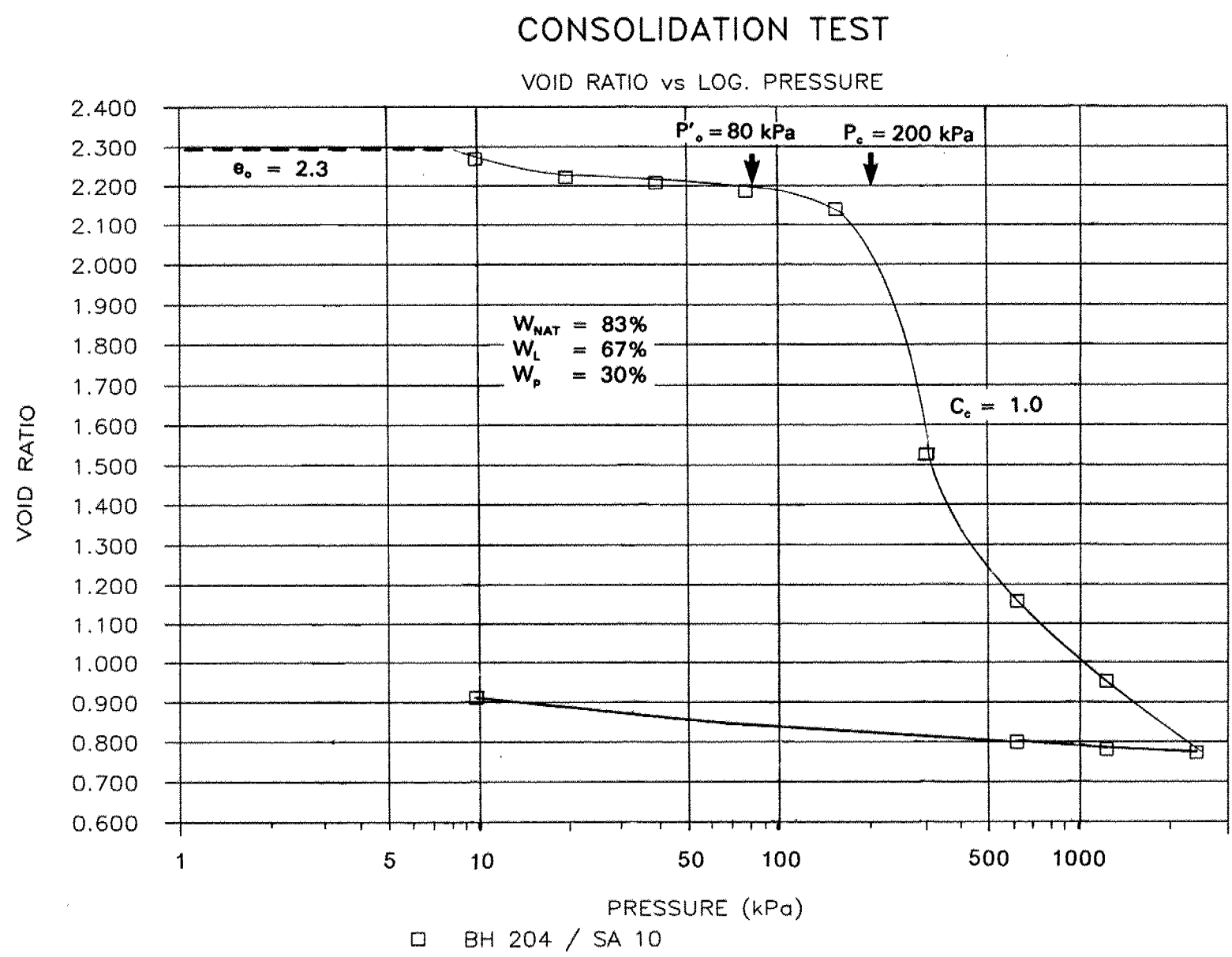


Symbol	BH	SA	Depth (m)	Undrained Shear Strength (kPa)	
				<i>U</i> Test	Lab Vane
□	201	8	9.1 - 9.5	32	32
+	203	6	6.1 - 6.5	37	33
◇	204	10	12.2 - 12.6	47	41

**UNCONFINED COMPRESSION TEST (*U*)**

**FIGURE 11**

Golder Associates



CONSOLIDATION TEST  
VOID RATIO VS. LOG PRESSURE

FIGURE 12



**Appendix A**

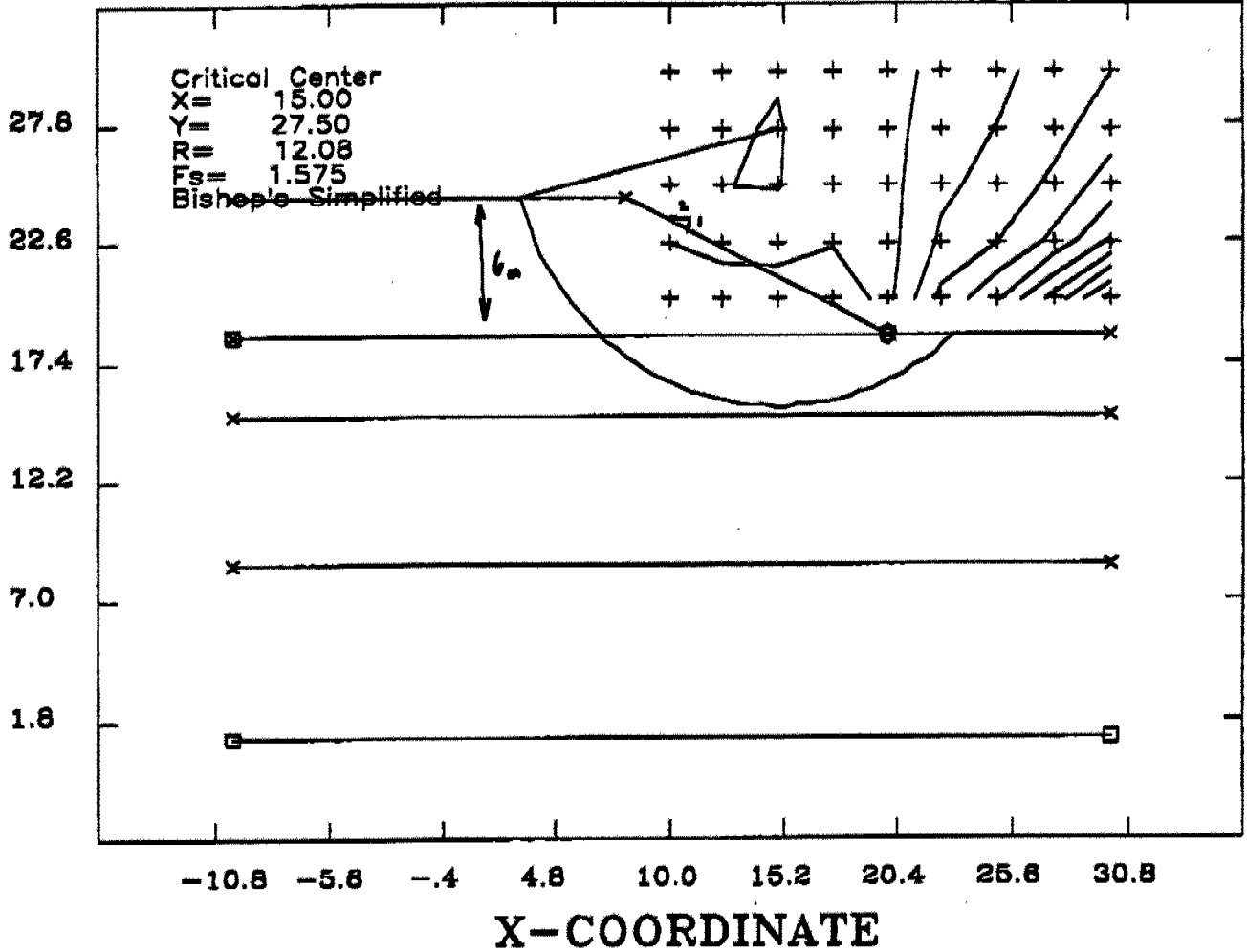
**RESULTS OF STABILITY ANALYSES**

# CROSS-SECTION OF GEOMETRY

C-1 Geometry: Short term conditions (BH 201)

(BH 201)

6m — 2:1 slope



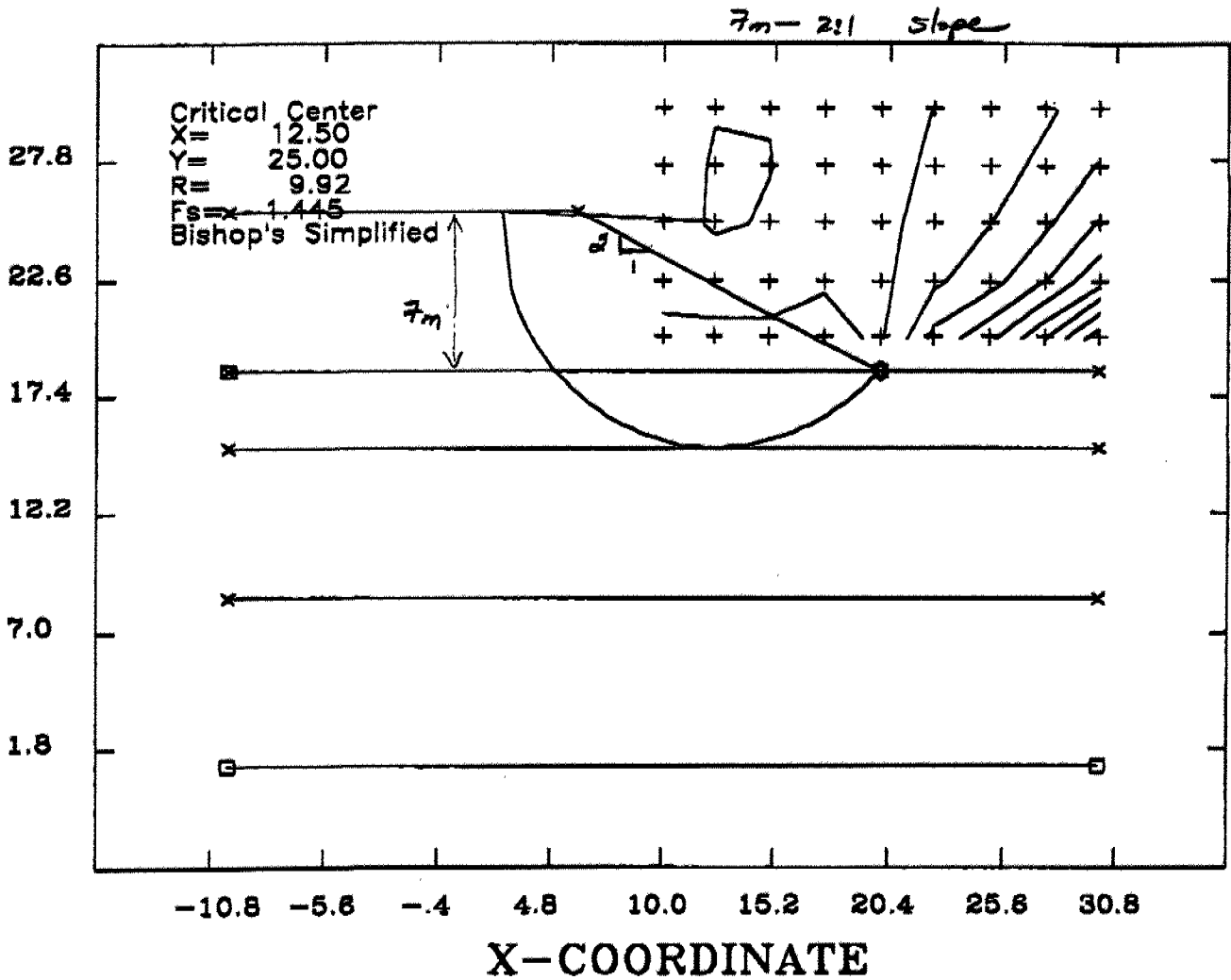
UNIT WEIGHT	COHESION	PHI	DESCRIPTION
19.00	.00	35.00	embankment — sand
16.50	28.00	.00	saturated silty clay
16.50	40.00	.00	saturated silty clay
16.50	48.00	.00	saturated silty clay

File name : C1.SET

# CROSS-SECTION OF GEOMETRY

E-1 Geometry; Short term conditions

(BH 201')

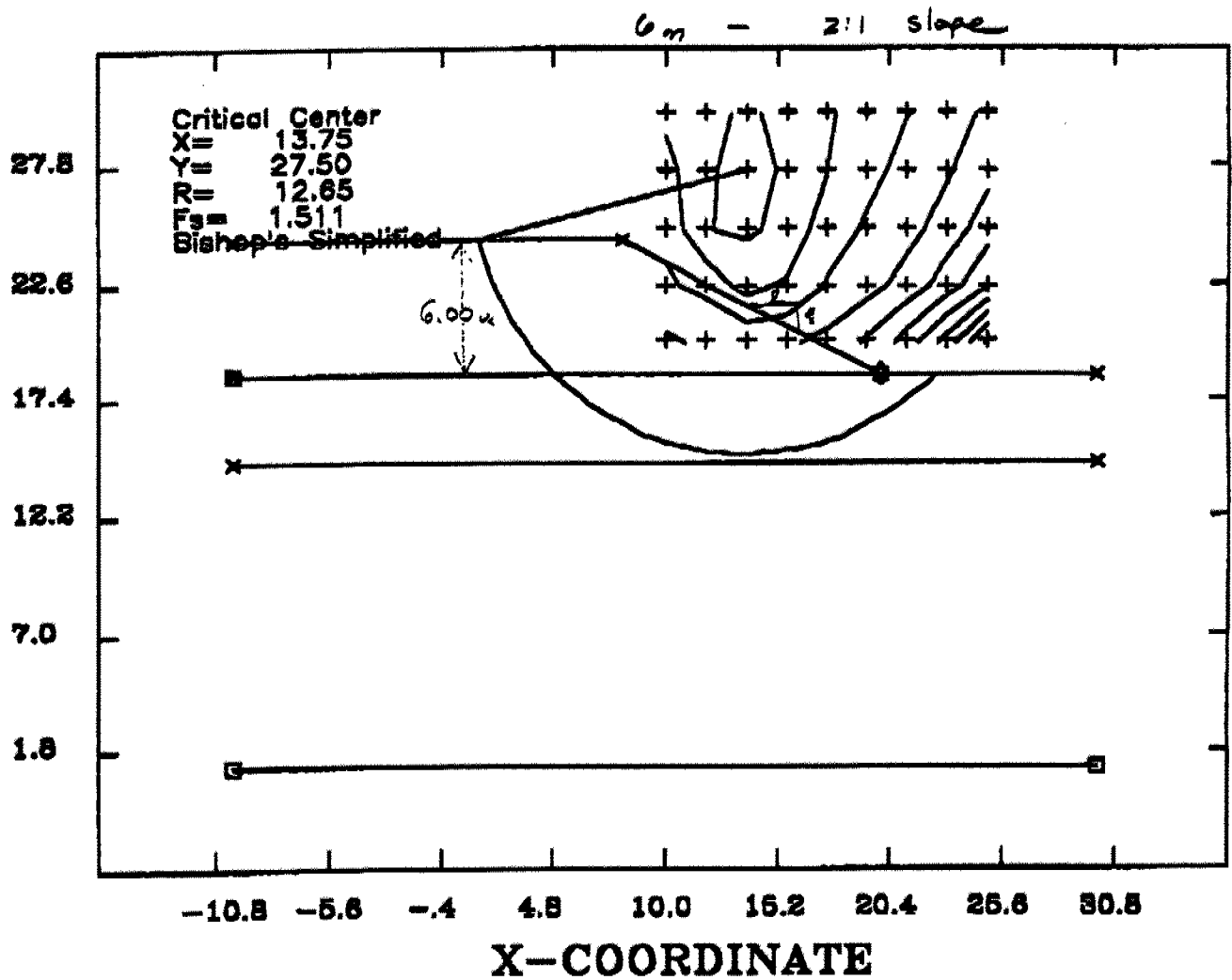


UNIT WEIGHT	COHESION	PHI	DESCRIPTION
19.00	.00	35.00	embankment - sand
16.50	28.00	.00	saturated silty clay
16.50	40.00	.00	saturated silty clay
16.50	48.00	.00	saturated silty clay

File name : e1.SET

# CROSS-SECTION OF GEOMETRY

C-2 Geometry, Short term conditions (BH 203)



UNIT WEIGHT	COHESION	PHI	DESCRIPTION
19.00	.00	35.00	embankment - sand
16.50	28.00	.00	saturated silty clay
16.50	40.00	.00	saturated silty clay

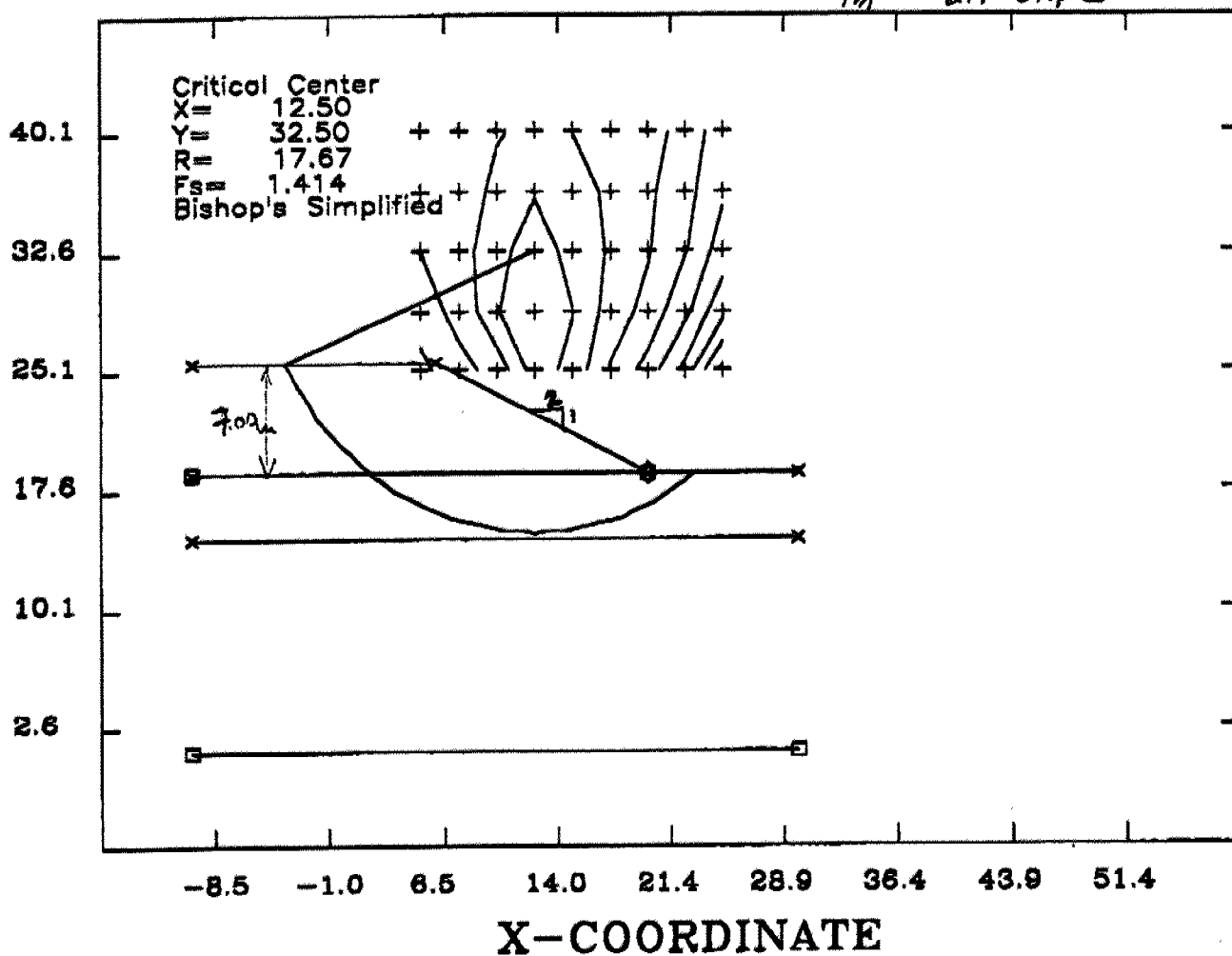
File name : C2.SET

# CROSS-SECTION OF GEOMETRY

E-2 Geometry; Short term conditions

(BH 203)

7m - 2:1 slope

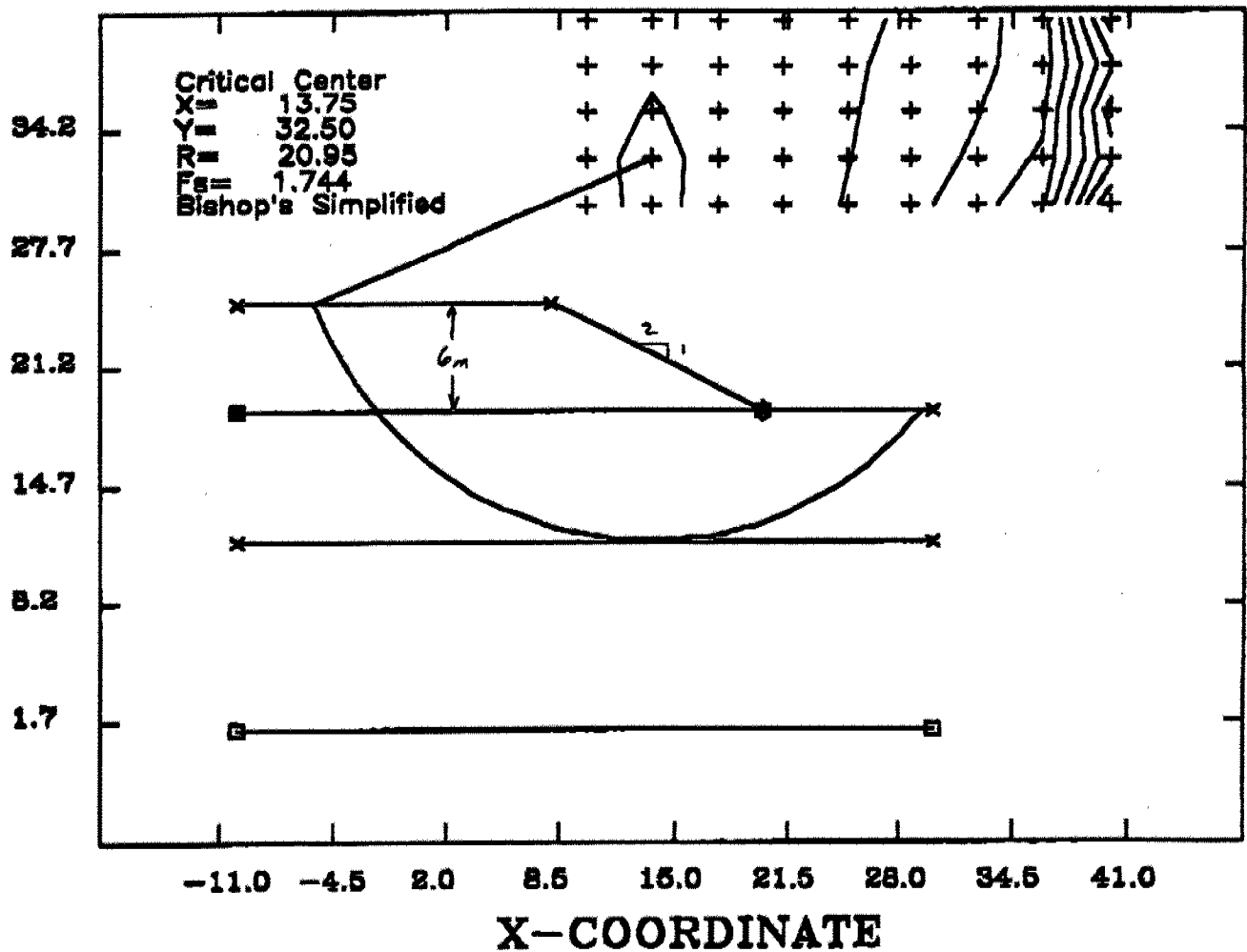


UNIT WEIGHT	COHESION	PHI	DESCRIPTION
19.00	.00	35.00	embankment - sand
16.50	28.00	.00	saturated silty clay
16.50	40.00	.00	saturated silty clay

File name : E2.SET

# CROSS-SECTION OF GEOMETRY

C-3 Geometry: Short term conditions (BH 204)



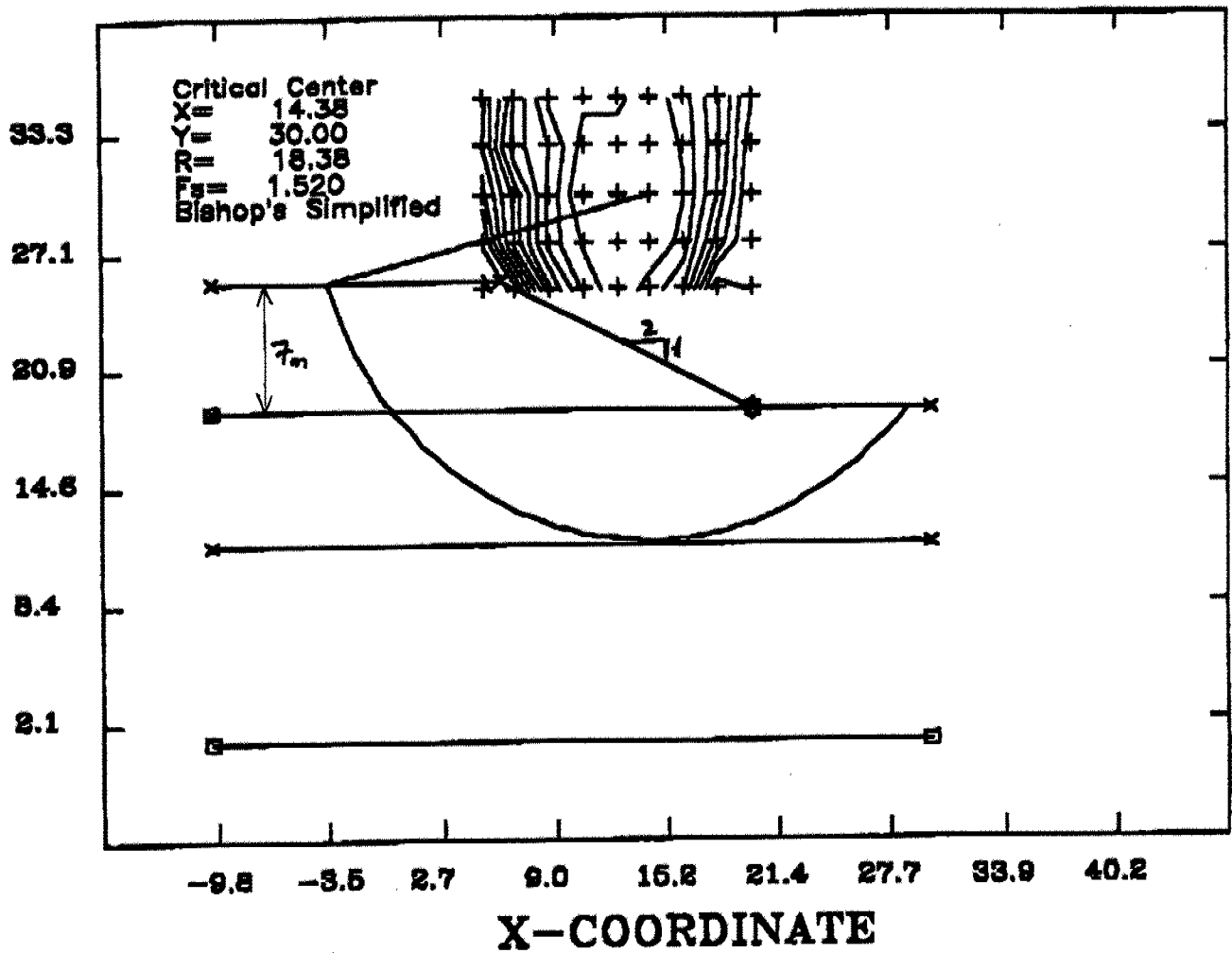
UNIT WEIGHT	COHESION	PHI	DESCRIPTION
19.00	.00	35.00	embankment - sand
16.50	35.00	.00	saturated silty clay
16.50	50.00	.00	saturated silty clay

File name : C3.SET

# CROSS-SECTION OF GEOMETRY

E-3 Geometry: Short term conditions (BH 204, H 7m, SL2:1)

Y-COORDINATE



UNIT WEIGHT	COHESION	PHI	DESCRIPTION
19.00	.00	35.00	embankment - sand
16.50	35.00	.00	saturated silty clay
16.50	50.00	.00	saturated silty clay

File name : E3.SET

