Moosomin Dam Information for Dam Safety Review 2016

Background

Moosomin Dam located in NW29-12-31 W1 and is approximately 10 kilometres (6 miles) south of the Town of Moosomin on Highway 8. The Dam is sited on the Pipestone Creek. The Project construction was started in 1953 with completion in November 1954 and includes a 13.5 metre high zoned earthfill embankment, an uncontrolled overflow concrete spillway and a gated riparian outlet. The spillway structure consists of an ogee crest, sloping chute, and stilling basin with a maximum discharge capacity of 448 m3/s. The spillway is anchored by 60 hold-down piles. Embankment is comprised of an upstream portion of clay and a downstream portion of shale complete with a downstream horizontal blanket filter. The embankment has with an average depth of 1.65 metre deep core trench, a 150 metre upstream natural clay blanket, an upstream slope of 3:1 with 305 millimetres (12 inches) of bedding gravel and 457 millimetres (18 inches) of riprap, and a 6.0 metre wide berm with a 5:1 slope. The top portion of the downstream slope is 2:1 with a 3.0 metre wide berm and bottom portion is 4:1. The original streambed section has a 100m long berm upstream and a 15 metre wide berm downstream. The riparian outlet is located near the left abutment and includes an inlet, 1.2 metre square conduit which is about 70.26 metres long, a reinforced concrete gatewell and stilling basin. The maximum outlet capacity of the riparian conduit at FSL is 8.4 m^3/s. The approximate embankment crest length is about 490 metres. Storage capacity at FSL is 11,156 dam^3. Project uses are irrigation, water supply, and recreation.

The project had a detailed Probable Maximum Flood (PMF) study conducted in 1986 using a modern technique of determining a Probable Maximum Precipitation (PMP) storm event and modeling it over the drainage basin. That study used HEC-1 for the rainfall PMF which concluded that an appropriate rainfall PMF peak inflow was 820 m^3/s with a volume of 737,400 dam^3. The same study found the snowmelt PMF peak inflow was 740 m^3/s with a volume of 764,640 dam^3. Both reports present the step by step processes used to support the conclusions.

In 1989, PFRA conducted a detailed study of the project. The Phase 1 Dam Safety Evaluation Report details the general assessment of the structural, hydraulic, hydrologic, geotechnical, and operational safety of the dam. Significant effort was put into completing the evaluation including the compiling of all relevant project data, the assessment of the physical condition of the infrastructure, resolution of any data gaps regarding geotechnical or hydrotechnical understanding of the project. The final report is available for review as part of the relevant material for this Dam Safety Review.

A revitalization of the PFRA dam safety program in 2007 along with an update to the CDA guidelines led to a renewed interest in Moosomin Dam. As a result, a Dam Classification Study was commissioned in 2013 using available LiDAR topography and modern dam break and hydraulic modeling practices. The study recommended the Dam Classification to be in the High Consequence category based on the expected loss of life of 1.8 and 2.2 for piping failure and flood induced failure respectively. The loss of life is predominantly related to the highway located just downstream of the dam. Similarly economic damages of $17million and $22million are expected for flood induced and piping failures. The

downstream study boundary terminated near the Town of Reston, Manitoba. Based on the High Consequence class, the IDF based on CDA standards is expected to be 1/3 of the way between the 1/1000 year flood and the PMF. A risk based IDF analysis has not been completed.

The project hydrology was updated in 2016. The update included hydrometric data on Pipestone Creek up to 2015 as well as consideration for other nearby gauged waterways. The results of the hydrologic update are as follows:

Flood Event	Snowmelt Runoff		Rainfall Runoff	
	Instantaneous Peak Flow (m^3/s)	Runoff Volume (dam^3)	Instantaneous Peak Flow (m^3/s)	Runoff Volume (dam^3)
1:2	20	12700	6.1	2660
1:5	42	26500	21	11900
1:10	61	38600	39	23500
1:20	82	53200	64	40200
1:50	120	77600	110	71200
1:100	150	101000	150	103000
1:200	190	130000	200	142000
1:500	260	179000	290	209000
1:1,000	300	215000	340	254000

Project Summary Information

Top of Dam	547.93 m	Full Supply Level (FSL)	543.978 m
Top Width of Embankment	5.5 m	Storage Capacity at FSL	11,156 dam^3
Maximum Height of Dam	13.5 m	Live Storage at FSL	10,845 dam^3
Approximate Crest Length	490 m	Flooded Area at FSL	389 ha
Ogee Weir Height	0.914 m	Reservoir Length at FSL	8 Km
Apron Slab Elevation	543.064 m	Storage Capacity at Top of Dam	33,286 dam^3
Crest Width	30.48 m	Dead Storage at 538.44 m	311 dam^3
Chute Slope	6:1	Approach Channel Elevation	543.064 m
Wing Wall Radius	3.962 m	Approach Channel Bed Width	36.58 m

History of Inspections, Issues and Repairs

Inspection Records

Records are available of inspections at Moosomin dam to-date to immediately following its construction. The inspection activities range from basic site visits to extensive investigations involving drilling, coring, seepage tracing, laboratory testing, and detailed analysis. The most detailed inspection was in regard to delineating spillway underslab voids in 1990. The bulk of the available records for past inspections include extensive photographic records, inspection checklists and notes, and limited results of testing and specific investigations.

Conduit Cracks and Joints Separation

The history of repairs and issues at Moosomin Dam starts in 1954 with the start of cracks and separations in the riparian conduit that needed immediate repair. The cracks and joint openings in the riparian conduit were a concern that designers were aware of before construction due to the foundation material having 3 to 4.5 metres of soft clay underlain by 1.5 to 7.5 metres of pervious sand and gravel which is further underlain by clay shale (bedrock). From the Geology Databook, cracking and joint opening in the riparian conduit is associated with settlement and differential movement in the fill and foundation material. Recommended to continue monitoring and carefully check in the field. Inspections in 1958 and 1960, stated “observed gas (may be methane) was entering conduit through crack around Joint B”. Conduit joints were repaired with caulking in 1961 and similar repairs were performed in 1971. 2003 involved a conduit inspection by divers that included the repair of cracks on the upstream conduit floor slab. Then in 2005 divers re-inspected the conduit repairs from the 2003 inspection and repair program. The Geotechnical Databook states that foundation settlement was essentially finished within one year of completion of construction, which measured in the range from 610 mm to 700 mm.

Slope Instability

There have been two slope failures at the Moosomin Dam site. A small “local” slide occurred in 1954 during construction while excavating the diversion inlet along the toe of the North abutment and appeared to be caused by a thin seam of bentonite. Also, before construction was completed in 1954, a slope failure on the south side of the spillway approach channel on the South abutment occurred “along a bentonite seam appearing in the bottom of the inlet cut” that was assigned as an issue to monitor and not repair. The original thinking was that both slump blocks did not pose a threat to the riparian, spillway or dam safety, and as such would only require monitoring. The South abutment slump block did encounter further movement in 1955; however, “no movements have been observed since then”, from the Geotechnical Databook.

Borehole WB5A encountered a thin bentonite layer at a depth of approximately 1.8 metres (6 feet) in the south abutment. The Geology Databook states the occurrence of bentonite in the Moosomin area. Furthermore, the upper cretaceous marine sediments belong to the Millwood Member of the Riding Mountain Formation; however, “it should be noted that due to the presence of bentonite layers within

the shale at the Moosomin site, some writers refer to the shale as Bearpaw Formation". It also goes onto state that "potential instability or zones of weakness associated with bentonite layers in the shale is an important consideration at the Moosomin site". Therefore, these two slides quite well have been caused by shear failures in the bentonite present in the abutments.

Two slides were also reported in the downstream shale slope of the embankment, one in 1968 and the other in 1974. The first embankment slide in 1968 was instrumented with straddle markers and underwent intensive monitoring. The 1974 slide was noted as "inactive at the time of discovery" and therefore was only monitored on scheduled inspections. The 1980 dam safety inspection reported that both downstream embankment slides appeared inactive at that time. The 1989 Dam Safety Evaluation report noted a small slump along the downstream slope of the embankment, although no serious embankment instability was suspected. Therefore, the recommendation was to continue to monitor the area.

From the Geology Databook, the most distinctive landforms associated with the reservoir valley walls are the high-level terrace and a small stabilized slump block. The slump is located approximately 2 kilometres upstream of the embankment on the West side of the reservoir. The Geology Databook also went on to say that the slumping appears to be of the rotational type and is probably developed in the Riding Mountain shale. Furthermore, "reactivation of this slump or the development of new slumps is not likely to affect the structural integrity of the dam". Therefore, the monitoring of this slump has been neglected.

Spillway Heave, Underslab Voids, Joints and Drainage System

Spillway repairs started in 1955, to fix extensive concrete spalling and transverse cracking of the slab and modify the drainage system. Repairs were also performed in 1971 due to frost heave of the clay shale foundation. In 1980, a 3 inch void was found "in area of heave" that core samples were taken. This was followed up in 1987 whereby the Geotechnical Division performed an assessment of the underslab voids. Furthermore, an inspection of the joints and underslab voids was done in 1989 prior to a 1990 contract that had the spillway rehabilitated in which the spillway drainage system was redone, a manhole installed to monitor flows and concrete repairs. Following the rehab project a ground penetrating radar (GPR) survey was initiated to map out underslab voids, whereby the results were not favourable for absolute delineation of the voids. Thereby, the established coring procedure was deemed appropriate going forward. A tracer dye test was performed upstream of the spillway in 1990 to check the connection of the reservoir in the inlet channel and the longitudinal joints; the recommendation from this investigation was that an approach channel blanket was not required. Spillway joints and drainage system rehabilitated again in 2001, this included the installation of waterstop in the joints. 2012 had transverse joint 3 flushed and camera inspected which showed "all good" since there was a concern that it was plugged and possibly not draining efficiently. Inspection in 2013 of dewatered basin and spillway resulted in some minor grouting and patching be performed on numerous joints. Technical inspection readings of the reference marks in 2012 showed a maximum heave of approximately 23 millimetres from original and a range of settlement of 1 millimetre to a heave of 6 millimetres from the previous readings.

Miscellaneous Embankment

Over the years, the embankment has had numerous grading and re-gravelling done on the crest and berm. Woody vegetation has also been sprayed and removed. Replacement of riprap on the upstream slope has also been part of the ongoing repairs for the Project. From the Geotechnical Databook, during construction, work was either stopped or slowed due to two issues that arose; one interruption was a spring that developed "which flowed very strongly" during excavation of the key trench. It was believed that this spring was caused by a previous drill hole that penetrated the sand and gravel layer underneath thereby connecting the confined aquifer to ground surface. The spring was stopped and the trench dewatered, and excavation and backfill proceeded. The other problem that was encountered during construction that stopped progress on the embankment was "very heavy rains in the spring of 1954", from the Geology Databook.

Ongoing Issues and Recommendations

Issues and items that continue to be monitored at Moosomin Dam include:

- Relief well system is periodically observed to be operational with no concerns. No formal monitoring of the flowrates of the relief wells is done and there is no complete inventory of all the wells.
- The slump in the spillway approach channel has erosion occurring that is being deposited in the stilling basin and exit channel. As well, erosion of the slump debris may reactivate the slide.
- Shoreline erosion may reactivate the old slump block on the West side or cause further slumping. Such movements are believed to not endanger the Dam.
- From the 1989 Dam Safety Evaluation report, short of a complete redesign of the chute slab, it is not possible to completely eliminate seepage water from the underslab. As such, vertical displacement of the slab and the existence of voids continue to be monitored. A recommendation from the 1989 Dam Safety Evaluation report stated that periodic monitoring should be conducted to detect any development of voids in the future by the installation of inspection ports at appropriate locations through the slab. Although, this recommendation was obeyed, the installation was unsuccessfully done and these inspection ports are inoperable. Thereby, severely restricting the ability to monitor underslab voids at this Project.
- From the 1989 Dam Safety Evaluation report, access to the South end of the dam is a concern. The only method of access is when conditions are dry.
- From the Geology Databook, the belief is that the heave will reduce in time due to the clay; however, lab tests have shown that swelling in bentonite may continue almost indefinitely and therefore the movement potential should be carefully monitored and checked.
- The location and extent of bentonite layers in the abutments has not been determined.
- According to the 1989 Dam Safety Evaluation report, the exit channel was never excavated to the grades shown on the original drawings, and therefore tailwater levels may be higher than desired at some discharges.
- The majority of settlement of the riparian conduit and gatewell occurred within the first year after construction; however, small amounts of settlement have been recorded since that time and continue to be monitored.
- The downstream slope of the embankment has had a couple of slumps which to date are considered inactive; no new movements have been observed.
- From the Dam Safety Issue List, there are trees growing just above the berm on the downstream slope of the dam. Furthermore, there were wet spots in the wheel tracks on the berm near the young trees which may indicate possible seepage.
- From the Dam Safety Issue List, no formal manual exists which contains a comprehensive and detailed set of guidelines for operating and maintaining the project.
- From the Dam Safety Issue List, there are 4 old steel piezometer pipes that run on the backslope of the dam that need to be decommissioned.

Recommendations from previous studies, reports and Dam Safety Evaluations include:

- From the Geology Databook, the small slump observed about 2 Kilometres upstream of the embankment on the West side of the reservoir should be examined for signs of recent movement and a thorough inspection should be made of the valley walls along the entire reservoir.
- From the Geology Databook, cracking and joint opening in the riparian conduit is associated with settlement and differential movement of the fill and foundation material; as such, this should be monitored and carefully checked in the field.
- From the Geology Databook, a site geology plan should be prepared on a detailed field inspection of the site and available site testhole data.
- From 1989 Dam Safety Evaluation report, if significant erosion occurs to the slump in the spillway approach channel, which would jeopardize the safe operation of the Project, consideration should be given to straightening the approach channel and flattening and armouring the side slopes. Furthermore, current drainage at the top of the scarp of the slump is not well defined and infiltration or runoff could reactivate the slumping. Therefore, it is recommended that the upper scarp be graded to promote proper drainage and that the approach channel be monitored as part of annual inspections.

Technical Instrumentation and Surveillance Monitoring

As per the Geology Databook, “due to the suspected instability of the highly plastic clay layer in the foundation, the original design recommendations for the embankment called for a fill with flatter than usual slopes”. As such, crest alignment pins, toe alignment pins, settlement gauges, rebound gauges, piezometers and relief wells were installed to monitor the Dam. Over time, some shortly after construction was completed, all the technical instrumentation that was installed at the Dam were lost, destroyed or abandoned except for a small number of relief wells that continue operate. The spillway reference marks are also still being read. From a Geotechnical Memo, the spillway contour plot of 1990 showed a maximum heave of approximately 70 millimetres in the lower centre of the chute. After construction, the max average rate of heave was about 6.5 mm/yr for 5 years in the lower centre of the chute. In general, the rate of heave reduced to about 1 mm/yr from 5 to 10 years after construction to date except for 3 surveys performed early in the spring of 1963, 1970 and 1989.

A system of relief wells was installed to reduce the high uplift pressures expected in the sand and gravel layer in the foundation. 17 relief wells of 7 different types were installed approximately 12 metres deep on 30 metre centres along the downstream toe and on 7.5 metre centres in the downstream area of the old streambed. To date, one third of the relief wells are located and still operational. The other two thirds of the relief wells have either been lost or destroyed. The relief wells have been flushed twice during their operation as part of general maintenance according to the 1989 Dam Safety Evaluation report. Although a 2001 internal memo, assessed the relief well system and states that the “flushing did not substantially improve performance of the wells”. This investigation found that the relief wells were performing satisfactorily and that there were no current requirements to rehab them. It did recommend that a better understanding of existing piezometric conditions in the sand and gravel foundation layer is required for understanding non-functional relief wells.

From the Geotechnical Databook, the maximum settlement from the crest pins was 260 millimetres. While the maximum heave at the downstream toe from the pins was 110 millimetres. The crest alignment pins had moved a maximum 47 millimetres parallel to the dam centre line by 1970. The settlement gauges that were installed on the crest of the embankment showed that the foundation settlement was essentially finished within one year of completion of construction. The average fill compression from the settlement gauges was 275 millimetres. The rebound gauges were installed in the spring of 1954, but 2 were lost because of the slide in the hillside on the South abutment in the spillway entrance channel. The limited rebound data showed more heave of the clay shale related to frost action than rebound. High water levels in the piezometers during construction indicated that the pressure levels in the pervious foundation were considerable; however, pressure levels stabilized after the initial filling of the reservoir.

Nine standpipe piezometers were installed in 2012. Three were installed in the embankment to monitor a potential water source for a mature stand of willows growing on the downstream slope of the embankment above the berm. The remaining piezometers were installed to monitor embankment or foundation pore water pressures. In 2014, nine vibrating wire sensors were installed in the existing standpipe piezometers to more accurately monitor pore water pressure.

Available records include Microsoft Word documents and Excel spreadsheets for 4 historical standpipe piezometer logs that have various readings from the 1950's to the 1970's and one piezometer that was read until 2000. In addition to these, there are also Microsoft Word and Excel files for 3 additional standpipe piezometers that were installed in 1999 with an additional 9 installed in 2012. The reading schedule varied from year to year, with some years only having one reading obtained. , there is an Excel spreadsheet from 2014 that stores the raw data for 9 of the standpipes since they were converted to vibrating wire piezometers (VWP) with readings taken every 12 hours. There are Portable Document Format (PDF) files as well as Excel spreadsheets that have the readings and plots of the reference marks that were installed on the spillway slab after construction was completed with sporadic readings obtained throughout the project's history until the last obtained reading in 2013. Word documents and PDF's contain the infrequent readings of the relief wells that were installed during construction and were monitored occasionally over the last 70 years. There is a manhole drain that is connected to the spillway drainage system that is monitored on a dam safety inspection schedule that have those flow rate readings contained in the dam safety inspection reports. The plot and analysis data are available in AutoCAD drawings, PDF's and Excel graphs illustrating the reference mark settlement /heave and piezometric change over time and comparison with reservoir level or relief well head.

Additional reference material in the following pages includes:

Listing of project reports

Inventory of all project drawings

Limited relevant project drawings

Footprint of available LiDAR

Relevant Project Reports

1950 Soil Mechanics Notes on Pipestone Creek, PFRA

1953 Report on Pipestone Creek Project, PFRA

1953 Design Analysis on Structures, PFRA

1955 Report on the Construction of the Dam at Moosomin, Sask (Pipestone Creek), PFRA

1955 Inspection trip to Moosomin Dam, May 5-6, 1955, PFRA

1955 Inspection of Pipestone Dam, Conduit and Spillway, PFRA "(Rough Draft)"

1956 Soil Mechanics and Materials Report on Construction and First Year Operation of Moosomin Dam, PFRA

1956 The Moosomin Dam, PFRA (Library)

1961 Test Installations and Inspection Report Moosomin Dam, PFRA

1962 Progress Report, Heave Observations of Spillway on Clay Shale, PFRA

1972 Report on Moosomin Dam Maintenance 1971, PFRA

1979 Pipestone Creek at Saskatchewan-Manitoba Boundary, Natural Flow, Prairie Provinces Water Board

1982 Project Databook (includes Hydrology, Geology, Geotechnical, Design, Construction, O&M), PFRA

1985 Moosomin Dam and its effect on the apportionment of Pipestone Creek flows, Prairie Provinces Water Board (Library)

1987 The Soils of Moosomin (121), Martin (122), Rocanville (151), Spy Hill (152): rural municipalities Saskatchewan, University of Saskatchewan Institute of Pedology

1989 Phase 1 Dam Safety Evaluation Report – Moosomin Dam, PFRA

1989 Moosomin Dam Spillway Concrete Condition Survey, PFRA

1990 Moosomin Reservoir modelling study, PFRA (Library)

1991 GPR Void Survey Moosomin Dam Spillway, EBA

1993 Pipestone Creek (Moosomin Dam) project restoration/improvement of Full Supply Level, PFRA (Library)

2014 Moosomin Dam Classification Study, Golder Associates

(1950 to Present) Miscellaneous memos and documents regarding design, construction, operation and maintenance issues associated with Moosomin Dam

	A	B	C	D	E	H	I	J	K
1	**MOOSOMIN DAM** (PIPESTONE CREEK)								
2	**N.W. Sec. 29 & S.W. Sec. 32, Twp. 12, Rge. 31, W1M - UTM 13 (Extended), 5549238 N, 736930 E**								
3	**File Revision Date - Feb. 4, 2014**								
4	**Drawing #**	**Revision Number As Constructed Superseded by**	**Contract Name or Contract #** (if applicable)	**Drawing Title**	**Date**	**Drawing Obsolete** (Y / N)	**Hyperlink**	**Comments**	**Oracle**
5	87	No Scan					87		
6	253			Pipestone Creek Project - General Plan Sec's 29 & 32-12-31-W1	April 10, 1953		253		
7	254			Pipestone Creek Project - Pipestone Spillway General Plan & Cross Sections	April 7, 1953		254		
8	254	As Constructed		Pipestone Creek Project - Pipestone Spillway General Plan & Cross Sections	October 18, 1955		254_C		
9	255	As Constructed		Pipestone Creek Project - Pipestone Spillway Sidewall Reinforcing Details	April 7, 1953		255_C		
10	256			Pipestone Creek Project - Pipestone Spillway Floor Slab and Wingwall Details	April 7, 1953		256		
11	257			Pipestone Creek Project - Riparian Outlet General Plan Conduit and Gatewell Details	April 25, 1953		257		
12	257	As Constructed		Pipestone Creek Project - Riparian Outlet General Plan Conduit and Gatewell Details	April 25, 1953		257_C		
13	258			Pipestone Creek Project - Riparian Outlet Inlet and Stilling Basin Details	May 6, 1953		258		
14	425			Pipestone Creek Project - General Plan	December 4, 1953		425		
15	430		Moosomin Dam	Pipestone Creek - Topographical Plan Dam Area	November, 1953		430		
16	1123		Moosomin Storage Project	Pipestone Creek Sketch Map Showing Roads & Municipalities Affected by Proposed Dam	November 26, 1950		1123		
17	1435		Moosomin Storage Project	Profiles of Proposed Centrelines of Dam & Spillway on Pipestone Creek	March, 1951		1435		
18	2271	No Scan					2271		
19	2601			Topography of Proposed Pipestone Creek Damsite in Sec's 29 & 32-12-31-W1	August, 1950		2601		
20	2839	As Constructed		Pipestone Creek Project - General Plan Moosomin Dam	December, 1954		2839	As Constructed on drawing but no C with #	
21	2878	As Constructed		Pipestone Creek Project - Pipestone Spillway Floor Slab & Wingwall Details	December, 1954		2878_C		
22	2892	As Constructed		Pipestone Creek Project - Riparian Outlet Inlet and Stilling Basin Details	July 8, 1955		2892_C		
23	3145			Moosomin Storage Project - Layout Plan Pipestone Creek Dam			3145		
24	3155		Moosomin Storage Project	Pipestone Creek Plan Showing Topography and Testhole Locations	October, 1953		3155		
25	3156		Moosomin Storage Project	Pipestone Creek Plan of Miscellaneous Holes showing Drill Logs & Soil Test Results	October, 1953		3156		
26	3157		Moosomin Storage Project	Pipestone Creek Revised Design Section	October, 1953		3157		
27	3158		Moosomin Storage Project	Pipestone Creek Profile of Line X-Y-Z Showing Drill Logs & Soil Test Results	October, 1953		3158		
28	3159		Moosomin Storage Project	Pipestone Creek Profile of Line X-Y-Z Showing Drill Logs & Soil Test Results	October, 1953		3159		
29	3160		Moosomin Storage Project	Pipestone Creek Profile Dam Centreline Showing Drill Logs & Testhole Results	October, 1953		3160		
30	3193	As Constructed		Pipestone Creek Project - Dam and Spillway Plan Moosomin Dam	December, 1954		3193	As Constructed on drawing but no C with #	
31	3194			Pipestone Creek Project - Moosomin Dam A/C Profiles of Dam Location of Pipes in Weir	December, 1954		3194		
32	3194	As Constructed		Pipestone Creek Project - Moosomin Dam A/C Profiles of Dam Location of Pipes in Weir	December, 1954		3194_C		
33	3206	As Constructed	Moosomin Storage Project	Pipestone Creek Revised Design Section	June, 1954		3206_C		
34	3207	As Constructed	Moosomin Storage Project	Pipestone Creek Profile Dam Centreline Showing Drill Logs & Testhole Results	June, 1955		3207	As Constructed on drawing but no C with #	
35	3523			Pipestone Creek Reservoir Capacity Curve			3523		
36	3527			Vicinity Map of Pipestone Dam			3527		
37	3615						3615		
38	3673	No Scan					3673		
39	3720			Pipestone Creek Project - Pipestone Spillway Floor Slab & Wingwall Details	July 21, 1955		3720		
40	3757	As Constructed		Pipestone Creek Project - General Plan	June, 1955		3757_C		
41	3758	As Constructed	Moosomin Storage Project	Pipestone Creek Revised Design Section	December, 1954		3758	As Constructed on drawing but no C with #	
42	3759		Moosomin Storage Project	Pipestone Creek Profile Dam Centreline A/C Showing Drill Logs & Testhole Results	November, 1955		3759		
43	4011-1			Wire Mesh Frames for Handrail on Spillway on Moosomin Dam	April, 1955		4011-1		
44	4011-2			Handrail for Spillway on Pipestone Creek Project - Moosomin Dam	April, 1955		4011-2		
45	4011-3			Handrail for Spillway on Pipestone Creek Project - Moosomin Dam	April, 1955		4011-3		
46	4205	No Scan					4205		
47	4555		Moosomin Reservoir	Keenan Road Bridge General & Detail Plan Proposed Timber Bridge SE1/4-11-13-32-WPM	February 18,1957		4555		
48	4556		Moosomin Reservoir	Pipestone Creek Project - Location Plan at Proposed Bridge Site	February 18,1957		4556		
49	4771	No Scan					4771		
50	4790	No Scan					4790		
51	4791	No Scan					4791		
52	4792	No Scan					4792		
53	4929			Keenan Road Sketch Plan Showing Proposed Road Relocation	October 8, 1957		4929		
54	4967		Moosomin Dam	Pipestone Creek - Proposed Road Relocation South of Keenan Bridge	December 2, 1957		4967		
55	6483			Topography, Road south of Keenan Bridge Sec 11&12-13-32-W1	September 12, 1958		6483		
56	7722			NO NAME	May 18, 1955		7722		
57	8137		Moosomin Reservoir	Pipestone Creek Project - Keenan Road Bridge Plan Showing Abutment Reinforcement	December, 1959		8137		
58	9157	No Scan					9157		
59	16031			Pipestone Creek Project - Key Plan Showing Joint Sealer Type	July 27, 1961		16031		
60	17135	As Constructed		Pipestone Lake Project - Riparian Outlet Works	August 16, 1966		17135_C		
61	17701		Coal Lake-Pipestone Creek	Preliminary Study of Surface Geology of Damsite	June19, 1967		17701		
62	32143	No Scan					32143		
63	32144	No Scan					32144		
64	32145	No Scan					32145		
65	32146	No Scan					32146		
66	32147	No Scan					32147		

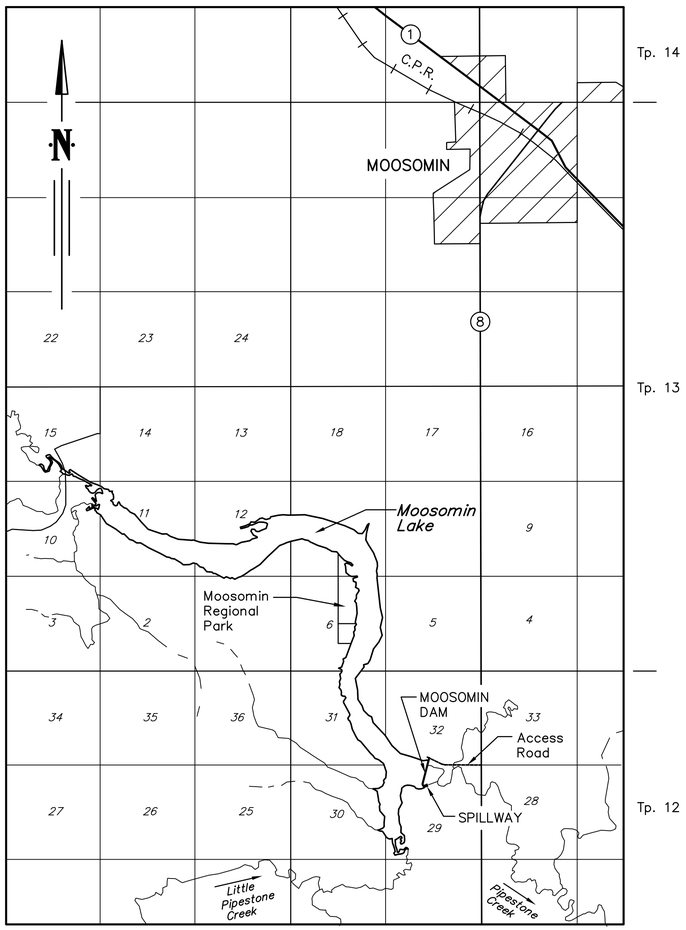
	A	B	C	D	E	H	I	J	K
67	32148		Cromer Dam	Topography Showing Hole Locations Profile Spillway Centreline showing Drill Logs &Test Results	June, 1957		32148		
68	32149		Cromer Dam	Profile Dam Centreline and Borrow Holes showing Drill Logs and Test Results	July, 1957		32149		
69	32150		Cromer Dam	Compaction and Consolidation Tests on Clay Borrow	September 13, 1957		32150		
70	32151		Cromer Dam	Unconfined Compressive Strength Foundation Clay	September, 1957		32151		
71	32152	No Scan					32152		
72	32153		Cromer Dam	Topographical Plan Showing Drill Hole Locations	December 17, 1959		32153		
73	32154		Cromer Dam	Profiles Dam Centreline and Conduit Centreline	January 5, 1960		32154		
74	32155		Cromer Dam	Profiles of Line A,B,C and Borrow Areas	January 5, 1960		32155		
75	32156		Cromer Dam	Design Considerations	February, 1960		32156		
76	32157	No Scan					32157		
77	37111		Oak Lake Project	Profile of Proposed Pipestone Creek Diversion showing Drill Logs & Test Results	January 12,1955		37111		
78	37134		Moosomin Storage Project	Pipestone Creek - Topography & Profiles showing Testhole Logs & Locations	June, 1950		37134		
79	37135		Moosomin Storage Project	Pipestone Creek - Miscellaneous Testhole Logs	June, 1950		37135		
80	37136	No Scan		Suggested Design	October 28, 1952		37136	No Scan	
81	37137	No Scan		Design Section	February 28, 1953		37137	No Scan	
82	37138	No Scan		Concrete Aggregate	June 1, 1953		37138	No Scan	
83	37139		Moosomin Storage Project	Pipestone Creek - Profile Dam Centreline showing Drill Logs and Testhole Results	October 30, 1953		37139		
84	37140	No Scan		Pipestone Foundation Settlement Semi-Log Scales	October 8, 1954		37140	No Scan	
85	37141	No Scan		Pipestone Foundation Settlement Arith Scale	October 8, 1954		37141	No Scan	
86	37142			Pipestone Creek Spillway Swelling Tests on Weathered Shale	November 22, 1954		37142		
87	37143		Moosomin Storage Project	Plan Showing Soil Profile and Relief Well Installation	January 24, 1955		37143		
88	37144	No Scan		Sketch of Spillway Showing Movement Contours - October 1954 to October1960			37144	No Scan	
89	37145	No Scan		Sketch of Spillway Showing Movement Contours - October 1954 to October1960			37145	No Scan	
90	37146			Sketch of Spillway Showing Movement Contours - October 1954 to October1960			37146		
91	37147		Moosomin Dam	Conduit Brass Reference Points	May, 1955		37147		
92	37148		Moosomin Dam	Design of Relief Well System	April, 1956		37148		
93	37149	No Scan		Moosomin Dam Spillway	August 23, 1955		37149	No Scan	
94	37150	No Scan		Unconfined Compressive Strengths AH120 - 121 - 122	December 16, 1955		37150	No Scan	
95	37151	No Scan		Pressure vs. Void Ratio Curve AH120	December 16, 1955		37151	No Scan	
96	37152	No Scan		Pressure vs. Void Ratio Curve AH122	December 16, 1955		37152	No Scan	
97	37153	No Scan		Density vs. Water Content - Main Fill	December 16, 1955		37153	No Scan	
98	37154	No Scan		Density vs. Water Content - Main Fil Points Averaged	December 16, 1955		37154	No Scan	
99	37155	No Scan		Density vs. Water Content - Shale Section	December 16, 1955		37155	No Scan	
100	37156	No Scan		Hold Down Pile Holes	December 16, 1955		37156	No Scan	
101	37157		Moosomin Dam	Installation Locations and Settlement Data	August, 1955		37157		
102	37158		Moosomin Dam	Settlement Gauges, Torpedo, Bar & Piezometers	June 7, 1955		37158		
103	37159		Moosomin Dam	Settlement Gage Readings and Typical Crossection of Dam	July, 1955		37159		
104	37160		Moosomin Dam	Piezometer Readings	December 16, 1955		37160		
105	37161		Moosomin Dam	Tables of Readings to Determine Spillway Movements	July, 1955		37161		
106	37162		Moosomin Dam	Tables of Readings to Determine Movement of Dam & Rebound Gages	July, 1955		37162		
107	37163	No Scan		Slide at Diversion Inlet	December 16, 1955		37163	No Scan	
108	37164	No Scan		Modifications of Spilway Drainage System at Staion 1+50	January 6, 1956		37164	No Scan	
109	37165	No Scan		1953 Concrete Test Results - Deposit #25	April 18, 1957		37165	No Scan	
110	37166	No Scan		1953 - 1954 Concrete Test Results - Deposit #25	April 18, 1957		37166	No Scan	
111	37167	No Scan		1953 - 1954 Concrete Test Results - Deposit #25	April 18, 1957		37167	No Scan	
112	37168	No Scan		Vertical Movement of Spilway Walls - October 1954 to May 1958	Junuary 26, 1959		37168	No Scan	
113	37169	No Scan		Location Plan	March 24, 1961		37169	No Scan	
114	37170		Moosomin Dam	Summary of Settlement Gauge Data June 1954-1961	April 25, 1961		37170		
115	37171		Moosomin Dam	Summary of Settlement Gauge Data Oct. 1954-1961	April 25, 1961		37171		
116	37172	Revision 'A'	Moosomin Dam	Movement Line Observations	April 25, 1961		37172a		
117	37173		Moosomin Dam	Relief Well Data			37173		
118	37174		Moosomin Dam	Piezometric & Standpipe Water Elevations			37174		
119	37175		Moosomin Dam	Water Levels at Downstream Toe. Location of Relief Wells, Piezometers	April, 1961		37175		
120	37176		Moosomin Dam	Test Installation Location Plan	April, 1961		37176		
121	37177		Moosomin Dam	Summary of Conduit Movement Data Sept.1954 to Oct.1959	April, 1961		37177		
122	37178	No Scan		Mossomin Dam Relief Well Cover	August 2, 1961		37178	No Scan	
123	37179		Moosomin Dam	Water Levels at Downstream Toe. Location of Relief Wells, Piezometers	September, 1966		37179		
124	37180	Revision 'A'	Moosomin Dam	Movement Line Observations	September, 1966		37180a		
125	37181	No Scan		Sketch of Spillway Showing Movement Contours (1954 to 1963)	September 22, 1966		37181	No Scan	
126	40082		Pipestone Creek	Frequency Curves of Summer Floods CFS & Dollars Below Cromer Reservoir 1914-1956	February, 1958		40082		
127	40127		Pipestone Creek	Below Moosomin Dam Flood Frequency Curve 1914-1956	November, 1957		40127		
128	40131		Pipestone Creek Watershed	Runoff Frequency Curves - Estimated	June, 1958		40131		
129	40137		Pipestone Creek Watershed	Flood Frequency Curves - Estimated	June, 1958		40137		
130	40138		Pipestone Creek	Relationship Between Max Flow & Other Factors - Near Reston	January, 1958		40138		
131	40370			Little Pipestone Reservoir with Storage of 2000 Ac Ft			40370		
132	40371			Little Pipestone Reservoir Sec 21-11-33-1 Draft Storage Curve			40371		
133	41555			Availabe Hydrometric Data Pipestone Creek Drainage Area	November, 1957		41555		
134	41560		Pipestone Creek Watershed	Key Map	March, 1957		41560		
135	41573		Pipestone Lake Reservoir	Water Levels - Restored	January, 1958		41573		

	A	B	C	D	E	H	I	J	K
136	41861		Pipestone Creek Project	Capacity & Water Surface Area Curves	December, 1957		41861		
137	41866			Median Flows for Pipestone Creek and Tributaries 1914-1956	December, 1957		41866		
138	41882		Pipestone Creek	Flood Frequency Curves Below Cromer Reservoir Alternative 1 1914-1956	January, 1958		41882		
139	42688		Wawota Community Project	Storage Yield Curves Little Pipestone Creek SW 21-31-33-W1 Fig.1	July 13, 1972		42688		
140	42689		Wawota Community Project	Flood Hydrographs Little Pipestone Creek SW 21-31-33-W1 Fig.2	July 17, 1972		42689		
141	42690		Wawota Community Project	Maximum Probable Flood Hydrograph Little Pipestone Creek SW 21-31-33-W1 Fig.3	July 17, 1972		42690		
142	44024		Nut Lake Hydrology Study	Relationship of Annual Max Daily Mean Discharge Between Nut Lake Inflow & Pipestone Cr Flow	March, 1984		44024		
143	44203			Drainage Basin Map	October 1986		44203		
144	44204			Frequency Curve Snowmelt Runoff Events - Moosomin Dam	October 1986		44204		
145	44205						44205		
146	44206		Moosomin Dam Safety	Rainfall Hydrographs Pipestone Creek at Moosomin Dam	October 9, 1986		44206		
147	44207		Moosomin Dam Safety	Snowmelt Hydrographs Pipestone Creek at Moosomin Dam	October 9, 1986		44207		
148	44208			Capacity & Flooded Area Curves - Moosomin Reservoir	October 1986		44208		
149	44209			Spillway Rating Curve Moosomin Reservoir	October 1986		44209		
150	62180			Sketch Showing Cracks in Floor Slab of Conduit	October 30, 1954		62180		
151	62181			Sketch Showing Cracks in Floor Slab of Conduit	October 30, 1954		62181		
152	62182			Conduit Profiles - Original & As Of October 30, 1954	October 30, 1954		62182		
153	63517						63517		
154	66098						66098	No Scan	
155	66202						66202		
156	102347	Revision 'A'		Location Plan, Profile and Typical Cross Section	March 1984		102347a		Yes
157	102348						102348		
158	102349						102349		
159	103110						103110		
160	103224	Revision 'A'					103224a		
161	103391	Revision 'A'					103391a		
162	103392			Plan of Spillway Slab Numbering System	June 1989		103392		Yes
163	103393	Revision 'A'					103393a		
164	103394						103394		
165	103395						103395		
166	103501						103501		
167	103502	Revision 'A'					103502a		
168	103567						103567a		
169	113006		Moosomin Dam	Reservoir Take Line Investigations in the E1/2 Sec.6 and SE1/4-7-13-31-W1	October, 1986		113006		
170	113006	Revision 'A'	Moosomin Dam	Reservoir Take Line Investigations in the E1/2 Sec.6 and SE1/4-7-13-31-W1	October, 1986		113006		
171	114789			Location Plan, Profile of Four Reservoir Road Crossing Existing & Proposed FSL & 1:50 Flood Flow	May 29, 1990		114789		
172	116086	As Constructed	**Contract 4 - Dam & Spillway Rehabilitation**	Vicinity Map & Drawing Index	June / 1990		116086_C		Yes
173	116087	As Constructed		General Plan	" "		116087_C		Yes
174	116088	As Constructed		Spillway Drainage System - Earthwork - Sheet 1 of 2	" "		116088_C		Yes
175	116089	As Constructed		Spillway Drainage System - Earthwork - Sheet 2 of 2	" "		116089_C		Yes
176	116090	As Constructed		Spillway Drainage System - Manhole Details	" "		116090_C		Yes
177	116091	As Constructed		Concrete Spillway Repairs - Floor Slab	" "		116091_C		Yes
178	116092	As Constructed		Concrete Spillway Repairs - Walls	" "		116092_C		Yes
179	116093	As Constructed		Concrete Spillway Repairs - Details	" "		116093_C		Yes
180	117604			Riparian Outlet Rating Curve (Metric)	October 1982		117604		Yes
181	117605			Riparian Outlet Rating Curve (Imperial)	October 1982		117605		Yes
182	117606			Operating Spillway Discharge Rating Curve (Metric)	November 1993		117606		Yes
183	117606	Revision 'A'		Operating Spillway Discharge Rating Curve (Metric)	August 2013		117606a		
184	117607			Operating Spillway Discharge Rating Curve (Imperial)	November 1993		117607		Yes
185	117607	Revision 'A'		Operating Spillway Discharge Rating Curve (Imperial)	August 2013		117607a		Yes
186	117973		Moosomin Dam	Gated Spillway System Rubber Dam Alternatives	March, 1993		117973		
187	205588		Moosomin Dam	Chute Spillway Joint Condition - Inspection on Oct. 17 2000	February 2001		205588		
188	206248		Moosomin Dam	Simulated Levels (PFRA, 1992)	March, 1993		206248		
189	206249		Moosomin Dam	Simulated Levels FSL=543.91 (Sask Water, 1990)	March, 1993		206249		
190	206250		Moosomin Dam	Simulated Levles FSL=544.91 (Sask Water, 1990)	March, 1993		206250		
191	206251		Moosomin Dam	Steel Flap Gate Vs Rubber Dam	March, 1993		206251		
192	206252		Moosomin Dam	Rating Curves (Imperial)	March, 1993		206252		
193	206253		Moosomin Dam	Rating Curves (Metric)	March, 1993		206253		
194	206254		Moosomin Dam	Cross Section 1 Steady State Water Levels	March, 1993		206254		
195	206255		Moosomin Dam	Cross Section 2 Steady State Water Levels	March, 1993		206255		
196	206256		Moosomin Dam	Cross Section 3 Steady State Water Levels	March, 1993		206256		
197	206257		Moosomin Dam	Cross Section 4 Steady State Water Levels	March, 1993		206257		
198	206258		Moosomin Dam	Cross Section 5 Steady State Water Levels	March, 1993		206258		
199	206259		Moosomin Dam	Cross Section 6 Steady State Water Levels	March, 1993		206259		
200	206260		Moosomin Dam	Cross Section Bridge and Road Steady State Water Levels	March, 1993		206260		
201	206261		Moosomin Dam	Location Plan Downstream Cross Sections	March, 1993		206261		
202	206262		Moosomin Dam	Stage Hydrograph at 100.088 km	March, 1993		206262		
203	206263		Moosomin Dam	Flow Hydrograph at 100.088 km	March, 1993		206263		
204	206264		Moosomin Dam	Stage Hydrograph at 100.088 km	March, 1993		206264		

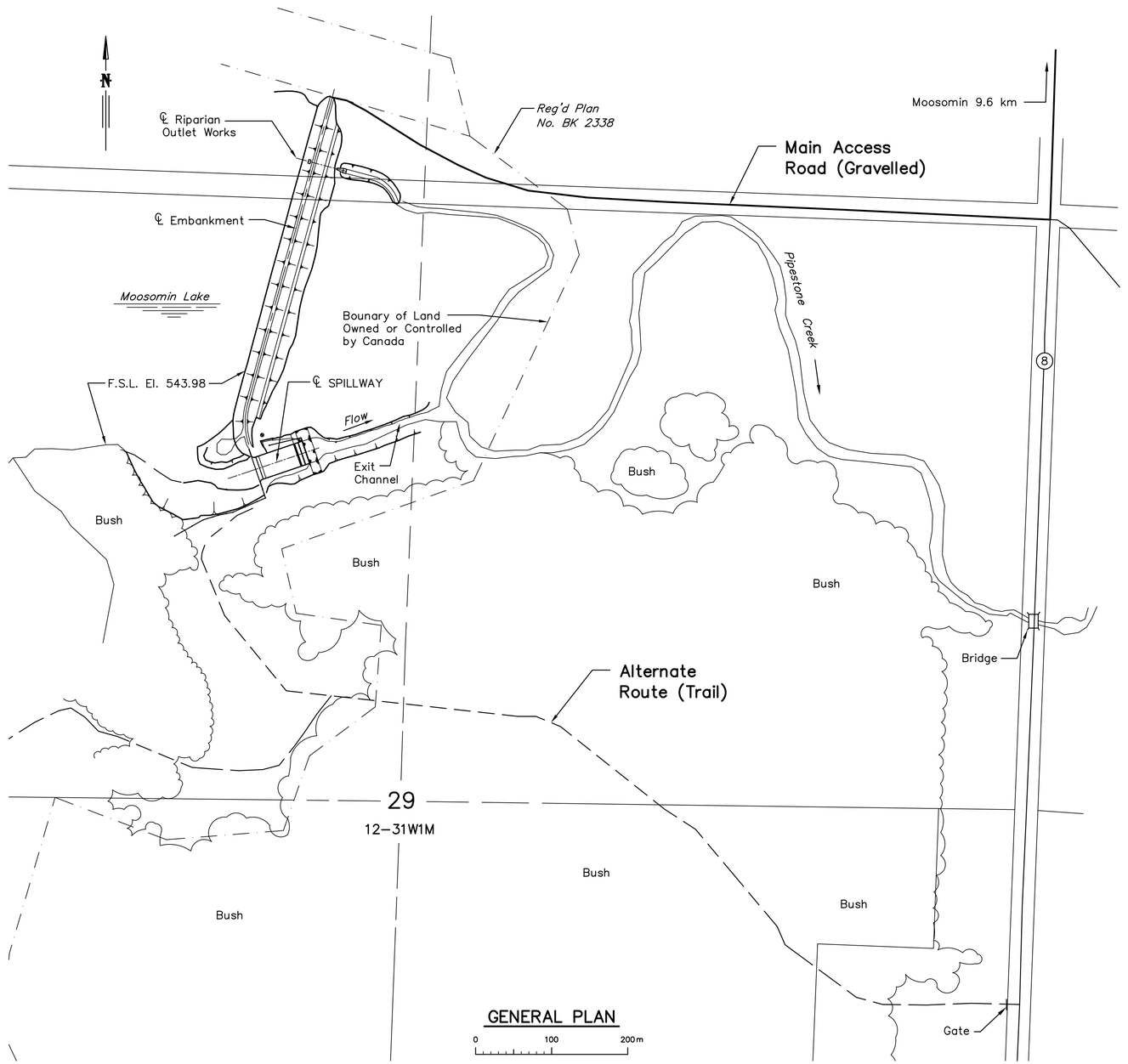
	A	B	C	D	E	H	I	J	K
205	206265		Moosomin Dam	Flow Hydrograph at 100.088 km	March, 1993		206265		
206	206266		Moosomin Dam	Rubber Dam - Height Versus Tension	March, 1993		206266		
207	206267		Moosomin Dam	Rubber Dam - Mechanical Schematic	March, 1993		206267		
208	206553						206553		
209	206650			Access Ladder Details			206650		
210	206651			Stoplog Bundles & Lifting Hook Details			206651		
211	207422		**Contract 6 - Spillway Joint Repairs**	Vicinity Map, General Plan & Drawing Index	August / 2001		207422		Yes
212	207422	As Constructed		Vicinity Map, General Plan & Drawing Index	" "		207422_C		Yes
213	207423			Site Plan & Cofferdam Details	" "		207423		Yes
214	207423	As Constructed		Site Plan & Cofferdam Details	" "		207423_C		Yes
215	207424			Chute Spillway Repairs - Plan	" "		207424		Yes
216	207424	As Constructed		Chute Spillway Repairs - Plan	" "		207424_C		Yes
217	207425			Drainage System Repair Details	" "		207425		Yes
218	207425	As Constructed		Drainage System Repair Details	" "		207425_C		Yes
219	207426			Expansion Joint Repair Details	" "		207426		Yes
220	207426	As Constructed		Expansion Joint Repair Details	" "		207426_C		Yes
221	207427			EDMP Membrane & Inspection Port Details	" "		207427		Yes
222	207427	As Constructed		EDMP Membrane & Inspection Port Details	" "		207427_C		Yes
223	207598			General Plan & Riparian Conduit Details	June / 2003		207598		Yes
224	207598	As Constructed		Riparian Conduit - Crack Repair Details	" "		207598_C		Yes
225	208307		**Safety Signs Project**	Vicinity Map & General Plan	August / 2008		208307		Yes
226	208307	As Constructed		Vicinity Map & General Plan	" "		208307_C		Yes
227	208308			Safety Sign, Navigation Boom & anchor Locations & Details	" "		208308		Yes
228	208308	As Constructed		Safety Sign, Navigation Boom & anchor Locations & Details	" "		208308_C		Yes
229	208309			Reinforced Concrete Piles & Installation Details for Large Sign	" "		208309		Yes
230	208309	As Constructed		Reinforced Concrete Piles & Installation Details for Large Sign	" "		208309_C		Yes
231	208313			Vicinity Map & General Plan	October / 2008		208313		Yes
232	208314			Safety Sign, Navigation Boom & Anchor Locations & Details	" "		208314		Yes
233	208543	As Constructed	**Current Configuration & Drawing List - 2011**	Plan of Dam & Spillway	September 2011		208543_C		Yes
234	208544	As Constructed		CL Section of Spillway	" "		208544_C		Yes
235	208545	As Constructed		CL Section of Riparian	" "		208545_C		Yes
236	208880			Reservoir Topography & Land Ownership in S.E. 1/4 Sec. 6, Twp. 13, Rge. 31 W1M	February 2014		208880		Yes
237	208881			Reservoir Topography & Land Ownership in N.E. 1/4 Sec. 6, Twp. 13, Rge. 31 W1M	" "		208881		Yes
238	208882			Reservoir Topography & Land Ownership in S.E. 1/4 Sec. 7, Twp. 13, Rge. 31 W1M	" "		208882		Yes

	A	B	C	D	E	F
1	**MOOSOMIN DAM (PIPESTONE CREEK)**					
2	**N.W. Sec. 29 & S.W. Sec. 32, Twp. 12, Rge. 31, W1M - UTM 13 (Extended), 5549238 N, 736930 E**					
3	File Revision Date - January 26, 2011					
4	**GEOTECHNICAL DRILL HOLE LOGS**					
5	**PLAN #**	**DRAWING TITLE**	**DATE DRILLED**	**GPS LOCATION**	**HYPERLINK**	ORACLE
6	37134	Pipestone Creek - Topography & Profiles showing Testhole Logs & Locations	June 1950		37134	
7	37135	Pipestone Creek - Miscellaneous Testhole Logs	June, 1950		37135	
8	37136	Suggested Design	October, 1952		37136	
9	37137	Design Section	February, 1953		37137	
10	37138	Concrete Aggregate	June, 1953		37138	
11	37139	Pipestone Creek - Profile Dam Centreline showing Drill Logs and Testhole Results	October, 1953		37139	
12	37140	Pipestone Foundation Settlement Semi-Log Scales	October, 1954		37140	
13	37141	Pipestone Foundation Settlement Arith Scale	October, 1954		37141	
14	37142	Pipestone Creek Spillway Swelling Tests on Weathered Shale	November, 1954		37142	
15	37143	Plan Showing Soil Profile and Relief Well Installation	January, 1955		37143	
16	37144	Sketch of Spillway Showing Movement Contours - October 1954 to October1960			37144	
17	37145	Sketch of Spillway Showing Movement Contours - October 1954 to October1960			37145	
18	37146	Sketch of Spillway Showing Movement Contours - October 1954 to October1960			37146	
19	37147	Conduit Brass Reference Points	May, 1955		37147	
20	37148	Design of Relief Well System	April, 1956		37148	
21	37149	Moosomin Dam Spillway	August, 1955		37149	
22	37150	Unconfined Compressive Strengths AH120 - 121 - 122	December, 1955		37150	
23	37151	Pressure vs. Void Ratio Curve AH120	December, 1955		37151	
24	37152	Pressure vs. Void Ratio Curve AH122	December, 1955		37152	
25	37153	Density vs. Water Content - Main Fill	December, 1955		37153	
26	37154	Density vs. Water Content - Main Fil Points Averaged	December, 1955		37154	
27	37155	Density vs. Water Content - Shale Section	December, 1955		37155	
28	37156	Hold Down Pile Holes	December, 1955		37156	
29	37157	Installation Locations and Settlement Data	August, 1955		37157	
30	37158	Settlement Gauges, Torpedo, Bar & Piezometers	June, 1955		37158	
31	37159	Settlement Gage Readings and Typical Crossection of Dam	July, 1955		37159	
32	37160	Piezometer Readings	December, 1955		37160	
33	37161	Tables of Readings to Determine Spillway Movements	July, 1955		37161	
34	37162	Tables of Readings to Determine Movement of Dam & Rebound Gages	July, 1955		37162	
35	37163	Slide at Diversion Inlet	December, 1955		37163	
36	37164	Modifications of Spilway Drainage System at Staion 1+50	January, 1956		37164	
37	37165	1953 Concrete Test Results - Deposit #25	April, 1957		37165	
38	37166	1953 - 1954 Concrete Test Results - Deposit #25	April, 1957		37166	
39	37167	1953 - 1954 Concrete Test Results - Deposit #25	April, 1957		37167	
40	37168	Vertical Movement of Spilway Walls - October 1954 to May 1958	Junuary, 1959		37168	
41	37169	Location Plan	March, 1961		37169	
42	37170	Summary of Settlement Gauge Data June 1954-1961	April, 1961		37170	
43	37171	Summary of Settlement Gauge Data Oct. 1954-1961	April, 1961		37171	
44	37172	Movement Line Observations	April, 1961		37172a	
45	37173	Relief Well Data			37173	
46	37174	Piezometric & Standpipe Water Elevations			37174	
47	37175	Water Levels at Downstream Toe. Location of Relief Wells, Piezometers	April, 1961		37175	
48	37176	Test Installation Location Plan	April, 1961		37176	
49	37177	Summary of Conduit Movement Data Sept.1954 to Oct.1959	April, 1961		37177	
50	37178	Mossomin Dam Relief Well Cover	August, 1961		37178	
51	37179	Water Levels at Downstream Toe. Location of Relief Wells, Piezometers	September, 1966		37179	
52	37180	Movement Line Observations	September, 1966		37180a	

	A	B	C	D	E	F
53	37181	Sketch of Spillway Showing Movement Contours (1954 to 1963)	September, 1966		37181	
54	102347a	Location Plan, Profile and Typical Cross Section	March 1984		102347a	Yes
55	103379				103379	
56	103380				103380	
57	103381				103381	
58	103382				103382	
59	208475	Piezometer C637, C638 & C639 Data			208475	Yes
60	208789	Existing Standpipe Locations	Jan-13		208789	Yes
61	351897	AH 628, AH 629 & AH 630	May 1990		351897	Yes
62	351898	AH 631 & AH 632	May 1990		351898	Yes
63	351899	AH 633 & AH 634	September 1990		351899	Yes
64	351900	TP 636	October 1990		351900	Yes
65	357426	C 637	September 1999		357426	Yes
66	357427	C 638	September 1999		357427	Yes
67	357428	C 639	September 1999		357428	Yes
68	357429	C 640	October 1999		357429	Yes
69	357430	C 641	October 1999		357430	Yes
70	357431	C 642	October 1999		357431	Yes
71	359495	RS 11 & RS 12	May 1989		359495	Yes
72	359496	RS2	November 1989		359496	Yes
73	359497	RS 4 & RS 5	May 1990		359497	Yes
74	359498	RS 6	September 1990		359498	Yes
75	359499	RS 7	September 1990		359499	Yes
76	359500	RS 9 & RS 10	September 1990		359500	Yes
77	359501	RS 11 & RS 12	October 1990		359501	Yes
78	359724	AH643	October 2012	UTM 13 Extended, 736978.9 E, 5549405.9 N	359724	Yes
79	359725	AH644	October 2012	UTM 13 Extended, 736960.7 E, 5549297.8 N	359725	Yes
80	359726	AH645	October 2012	UTM 13 Extended, 736938.7 E, 5549183.9 N	359726	Yes
81	359727	AH646	October 2012	UTM 13 Extended, 736938.1 E, 5549181.7 N	359727	Yes
82	359728	AH646A	October 2012	UTM 13 Extended, 736938.4 E, 5549182.7 N	359728	Yes
83	359729	AH647	October 2012	UTM 13 Extended, 736949.4 E, 5549349.5 N	359729	Yes
84	359730	AH648	October 2012	UTM 13 Extended, 736955.4 E, 5549347.8 N	359730	Yes
85	359731	AH649	October 2012	UTM 13 Extended, 736918.7 E, 5549184.4 N	359731	Yes
86	359732	AH650	October 2012	UTM 13 Extended, 736923.8 E, 5549183.2 N	359732	Yes
87	359733	AH651	October 2012	UTM 13 Extended, 736896.3 E, 5548980.9 N	359733	Yes
88	359734	AH652	October 2012	UTM 13 Extended, 736916.9 E, 5548977.9 N	359734	Yes



VICINITY MAP



GENERAL PLAN

0 100 200m

ALL DIMENSION, STATIONING AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE SHOWN.

Mark	Grid Ref.	Nature of Revision	Date	Eng.	Draft.

Designed

Drawn RM

Checked

Approved

Position Title

Date

Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

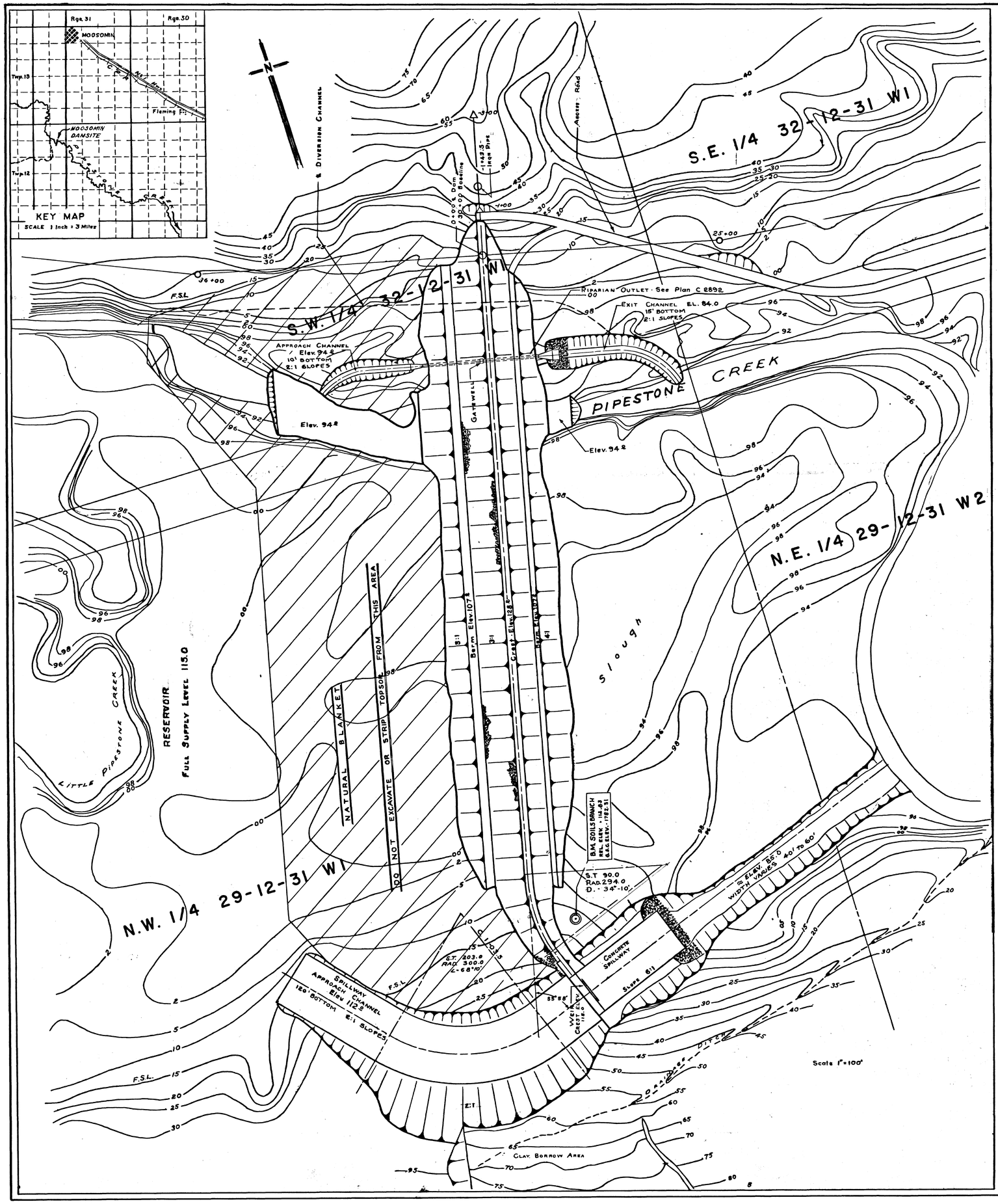
PFRA ARAP

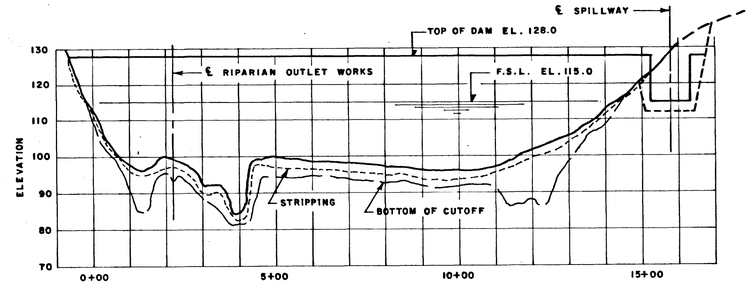
Prairie Farm Rehabilitation Administration / Administration du rétablissement agricole des Prairies

PIPESTONE CREEK (MOOSOMIN DAM) PROJECT

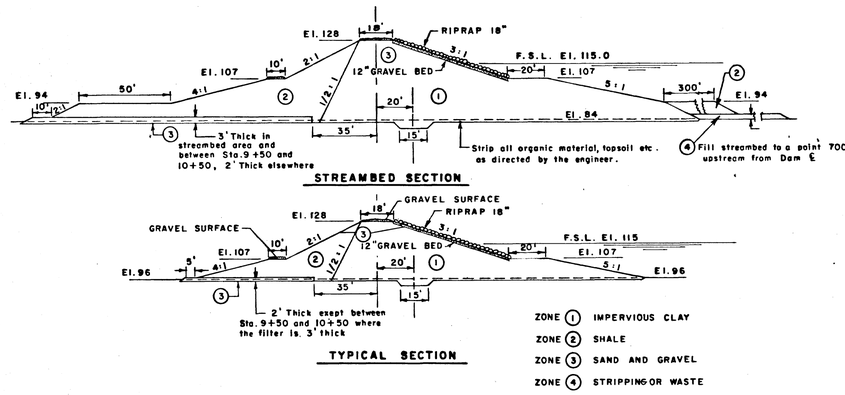
VICINITY MAP AND GENERAL PLAN

Scale	Date		
As Shown	October 2008	208313	FIG. 1

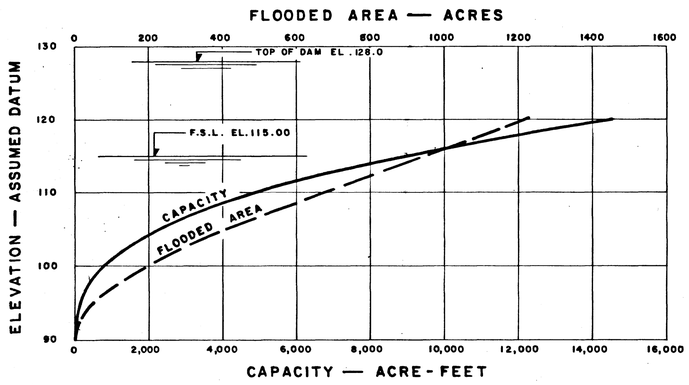




EMBANKMENT ℄ PROFILE



EMBANKMENT CROSS SECTIONS



FLOODED AREA AND CAPACITY CURVES

NOTE:

Add 1669.47 feet to all elevations shown to convert assumed datum to Geodetic datum.

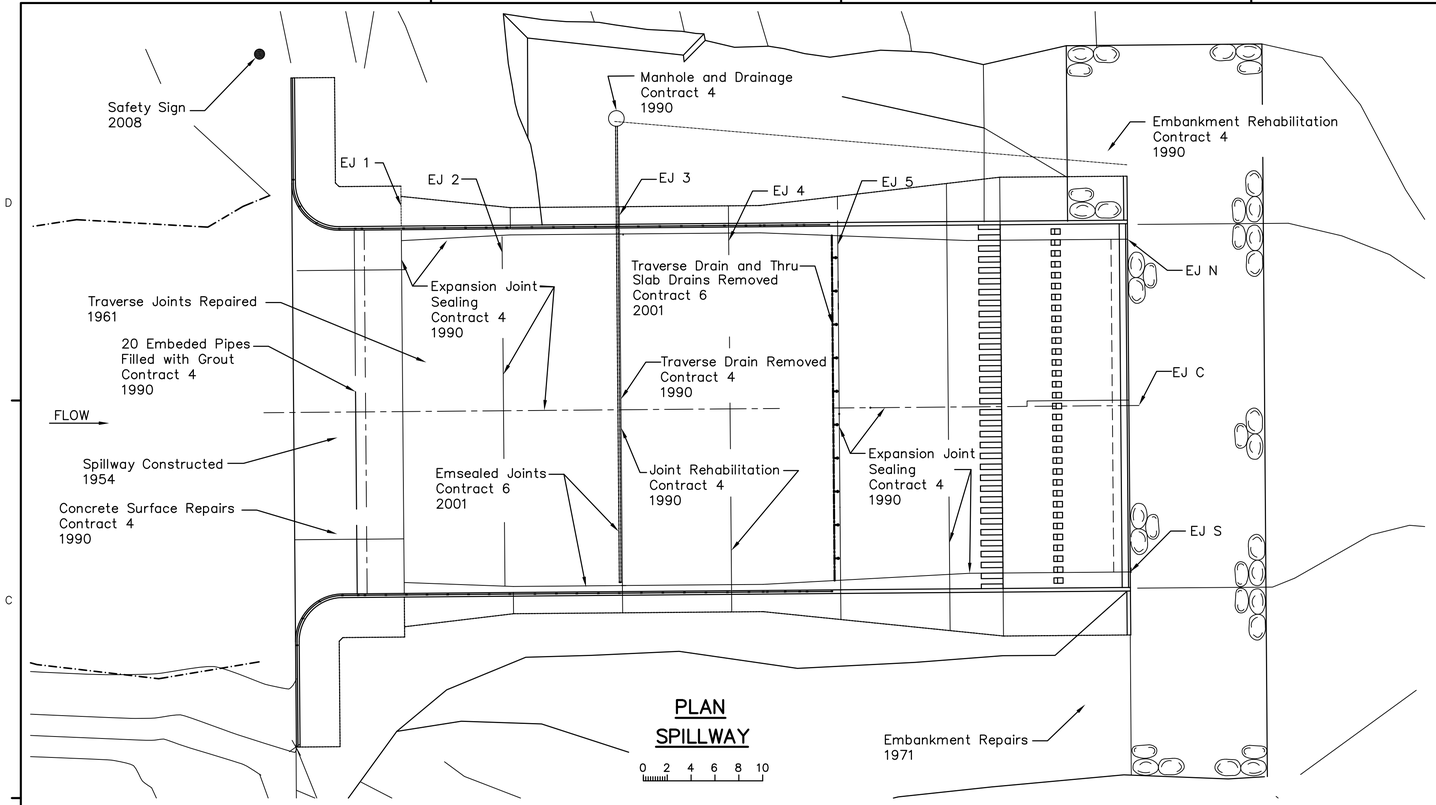
DEPARTMENT OF AGRICULTURE - CANADA
P.F.R.A.
PIPESTONE CREEK PROJECT

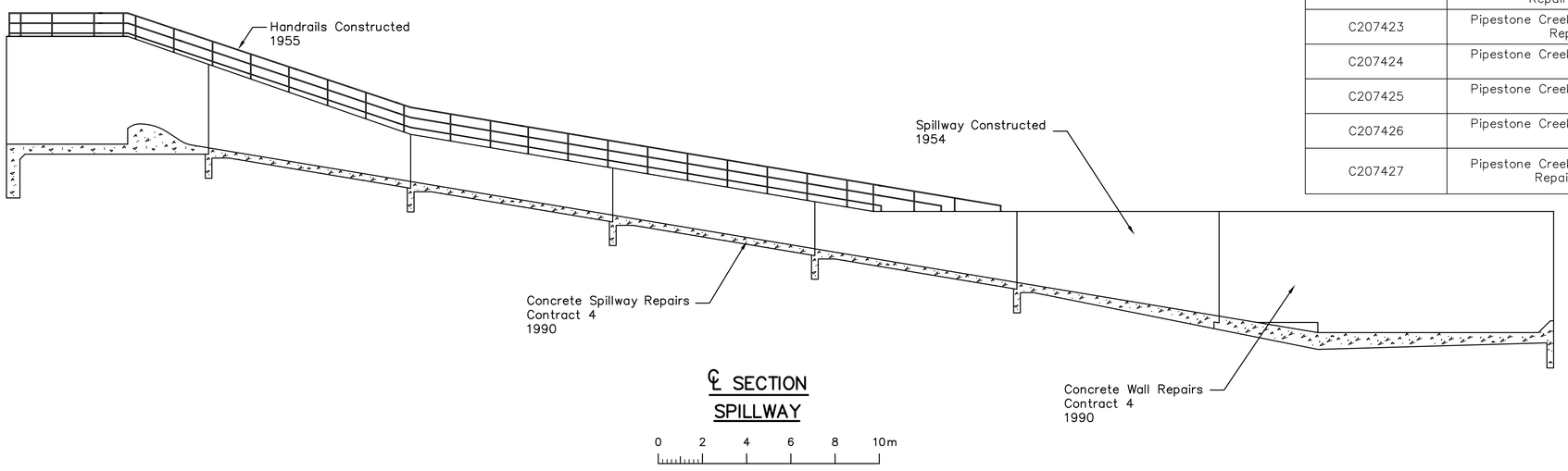
GENERAL PLAN

AS CONSTRUCTED

SCALE AS SHOWN	DATE - JUNE 1955	SHEET 1 OF 6	
SUBMITTED BY		DESIGNED BY	
DATE		DRAWN BY	
APPROVED BY		TRACED BY JG	
DATE		CHECKED BY N.H.J.	
		PIPESTONE	XL 534

C 3757 3757-D74





DRAWING LIST

Plan No.	Title or Contract	Component	Date
256	Pipestone Spillway Floor Slab and Wingwall Details	Spillway	1953
C254	Pipestone Creek Project – Pipestone Spillway – General Plan and Cross Sections – As Constructed	Spillway	1955
C255	Pipestone Creek Project – Pipestone Spillway – Sidewall Reinforcing Details – As Constructed	Spillway	1953
C2878	Pipestone Creek Project – Pipestone Spillway Floor Slab and Wingwall Details – As Constructed	Spillway	1954
3193	Dam and Spillway Plan moosomin dam – As Constructed	Spillway	1954
3615	Sequence of Construction for the Alteration of Drainage System at Moosomin Spillway	Spillway	1955
4011–1 /64899	Details of: Wire Mesh Frames for Handrails on the Spillway on Moosomin Dam	Handrails	1955
4011–2 /64900	Details of: Handrail for Spillway on Pipestone Creek Poject – Moosomin Dam	Handrails	1955
4011–3 /64901	Details of: Handrail for Spillway on Pipestone Creek Project – Moosomin Dam	Handrails	1955
102348	Moosomin Dam – Sketch of Spillway showing Movement Contours and Core Hole Locations	Spillway	1984
102349	Moosomin Dam – Sketch of Spillway Showing Movement Contours	Spillway	1983
103110	Moosomin Dam – Sketch Showing Movement Contours	Spillway	1983
103224A	Moosomin Dam – Sketch Showing Movement Contours	Spillway	1988
103391A	Moosomin Dam – Skech Showing Movement Contours	Spillway	1989
103393A	Moosomin Dam – Plan of Spillway Underslab Drainage System	Spillway	1989
103394	Moosomin Dam – Plan of Spillway Showing Underslab Voids August 1987	Spillway	1989
C116086	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Vicinity Map & Drawing Index	Location Map, Drawing Index	1990
C116087	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – General Plan	Site Plan	1990
C116088	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Spillway Drainage System Earthwork – Sheet 1 of 2	Embankment, Spillway	1990
C116089	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Spillway Drainage System Earthwork – Sheet 2 of 2	Embankment, Spillway	1990
C116090	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Spillway Drainage System – Manhole	Spillway, Embankment	1990
C116091	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Concrete Spillway Repairs – Floor Slab	Spillway	1990
C116092	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Concrete Spillway Repairs – Walls	Spillway	1990
C116093	Pipestone Creek (Moosomin Dam) Project – Contract 4 – Dam & Spillway Rehab. – Concrete Spillway Repairs Details	Spillway	1990
C207422	Pipestone Creek (Moosomin Dam) Project – Contract 6 – Spillway Joint Repairs – Vicinity Map, General Plan & Drawing Index	Site Plan, Drawing Index	2001
C207423	Pipestone Creek (Moosomin Dam) Project – Contract 6 – Spillway Joint Repairs – Site Plan & Typical Cofferdam Details	Site Plan, Drawing Index	2001
C207424	Pipestone Creek (Moosomin Dam) Project – Contract 6 – Spillway Joint Repairs – Chute Spillway Repairs Plan	Spillway	2001
C207425	Pipestone Creek (Moosomin Dam) Project – Contract 6 – Spillway Joint Repairs – Drainage System Repair Details	Spillway	2001
C207426	Pipestone Creek (Moosomin Dam) Project – Contract 6 – Spillway Joint Repairs – Expansion Joint Repair Details	Spillway	2001
C207427	Pipestone Creek (Moosomin Dam) Project – Contract 6 – Spillway Joint Repairs – EDMP Membrane & Inspection Port Details	Spillway	2001

Mark	Grid Ref.	Nature of Revision	Date	Eng.	Draft.

Designed: TD
Drawn: TD AP
Checked:
Approved:
Position Title:
Date: Sept 2011

AESB - DGSA
Agri-Environment Services Branch
Direction générale des services agroenvironnementaux
Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada
Canada

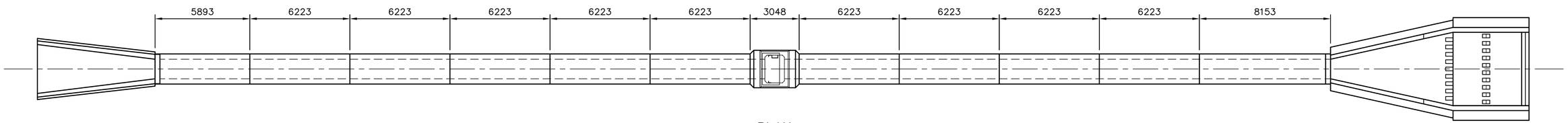
PIPESTONE CREEK (MOOSOMIN DAM)

CENTERLINE SECTION OF SPILLWAY – 2011
CURRENT CONFIGURATION AND DRAWING LIST

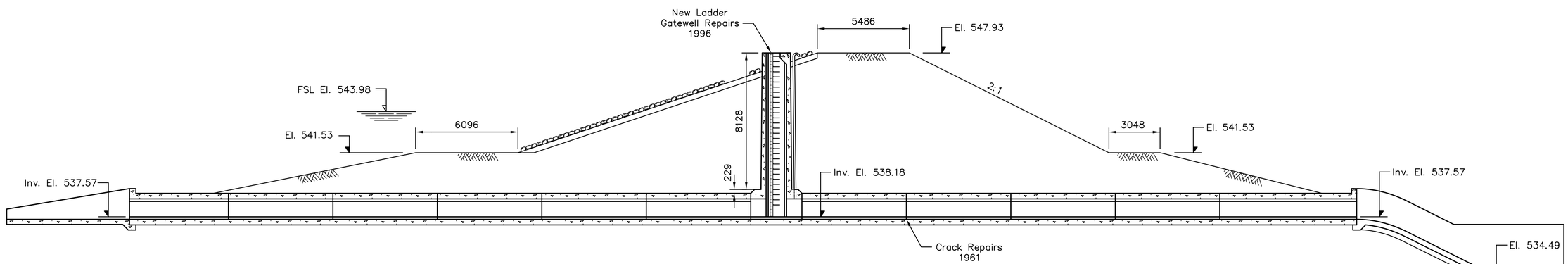
Scale: As Shown | Date: Sept 2011 | Sheet 2 of 3 | C208544

DRAWING LIST

Plan No.	Title or Contract	Component	Date
258	Riparian Outlet, Inlet and Stilling Basin Details	Riparian	1953
C257	Pipestone Creek Project – Riparian Outlet – General Plan – Conduit and Gatwell Details – As Constructed	Riparian	1953
C17135	Pipestone Lake Project – Riparian Outlet Works – Gatewell Details	Riparian	1966
37177	Moosomin Dam – Sept. 1954 to OCt 1959 – Summary of Conduit Movement Data	Riparian	1961
62180	Moosomin Dam – Sketch Showing Cracks on Floor Slab of Conduit as Of Oct. 30 1954	Riparian	1954
62181	Moosomin Dam – Sketch Showing Cracks in Floow Slab of Conduit as of Oct. 30 1954	Riparian	1954
103395	Moosomin Dam – Conduit Details and Invert Profiles	Riparian	1989
206650	Pipestone Creek (Moosomin Dam) – Access Ladder Details	Riparian	1996
206651	Pipestone Creek (Moosomin Dam) – Stoplog Bundles and Lifting Hook Details	Soplogs	1996
C207598	Pipestone Creek (Moosomin Dam) Project – Riparian Conduit Crack Repair Details	Riparian	2003



PLAN



℄ RIPARIAN OUTLET

0 2 4 6 8 10m

Mark	Grid Ref.	Nature of Revision	Date	Eng.	Draft.

Designed: TD
Drawn: TD AP
Checked:

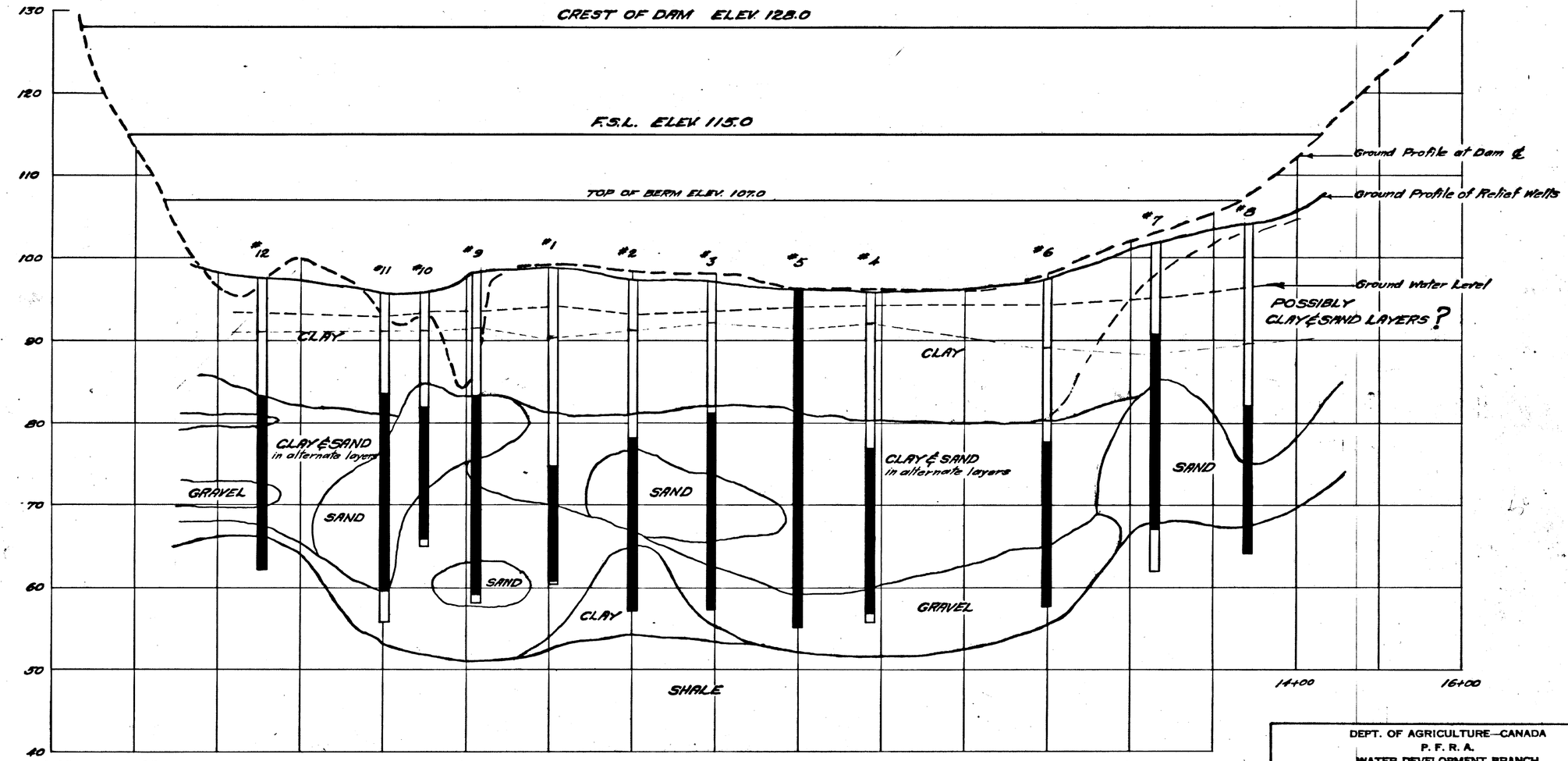
Approved:
Position Title:
Date: Sept 2011

AESB - DGSA
Agri-Environment Services Branch
Direction générale des services agroenvironnementaux
Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada
Canada

PIPESTONE CREEK (MOOSOMIN DAM)

CENTERLINE SECTION OF RIPARIAN – 2011
CURRENT CONFIGURATION AND DRAWING LIST

Scale: As Shown | Date: Sept 2011 | Sheet 3 of 3 | C208545



LEGEND

Riser Pipe

Perforated section

- CLAY
- CLAY & SAND in alternate layers
- SAND
- GRAVEL
- SHALE
- POSSIBLY CLAY & SAND LAYERS

DEPT. OF AGRICULTURE—CANADA
P. F. R. A.
WATER DEVELOPMENT BRANCH
MOOSOMIN STORAGE PROJECT
MOOSOMIN DAM

PLAN
showing
SOIL PROFILE AND
RELIEF WELL INSTALLATION

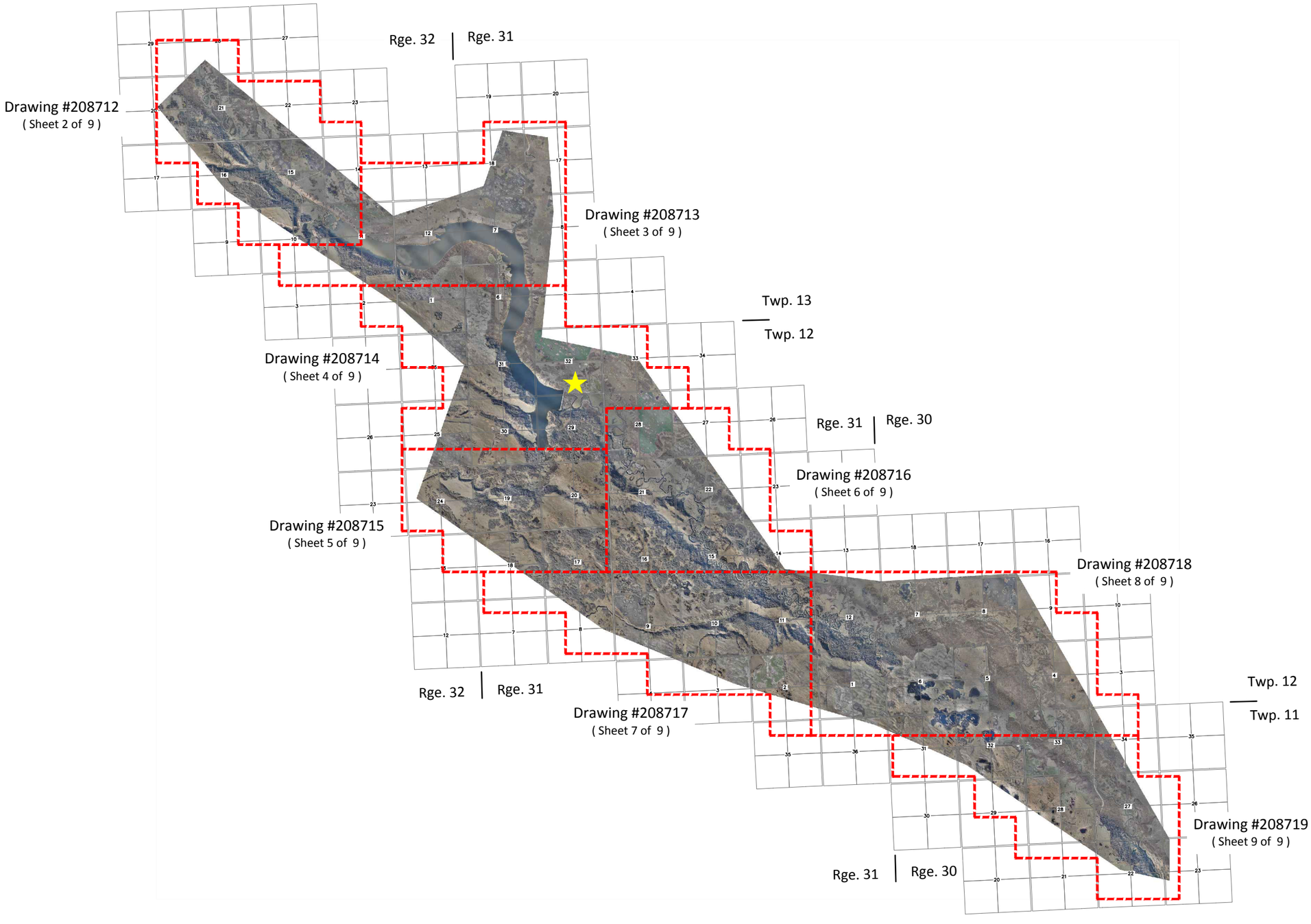
SCALE VERT. 1"=10' HORZ. 1"=100 DATE JAN. 24, 1955 SHEET

SUBMITTED ____ DATE ____
APPROVED ____ DATE ____ SHEET NO. ____

DESIGNED BY ____
DRAWN BY K.N.L.
TRACED BY R.T.A.
CHECKED BY ____

PLAN NO. ~~1893-0-15~~

37143



Designed	Approved	Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada	MOOSOMIN DAM (PIPESTONE CREEK)
Drawn	Position Title	Corporate Management Branch / Direction générale de la gestion intégrée	MOOSOMIN DAM & RESERVOIR TOPOGRAPHY PLAN
Checked	Date	Canada	Scale: As Shown; Date: Oct./2012; AAFC No.: 208711; 1 of 9