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Port Severn Dam

DBA ENGINEERING LTD.
DHILLON BURLEIGH & ASSOCIATES

PUBLIC WORKS CANADA

PROJECT NO.: 92-284/SP175

PORT SEVERIN DAM

GEOTECHNICAL
INVESTIGATION

CIVIL

PAVEMENT

GEOTECHNICAL

ENVIRONMENTAL &

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PORT SEVERIN DAM

**GEOTECHNICAL
INVESTIGATION**

PREPARED BY:

DBA ENGINEERING LTD.

NOVEMBER 17, 1992

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Part I
Factual Geotechnical Investigation
Port Severn Main Dam
Trent-Severn Waterway
Port Severn, Ontario

HISTORICAL

The Port Severn Main Dam is located on the Trent Severn Waterway, adjacent to Georgian Bay in Port Severn, Ontario. The existing dam of the concrete buttress type contains nine log controlled spillway structures - two of which are in common use to control the out flow from the Simcoe/Couchiching and Black River watersheds. The existing dam is reported to have been constructed in 1915 with only minor repairs undertaken since this date. The dam is founded on bedrock and the west abutment incorporates a lift lock and swing bridge. The water level on the upstream pond is near elevation 180.5, while the water level downstream is approximate elevation is 176.4. The difference in water levels accommodated by the lift lock is in the region of 4.1 m (13.4 feet).

TERMS OF REFERENCE

The purpose of this factual geotechnical investigation was to determine the quality of the concrete in the existing dam to determine the nature of the bedrock foundation and to evaluate the water tightness of the dam and bedrock. This investigation was carried out under the Terms of Reference, provided to DBA from Public Works Canada dated August 24, 1992, file no. 8554-0035-52314. A copy of these terms of reference are included as Appendix I.

FIELD INVESTIGATION

The field investigation consisted of twenty boreholes drilled through the dam and penetrating 3 m into the underlying bedrock. Coring was carried out using two machines perched on top of the dam along the lift mechanism railway. Coring was done using NQ core barrels. The core was carefully boxed in the field, shipped to the laboratory for detailed logging, photographing and selection of test samples. After completion of the laboratory study all cores with the exception of the concrete test samples were shipped to the Trent-Severn Waterway yard on Asburnham Street in Peterborough, Ontario.

On completion of the boreholes located at the piers, both falling head and packer tests were carried out. In almost all piers the packer was set with the top seal in sound concrete in the dam and the lower seal generally 0.6 to 0.7 m into the bedrock below the base of the dam/rock interface. Packer testing incorporated relatively low pressure testing with pressures in the range of 60 to 200 KPa (10 to 30 psi). In most cases the capacity for water take exceeded the pump capacity except at the lower pressures. With the packers in place, a falling head test was carried out to determine the extent of leakage in the concrete portion of the dam. The packer was then removed and the falling head test repeated over the entire length of the borehole. Three constant intervals of time were used to evaluate the water take during any test, however, it was generally found that a constant rate of flow was easily established.

The borehole data for each borehole consists of the general borehole log which describes the general nature of the material encountered and includes the elevations. Drilling notes are incorporated into this log. Following this general log sheet the core log describes the core in detail and indicates the location of packer tests and falling head tests. The core log contains various graphics and abbreviations that require interpretation using the "Exploratory Sheet to Core Log", this is enclosed as Drawing No. 22, while the boreholes are number Drawings 2 to 21. It is worth noting that borehole 19 and 19B are the same hole, however, because of a broken core barrel in borehole 19, borehole 19B was drilled adjacent to 19. The photograph of the concrete and rock core complete the borehole log information and follow the core log sheet.

Drawing No. 1 indicates the location of all the boreholes. These locations approximate the locations requested by DPW. The elevation of the boreholes is referenced to bench mark # 6143401 elevation 182.050 located at the north west end of the structure adjacent to the swing bridge seat. The elevations for the boreholes has been rounded to the nearest 0.1 value, the deck of the bridge is relatively flat with abutments being the highest elevation, 181.89 m and 181.86 m for the west and east abutments and the lowest area being near spillways 3 and 4 at elevation 181.84 m. More exact elevations of each borehole has been included on Table No. 4.

A composite pictorial view of the dam looking north from the downstream side and south showing the upstream view is shown as Drawing No. 1A.

STRATIGRAPHY

The stratigraphy at the dam site consists of the concrete dam over bedrock. The details of these layers obtained from the core results follows; a pictorial description of the core is shown as Drawings 2 to 21 .

(a) Concrete

The dam which was constructed in 1915 some 77 years ago reflects its age. The detailed condition survey is discussed under another heading. The concrete in the dam is generally only fair in quality. It is apparent that large size aggregate (>75 mm) was used in the manufacturing of the concrete. In many cases breaks are apparent along a poor bond at the contact with the large aggregate pieces. Construction joints are visible throughout the core, (and visually on the exterior of the dam) these construction joints are sometimes open with signs of open joints or eroded paste along the joints. The concrete in the abutments shows pockets of poorly cemented (or eroded) material typical of honey combing although these pockets are not likely continuous. The concrete in the piers tend to be in better condition than that at the base of the spillway where the sills show more sign of deterioration. Deck beams and seats show exposed reinforcing and are in numerous cases in poor condition.

Thirty one representative concrete samples were subjected to compression strength testing. This testing was carried out in accordance with CSA A23.179C Specifications in a wet condition. The breakdown of core location and strength is indicated on Table I. When considering the results of this table, it must be remembered that in general only sound concrete can be tested, hence weaker zones, areas of honeycomb etc. are not reflected in the values presented.

The strength test results reveal a wide spread in values with a significant number of low strengths i.e. < 20 MPa. The lower strength reflect a failure around large aggregate or what appears to be poor cement paste.

TABLE 1
Port Severn
Core Samples

Lab No.	Borehole	Elevation	Compressive Strength (MPa)
1	1	1.44	33.1
2	1	5.32	17.9
3	2	7.01	30.1
4	3	2.10	26.7
5	3	4.59	26.4
6	4	7.10	27.6
7	5	0.28	31.5
8	5	5.90	19.1
9	6	0.21	37.2
10	7	0.41	18.3
11	7	3.38	14.8
12	8	7.05	27.1
13	9	1.30	15.7
14	9	4.63	26.5
15	10	6.83	23.5
16	11	1.55	17.8
17	11	6.68	18.8
18	12	5.00	18.0
19	13	4.51	23.5
20	13	0.59	22.4
21	14	0.45	25.5
22	15	0.41	21.3
23	15	5.01	27.4
24	16	0.38	36.3
25	17	0.70	34.8
26	17	4.31	31.3
27	18	4.55	31.5
28	19	0.27	34.4
29	19	0.42	24.5
30	19	3.63	28.5
31	19	3.98	32.6
32	20	2.02	18.9

The contact of the concrete with the bedrock in most boreholes is good. Where large aggregate contacts the bedrock the joint is broken and shows signs of discoloration. It appears that small boulders were either left in place or added to the bottom of the concrete as the native bedrock stone is cored in several boreholes above the bedrock contact. A detailed description of the cored concrete is presented on the core log for each borehole. At boreholes 4, 5, 6, 11 and 18 the contact with bedrock is poor with signs of erosion and poor quality concrete paste. At borehole no. 11, there is missing material at the bedrock location.

BEDROCK

The bedrock has been identified as a migmatite gneiss. It is banded black and white and contains some pink coloration. There are numerous quartz veins; feldspar, biotite and hornblende are common. The bedrock is unweathered, of high strength and has bedding/joints at close to moderate intervals. The bedding joints are rough planar to rough undulating with both vertical and diagonal cross joints. Some of the joints show evidence of missing material.

The rock core recovery is generally 100 percent or very close to this percentage. The R.Q.D. value varies but is generally high reflecting a sound rock. Between boreholes 12 (bedrock contact elevation 173.7 m) and borehole 13 (bedrock contact elevation 176.6 m) a variation of 3 m in contact elevation was noted, with the bedrock remaining virtually flat on both sides of this point. As discussed earlier, the contact with concrete shows approximately 75 percent of the boreholes locations to be intact. Some boulders of the bedrock project into the concrete. Poorer rock quality tends to exist approximately up to 10 - 20 cm below the bedrock contact.

The bedrock is described in considerable detail on the core logs. The explanatory sheet for the core logs is Drawing No. 22 and should be referred to when interpreting the core logs. Detailed photographs of the rock core (and concrete) are included.

TABLE 2
Rock to Concrete Contact

Borehole No.	Approx. Elevation Bedrock/Concrete Contact	Comment
1	173.9	Contact intact; fractured rock immediately below contact. Some deterioration of concrete immediately above contact.
2	174.2	Contact intact; area sound above and below.
3	173.8	Contact intact; broken bedrock zone 30 cm below contact.
4	174.0	Possible erosion at contact, weak paste, fracture in concrete just above contact.
5	174.2	Possible erosion at contact.
6	174.1	Weak paste and possible erosion at contact.
7	174.2	Probably good contact; core broken at contact due to drilling.
8	174.1	Contact intact.
9	174.4	Contact intact, fractures 5-10 cm beneath contact zone.
10	174.2	Probably good contact.
11	174.5	Missing material at bedrock contact.
12	173.7	Contact intact.
13	176.6	Contact intact.
14	176.8	Contact intact.

TABLE 2 Continued
Rock to Concrete Contact

Borehole No.	Approx. Elevation Bedrock/Concrete Contact	Comment
15	176.7	Broken rock immediately below contact.
16	176.6	Contact intact.
17	176.8	Contact intact; fracture in concrete just above contact.
18	176.4	Contact eroded; boulder or crevice at borehole contact location.
19/19B	177.4	Broken rock at contact.
20	177.3	Possibly intact contact.

LEAKAGE

Both falling head tests and packer tests were carried out to assist in evaluating the water tightness of the concrete dam and the bedrock. The packer tests were carried out using a double packer of approximately 1.7 m in length. The packer was located at the contact with the concrete and bedrock with 0.6 to 0.7 m length into the bedrock. Falling head tests were carried out in the concrete portion of the dam and in the entire hole to evaluate the difference in values for the concrete and bedrock.

The permeability or potential for leakage should be described as to how much seepage can pass through the concrete or bedrock under the existing head. Measurements such as those taken are not accurate as some seepage moves down, up and in 360 °. The value of permeability is therefore subject to very large errors and as well is not generally useful when considering grouting. A test that considers the flow

radially from the test hole and is used extensively in grouting is the lugeon test (μl). Table No. 3 attempts to summarize the results of the packer and falling head tests. These results must be considered as only indicators of permeability and that the error could be in the region of ± 10 to 100 times the values shown. The values of Table 3 basically should be used to reach two conclusions:

1. The concrete dam is reasonably sound and grouting the concrete itself will be difficult. Highly viscous grout with low grouting pressures are required. High grouting pressure may cause separation (fracturing) along the construction joints.
2. The bedrock beneath the dam is highly permeable and because of high leakage velocities will be difficult to grout.

TABLE 3
Permeability/Falling Head Test Results

Borehole No.	Test Description	Approx. Permeability cm/sec.	Lugeon
1	(A) Falling head test in concrete dam section to 6.8 m depth.	No take	-----
	(B) Falling head test in rock ~3 m length below dam.	Could not fill hole	>100 μl
	(C) Packer test, rock concrete contact, 0.5 m into rock.	10^{-1} to 10^{-2}	>100 μl
3	(A) Falling head test in concrete dam section to 7 m depth.	no take	-----
	(B) Falling head test in rock ~3m length below dam.	Could not fill hole	>100 μl
5	(A) Falling head test concrete dam to 6.5 m depth.	< 1 litre/minute	-----
	(B) Falling head test in rock ~3 m length below dam.	10^{-2} cm/sec.	>100 μl

TABLE 3 Continued
Permeability/Falling Head Test Results

Borehole No.	Test Description	Approximate Permeability cm/sec.	Lugeon
7	(C) Packer test; rock to concrete contact 0.6 m into rock.	10^{-3} cm/sec.	>100 μ l
	(A) Falling head test; concrete dam to 6.7 m depth.	<1 litre/min.	-----
	(B) Falling head test in rock ~3 m length below dam.	Could not fill hole	>100 μ l
9	(C) Packer test; rock to concrete contact 0.7 m into rock.	10^{-4} cm/sec.	~15 μ l
	(A) Falling head test; concrete dam to 6.5 m depth.	No take	
	(B) Falling head test in rock approximately 3 m length below dam.	10^{-2} cm/sec.	>100 μ l
11	(C) Packer test rock to concrete contact 0.7 m into rock.	10^{-3} cm/sec.	>100 μ l
	(A) Falling head test in concrete dam to 6.1 m depth.	~1 litre/min.	----
	(B) Falling head test in rock approximately 3 m length below dam	10^{-3} cm/sec.	>100 μ l
13	(A) Falling head test; concrete dam to 4 m depth.	Negligible take	----
	(B) Falling head test in rock ~3 m length below dam.	10^{-3}	>100 μ l
	(C) Packer test; rock to concrete contact 0.7 m into rock.	10^{-3}	100 μ l

TABLE 3 Continued
Permeability/Falling Head Test Results

Borehole No.	Test Description	Approximate Permeability cm/sec.	Lugeon
15	(A) Falling head test; concrete dam to 4.5 m depth.	Negligible take	----
	(B) Falling head test; in rock approximately 3 m length below dam.	10^{-2} to 10^{-3}	>100 μ l
	(C) Packer test rock to concrete contact 0.6 m into rock.	10^{-3} cm/sec.	>100 μ l
17	(A) Falling head test concrete dam to 4.4 m depth.	1 litre/m	
	Falling head test; in rock approximately 3 m length below dam.	10^{-2} to 10^{-3}	>100 μ l
19/19b	(A) Falling head test; concrete dam* to 3.2 m depth	10^{-4}	~ 15 μ l
	(B) Falling head test; in rock approximately 3 m length below dam.	10^{-4}	~ 15 +10 μ l
	(C) Packer test rock to concrete contact 0.7 m into rock.	10^{-3} cm/sec.	>100 μ l

Both of these conclusions indicates that only a highly skilled specialized grouting contractor should be considered for this project, if it is decided to grout the dam.

Despite the fact that there is a high degree of leakage beneath the dam there is no indication of a major overall problem. The bedrock core shows sound, strong rock with minor signs of erosion. The concrete dam does show some sign of erosion of the cement paste near the bedrock contact, (Table 2) and shows signs of old age nearing the end of a typical life expectancy.

Some general comments related to grouting are as follows:

Based on the results of the leakage testing the most significant water seepage would occur through the fractured rock zone immediately below the concrete sill slab. With respect to the concrete piers and abutments the concrete appears to have very low permeability. Significant water seepage through the concrete structure would occur at the horizontal construction joints.

Grouting of the fractured rock mass beneath the concrete sill slab may be feasible using conventional grouting techniques. Grouting of the concrete structure may not be effective due to leached deposits in the horizontal joints.

Grouting recommendations for the fractured rock zone are as follows:

Grouting of the rock mass ideally should be carried out under dry conditions utilizing a cofferdam. If this is not feasible grouting may possibly be carried out using a modified procedure for flowing water conditions, however, grouting should be carried out when the water level has been drawn down to its lowest possible elevation.

A grouting trial should be carried out in one opening/spillway to evaluate grouting procedure including consistency of grout mix, need for accelerators - thixotropic agents, spacing of grout holes and monitoring requirements. As an initial procedure the following is recommended:

Grout holes 64 mm in diameter be drilled 2.1 m on centre through the concrete sill slab to a minimum depth of 300 mm into the sound rock - RQD 90 percent or better.

Install packer monitoring tubes in all drill holes except grout hole. Monitoring tubes to be installed such that the top is above water to facilitate monitoring of the grouting operations.

Utilize a prebagged grout mix as manufactured by Intrusion Prepak or Stealth grout as manufactured by KPM Industries. Alternatively a more flexible site batched grout may be employed however, laboratory trial batches will have to be carried out to achieve strength requirements and volume stability at various water total cementitious ratios from 5:1 to 0.45. The grout should be composed of:

Type 10 Portland Cement

Silica Fume - Not to exceed 10 percent of total cementitious content

Flyash Type C - Not to exceed 25 percent of total cementitious content.

Accelerator dosages to achieve initial set at 20, 40, 60, 120, 240 Minutes.

Thixotropic agent dosage to achieve desired workability at low water cementitious ratios.

Minimum 28 day compressive strength of grout should be 30 Mpa

Grout mixer to be high speed colloidal mixer.

Grout pump to be continuous feed positive displacement type equipped with a flow meter, pressure gauge to indicate grout injection pressure at pump and grout pressure in the grout hole.

Grouting to commence at upstream hole utilizing grout at w/cementitious ratio of 5:1 reduced to minimum w/cementitious ratio at which no grout take occurs using a grouting pressure calculated according to depth based on the effective pressure, approximately 0.07 kPa per 300 mm of overburden. To commence grouting operations higher initial pressures may be used to achieve grout flow but shall be reduced as soon as grout flow is evident. Following no grout take the w/cementitious ratio shall be increased until flow occurs at design safe grouting pressures. Grouting shall continue and grouting progress monitored by recording time to intercept of adjacent grout monitoring tubes. Grout pressure in the grout hole shall be monitored. When grout pressure in the grout hole reaches the maximum design safe grouting pressure grouting shall continue until grout refusal occurs at this maximum pressure. Grouting and monitoring of the remaining holes shall be carried out in the same manner.

Upon completion of the trial grouting operation core samples should be obtained from locations between the grout holes to evaluate the void reduction in the rock mass.

Due to significant water flow conditions second and subsequent stages of grouting may be required to completely fill the fractured rock mass beneath the concrete sill slab. Also if the dry condition grouting procedure is not adopted an alternative, rapid set grouting procedure may be anticipated at least in areas of high flow.

Based on the results of the above trial, spacing of the grout holes can be adjusted and the grout mixes to be utilized in the first and subsequent stages finalized.

Grouting recommendations for the structural concrete piers and abutments are as follows:

Grouting of the concrete below the waterline ideally should be carried out under dry conditions utilizing a cofferdam. If this is not feasible grouting may be carried out under flowing water conditions; grouting preferably should be carried out when the water level has been drawn down to its lowest elevation.

As an initial procedure the following is recommended:

Grout holes 64 mm in diameter be drilled 1 m on centre along the centreline of the pier to a minimum depth of 300 mm into the sill slab.

Establish elevations of open horizontal joints.

Utilize a prebagged grout mix as manufactured by Intrusion Prepakts or Stealth grout as manufactured by KPM Industries. Minimum 28 day compressive strength of grout should be 30 Mpa.

Grout mixer to be high colloidal mixer.

Grout pump to be continuous feed positive displacement type equipped with a flow meter, pressure gauge to indicate grout injection pressure at pump and grout pressure in the grout zone.

Grout packers to be installed such that grouting zone is sealed a minimum of 300 mm into sound concrete on either side of the open joint.

Install packer monitoring tubes in drill holes immediately adjacent to the grout hole to facilitate monitoring of the grouting operations.

Grouting to commence at upstream hole at lowest zone of open joints utilizing at w/cementitious ratio of 5:1 reduced to minimum w/cementitious ratio at which no grout take occurs using a grouting pressure calculated according to depth based on the effective pressure, approximately 0.07 kPa per 300 mm of overburden. To commence grouting operations higher initial pressures may be used to achieve grout flow but shall be reduced as soon as grout flow is evident. Following no grout take w/cementitious ratio shall be increased until flow occurs at design safe grouting pressures. Grouting shall continue and grouting progress monitored by recording time to intercept of adjacent grout monitoring tubes. Grout pressure in the grout hole shall be monitored. When grout pressure in the grout hole reaches the maximum design safe grouting pressure, grouting shall continue until grout refusal occurs at this maximum pressure. Grouting of the open joint zones above the grouted zone shall be carried out in the same manner followed by grouting of the adjacent holes.

Upon completion of the trial grouting operations core samples should be obtained from locations between the grout holes to evaluate the void reduction in the rock mass.

Based on the results of the above trial, spacing of the grout holes can be adjusted and the mixes to be utilized finalized.

Crack Repair to Concrete Dam

It is possible that leached deposits may be difficult to remove from cracked areas making the repairs to the concrete dam difficult and of questionable merit. Crack repair should be carried out in the dry.

The contractor will provide all labour materials plant and equipment to pressure inject epoxy grout into cracks in the concrete on the dam structures including sills, piers, sluice-ways and log chutes. Work should conform to -C881 - Epoxy Resin Based Bonding Systems for Concrete. Normal qualifications and inspections and testing will be outlined. Grouting separation along construction joints must be avoided.

It is anticipated that the contractor will:

1. Remove all deteriorated concrete,
2. Inject epoxy grout,
3. Place repair concrete,
4. Complete local surface repairs.

Typical Epoxy Grout Injection Resin products include Capweld 333, Sikadur 52 or equal alternatives. The epoxy bonder for installation of injection posts can consist of Capbond EX Epoxy Bonder or Sikadur 31 Hi Mod Gel or equivalent. A spill contingency plan should be available to provide environmental protection in case of accidental spill.

The contractors equipment should be designed for continuous proportioning mixing and pressure injection of a two part component epoxy injection grout. The injection machine must be capable of monitoring uniform proportioning mixing through a pressure range of 0-150 psi. Pressure gauges are required at the pump and at the injection point. The use of pressure pots or caulking guns is not permitted.

Epoxy grouting should be carried out with temperatures above 5°C without the presence of ice. Loose concrete, dirt, algae and other deleterious material must be removed. Surface injection posts or injection packers should be located at not more than 30 cm spacing. Grouting should begin at the lowest point using grouting pressures carefully predetermined by the engineer. Full depth penetration of the crack with epoxy grout is expected. Holes can be dry packed with approved patch material. Final surface cleaning with hand tools and hydro blasting should be specified.

TABLE 4
Borehole Location

Borehole No.	Reference (See Dwg. 1)	Precise Elevation
1	1.22 m west canal wall 0.96 m south of north reference wall	181.89
2	3.87 m west centreline pier 2 1.80 m north of south reference wall	181.86
3	Centreline pier 2 1.80 m north of south reference wall	181.85
4	3.73 m east centreline pier 2 1.71 m north of south reference wall	181.84
5	Centreline pier 3 2.35 m north of south reference wall	181.84
6	3.76 m east of centreline pier 3 1.78 m north of south reference wall	181.84
7	Centreline pier 4 1.72 m north of south reference wall	181.85
8	3.99 m east of centreline pier 4 1.74 m north of south reference wall	181.84
9	Centreline pier 5 1.79 m north of south reference wall	181.85
10	4.89 m east of centreline pier 5 0.96 m north of south reference line	181.85
11	Centreline pier 6 1.63 m north of south reference line	181.87
12	3.72 m east of centreline pier 6 1.72 m north of south reference line	181.86
13	Centreline pier 7 1.67 m north of south reference line	181.86

TABLE 4
Borehole Location

Borehole No.	Reference (See Drawing 1)	Precise Elevation
14	4.04 m east of centreline pier 7 1.74 m north of south reference line	181.86
15	Centreline pier 8 1.69 m north of south reference line	181.87
16	3.86 m east of centreline pier 8 1.76 m north of south reference line	181.85
17	Centreline pier 9 1.65 m north of south reference line	181.86
18	3.93 m east of centreline pier 9 1.74 m north of south reference line	181.86
19B	3.81 m east of BH18 on approximate centreline of east abutment 1.48 m north of south reference line	181.86
20	3.81 east of borehole, borehole 18 0.61 m north wall corner (see drawing 1)	181.86

GENERAL COMMENTS

The data presented has been obtained from 20 cored holes located along the structure. Variations from the conditions encountered should be anticipated. The concrete strengths reflect only the value for the section tested and large variations above and below those reported will occur. The leakage measurements are accurate only to the extent that they show a reasonably tight concrete structure and a bedrock with a high degree of leakage. The concrete dam contact with the bedrock is fair to good as over 70 percent of the rock/concrete interfaces were intact.

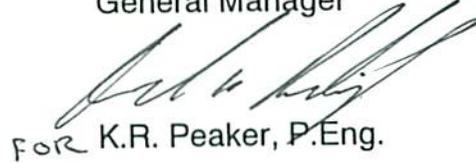
This report (Part 1) is a factual report and does not consider the overall stability of the dam, nor the possible effects of repairs or methods of repair.

Part 2 of this report contains the condition survey obtained from visual observation and should be considered in conjunction with Part 1

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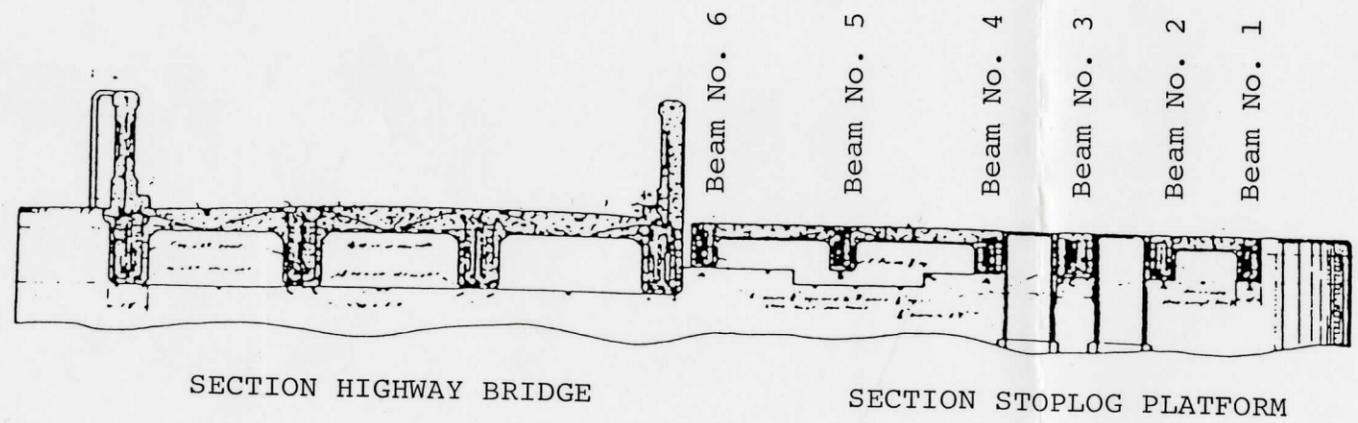
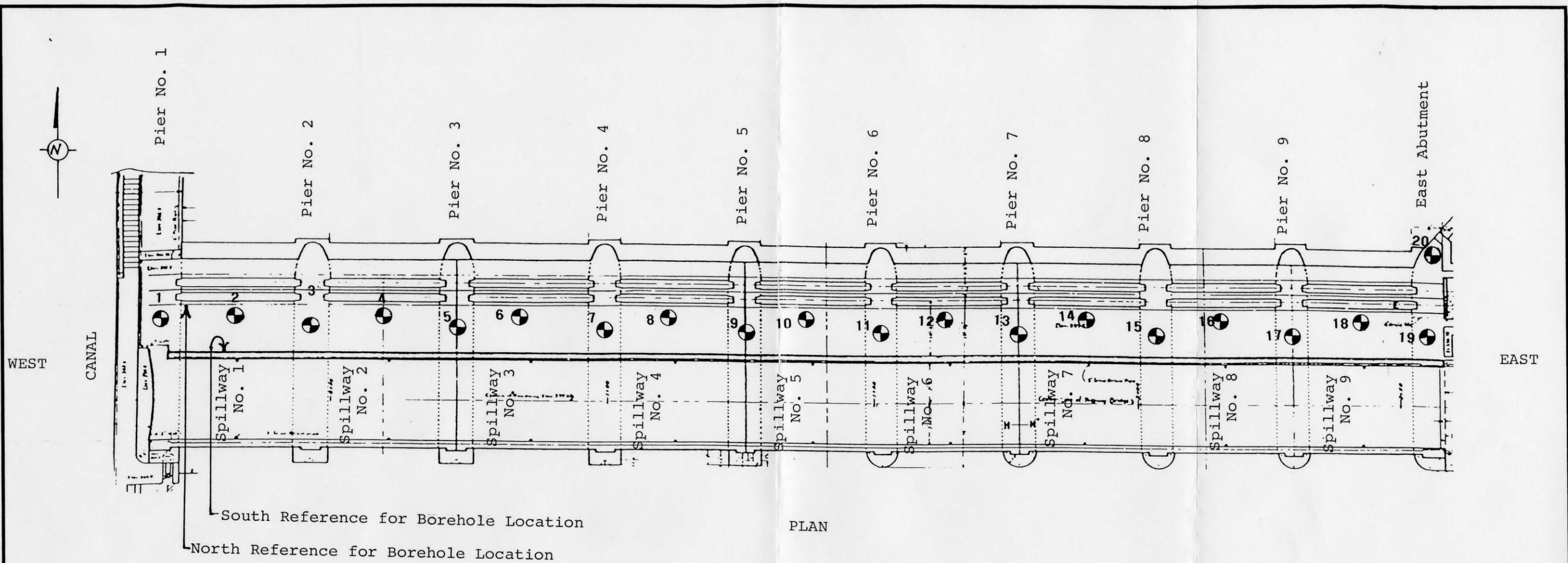


P.S. Dhillon, P.Eng.,
General Manager


FOR K.R. Peaker, P.Eng.

KRP:rcb
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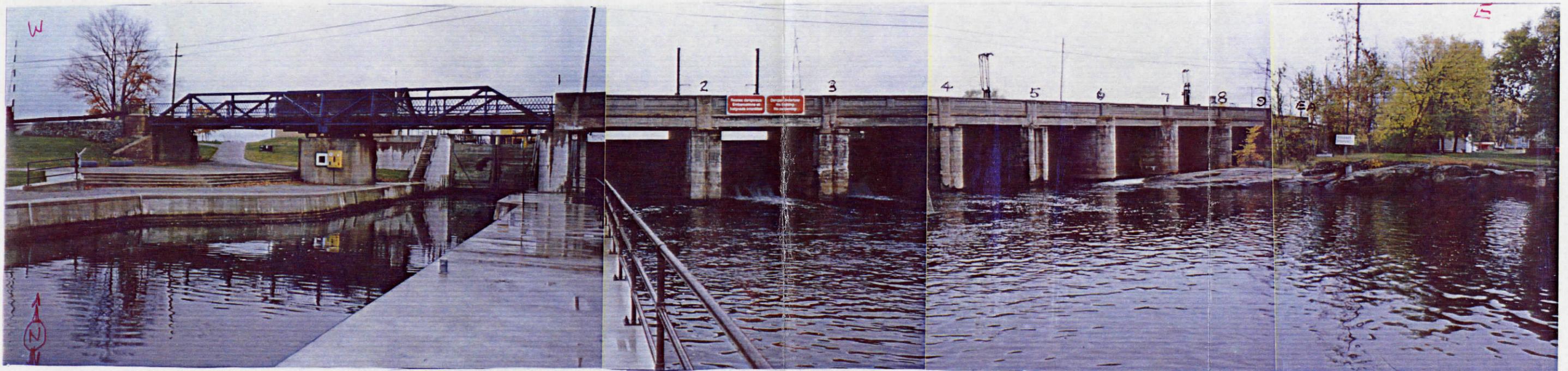
Public Works Canada (6)
File (1)



DBA / SP 175		
SCALE: NO SCALE	APPROVED BY:	DRAWN BY
DATE: NOV 92		REVISED
BOREHOLE LOCATIONS ; PIER REFERENCE DRAWING		
PORT SEVERN MAIN DAM		DRAWING NUMBER 1



UPSTREAM LOOKING SOUTH



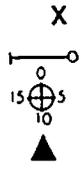
DOWNSTREAM LOOKING NORTH

PORT SEVERN MAIN DAM, PORT SEVERN, ONTARIO

Log of Borehole 1

S & P

- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test: — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test: + s Penetrometer



Project Port Severn Main Dam Dwg No 2
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

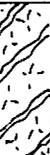
G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight (N/m ³)
					20	40	60	80	% Dry Weight			
					Shear Strength MPa				10	20	30	
		CONCRETE	181.9	0								Run #1
				2								Run #2
				4								Run #3
				6								Run #4
				8								Run #5
		BEDROCK	173.9	8								Run #6
				10								Run #7
		END OF BOREHOLE	171.1	12								Run #8
		<u>NOTES</u>		14								
		1) Hole advanced by means of wash boring drill rig on Oct. 5th/92.		16								
		2) Water level in hole Depth Date 5.36m Oct. 6th/92		18								
		3) Return of water lost at 8.19m depth.		20								
		4) Water level upper pond = 180.5 Water level downstream = 176.4										

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.89m	Datum Geodetic	Borehole No. 1
Location	Date Started Oct. 5/92	Completed Oct. 5/92	Logged By Shaheen & Peaker	Sheet 1 of 2
Client Public Works Canada	Drilling Agency Malone	Drill Type B. 40	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
181.89	1	▲	CONCRETE, broken core to 0.2m, open joints or eroded paste along joints to about 2.1m, flat construction at 4.44 m, joints or breaks commonly occur at poor bond with coarse aggregates.											No. 1	100%		NQ			
	2	▲												No. 2	100%		NQ			
	3	▲												No. 3	99%		NQ			
	4	▲												No. 4	100%		NQ			
	5	▲												No. 4	100%		NQ			
	6	▲	Open joints or eroded paste along joints below 6.2m.											No. 5	99%		NQ			
	7	▲												No. 5	99%		NQ		↑	
173.9	8	▲	MIGMATITE GNEISS, banded black and white, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers or pockets, unweathered, high strength, bedding joints are at close to moderate intervals and are rough planar to rough undulating eroded material at joint surface at 9.25m.				VC							No. 6	99%	84	NQ		↓	
	9	▲		I	B	F	C	RP	T	O				No. 7	99%	100	NQ	No Water Recovery		
Remarks																				

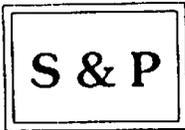
CORE LOG

CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.89			Datum Geodetic			Borehole No. 1						
Location				Date Started Oct. 5/92			Completed Oct. 5/92			Logged By Shaheen & Peaker			Sheet 2 of 2						
Client Public Works Canada				Drilling Agency Malone			Drill Type B-40			Core Barrel & Bit Design NQ			Project No. SP175						
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.89			MIGMATITE GNEISS	I	B	F	C	R	P	T	O			No. 7 99%	100	NQ	No Water Recov- ery		
171.1	11		END OF BOREHOLE											No. 8 97%	100	NQ			
	12																		
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		
Remarks																			

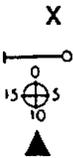


Port Severn Bridge
Concrete and Rock Core Borehole No. 1

Log of Borehole 2



- Auger Sample Natural Moisture
- SPT (N) Value Plastic and Liquid Limit
- Dynamic Cone Test Undrained Triaxial at Overburden Pressure
- Shelby Tube % Strain at Failure
- Field Vane Test: Penetrometer



Project Port Severn Main Dam Dwg No. 3
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H m	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³	
					20	40	60	80	% Dry Weight				
					Shear Strength MPa				10	20	30		
		CONCRETE DECK	181.9	0	Grid content for the rest of the table								
		0.15m		2									
				4									
				6									
		CONCRETE	175.0	8									
		BEDROCK	174.2	10									
		END OF BOREHOLE	171.1	12									
		NOTES		14									
		1) Hole advanced by means wash boring drill rig on Oct. 6th/92.		16									
		2) Water level in hole - not possible to measure		18									
		3) No return of water		20									
				22									
				24									
				26									
				28									
				30									
				32									
				34									
				36									
				38									
				40									
				42									
				44									
				46									
				48									
				50									
				52									
				54									
				56									
				58									
				60									
				62									
				64									
				66									
				68									
				70									
				72									
				74									
				76									
				78									
				80									
				82									
				84									
				86									
				88									
				90									
				92									
				94									
				96									
				98									
				100									

Run #1
Run #2
Run #3

CORE LOG

CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.86m			Datum Geodetic			Borehole No. 2						
Location				Date Started Oct. 6/92			Completed Oct. 6/92			Logged By Shaheen & Peaker			Sheet 1 of 2						
Client Public Works Canada				Drilling Agency Malone			Drill Type B40			Core Barrel & Bit Design NQ			Project No. SP175						
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.86			Deck																
	1																		
	2																		
	3		Space																
	4																		
	5																		
	6																		
175.0	7		Concrete, eroded paste in joints at 7.2 and 7.3m.											NO1		NQ	No Water Recovery		
174.3	8		Migmatite Gneiss, banded pink, black and white, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers or pockets, thick pegmatite layer at 9.6m, unweathered high strength, bedding joints are at very close to moderate intervals and rough planar to rough undulating, diagonal cross joints at 9.46m.				M							100	100				
	9						C	R	T	O				NO2			No Water Recovery		
							B	F							68	NQ			
							C	D						98					
							B	F	M										
Remarks																			

CORE LOG

CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.86			Datum Geodetic			Borehole No. 2						
Location Public Works Canada				Date Started Oct. 5/92			Completed Oct. 5/92			Logged By Shaheen & Peaker			Sheet 2 of 2						
Client				Drilling Agency Malone			Drill Type B40			Core Barrel & Bit Design NO			Project No. SP175						
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.86			Migmatite Gneiss	I	B	F	M	RE	RU	T	O				NO3			No Water Recovery	
171.1			End of Borehole												100	100	NO		
Remarks																			

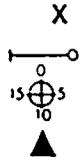


Port Severn Dam
Concrete and Rock Core Borehole No. 2

Log of Borehole 3



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test + s Penetrometer



Project Port Severn Main Dam Dwg. No. 4
Port Severn, Ontario

Project No. SP175

Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits % Dry Weight			Natural Unit Weight kN/m ³
					20	40	60	80	10	20	30	
		CONCRETE	181.8	0								Run #1
				2								Run #2
				4								Run #3
				6								Run #4
				8								Run #5
		BEDROCK	173.8	8								Run #6
				10								Run #7
		END OF BOREHOLE	170.5	10								Run #8
		NOTES		12								
		1) Hole advanced by means of wash boring drill rig on Oct. 6,7/92		14								
		2) Water level in hole 4.61m		16								
		3) No return of water for Run #7		18								
				20								



Port Severn Dam
Concrete and Rock Core Borehole No. 3

CORE LOG

CORE LOG																		
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.84m			Datum Geodetic			Borehole No. 4					
Location				Date Started October 7/92			Completed October 7/92			Logged By Shaheen & Peaker			Sheet 1 of 2					
Client Public Works Canada				Drilling Agency Malone			Drill Type CME - 45			Core Barrel & Bit Design NO			Project No. SP175					
ELEVATION (m)	DEPTH (m)	SYMBOL	Deck GENERAL DESCRIPTION	Joint Characteristics							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No CORE RECOVERY %	R Q D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
181.84			DECK															
	1																	
	2		SPACE															
	3																	
	4																	
	5																	
	6																	
175.0			Concrete, open joints or possible eroded paste at 6.9m, 7.4m and 7.8m.											NO1			no water re-covery	
174.0			Migmatite Gneiss, banded black and white, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers or pockets, unweathered, high strength, bedding joints are rough planar to rough undulating at very close to moderate spacing, trace of slicken-sides at 10.6m.	1	B	F	C							95%		NQ		
				2	B	F	C							78				
				1	B	F	C							100%		NQ	no water re-covery	
Remarks																		

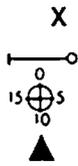


Port Severn Dam
Concrete and Rock Core Borehole No. 4

Log of Borehole 5



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test + s Penetrometer



Project Port Severn Main Dam Dwg No 6
Port Severn
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	N Value				Natural Moisture Content and Atterberg Limits % Dry Weight			Natural Unit Weight (kN/m ³)
				20	40	60	80	10	20	30	
		CONCRETE	181.8	Shear Strength MPa							Run #1
											Run #2
											Run #3
											Run #4
											Run #5
		BEDROCK	174.2								Run #6
											Run #7
		END OF BOREHOLE	171.1								Run #8
		<p>NOTES</p> <p>1) Hole advanced by means of wash boring drill rig on Oct. 7,8/92.</p> <p>2) Water level in hole 5.44m</p> <p>3) No return of water for Run #7</p>									

CORE LOG

CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical		Ground Elevation 181.84m		Datum Geodetic		Borehole No. 5									
Location				Date Started Oct. 7/92		Completed Oct. 8/92		Logged By Shaheen & Peaker		Sheet 1 of 2									
Client Public Works Canada				Drilling Agency Malone		Drill Type B40		Core Barrel & Bit Design NO		Project No. SP175									
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE	WEATHERING								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.8	1	▲	CONCRETE, possible construction joint at 0.44, open joints or eroded paste along joints at 0.9m and at bedrock contact at 7.62m, piece of waste at 4m.											NO1	100%	NQ			
	2	▲													NO2	100%	NQ		
	3	▲													NO3	100%	NQ		
	4	▲													NO4	100%	NQ		
	5	▲													NO5	100%	NQ		
	6	▲													NO6	100%	NQ		
	7	▲													NO7	100%	NQ		
174.2	8		MIGMATITE GNEISS, banded black and white, some pink, quartz, feldspar, biotite, hornblende, numerous quartz veins and brecciated gneiss at 10m, unweathered, high strength, bedding, joints are at very close to moderate intervals and rough planar to rough undulating, vertical and diagonal cross joints to 9.3m.	3	B	F	C							NO6	66	NQ			
	9				2	B	F	C							NO7	99%	NQ		
						B	F	C							NO8	100%	NQ	no water recover	
					I	B	F	C							NO8	91	NQ		
Remarks Ca - calcite																			

CORE LOG

CORE LOG																		
Project Port Severn Main Dam					Orientation Vertical			Ground Elevation 181.84m			Datum Geodetic			Borehole No. 5				
Location					Date Started Oct. 7/92			Completed Oct. 8/92			Logged By Shaheen & Peaker			Sheet 2 of 2				
Client Public Works Canada					Drilling Agency Malone			Drill Type B40			Core Barrel & Bit Design NQ			Project No. SP175				
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
171.84			Migmatite Gneiss	2	B	F	C	R	T	O				NO8	99%	91	NQ	no water re-covery
171.1			End of Borehole															
	11																	
	12																	
	13																	
	14																	
	15																	
	16																	
	17																	
	18																	
	19																	
Remarks																		

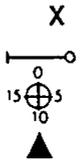


Port Severn Dam
Concrete and Rock Core Borehole No. 5

Log of Borehole 6



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test: — Undrained Triaxial at Overburden Pressure
- Shelby Tube • • • % Strain at Failure
- Field Vane Test + s Penetrometer



Project Port Severn Main Dam Dwg. No. 7
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight			
					Shear Strength MPa				10	20	30	
		CONCRETE DECK	181.8	0								
		=0.15m		2								
		EMPTY SPACE		4								
				6								
		CONCRETE	175.0	8								Run #1
		BEDROCK	174.1	10								Run #2
		END OF BOREHOLE	170.9	12								Run #3
		<u>NOTES</u>		14								
		1) Hole advanced by means of wash boring drill rig on Oct. 8th/92.		16								
		2) Water level in hole -not possible to measure		18								
		3) No return of water		20								

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.84m	Datum Geodetic	Borehole No. 6
Location	Date Started October 8/92	Completed October 8/92	Logged By Shaheen & Peaker	Sheet 1 of 2
Client Public Works Canada	Drilling Agency Malone	Drill Type CME - 45	Core Barrel & Bit Design NO	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NO. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
181.8	1		Deck															
	2																	
	3		Space															
	4																	
	5																	
	6																	
175.0	7		Concrete, broken concrete gravel from 6.9 to 7.0m, open joints or eroded paste, weak concrete seam at 7.5m.											NO1				no water recovery
174.1	8		Migmatite Gneiss, banded white and black, some pink, quartz, feldspar biotite, hornblende, occasional pegmatite layers, unweathered, high strength bedding joints are at very close to moderate intervals, vertical and diagonal cross joints from 8.7 to 10m.	1	B	F	C							95%	62	NQ		
	9													No.2				no water recovery
				3	B	F	C							100%	65	NQ		

Remarks

CORE LOG

Project Port Severn Main Dam				Orientation Vertical		Ground Elevation 181.84m		Datum Geodetic		Borehole No. 6	
Location				Date Started October 8/92		Completed October 8/92		Logged By Shaheen & Peaker		Sheet 2 of 2	
Client Public Works Canada				Drilling Agency Malone		Drill Type CME - 45		Core Barrel & Bit Design NQ		Project No. SP175	

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.84			Migmatite Gneiss	1	B	F	C	RU RR	T	O					NO3				
170.9	11		END OF BOREHOLE												100%				no water recovery
	12																		
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		

Remarks

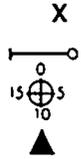


Port Severn Dam
Concrete and Rock Core Borehole No. 6

Log of Borehole 7



- Auger Sample ⊗ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test + s Penetrometer



Project Port Severn Main Dam Dwg. No. 8
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits % Dry Weight			Natural Unit Weight kN/m ³
					20	40	60	80	10	20	30	
		CONCRETE	181.8	0								Run #1
				2								Run #2
				4								Run #3
				6								Run #4
			174.2	8								Run #5
		BEDROCK		10								Run #6
				12								Run #7
		END OF BOREHOLE	171.0	14								Run #8
		<p><u>NOTES</u></p> <p>1) Hole advanced by means of wash boring drill rig on Oct. 8th/92</p> <p>2) Water level in hole 5.37m</p> <p>3) No return of water for Run #7</p>										
				16								
				18								
				20								

CORE LOG

CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical		Ground Elevation 181.85m		Datum Geodetic			Borehole No. 7								
Location				Date Started October 8/92		Completed October 8/92		Logged By Shaheen & Peaker			Sheet 1 of 2								
Client Public Works Canada				Drilling Agency Malone		Drill Type CME - 45		Core Barrel & Bit Design NQ			Project No. SP175								
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R Q D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE	WEATHERING								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.85	1	▲	Concrete, open joint or eroded paste at 0.9m, 1.1m, 3.3m and 3.6m, broekn up core at 1.5m, joints commonly occur at poor bond with coarse aggregates.											NO1					
	2	▲													100%	NQ			
	3	▲													NO2				
	4	▲													98%	NQ			
	5	▲													NO3				
	6	▲													100%	NQ			
	7	▲													NO4				
	8	▲	Migmatite Gneiss, banded white and black, some pink, quartz feldspar, biotite, hornblende, occasional pegmatitic layers, eroded schist layer from 8.8 to 8.9m, bedding joints are at very close to moderate intervals with rough planar to moderate intervals with rough undulating surfaces, diagonal cross joints at 8.1m and 9 to 9.8m.	1	B	F	VC								NO5				
	9	▲			2	B	F	C	M	RU					NO6	96%	73	NQ	
	10	▲			1	B	F			SP	T	O			NO7	47	NQ	no water recovery	
	11	▲			3	B	F	C		RU					NO8	94%	67	NQ	
	12	▲		1	B	F	VC		RU										
Remarks																			

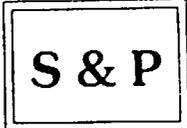
CORE LOG

CORE LOG																			
Project Port Severn Main Dam					Orientation Vertical			Ground Elevation 181.85m			Datum Geodetic			Borehole No. 7					
Location					Date Started October 8/92			Completed October 8/92			Logged By Shaheen & Peaker			Sheet 2 of 2					
Client Public Works Canada					Drilling Agency Malone			Drill Type CME - 45			Core Barrel & Bit Design NQ			Project No. SP 175					
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No CORE RECOVERY %	ROD %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.85			Migmatite Gneiss 2 sets of diagonal cross joints at 10.6m.	1	B	F	M		RUT	O				NO9					
				3	C	D	VC		RF					99%	67	NQ		no water re-covery	
171.0	11		END OF BOREHOLE																
	12																		
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		
Remarks																			

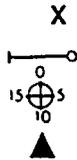


Port Severn Dam
Concrete and Rock Core Borehole No. 7

Log of Borehole 8



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Sheelby Tube ● ● ■ % Strain at Failure
- Field Vane Test • s Penetrometer



Project Port Severn Main Dam Dwg No 9
Port Severn, Ontario
 Project No SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight		MPa	
		CONCRETE DECK	181.8	0								
		=0.15m		2								
		EMPTY SPACE		4								
			174.9	6								
		CONCRETE	174.1	8								Run #1
		BEDROCK		10								Run #2
				12								Run #3
		END OF BOREHOLE	170.7	14								
		<u>NOTES</u>		16								
		1) Hole advanced by means of wash boring drill rig on Oct. 9th/92		18								
		2) Water level in hole -not possible to measure		20								
		3) No return of water										

CORE LOG

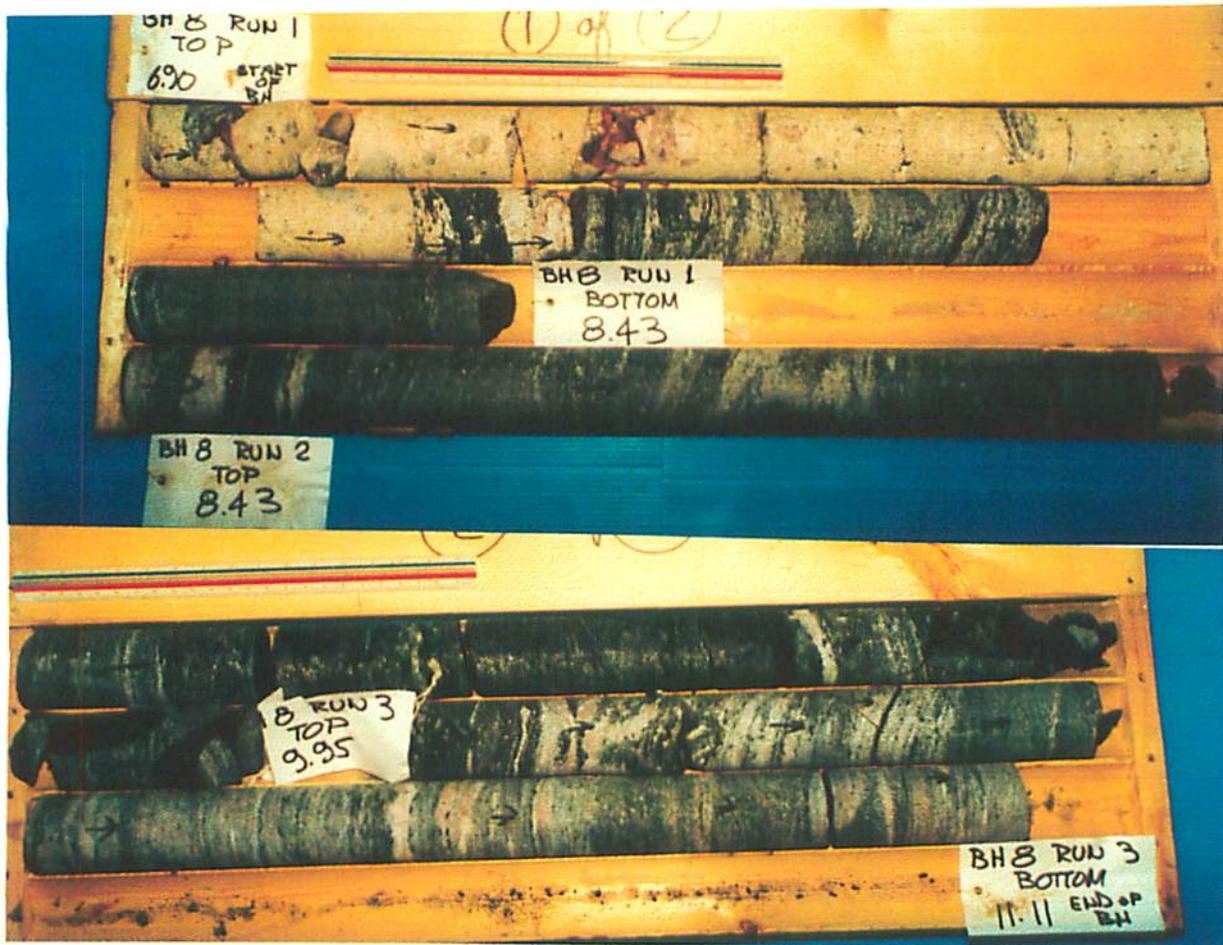
CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.84m			Datum Geodetic			Borehole No. 8						
Location				Date Started October 9/92			Completed October 9/92			Logged By Shaheen & Peaker			Sheet 1 of 2						
Client Public Works Canada				Drilling Agency Malone			Drill Type CME - 45			Core Barrel & Bit Design NO			Project No. SP175						
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	ROD %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.84			Deck																
	1																		
	2																		
	3		Space																
	4																		
	5																		
	6																		
174.9	7		Concrete, open joint or eroded paste throughout.												NO1 100%		NO	No water recovery	
174.1	8		Migmatite Gneiss, banded black and white, some pink quartz, feldspar, biotite, hornblende, occasional pegmatitic layers, biotite schist from 9.4 to 9.7m	1	B	F	M	CV	RU	RP	T	O				88	NO	No water recovery	
	9		unweathered, high strength, bedding joints are at very close to moderate intervals with rough planer to rough undulating surfaces, cross joints at 9.1m and 9.8m to 10.3m.	2	B	F	D	C							NO2 100%	72	NO	No water recovery	
				1	B	F	VC												
				3	B	F	D												
Remarks																			

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.84m	Datum Geodetic	Borehole No. 8
Location	Date Started October 9/92	Completed October 9/92	Logged By Shaheen & Peaker	Sheet 2 of 2
Client Public Works Canada	Drilling Agency Malone	Drill Type CME - 45	Core Barrel & Bit Design NO	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
171.84			Migmatite Gneiss	2	B C	F D								No. 3 100%	85	NQ	No water recovery	
170.7	11		End of Borehole		1	B F		C M	R R	T O								
	12																	
	13																	
	14																	
	15																	
	16																	
	17																	
	18																	
	19																	

Remarks

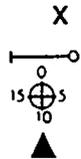


Log of Borehole 9



- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test

- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at Overburden Pressure
- % Strain at Failure
- Penetrometer



Project Port Severn Main Dam Dwg No 10

Port Severn, Ontario

Hole location and datum see drawing No 1

Project No SP 175

G W L	S Y M B O L	Soil Description	ELEV. m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight			
					Shear Strength MPa				10	20	30	
		CONCRETE	181.8	0								Run #1
				2								Run #2
				4								Run #3
				6								Run #4
			174.4	8								Run #5
		BEDROCK		10								Run #6
				12								Run #7
		END OF BOREHOLE	171.2	14								Run #8
		<u>NOTES</u>		16								
		1) Hole advanced by means of wash boring drill rig on Oct.13,14/92		18								
		2) Water level in hole 4.20m		20								
		3) Return of water present for entire hole.										

CORE LOG

Project				Orientation		Ground Elevation		Datum		Borehole No.									
Port Severn Main Dam				Vertical		181.85m		Geodetic		9									
Location				Date Started		Completed		Logged By		Sheet of									
				Oct. 13/92		Oct. 14/92		Shaheen & Peaker		1 2									
Client				Drilling Agency		Drill Type		Core Barrel & BH Design		Project No.									
Public Works Canada				Malone		B40		NO		SP175									
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE	WEATHERING								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.85	1	▲	CONCRETE, open joints or eroded paste along joints to 0.6m, at 1.27m, 2.5 to 2.7m and 4.1m piece of wood at 2.7m, layer of partly eroded paste at 4.7m.											NO1 100%	NQ				
	2	▲												NO2 99%	NQ				
	3	▲												NO3 100%	NQ				
	4	▲												NO4 99%	NQ				
	5	▲												NO4 99%	NQ				
	6	▲												NO4 99%	NQ				
	7	▲												NO5 100%	NQ				
174.4	8	▨	MIGMATITE GNEISS, banded black and white, some pink, quartz, feldspar, biotite, hornblende, some pegmatitic layers or pockets, unweathered, high strength, bedding joints are at very close to moderate intervals and rough planar to rough undulating vertical and diagonal cross joints throughout, missing material in joints at 7.7m.	2	B C	F V	C VC							NO6 100%	NQ	est 60% water recovery			
	9	▨		1	B	F	M		R	U	R	P	T	O	100%				
		▨		2	B C	F D		C											
		▨		1	B	F		C							NO7 100%	31	NQ		
		▨		2	B C	F V									NO8				
Remarks																			

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.85m	Datum Geodetic	Borehole No. 9
Location	Date Started Oct. 13/92	Completed Oct. 14/92	Logged By Shaheen & Peaker	Sheet 2 of 2
Client Public Works Canada	Drilling Agency Malone	Drill Type B40	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.85			End of Borehole	4	B C	F D V	C V	R U R P	T	O				NO8	100%	64	NQ		
171.2																			
	11																		
	12																		
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		

Remarks

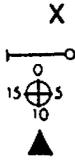


Port Severn Dam
Concrete and Rock Core Borehole No. 9

Log of Borehole 10



- Auger Sample Natural Moisture
- SPT (N) Value Plastic and Liquid Limit
- Dynamic Cone Test Undrained Triaxial at Overburden Pressure
- Shelby Tube % Strain at Failure
- Field Vane Test Penetrometer



Project Port Severn Main Dam Dwg No 11
Port Severn, Ontario
 Project No SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H m	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight (N/m ³)	
					20	40	60	80	% Dry Weight				
										10	20	30	
		CONCRETE DECK	181.8	0									
		=0.15m		2									
		EMPTY SPACE		4									
			175.5	6									Run #1
		CONCRETE		8									Run #2
			174.2	10									Run #3
		BEDROCK		12									Run #4
			171.2	14									Run #5
		END OF BOREHOLE		16									
		<u>NOTES</u>		18									
		1) Hole advanced by means of wash boring drill rig on Oct. 14,15/92.		20									
		2) Water level in hole -not possible to measure											
		3) No return of water.											

CORE LOG

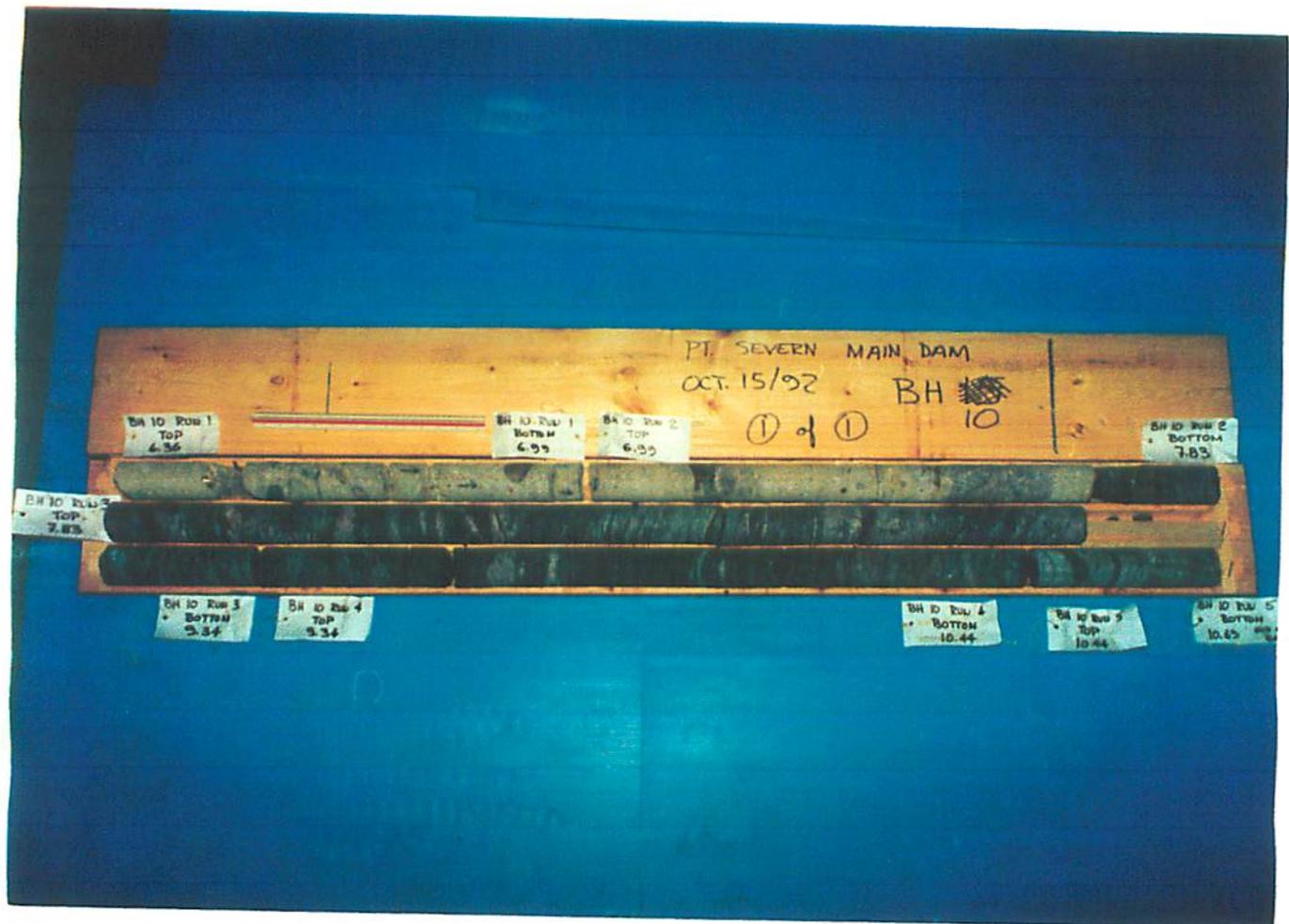
Project		Orientation		Ground Elevation		Datum		Borehole No.											
Port Severn Main Dam		Vertical		181.85m		Geodetic		10											
Location		Date Started		Completed		Logged By		Sheet of											
		October 14/92		October 15/92		Shaheen & Peaker		1 of 2											
Client		Drilling Agency		Drill Type		Core Barrel & Bit Design		Project No.											
Public Works Canada		Malone		B - 40		NQ		SP175											
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics							WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NO	CORE RECOVERY %	ROD %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.85			Deck																
	1																		
	2		Space																
	3																		
	4																		
	5																		
	6																		
175.5		▲	CONCRETE, open joints or eroded paste at 6.71 and 6.77m,											NO1	100%	NQ	No water recovery		
	7	▲												NO2	100%	NQ	No water recovery		
175.5		▲																	
	8	▨	MIGMATITE GNEISS, banded black and white, some pink quartz, feldspar biotite, hornblende, occasional pegmatitic layers unweathered, high strength, bedding joints are at close to moderate intervals, very close spacing at 8.65m, joint surfaces are rough planar to rough undulating, missing core due to weak material or open joint at 9.62m.	3	B C	F D	VC							NO3	97	NQ	No water recovery		
	9	▨		1	B	F	M VCRP RU	T	O					NO4	94	82	NQ	No water recovery	
Remarks																			

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.85m	Datum Geodetic	Borehole No. 10
Location	Date Started October 14/92	Completed October 15/92	Logged By Shaheen & Peaker	Sheet 2 of 2
Client Public Works Canada	Drilling Agency Malone	Drill Type B - 40	Core Barrel & Bit Design NO	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUI No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.9			Migmatite Gneiss	1	B	F	M	RU	T	O				NO4 94%	82	NQ	No water recovery		
171.2			End of Borehole											NO5 100%	100	NQ			

Remarks



Port Severn Dam
Concrete and Rock Core Borehole No. 10

Log of Borehole 11

S & P

- Auger Sample Natural Moisture
- SPT (N) Value Plastic and Liquid Limit
- Dynamic Cone Test Undrained Triaxial at Overburden Pressure
- Shelby Tube % Strain at Failure
- Field Vane Test Penetrometer



Project Port Severn Main Dam Dwg No. 12

Port Severn, Ontario

Project No. SP175

Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight			
					Shear Strength				10	20	30	
		CONCRETE	181.9	0								Run #1
				2								Run #2
				4								Run #3
				6								Run #4
				8								Run #5
			174.5	10								Run #6
		BEDROCK		12								Run #7
				14								Run #8
		END OF BOREHOLE	171.4	16								
		<u>NOTES</u>		18								
		1) Hole advanced by means of wash boring drill rig on Oct. 15,16/92		20								
		2) Water level in hole 4.52m										
		3) Return of water present for entire hole.										

CORE LOG

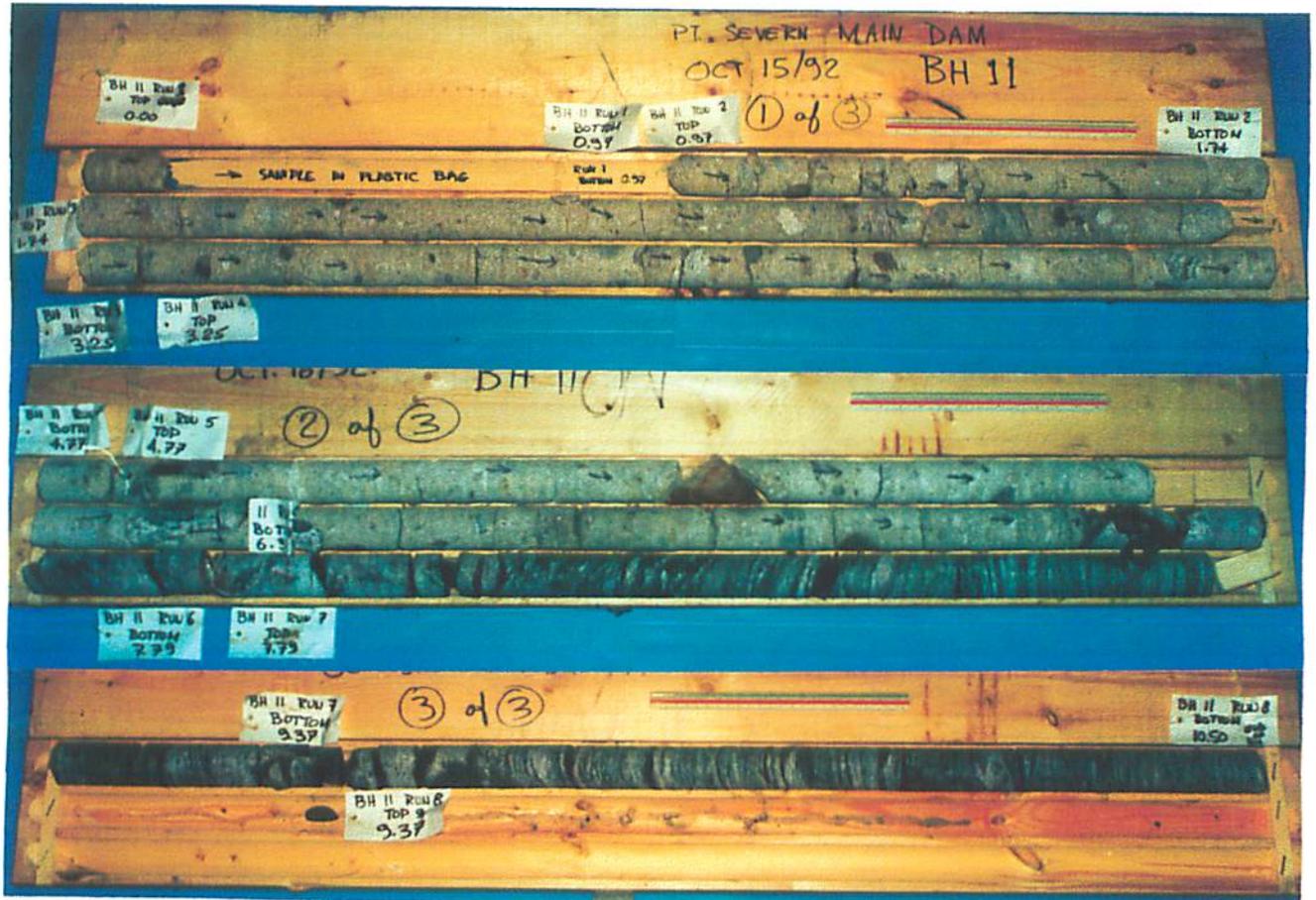
CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.87			Datum Geodetic			Borehole No. 11						
Location				Date Started October 15/92			Completed October 16/92			Logged By Shaheen & Peaker			Sheet of 1 2						
Client Public Works Canada				Drilling Agency Malone			Drill Type CME - 45			Core Barrel & Bit Design NQ			Project No. SP175						
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								STRENGTH	FRACTURE FREQUENCY	RUN No CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS		
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE	WEATHERING								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.87		▲	CONCRETE, core broken to rubble in run 1, open joints at 1.7m, 2.8m and 3.5m, piece of wood at 5.5m, probable missing material at bedrock contact, joints are commonly along coarse aggregate bonds.											NO1		NQ			
	1	▲													NO2		NQ		
	2	■													100%				
	3	▲													NO3		NQ		
	4	▲													100%				
	5	▲													NO4		NQ		
	6	▲													99%				
174.5	7	▲	MIGMATITE GNEISS, banded white and black, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic seams, pegmatite layer from 7.36 to 8.11m, unweathered, high strength, bedding joints are at close to very close intervals, vertical and diagonal cross joints at 9 to 9.5 m, joint surfaces are rough planar to rough undulating, mud coating on vertical joint surface at 9.37m.											NO5		NQ			
	8	▲													99%				
	9	▲													NO6		NQ		
		▲													95%				
		▲												NO7		NQ			
		▲												99%					
		▲												NO8		NQ			
		▲												99%					
Remarks				23 68 72															

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.87	Datum Geodetic	Borehole No. 11
Location	Date Started October 15/92	Completed October 15/92	Logged By Shaheen & Peaker	Sheet 2 of 2
Client Public Works Canada	Drilling Agency Malone	Drill Type CME - 45	Core Barrel & Bit Design NQ	Project No. SP175

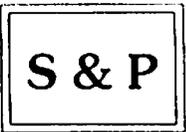
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics									WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
171.9			Migmatite Gneiss	1	B	F	C	RU	T	O					NO8				
171.4			End of Borehole					RP							99%	72	NQ		
	11																		
	12																		
	13																		
	14																		
	15																		
	16																		
	17																		
	18																		
	19																		

Remarks

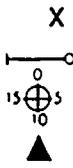


Port Severn Dam
Concrete and Rock Core Borehole No. 11

Log of Borehole 12

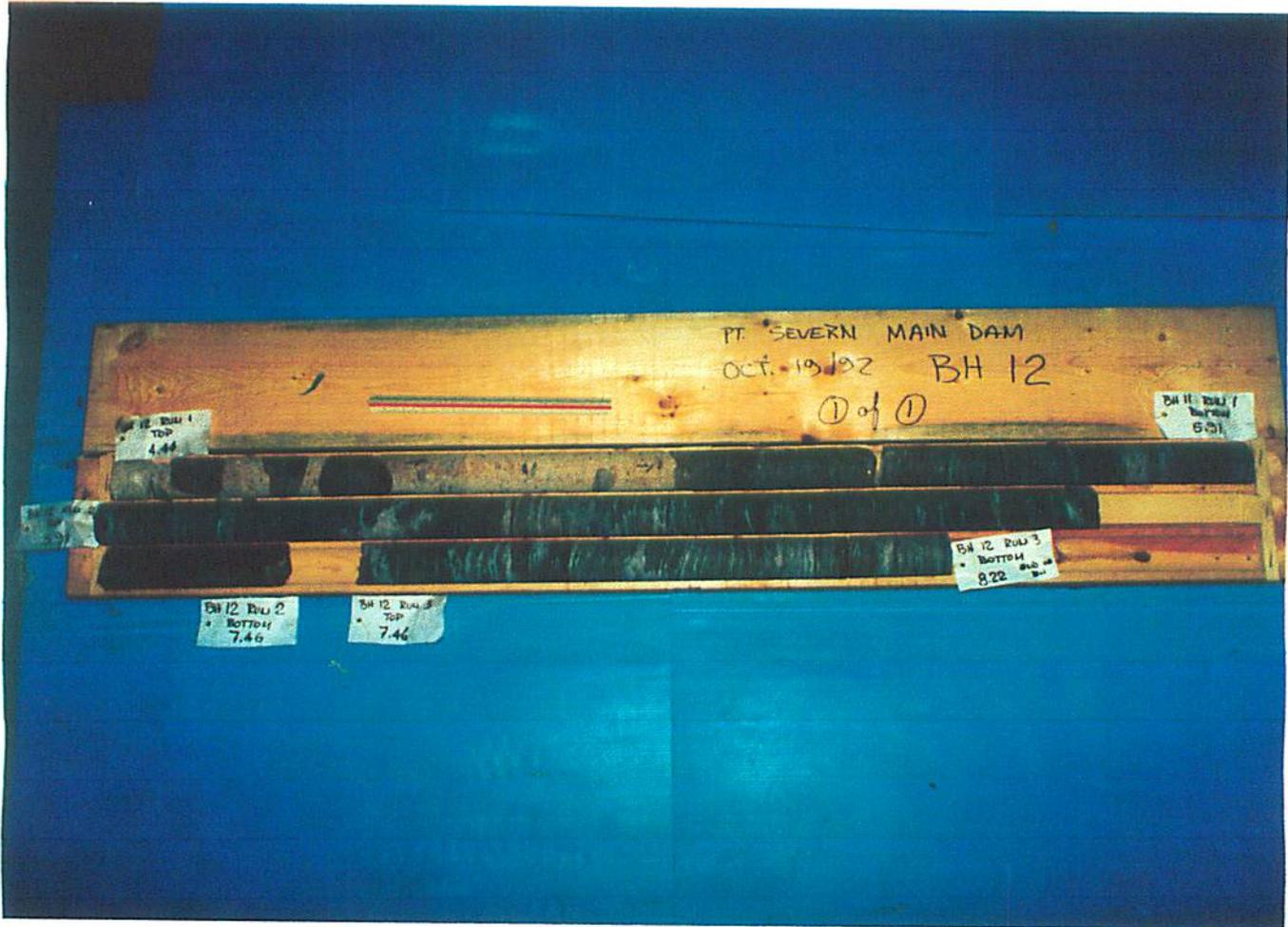


- Auger Sample ⊗ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test - s Penetrometer



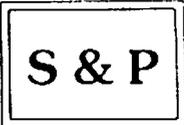
Project Port Severn Main Dam Dwg No 13
Port Severn, Ontario
 Project No SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	N Value				Natural Moisture Content and Atterberg Limits % Dry Weight			Natural Unit Weight kN/m ³
				20	40	60	80	10	20	30	
		CONCRETE DECK	181.9								
		=0.15m EMPTY SPACE									
		CONCRETE	177.4								Run #1
		BEDROCK	176.7								Run #2
		END OF BOREHOLE	173.5								Run #3
		<u>NOTES</u> 1) Hole advanced by means of wash boring drill rig on Oct. 16,19/92 2) Water level in hole. -not possible to measure 3) No return of water.									

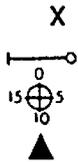


Port Severn Dam
Concrete and Rock Core Borehole No. 12

Log of Borehole 13



- Auger Sample Natural Moisture
- SPT (N) Value Plastic and Liquid Limit
- Dynamic Cone Test Undrained Triaxial at Overburden Pressure
- Shelby Tube % Strain at Failure
- Field Vane Test Penetrometer



Project Port Severn Main Dam Dwg. No. 14
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV. m	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
				20	40	60	80	% Dry Weight			
				Shear Strength				10	20	30	
				MPa							
		CONCRETE	181.9								Run #1
											Run #2
											Run #3
		BEDROCK	176.6								Run #4
											Run #5
		END OF BOREHOLE	173.5								Run #6
		<u>NOTES</u>									
		1) Hole advanced by means of wash boring drill rig on Oct. 19th/92									
		2) Water level in hole 4.26m									
		3) No return of water for Run #6									

CORE LOG

CORE LOG																				
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.86			Datum Gedetic			Borehole No. 13							
Location				Date Started Oct. 19/92			Completed Oct. 19/92			Logged By Shaheen & Peaker			Sheet 1 of 1							
Client Public Works Canada				Drilling Agency Malone			Drill Type CME - 45			Core Barrel & Bit Design NQ			Project No. SP175							
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
181.86	1	▲	Concrete, construction joint at 0.6m, open joints or less eroded paste at 0.6 and 1.3m, paste layer at 2.86m, friable seam at 4.5m.																	
	2	▲													NO1			NQ		
	3	▲													100%					
	4	▲													NO2			NQ		
	5	▲													100%					
176.7	6	▨	Migmatite Gneiss, banded white and black, some pink quartz feldspar, biotite, hornblende, unweathered, high strength, bedding joints are at close to moderate intervals and are rough planar to rough undulating, dipping cross joints throughout.		B	F														
	7	▨			2	B	F	C	D						NO3			NQ		
	8	▨			1	B	F								99%					
	9	▨			2	B	F	C	D						NO4			NQ		
	10	▨		1	B	F								NO5			NQ	est 80% water re-covery		
	11	▨		2	B	F	C	D						100%	96					
	12	▨		1	B	F														
	13	▨		1	B	F														
173.5	14	▨	END OF BOREHOLE	1	C	D														
	15																			
	16																			
	17																			
	18																			
	19																			
Remarks																				

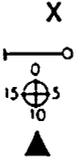


Port Severn Dam
Concrete and Rock Core Borehole No. 13

Log of Borehole 14



- Auger Sample Natural Moisture
- SPT (N) Value Plastic and Liquid Limit
- Dynamic Cone Test: Undrained Triaxial at Overburden Pressure
- Shelby Tube % Strain at Failure
- Field Vane Test Penetrometer

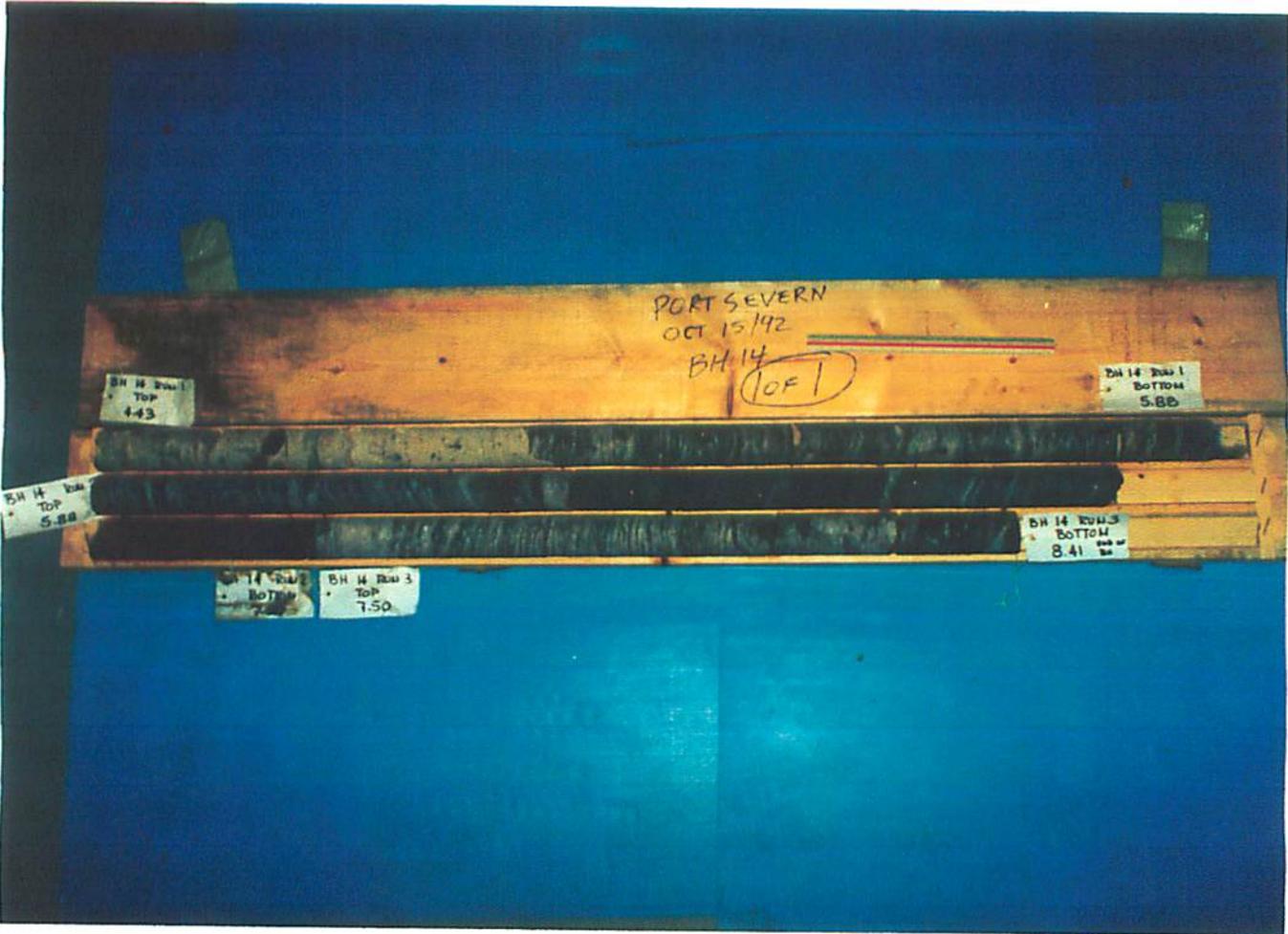


Project Port Severn Main Dam Dwg No 15
Port Severn, Ontario
 Project No SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³	
					20	40	60	80	Shear Strength MPa		% Dry Weight		
										10	20	30	
		CONCRETE DECK	181.9	0									
		=0.15m											
		EMPTY SPACE		2									
				4									
		CONCRETE	177.4										
			176.8										
		BEDROCK		6									Run #1
				8									Run #2
				10									Run #3
		END OF BOREHOLE	173.5	12									
				14									
				16									
				18									
				20									
				22									
				24									
				26									
				28									
				30									
				32									
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				264									
				266									
				268									
				270									
				272									
				274									
				276									

CORE LOG

CORE LOG																			
Project Port Severn Main Dam					Orientation Vertical			Ground Elevation 181.86			Datum Geodetic			Borehole No. 14					
Location					Date Started October 15/92			Completed October 15/92			Logged By Shaheen & Peaker			Sheet 1 of 1					
Client Public Works Canada					Drilling Agency Malone			Drill Type CME - 45			Core Barrel & Bit Design NO			Project No. SP175					
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.86			Deck																
	1		Space																
	2																		
	3																		
	4																		
177.4			CONCRETE, slightly eroded or open joint at 4cm and 33cm.											NO1			no water re-covery		
176.8	5		MIGMATITE GNEISS, banded white and black, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers unweathered, high strength, bedding joints are at close to moderate intervals and are rough planar to rough undulating.				C							100%	95	NQ	no water re-covery		
	6							W							NO2	92	NQ	no water re-covery	
	7				1	B	F		R	R	T	O			99%				
	8							C							NO3	100	NQ	no water re-covery	
			End of Borehole																
173.5																			
	9																		
Remarks																			



Port Severn Dam
Concrete and Rock Core Borehole No. 14

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.87m	Datum Geodetic	Borehole No. 15
Location	Date Started Oct. 14/92	Completed Oct. 14/92	Logged By Shaheen & Peaker	Sheet 1 of 1
Client Public Works Canada	Drilling Agency Malone	Drill Type CME-45	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No. CORE RECOVERY %	ROD %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST
				No. OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.8	1	▲	CONCRETE Open joints or eroded paste along joints to 1.5m and at 4.5m to 4.8m, brown staining on diagonal joint at 3.6m.											No. 1 100%		NQ			
	2	▲												No. 2 100%		NQ			
	3	▲												No. 3 98%		NQ			
	4	▲												No. 4 98%		NQ			
176.7	5	▨	MIGMATITE GNEISS Banded white and black, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers or pockets, unweathered, high strength, bedding joints are at very close to moderate intervals, vertical cross joints with sandy silt at 5.2m to 5.4m	2	B	F	VC		Si					98%	74				
	6	▨						M		RU				No. 5 99%	96				
	7	▨		I	B	F	VC			RP	T	O		No. 6 100%	100	NQ			
173.6	8	▨	END OF BOREHOLE					M											
	9							C											

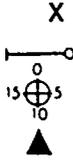
Remarks



Log of Borehole 16



- Auger Sample Natural Moisture
- SPT (N) Value Plastic and Liquid Limit
- Dynamic Cone Test Undrained Tnaxial at Overburden Pressure
- Shelby Tube % Strain at Failure
- Field Vane Test Penetrometer



Project Port Severn Main Dam Dwg No 17
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H m	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight g/cm ³
					20	40	60	80	% Dry Weight			
					Shear Strength				10	20	30	
		CONCRETE DECK	181.8	0								
		=0.15m		2								
		EMPTY SPACE		4								
		CONCRETE	177.4	6								Run #1
		BEDROCK	176.6	8								Run #2
		END OF BOREHOLE	173.2	10								Run #3
		<u>NOTES</u>		12								
		1) Hole advanced by means of wash boring drill rig on Oct. 14th/92.		14								
		2) Water level in hole - not possible to measure		16								
		3) No return of water		18								
				20								

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.85	Datum Geodetic	Borehole No. 16
Location	Date Started Oct. 14/92	Completed Oct. 14/92	Logged By Shaheen & Peaker	Sheet 1 of 1
Client Public Works Canada	Drilling Agency Malone	Drill Type CME-45	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.85			DECK																
	1																		
	2		SPACE																
	3																		
	4																		
177.4			CONCRETE Open joint or eroded paste at joint at 5.2m.											No. 1		NQ	No Water Recovery		
176.6			MIGMATITE GNEISS Banded white, black and pink; quartz, feldspar, biotite hornblende; occasional pegmatitic seams; eroded biotite rich seams at 5.5m and 7.8m unweathered, high strength bedding joints are at very close to moderate intervals and are rough planar to rough undulating.				C							100%					
	6						VC												
	7						C							No. 2		NQ	No Water Recovery		
							M							100%	100				
							VC												
	8						M							No. 3		NQ	No Water Recovery		
														99%	100				
173.2			END OF BOREHOLE																
	9																		

Remarks

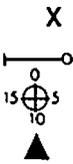


Port Severn Dam
Concrete and Rock Core Borehole No. 16

Log of Borehole 17



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test → s Penetrometer



Project Port Severn Main Dam Dwg. No. 18
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight			
					Shear Strength MPa				10	20	30	
		CONCRETE	181.9	0								Run #1
				2								Run #2
				4								Run #3
			176.8	6								Run #4
		BEDROCK		8								Run #5
				10								Run #6
				12								Run #7
		END OF BOREHOLE	173.1	14								
		<u>NOTES</u>		16								
		1) Hole advanced by means of wash boring drill rig on Oct. 13th/92.		18								
		2) Water level in hole 3.88m		20								
		3) Return of water present for entire hole.										

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.86m	Datum Geodetic	Borehole No. 17
Location	Date Started Oct. 13/92	Completed Oct. 13/92	Logged By Shaheen & Peaker	Sheet 1 of 1
Client Public Works Canada	Drilling Agency Malone	Drill Type CME-45	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN NO	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.86	1		CONCRETE Open joint or eroded paste and wood from 1.49m to 1.58m, open joint or eroded paste at 1.9m, 2.7m to 3.0m, 4.1m and 4.4m, probable cavity along joint at 5.7m.											No. 1		NQ			
	2													No. 2		NQ			
	3													No. 3		NQ			
	4													No. 4		NQ			
146.8	5		MIGMATITE GNEISS Banded black and white, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers and pockets, unweathered, high strength bedding joints are at close to moderate intervals with very close spacing at 7.9m, joint surfaces are rough planar to rough undulating, concrete in joint at 5.7m, missing core in Run #6 attributed to friable biotite schist layer at 7.9m.				M		T										
	6							C		C*									
	7				I	B	F	M	R	U	R	P	T	O	No. 5	100%	93	NQ	
	8							C		M					No. 6				
								VC							No. 7				
															No. 91	86	NQ		
															No. 90	90	NQ		
173.1	9		END OF BOREHOLE																

Remarks C*- Concrete in joint

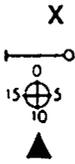


Port Severn Dam
Concrete and Rock Core Borehole No. 17

Log of Borehole 18



- Auger Sample ⊗ Natural Moisture
- SPT (N) Value ○ ○ ⊘ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube ● ● ■ % Strain at Failure
- Field Vane Test · s Penetrometer



Project Port Severn Main Dam Dwg No 19

Port Severn, Ontario

Project No SP175

Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value			Natural Moisture Content and Atterberg Limits			Natural Unit Weight -N/m ³
					20	40	60	80	Shear Strength	MPa	
		CONCRETE DECK =0.15m	181.9	0							
		EMPTY SPACE		2							
		CONCRETE	177.4	4							Run #1
		BEDROCK	176.4	6							Run #2
		END OF BOREHOLE	173.3	8							Run #3
		<u>NOTES</u> 1) Hole advanced by means of wash boring drill rig on Oct. 15th/92 2) Water level in hole -not possible to measure 3) No return of water.		10							
				12							
				14							
				16							
				18							
				20							

CORE LOG

CORE LOG																			
Project Port Severn Main Dam				Orientation Vertical			Ground Elevation 181.86m			Datum Geodetic			Borehole No. 18						
Location				Date Started Oct. 15/92			Completed Oct. 15/92			Logged By Shaheen & Peaker			Sheet 1 of 1						
Client Public Works Canada				Drilling Agency Malone			Drill Type CME-45			Core Barrel & Bit Design NQ			Project No. SP175						
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.86			DECK																
	1																		
	2		SPACE																
	3																		
	4																		
177.4			CONCRETE Probable eroded paste at 4.5m and at 4.7m, contact with bedrock is steep and diagonal.											No. 1	98%	88	NQ	No Water Recovery	
176.4			MIGNATITE GNEISS Banded white and black, some pink, quartz, feldspar, biotite, hornblende, occasional pegmatitic layers, unweathered, high strength, bedding joints are at very close to moderate intervals and rough planar to rough undulating, possible open joints less than 5mm thick with weathered material removed during drilling				C												
	6							VC											
	7							M							No. 2				No Water Recovery
	8							C							100%	90	NQ		No Water Recovery
							RU												
							VC												
							VC												
							M							No. 3	99%	95	NQ	No Water Recovery	
173.3			END OF BOREHOLE																
	9																		

Remarks



Port Severn Dam
Concrete and Rock Core Borehole No. 18

Log of Borehole 19B



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Sheelby Tube • • ■ % Strain at Failure
- Field Vane Test: + 5 Penetrometer



Project Port Severn Main Dam Dwg. No. 20
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight		10	
					Shear Strength MPa							
		CONCRETE	181.9	0								Run #1
				2								Run #2
				4								Run #3
		BEDROCK	177.4	6								Run #4
		END OF BOREHOLE	174.3	8								Run #5
		NOTES 1) Hole advanced by means of wash boring drill rig on Oct. 19,20/92. 2) Water level in hole 2.71m 3) Hole 19 abandoned after core barrel broke off.										
				10								
				12								
				14								
				16								
				18								
				20								

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.9m	Datum Geodetic	Borehole No. 19
Location	Date Started Oct. 15/92	Completed Oct. 16/92	Logged By Shaheen & Peaker	Sheet 1 of 1
Client	Drilling Agency Malone	Drill Type CME-45	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	ROD %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.9	1	▲	CONCRETE Open or eroded paste at 1.47m to 1.9m, 2.08m and below 2.67m, mainly pebbles at 3.46m, joints commonly occur with poor bond to coarse aggregate.											No. 1 98%		NQ			
	2	▲												No. 2 100%		NQ	Estimated 80% Water Recovery		
	3	▲												No. 3 99%		NQ	Very Little Water Recovery		
177.4	5	▨	MIGMATITE GNEISS Banded white, black and pink, occasional shist layers, pegmatite layer from 4.41m to 5.06m, unweathered, high strength, bedding joints at very close to moderate intervals and rough planar to rough undulating, vertical cross joints from 4.4m to 5m, possible clay seam at 5.5m.	2	B C	F V	C V	R U R P	T					No. 4 99%	66	NQ	No Water Recovery		
174.3	6	▨		1	B	F	M		NC T	0									
	7		END OF BOREHOLE																
	8																		
	9																		

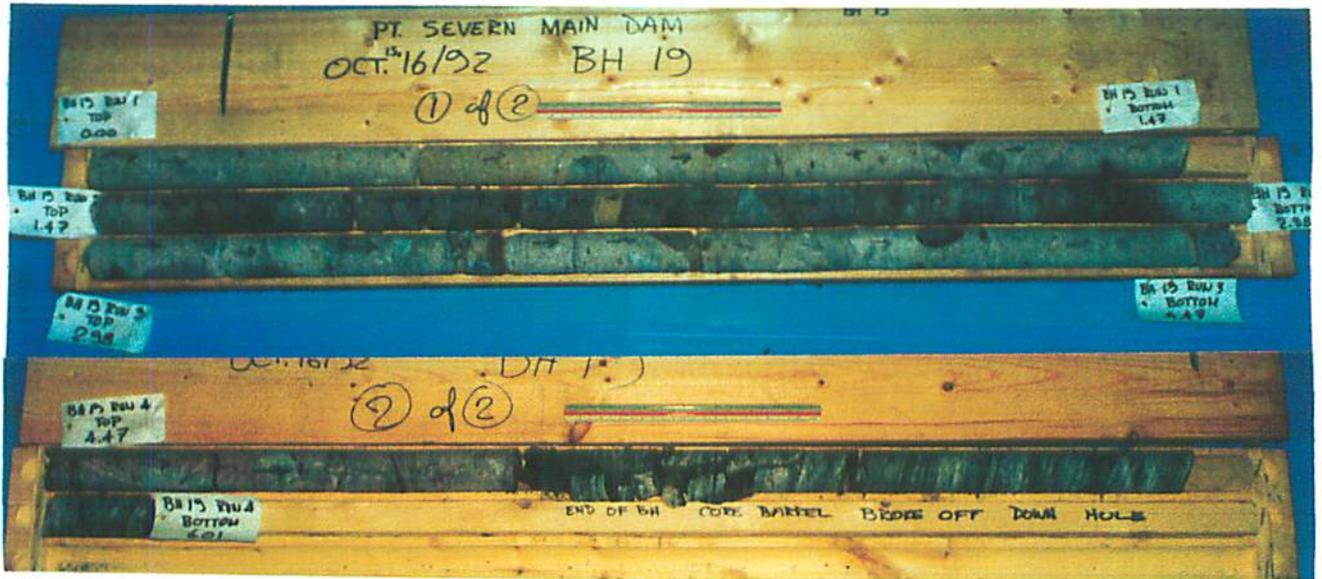
Remarks

CORE LOG

Project Port Severn Main Dam	Orientation Vertical	Ground Elevation 181.86m	Datum Geodetic	Borehole No. 19B
Location	Date Started Oct. 19/92	Completed Oct. 20/92	Logged By Shaheen & Peaker	Sheet 1 of 1
Client Public Works Canada	Drilling Agency Malone	Drill Type CME-45	Core Barrel & Bit Design NQ	Project No. SP175

ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No	CORE RECOVERY %	R O D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS	PACKER TEST
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
181.86	1		CONCRETE Open joints or eroded material along joints to 1.8m, friable concrete seam at 2.65m, open joint and/or weak material at 3.2m.											No. 1	93%	NQ				
	2														No. 2	100%	NQ	Very Little Water Recovery		
	3														No. 3	100%	NQ	No Water Recovery		
	4														No. 4	97%	74	NQ		Very Little Water Recovery
177.4	5		MIGMATITE GNEISS Banded black and white, some pink, quartz, feldspar, biotite, hornblende, pegmatite layer from 4.46m to 5.03m, eroded schist seams at 6.6m and 7.4m, unweathered, high strength, bedding joints are at very close to moderate intervals and rough planar to rough undulating diagonal cross joints at 7m.				C													
	6							VC												
	7																			
174.3	8		END OF BOREHOLE																	
	9																			

Remarks



Borehole 19 - Terminated When Broke Off in Hole



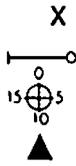
Port Severn Dam
Concrete and Rock Core Borehole No. 19 and 19B



Log of Borehole 20



- Auger Sample ☒ Natural Moisture
- SPT (N) Value ○ ○ Plastic and Liquid Limit
- Dynamic Cone Test — Undrained Triaxial at Overburden Pressure
- Shelby Tube • • • % Strain at Failure
- Field Vane Test + s Penetrometer



Project Port Severn Main Dam Dwg No. 21
Port Severn, Ontario
 Project No. SP175
 Hole location and datum see drawing No. 1

G W L	S Y M B O L	Soil Description	ELEV m	D E P T H	N Value				Natural Moisture Content and Atterberg Limits			Natural Unit Weight kN/m ³
					20	40	60	80	% Dry Weight			
					Shear Strength MPa				10	20	30	
		CONCRETE	181.9	0								Run #1
				2								Run #2
				4								Run #3
				6								Run #4
		BEDROCK	177.3	8								Run #5
				10								Run #6
		END OF BOREHOLE	174.2	12								Run #7
		<u>NOTES</u>		14								
		1) Hole advanced by means of wash boring drill rig on Oct. 19th/92.		16								
		2) Water level in hole 2.43m		18								
		3) Return of water stopped at the end of Run #1.		20								

CORE LOG

CORE LOG																			
Project Port Severn Main Dam					Orientation Vertical			Ground Elevation 181.86			Datum Geodetic			Borehole No. 20					
Location					Date Started Oct. 19/92			Completed Oct. 19/92			Logged By Shaheen & Peaker			Sheet 1 of 1					
Client Public Works Canada					Drilling Agency Malone			Drill Type CME-45			Core Barrel & Bit Design NQ			Project No. SP175					
ELEVATION (m)	DEPTH (m)	SYMBOL	GENERAL DESCRIPTION	Joint Characteristics								WEATHERING	STRENGTH	FRACTURE FREQUENCY	RUN No.	CORE RECOVERY %	R Q D %	CORE SIZE/CASING	WATER RECOVERY LEVEL & TESTS
				No OF SETS	JOINT TYPE	ORIENTATION	SPACING	ROUGHNESS	FILLING	APERTURE									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
181.86			CONCRETE Open joints or eroded paste along joints to 2.2m and from 2.6m to 3.7m, rubble at 1m and broken brown stained concrete at 3.6m												No. 1 94%		NQ	No Water Recovery at 1.06m	
	1															No. 2 97%		NQ	No Water Recovery
	2															No. 3 97%		NQ	No Water Recovery
	3															No. 4 100%		NQ	No Water Recovery
177.3			MIGMATITE GNEISS Banded white and black, some pink layers, quartz, feldspar, biotite, hornblende, pegmatite layer from 4.9m to 5.7m, unweathered, high strength, bedding joints are at very close to moderate intervals and rough planar to rough undulating, vertical cross joints at 5.1m, friable material in joint at 4.7m		B	F	C		SA						No. 5 100%	65	NQ	No Water Recovery	
	5					C	V	VC											
	6							M											
	7			I	B	F	M	RU	RP	T	O				No. 6 99%	88	NQ	No Water Recovery	
	7						C	VC											
174.2			END OF BOREHOLE				M								No. 7 100%		NQ	No Water Recovery	
	8																		
	9																		
Remarks																			



Port Severn Dam
Concrete and Rock Core Borehole No. 20

**Part 2 Condition Survey
Port Severn Main Dam
Trent-Severn Waterway
Port Severn, Ontario**

The condition survey is limited to visual observations to exposed areas above the water level. The following pages provide a brief description of each spillway or pier followed by a photographic highlight for that area. Drawing No. 1 indicates the location of the pier numbers and Drawing No. 1A shows an overall photographic layout of the dam.

The detailed photographic survey is included as a photographic album including a description of each photograph. This album has not been duplicated, Appendix No. 2 includes a description of each detailed photograph however, the photographs must be viewed from the album. A video is available with the album showing the major areas of concern. This video like the album is available as a single copy and has not been duplicated.

Pier 1

This pier also continues upstream and downstream as the canal wall. Under deck between first and second beams the face is badly eroded (roll 10/19). There is slight weathering into first timber slip. The column dividing both timber slips has a shear break just above steel plates, it runs full width of column (roll 11/1). Downstream there is a large eroded area under deck under fifth and sixth beams, also there is an assortment of electrical wiring coming out of conduit (roll 11/5). Downstream at Dam the face is badly eroded and allows water to leak through (roll 12/5). Further downstream, approximately 2.0 m, there is a badly eroded section about 1.0 m above water level. These above two sections are probably responsible for water leaking to west face of Pier 1 (roll 13/21). The downstream nose is also badly eroded and has a horizontal shift to it, about one of the construction joints (roll 12/3, 7).



11/5
East Side Downstream Face



10/19
East Face Pier 1

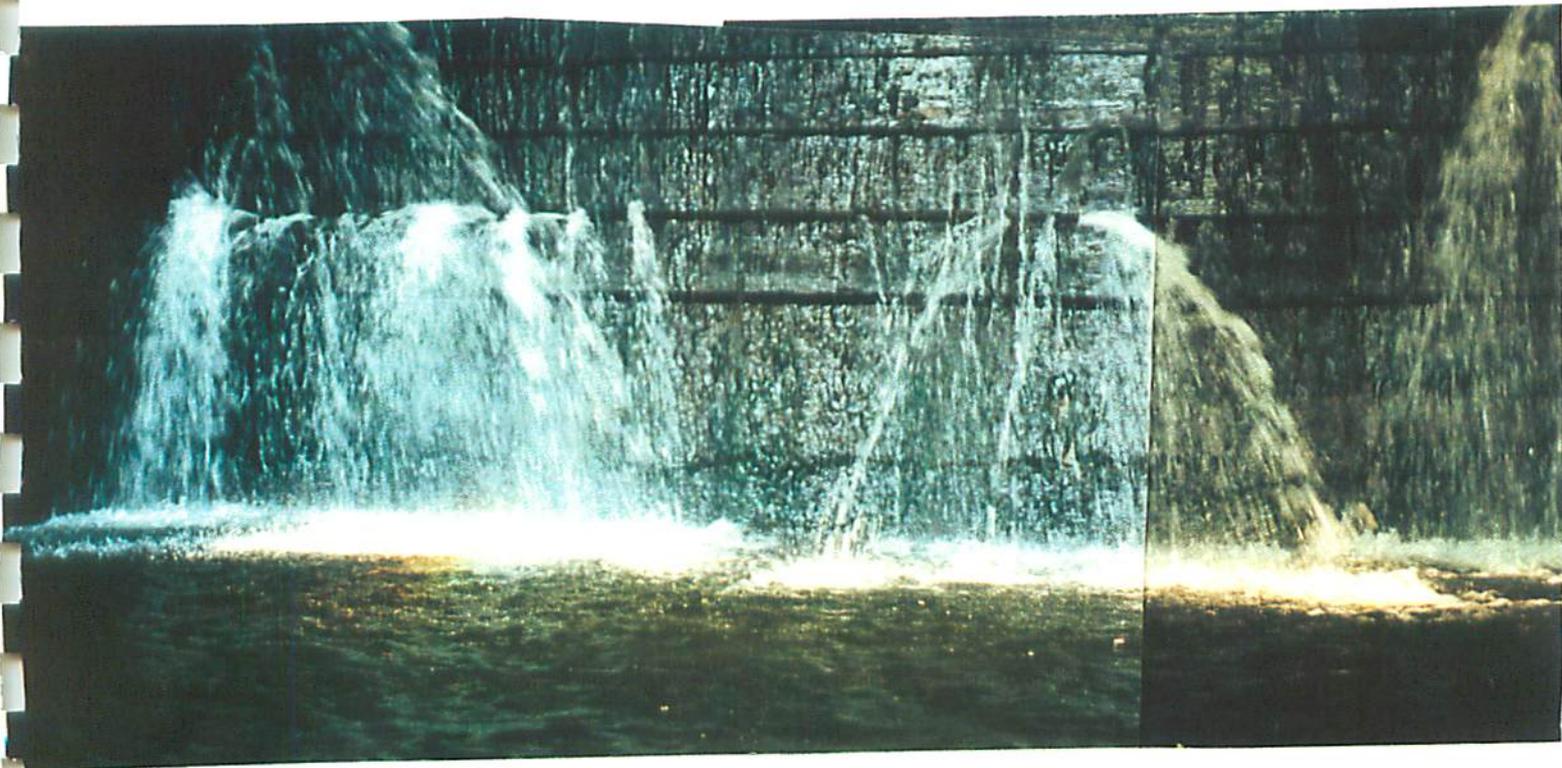
Port Severn Dam
Pier No. 1

Spillway 1

The deck over Pier 1 has several patches over concrete with cracks running in and out of these patches. These patches are parallel with the canal to the west. (roll 3/16, 17, 18, 19, 20, 21). The downstream face of the first beam has weathering at face of span, the surface concrete has lift and flaked off in some areas (roll 10/18). The second beam upstream face has two locations where the lower edge of the beam has broken off and exposed the rebar 1) at east end of beam, 0.6 m 1 long section and 0.3 m high (roll 10/21) and 2) at the centre of the span, 0.4 m long section (roll 10/20). The second beam on the downstream face has deep erosion gouges 25 mm deep at the west end of beam (roll 10/23). The upstream face of the third beam at east end has a horizontal crack (roll 11/2). The dam timber leaks across the width of the spillway and through eroded cracks in pier 1 face at dam (roll 12/1,2,5). Note major cracks along wall below stop logs (roll 12/1, 2).



10/21
Upstream Face Beam No. 2



12/1 and 2
Downstream Spillway No. 1

Port Severn Dam
Spillway No. 1

Pier 2

The upstream east face is not too bad except at the point where the first beam joins the pier, there is a wide eroded crack and some vertical cracking going down almost to the water level. Between the first and second beams there is some weathering across the face starting at the just below the beams. The downstream east face was not too bad. The west upstream face has a similar vertical diagonal crack starting where beam 1 joins face. The west face has weathering between first and second beams. The dam timber slip has some erosion at upper construction joint (roll 11/3). At the fifth and sixth beams there is a large loose section of concrete approximately 1.0 m high (roll 11/4). At the dam and downstream face there is considerable erosion (roll 12/6). The downstream nose has weathered and eroded mostly at the top third of pier (roll 12/8, 10).



Downstream Pier No. 2



11/4

Downstream West Face Pier No. 2

Port Severn Dam
Pier No. 2

Spillway 2

The deck is generally good. On pier 2 at south rail going northwest to second timber slip the deck has a diagonal crack (roll 3/14, 15). Beam 1 has small vertical cracks at centre of span and at west end of upstream face there are erosion gouges running horizontal to pier 2. The downstream face at centre of span has a 0.5 m long eroded section at bottom of beam (roll 10/6). The downstream face of the second beam has erosion gouges running horizontal from pier 2 to 1 m east of pier 25 mm deep in places (roll 10/8, 9, 10). The fourth beam has a series of seven vertical cracks, basically at centre of span about 0.3 m apart (roll 10/14 shows two) on the upstream face. As well as at the west end there are a series of erosion gouges. This spillway is used mostly to control water level upstream, water leaks quite rapidly and the water level is quite deep.



10/15
Beam No. 4 at Pier No. 2



10/3
Beam No. 1 at Pier No. 2

Pier 3

The east face has eroded in line with beam 1 and under beams down to first timber slip and into slip. Downstream of dam and under highway bridge beams the east face of pier has eroded severely (roll 9/22). Further downstream there is 1.0 m vertical crack, 4.5 m upstream from downstream nose of pier (roll 12/19). The downstream nose and up the east face has eroded severely as well (roll 12/15, 16). The upstream nose has a hole into it 0.5 m down from the top of the pier. On the west face is line with beam 1 more erosion can be seen as well as vertical cracking with calcium deposits (roll 10/1). More erosion under deck from first and second beam. The column between timber slips has eroded severely directly under beam, a 0.3 m high section of concrete has broken out (roll 11/11). Downstream from dam under highway bridge directly under beams, the face has eroded (roll 10/12, 13 and roll 12/13). Further downstream and 1.0 m above waterline there is an eroded hole into pier 0.6 m long, 0.2 m high and 170 mm deep (roll 12/12, 14).



12/13
Downstream West Face



10/13
West Face Note Void Under Beam

Spillway 3

West of pier 4 just to the west and at second timber slip from south rail northwest to slip 45 ° crack. The deck over pier 3 has a construction joint that was patched and subsequently cracked, the full width of deck. From north rail southeast to first timber slip deck has 45° crack, from centre rail southeast into second timber slip and from south rail northeast into second timber slip both are wide cracks. The first beam has some weathering and cracking, at east end and two vertical cracks, 1.8 m west of pier 6 and 2.7 m east of pier 3. Where the first beam meets pier 3 there is erosion at bottom edge of beam 1, 0.5 m east of pier. On the bottom face of beam there is a long crack running down centre of beam to Pier 4, 2.2 m west of Pier 4 the downstream bottom edge of second beam has eroded off and 2.4 m west of pier 6 there is a hole in the bottom of beam 0.1 m in diameter and 50 mm deep (roll 9/5, 9, 3). The second beam one area 1.5 m east of Pier 3 0.1 m exposed rebar on the upstream face and on the downstream face there are two 1) 1.1 m west of Pier 4 and 2) at centre of span the face is weathered. The third beam has one crack on the bottom face 1.3 m west of Pier 6, rebar exposed in eroded area 0.6 m by 0.1 m (roll ;9/15). The fourth beam bottom upstream edge has eroded off close to Pier 4. On the downstream face of the fourth beam a 1.0 m long section has eroded off exposing rebar up the entire downstream face :(roll 9/17) and at the centre of the span a 0.5 m long section at bottom of beam has eroded and exposed the rebar. The dam timbers leak quite badly +1.5 m deep water. This spillway and the next one west are the two spillways used to control water level upstream.



12/17
Exposed
Reinforcement
Beam No. 4



9/5
Bottom
Beam No. 1



9/15
Beam No. 3
Bottom Face

Pier 4

The east face has a large weathered area between first and second beams, upstream there are several vertical cracks, parallel to one another in a regular pattern. Probably, this pattern is showing form work configuration. The column between the two timber slips on east face of Pier 4 has erosion gouges at 0.3 m below bottom of third beam. Downstream of dam there is some erosion/weathering under highway bridge (roll 8/23). The west face of pier at upstream has some weathering at lower construction joint. The column separating timber slips has cracking, 0.3 m and 0.5 m below bottom of beam in the dam slip just above timber there is an eroded area full width of slip (roll 9/19), this eroded area runs downstream of slip for approximately 1 m in length. Further downstream, approximately 1.5 m from downstream nose and halfway up the face is weathered such as in (roll 12/21).



8/14
Upstream East
Face Pier No. 4



9/14
West Face
Pier No. 4

Port Severn Dam
Pier No. 4

Spillway 4

The deck is generally in good condition with the exception of a crack that starts at centre of pier and runs on a diagonal to the southeast corner of opening over first timber slip. (roll 3/4). The upstream face of beam 1 has one major crack in it at the center of span at the bottom of the beam (roll 8/23, tape 50 x 100 mm). The downstream face of the first beam has a large section at the lower third of beam broken off exposing rebar 1.0 m in length at Pier 5 (roll 8/10) and at the west end of beam 1 downstream face 1.0 east of Pier 4 there is an exposed section of rebar (roll 8/9). The upstream face of beam 2 has three areas of concern: 1) the concrete from bottom edge of beam up to middle of beam has broken off exposing the rebar 0.5 m in length (roll 8/11), 2) at approximately the centre of span the bottom edge has broken off approximately 280 mm in length (roll 8/12 and 3) the bottom edge of the beam has broken off exposing the rebar for 1.2 m length at Pier 4. The bottom of the second beam has a weathered section at centre of span (roll 8/20). The downstream face has a weathered section 1.3 m east of Pier 4 some gouges are 40 mm deep (roll 8/15, 16). The third beam has one major area located at Pier 4 the bottom face of beam has eroded out exposing rebar, 0.5 m in length (roll 8/18, 19). The fourth beam has two major areas of concern, the first being at Pier 5, the bottom face of beam has eroded off exposing rebar and the second, the downstream face has eroded exposing three sections of rebar. Dam leaks and the water level just downstream of dam is quite deep +1.0 m.



8/19
Bottom Face
Beam No. 3



8/21
Beam No. 4
Bottom Face

Pier 5

The upstream east face has quite extensive erosion directly below the beams, three severe locations are 1) from first to second beams, 2) in column between timber slips and 3) downstream of dam under highway bridge (roll 8/5, 4, 6). Downstream on east side of pier there is extensive erosion halfway up the face at the dam. On the west face upstream of dam erosion starts again at first beam and runs downstream to first timber slip downstream of dam there is large erosion directly below beams (roll 13/3). Also noted is the extensive cracking of the top of the downstream nose of Pier 5 (roll 13/1, 23).



5/22
Underside at
Highway Bridge



13/1
Looking Up At
Underside
Downstream

Port Severn Dam
Pier No. 5

Spillway 5

The deck from Pier 6 to Pier 5 is generally in good shape except for a crack 0.94 m west of centreline of Pier 6 running north from north rail to upstream edge of deck. The construction joint in Pier 5 has been patched and subsequently cracked. It runs from the north edge of deck south past south rail. The downstream face of first beam has some weathered section approximately 2.1 m west of Pier 6 and 1.3 m east of Pier 5 there is a crack exposing rebar. The second beam has quite a number of bad locations starting at Pier 6. The bottom edge of beam has eroded exposing a 0.6 m long section of rebar, closer to centre of span, there is a section of bad weathering, (photo's roll 7/21, 22, the tape strip is 50 x 100 mm) and this weathering is also on the upstream face of second beam at Pier 5. The downstream face of second beam has a couple of noticeable spots. The first is at Pier 6, there is bad weathering gouges and the second, towards the center of span. The surface concrete has eroded off exposing rebar in two spots. The third beam shows only a little wear 1) at centre of span on the upstream face the surface concrete has eroded exposing rebar, 2) the underside at centre of beam the concrete has eroded exposing rebar and further along there is a crack at bottom edge of beam (roll 8/3). The dam leaks up to third timber above water line.



7/20
Underside
Beam No. 2
Upstream



3/1
Northside of
Rail

Port Severn Dam
Spillway No. 5

Pier 6

The upstream nose has a large section of concrete eroded out. It starts 0.6 m below top, it is 0.37 m high, 0.25 m wide at the bottom and is 40 m m deep. Continuing downstream on the east face to the first timber slip the entire wall is badly weathered which includes a section of concrete eroded out 0.51 m high, 0.42 m wide, at widest point, and 40 mm deep and erosion gouges starting directly under first beam and running horizontal to first timber slip, some of these gouges are 50-70 mm deep and 0.23 m high. The upstream west face weathered, but not as badly as the east face. Mostly, under deck between first and second beams and a few horizontal cracks running downstream to first timber slip. Downstream of dam, the east face Pier 4 is not too bad however, on the west face there is some weathered erosion at top just under the highway bridge. Down at water level at dam there is quite a bit of erosion into face created by water leaking through the dam.



13/4
Downstream
Pier No. 6 Showing
Erosion and
Deterioration West
Side



13/5
Downstream
Underside
Highway Area
West Side Pier No. 6



7/12
East Face of
Pier No. 6



7/16
West Face
Upstream
Under First and
Second Beam

Port Severn Dam
Pier No. 6

Spillway 6

The deck to Pier 6 is in good shape except for:

- 1) A horizontal crack in west of centreline Pier 7 goes from north rail to north edge of deck.
- 2) Horizontal crack 1.1 m west of centreline Pier 7 from south rail, south 0.9 m.
- 3) A series of cracks running from the north rail to north edge of deck at distances from centreline Pier 6, 0.95 m, 1.7 m, 2.3 m, 3.6 m and 4.7 m. The upstream face of the first beam is badly weathered total length of span, numerous vertical cracks and horizontal erosion cracks. The downstream face of the first beam at Pier 7 is cracked at centre of span at the bottom of beam. As well as some areas just east of centre and at Pier 6 where the surface concrete has scaled off. The upstream face of the second beam has weathered and cracked for most of its length. Approximately 2.0 m from Pier 7 the bottom face of second beam has broken out exposing rebar basically at centre of beam. At this location there is a crack running along bottom face to upstream face of beam and up and runs parallel to beam for 0.3 m.



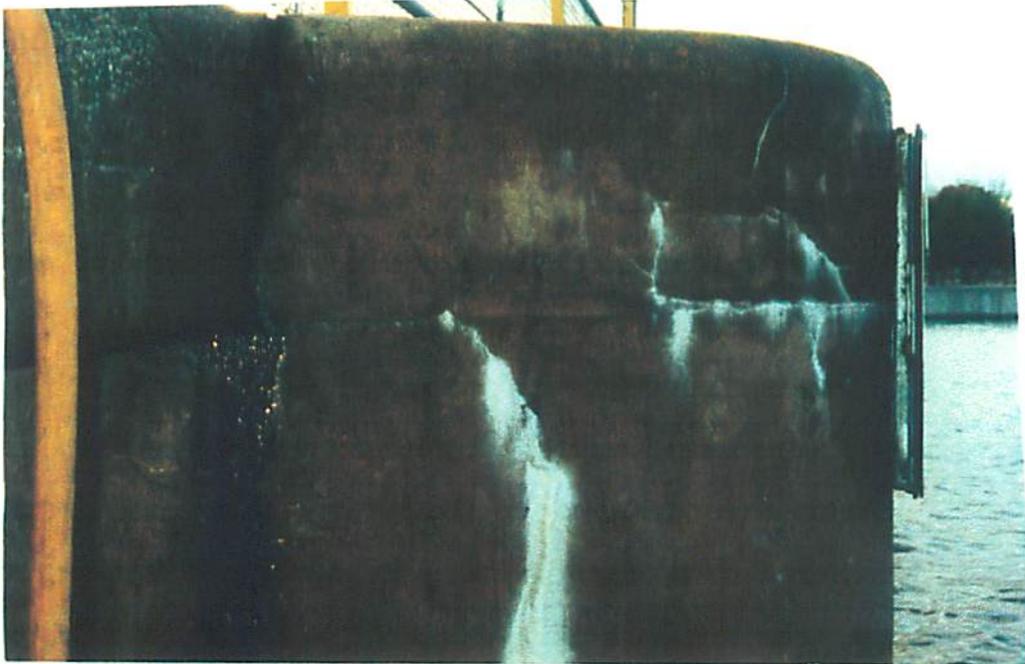
7/9
Beam No. 2
Upstream Face
Note Conditions of
Beam No.'s 3 and 4



7/5
Underside
of Beam No. 2

Pier 7

Upstream east face of Pier 7 a number of cracks, the first being almost at the upstream nose of pier. There is a crack that runs down 0.2 m almost vertically 0.2 m and 0.3 m across top of pier towards the centre. There is a 0.38 m long vertical crack that runs from first construction joint down to second construction joint with calcium deposits. Under deck between first and second beams the east face has weathered badly, two sections of concrete broken off and smaller vertical and horizontal cracks below. In the calcium between the two timber slips 0.3 m down from bottom of beam 3 there are erosion cracks and a vertical crack. Downstream the east face is quite badly eroded including the top half (1/2) of the downstream nose. The west face is slightly eroded.



6/1
East Face
Upstream



6/3
East Face
Upstream

Port Severn Dam
Pier No. 7

Spillway 7

The deck is in fairly good condition with the exception of a series (five) cracks running from the north rail to the north edge of the deck, the distance from the centre of Pier 8 west to each crack is 1.3 m, 2.1, 2.6, 3.1, 3.6 m. The next area is directly over Pier 7 running full width of the deck along the expansion joint. It has been repaired and subsequently it has cracked and at approximately 1.0 m south of the south rail it has lifted out. The upstream face of the first beam (deck) has a series of erosion cracks at lower portion of face at Pier 8. Continuing west along face towards the centre of the span there is more erosion where marks running from deck down on a 15 degree angle and 0.2 m long. The second beam is quite weathered starting at Pier 8 running 1.0 m toward Pier 7. Then 0.6 m further there is a section 1.5 m long where the surface concrete has (scaled) lifted. The dam timbers leak up to the third timber from bottom.



5/19
Beam No. 2
at P8



2/8
Repairs at
Surface

Pier 8

The upstream east side of Pier 8 is in fairly good condition except for a few vertical cracks. Directly under first beam there are a couple of horizontal cracks running downstream into a large weathered area, 0.6 m wide, 0.3 m high. This weathered section runs into upstream timber slip. The column between the two slips is badly weathered and cracked at waterline. It is eroded to 0.2 m above water. The very upstream nose of Pier 2 has a section of concrete eroded out 0.3 m high, 0.15 m high starting 0.7 m down from top of pier. The upstream west face of the pier has an eroded section at lower construction joint, 0.9 m down from top and just above lower construction joint, 0.9 m down from top and just above there are a few cracks. The eroded area at the construction joint downstream under first beam. The pier face under deck down to upper timber slip has weathered and cracked. It is 0.7 m long and 0.2 m high. Erosion can be seen in the column separating the two slips. Downstream of dam which leaks up to sixth timber from bottom, mostly from third down. The west face at water level has erosion cut into concrete running almost full downstream length. The downstream nose of Pier 8 is badly eroded around full width of nose, mostly at third construction joint down from top of pier.



5/10
Pier No. 8
Between
Support
Beams



5/14
Pier No. 8
Upstream

Port Severn Dam
Pier No. 8



5/12
East Face
Upstream
Column at
Beam No. 3



5/25
Column Under
Beam No. 3

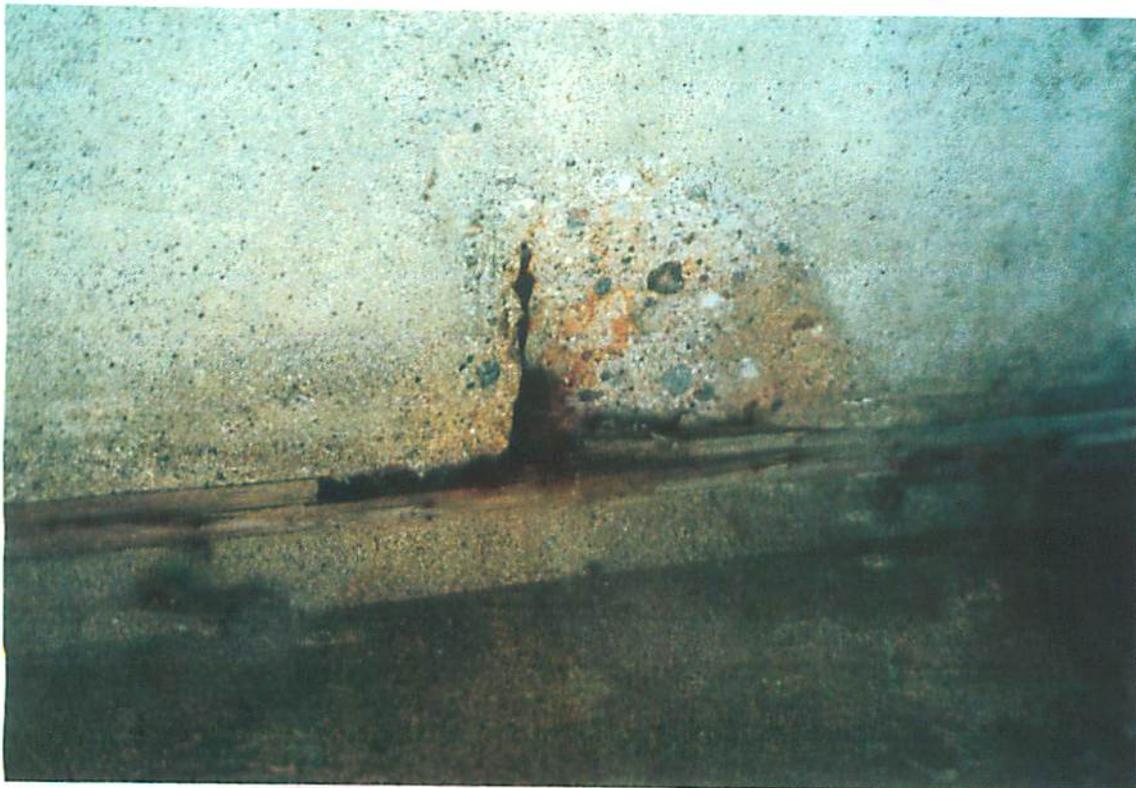
Port Severn Dam
Pier No. 8

Spillway 8

Deck surface from Pier 9 to Pier 8 is generally good except for weathering and few slight cracks (roll 2/1, 4-6). These cracks are just east of Pier 8. Number one runs from north rail to upstream edge of deck and four to six runs from the south rail to the south approximately 1.0 m in length. Photo number 24 on roll 1 shows general condition of concrete on deck surface. The underside of deck between first and second beams at the west face of Pier 9 has broken off and runs 0.2 m along beam, 0.13 m wide and 30 mm deep into the concrete. The beams shown some signs of erosion. The first beam is eroded and chipped exposing the rebar also the underside is cracked basically at the centre of the span for 1.24 m in length. The second beam has a number of bad spots starting 0.43 m east of Pier 8 on the upstream face surface concrete has eroded off exposing rebar, then 1.17 m east of Pier 8 the upstream face at bottom of beam has eroded off exposing 0.4 m of rebar and then 0.74 m. Further there are two sections on the underside face of the second beam that eroded and exposing the rebar. The dam timber are leaking up to the fifth timber from water line.



5/23
Beam No. 1
Underside
Face



5/1
Underside of
Deck Between
Beams 1 and 2



5/5
Beam No. 2
Upstream
Face



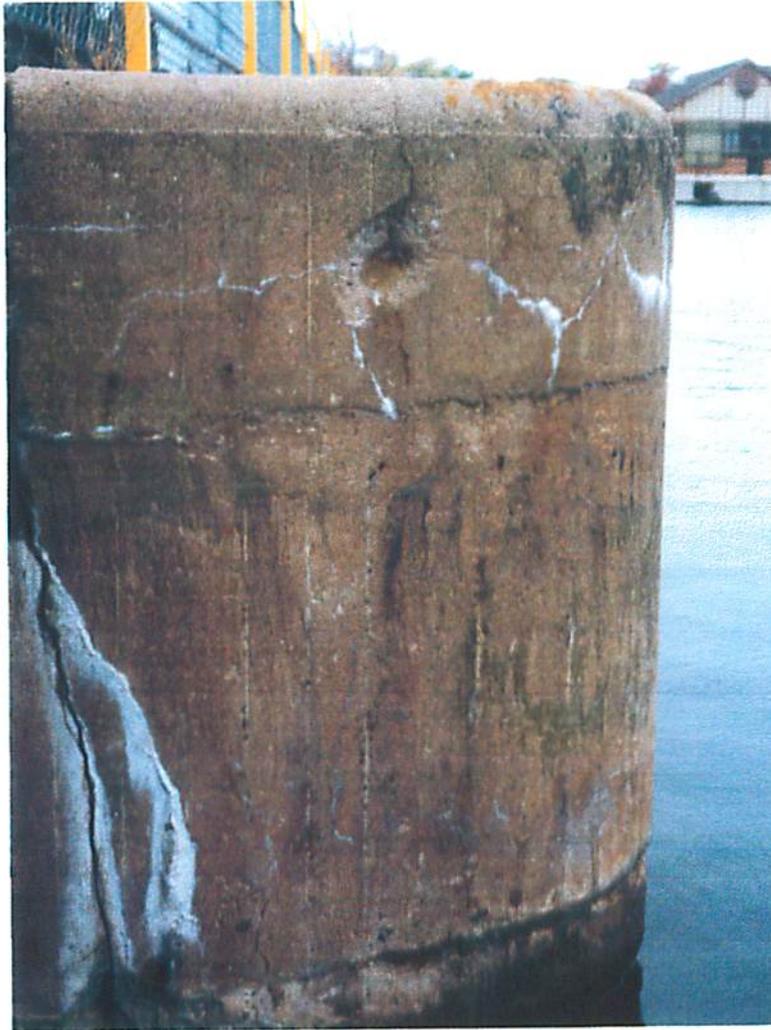
5/3
Beam No. 1
Downstream
Edge



1

Pier 9

On the east side of Pier 9, there are small cracks in the top 0.4 m with a section of concrete broken out. In line with first beam a vertical crack runs down to water line approximately 0.8 m and then continuing downstream to dam there are numerous small cracks running both vertically and horizontally. Downstream of dam Pier 9 was generally good except for erosion at water line. On west face of Pier 9 again small vertical and horizontal cracks in top of 0.4 m then directly under first beam runs down to water line 0.7 m long. Under deck to first timber slip the pier face has weathered in quite a large area 0.5 m long, 0.3 m high, starting 0.3 m below beams. Downstream on west face of Pier 1 is generally good except for erosion at water line.



4/20
East Face
Pier No. 9
Upstream



4/22
West Face
Pier No. 9
Upstream

Spillway 9, from East Abutment to Pier 9

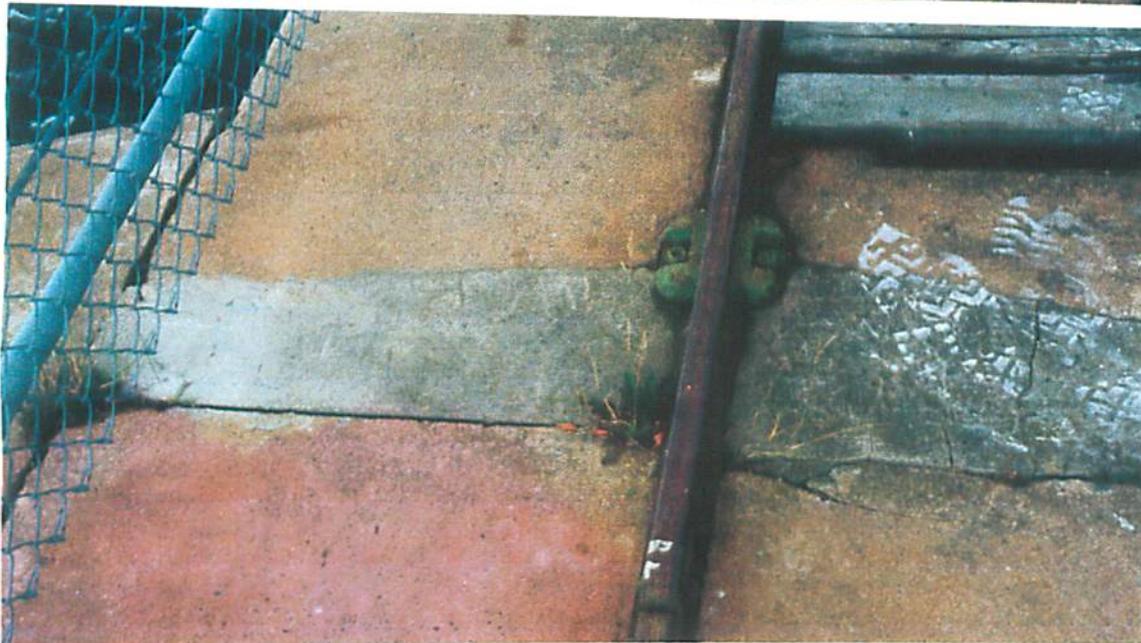
The deck surface is good, no major or minor cracks noted in this section. Deck over Pier 9 has a large patch running full length of deck, and now this patch is cracking. The front face of deck (first beam) has erosion wear marks but generally in good condition except for a spot 1.5 m from East Abutment. The concrete has cracked and exposed the rebar. The second beam has a number of bad spots, the first one is within one metre from the East Abutment. The concrete has cracked and exposed the rebar from 0.5 m long and 50 mm high, the second is 1.5 m from the East Abutment. The upstream face of the beam is good at 1.5 m from East Abutment. The underside of beam has spalled and cracked exposing the rebar and then 0.3 m further toward Pier 9 another eroded section of concrete broken off exposing rebar. The section of concrete is 0.3 m long full width of second beam and 50 mm deep into concrete. The third beam has eroded, cracked and exposing rebar on the underside of beam at the east abutment, full width of beam and 0.45 m long. The dam timbers leak at bottom and up to fifth timber.



4/7
Support
Beam No. 2



4/12
Support Beam
No. 3



1/13
Deck at
Pier/Spillway
No. 9

Port Severn Dam
Spillway No. 9

East Abutment

The East Abutment upstream is very badly cracked both on the deck surface as well as vertically through the structure. Most of the major cracking is from the upper construction joint to the top of structure (roll 4/1, 2, 3, 4). Sections of concrete have broken away from the structure face along the same construction joint and at the water level (roll 4/4). The structure also has some differential cracking, 25 mm in height (roll 1/5) moving towards dam the structure is not that bad except for a local spalled or sealed spot between first and second support beam just under the deck. The downstream section is also not that bad except for some erosion into structure face at the water line and approximately 1.0 m from the concrete spillway. There is some vertical cracking about 1 m from dam from water level up to first construction joint. At downstream end of abutment, there is some erosion in the middle third of structure, possibly runoff freezing and thawing from highway bridge. Between second and third and third and fourth beams are the timber slips, the dam timbers are in the second one, under the third beam is the dividing 'column' both these are eroded and cracked in the abutment.



1/6

**Cracking of
Upstream
Wing/Wall
and Abutment
General
Deterioration
and Aging Shows
Need of Removal
and Repair**

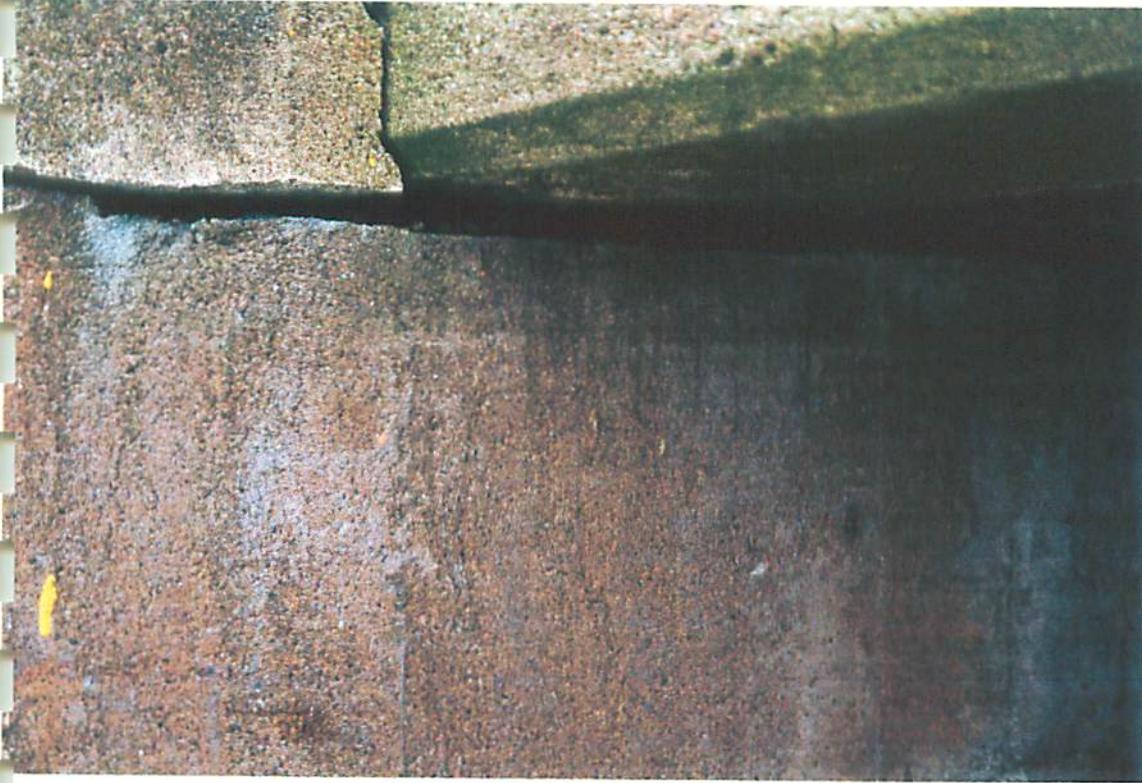


1/11

**Port Severn Dam
East Abutment**

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**4/5
Upstream Beam
and East Abutment**



**4/11
Between
Beams 2 and 3**

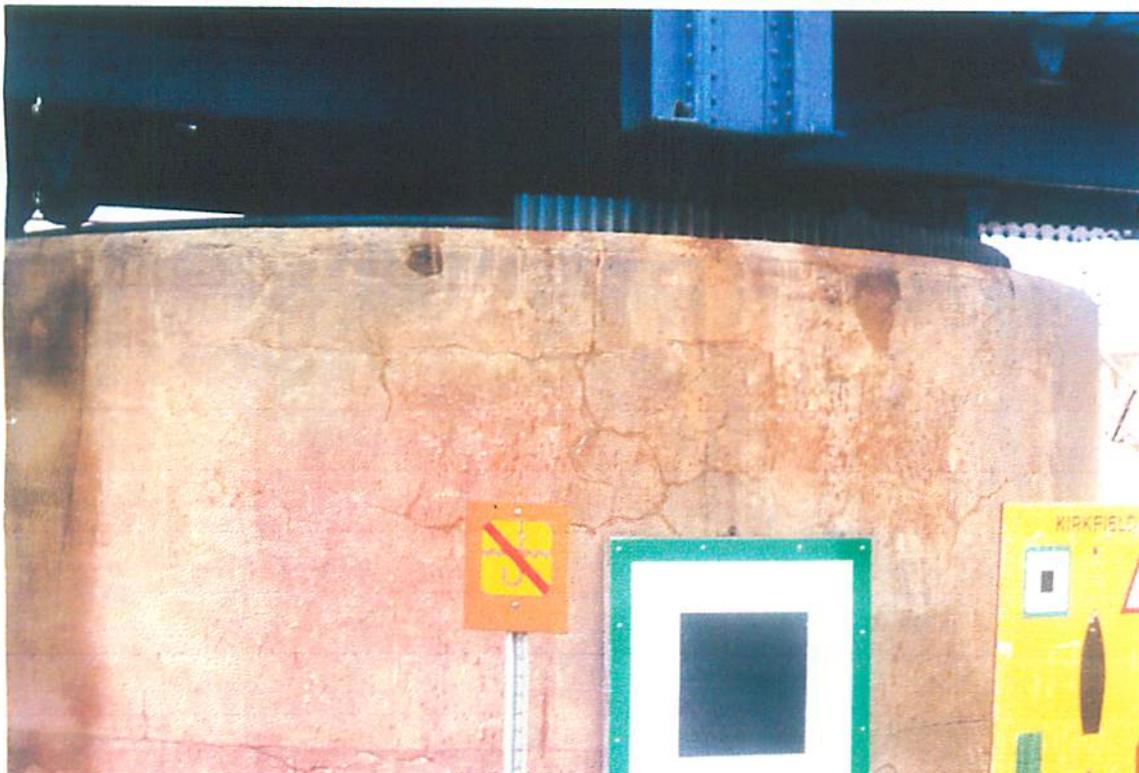
**Port Severn Dam
East Abutment**

Swing Bridge

The foundation for the bridge is not too bad on the north hemisphere but on the south hemisphere there are a number of bad areas. At the bottom centre a 1.0 m by 0.8 m area is badly weathered (roll 3/22). The top third of the foundation also at the centre there are numerous cracks (roll 3/23, 24). On the west side there is also cracking at about 1.0 m from the ground (roll 3/25).



3/22
Weathering and
Spalling
South Centre



3/23
Top South
Possible
Delamination
Potential

Port Severn Dam
Swing Bridge

APPENDIX I
TERMS OF REFERENCE

TERMS OF REFERENCE
for
GEOTECHNICAL INVESTIGATIONS
PORT SEVERN MAIN DAM
Trent-Severn Waterway

=====
August 24, 1992

File # 8554-0035-52314

1.0 LOCATION

The dam is located on the Trent Severn Waterway, adjacent to Georgian Bay, in Port Severn, Ontario. Access to the dam may be obtained from highway #69, via a township road, which crosses the control dam. There is a swing bridge in the immediate area.

2.0 BACKGROUND

The existing dam was built in 1915, and no major repairs have been since undertaken. The dam controls the outflow from the Lake Simcoe/Couchiching and Black River watersheds. There is an electrical power generating station (owned by Ontario Hydro) upstream of the dam, at Big Chute.

It is proposed to carry out concrete repairs to the dam, pressure grout the underlying bedrock and to replace the existing stop-logs with low-profile mechanized water control gates.

The purpose of this investigation is to determine the quality of the concrete in the existing dam, the nature of the bedrock foundation, and to evaluate the water-tightness of the dam and bedrock.

3.0 SCOPE OF WORK

- .1 Drill boreholes as shown on the attached plan. All holes are to extend three meters into bedrock. The exact location of each borehole will be determined on site by the Consultant.
- .2 Determine the presence and size of any discontinuities, joints or voids in the concrete dam structure and in the bedrock.
- .3 Determine the quality of the existing concrete by taking two samples in each of the boreholes in the piers and abutments, and one sample in each of the remaining boreholes, and testing each for compressive strength. If significant areas of poor concrete are encountered in any borehole, contact the PWC project manager immediately so that the need for additional boreholes can be assessed.

- .4 Evaluate the quality of the concrete-to-bedrock contact in each borehole.
- .5 Determine bedrock type and elevation at each borehole and provide Rock Quality Designation.
- .6 Measure static water elevation in each borehole.
- .7 Determine the permeability of the bedrock by falling head pumping tests in 10 selected holes.
- .8 Do 6 pressure packer tests in selected holes.
- .9 Establish geodetic elevations for all boreholes by field levelling. Indicate the location, number and elevation of the geodetic benchmark used. Elevations on the existing drawings provided are not necessarily geodetic. Tie each borehole location to permanent structures with field measured dimensions.
- .10 Deliver cores to the Trent-Severn Waterway yard on Ashburnham St. in Peterborough. Notify the Trent-Severn Waterway in advance of delivery. Cores are to be in core-boxes and labelled with date and location of the work (ie. Port Severn Main Dam).
- .11 Fill all boreholes completely, including deck and apron, with a non-shrink cement grout.
- .12 Record the condition of all concrete surfaces by sketching or photographing cracks, joints, and areas of seepage and deterioration on the deck, piers, abutments, sills and aprons. Note any abnormalities which may indicate structural deficiencies and immediate or potential safety problems. Comment on the causes of all the problems found.

4.0 REPORT

Provide 6 copies of a report containing the following:

- .1 A site plan indicating the exact location of each borehole.
- .2 A complete log of all the test borings, showing bedrock type and elevation, water table elevation, descriptions and properties of the different strata encountered. Quality must be suitable for reproduction on tender drawings.
- .3 Results of all field and laboratory testing and analyses.
- .4 Photographs indicating the concrete surface condition of all components of the dam.

- .5 Comments on the following:
 - a) low compressive strength of concrete cores;
 - b) low core recovery;
 - c) low values of RQD;
 - d) high values of permeability.
- .6 A discussion of the quality and permeability of bedrock with respect to pressure grouting. Provide recommendations for type of grout and grouting methods.
- .7 The report must be prepared by a Geotechnical Engineer registered with the A.P.E.O.

5.0 GENERAL REQUIREMENTS

- .1 All data must be in the metric system.
- .2 Notify the Trent-Severn Waterway office in Peterborough at least one week before moving on site. Arrange for switching of flow through selected sluices as required to carry out the drilling. Trent-Severn Waterway staff will move stop-logs. Canal operational requirements will take precedence over the Consultant's requirements.
- .3 Locate all utilities before drilling and be responsible for any damage caused to them. Consult Trent-Severn Waterway staff for the location of their utilities.
- .4 The removal and reinstallation of dam fencing or railing, if required, will be the responsibility of the Consultant. No removal will be allowed unless approved in advance by the Trent-Severn Waterway.
- .5 Restore all damage caused by this contract to match the original conditions, including re-sodding of grassed areas. An amount of money equivalent to the cost of restoring any damage caused will be withheld until rectification of the damage has been made to the Waterway's satisfaction.
- .6 Remove all debris and drilling material from the site.
- .7 All drilling is to be supervised by an experienced Soils Technician under the general supervision of a Geotechnical Engineer.

6.0 QUANTITIES AND OFFER

- .1 The estimated total length of drilling is 200 meters.
- .2 The estimated price for drilling is to include the supply and advancement of all casing, as may be required to complete the investigation.

- .3 Offer should be presented as "FEES" and "DISBURSEMENTS". Actual drilling charges are to be indicated as disbursements, with no mark-up by the Consultant.
- .4 Do not include G.S.T. in the estimate or offer.

7.0 INFORMATION ENCLOSED

- .1 Borehole plan on "Plan of Port Severn Main Dam", ref. no. T-11-273.8.
- .2 Steel Reinforcement, as shown on drawing , ref. no. T-11-273.8.
- .3 Layout Plan of Dam as shown on drawing, ref. no. T-11-273.8.
- .4 Location of the dam, Drawing ref. no. 10-428, sheet 86.

James Richardson, P. Eng.
Project Manager, Engineering
PWC (EC) A&ES

APPENDIX II
FIELD NOTES FOR CONDITION SURVEY
PORT SEVERN MAIN DAM

**PORT SEVERIN MAIN DAM
FIELD NOTES
VISUAL CONDITION SURVEY**

Deck (Rail side)

Roll #1 (3&4)

1. Transverse crack at east end over east abut, 2.7m long from start edge of deck N to S rail, from S leg Lt crack to 40mm wide.

2. @ 0.86m N of S edge of deck 0.4m long (west) from E edge of East Abutment.

5. @ 0.6m E of E edge of deck crack through 20mm wide through concrete structure 20mm differential lift.

6. Deck side @ upstream over E abutment cracked right through starting 1.09m S of N pt, 10mm wide, goes back 0.2m up and through top section of E abut cracked and section of concrete 0.1m high, 0.1m wide down to 10mm wide crack.

7. Showing extent of section concrete missing in crack above.

8. 10mm wide crack #6 running on top deck of E Abut up stream to crack running 11 l to river side of E abutment, 0.17m in base river side, 20mm wide. Running (back) down stream to N edge of deck. Smaller cracks 1.) @ transverse pt. 2.) 0.4m towards deck & out to water side of structure 3.) 1.03m by transverse pt & out to water side structure (will get water view later)

*Note: Deck good going East to Pier 9 and expansion joint over said Pier.

9. N/A

10. along #(5) cracked right through section 0.11m wide in place grass growing in crack, section movable.

11& 12. looking E @ E Abutment down to water numerous cracks mostly running parallel to water 1) 0.15m down from top 2) 0.1m down from 1) Sections missing widest one 50mm cracks start vertical this to 45° into structure. Looking E upstream to downstream.

(13,14,15,16) Deck over Pier 9) Plan shows expansion (control) it. has been repaired from N edge to S edge. (35m to 15m) wide

Note: Deck from P9 to P8 good control joints just surface scaling P9,8,7,5,3

(17,18,19,20,21,22) Deck over P8 cracked full width from up stream end of Pier S edge of deck.

(23,24) showing surface condition of deck between P9 & P8 end Roll #1

Roll #2

1. @ P8 0.8m E of centre surface crack to up stream edge. (N/S) from N rail

2. @ P8 0.76m N of N rail 0.9m long from centre to E.

3. @ P8 0.7m N of N rail 0.6m long centre to W. including surface spalling (scaling)

(4,5,6,7) P8 surface crack from S rail to S edge of deck 0.97m N of centre

(8,9,10,11,12) over P7 crack along control joint been repaired (10,11) show crack on both side of repair 1m S of S rail 10mm differ. lift.

8. Shown widest repair 0.25m

13. P8- P7 surface crack 1.3 W of centreline P8

14. Surface crack 0.8m from #13

15. \

16. surface cracks 0.5m centres from #14, last one 3.6m W. of centreline P8

17. /

18. Surface crack 1.1m W of P7 from S rail 0.9m long

19. Surface 1m W of centreline P7 from N rail to N edge.

20. Suf. 4.7 E of P6 N from N rail N. edge

21. 3.6

22. 2.3

Surface cracks from N rail to N. edge of deck west of P6

23. 1.7

24. 0.95

Roll #3

1. P5 N of rail

2 & 3. N to S rail, patched cracking, coming out in sections 35mm (thick) deep, 0.27m wide @ N edge 0.1m wide @ N to centre rail, 40mm centre to S rail

4. P4 from centre to 0.55m E edge P4

5-11. P3 along control joint repairs, patching at S edge Barrier support for highway traffic barrier going E to W before lock.

At N. Edge and to the West patched add cracked crack 10mm wide S. to N rail. N to centre rail in two 55mm wide, centre to S rail to S edge by barrier support two cracks 0.13m wide

12. P3 N rail side support SE (45°) crack

13. P3 @ centre Rail SE crack, @ South Rail NE crack 50mm wide to support

14. on P2 from centre to S east edge cracked and chipped 50mm towards centre 20mm by SE corner

15. on P2 from centre to SW corner cracked & chipped from centre crack to chip 60mm by S wide.

16. W. end of Deck over P1 @ S end of deck

Note: P1 separates Dam and Canal

17 & 18. looking west at canal new concrete at canal, then old concrete then original deck
@ P1

20. SW crack with deck to S rail @ P1

21. NW crack to N rail @ P1

22. looking S at West stain leading to canal 1st stair fairly new top i) deck cracked and sections broken at joint in stair end deck.

23. S side of main support for Turet Bridge long. spalling (scaling) from ground up 1.0m * 0.8m wide, rect of support small cracking

24 & 25. S hemi of support has most number of crack

END OF ROLL #3

Roll #4

1,2,3,4. Upstream Face of E Abutment numerous cracks and broken sections of concrete

5. Up stream Beam (deck) and E abutment 25mm gap along construction joint

6. E Abut (up stream between 1st & 2nd support beams 2nd support beam carries load of N rail of log pulling apparatus. Abut three cracked between two beams

this centre rt crack goes through and along length of 2nd support

7. 0.88 toward P9 crumbling in pieces. Rebar exposed and very rusted. 50mm gap

8& 9 N/A

10. spalling/ crack bottom side 1.53m toward P9

11. Between 2nd & 3rd beam support 3rd support carries load of centre rail for log apparatus on deck

12 & 13. 3rd support beam looking at under side support beam looking up beam 0.3m wide, section of concrete 0.45m long (towards P1)

14. Concrete Column in Abut dividing the two timber slips, section of concrete missing 1.0m down from deck, 0.1m high

15. Underside of 2nd support beam from upstream section of concrete croaked off 1.8m from E face of P9 total width of beam 0.3m long 50mm into beam rebar exposed and rotting (very badly rusted)

16. Spalling front base of deck 0.8m toward E Abutment upstream from P9 0.23m down

17 & 18. 3rd support upstream 1.2m from P9 toward E about up in. Bottom edge spalling (mm) off.

19. E Abut side vertical crack at front (1st) support of deck down to large erosion

20. E. face P9 upstream section of concrete broke away 0.2m x 0.2m, 701mm deep onto concrete

21. E. face P9 upstream between 1st & 2nd support beams

22. P9 W side upstream

1. at bottom corner of deck @ P9 included and loose 0.38m down from top and 0.3m out from edge of deck.

2. series of cracks 0.6m out from deck horizontal crack 0.3m down

3. vertical crack 0.6m out from edge.

23. W. face P9 Upstream Vertical crack 0.7m long.

24 & 25 W. face Upstream P9

24- large spalling 0.3m down from construction joint. 0.26m high 0.5m across starting 0.11m in from #23 crack. number of crack coursing through it.

25 - Under 2nd support beam large section of concrete broken off 0.24m down base intersection joint 0.2m across .

End of Roll #4

Roll #5

1 & 2 Underside of deck between 1st and 2nd Beam, 0.19m W of P9

3.

1st beam underside 1.04m W from P9 Rebar exposed for downstream 1/2 of beam

4. underside of 1st beam between P9 and P8 2.24m from P9 crack running basically up through centre of beam for 1.04m long

5. Underside of 2nd beam 1.17m E of P2 0.4m section of cement cracked off. Rebar exposed, 0.7m up from bottom edge.

6. 0.74 and 0.97m further sections of concrete cracked off. 0.1m long (width wise) under bridge 2.) 0.13 long

7.

0.7m E of P8

0.43 from #5 rebar exposed

8. Upstream E. face P8, 1) 0.5 - from front edge of deck 0.38 - high cup from construction joint. 2) series of cracks 0.1m in 1) 0.25m long (vertical)

9. spalling under deck in E face of P8, 0.6m wide

10. in spalling #9 cracks (both vert & horz.)

vertical crack, 0.13 apart horizontal one at my top of spalling middle 0.14 down from top and lower 0.2m down from middle.

11.E. face upstream P8 spalling 0.25m high from construction joint 0.13m vertical from side of spalling 0.6m wide, chips and section o of concrete off at top edge and both of spalling crack under 2nd beam 0.9 down from bottom of beam, 0.27 and 0.33m

12. E face upstream P8 Column at 3rd beam separating timber slips for dam, cracked 50mm down 0.13 down, 0.9m down is W.L. big chip 0.2m high starting 0.1m from WL full width of column.

13 & 14. Upstream N. on P8 big section off 0.7m down 25m across, 0.13m high

15& 16 W side of P8 cracks in upper section above construction joint which 0.9m down from top along C joint, 1.0m along from upstream edge of deck and 0.1m high large eroded section.

17. Front face of deck at P8 cracks 0.6m from P8 towards P7 bottom one 80mm up from bottom of 1st beam 0.2m up from bottom.

18.

spalling P8 W face from 1st to 2nd beam 0.25 down from bottom edge of beam 0.67m long 0.1m high Vt cracks .21m apart .13m to 1st crack from downstream fare of 1st beam. Horizontal crack 0.1m down from bottom side of beam.

19. 2nd beam from P8 for 1.0m, 60mm high upstream face has spalled.

20,21,22. Continuation of spalling from #19 , 0.6m apart but these run for 1.5m along lower upstream face of 2nd beam

23 & 24 spalling and cracks front fare of deck 2.4m west of P8, 0.1m down from top

25.

0.8m down from bottom of beam column under 3rd beam. beam two timber slips eroded at old WL , 0.75m down from bottom of beam downstream edge has section of concrete missing

End of Roll#5

Roll #6

1. E face upstream P7 section of cement broken off where deck meets P7 , 0.3m high from top, 0.1m wide from deck fare 2) 0.8m from deck face 0.2m down from top, crack in P7.

2. vertical crack i.e. face of P7 has calcium deposit on outside 0.38m long, 0.43 out from deck fare.

3. E. face upstream P7

1) loose broken sections

1a) 0.32 long x 0.2m wide

1b) 0.25m long x 0.2 wide

just upstream large section broken out 0.21m P x 0.12m W x 80mm deep between two (a) and (b) small section broken out 0.1 x 0.1 x 60mm deep

2) spalled area 0.41 x 0.57 w

(a) in line with down stream edge of 1st beam

(b) 0.35m up stream from upstream fare of 2nd beam

4. E. face upstream P7

crack in column between timber slips, 0.3m down from under side of beam

5& 6.

(5) W face of P7 couple of noticeable cracks.

(1) horizontal 0.2m down from 0.5m long towards upstream

(2) 45 degree crack, from deck joint down to 2nd construction joint 0.8m long has calcium

(6) Horizontal crack 0.17m below 2nd construction joint a couple of little sections broke out

7&8 W. face upstream P7

1) at upper construction joint before 1st and 2nd beams large eroded area 0.15 down stream from downstream edge of 1st beam, 0.23 long x 0.15 m wide x 40mm into concrete

2) 0.35 downstream from downstream edge of 1st vertical crack 0.60m long running between 1st and 2nd construction joint.

3) 70mm above 2nd construction joint, 0.25m long toward downstream, horizontal crack

4) 0.17m above 2nd construction joint x 0.2m long towards upstream

all in spalled area 0.36m long by 0.60 high

(9,10,11,12,13,14,15,16) Upstream face of deck (1st support beam) from P7 to P6

1) construction joint that has spalled open

2) numerous vertical cracks some full depth of beam other %

3) major vertical crack, 2.56m W of W face of P7 full depth of beam #1

4) Wear gauge starting 2m W of W P7 running diagonally down across deck face for 1.2m to centreline spalling P7-P6, one crack following same pattern.

5) Wear marks 2m E of E face P6 to 3m E of E face P6 down 0.25m from top

6) crack at P6 E face 0.2m below top 0.33l, 0.1m below top

17. Downstream face of 1st beam @ W P7 Spalling and cracks

left 0.3 surface concrete has scaled (spalled) but still there.

(18/19) Downstream face 1st beam 0.7m long spalled, 1.10m E of centreline span P7 to P6 left 0.4m surface concrete has lifted.

(20) Bottom downstream edge (eroded) spalled off exposing rebar 0.13m from end (18/19)

(21) @ centreline downstream edge of 1st beam spalled exposing rebar 70mm long, small crack to the left, 50mm above bottom edge of beam 0.2m long

(22)

spalled section downstream face, 1st beam @ 0.5m E of P6

(23,24,25)

Spalled area, 0.7m long, 0.2m rt side has lifted but still intact.

End of Roll #6

Roll #7

(1,2,3,4)

spalled and scaled upstream face 2nd beam From P7

1) lifted surface concrete 0.14m with * 0.7m long

2) crack starts at end of 1) run back toward P3 0.3m 75mm above, bottom of beam crack run down and through

5. bottom of beam including section of concrete eroded off exposing rebar

3) spalled/scaled 1.0m long from end of 1, 0.18 wide

(6,7,8,9)

Upstream fare of 2nd beam

(6) spalling edge 2m E of W fare of P6, Horizontal crack 0.19m below bottom side of deck, 1.3m long.

(10)

Upstream Nose of P6

large section of concrete broken out 0.6m below deck 0.37 long, 0.25m width at base 40mm deep into cement.

(11,12) E. face of P6

1) crack lines from under 1st down stream, 0.2m up from construction joint running into up stream for timbers 0.97m long

2) Large eroded section starting @ 0.86 (c.jt.) 0.51m high, 0.42 wide out widest part, 40mm deep into concrete.

13) E. face upstream P6

Gauges/wear marks into concrete 50-70 mm deep into concrete

14) W. face P6 upstream

1) crack/gauge 0.75 from top 50mm high, 0.7m long

(15 & 16) W. face upstream P6 under 1st and 2nd beam

2) gauge in line with downstream face of 1st beam along construction joint, 0.2m long, 0.15 high, 40mm deep

3) series of gauges 0.3m long, 0.2m high, 30mm deep

4) section missing along with above gauges 0.2m long, 0.1m high, 40mm deep.

spalled area between 1 and 2 beam , 0.3 - high

5) cracks (vertical & horizontal) vertical cracks 0.15m (6") apart

(17) spalled/scaled section 2.1m W toward P5 from P6 0.15m down from underside of deck

(18) lifted scaled section 2.8m W of P6

(19) 1.3m E. of P5 downstream face of 1st beam, crack exposing rebar

(20) 2nd beam at W face P6 0.6m long crack, spalling above it. Rebar exposed.

(21) tape strip 50mm wide 100mm long spalling

(21 & 22) 2nd beam upstream P6 & P5 spalling

(23) 2nd @ P5 E side cracks/ spalling

(24) downstream beam face 2nd beam at P6 W face

(25) further along above beam crack exposing rebar

End of Roll 7

Roll #8

- 1) centreline of span 3rd beam upstream crack exposing rebar
 - 2) underside of 3rd beam @ centreline of SPAN P6 to P5
 - 3) Upstream bottom of 3rd beam crack
 - 4) 3rd Beam and column at P5 E face crack
 - 5) crack face P5 under 1st and 2nd beam
 - 6) E face P5 downstream of dam long eroded section
 - 7) Upstream west face Pier 5 erosion
 - 8) centre upstream span P5/4 face crack 10cm of tape
 - 9) down stream face of 1st beam 10m E of P4 crack rebar exposed
 - 10) W face up stream P5 + down stream 1st beam rebar exposed 1.0m
 - 11) upstream 2nd beam E end rebar exposed 0.5m
 - 12) U.S. face 2nd beam chunk of concrete removed re-bar exposed
- Note: underside of deck between beam 1.2 no cracks minor scalling
- U.S.= upstream D.S. down stream
- 13) us 2nd beam W end 12m exposed rebar
 - 14) cracks on E face US P4
 - 15) DS face 2nd Beam pencil to depth 40mm 1.3m E to P4

16) 0.5m E of 15 construction erosion,

17) erosion under 3rd beam W face P5

18) erosion US face 3rd beam at P4

19) bottom of 18 showing rebar

20) bottom of 2nd beam centre of span erosion

21) 4th beam bottom E end exposed rebar

22) W face of P5 DS beam 4 to 1st beam of highway- concrete 1.7m broken away along construction joint.

23) E face P4 highway beam US view erosion re-bar exposed

24) US end W face P6

25) Same

End of Roll 8

Roll #9

- 1) US face of 1st beam deck @ P4
- 2) 1.77m W of P4 vertical crack through deck 1st beam
- 3) bottom of 1st beam 2.4m W of P4 a hole 50mm of concrete.
- 4) N/A
- 5) long crack bottom beam #1
- 6) US face of span vert. crack 2.7m E of Pier 3
- 7) 1st beam US at P3 erosion, crack
- 8) typical scaling 4 long DS face Beam #1, W end
- 9) DS face 8 beam #1 2.2m from Pier 4
- 10) 2nd beam US face 1.5m from P3, 0.1m of exposed rebeam
- 11) US timber slip P3 E face
- 12) Erosion DS face centre of beam #2
- 13) 6cm Exp. re-bar 1.1m from DS face beam #2
- 14) US timber slip W face P4
- 15-18) 1.3m from P4 patch of exp. re-bar 0.6 x 0.1m bottom beam 3
- 19) DS timber slip W face P4
- 20) DS of 19 cont. of erosion at construction joint

21) Bottom 4th beam end at P4

22) E face P.T. under beam 5 erosion under construction joint.

23-24) Us end P3,

End of Roll

Roll #10 P3 P2

1) W. S face P3

2) Small cracks US face Beam #7

3) Erosion US face beam #1 joint with E face P2

4) E U.S face/ 10SE P2

5) D.S. of 4) cont

6) DS face beam 1 centre

7) W face P3 under beam W end beam

8 - 10) Erosion DS face #2

11) US W face P3 under beam #3

12) DS of N erosion under const joint beam 4+5

13) chunk of concrete missing E end of 1st highway beam DS of 12)

14) cracks, centre US face beam 4

15) W US face beam #4

16) 1st beam at W US face P2

17) W US face P2 between beam 1+2

18) DS face beam 1

19) E US face P1 between beam 1+2

20) US face centre beam #2 exposed re-bar 0.4m

21) US face beam 2 E end exposed re-bar 0.6 long + 0.3 high

22) broken edge of concrete W US face P2 Timber slip

23) DS face beam 2 W end 25mm deep erosion

24) same as 23) at US face P1

Roll #11

- 1) Loose chunk E US face P1 under beam 3
- 2) Erosion mark US E end face beam 3
- 3) DS Timber slip W face P2
- 4) Large loose chunk of between beam 5+6 concrete W face of P2
- 5) erosion of E face P1 between beam 5+6

Roll 12

- 1,2) DS face under dam timber crack
- 3) DS E face P1
- 4,5) erosion upper middle E face P1
- 6) large section of missing concrete centre of P1
- 7) 0.5 x 0.3m chunk missing concrete centre of E face P1, 1.0m DS of dam
- 8) erosion 1.5m DS of dam W face of P2
- 9) DS end of P1 eroded section of E face separated at construction joint
- 10) erosion DS end W face P2
- 11) DS end of P3
- 12) E face DS of P2 erosion
- 13) W face DS of P3 at underside of highway deck large erosion
- 14) W face DS of P3 large erosion cut into concrete 0.6m long 0.2m high, 170mm deep
- 15) DS nose P3 @ top of pier 1/2 way down erosion cracks
- 16) continuation of 15 upstream P3 DS E face erosion
- 17, 18) DS face of 4th beam for dam concrete off exposing rebar 1.0m long, from P3 going almost to centreline of spa P3-P4
- 18) 0.5m large section exposing rebar 1.5m from W fame P4
- 19) vertical crack DS E face P3 , 4.5m upstream from DS edge P3 1.0m high
- 20) DS W face P4 @ dam erosion from water leaking through timbers
- 21) erosion 1.5m upstream DS end of P4 W face
- 22) DS 4th beam @ E P4
- 23) erosion W face DS P5 1.5m above WL erosion
- 24) DS W face P5 2.2m upstream from DS edge

Roll 13

- 1) underside of DS P5 erosion
- 2) @ E P4 4th beam US side under deck, rebar exposed
- 3) @ W P5 4th Beam rebar exposed
- 4) DS @ dam W P6 erosion
- 5) DS at underside of highway erosion along construction joint W P6
- 6) DS E face P5 1/2 way up large erosion @ dam
- 7) DS nose P7 top % eroded
- 8) DS E face P7 erosion
- 9) @ dam DS W face P8
- 10) DS nose P8
- 11) DS E face P8 & dam
- 12) DS E face P9
- 13) DS E Abutment 1.5m from Dam
- 14) N/A
- 15) DS E abutment @ WL erosion
- 16) DS E abutment
- 17& 18) general shot US whole dam, looking W
- 19) Top side US dam looking West
- 20) looking E DS general shot
- 21) DS look US Turret Bridge
- 22) Highway Bridge looking W
- 23) Top of P5 DS
- 24) Top of P3 DS