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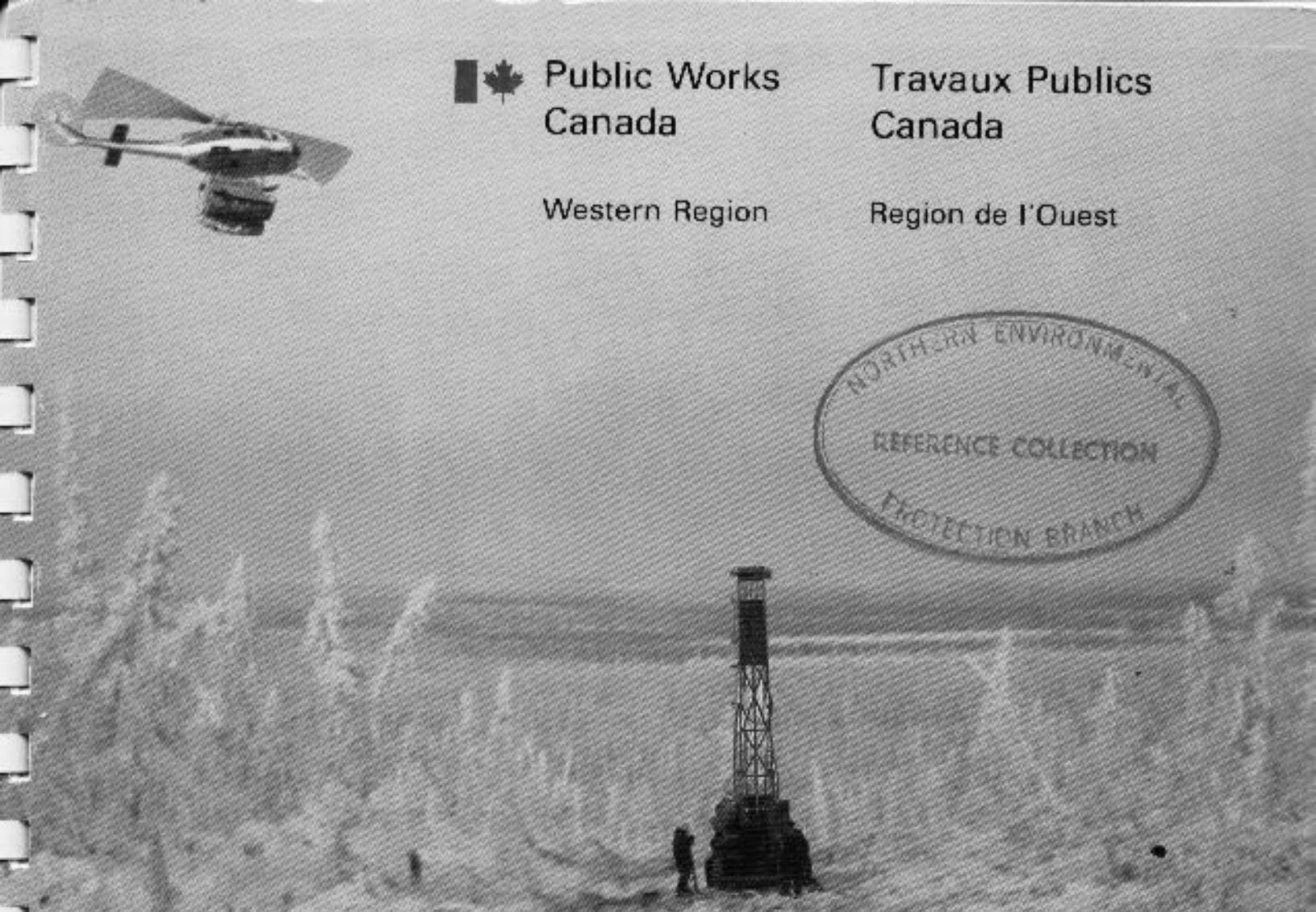

SUPPLEMENTARY REPORT

GEOTECHNICAL INVESTIGATION

PROPOSED MARTIN RIVER BRIDGE
MILE 306.7
MACKENZIE HIGHWAY

PUBLIC WORKS CANADA

WESTERN REGION

REPORT ON

GEOTECHNICAL INVESTIGATION

PROPOSED MARTIN RIVER BRIDGE

MILE 306.7 MACKENZIE HIGHWAY

Submitted by:

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Western Region

June 9, 1976

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I Preliminary

The initial highway alignment in the area of the Martin River was established in 1972. Geotechnical exploration along the route was carried out that same year and included foundation borings for a bridge structure at the Martin River and investigation of the bridge approaches. These initial borings identified an extensive permafrost condition in the north-west valley bank which is immediately adjacent to the stream channel. Materials in the slope were ice-rich, thaw-unstable clays that were particularly sensitive to surface disturbance, and which presented a major design and construction problem. In February 1973 an evaluation report was prepared comparing costs and other factors for two different levels of crossing along the original alignment, as well as two projected alternate alignments. It was concluded that an alternate routing some 3500 feet downstream from the original alignment was most suitable and has been selected as the crossing site.

The proposed crossing route and the original alignment are shown on the site plan in Appendix A. Also shown thereon is a temporary Bailey Bridge located some 2500' upstream from the proposed crossing. The temporary bridge is founded upon timber cribs filled with heavy granular deposits from the river bed. This Bailey Bridge will be relocated to the revised crossing site and recon-

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structed roughly 150' downstream from the centerline and the proposed location of the permanent structure.

Detailed log sheets for four (4) foundation borings at the original crossing site are included in Appendix B, along with log sheets for two (2) holes drilled at the present site.

II Crossing Site

The proposed crossing site is located at Mile 306.7 on the Mackenzie Highway. Surficial geology in the area consists of thin (30-60') ablation moraine deposits, on basal glacial till, over shale bedrock. The Martin River has incised a relatively narrow, shallow valley into the ablation moraine materials (primarily sands and silts with some clay), and in the area of the crossing is currently flowing near the ablation moraine-basal till interface. The surface of the till has a relatively high granular content and the stream bed is paved with boulders that are probably products of erosion into this stratum.

At the bridge site the river is presently adjacent to the valley slope on the east and the approach to the bridge from that side will be on ablation moraine deposits. On the opposite side is a narrow, valley floor some 500 feet in width where the subsoil consists of relatively shallow

(10-15') flood plain deposits - sands, silts, clays and some gravels, over glacial till.

With reference to the site plan in Appendix A, the crossing site is located roughly 500 feet downstream from an oxbow cutoff. Meanders are currently forming in the area of the crossing as a result of the cutoff, and a hydrology consultant has recommended that the east bank be protected against lateral scour at the bridge, and the west bank be protected about 150 feet upstream from the bridge. In addition, the river is presently encroaching on the upper end of the oxbow lake some 2500 feet upstream of the proposed bridge site, and, as the oxbow lake is roughly 7 feet lower than the river channel at this point, the river will eventually break through to the old, cutoff, channel. A possible dyking area some 500 feet upstream of the proposed bridge is shown on the site plan, to direct the flow when this event occurs.

III Subsoil Conditions At Bridge Structure

The two boreholes and the approximate subsoil stratigraphy at the crossing are shown on Drawing A-1 in Appendix A. Hole #5 on the east side of the river was drilled with a rotary rig in February 1975; hole #6 on the west side was drilled with a

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power auger in March, 1976. Permafrost was reported on the east side but appeared to terminate near a depth of 20 feet in hole #5 (Note - several auger holes were attempted on the east side in March '76 but the equipment was unable to penetrate a frozen granular layer near a depth of 10 feet).

The upper limit of the glacial till is shown on Drawing A-1 near elevation 442 or roughly 6 feet below the stream-bed. Deposits above the till to stream-bed have a significant heavy granular content (gravel, cobbles and boulders), and may be reworked till materials. Maximum penetration into the till was roughly 15 feet. The till is very stiff or dense and auger advance was very difficult near the bottom of hole #6 (West side).

The four boreholes at the original crossing site (3500' upstream) encountered similar subsoil stratigraphy, with shale below the till at an elevation of roughly 435-440 (20-25' below stream-bed). Shale was not reported in either drill hole at the revised crossing, however it is anticipated near elevation 425. It is tentatively planned to drill two additional holes at the revised crossing site to confirm the depth to shale when a rotary rig becomes available in the area, probably in late summer of 1976.

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IV Foundation Support of Bridge Structure

There are no design details for the proposed permanent bridge, however a single span structure in the order of 130-150 feet in total length is anticipated. A driven pile foundation system is recommended for the abutments.

The glacial till and/or the underlying shale will form the bearing strata for the foundation elements. Steel H-piles are recommended for use primarily because of their high driving strength, high load capacity and relative ease in splicing. The glacial till at this site will provide adequate lateral support such that instability in the form of pile buckling will not be a problem.

Hard driving is anticipated both in the heavy granular zone above the glacial till, and in the glacial till itself. A relatively heavy section-10BP @ 57 lbs./ft.-is recommended. It is anticipated that pile penetration through the granular zone on the east side of the channel will be practically impossible due to the presence of permafrost, hence it is recommended that lead holes be prebored for the piles to the lower limit of the permafrost on this side and the piles driven into the till at the base of the holes. The lead holes should be 14" in diameter assuming a 10" H-pile section. Following pile installation, the cavity around each pile should be filled with free running sand.

The subsoil stratigraphy at this site will permit the use of either lightly loaded piles, designed on the basis of shaft friction in the glacial till, or heavily loaded piles, designed for the full structural strength of the pile section acting as a column, and driven to refusal, probably into the shale below the till. "Refusal" will depend upon the energy rating of the drive hammer, but assuming an energy in the order of 15,000 ft. lbs., piles should be driven to blow counts in the order of 15 blows per inch. To ensure that refusal has been reached, driving should be continued for at least 100 blows after the refusal requirement is first recorded. It is anticipated that final refusal will occur near elevation 415-420 or roughly 30-35 feet below stream-bed elevation, however this estimate could be revised pending confirmation of the depth to shale.

Lightly loaded piles may be designed on the basis of an average allowable shaft friction of 500 psf. in unfrozen subsoil (i.e. below a depth of roughly 20 feet from existing grade on the east), with end-bearing ignored.

The allowable lateral load for piles at this site may be assumed at 5 kips per pile for a lateral movement in the order of 1/4 to 1/2 inch.

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There is an abundance of fine dune sand in the Martin River area and it is assumed the backfill against the abutments will be compacted sand. For a simple vertical retaining wall abutment, the earth pressure may be calculated by assuming the backfill to be a fluid with a density of 60 lbs./ cu. ft.

Fill heights immediately adjacent to the abutments will be in the order of 15-20'. Unit loadings imposed on the subsoil from the fills will be relatively small and, as consolidation will only take place in the strata above the glacial till, overall embankment settlements should be minor.

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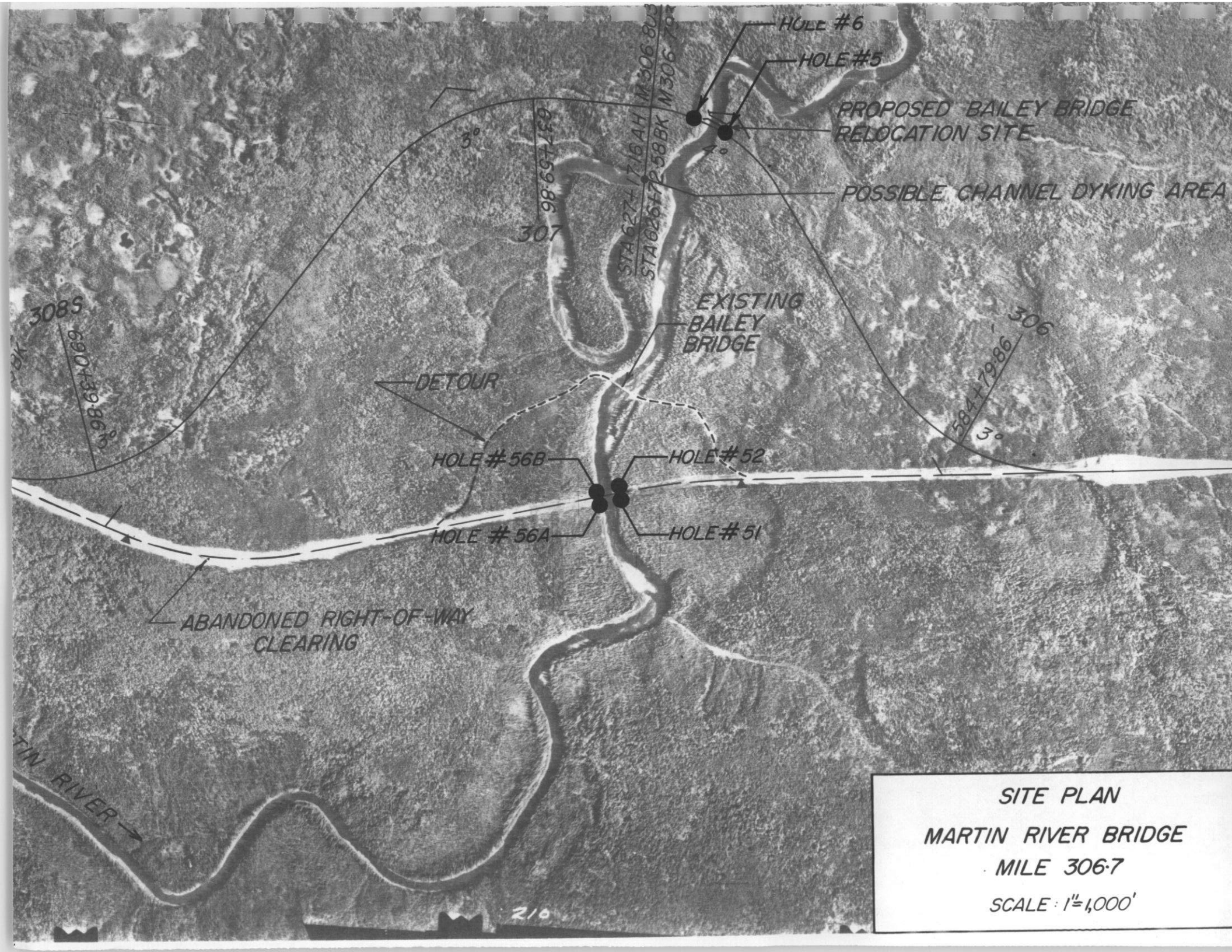
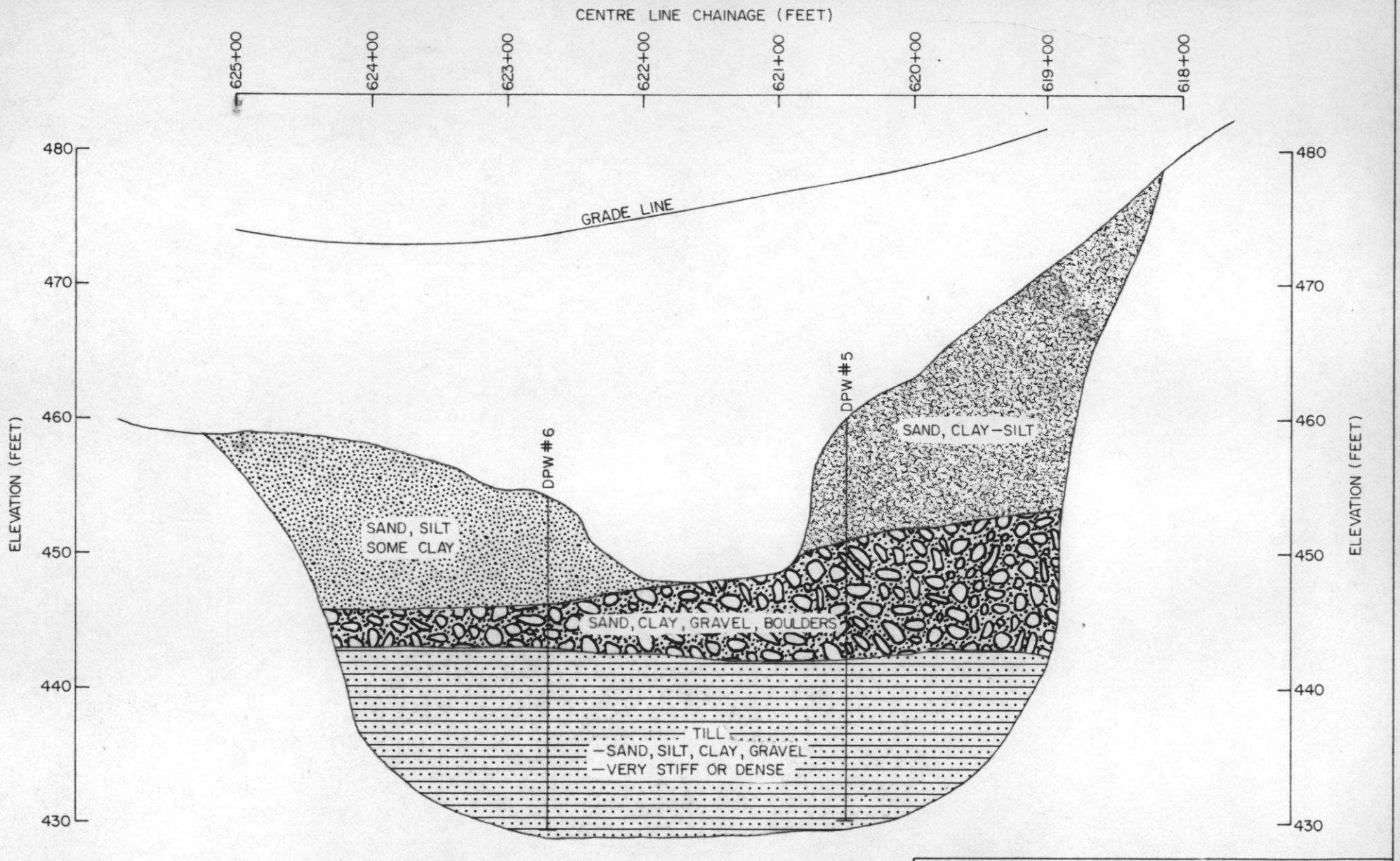

HOLE #6
HOLE #5
PROPOSED BAILEY BRIDGE
RELOCATION SITE
POSSIBLE CHANNEL DYKING AREA
EXISTING
BAILEY
BRIDGE
DETOUR
HOLE #56B
HOLE #52
HOLE #56A
HOLE #51
ABANDONED RIGHT-OF-WAY
CLEARING
MARTIN RIVER
307
308S
306
3°
7°
SITE PLAN
MARTIN RIVER BRIDGE
MILE 306·7
SCALE: 1"=1,000'



NOTE: STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN ASSUMED.

SCALE: VERT 1"=10'
HORIZ 1"=100'

PUBLIC WORKS CANADA
WESTERN REGION

MARTIN RIVER CROSSING
MILE 306·7
MACKENZIE HIGHWAY

DWG NO A-1

MARTEN RIVER BRIDGE - SOUTH BANK 51 LINE #1 STA. 615+00 -25' Lt. ℄ AUG. 17/1972

20 40 60 80 10 20 30 40 50

SM 8' MUSSEG OVER CLAY, SILT, SAND & PEBBLES — 2.5'

SILT, SAND, GRAVEL, COBBLES AND BOULDERS
GP - DENSE GRANULAR MTLS.
- VERY HARD DRILLING.

13

SILTY, SANDY, CLAY WITH PEBBLES — TILL
CL - LOW PLASTIC
- DENSE

19

SHALE.
- SOFT TO MEDIUM HARD

36

BOTTOM OF HOLE - 36'

SURFACE FROST ONLY TO APPROX. 3-4'

0 64.7 -72- 18 0

0 -44- 34 22

0 40 for 3"

7.2 64 -56- 27 17

0 38 for 6"

-61 -18- 64 18

10.9 -24- 76 0

KAITEN RIVER BRIDGE. - SOUTH BANK 52 STN. 615+20 - 25' Rt. ℄ LINE #1 AUG. 17/72.

10 20 30 40 50

SILT, SAND, GRAVEL,
COBBLES AND BOULDERS
- DENSE GRANULAR MTS.
GP - HARD DRILLING.

5

6

13'
SILTY SANDY CLAY - TILL
- LOW PLASTIC
CL - DENSE
- PEBBLES THROUGHOUT
21'
SHALE
- SOFT TO MEDIUM
26'
BOTTOM OF HOLE - 26'

NO EVIDENCE OF FROST

15

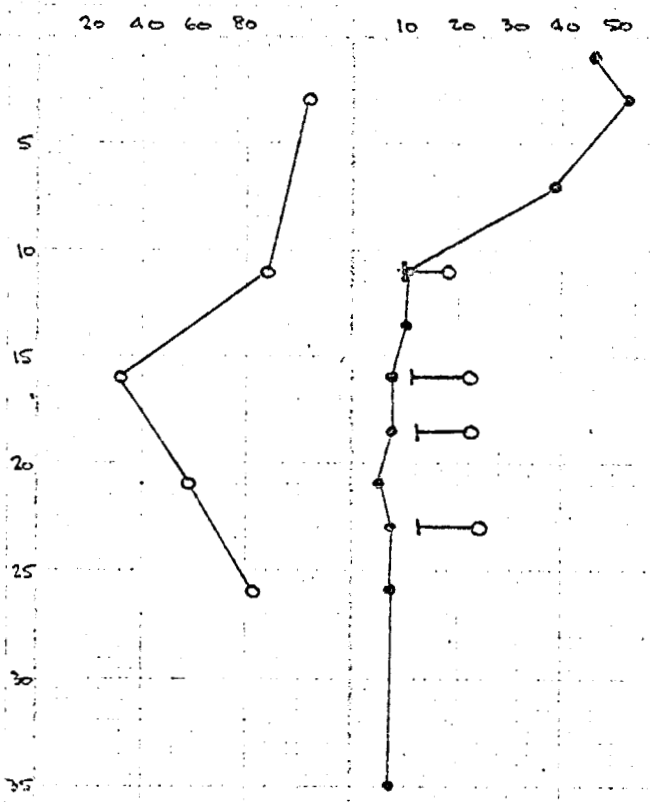
20

25

30

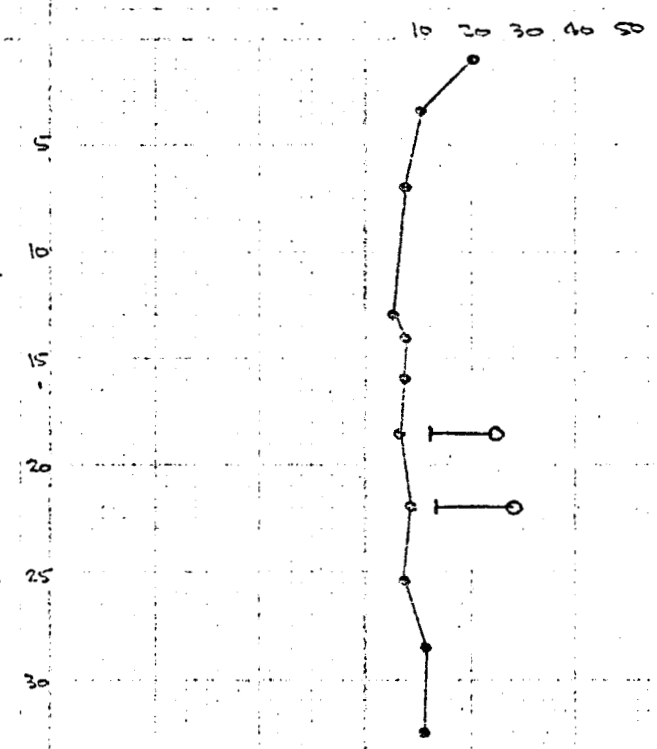
13.4				-29-	36 35
13.1	22.3	12.7	9.6	-42-	40 18
6.7				-49-	50 1
8.0				-16-	76 8

MARTEN RIVER BRIDGE - NORTH BANK S6A LINE #1
STA. 617+00 - 45' Lt. ℄ AUG. 23/72



	1' ABBS. TOPSOIL WITH SILTY CLAY					
CI	- MEDIUM PLASTIC					
	- FROZEN WITH ICE LENSES	5	46.7	-86-	14	0
	- WET ON THAWING.		52.7	-93-	7	0
	8.5'					
	SILTY SANDY CLAY WITH PEBBLES - GLACIAL TILL		38.6	-46-	44	10
	- LOW PLASTIC	10	10.2	-33-	44	23
CL	- SALTY ZONES		9.9	-36-	51	13
	- NO VISUAL ICE OR	15	7.0	-34-	38	28
SC	EVIDENCE OF FROST BELOW 12'		7.2	-49-	48	3
	- WATER BEARING SEAMS	20	4.9	-21-	23	56
	TO 18'		6.7	-51-	41	8
	23'	25	7.0	-24-	68	8
	SHALE.					
	- SOFT TO MEDIUM HARD					
		30				
	35'	35	6.9	-15-	68	17
	BOTTOM OF HOLE - 35'					
	- PERMAFROST TO 12'					
	- HOLE APPROX. 8' ABOVE	40				
	WATER LEVEL.					

MARTEN RIVER CROSSING. – NORTH BANK 56B LINE #1 STA. 617+00 – 45' Rt. ℄ AUG. 30/73



SC CLAY, SILT, SAND
– COBBLES & BOULDERS

3'

SILT, SAND, CLAY, PEBBLES
– GLACIAL TILL
– LOW PLASTIC
SC – DENSE
CL – NO EVIDENCE OF FROST
GC

26'

SAND, SILT, GRAVEL
– SHALE PIECES
– SHALE ?
– RESULTS INCONCLUSIVE BELOW 26'
– HOLE SLOUGHING
– MAY BE SHALE.

45'

BOTTOM OF HOLE – 45'

20.0	-30-	67	3
10.1	-12-	52	36
11.0	-22-	45	33
4.6	-21-	28	51
6.7	-40-	51	9
6.6	-16-	26	58
5.9	-45-	46	9
8.2	-53-	42	5
6.9	-39-	50	11
11.0			
10.8	-15-	61	24

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DRILL HOLE REPORT

SITE: MARTIN RIVER - SOUTH BANK

FIELD ENG.	DATE DRILLED. 23/1/75	AIRPHOTO NO.	CHAINAGE.	OFFSET.	TEST HOLE 5
TECH.	RIG.	SURFACE DRAINAGE.	VEGETATION.	ELEV.	MILE

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION	GRAIN-SIZE ANALYSIS CLAY %	SILT %	SAND %	GRAVEL %	RELATIVE THAWED MOISTURE CONTENT	REMARKS
						Peat & Organics — 1'								
2					SM	Sand, Silty - Fine to Medium — 3.5'		Frozen to Approx. 20'					Moist	
4					ML	Silt - Clayey - Sandy - Moist to Wet on Thawing			73	-	27	0	Moist	
6														
8									75	-	25	0	Moist	
10						— 9'			41	-	48	11	Wet	
12					SC	Sand, Clay, Gravel, Boulders Probably - Till Below 18 - 20'								
14					CL									
16					GP	- Free Water in Hole @ 24'			8	-	16	76	Moist	
18														
20									48	-	30	22	Damp	
22														
24									33	-	35	32	Damp	
26														
28						Bottom of Hole - 30'									

DRY DENSITY (lbs./ Ft.³)
WATER CONTENT (% of dry weight)
ICE CONTENT (% of sample volume)
PLASTIC LIMIT — LIQUID LIMIT

DEPARTMENT OF PUBLIC WORKS, CANADA
MACKENZIE HIGHWAY

DRILL HOLE REPORT

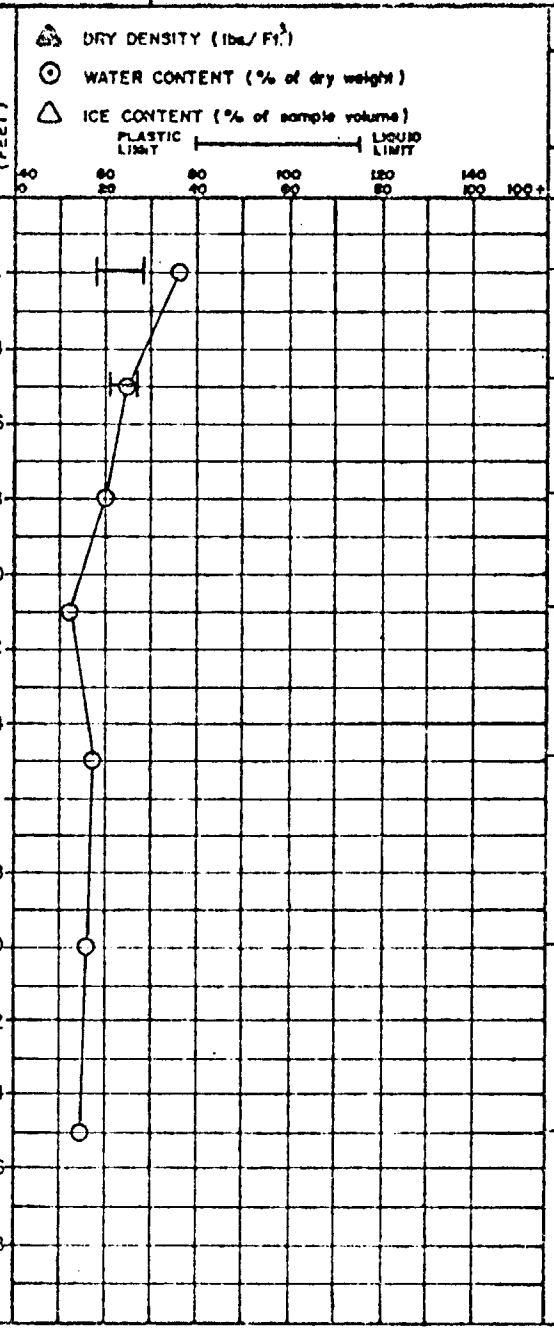
SITE: MARTIN RIVER - NORTH BANK

FIELD ENG.	DATE DRILLED. 20/3/76	AIRPHOTO NO.	CHAINAGE.	OFFSET.
TECH. D. Currie	RIG. B-50 Auger	SURFACE DRAINAGE.	VEGETATION.	ELEV.

TEST HOLE 6

MILE

DEPTH (FEET)	SAMPLE NUMBER	SAMPLE TYPE	% RECOVERY	PENETRATION RESISTANCE	UNIFIED SOIL SYMBOL	SOIL DESCRIPTION	LIMITS OF FROZEN GROUND	ICE DESCRIPTION
2					ML CL	Silt - Sandy Clayey To Clay - Silty Sandy		Frozen To 3'
4								
6						Wet Layer @ 8'		
8						8'		
10					GC	Gravel - Clay Sand Mixture		
12						11'		
14						Clay - Sandy Silty - Pebbles		
16					Cl	- Till - Medium Plastic		
18						- Very Stiff or Dense		
20						- Very Hard Drilling @ 25'		
22								
24								
26						25'		
28						Bottom of Hole - 25'		



GRAIN-SIZE ANALYSIS				RELATIVE THAWED MOISTURE CONTENT
CLAY %	SILT %	SAND %	GRAVEL %	
64	36	0		Sat.
59	41	0		Wet
9	23	68		Sat.
32	22	46		Moist
42	46	12		Sat.
59	36	5		Moist
56	37	7		Wet

REMARKS

Moisture Contents Below 8' Contaminated By Seepage @ 8' Level.