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Manitoba
Conservation
Water Resources

PROVINCE OF MANITOBA

DEPARTMENT OF AGRICULTURE AND CONSERVATION

WATER CONTROL AND CONSERVATION BRANCH

RED RIVER FLOODWAY

MODEL TESTS

OF

INLET TRANSITION

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Floodway Division.

TABLE OF CONTENTS

	Page
Introduction	1
Description of The Model	1
Testing Program	2
Analysis of Results	3
Transition Location	3
Dyke and Spoil Bank	3
Scour	4
Ice Flow Tests	4
Conclusions	4

Table I Test Summary-Red River Floodway Inlet Transition.

Plates

1. Configurations and Tests with Floodway Inlet Transition in Upstream Location.
2. Configurations and Tests with Floodway Inlet Transition in Downstream Location.

RED RIVER FLOODWAY

MODEL TESTS OF INLET TRANSITION

This report contains the testing program and summary of test results from the model studies carried out on the inlet transition to the Floodway. The inlet transition was designed to provide a smooth entrance of flows from the Red River to the Floodway under flood conditions. Model tests were undertaken to determine:

1. The best location of the transition;
2. The best location and arrangement of the adjacent dyke and spoil area;
3. The possibility of scour action; and
4. The effect of ice flows on the inlet and Floodway.

The model tests were performed at the University of Manitoba under supervision by the Floodway Division and constituted stage II of the testing program established by H. G. Acres & Company Limited for model tests on the inlet control works.

Description of The Model

The moveable bed inlet control works model, constructed at a horizontal scale of 1:120 and a vertical scale of 1:60, covered a reach of the Red River extending approximately 3,000 feet upstream and 10,000 feet downstream of the Floodway inlet plus approximately 3,000 feet of Floodway channel. Only the portion of the model upstream of the control structure was modelled accurately for tests on the inlet transition. Water levels and flows upstream of the control structure were controlled

by an interim design of the structure gates so that accurate flow patterns would be obtained.

A detailed description of the model is contained in a separate report. [1]

Testing Program

The testing program for the inlet transition was prepared and supervised by the Floodway division and was included as stage II of the testing program prepared by H. G. Acres & Company Limited for the inlet control works model at the University of Manitoba. The program was outlined to test the inlet transition in two locations with various arrangements of the dyke and spoil areas.

The tests were primarily run at the prototype design discharge of 60,000 c.f.s., however, the range of flows, from the lowest measureable flow of 5,000 c.f.s. to the maximum of 100,000 c.f.s., was also tested. Velocity measurements and water surface elevations were taken for each test and the flow patterns were analysed. Initially, the tests were run for six hours; however, since no scour patterns developed the testing time was reduced to three hours.

When testing of the various configurations was completed, the upstream location of the transition was selected with the west bank of the inlet curved on a 100 foot radius and with the east dyke curved to St. Mary's road as shown on Plate 1. This arrangement was tested under simulated spring breakup conditions using paraffin cakes to represent floating ice pans.

1. Hydraulic Model Tests of the Inlet Control Works, H. G. Acres & Company Limited, January, 1963.

A summary of the tests carried out is presented in Table I and the configurations tested are shown on Plates 1 and 2.

Analysis of Results

Transition Location: In general the transitions provided a smooth inlet of water into the Floodway channels although the velocities were higher along the west side reaching a maximum of 4.0 f.p.s. The upstream location was selected because of disadvantages in the downstream location. Although the velocity distribution was more uniform across the downstream transitions the velocities were slightly higher. In addition the broader inlet crest resulted in higher hydraulic losses and lower Floodway capacity for flows up to 20,000 c.f.s.

Dyke and Spoil Bank: Various configurations were tested in an attempt to improve the velocity distribution and entrance conditions. Although changes in the configurations had a minor effect on the flow patterns, the tests led to selection of the following:

(a) The east dyke curved to St. Mary's Road,

(b) The west bank curved at a 100 foot radius,

(c) The spoil bank extended upstream as far as possible without affecting stability of the banks.

Minor improvements in the flow patterns resulted with the east dyke curved upstream past St. Mary's Road but were not sufficient to justify the cost of the additional right-of-way required.

Scour: The scour tests were evaluated by H. G. Acres & Company Limited and are presented in a separate report.[1] In general no scour action was observed and no slope protection recommended. Observation of flows in the prototype may indicate that minor protection will be required at the west bank and spoil area where velocities approach five feet per second. In addition, the one percent slope in the inlet transition may be subject to scour when flows begin to enter the Floodway under rising river stage. This condition may, however, be alleviated to some extent by operation of the control structure gates.

Ice Flow Tests: Depending on the river stage up to 55 percent of the ice flow entered the Floodway. The ice passed through the transition smoothly with no jamming except for tests run with 5,000 c.f.s. in the Floodway. Under this low flow condition some cakes grounded causing local scour around the ice pan.

Conclusions

Model tests verified the overall hydraulic design of the inlet insofar as the accuracy of the model would allow.

The selected design for the inlet transition provides a satisfactory diversion of water into the Floodway channel at all flows and under spring break-up conditions. The location of the diversion channel, required in the construction of the control structure which

1. Inlet Control Works Model - Floodway Transition - Analysis of Results, H. G. Acres & Company Limited, November 12, 1962.

was tested subsequent to the inlet transition, necessitated relocating the transition approximately 130 feet downstream in the Floodway channel. Velocity measurements taken in the transition during the testing indicate no change in overall performance. In addition, further modifications are required in the location and elevation of the spoil bank and east dyke. The tests carried out indicate that these modifications will have little or no effect on the performance of the transition.

There was no indication that general rip-rapping or surface protection is required at the Floodway inlet. Minor remedial action may be required, however, if local scour occurs during operation of the prototype.

TABLE 1

TEST SUMMARY

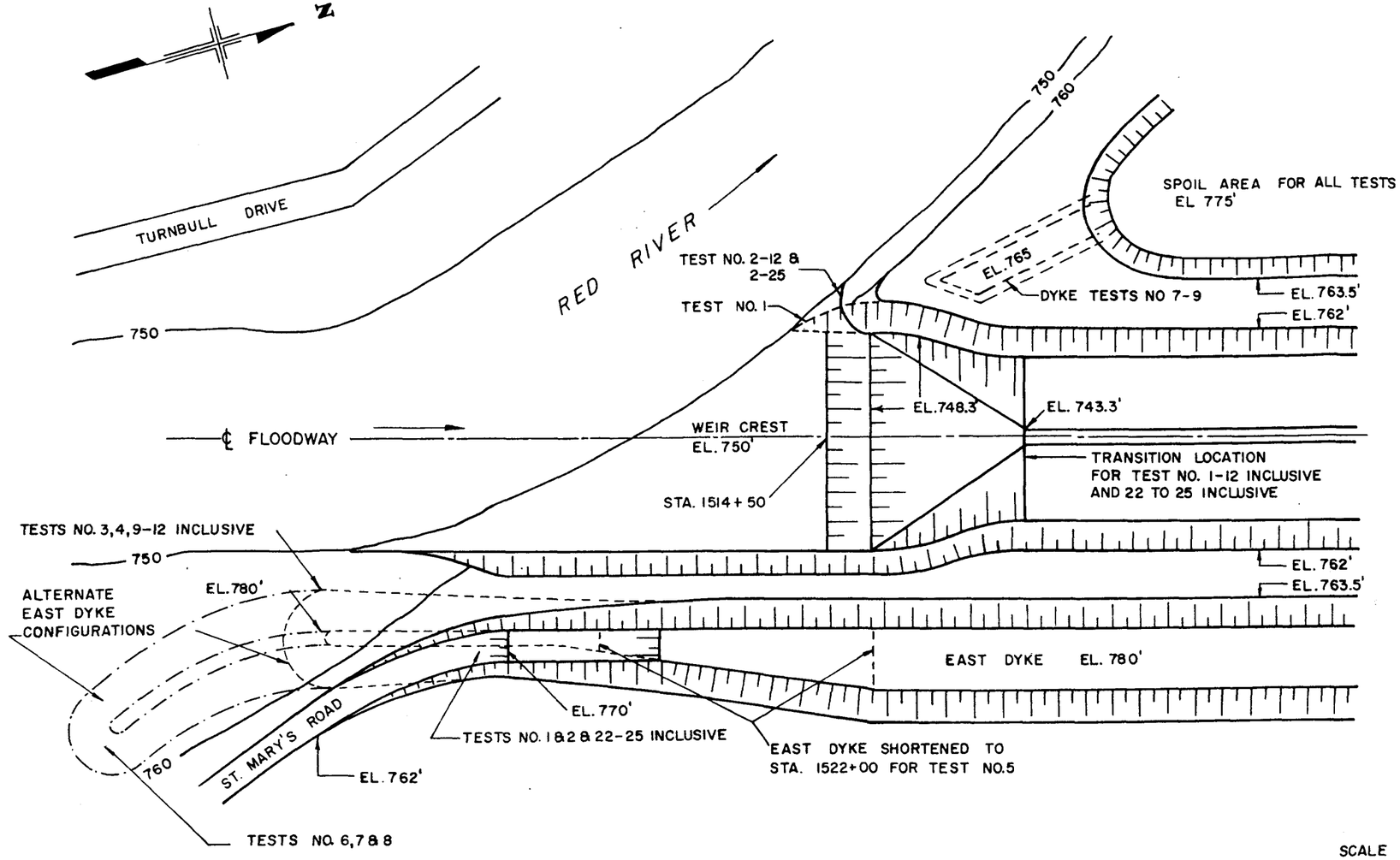
RED RIVER FLOODWAY - INLET TRANSITION

TEST NO	SITUATION TEST NO	RED RIVER DISCHARGE	FLOODWAY DISCHARGE	HEADWATER ELEVATION	REMARKS
1	5	130,700	60,000	770.25	- Design discharge
2	6	130,700	60,000	770.25	Tests No. 1 - 12
3	7	130,700	60,000	770.25	tested the transition in
4	7 *	130,700	60,000	770.25	the upstream location with
5	8	130,700	60,000	770.25	various configurations
6	9	130,700	60,000	770.25	and flows.
7	10	130,700	60,000	770.25	Tests No. 13-21 with
8	11	130,700	60,000	770.25	transition in downstream
9	12	130,700	60,000	770.25	position.
10	13	37,200	5,000	752.35	
11	14	55,600	20,000	758.96	
12	15	168,500	100,000	778.05	- Maximum Floodway discharge
13	16	130,700	60,000	770.25	
14	17	130,700	60,000	770.25	
15	18	168,500	100,000	778.05	- Maximum Floodway discharge
16	19	207,500	80,000	774.36	
17	20	79,000	40,000	765.30	
18	21	55,600	20,000	758.96	
19	22	37,200	5,000	-	Unsteady inlet conditions
20	23	130,700	60,000	770.25	
21	24	31,000	6,200	753.0	

TABLE I (Con't)

TEST NO.	SITUATION TEST NO.	RED RIVER DISCHARGE	FLOODWAY DISCHARGE	HEADWATER ELEVATION	REMARKS
22	25	37,200	5,000	752.4	Tests 22 - 25
23	26	43,000	10,000	754.8	tested ice flows
24	27	55,600	20,000	759.0	
25	28	79,000	40,000	765.3	

Note The configurations tested are shown on Plates 1 and 2.



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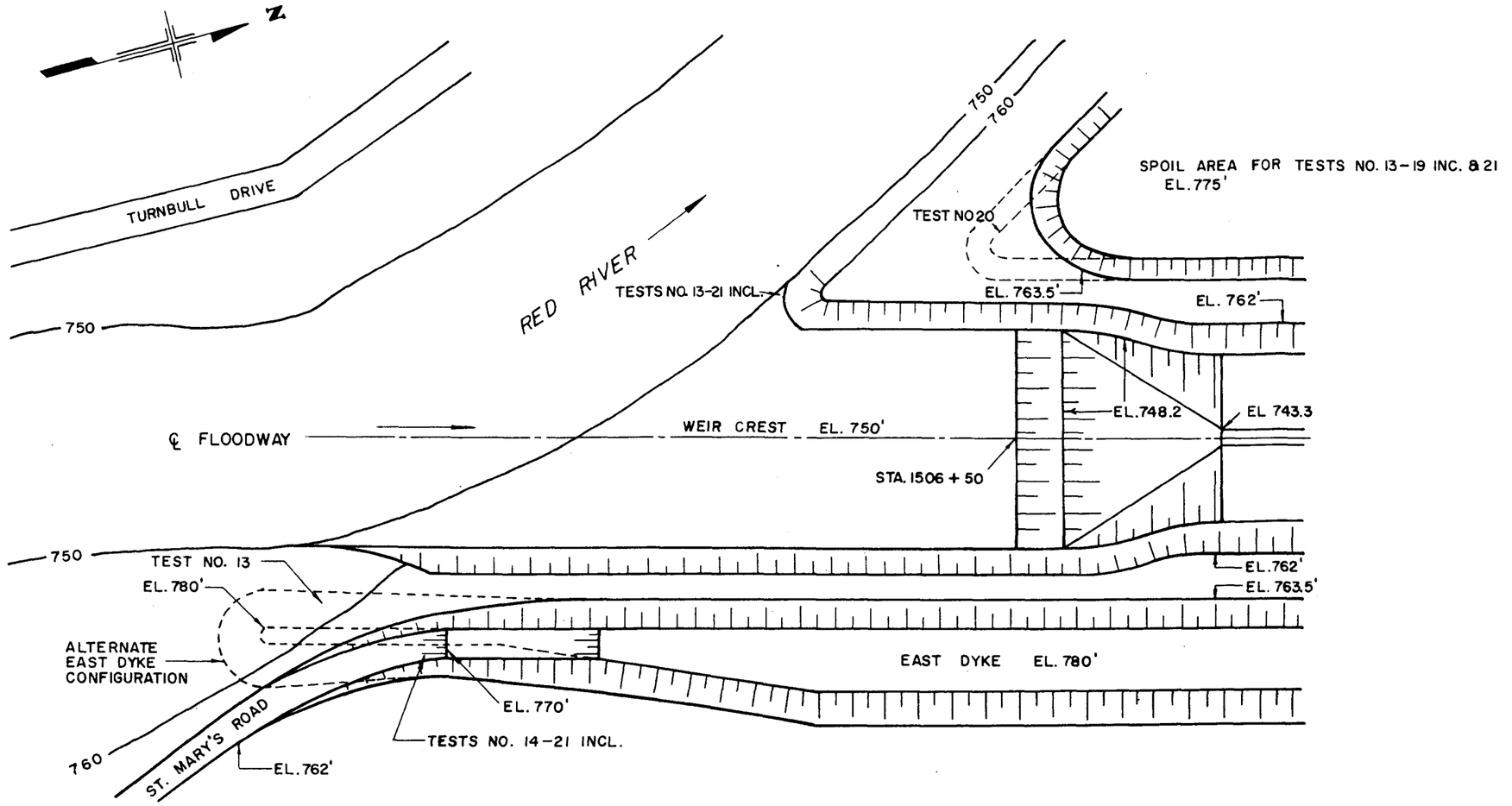
RED RIVER FLOODWAY

CONFIGURATIONS AND TESTS WITH FLOODWAY INLET TRANSITION IN UPSTREAM LOCATION

PREPARED BY W C	DATE APRIL 1963
DRAWN BY W F	PLATE 1



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RED RIVER FLOODWAY CONFIGURATIONS AND TESTS WITH FLOODWAY INLET TRANSITION IN DOWNSTREAM LOCATION	
PREPARED BY W C	DATE APRIL 1963
DRAWN BY W F	PLATE 2