

Aggregate Resource Inventory of the Rural Municipality of Pembina

By R.V. Young

Manitoba
Energy and Mines
Mines Branch



1991



Aggregate Report AR92-2

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By R.V. Young
Winnipeg, 1991

Energy and Mines

Mines Branch

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ABSTRACT

An aggregate resource inventory was carried out in the Rural Municipality of Pembina. Airphoto interpretation, followed by field investigation, was used to identify and define sand and gravel deposits. Seventeen sand and gravel deposits and 51 shale bedrock quarries were defined as being potential sources of aggregate. Estimated reserves of sand and gravel are in excess of 16.7 million cubic metres. The sand and gravel is characterized by high shale content.

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MAP

Map AR92-2: Aggregate Resources in the Rural Municipality of Pembina, 1:50 000	in pocket
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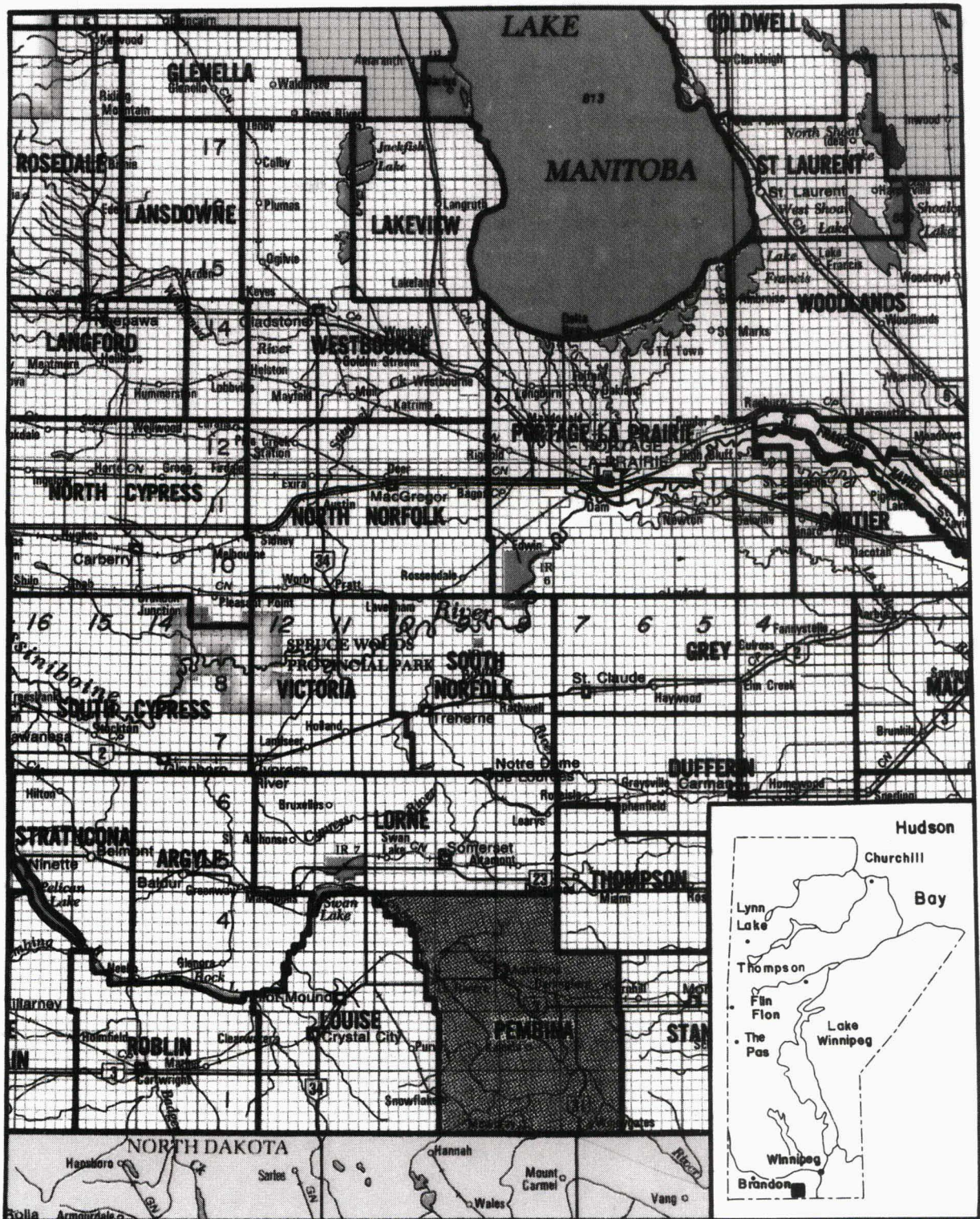


Figure 1: Location of the Rural Municipality of Pembina.

INTRODUCTION

OBJECTIVES

An aggregate resource inventory was carried out in the Rural Municipality of Pembina, with the objectives of determining the location, quality, and reserves of aggregate resources. The information contained within this report may be used to assist in land-use planning and resource management, and by consumers of sand and gravel.

LOCATION AND ACCESS

The study area (Fig. 1) encompasses 1095 km² located 144 km southwest of Winnipeg. The Municipality includes Townships 1 to 4 and Ranges 7 to 10 west of Principal Meridian. The largest settlements are the Towns of Manitou and La Rivière. Access is by Provincial Highways 3 and 31 and several provincial roads. Most of the municipality is accessible by section roads, but large areas within the Pembina River valley are not accessible due to steep slopes and dense vegetation.

METHODOLOGY

Geological field investigations were conducted during the summers of 1990 and 1991. Airphotos, at scales of 1:56 000 and 1:15 840, were used to identify potential aggregate deposits. Existing sand and gravel pits, including borrow pits, were examined and sampled. Undeveloped and potential deposits were tested by backhoe to a maximum depth of 6 m. All bedrock quarries and borrow pits were described and the locations included on the map accompanying this report.

The coarse aggregate sample fraction (19.9 - 76.3 mm) was sieved in the field and weights recorded. Clast sizes greater than 76.3 mm (3") were recorded as sparse, moderate or abundant. A representative sample of the less

than 19.1 mm size range was retained and sieved in the laboratory. Sizes less than 0.074 mm were recorded as combined silt/clay fraction.

The field sieved coarse aggregate was used to perform petrographic analysis when sufficient sample was available. Each clast was classified according to rock type and the number of clasts for each rock type was counted. Rock types were grouped into four categories: good, fair, poor and deleterious according to their suitability as aggregate. The percent shale by weight was also calculated for the coarse fraction, and the 4.76 - 9.5 mm size for selected samples.

Reserve estimates were calculated by multiplying deposit depth by deposit area, and adjusting the reserves for areas depleted or not available for mining. Surface and mineral ownership was recorded for each aggregate deposit.

PREVIOUS WORK

The surficial geology map by Elson (1959) was used to assist with the identification of potential aggregate deposits within the municipality. Manitoba Department of Highways and Transportation Services (1976, 1977) tested several gravel pits including backhoe testing of selected sites and grain size analysis of gravel samples.

ACKNOWLEDGEMENTS

Able field and laboratory assistance was provided by Gerald Olsen. Maps and figures were drafted by C. Wojciechowski. S. Weselak prepared the camera ready copy on desktop publishing software, and D.A. Baldwin edited the manuscript. Mineral ownership data for the municipality was provided by The Crown Lands Branch.



Figure 2: View of the Pembina Valley looking north from site RY636. The valley is approximately 3 km wide.

AGGREGATE RESOURCES

Sand and gravel is found within the Pembina Spillway, meltwater channels and glaciofluvial deposits. Seventeen aggregate deposits were identified and 17 sand and gravel and borrow pits. In addition, 51 shale quarries and borrow pits and one till borrow pit (RY669) were identified. The bedrock shale quarries are located along the Pembina Spillway, its tributaries and minor creeks that have eroded into bedrock. North of Manitou several shale quarries are located on knolls of near surface bedrock.

The Pembina Spillway (Fig. 2) is a major glacial meltwater spillway located in the west and south portions of the study area. The spillway is 2 to 4 km wide with a depth of approximately 76 m and is eroded into the underlying shale bedrock. Sand and gravel deposits are confined to terraces within the spillway (Fig. 3 and 4). The terraces are composed almost entirely of reworked shale bedrock gravel and cobbles in a silty very fine sand matrix. The only good quality sand and gravel found within The Pembina Spillway is at site RY674, where 5 m of sandy till overlies 10 m of sandy pebble gravel; however the thick overburden and steep slopes makes mineral extraction from this site difficult.

Sand and gravel is also associated with minor meltwater channels as channel terraces and small pockets of overbank deposits. These deposits are generally shallow, 1 to 3 m deep, and are generally underlain by till. The sand and gravel in these deposits have a high silt content.

Glaciofluvial sand and gravel deposits include eskers, kames, morainic outwash and ice-contact stratified drift. These deposits are 2 to 6 m in depth and may be overlain by silt or till. The largest of these deposits 12367 which

ranges from till at sites BB203 to sand and gravel at sites BB202 and BB204.

The large number of shale bedrock quarries and the lack of actively mined gravel pits within the municipality indicates there is limited mining of sand and gravel. Gravel terraces within The Pembina Spillway have limited development potential because these deposits generally contain coarse shale boulders or silty fine grained reworked shale bedrock. Meltwater channel deposits have limited potential for mining because they are generally shallow, are fine grained with a high silt content, and contain 75 to 85% shale clasts. Pits in these deposits are generally small borrow pits where there is no evidence of processing and the sand and gravel is used locally as fill. Glaciofluvial deposits have the best potential for development. Although these deposits are overlain by till or silt, the shale content varies from 11 to 74%. Deposit 12367 has the best potential for development, but only a small portion of the deposit is located within the boundary of the municipality.

Exposure and deposit information is provided in Appendix A. This information includes deposit reserves, exposure data, sieve analysis and petrographic analysis. Total reserves within the study area are 16.7 million cubic metres. A total of 29 sites were tested by backhoe and 24 samples were analyzed. Location of deposits, exposures and backhoe test sites are shown on Map AR92-2. All exposures not defined within a sand or gravel deposit have an assigned computer deposit number of 12379X, however this deposit number is not shown on the map.



Figure 3: Roadcut through Pembina Valley terrace at site RY671. The terrace consists of 1.5 m of shale cobble gravel overlying shale bedrock.



Figure 4: Roadcut through Pembina Valley terrace at site RY641. The terrace deposit consists of 1 m of shale cobbles and boulders in a silt matrix overlying shale bedrock.

REFERENCES

Elson, J.A.

- 1959: Surficial Geology, Brandon, Map Sheet 62G, Map 1067A, 1:253,440 in Halstead, E.C, 1959, Ground-Water Resources of The Brandon Map-Area Manitoba, Geological Survey of Canada Memoir 300.

Manitoba Department of Highways and Transportation.

- 1976: Aggregate Resource Inventory Block File 4 and 5, Geotechnical Section, Materials and Research Division.
- 1977: Aggregate Resource Inventory Block File 6, Geotechnical Section, Materials and Research Division.

APPENDIX A: EXPOSURE INFORMATION

DEPOSIT # 012361

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER) (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
SE-36-004-10W	840000	30	588000	PRIVATE/PRIVATE	
NE-25-004-10W	260000	20	208000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		796000		

EXPOSURE INFORMATION

EXPOSURE #: BB181 (SE-36-004-10W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 3.8 METRES ESTIMATED STONE CONTENT: MEDIUM
 SECTION: A MATERIAL DESCRIPTION: PEBBLE GRAVEL SHALE RICH
 SECTION HEIGHT: 4.5 M DEPTH TO WATER TABLE: 4.5 M
 HEIGHT SAMPLED: 2.5 M OVERBURDEN THICKNESS: 0.7 M
 MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE ON EDGE OF PIT ON ROAD ALLOWANCE 0.0-0.7 M-SOIL
 -99.9% SHALE, FEW GRANITIC AND LIMESTONES 0.7-4.5 M-PEBBLE GRAVEL
 -SHALE RICH

EXPOSURE #: BB180 (SE-36-004-10W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLY SAND HIGH SILT
 SECTION HEIGHT: 4.5 M DEPTH TO WATER TABLE: 4.5 M
 HEIGHT SAMPLED: 2.5 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE IN BOTTOM OF PIT 0.0-1.5 M-SILTY PEBBLY SAND
 -100% SHALE 1.5-2.0 M-SILT
 2.0-4.5 M-SILTY PEBBLE SAND
 -MOIST
 4.5- M-SHALE BEDROCK

EXPOSURE #: RY665 (SE-36-004-10W) VISITED: 9006
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SHALE RICH PEBBLE SAND AND SILT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 2.5 M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: TILL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION:

-POOR QUALITY DUE TO HIGH SILT CONTENT.
 -10000 CUBIC M REMOVED
 -OVERGROWN PIT

GENERAL STRATIGRAPHY:

0.0-1.0 M-SILT
 1.0-5.0 M-PEBBLY SAND AND SILT BEDS
 -WELL ROUNDED SHALE CLASTS
 -MASSIVE TO POORLY BEDDED
 -LITHOLOGY 100% SHALE

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
BB180 A (SE-36-004-10W)	100	98	93	93	87	77	67	56	43	29	21	SPARSE
BB181 A (SE-36-004-10W)	100	99	88	81	58	43	30	21	16	14	14	SPARSE
RY638 A (NE-24-001-09W)	100	98	89	73	59	47	38	28	21	18	17	SPARSE
RY665 A (SE-36-004-10W)	100	99	92	77	64	55	45	34	25	20	19	SPARSE
(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)												

PETROGRAPHIC ANALYSIS (19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY665 A	-	-	-	100	100	SHALE 4.7-9.5 MM = 96%

DEPOSIT #012362

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
SE-27-004-09W	160000	0	160000	PRIVATE/PRIVATE	
SW-26-004-09W	17500	0	17500	PRIVATE/PRIVATE	
NW-23-004-09W	21000	0	21000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		198500		

EXPOSURE INFORMATION

EXPOSURE #: BB182 (NW-23-004-09W)
EXPOSURE TYPE: BACKHOE TEST PIT

VISITED: 9105
LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING

ECONOMIC THICKNESS: 1.7 METRES

ESTIMATED STONE CONTENT: LOW

SECTION: A

MATERIAL DESCRIPTION: COARSE SAND OCCASIONAL PEBBLE

SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: M

HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.3 M

MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION:

-ESKER RIDGE

-SHALLOW DEPOSIT, HOLE BELOW RY667

GENERAL STRATIGRAPHY:

0.0-0.3 M-SOIL

0.3-2.0 M-COARSE SAND-BEDDED

2.0-2.5 M-SHALE BOULDERS

2.5-3.5 M-SHALE BEDROCK

EXPOSURE #: RY667 (NW-23-004-09W)

VISITED: 9006

EXPOSURE TYPE: DITCH OR ROAD CUT

LAND USE: HIGHWAY, ROADWAY, RAILWAY

SURROUNDING LAND USE: AGRICULTURE, HAYING

ECONOMIC THICKNESS: 2.0 METRES

ESTIMATED STONE CONTENT: MEDIUM

SECTION: A

MATERIAL DESCRIPTION: SAND AND PEBBLE GRAVEL

SECTION HEIGHT: 2.0 M DEPTH TO WATER TABLE: M

HEIGHT SAMPLED: 1.5 M OVERBURDEN THICKNESS: 0.5 M

MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION:

-ROADCUT ALONG RIDGE THREE MILES

GENERAL STRATIGRAPHY:

0.0-0.5 M-SOIL

0.5-2.0 M-PEBBLE GRAVEL FLANKED BY MEDIUM SAND

SOUTH OF ST. LEON

-RIDGE 25 M WIDE, 2 M HIGH

SIEVE ANALYSIS

PERCENT PASSING

	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY667 A (NW-23-004-09W)	100	99	95	80	65	52	38	27	18	14	13	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY667 A	4	15	12	69	63	SHALE 4.7-9.5 MM = 68%

DEPOSIT #012363

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
SE-26-002-09W	49000	0	49000	PRIVATE/PRIVATE	
NE-23-002-09W	259000	45	142450	PRIVATE/PRIVATE	
SW-26-002-09W	126000	0	126000	PRIVATE/PRIVATE	
NW-23-002-09W	525000	60	210000	PRIVATE/PRIVATE	
DEPOSIT RESERVES			527450		

EXPOSURE INFORMATION

EXPOSURE #: RY650 (NW-23-002-09W) VISITED: 9006
EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: PASTURE, GRAZING
ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT: LOW
SECTION: A MATERIAL DESCRIPTION: SHALE PEBBLE GRAVEL
SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.3 M
MATERIAL AT BASE: SAND AND GRAVEL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-SAME AS RY649
-100% SHALE REWORKED SHALE BEDROCK
TERRACE DEPOSIT

EXPOSURE #: BB179 (NW-23-002-09W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: PASTURE, GRAZING
ECONOMIC THICKNESS: 3.5 METRES ESTIMATED STONE CONTENT: HIGH
SECTION: A MATERIAL DESCRIPTION: SHALE COBBLES AND BOULDERS
SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.3 M
MATERIAL AT BASE: GRAVEL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-PEMBINA VALLEY TERRACE. 0.0-0.3 M-SOIL
-HOLE CAVES IN AT 3.5 M 0.3-3.5 M-COBBLY SHALE
-NO SAMPLE, 100% SHALE COBBLES -MASSIVE
-POOR QUALITY -SHALE BOULDERS
-REWORKED SHALE BEDROCK

EXPOSURE #: RY649 (NW-23-002-09W) VISITED: 9006
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED
 ECONOMIC THICKNESS: 7.0 METRES ESTIMATED STONE CONTENT: MEDIUM
 SECTION: A MATERIAL DESCRIPTION: SILTY SHALE GRAVEL
 SECTION HEIGHT: 7.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAND AND GRAVEL

NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PEMBINA RIVER TERRACE DEPOSIT 0.0-0.5 M-SOIL
 CONSISTING OF 100% REWORKED SHALE 0.5-7.0 M-SHALE GRAVEL, HIGH SILT CONTENT, POORLY
 BEDROCK BEDDED TO MASSIVE
 -TERRACE DEPOSIT -100% SHALE
 -50000 CUBIC M REMOVED
 -UNECONOMIC, NO PROCESSED PILES

DEPOSIT #012364

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
SE-17-002-09W	420000	85	63000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		63000		

EXPOSURE INFORMATION
 EXPOSURE #: BB178 (SE-17-002-09W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: PASTURE, GRAZING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: COARSE PEBBLE SAND
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: 3.5 M
 HEIGHT SAMPLED: 3.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: SAND AND GRAVEL
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE IN BOTTOM OF GRAVEL PIT ON 0.0-1.5 M-TILL AT BASE OF PIT
 NORTH SIDE OF PIT 1.5-4.0 M-COARSE PEBBLY SAND
 -HOLE CAVES IN AT 4.0 M -COARSER SAND AND PEBBLES AT 3.5 M

EXPOSURE #: RY651 (SE-17-002-09W) VISITED: 9006
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: B MATERIAL DESCRIPTION: PEBBLY SAND
 SECTION HEIGHT: 7.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 6.0 M OVERBURDEN THICKNESS: 0.2 M
 MATERIAL AT BASE: TILL
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 SECTION: A MATERIAL DESCRIPTION: PEBBLY SAND
 SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 3.0 M OVERBURDEN THICKNESS: 0.2 M
 MATERIAL AT BASE: TILL
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PHOTOS-ROLL #2-6-13 AND CLOSE UP 0.0-0.2 M-SOIL
 -PIT MINED ON BOTH SIDES OF SMALL CREEK 0.2-1.0 M-SILT
 -PIT AREA 300 M BY 100 M INCLUDES PIT AREA 1.0-2.0 M-MASSIVE TO POORLY BEDDED PEBBLY SAND
 2.0-6.0 M-BEDDED GRAVEL AND GRAVEL BEDS
 6.0- M-SANDY TILL.

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
BB178 A (SE-17-002-09W)	100	100	96	92	84	71	57	45	31	18	13	SPARSE
RY651 B (SE-17-002-09W)	98	94	87	79	69	55	39	22	11	10	9	SPARSE
RY651 A (SE-17-002-09W)	100	98	91	81	67	52	37	24	16	12	11	SPARSE
(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)												

PETROGRAPHIC ANALYSIS (19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY651 B	12	0	21	67	60	SHALE 4.7-9.5 MM =74%
BB178 A	24	8	4	64	26	SHALE 4.7-9.5 MM =35%
RY651 A	18	1	33	48	41	

DEPOSIT #012365

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NE-34-001-09W	1858500	5	1765575	PRIVATE/PRIVATE	
SE-35-001-09W	1071000	0	1071000	PRIVATE/PRIVATE	
SW-11-002-09W	9000	0	9000	PRIVATE/PRIVATE	
NE-03-002-09W	1170000	0	1170000	PRIVATE/PRIVATE	
NW-26-001-09W	460000	0	460000	PRIVATE/PRIVATE	
NW-03-002-09W	21000	0	21000	PRIVATE/PRIVATE	
NE-26-001-09W	465000	5	441750	PRIVATE/PRIVATE	
NW-35-001-09W	680000	0	680000	PRIVATE/PRIVATE	
NE-27-001-09W	16000	99	160	PRIVATE/PRIVATE	
SE-03-002-09W	1768000	0	1768000	PRIVATE/PRIVATE	
SE-34-001-09W	1620000	10	1458000	PRIVATE/PRIVATE	
SW-03-002-09W	36000	0	36000	PRIVATE/PRIVATE	
SW-35-001-09W	3100000	0	3100000	PRIVATE/PRIVATE	
SE-10-002-09W	525000	0	525000	PRIVATE/PRIVATE	
DEPOSIT RESERVES			12505485		

EXPOSURE INFORMATION

EXPOSURE #: BB177 (NE-34-001-09W)

VISITED: 9105

EXPOSURE TYPE: BACKHOE TEST PIT

LAND USE: HIGHWAY, ROADWAY, RAILWAY

SURROUNDING LAND USE: PASTURE, GRAZING

ECONOMIC THICKNESS: 3.5 METRES

ESTIMATED STONE CONTENT: MEDIUM HIGH

SECTION: A

MATERIAL DESCRIPTION: SHALE RICH COBBLE GRAVEL

SECTION HEIGHT: 3.5 M

DEPTH TO WATER TABLE: M

HEIGHT SAMPLED: 0.0 M

OVERBURDEN THICKNESS: 0.0 M

MATERIAL AT BASE: SAND AND GRAVEL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION:

GENERAL STRATIGRAPHY:

-100% SHALE COBBLES AND PEBBLES

0.0-3.5 M-SHALE RICH COBBLE GRAVEL

-PEMBINA VALLEY TERRACE

-MASSIVE

-LOW QUALITY DUE TO HIGH SHALE CONTENT

-SILTY WITH OCCASIONAL SAND LENS

-NO SAMPLE

EXPOSURE #: BB176 (SE-34-001-09W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: PASTURE, GRAZING
ECONOMIC THICKNESS: 4.5 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: COBBLE GRAVEL SHALE RICH
SECTION HEIGHT: 4.5 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 3.0 M OVERBURDEN THICKNESS: 0.0 M
MATERIAL AT BASE: GRAVEL
SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-ON UPPER TERRACE FROM BB175 0.0-0.2 M-SOIL
-PEMBINA VALLEY TERRACE 0.2-4.5 M-SHALE RICH COBBLE GRAVEL AND SAND
-98% SHALE, NO PEBBLE COUNT DONE -HIGH SILT
-2% PRECAMBRIAN AND LIMESTONE -BOULDERS

EXPOSURE #: BB175 (SE-34-001-09W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: PASTURE, GRAZING
ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT: HIGH
SECTION: A MATERIAL DESCRIPTION: COBBLE GRAVEL SHALE RICH
SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 3.0 M OVERBURDEN THICKNESS: 0.1 M
MATERIAL AT BASE: SAND AND GRAVEL
SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-SAMPLE 100% SHALE 0.0-0.1 M-SOIL
-POOR QUALITY DUE TO HIGH SHALE 0.1-5.0 M-SHALE RICH COBBLE GRAVEL
-MASSIVE.
-OCCASIONAL COARSE SAND BED
-HIGH SILT CONTENT

EXPOSURE #: RY641 (NE-34-001-09W) VISITED: 9006
EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: PASTURE, GRAZING
ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT: MEDIUM
SECTION: A MATERIAL DESCRIPTION: SHALE RICH COBBLY GRAVEL
SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.3 M
MATERIAL AT BASE: SAND AND GRAVEL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-PHOTOS-ROLL #1-31-35, ROLL #2-1-4 0.0-0.3 M-SOIL
-PHOTO OF ROADCUT WITH SURVEY POLE 0.3-3.0 M-COBBLY COARSE GRAVEL
-PEMBINA RIVER TERRACE, CUT -HIGH SHALE CONTENT
-UNECONOMIC DUE TO COARSENESS AND -"DIRTY" GRAVEL WITH HIGH SILT AND
VERY HIGH SHALE CONTENT SHALE CONTENT
-ON TERRACE 200 M FROM PEMBINA RIVER

SIEVE ANALYSIS

	PERCENT PASSING											(PLUS 6")
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	
BB175 A (SE-34-001-09W)	92	72	48	42	29	21	15	12	11	10	9	ABUNDANT
BB176 A (SE-34-001-09W)	94	76	58	50	37	27	20	15	13	12	12	ABUNDANT

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

DEPOSIT #012366

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
NE-24-001-09W	188000	10	169200	PRIVATE/PRIVATE	
SE-24-001-09W	186000	0	186000	CROWN(PROVINCIAL) /CROWN	
	DEPOSIT RESERVES		355200		

EXPOSURE INFORMATION

EXPOSURE #: RY637 (SE-24-001-09W) VISITED: 9006
 EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SILT OVER SHALE RICH PEBBLE GRAVEL
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
 MATERIAL AT BASE: SAND AND GRAVEL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PEMBINA RIVER TERRACE 0.0-2.0 M-ORGANIC RICH SILT
 -DEPOSIT UNECONOMIC DUE TO HIGH SHALE 2.0-4.0 M-SHALE RICH PEBBLE GRAVEL
 AND SILT CONTENT -REWORKED BEDROCK, HIGH SILT CONTENT
 -100% SHALE LITHOLOGY -WELL IMBRICATED PEBBLES

EXPOSURE #: RY636 (SE-24-001-09W) VISITED: 9006
 EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 1.0 METRES ESTIMATED STONE CONTENT: HIGH
 SECTION: A MATERIAL DESCRIPTION: SHALE RICH COBBLES OVER SHALE
 SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PHOTO23-26 0.0-1.0 M-SHALE RICH "DIRTY" (SILTY) COBBLES
 AND BOULDERS
 -PHOTOS LOOKING NORTH ACROSS 1.0-3.0 M-SHALE BEDROCK
 PEMBINA RIVER. -DEPOSIT TOO COARSE AND SAND RICH
 -UNECONOMIC AND HIGH ORGANIC CONTENT

EXPOSURE #: RY638 (NE-24-001-09W) VISITED: 9006
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 1.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SHALE RICH PEBBLE GRAVEL
 SECTION HEIGHT: 1.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 1.0 M OVERBURDEN THICKNESS: 0.2 M
 MATERIAL AT BASE: SAME AS IN PIT WALL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 NOTE: REHABILITATED BORROW PIT ON 0.0-0.2 M-SOIL
 PEMBINA RIVER TERRACE 0.2-1.5 M-SHALE RICH PEBBLE GRAVEL, "DIRTY" WITH
 -LOCATION OF "BONES" HIGH SILT
 -UNECONOMIC DUE TO HIGH SILT AND SHALE -MASSIVE
 -ON TERRACE OF PEMBINA RIVER
 -ALMOST REWORKED BEDROCK

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY638 A (NE-24-001-09W)	100	98	89	73	59	47	38	28	21	18	17	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY638 A	10	0	7	83	63	SHALE 4.7-9.5 MM =73%

DEPOSIT #012367

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
SW-31-004-07W	165000	0	165000	PRIVATE/PRIVATE	
NW-31-004-07W	276000	40	165600	PRIVATE/PRIVATE	
NE-36-004-08W	306000	0	306000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		636600		

EXPOSURE INFORMATION

EXPOSURE #: BB204 (NW-31-004-07W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
SURROUNDING LAND USE: HIGHWAY, ROADWAY, RAILWAY
ECONOMIC THICKNESS: 6.0 METRES ESTIMATED STONE CONTENT: MEDIUM
SECTION: A MATERIAL DESCRIPTION: SANDY PEBBLE GRAVEL AND SANDY TILL
SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
MATERIAL AT BASE: SAND AND GRAVEL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-AT BASE OF PIT AT RY713 0.0-0.5 M-PEBBLE SAND
-SEQUENCE OF SANDY PEBBLE GRAVEL AND 0.5-1.5 M-SANDY TILL
SANDY TILL 1.5-2.5 M-PEBBLE GRAVEL
2.5-5.0 M-SANDY COBBLY TILL
5.0-6.0 M-SANDY PEBBLE GRAVEL WITH TILL
LENSES

EXPOSURE #: BB203 (NE-36-004-08W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: FOREST NATURAL
ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: SANDY TILL
SECTION HEIGHT: 0.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
MATERIAL AT BASE:
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-HOLE ON CREST OF RIDGE 0.0-0.2 M-SOIL
-WATER LAID TILL WITH SAND LENSES 0.2-6.0 M-SANDY TILL WITH OCCASIONAL SAND LENSES
-GLACIOFLUVIAL WATER LAID TILL -HIGH STONE CONTENT OF TILL

EXPOSURE #: BB202 (NE-36-004-08W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: FOREST NATURAL
ECONOMIC THICKNESS: 6.0 METRES ESTIMATED STONE CONTENT: MEDIUM
SECTION: A MATERIAL DESCRIPTION: PEBBLY FINE SAND AND COBBLES
SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 2.5 M OVERBURDEN THICKNESS: 0.3 M
MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-HOLE ON CREST OF RIDGE 0.0-0.3 M-SOIL
0.3-1.8 M-FINE SAND
1.8-6.0 M-PEBBLY FINE SAND
-OCCASIONAL COBBLES
-MASSIVE WITH NO OBSERVED BEDDING

EXPOSURE #: RY713 (NW-31-004-07W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: FLOWTILL OVER PEBBLY COARSE SAND
 SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 4.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PIT ON RIDGE ON BOUNDARY OF MUNICIPALITY 0.0-3.0 M-SANDY FLOWTILL
 OF PEMBINA -OCCASIONAL PEBBLE BED
 -DEPOSIT LONG RIDGE 3.0-6.0 M-PEBBLY COARSE SAND
 -OVERGROWN PIT5000 CUBIC M ONCE -MASSIVE
 REMOVED -OCCASIONAL TILL LENS
 -RIDGE RUNS N-S TO RM LORNE
 -VERY LOW SHALE CONTENT

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
BB202 A (NE-36-004-08W)	100	95	87	78	71	66	60	55	48	39	31	SPARSE
RY713 A (NW-31-004-07W)	100	100	92	87	78	70	61	53	42	31	23	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
BB202 A	19	49	2	29	20	SHALE 4.7-9.5 MM =15%
RY713 A	1	21	61	18	13	SHALE 4.7-9.5 MM =11%

DEPOSIT #012368

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
NW-26-004-08W	85000	0	85000	PRIVATE/PRIVATE	
NE-27-004-08W	70000	0	70000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		155000		

EXPOSURE INFORMATION

EXPOSURE #: BB199 (NW-26-004-08W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT: MEDIUM
SECTION: A MATERIAL DESCRIPTION: FINE SILTY SAND OVER PEBBLY SAND
SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: 3.0 M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.5 M
MATERIAL AT BASE: SAND AND GRAVEL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-HOLE FILLING WITH WATER AT 4.0 M 0.0-0.5 M-PIT BOTTOM
-HOLE ON CREST OF RIDGE 0.5-3.0 M-SILTY FINE SAND
-NO SAMPLE AS TOO WET TO SIEVE 3.0-4.0 M-PEBBLY FINE SAND WITH TILL LENSES
-RIDGE CREST 1.5 M ABOVE DITCH 4.0-5.0 M-PEBBLE GRAVEL SHALE RICH AND
COARSE SHALE SAND
5.0-6.0 M-PEBBLE GRAVEL AND SILT BEDS

EXPOSURE #: RY709 (NW-26-004-08W) VISITED: 9105
EXPOSURE TYPE: HAND DUG HOLE LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 2.5 METRES ESTIMATED STONE CONTENT: LOW
SECTION: A MATERIAL DESCRIPTION: COARSE SAND SHALE RICH
SECTION HEIGHT: 2.5 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
MATERIAL AT BASE: SAND
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-COARSE SAND ON ROADCUT ACROSS RIDGE

DEPOSIT #012369

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
SE-23-004-08W	24000	0	24000	PRIVATE/PRIVATE	
SW-24-004-08W	132000	40	79200	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		103200		

EXPOSURE INFORMATION

EXPOSURE #: RY707 (SW-24-004-08W) VISITED: 9105
 EXPOSURE TYPE: BORROW PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 1.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLY SAND
 SECTION HEIGHT: 2.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: SAND AND GRAVEL
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -TERRACE DEPOSIT ON SIDE OF CREEK 0.0-0.5 M-SOIL
 -POOR QUALITY HIGH SILT 0.5-1.5 M-SILTY SHALE RICH ALLUVIUM
 -100% SHALE CLASTS -OCCASIONAL PEBBLE BED
 -SMALL BORROW PIT 20 CUBIC M REMOVED 1.5-2.5 M-SHALE RICH PEBBLE SAND

EXPOSURE #: BB198 (SW-24-004-08W) VISITED: 9105
 EXPOSURE TYPE: LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SHALE PEBBLY SAND
 SECTION HEIGHT: 5.5 M DEPTH TO WATER TABLE: 4.5 M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: TILL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE IN BOTTOM OF PIT ATRY707 0.0- M-PIT BOTTOM
 -DEPOSIT CONTINUES TO 4.5 M 0.0-3.5 M-SHALE RICH PEBBLY SAND WITH
 OCCASIONAL SILT BEDS
 3.5-4.5 M-SILT AND SHALE SAND
 4.5-5.5 M-GREY TILL

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY707 A (SW-24-004-08W)	100	99	93	91	77	51	32	23	18	16	15	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS (19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY707 A	-	-	-	100	100	SHALE 4.7-9.5 MM = 100%

DEPOSIT #012370A

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
SE-09-004-08W	57000	30	39900	PRIVATE/PRIVATE	
NW-09-004-08W	69000	0	69000	PRIVATE/PRIVATE	
SW-09-004-08W	42000	0	42000	PRIVATE/PRIVATE	
DEPOSIT RESERVES			150900		

EXPOSURE INFORMATION

EXPOSURE #: RY714 (SW-09-004-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 3.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SHALE RICH PEBBLE SAND
 SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAND AND GRAVEL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:

- PIT LOCATED ON RIDGE IN CENTER OF FARM FIELD
- NO ACCESS
- SMALL PIT 100 CUBIC M REMOVED
- PARTIAL FARM GARBAGE DUMP
- POOR QUALITY
- OCCASIONAL COBBLE

DEPOSIT #012370B

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
SE-09-004-08W	35000	0	35000	PRIVATE/PRIVATE	
DEPOSIT RESERVES			35000		

DEPOSIT #012370C

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
SE-09-004-08W	93000	0	93000	PRIVATE/PRIVATE	
SW-10-004-08W	54000	80	10800	PRIVATE/PRIVATE	
DEPOSIT RESERVES			103800		

EXPOSURE INFORMATION

EXPOSURE #: RY706 (SW-10-004-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: MEDIUM
 SECTION: A MATERIAL DESCRIPTION: PEBBLE GRAVEL SHALE RICH
 SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 2.5 M OVERBURDEN THICKNESS: 1.5 M
 MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL PIT ON BOTH SIDES OF ROAD 0.0-0.5 M-TOPSOIL
 ALLOWANCE ON CREST OF SMALL RIDGE 0.5-1.5 M-SILTY TILL
 -BORROW PIT 1.5-3.5 M-PEBBLE GRAVEL
 -VERY HIGH SHALE CONTENT

EXPOSURE #: BB196 (SW-10-004-07W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.6 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: FINE SAND
 SECTION HEIGHT: 5.6 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 3.5 M OVERBURDEN THICKNESS: 0.7 M
 MATERIAL AT BASE: SAND

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE ON WEST OF RIDGE NEXT TO SMALL 0.0-0.7 M-SOIL
 BORROW PIT 0.7-2.0 M-SILTY TILL
 2.0-4.0 M-FINE SAND, OCCASIONAL PEBBLE
 -HIGH SHALE
 4.0-4.3 M-SILT
 4.3-5.6 M-FINE SAND, OCCASIONAL SHALE PEBBLE

SIEVE ANALYSIS

	PERCENT PASSING											(PLUS 6")
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	
BB196 A (SW-10-004-08W)	100	100	100	99	93	83	72	60	44	30	24	SPARSE
RY706 A (SW-10-004-08W)	100	98	86	78	61	47	37	26	16	12	11	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS (19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY706 A	1	3	1	96	91	SHALE 4.7-9.5 MM = 87%

DEPOSIT #012371

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NW-17-003-08W	31500	85	4725	PRIVATE/PRIVATE	
NE-18-003-08W	108500	0	108500	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		113225		

EXPOSURE INFORMATION

EXPOSURE #: BB193 (NW-17-003-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE RICH SANDY PEBBLE GRAVEL
 SECTION HEIGHT: 5.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 3.5 M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE:
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE NEXT TO BORROW PIT ON SMALL RIDGE 0.0-1.0 M-SOIL
 -UNECONOMIC 1.0-5.0 M-SANDY PEBBLE GRAVEL
 -SHALE RICH AND SILTY
 -MASSIVE
 5.0-5.5 M-SILTY TILL

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
BB193 A (NW-17-003-08W)	100	97	86	75	59	46	38	31	26	23	21	SPARSE
(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)												

PETROGRAPHIC ANALYSIS (19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
BB193 A	4	1	7	88	80	SHALE 4.7-9.5 MM = 95%

DEPOSIT #012372

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NW-34-002-08W	97500	40	58500	PRIVATE/PRIVATE	
NW-27-002-08W	288000	0	288000	PRIVATE/PRIVATE	
SW-34-002-08W	105000	0	105000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		451500		

EXPOSURE INFORMATION

EXPOSURE #: RY700 (NW-34-002-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLE GRAVEL ALL SHALE
 SECTION HEIGHT: 2.0 M DEPTH TO WATER TABLE: 2.0 M
 HEIGHT SAMPLED: 1.7 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -WELL MANAGED PIT, NO PROCESSING 0.0-0.5 M-SOIL
 -NO OVERSIZE 0.5-2.0 M-PEBBLE GRAVEL
 -100% SHALE CLASTS -100% SHALE
 -PIT IN MIDDLE OF FIELD OF PR528 -POOR HORIZONTAL BEDDING DIPPING SOUTH
 -PIT 100 M BY 50 M
 -3000 CUBIC M REMOVED, NO STOCK PILES

EXPOSURE #: BB191 (NW-27-002-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT: HIGH
 SECTION: A MATERIAL DESCRIPTION: PEBBLE GRAVEL SHALE RICH
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: 4.7 M
 HEIGHT SAMPLED: 2.5 M OVERBURDEN THICKNESS: 0.2 M
 MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE CAVES IN AT 5.0 M 0.0-0.2 M-SOIL
 -HOLE ON CREST OF RIDGE 0.2-5.0 M-SHALE PEBBLE GRAVEL
 -100% SHALE -COBBLES
 -REWORKED BEDROCK -WET AT 4.7 M
 -NO PEBBLE LITHOLOGY AS 100% SHALE

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
BB191 A (NW-27-002-08W)	100	97	84	73	51	34	24	19	17	16	16	MODERATE
RY700 A (NW-34-002-08W)	100	99	91	81	62	44	31	22	15	12	11	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

DEPOSIT #012373

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NE-34-002-08W	33000	99	330	PRIVATE/PRIVATE	
SW-35-002-08W	9000	0	9000	PRIVATE/PRIVATE	
NW-35-002-08W	55500	0	55500	PRIVATE/PRIVATE	
DEPOSIT RESERVES			64830		

EXPOSURE INFORMATION

EXPOSURE #: BB192 (NW-35-002-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.2 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: ALLUVIUM OVER MINOR PEBBLE GRAVEL
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: 1.7 M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: TILL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SANDY ALLUVIUM VENEER OVER MINOR 0.0-0.5 M-SOIL
 PEBBLY GRAVEL 0.5-1.5 M-FINE SANDY ALLUVIUM
 -GRAVEL IS 100% SHALE CLASTS 1.5-1.7 M-SHALE RICH PEBBLE GRAVEL
 -DEPOSIT IS CREEK ALLUVIUM -HIGH SILT
 -UNECONOMIC -WET
 1.7-4.0 M-SILTY TILL
 -HOLE CAVES IN AROUND 1.7 M

EXPOSURE #: RY699 (NE-34-002-08W) VISITED: 9105
 EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLY SAND
 SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: 3.0 M
 HEIGHT SAMPLED: 2.0 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAND

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL PIT/ROADCUT ON SMALL RIDGE ON 0.0-0.5 M-SOIL
 SIDE OF CREEK 0.5-3.0 M-PEBBLY SAND, SHALE RICH
 -3/4" MATERIAL 100% SHALE, TOO FEW
 PEBBLES FOR COUNT

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY699 A (NE-34-002-08W)	100	100	97	90	71	52	41	33	26	23	21	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

DEPOSIT #012374A

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
SE-27-002-08W	162500	0	162500	PRIVATE/PRIVATE	
NE-22-002-08W	80000	0	80000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		242500		

EXPOSURE INFORMATION

EXPOSURE #: BB189 (SE-27-002-08W)

VISITED: 9105

EXPOSURE TYPE: BACKHOE TEST PIT

LAND USE: HIGHWAY, ROADWAY, RAILWAY

SURROUNDING LAND USE: AGRICULTURE, HAYING

ECONOMIC THICKNESS: 2.5 METRES

ESTIMATED STONE CONTENT:

SECTION: A

MATERIAL DESCRIPTION: SHALE RICH PEBBLE GRAVEL

SECTION HEIGHT: 3.7 M

DEPTH TO WATER TABLE: 1.7 M

HEIGHT SAMPLED: 0.0 M

OVERBURDEN THICKNESS: 0.5 M

MATERIAL AT BASE: TILL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION:

GENERAL STRATIGRAPHY:

-NO SAMPLE AS SAMPLE IS TOO WET TO
FIELD SIEVE

0.0-0.5 M-SOIL

0.5-3.0 M-SHALE RICH PEBBLE GRAVEL,

-HOLE IN DITCH ON CREST OF RIDGE

WET AT 1.7 M

-HOLE CAVES IN AT 1.7 M

3.0-3.7 M-CLAYEY TILL

DEPOSIT #012374B

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NW-23-002-08W	96000	0	96000	PRIVATE/PRIVATE	
SW-23-002-08W	96000	95	4800	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		100800		

EXPOSURE INFORMATION

EXPOSURE #: RY698 (SW-23-002-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SHALE RICH PEBBLE GRAVEL
 SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: 3.5 M
 HEIGHT SAMPLED: 1.0 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAND AND GRAVEL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -LONG (300 M) NARROW (20 M) PIT 0.0-0.5 M-SOIL
 -PIT ON CREST OF RIDGE 0.5-1.5 M-SILTY ALLUVIUM, SHALE RICH
 -POOR ACCESS, POOR EXPOSURES 1.5-2.5 M-SHALE RICH PEBBLE GRAVEL
 -ESKER DEPOSIT ON SIDE OF CREEK -HIGH SILT, MASSIVE
 -GRAVEL CONTAINS TILL BALLS 2.5-3.5 M-SILTY TILL
 -POOR QUALITY
 -100% SHALE WITH OCCASIONAL
 NON-SHALE PEBBLE

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY698 A (SW-23-002-08W)	100	98	91	83	63	43	31	24	20	19	18	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY698 A	-	-	-	100	100	SHALE 4.7-9.5 MM = 89%

DEPOSIT #012375

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NW-24-002-08W	30000	80	6000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		6000		

EXPOSURE INFORMATION

EXPOSURE #: RY695 (NW-24-002-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 1.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLE GRAVEL-HIGH SILT AND CLAY
 SECTION HEIGHT: 2.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 1.5 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: TILL

SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL TERRACE ON SIDE OF CREEK 0.0-0.5 M-SOIL
 FLOWING INTO PEMBINA RIVER 0.5-1.5 M-PEBBLE GRAVEL, DIRTY WITH SILT AND CLAY
 -POOR QUALITY TERRACE ALLUVIUM 1.5-2.5 M-SILTY TILL
 -SMALL PIT, 500 CUBIC M REMOVED, PIT
 SHALLOW, 1.5-2.5 M DEEP
 -MORE OF BORROW PIT, NO PROCESSED MATERIAL

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY695 A (NW-24-002-08W)	100	96	85	75	60	49	40	31	22	16	13	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY695 A	12	3	16	70	42	SHALE 4.7-9.5 MM = 80%

DEPOSIT #012376

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER2 (SURFACE/GRAVEL)
SW-12-002-08W	36400	0	36400	PRIVATE/PRIVATE	
NE-11-002-08W	10400	0	10400	PRIVATE/PRIVATE	
NW-12-002-08W	5200	0	5200	PRIVATE/PRIVATE	
SE-11-002-08W	2600	0	2600	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		54600		

EXPOSURE INFORMATION

EXPOSURE #: BB186 (NW-12-002-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 1.3 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: VENEER SAND AND PEBBLY SAND
 SECTION HEIGHT: 4.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.3 M
 MATERIAL AT BASE:
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -VENEER SAND AND PEBBLY SAND OVER TILL. 0.0-0.3 M-SOIL
 -UNECONOMIC. 0.3-1.0 M-FINE SAND
 -ON CREST OF SMALL RIDGE 1.0-1.6 M-SHALE WITH PEBBLY SAND
 1.6-4.5 M-SANDY TILL

EXPOSURE #: RY696 (NE-12-002-08W) VISITED: 9105
 EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 1.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: TILL OVER COARSE SAND
 SECTION HEIGHT: 2.7 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SILT
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL RIDGE, TILL OVER SAND 0.0-0.5 M-SOIL
 0.5-1.5 M-TILL
 1.5-2.5 M-COARSE SAND
 2.5-2.7 M-SILT

DEPOSIT #012377

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NE-30-001-08W	45000	0	45000	PRIVATE/PRIVATE	
NW-29-001-08W	47500	99	475	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		45475		

EXPOSURE INFORMATION

EXPOSURE #: BB185 (NW-29-001-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: SILT OVER TILL
 SECTION HEIGHT: 4.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: TILL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PIT IS CONFINED TO IMMEDIATE EDGE OF 0.0-0.5 M-SOIL
 SPILLWAY 0.5-2.5 M-SILT, OCCASIONAL SAND BED
 -MASSIVE
 2.5-3.0 M-PEBBLY FINE SAND
 3.0-4.5 M-SANDY TILL

EXPOSURE #: RY678 (NW-29-001-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLY COARSE SAND
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 4.0 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAND AND GRAVEL
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL INACTIVE PIT, 50 CUBIC M 0.0-0.5 M-SOIL
 REMOVED, REVEGETATED 0.5-4.0 M-PEBBLY COARSE SAND OCCASIONAL COBBLE
 -PIT ON NORTH EDGE OF SPILLWAY -MASSIVE TO POOR HORIZONTAL BEDDING

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY678 A (NW-29-001-08W)	100	99	92	86	71	57	42	27	13	9	7	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY678 A	7	6	0	86	84	SHALE 4.7-9.5 MM =77%

DEPOSIT #012378

LOCATION	INITIAL RESERVES (m ³)	PERCENT DEPLETED	REMAINING RESERVES (m ³)	OWNER (SURFACE/GRAVEL)	OWNER 2 (SURFACE/GRAVEL)
NE-02-002-07W	38000	90	3800	PRIVATE/PRIVATE	
NW-01-002-07W	7000	0	7000	PRIVATE/PRIVATE	
	DEPOSIT RESERVES		10800		

EXPOSURE INFORMATION

EXPOSURE #: RY694 (NE-02-002-07W) VISITED: 9105
EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 1.0 METRES ESTIMATED STONE CONTENT: LOW
SECTION: A MATERIAL DESCRIPTION: SANDY PEBBLE GRAVEL
SECTION HEIGHT: 1.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
MATERIAL AT BASE: SAND AND GRAVEL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-SMALL ROADCUT NEXT TO ROAD

EXPOSURE #: BB183 (NW-01-002-07W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 1.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: MEDIUM SAND
SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.2 M
MATERIAL AT BASE: TILL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-SAND VENEER OVER TILL 0.0-0.2 M-SOIL
-HOLE ON SIDE OF CREEK-FLUVIAL 0.2-1.2 M-MEDIUM SAND OCCASIONAL PEBBLE
VENEER OF SAND -MASSIVE
-NO SAMPLE. 1.2-4.0 M-SILTY TILL

TOTAL REPORT RESERVES 16719865

ADDITIONAL INFORMATION (DATA NOT INCLUDED IN MAPPED DEPOSITS)

EXPOSURE INFORMATION DEPOSIT #012379X

EXPOSURE #: RY634 (SW-10-001-09W) VISITED: 9006
EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE (COMMONLY REVEGETATED)
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-INACTIVE BORROW PIT
-500 CUBIC M REMOVED

EXPOSURE #: RY635 (NE-12-001-09W) VISITED: 9006
EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE (COMMONLY REVEGETATED)
SURROUNDING LAND USE: FOREST NATURAL
ECONOMIC THICKNESS: 8.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
SECTION HEIGHT: 8.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 1.0 M
MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-3000 CUBIC M REMOVED
-ON SIDE OF SNOWFLAKE CREEK
-INACTIVE

EXPOSURE #: RY639 (SE-25-001-09W) VISITED: 9006
EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED
ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: LOW
SECTION: A MATERIAL DESCRIPTION: REWORKED SHALE BEDROCK
SECTION HEIGHT: 2.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-SMALL BORROW PIT OF REWORKED SAND
SIZE SHALE
-UNECONOMIC
-PEMBINA RIVER TERRACE

EXPOSURE #: RY640 (NE-35-001-09W) VISITED: 9006
EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: LOW
SECTION: A MATERIAL DESCRIPTION: SHALE PEBBLE SAND
SECTION HEIGHT: 2.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.3 M
MATERIAL AT BASE: SAND
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-PEMBINA RIVER TERRACE
-100% SHALE PEBBLE SAND AS REWORKED
BEDROCK
-BORROW PIT 100 CUBIC M REMOVED
-UNECONOMIC

EXPOSURE #: RY642 (SE-28-001-09W) VISITED: 9006
EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
UNATTENDED
ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: LOW
SECTION: A MATERIAL DESCRIPTION: SILT OVER REWORKED BEDROCK
SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
MATERIAL AT BASE: SAND AND GRAVEL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-POSSIBLE PEMBINA TERRACE 0.0-0.2 M-SOIL
-INACTIVE BORROW PITS 0.2-2.0 M-SILT
-UNECONOMIC 2.0-4.0 M-PEBBLE SIZE REWORKED BEDROCK,
-5000 CUBIC M REMOVED PURE SHALE
-POORLY BEDDED

EXPOSURE #: RY643 (SW-33-001-09W) VISITED: 9006
EXPOSURE TYPE: BEDROCK QUARRY LAND USE: HIGHWAY, ROADWAY, RAILWAY
SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.7 M
MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-50 CUBIC M REMOVED
-ON SIDE OF ROAD, INACTIVE

EXPOSURE #: RY644 (NW-33-001-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED

ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -TWO SMALL SHALE PITS ADJACENT TO EACH 0.0-2.0 M-SILTY SHALE RICH ALLUVIUM
 -ESTIMATED 2000 CUBIC M REMOVED 2.0-3.0 M-SHALE BEDROCK
 -OVERLYING ALLUVIUM ALSO MINED

EXPOSURE #: RY645 (SE-04-002-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED

ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SILTY ALLUVIUM OVER SHALE
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL INACTIVE SHALE BORROW PIT
 -ALLUVIUM AND SHALE MINED SAME AS RY644.
 -200 CUBIC M REMOVED

EXPOSURE #: RY646 (SW-18-002-08W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING

ECONOMIC THICKNESS: 10.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BEDROCK PIT
 SECTION HEIGHT: 10.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: SAME AS IN PIT WALL

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -MINED ON THREE LEVELS 0.0-2.0 M-SILT, SHALE RICH
 -50000 CUBIC M REMOVED, PRESENTLY INACTIVE 2.0-12.0 M-SHALE BEDROCK
 -PIT 200 BY 200 M
 -MUST BE ARTESIAN WELL AS SOURCE OF FLOWING WATER.

EXPOSURE #: RY647 (NW-18-002-08W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -50 CUBIC M REMOVED 0.0-1.0 M-SHALE RICH SILT
 -NEXT TO ROAD 1.0-3.0 M-SHALE BEDROCK

EXPOSURE #: RY648 (SE-25-002-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 7.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PIT ENCROACHES ONTO ROAD ALLOWANCE 0.0-0.2 M-SILT AND BEDDED SHALE
 -PIT 20 M BY 70 M 2.0-7.0 M-SHALE BEDROCK
 -POORLY MINED WITH 7.0 M VERTICLE FACES
 -PHOTO-ROLL #2-4-6

EXPOSURE #: RY652 (SE-11-003-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: PASTURE, GRAZING
 ECONOMIC THICKNESS: 7.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 7.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -INACTIVE SHALE QUARRY 0.0-1.0 M-SILT
 -10000 CUBIC M REMOVED 1.0-7.0 M-SHALE BEDROCK

EXPOSURE #: RY653 (SE-30-003-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED

ECONOMIC THICKNESS: 25.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 23.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -BORROW PIT ON SIDE OF HIGHWAY 3 0.0-2.0 M-SILT
 -VERTICAL FACE "DANGEROUS" 2.0-2.5 M-SHALE BEDROCK, FRACTURED
 -LOOSE SHALE ON BASE OF FACE MINED

EXPOSURE #: RY654 (SE-07-003-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: PASTURE, GRAZING

ECONOMIC THICKNESS: 12.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: INACTIVE SHALE PIT
 SECTION HEIGHT: 12.0 M DEPTH TO WATER TABLE: 12.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -20000 CUBIC M REMOVED
 -PIT ON SIDE OF CREEK
 -POTENTIAL FOR MINING TO EAST

EXPOSURE #: RY655 (NW-18-003-09W) VISITED: 9006
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: PASTURE, GRAZING

ECONOMIC THICKNESS: 7.0 METRES ESTIMATED STONE CONTENT: HIGH
 SECTION: A MATERIAL DESCRIPTION: COBBLY SHALE GRAVEL
 SECTION HEIGHT: 7.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: SAME AS IN PIT WALL

NO CHANNEL SAMPLE TAKEN

SECTION: B MATERIAL DESCRIPTION: COBBLY SHALE GRAVEL OVER SHALE
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PEMBINA RIVER TERRACE OVER SHALE 0.0-2.0 M-COBBLY SHALE GRAVEL, SAME AS
 BEDROCK RY655-A
 -PHOTO ROLL #2- 31-36-CONTACT BETWEEN 2.0-4.0 M-SHALE BEDROCK
 RIVER TERRACE, COBBLY SHALE GRAVEL
 AND SHALE BEDROCK

EXPOSURE #: RY656 (NW-30-003-08W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: BUILDING SITE(PERMANENT)
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: 5.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -ACTIVE SHALE PIT
 -30000 CUBIC M REMOVED
 -1/4 MILE NORTH OF MANITOU

EXPOSURE #: RY657 (NW-31-003-08W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 7.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 8.0 M DEPTH TO WATER TABLE: 7.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -ACTIVE SHALE PIT MINED ON TWO LEVELS 0.0-1.0 M-TILL
 -MAY HAVE ENCROACHED ONTO PR244 1.0-6.0 M-SHALE BEDROCK
 ROAD ALLOWANCE
 -20 000 CUBIC M REMOVED

EXPOSURE #: RY658 (SE-35-003-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: PASTURE, GRAZING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -3000 CUBIC M REMOVED
 -PIT 60 M BY 30 M

EXPOSURE #: RY659 (NW-35-003-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -ACTIVE PIT, 10000 CUBIC M REMOVED
 -PIT 100 M BY 30 M
 -ON BEDROCK RIDGE

EXPOSURE #: RY660 (NW-04-004-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -500 CUBIC M REMOVED 0.0-1.0 M-TILL
 -BORROW PIT 1.0-3.0 M-SHALE BEDROCK
 -PIT 30 M BY 50 M

EXPOSURE #: RY661 (NW-25-003-10W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED
 ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -50 CUBIC M REMOVED
 -ROADCUT/BORROW PIT

EXPOSURE #: RY662 (NW-14-004-10W)	VISITED: 9006
EXPOSURE TYPE: BEDROCK QUARRY	LAND USE: PIT-TEMPORARY USE
	SURROUNDING LAND USE: PASTURE, GRAZING
ECONOMIC THICKNESS: 5.0 METRES	ESTIMATED STONE CONTENT:
SECTION: A	MATERIAL DESCRIPTION: SHALE BORROW PIT
	SECTION HEIGHT: 5.0 M
	DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M
	OVERBURDEN THICKNESS: 0.0 M
	MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN	
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:
-50 CUBIC M REMOVED	
-ON SIDE OF PEMBINA RIVER VALLEY	

EXPOSURE #: RY663 (SW-22-004-10W)	VISITED: 9006
EXPOSURE TYPE: BEDROCK QUARRY	LAND USE: PIT-TEMPORARY USE
	SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED
ECONOMIC THICKNESS: 2.5 METRES	ESTIMATED STONE CONTENT:
SECTION: A	MATERIAL DESCRIPTION: SHALE BORROW PIT
	SECTION HEIGHT: 2.5 M
	DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M
	OVERBURDEN THICKNESS: 0.5 M
	MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN	
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:
-200 CUBIC M REMOVED	0.0-0.5 M-SILT
-IN WILDLIFE MANAGEMENT AREA	0.5-2.5 M-SHALE BEDROCK

EXPOSURE #: RY664 (NE-34-004-10W)	VISITED: 9006
EXPOSURE TYPE: DITCH OR ROAD CUT	LAND USE: HIGHWAY, ROADWAY, RAILWAY
	SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 2.0 METRES	ESTIMATED STONE CONTENT: LOW
SECTION: A	MATERIAL DESCRIPTION: SILTY FINE SAND OCCASIONAL PEBBLE
	SECTION HEIGHT: 2.0 M
	DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: 1.5 M
	OVERBURDEN THICKNESS: 0.3 M
	MATERIAL AT BASE: SAND
SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS	
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:
-ROADCUT ON CREST OF RIDGE	0.0-0.3 M-SOIL
-UNECONOMIC AS TOO FINE	0.3-2.0 M-VERY FINE SAND AND SILT WITH
-SIEVE ANALYSIS SHOWS DEPOSIT TO BE SILT	OCCASIONAL PEBBLE.

EXPOSURE #: RY666 (NE-18-004-09W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 6.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT-POSSIBLE BENTONITE PIT
 SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SHALE PIT ALONG SIDE OF CREEK
 -POSSIBLE BENTONITE PIT (SAMPLE)
 -5000 CUBIC M SHALE REMOVED
 -SAMPLE OF POSSIBLE BENTONITE

EXPOSURE #: RY668 (SE-13-003-10W) VISITED: 9006
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT: MEDIUM
 SECTION: A MATERIAL DESCRIPTION: SHALE PIT
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -DEPLETED AND REVEGETATED BORROW PIT
 -500 CUBIC M REMOVED

EXPOSURE #: RY669 (SW-20-002-08W) VISITED: 9105
 EXPOSURE TYPE: BORROW PIT LAND USE: AGRICULTURE, HAYING
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 6.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: TILL BORROW PIT
 SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: TILL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -1000 CUBIC M REMOVED FOR ROAD FILL
 OF SWAMP

EXPOSURE #: RY670 (SW-23-001-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: PASTURE, GRAZING
 ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: HIGH
 SECTION: A MATERIAL DESCRIPTION: COBBLY SHALE GRAVEL OVER SHALE
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.3 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PEMBINA VALLEY TERRACE DEPOSIT 0.0-0.3 M-SOIL
 -PIT PROBABLY USED FOR FILL 0.3-2.0 M-COBBLY SHALE ALLUVIUM
 -SHALE QUARRY -99% SHALE
 -SILTY "DIRTY" COBBLY SHALE
 2.0-5.0 M-SHALE BEDROCK

EXPOSURE #: RY671 (SW-27-001-08W) VISITED: 9105
 EXPOSURE TYPE: DITCH OR ROAD CUT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: SURFACE EASEMENT
 (OTHER THAN ROADWAY)
 ECONOMIC THICKNESS: 1.5 METRES ESTIMATED STONE CONTENT: HIGH
 SECTION: A MATERIAL DESCRIPTION: COBBLY GRAVEL OVER SHALE
 SECTION HEIGHT: 6.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -GRAVEL TERRACE OF COBBLY GRAVEL 0.0-1.5 M-COBBLY GRAVEL
 VENEER OVER SHALE BEDROCK IN PEMBINA 1.5-6.0 M-SHALE BEDROCK
 VALLEY
 -ROLL #1-PHOTO 1-5

EXPOSURE #: RY672 (NW-27-001-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SILTY TILL OVER SHALE BEDROCK
 SECTION HEIGHT: 10.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PEMBINA VALLEY TERRACE OF TILL OVER 0.0- 6.0 M-SILTY SHALE RICH TILL
 SHALE BEDROCK 6.0-10.0 M-SHALE BEDROCK
 -500 CUBIC M SHALE REMOVED
 -INACTIVE BORROW PIT/QUARRY

EXPOSURE #: RY673 (SE-28-001-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 2.0 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: PEBBLE GRAVEL OVER SHALE
 SECTION HEIGHT: 2.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 1.5 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PEMBINA VALLEY TERRACE 0.0-0.5 M-SOIL
 -SMALL BORROW PIT, 200 CUBIC M 0.5-2.0 M-SHALE RICH PEBBLE GRAVEL
 REMOVED IN CENTER OF FIELD 2.0- M-SHALE BEDROCK

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY673 A (SE-28-001-08W)	100	88	68	65	53	39	21	12	9	8	7	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY673 A	3	0	6	92	76	SHALE 4.7-9.5 MM = 82%

EXPOSURE #: RY674 (NE-28-001-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 10.0 METRES ESTIMATED STONE CONTENT: MEDIUM
 SECTION: A MATERIAL DESCRIPTION: SANDY PEBBLE GRAVEL
 SECTION HEIGHT: 15.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 10.0 M OVERBURDEN THICKNESS: 5.0 M
 MATERIAL AT BASE: BEDROCK
 SEE SIEVE ANALYSIS AND PETROGRAPHIC ANALYSIS
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PHOTO5-10 ROLL #1, LOOKING NORTH 0.0-5.0 M-SANDY TILL
 FROM RY673 5.0-15.0 M-SANDY PEBBLE GRAVEL
 -ON SIDE OF PEMBINA SPILLWAY AS TERRACE -OCCASIONAL TILL LENS
 --POORLY MANAGED AND MINED PIT -GRAVEL IS MASSIVE
 -WATER LAID GLACIAL FLUVIAL MASSIVE 15.0- M-SHALE BEDROCK
 DEPOSIT, GOOD QUALITY
 -PIT OVERGROWN

SIEVE ANALYSIS

	PERCENT PASSING											
	3.0	1.5	3/4	3/8	#4	#8	#16	#30	#50	#100	#200	(PLUS 6")
RY674 A (NE-28-001-08W)	100	96	84	71	60	52	46	38	27	17	12	SPARSE

(NOTE: ALL SAMPLES ARE 100% PASSING 6 INCHES)

PETROGRAPHIC ANALYSIS(19.1-38.1 mm)

SAMPLE	% GOOD	% FAIR	% POOR	% DELETERIOUS	% SHALE (BY WEIGHT)	COMMENTS
RY674 A	15	0	11	73	68	SHALE 4.7-9.5 MM =3%

EXPOSURE #: RY675 (SE-13-001-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 8.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: TILL OVER SHALE BEDROCK QUARRY
 SECTION HEIGHT: 12.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 4.0 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -ACTIVE SHALE QUARRY 0.0-4.0 M-SILTY TILL
 -1000 CUBIC M REMOVED 4.0-12.0 M-SHALE BEDROCK
 -POORLY MANAGED, NO STRIPPING.
 -INACTIVE AT 5-91
 -PIT 40 BY 60 M

EXPOSURE #: RY676 (SW-07-001-07W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: PASTURE, GRAZING

ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL (200 CUBIC M REMOVED) BORROW
 PIT ON SIDE OF CREEK
 -FARM USE

EXPOSURE #: RY677 (NE-27-001-08W) VISITED: 9105
 EXPOSURE TYPE: SAND AND GRAVEL PIT LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 10.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE QUARRY
 SECTION HEIGHT: 10.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN

ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -QUARRY MINED TO ROAD ALLOWANCE
 -PIT 40 M BY 30 M
 -2500 CUBIC M REMOVED

EXPOSURE #: RY679 (NW-34-001-08W)	VISITED: 9105
EXPOSURE TYPE: DITCH OR ROAD CUT	LAND USE: HIGHWAY, ROADWAY, RAILWAY
	SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 1.0 METRES	ESTIMATED STONE CONTENT: LOW
SECTION: A	MATERIAL DESCRIPTION: SILTY TILL OVER PEBBLY COARSE SAND
	SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 2.0 M
	MATERIAL AT BASE: TILL
NO CHANNEL SAMPLE TAKEN	
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:
-UNECONOMIC	0.0-1.5 M-SILTY TILL
	1.5-2.5 M-PEBBLY COARSE SAND
	-MASSIVE
	2.5-3.5 M-SILTY TILL, WET

EXPOSURE #: RY680 (SW-10-001-07W)	VISITED: 9105
EXPOSURE TYPE: BEDROCK QUARRY	LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
	SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 5.0 METRES	ESTIMATED STONE CONTENT:
SECTION: A	MATERIAL DESCRIPTION: SHALE BORROW PIT
	SECTION HEIGHT: M DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
	MATERIAL AT BASE:
NO CHANNEL SAMPLE TAKEN	
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:
-INACTIVE	
-1000 CUBIC M REMOVED	

EXPOSURE #: RY690 (NE-05-002-07W)	VISITED: 9105
EXPOSURE TYPE: BEDROCK QUARRY	LAND USE: PIT-TEMPORARY USE
	SURROUNDING LAND USE: AGRICULTURE, HAYING
ECONOMIC THICKNESS: 15.0 METRES	ESTIMATED STONE CONTENT:
SECTION: A	MATERIAL DESCRIPTION: SHALE BEDROCK QUARRY
	SECTION HEIGHT: 15.0 M DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 3.0 M
	MATERIAL AT BASE: BEDROCK
NO CHANNEL SAMPLE TAKEN	
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:
-LARGE TEMPORARY USE QUARRY	
-100 M BY50 M WIDE	

EXPOSURE #: RY691 (SE-13-001-07W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 8.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE:

NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL PIT 500 CUBIC M REMOVED

EXPOSURE #: RY692 (NW-26-001-07W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: AGRICULTURE, HAYING

ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 1.5 M
 MATERIAL AT BASE:

NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -200 CUBIC M REMOVED
 -ON SIDE OF SPILLWAY

EXPOSURE #: RY693 (NE-23-001-07W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL,
 UNATTENDED

ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: BEDROCK

NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -300 CUBIC M REMOVED
 -PIT 50 M BY 40 M
 -ON SIDE OF SPILLWAY
 -INACTIVE, POOR ACCESS

EXPOSURE #: RY697 (NW-01-002-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 10.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BEDROCK QUARRY
 SECTION HEIGHT: M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -LARGE QUARRY (3000 CUBIC M) REMOVED
 ON SIDE OF CREEK
 -ROAD TO QUARRY WASHED OUT

EXPOSURE #: RY701 (NE-08-003-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE QUARRY
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -ACTIVE SHALE QUARRY
 -3000 CUBIC M REMOVED
 -WELL MANAGED PIT
 -PIT 70 M BY 80 M

EXPOSURE #: RY702 (NW-21-003-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE QUARRY
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: 4.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -PARTIALLY REVEGETATED SHALE QUARRY
 -50 M BY 50 M
 -INACTIVE AND FILLED WITH GARBAGE AND
 FIELD STONES

EXPOSURE #: RY703 (NW-29-003-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE BORROW PIT-INACTIVE
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL BORROW PIT 20 M BY 30 M
 -INACTIVE AND PARTIALLY REVEGETATED

EXPOSURE #: RY704 (NE-25-003-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 5.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE QUARRY ACTIVE
 SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: 5.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -LARGE ACTIVE SHALE QUARRY
 -100 M BY 150 M
 -SIDES PARTIALLY SLOPED
 -WELL MANAGED PIT
 -20000 CUBIC M REMOVED

EXPOSURE #: RY705 (NE-30-001-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-TEMPORARY USE
 SURROUNDING LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED
 ECONOMIC THICKNESS: 6.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: TILL OVER SHALE BEDROCK
 SECTION HEIGHT: 10.0 M DEPTH TO WATER TABLE: 10.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 4.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -LARGE QUARRY (100 M BY 150 M) 0.0-4.0 M-SILTY TILL
 -ON SIDE OF PEMBINA SPILLWAY 4.0-6.0 M-SHALE BEDROCK
 -LOWER PORTION OF QUARRY OVERLAIN BY SILTY ALLUVIUM

EXPOSURE #: RY708 (NW-06-004-07W) VISITED: 9105
 EXPOSURE TYPE: HAND DUG HOLE LAND USE: WILDLIFE HABITAT-NATURAL, UNATTENDED
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.5 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: MEDIUM TO COARSE SAND
 SECTION HEIGHT: 0.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: M
 MATERIAL AT BASE: SAND AND GRAVEL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -SMALL BEACH RIDGE ON SOUTH END OF
 LIZARD LAKE.
 -RIDGE 1.5 M HIGH-HAND DUG HOLE

EXPOSURE #: RY710 (SE-33-004-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 4.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE QUARRY
 SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: 4.0 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.7 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -5000 CUBIC M REMOVED
 -INACTIVE, POOR ACCESS DUE TO HIGH
 WATER TABLE

EXPOSURE #: RY711 (SE-32-004-08W) VISITED: 9105
 EXPOSURE TYPE: BEDROCK QUARRY LAND USE: ACTIVE PIT
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 3.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SHALE QUARRY ACTIVE
 SECTION HEIGHT: 3.0 M DEPTH TO WATER TABLE: 3.5 M
 HEIGHT SAMPLED: M OVERBURDEN THICKNESS: 0.5 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -5000 CUBIC M REMOVED
 -QUARRY 100 M BY 150 M
 -MINED TO WATER TABLE
 -MINED TO EDGE OF ROAD ALLOWANCE

EXPOSURE #: RY712 (NW-20-004-08W)	VISITED: 9105	
EXPOSURE TYPE: BEDROCK QUARRY	LAND USE: ACTIVE PIT	
	SURROUNDING LAND USE: AGRICULTURE, HAYING	
ECONOMIC THICKNESS: 3.0 METRES	ESTIMATED STONE CONTENT:	
SECTION: A	MATERIAL DESCRIPTION: SHALE QUARRY	
	SECTION HEIGHT: 3.0 M	DEPTH TO WATER TABLE: 3.0 M
	HEIGHT SAMPLED: 0.0 M	OVERBURDEN THICKNESS: 0.5 M
	MATERIAL AT BASE: BEDROCK	
NO CHANNEL SAMPLE TAKEN		
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:	
-SMALL ACTIVE SHALE QUARRY		
-500 CUBIC M REMOVED		
-PIT 20 M BY 60 M		

EXPOSURE #: RY715 (SW-35-003-07W)	VISITED: 9105	
EXPOSURE TYPE: BEDROCK QUARRY	LAND USE: PIT-NOT IN USE(COMMONLY REVEGETATED)	
	SURROUNDING LAND USE: AGRICULTURE, HAYING	
ECONOMIC THICKNESS: 3.0 METRES	ESTIMATED STONE CONTENT:	
SECTION: A	MATERIAL DESCRIPTION: TILL OVER SHALE BEDROCK	
	SECTION HEIGHT: 6.0 M	DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M	OVERBURDEN THICKNESS: 3.0 M
	MATERIAL AT BASE: BEDROCK	
NO CHANNEL SAMPLE TAKEN		
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:	
-INACTIVE QUARRY ON SIDE OF CREEK	0.0-3.0 M-SILTY TILL	
-1000 CUBIC M REMOVED	3.0-6.0 M-SHALE QUARRY	
	-BORROW PIT	

EXPOSURE #: RY716 (SW-03-004-07W)	VISITED: 9105	
EXPOSURE TYPE: HAND DUG HOLE	LAND USE: HIGHWAY, ROADWAY, RAILWAY	
	SURROUNDING LAND USE: AGRICULTURE, HAYING	
ECONOMIC THICKNESS: 0.5 METRES	ESTIMATED STONE CONTENT: MEDIUM	
SECTION: A	MATERIAL DESCRIPTION: SANDY PEBBLE GRAVEL	
	SECTION HEIGHT: 0.5 M	DEPTH TO WATER TABLE: M
	HEIGHT SAMPLED: M	OVERBURDEN THICKNESS: M
	MATERIAL AT BASE:	
NO CHANNEL SAMPLE TAKEN		
ADDITIONAL INFORMATION:	GENERAL STRATIGRAPHY:	
-HAND DUG HOLE		
-MAY BE SANDY TILL		

EXPOSURE #: BB184 (SW-12-002-07W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.3 METRES ESTIMATED STONE CONTENT: LOW
 SECTION: A MATERIAL DESCRIPTION: FINE SAND VENEER OVER TILL
 SECTION HEIGHT: 4.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.2 M
 MATERIAL AT BASE: TILL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE ON EDGE OF CREEK 0.0-0.2 M-SOIL
 -UNECONOMIC 0.2-0.5 M-FINE SAND
 0.5-4.5 M-SILTY SANDY TILL

EXPOSURE #: BB187 (SE-26-002-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: TILL
 SECTION HEIGHT: 4.2 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE:
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE ON MINOR STREAM TERRACE WEST OF 0.0-1.0 M-SOIL
 HUDDERITE PIT 1.0-3.0 M-SANDY TILL
 3.0-4.2 M-PEBBLY CLAY

EXPOSURE #: BB188 (SE-26-002-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY, ROADWAY, RAILWAY
 SURROUNDING LAND USE: AGRICULTURE, HAYING
 ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: TILL
 SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: TILL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 0.0-1.0 M-SOIL
 1.0-3.5 M-CLAYEY TILL

EXPOSURE #: BB190 (NW-23-002-08W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY,ROADWAY,RAILWAY
SURROUNDING LAND USE: PASTURE,GRAZING
ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: TILL
SECTION HEIGHT: 5.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.5 M
MATERIAL AT BASE: TILL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-HOLE ON ESKER LIKE RIDGE ON SIDE OF 0.0-0.5 M-SOIL
SMALL CREEK 0.5-2.3 M-DRY TILL, SANDY
-RIDGE IS TILL RIDGE 2.3-2.7 M-SILT
2.7-5.0 M-SANDY TILL

EXPOSURE #: BB194 (NW-34-003-07W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY,ROADWAY,RAILWAY
SURROUNDING LAND USE: AGRICULTURE,HAYING
ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: SILTY TILL
SECTION HEIGHT: 4.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.3 M
MATERIAL AT BASE: TILL
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
0.0-0.3 M-SOIL
0.3-4.0 M-SILTY TILL.

EXPOSURE #: BB195 (NE-34-003-07W) VISITED: 9105
EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY,ROADWAY,RAILWAY
SURROUNDING LAND USE: AGRICULTURE,HAYING
ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
SECTION: A MATERIAL DESCRIPTION: SILTY TILL
SECTION HEIGHT: 0.0 M DEPTH TO WATER TABLE: M
HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
MATERIAL AT BASE:
NO CHANNEL SAMPLE TAKEN
ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
-HOLE ON SMALL RIDGE 0.0-0.7 M-SOIL
-CONSISTS OF SILTY TILL 0.7-3.8 M-SILTY TILL.

EXPOSURE #: BB197 (NW-13-004-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY,ROADWAY,RAILWAY
 SURROUNDING LAND USE: AGRICULTURE,HAYING
 ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: SILTY TILL
 SECTION HEIGHT: 3.5 M DEPTH TO WATER TABLE: 3.0 M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 1.0 M
 MATERIAL AT BASE: TILL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -HOLE ON UNDEVELOPED ROAD ALLOWANCE 0.0-1.0 M-SOIL
 1.0-3.5 M-SILTY TILL

EXPOSURE #: BB200 (NE-27-004-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY,ROADWAY,RAILWAY
 SURROUNDING LAND USE: SURFACE EASEMENT
 (OTHER THAN ROADWAY)
 ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: ORGANIC SWAMP DEPOSITS OVER TILL
 SECTION HEIGHT: 2.5 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: TILL
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 -DEPOSIT IS SWAMP ORGANICS OVER TILL 0.0-1.5 M-SOIL
 1.5-2.0 M-ORGANIC SWAMP DEPOSITS.
 2.0-2.5 M-TILL WASHED FROM WATER TABLE
 -HOLE FILLED WITH WATER AT 2.0 M

EXPOSURE #: BB201 (NE-27-004-08W) VISITED: 9105
 EXPOSURE TYPE: BACKHOE TEST PIT LAND USE: HIGHWAY,ROADWAY,RAILWAY
 SURROUNDING LAND USE: AGRICULTURE,HAYING
 ECONOMIC THICKNESS: 0.0 METRES ESTIMATED STONE CONTENT:
 SECTION: A MATERIAL DESCRIPTION: TILL OVER SHALE BEDROCK
 SECTION HEIGHT: 1.8 M DEPTH TO WATER TABLE: M
 HEIGHT SAMPLED: 0.0 M OVERBURDEN THICKNESS: 0.0 M
 MATERIAL AT BASE: BEDROCK
 NO CHANNEL SAMPLE TAKEN
 ADDITIONAL INFORMATION: GENERAL STRATIGRAPHY:
 0.0-0.3 M-SOIL
 0.3-1.5 M-SILTY TILL
 1.5-1.8 M-SHALE BEDROCK

APPENDIX B: GRAIN SIZE CLASSIFICATION

Screen (mm)		Wentworth size class*	
Field Processing	Sample is 100% Passing 6" (152.4mm)	Gravel	Boulders -8 phi (256mm)
	3" (76.1mm)		Cobbles
	1 1/2" (38.1mm)	Pebbles	Coarse -6 phi (64mm)
	3/4" (19.1mm)		Medium
Laboratory Processing	3/8" (9.5mm)		Fine
	#4 (4.8mm)		
	#8 (2.4mm)	Sand	Granules -2 phi (4mm)
	#16 (1.2mm)		Coarse -1 phi (2mm)
	#30 (0.6mm)		Medium
	#50 (0.3mm)		Fine
	#100 (0.15mm)		
	#200 (0.07mm)		
	< 200	Fines	Silt & Clay < 0.063mm +4 phi (0.063mm)

* modified from Folk, 1974

APPENDIX C: GLOSSARY

AGGREGATE

Any inert, construction material (sand, gravel, slag, crushed stone or other mineral material).

AGGREGATE RESERVES

Aggregate in a deposit which is proven and is economically significant.

ALLUVIUM

Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during postglacial time by a stream.

BEACH DEPOSITS

These are relatively narrow, linear features formed at the shores of glacial lakes that existed during deglaciation. Well developed beaches are usually less than 20 feet (6 m) thick. The aggregate is well sorted and stratified and sand-sized material commonly predominates.

BEDROCK

In-place pre-Quaternary material exposed at the surface or underlying the surficial material.

BINDER

Material that produces or promotes consolidation in loosely aggregated sediments. Usually mud or clay, sometimes till is used for binder.

CARBONATE ROCKS

A broad term referring to those sedimentary rocks consisting chiefly of carbonate minerals, mainly limestone and dolostone.

CLAST

An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering of a large rock mass. Synonyms include particle and fragment.

CROWN LAND

Land reserved and administered by the Crown. Sand and gravel usually administered by the Crown.

CROWN SAND AND GRAVEL

Sand and gravel reserved and administered by the Crown.

DELETERIOUS LITHOLOGY

A general term used to designate those rock types which are chemically or physically unsuited for use as construction or road-building aggregates. Such lithologies as chert, shale, siltstone, and sandstone may deteriorate rapidly.

DEPOSIT

An accumulation of sediments left in a new location by a natural transportative agent such as water, wind, ice, or gravity.

An aggregate deposit is a deposit of sand and gravel considered to be of economic significance.

DIRT

See fines.

DOLOMITE (DOLOSTONE)

A carbonate sedimentary rock consisting chiefly of the mineral dolomite and containing relatively little calcite (dolomite is also known as dolostone).

DRIFT

A general term for all unconsolidated rock debris transported from one place and deposited in another; distinguished from underlying bedrock. In North America, glacial activity has been the dominant mode of transport and deposition of drift. Synonyms include overburden and surficial deposit.

DURABLE ROCK

A rock fragment which is hard and inert and can be used as aggregate without breaking, crumbling or reacting with the cementing material.

EOLIAN

Pertaining to wind action.

EPOCH

A geological-time unit longer than an age and a subdivision of a period.

ESKERS

Eskers are narrow, sinuous ridges of sand and gravel. They vary greatly in size. Many eskers consist of a central core of poorly sorted and stratified gravel. The core material is often draped by better sorted and stratified sand and gravel.

FINES

A general term used to describe the size fraction of an aggregate which passes (is finer than) the No. 200 mesh screen (0.074 mm). Also described informally as "dirt", these particles are in the silt- and clay-size range.

FLUVIAL

Pertaining to rivers or streams.

GLACIOFLUVIAL DEPOSITS

Material deposited by streams flowing from, on, or within melting glacier ice, generally composed of sorted, stratified sand and gravel; includes outwash, kame, esker, etc.

GLACIOLACUSTRINE DELTAS

These features were formed where streams or rivers of glacial meltwater flowed into lakes and deposited their suspended sediment. Such deposits tend to consist mainly of sand and abundant silt. However, in near-ice or ice-contact positions, coarse material may be present.

GLACIOLACUSTRINE DEPOSITS

Material deposited in lakes affected by glacier ice or by meltwater flowing directly from glaciers; composed of well-sorted clay, silt, or sand.

GRANULAR BASE COURSE

Components of a road placed on subgrade and designed to provide strength, stability, and drainage, as well as support for surfacing materials. Several types have been defined: Granular Base Course A consists of crushed and processed aggregate and has relatively stringent quality standards in comparison to Granular Base Course B and C which are usually pit-run or other unprocessed aggregate.

GROUND MORaine

A deposit of till with a flat or undulating surface.

HOLOCENE

An epoch of the Quaternary period covering the time period from the retreat of the continental glaciers to the present, about 10 000 years.

HUMMOCKY

An irregular or knob and kettle surface.

HUMMOCKY MORaine

A landscape composed primarily of till with a hummocky surface.

ICE-CONTACT DEPOSIT

Material deposited in contact with glacier ice by meltwater; includes kames, eskers, kame terraces, etc.

ICE-CONTACT TERRACES

These are glaciofluvial features deposited between the glacial margin and a confining topographic high, such as the side of a valley. The structure may be similar to outwash deposits.

KAMES

Kames are mounds of poorly sorted sand and gravel deposited by meltwater in depressions or fissures on the ice surface or at its margin. The deposits consist mainly of irregularly bedded and cross-bedded, poorly sorted sand and gravel. Deposits include single mounds, linear ridges (crevasse fillings) or complex groups of landforms.

LACUSTRINE DEPOSIT

Material deposited in a lake.

LITHOLOGY

The description of rocks on the basis of such characteristics as color, structure, mineralogic composition, and grain size. Generally, the description of the physical character of a rock.

MELTwater CHANNEL

A drainage way produced by water flowing away from a melting glacier margin.

MORaine

A distinct accumulation of glacial drift. Could represent an ice marginal position.

OUTWASH

Outwash deposits consist of sand and gravel laid down by meltwaters beyond the margin of the ice lobes. They occur as sheets

or as terraced valley fills (valley trains) and may be very large in extent and thickness. Well developed outwash deposits have good horizontal bedding and are uniform in grain-size distribution. Outwash deposited near the glacier's margin is much more variable in texture and structure.

PIT RUN

Unprocessed aggregate removed from pit. Generally consists of fine pebble gravel with minor amounts of material coarser than 38 mm (1 1/2"). It is used for road maintenance, upgrading and resurfacing.

PLEISTOCENE

An epoch of the recent geological past including the time from approximately 1.8 million years ago to 10 000 years ago. Much of the Pleistocene was characterized by extensive glacial activity.

QUATERNARY

The second period of the Cenozoic era, thought to cover the last 2-3 million years. It consists of two epochs: The Pleistocene and the Holocene.

RESOURCE

An aggregate deposit or environment which may or may not be proven and is presently not economically significant.

SHALE

A fine-grained, sedimentary rock formed by the consolidation of clay, silt, or mud and characterized by well developed bedding planes, along which the rock breaks readily into thin layers. The term shale is also commonly used for fissile claystone, siltstone, and mudstone.

SPILLWAY

Large drainage valley formed by meltwater flowing from a glacial lake. Spillways often have gravel terraces.

STONE

That component of aggregate coarser than 4.76 mm or the #4 sieve, includes pebbles, cobbles and boulders.

SURFICIAL GEOLOGY

A form of geological mapping dealing with all materials occurring at surface in an area: unlithified or lithified (sediments or bedrock).

TERRACE

A relatively flat, stair-stepped, depositional or erosional surface bounded by an ascending slope on one side and a descending slope on the other.

TILL

Unsorted and unstratified rock debris, deposited directly by glaciers, and ranging in size from clay to large boulders.

WISCONSINAN

Pertaining to the last glacial stage of the Pleistocene Epoch in North America. It began approximately 100 000 years ago and ended approximately 10 000 years ago. The glacial deposits and landforms of southern Manitoba are predominantly the result of glacial activity during the Wisconsinan Stage.