J. A. GRIFFITHS (6)

58/30

WATER RESOURCES DIVISION
1577 DUBLIN AVENUE
WINNIPEG, MANITOBA
R3E 3J5

ROYAL COMMISSION ON FLOOD-COST BENEFIT

REPORT NO. 14

MAINTENANCE COSTS

Greater Winnipeg Floodways
Portage Diversions
Russell Reservoir

Nov. 13/58

TC
426.5
.M3A1
R6T4
r. 14

TEMPLETON ENGINEERING COMPANY
CONSULTING ENGINEERS
1632 Portage Avenue
WINNIPEG 12, MANITOBA

TC
426.5
.M3A1
R6T4
F14

TEMPLETON ENGINEERING COMPANY
PROFESSIONAL ENGINEERS
1632 PORTAGE AVENUE TELEPHONE SPruce 4-1811
WINNIPEG 12, MANITOBA

November 13, 1958.

Royal Commission on Flood-Cost Benefit,
2nd Floor, 149 Colony Street,
Winnipeg, Manitoba

Re: Maintenance of Floodways and Diversions

Gentlemen:--

The purpose of this report is to outline the ordinary maintenance required on the channel, dykes and structures required for the Greater Winnipeg Floodway and the Portage Diversions.

The costs of the projects include the right of way on which to place the spoil banks (surplus earth from the excavation). Eventually the spoil areas could be used productively--either for agriculture or industrial or housing developments, but for the first five or ten years the spoil areas would be unproductive and would require maintenance. The maintenance costs estimated below include the maintenance of the spoil areas for ten years and after that time only maintenance of the berm on each side of the channel and the channel itself.

It is customary that when a structure such as a culvert or bridge is put under a railway track, that the agency placing the structure signs an agreement with the railway to maintain that structure. It is assumed in this report that the costs of all structures for railway, highway, aqueduct and drop structures will be borne by the agency maintaining the floodway or diversion and are included in the estimates below.

It should be pointed out that the maintenance costs listed below do not include amortization of the structures. That factor is included elsewhere in the economic studies.

The maintenance costs have been divided into the following groups:

I Channel and Dyke Maintenance.

II Railway & Highway Bridge Maintenance.

III Control and Other Structures Maintenance.

IV Administration and Engineering.

I Channel and Dyke Maintenance

This falls into 3 main categories, namely; the cutting and disposal of the vegetation in the channel; maintenance of the slopes from erosion; removal of silt deposited during the period of use of the floodway;

(a) Cutting and Disposal of Vegetation

The cutting of the grass each year is necessary to keep down the growth of shrubs and maintain the floodway at the coefficient to which it was designed. The grass cut should be disposed of either by raking it up and hauling it away, or by mulching it and leaving it as fertilizer. Controlled burning is not recommended as it may increase erosion. Several agencies consulted had different prices on the cost of mowing and disposing of the grass cover. The Airport Manager of the Winnipeg Airport advises that their costs run around $5.00 to $5.25 per hour for a sickle mover and removal, and each machine mows about an acre per hour. Mulching machines would cost approximately $6.00 per acre. He pointed out that the Airport mowing is fairly fussy around lights, avoiding certain areas at certain times, etc., and left the impression that the acre per hour was high. Mr. T. Weber, Chairman of the Drainage Board, stated that they have only started seeding drainage ditches in the last four or five years and have not had much experience in mowing them. Their mowing contract this Fall was at the rate of $25.00 per mile for a 600 foot wide strip with 6:1 side slopes -- (approximately $0.35 per acre). This did not include removal and is so cheap it is difficult to see how the Contractor can operate. Mr. Griffiths, Assistant Deputy Minister of the Department of Public Works, advises that it costs $6.00 per acre for mowing Highway 75 one and three quarters times. He also advises that it costs about $11.00 per acre for mowing Highway 4 one and one half times. In each of these there are varying degrees of hand mowing around poles and signs. This is considered more costly than mowing the floodways.

(a) Cutting and Disposal of Vegetation (continued)

It would appear that a figure of $2.50 per acre per year would be reasonable on 6:1 side slopes and the channel bottom and top of the spoil banks, and $3.50 per acre per year on the steeper 3:1 side slopes.

We have assumed that in one year out of seven the revenue from the grass would pay for the cutting.

As mentioned above, it was assumed that maintenance of the spoil banks would not be a charge after ten years.

Applying all of these factors the cost per acre for cutting of vegetation is computed to be $2.57 per acre for the Greater Winnipeg Floodways. In the table of channel and dyke maintenance, the cost has been weighed to reflect the lesser area to be mowed over the last forty years of the fifty year period for which the estimate is made.

The Portage Diversions have steeper slopes and there is less demand for hay, so that the revenue factor is not considered. In addition it is assumed that the spoil banks would be maintained throughout the life of the project. The cost of cutting of vegetation is computed to be $3.50 per acre for the Portage Diversions.

(b) Maintenance of Slope Erosion

The cost of maintenance of the dykes and channel slopes due to erosion from storms should not be too significant after the grass cover has caught sufficiently for the roots to hold the slopes, however, a certain amount of this work would probably be necessary each year. For very large floods the velocity is high enough to cause some erosion of the slopes. These floods are infrequent and therefore the yearly maintenance cost is not too significant. For estimating purposes we have assumed that one truck and two men would be required an average of three months per annum to repair such damages to the 60-768 Greater Winnipeg Floodway. The estimated cost of this would be $3,000.00, or $0.30 per acre. This figure was also used for the Portage Diversion.

(c) Removal of Silt Deposited

It is likely that silt and debris will be deposited in the floodway from small floods, ditches and winds. In order to maintain the floodway at its designed capacity, removal of this deposition would be required periodically. Three inches of silt deposited in the bottom of the greater floodway channel would amount to 600,000 cubic yards for a 60-768 floodway. For estimating purposes we have assumed that this amount of material would be removed every five years at an average cost of $0.30 per cubic yard, or $180,000, or an average of $36,000 per annum for a 60-768 floodway, with others in proportion to the area of the channel. The cost for the Portage Diversion on the same basis for a 25,000 c.f.s. floodway is estimated at $24,000 per annum, with the other diversions in proportion to the areas of the channels.

The Portage Diversions may have a problem with the formation of a sand dune across the mouth of the diversion caused by wave action on Lake Manitoba. An amount of $1200 was allowed each time the diversion is operated to allow for cleaning this dune out. This amounts to $200 per year. This is in addition to the removal of river silt from the channel. In addition, some dykes will not be acceptable to the Municipality as roads, so that the Diversion Authority will have to maintain them. This is estimated at twenty miles of road on which must be spread three inches of gravel every four years. This amounts to an annual cost of $7,800.

II Railway & Highway Bridge Maintenance

In an effort to determine the annual maintenance cost of steel bridges, the Canadian National Railways, Canadian Pacific Railway, the City of Winnipeg and the Province of Manitoba were contacted for their recommendations. Mr. Hugo, Bridge Engineer of the Canadian National Railways, advised that a figure of 1% of the original cost could be used as an average maintenance cost. Local officers of the Canadian Pacific Railway have no information. The City of Winnipeg gave figures of bridge maintenance for the last five years, which indicated the average maintenance for those years varied from 0.6% to 4.7% of the original cost. It should be remembered that these bridges are old and the maintenance is probably higher than average. (See Table 3 attached).

Mr. Depaw, Bridge Engineer for the Province of Manitoba, had no figures available on bridge maintenance, but was of the opinion that 1% of the initial cost would not be too far out of line.

The yearly cost of maintenance of bridges have been assumed as 1% of the initial cost of the structures.

III Control and Other Structures Maintenance

This item includes the dam with the gates across the main stem of the river immediately downstream of the intake to the Floodway or Diversion. It also includes the drop structures on the floodways themselves and the tributaries to the main rivers.

The dam and gate structures across the main stems are in the water all of the time and are subject to ice and water erosion to the same extent as bridges. The gates would have to be operated yearly to see that the mechanism was working and a greasing and painting maintenance program put in effect. In addition some extraordinary maintenance would probably be required to keep the gates in service fifty years, the amortization period.

The costs below include an annual maintenance cost of 1% of the capital cost for the main control structures.

The other structures are not subjected to nearly as much wear and are estimated to cost 1/4 of 1% of the capital cost per year for maintenance.

III Control and Other Structures Maintenance (continued)

Although the lump sum of the estimated annual maintenance cost of this item seems high, it is felt that near the end of the fifty year period it will be higher and this figure may not be too far out of line.

IV Engineering and Administration

In order to see that the floodway and diversions are maintained for the purposes for which they were designed, a central authority would probably be required. It is estimated that the cost of this authority would amount to 10% of the cost of the maintenance. This cost is included in the cost of each item of maintenance.

TABLE 1

GREATER WINNIPEG FLOODWAY

Estimated Annual Maintenance Costs
(Including Engineering & Administration)

Floodway Design	Control & Other Structures	Channel & Dyke Maintenance	Bridges	Total
20-766	$40,900	$21,600	$65,900	$128,400
40-766	41,500	35,600	87,500	164,600
60-766	42,000	59,500	126,100	227,600
40-768	41,600	34,400	90,900	166,900
60-768	42,100	58,400	124,000	224,500
80-768	42,900	78,000	153,000	273,900
60-770	42,400	59,000	123,500	224,900
80-770	42,900	79,000	155,100	277,000
100-770	42,700	90,500	175,100	308,300
145-773	46,400	119,500	228,300	394,200

TABLE 2

PORTAGE DIVERSION

Fort la Reine III

Estimated Annual Maintenance Costs
(Including Engineering & Administration)

Diversion Capacity	Control & Other Structures	Channel & Dyke Maintenance	Bridges	Total
10,000	$13,300	$38,000	$23,000	$74,300
25,000	15,800	41,500	40,500	97,800
40,000	17,100	46,000	50,900	114,000

PORTAGE DIVERSION

High Bluff Diversion

Estimated Annual Maintenance Costs

10,000	$11,600	$37,100	$15,000	$63,700
25,000	13,600	43,000	25,800	82,400
40,000	14,800	48,100	36,300	99,200

TABLE 2

PORTAGE DIVERSION

Fort la Reine III

Estimated Annual Maintenance Costs
(Including Engineering & Administration)

Diversion Capacity	Control & Other Structures	Channel & Dyke Maintenance	Bridges	Total
10,000	$13,300	$38,000	$23,000	$84,300
25,000	15,800	41,500	40,500	122,800
40,000	17,100	46,000	50,900	154,000

PORTAGE DIVERSION

High Bluff Diversion

Estimated Annual Maintenance Costs

10,000	$11,600	$37,100	$15,000	$73,700	63750
25,000	13,600	43,000	25,800	107,400	82400
40,000	14,800	48,100	36,300	139,200	99200

TABLE 3

CITY OF WINNIPEG

BRIDGE MAINTENANCE COSTS

1953 to 1957

Steel Bridges

Bridge	Built	Initial Cost	Present Day Cost	Mtce Costs 5 years	Average Mtce cost	Av. Maintenance expressed as % of Initial Cost	% of Present Day cost
Arlington	1910	$272,305	$1,900,000	$31,664	$6,333	2.3	0.3
Main	1931	360,000	1,330,000	10,086	2,017	0.6	0.2
Louise	1909	176,438	1,230,000	41,702	8,340	4.7	0.7
Osborne	1913	208,367	1,460,000	35,397	7,080	3.4	0.5
Redwood	1908	168,369	1,180,000	29,370	5,874	3.5	0.5
Salter	1932	520,000	2,430,000	26,305	5,261	1.0	0.2
TOTALS		$1,685,479	$9,530,000		$34,895	2.0	0.4

Maintenance of the Russell Reservoir

The maintenance of this structure will mainly consist of maintaining the upstream and downstream faces of the dam, the spillway, conduits, gates, rip-rap.

For purposes of this estimate we have assumed that exposed faces of the dam could be maintained by two men and one truck working ten days at a cost of $900.00 per year.

We have assumed that the spillway maintenance cost would be 1/4 of 1% of the capital cost per year. This amounts to $2,800.00 per year.

We have assumed that the conduits would have to be relined once in fifty years at a cost of $195,000, or $3,900 per year and the gates would require 1 1/2% of the original cost per year maintenance. This amounts to $3,200.

The project calls for 277,100 cubic yards of rip-rap. This has a tendency to move down the slope with wave action. We have assumed that one half of the original amount will have been replaced in fifty years and at an annual cost of $7,800.

The total estimated annual cost of maintenance of the Russell Reservoir is:

Faces of the Dam	$900
Spillway	2,800
Conduits	3,900
Gates	3,200
Rip-Rap	7,800
TOTAL	$18,600

Respectfully submitted,

Templeton Engineering Company,

C. H. Templeton

C. H. Templeton, - P. Eng.

CHT:am