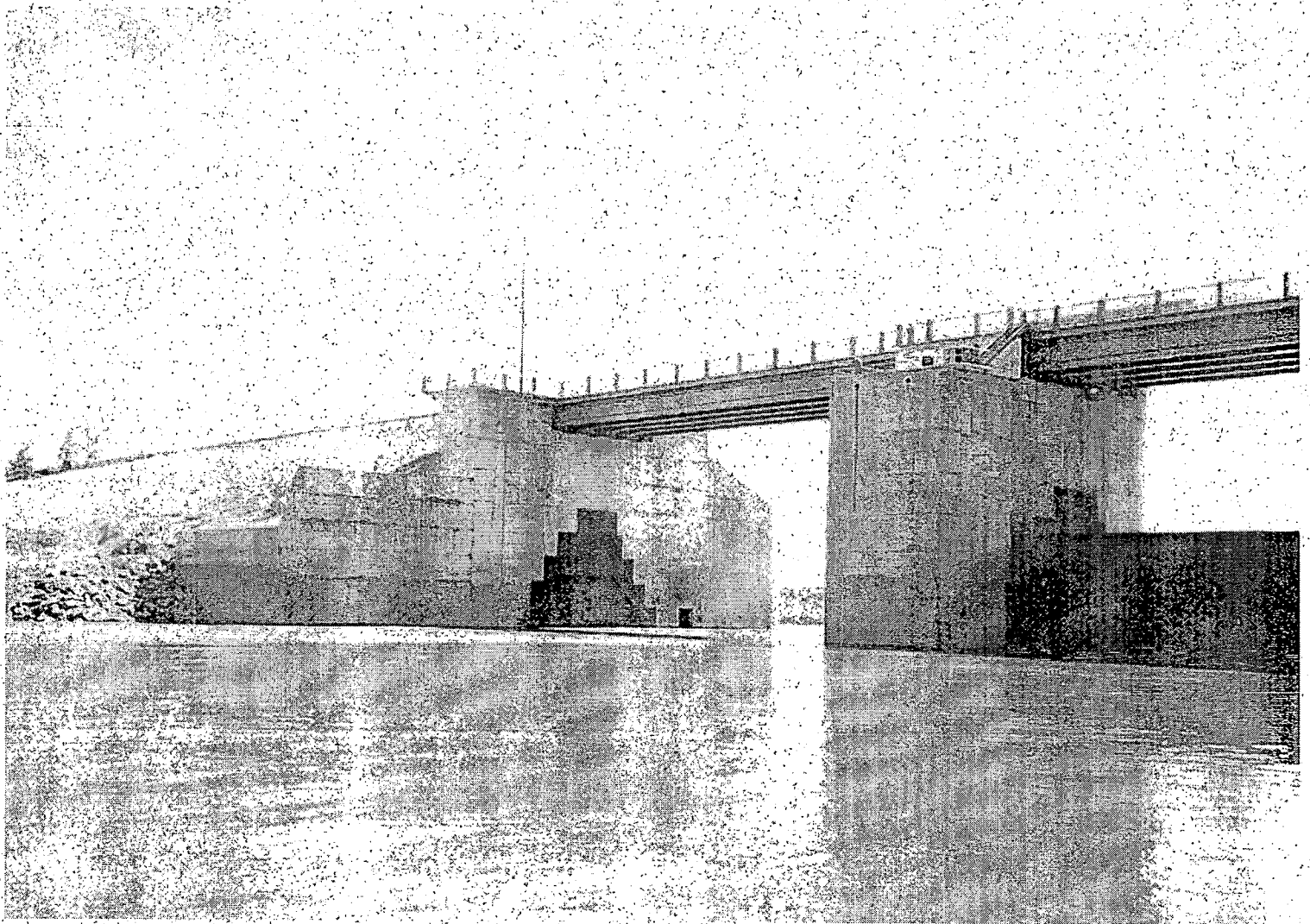


RED RIVER FLOODWAY INLET CONTROL STRUCTURE 1997 FLOOD DAMAGE TO DOWNSTREAM RIPRAP APRON REPORT



Submitted by:

**KGS
GROUP**

KONTZAMANIS • GRAUMANN • SMITH • MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

March 16, 1999

File No. 99-311-01

Manitoba Department of Natural Resources
Water Resources Branch
Box 18, 200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3

ATTENTION: Rick Hay, P.Eng.
Project Engineer

RE: Project 1653-C Remediation of the Downstream Riprap Apron
Red River Floodway Inlet Control Structure

Dear Mr. Hay:

Enclosed are three copies of our report "Red River Floodway Inlet Control Structure, 1997 Flood Damage to Downstream Riprap Apron Report" as requested. The total estimated incremental cost attributed to the 1997 flood is \$349,250.00.

Should you have any further questions please do not hesitate to contact me.

Sincerely,



Mark DeGagné, P.Eng.
Design Engineer

MD/af

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1.0 INTRODUCTION

Since the commissioning of the Red River Floodway Inlet Control Structure in 1967, several large flood events have caused a "scour hole" to form in the riverbed downstream of the structure. In 1995, the recommended solution for the total remediation of the scour problem was to line the scour hole with concrete filled bags and mats¹. The cost of this alternative was estimated to be approximately \$670,000.00 (see attached estimate), and was based upon a preliminary design and assessment of the site conditions at the time. The preliminary design was based upon a 1995 diving survey of the downstream riprap apron, and a review of historical surveys at the structure. It was also concluded that the rate of erosion was "not excessively large".

Subsequent to the 1997 flood, KGS Group performed a survey and assessment of the downstream "scour hole". In December of 1997, a sonar survey of the downstream area was performed. A significantly changed pattern of erosion was noted following this flood, and it was recommended that the previously recommended erosion protection scheme be pursued and implemented. This work was tendered in December of 1998.

A contract in the amount of \$2,268,800.00 was awarded by The Province of Manitoba to complete the repair and install erosion protection measures on the downstream riprap apron. A copy of the contract unit price table is attached. The design for the erosion control measures was based upon the post 1997 flood survey, and further requirements for protection of the downstream wing wall embankments. It became evident during the 1997 flood that the scour hole had expanded and began to significantly undermine the riprap protection on the wing wall

¹ KGS Group Final Report, "Red River Floodway – Inlet Control Structure, Erosion Study", November 1995

embankment. Emergency measures were taken during the 1997 flood to stabilize the embankments, which had begun to slough into the channel.

The purpose of this report is to provide an assessment and estimate of the damages related to the 1997 flood, and to a portion those damages to the value of the remediation work.

2.0 IMPACT OF THE 1997 FLOOD

A comparison of the pre and post 1997 flood surveys was performed. Contour diagrams of each survey are shown in Figures 1 and 2. From the contour diagrams, nine profiles were derived and are illustrated on the attached profile Figures 3 to 13.

It can be determined from the profile figures that the 1997 flood significantly changed the bed profile downstream of the structure. In general, additional scour of 1.5 to 2 metres was experienced directly adjacent to the structure sill, and the material scoured was pushed and deposited downstream approximately 30 to 40 metres. The deposition area increased elevation from 1995 by up to 3 metres. The mounding was most evident near the middle of the channel, and the greatest scour occurred near the abutments further undermining the wing wall embankments.

Following the review after the 1997 flood, it was apparent that additional erosion increased the amount of material removed and mounded downstream. The proposed concrete bag and block mat protection scheme remained essentially unchanged from the preliminary concept.

3.0 DAMAGE ASSESSMENT

The original design of the erosion protection took into account the requirement for additional fill in the deepest scour hole portions, but did not anticipate the requirement for excavation of the channel bed to prepare the bottom for the placement of the concrete filled bags and block mat. Because the bottom surface went from a relatively flat profile (except for directly adjacent to the abutments) in 1995 to a significantly rolling profile additional bed preparation was necessary. As well, the deepest scour holes beside the abutments further undermined the wing wall embankments. This undermining caused significant losses of the riprap protection on the embankments.

As a result of the 1997 flood, additional items for bed preparation and rockfill riprap were added to the scope of work during the final design of the remediation project. These items are highlighted in the attached Contract Unit Price Table. Considering that the final elevations for the concrete bags and block mats would likely have been different from the preliminary to final design stage, we have estimated that approximately 80 percent of the cost to excavate the channel to remove the mound is attributable to the 1997 flood. This cost amounts to approximately \$160,000.00. Similarly, we have estimated that 25 percent additional fill should be attributed to the 1997 flood amounting to \$37,500.00.

Historically, the toe of the embankment at the downstream wing wall has been rehabilitated following significant spring events. Remediation required following the 1997 flood exceeded these previous requirements, and as such the total cost for the supply and placement of the rockfill riprap along the wing wall embankments should be attributed to the 1997 flood event.

The cost under the current contract is \$120,000.00, and is based upon the supply and placement of 4000 tonnes of rockfill riprap material.

Based upon the discussion above the total estimated incremental damage associated with the flood of 1997 is \$349,000.00 including a 10 percent contingency. Table 1 below summarizes the estimated cost of damages due to the 1997 flood.

Table 1: Estimated Damages Summary

Item	Estimated Cost
Excavation for Bed Preparation	\$ 160,000.00
Rockfill for Bed Preparation	37,500.00
Rockfill Riprap	120,000.00
Subtotal	317,500.00
Contingency	31,750.00
Total	\$ 349,250.00

**1995 COST ESTIMATE
FOR RIPRAP APRON
EROSION CONTROL WORKS**

7.3.2 Cost Estimate

The cost estimate for supply and placement of the mat was based upon discussions with contractors specializing in this type of work. Based upon these discussions, expertise associated with placing and pumping the mats will likely have to come from out of the Province.

The summary of the cost estimate for the concrete mat alternative is listed below in Table 7.2.

**Table 7.2
Cost Estimate - Concrete Mat Alternative**

Description	Quantity	Unit Price	Amount
Mobilization/Demobilization	lump sum	\$15,000.00	\$15,000
Divers Inspection	30 days	\$1,000.00	\$30,000
Fabric form	54,400 ft ²	\$1.15	\$63,000
Concrete Grout	1,975 yd ³	\$140.00	\$277,000
Concrete Pump	150 hr	\$100.00	\$15,000
Granular Base (supply & install)	5,100 yd ³	\$20.00	\$102,000
Geotextile Fabric (supply & install)	5,100 yd ²	\$3.00	\$15,300
Total Direct Costs			\$517,000
Engineering			\$50,000
Contingencies (20%) of Indirect Costs			\$103,000
Total Project Cost			\$670,000

DECEMBER 1998 – CONTRACT UNIT

PRICE TABLE

PROJECT NO. 1653-C

**REMEDICATION OF THE DOWNSTREAM RIPRAP APRON
RED RIVER FLOODWAY INLET CONTROL STRUCTURE**

Description of Work	Estimated Quantity	Unit	Unit Price	Amount
Part 2 – West Side Remediation				
4) Mobilization & Demobilization	100%	L.S.	\$60,000.00	\$60,000.00
5) Geotextile (West Side Only)	3000	m ²	\$5.00	\$15,000.00
6) Fabriform® Concrete Bags (West Side Only)	830	m ²	\$530.00	\$439,900.00
4) Fabriform® Articulating Block Fabric (West Side Only)	1850	m ²	\$170.00	\$314,500.00
5) Excavation for Bed Preparation	100%	L.S.	\$100,000.00	\$100,000.00
6) Earth and Rockfill Materials				
.1 Rockfill for Riverbed Preparation	2500	Tonnes	\$30.00	\$75,000.00
.2 Rockfill Riprap	2000	Tonnes	\$30.00	\$60,000.00
7) Allowance for Independent Material Testing and diving inspections				\$10,000
9) Extra Work as may be required in accordance with the Terms of the Contract (See Instructions to Bidders)				\$60,000
SUB-TOTAL CONTRACT PRICE (Part 2 – West Side Remediation)			\$	<u>1,134,400.00</u>
TOTAL CONTRACT PRICE			\$	<u>2,268,800.00</u>

In accordance with the specifications of said work hereto attached and the plans, identified by the signatures of the Contractor and the Owner, and to observe, keep and perform all the terms, conditions and stipulations set out in this agreement, which includes those terms, conditions and stipulations set out in the General Conditions, all of which are hereby made and form part of this agreement, and to fully complete (including final acceptance of the work) on or before the day of **March 5, A.D., 1999 (Part 1)** and **November 30, A.D. 1999 (Part 2)**.

IN CONSIDERATION WHEREOF, and upon the Contractor fully completing and executing in every particular the work herein contracted for within the time hereinbefore set out, and upon the said Contractor satisfying the Owner that all just claims arising in connection with this Contract and the performance thereof have been paid, the Owner covenants, and agrees to pay to the Contractor at the following unit prices, or sums, for the quantities of the following types of work actually performed by the Contractor and approved by the Owner.

Description of Work	Estimated Quantity	Unit	Unit Price	Amount
Part 1 – East Side Remediation				
1) Mobilization & Demobilization	100%	L.S.	\$60,000.00	\$60,000.00
2) Geotextile (East Side Only)	3000	m ²	\$5.00	\$15,000.00
3) Fabriform [®] Concrete Bags (East Side Only)	830	m ²	\$530.00	\$439,900.00
4) Fabriform [®] Articulating Block Fabric (East Side Only)	1850	m ²	\$170.00	\$314,500.00
5) Excavation for Bed Preparation	100%	L.S.	\$100,000.00	\$100,000.00
6) Earth and Rockfill Materials				
1) Rockfill for Riverbed Preparation	2500	Tonnes	\$30.00	\$75,000.00
2) Rockfill Riprap	2000	Tonnes	\$30.00	\$60,000.00
7) Allowance for Independent Material Testing and diving inspections				\$10,000
9) Extra Work as may be required in accordance with the Terms of the Contract (See Instructions to Bidders)				\$60,000
SUB-TOTAL CONTRACT PRICE (Part 1 – East Side Remediation)			<u>\$ 1,134,400.00</u>	

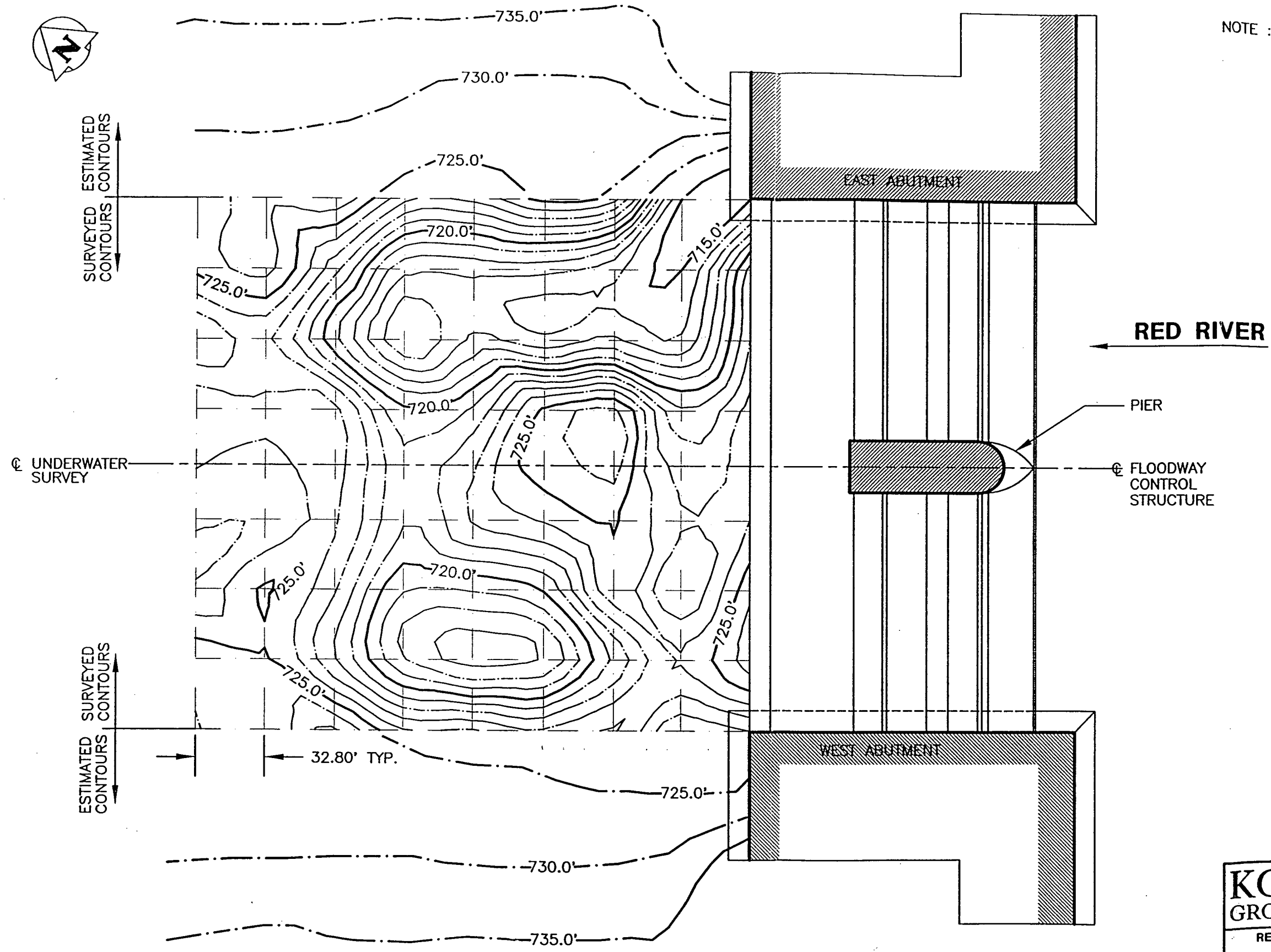
CONTOUR PLANS AND PROFILES

1995 AND 1998

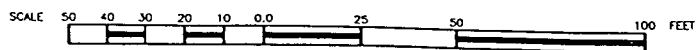
17' X 11" / SCALE: 1"=50' OR 1:600

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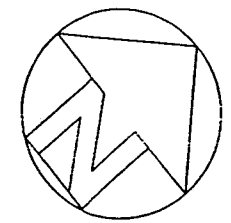
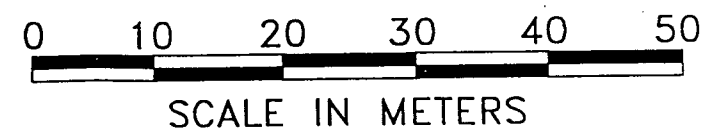
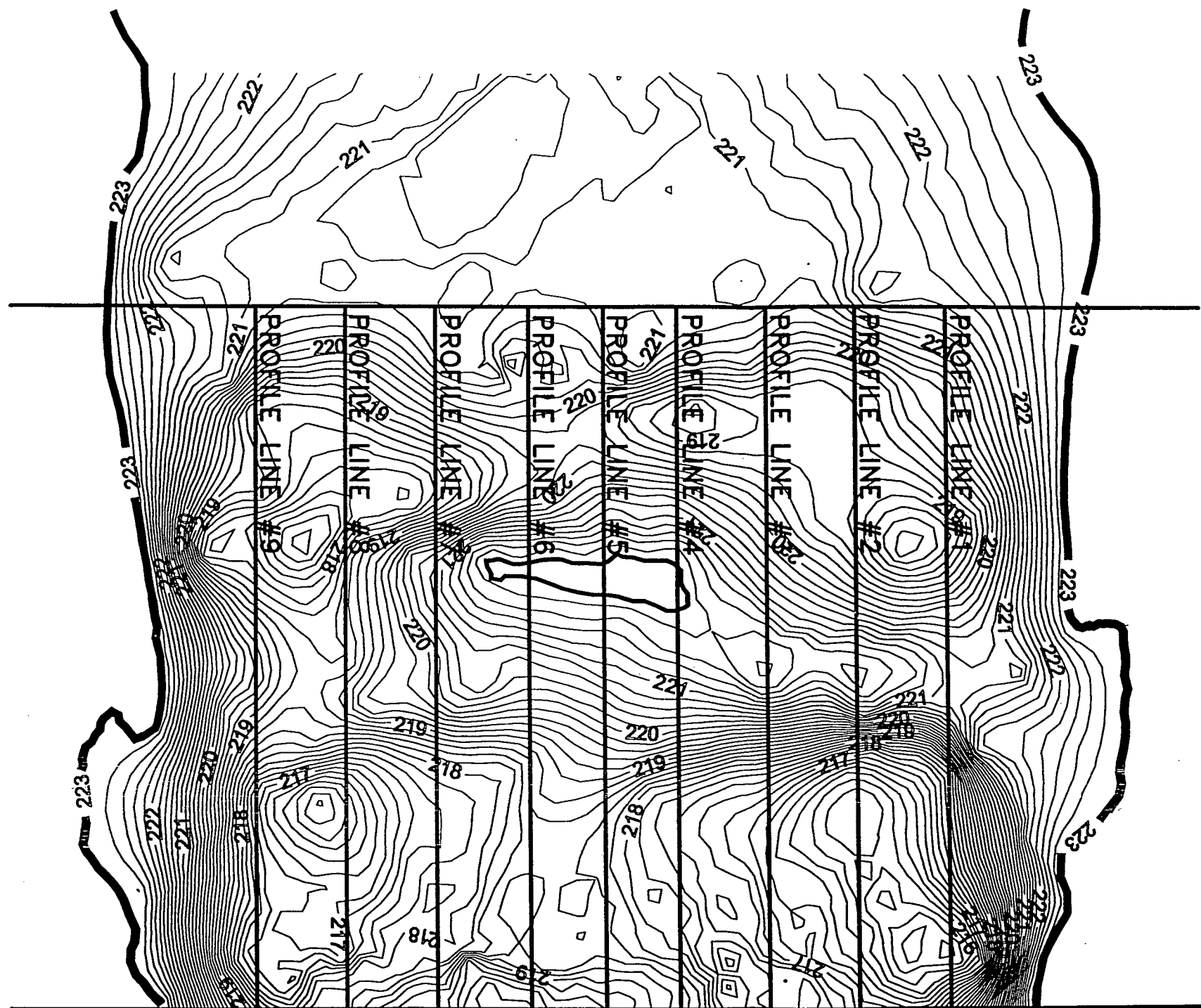
NOTE : CONTOURS ARE BASED ON 1995 DIVERS RECONNAISSANCE SURVEY



PLAN



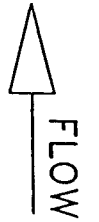
KGS GROUP	MANITOBA DEPARTMENT OF NATURAL RESOURCES
	RED RIVER FLOODWAY - INLET CENTRAL STRUCTURE EROSION STUDY
EROSION DOWNSTREAM & INLET STRUCTURE - 1995	
AUGUST 1995	FIGURE 5.1




WEST ABUTMENT

STRUCTURE SILL
PERPENDICULAR TO 309.5 DEGREES TRUE

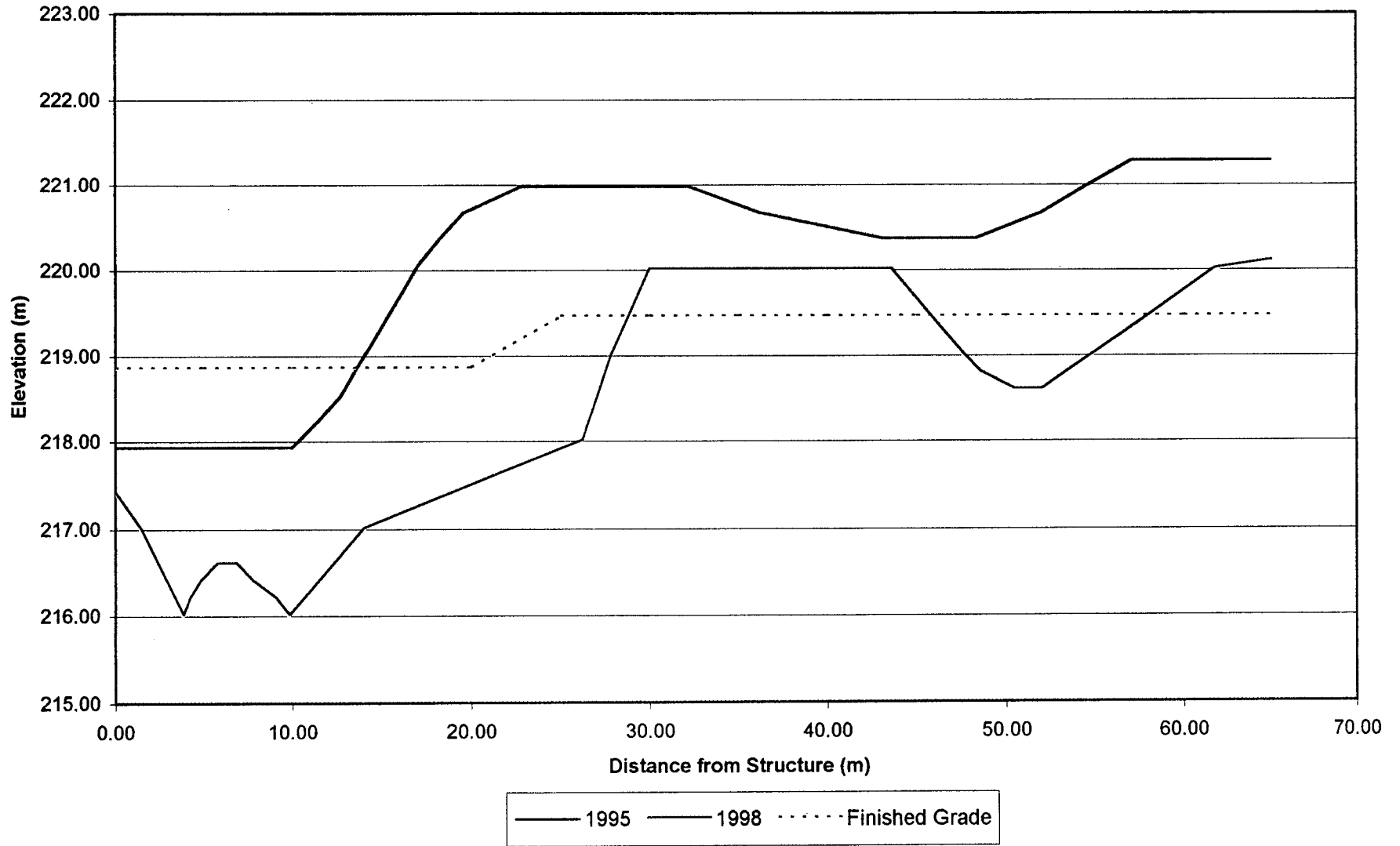
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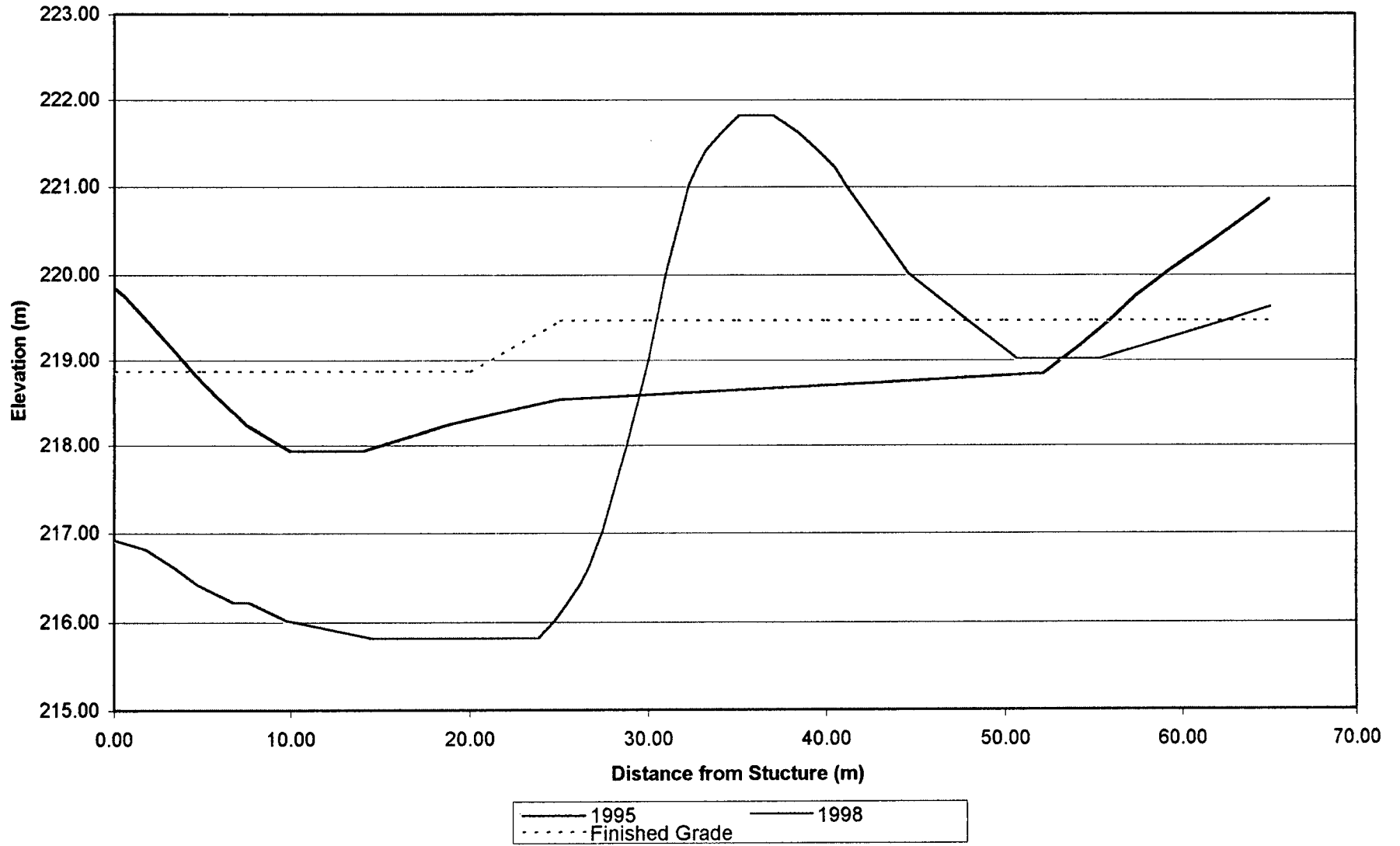
KGS GROUP	Manitoba NATURAL RESOURCES WATER RESOURCES BRANCH	
	RED RIVER FLOODWAY INLET CONTROL STRUCTURE EROSION ASSESSMENT	
RED RIVER FLOODWAY INLET CONTROL STRUCTURE - DOWNSTREAM RIVERBED CONTOUR PLAN (1998)		
07/98		FIGURE 5.1

KGS FILE NO.: 97-311-06
11"x17" PLOT SCALE: AS SHOWN

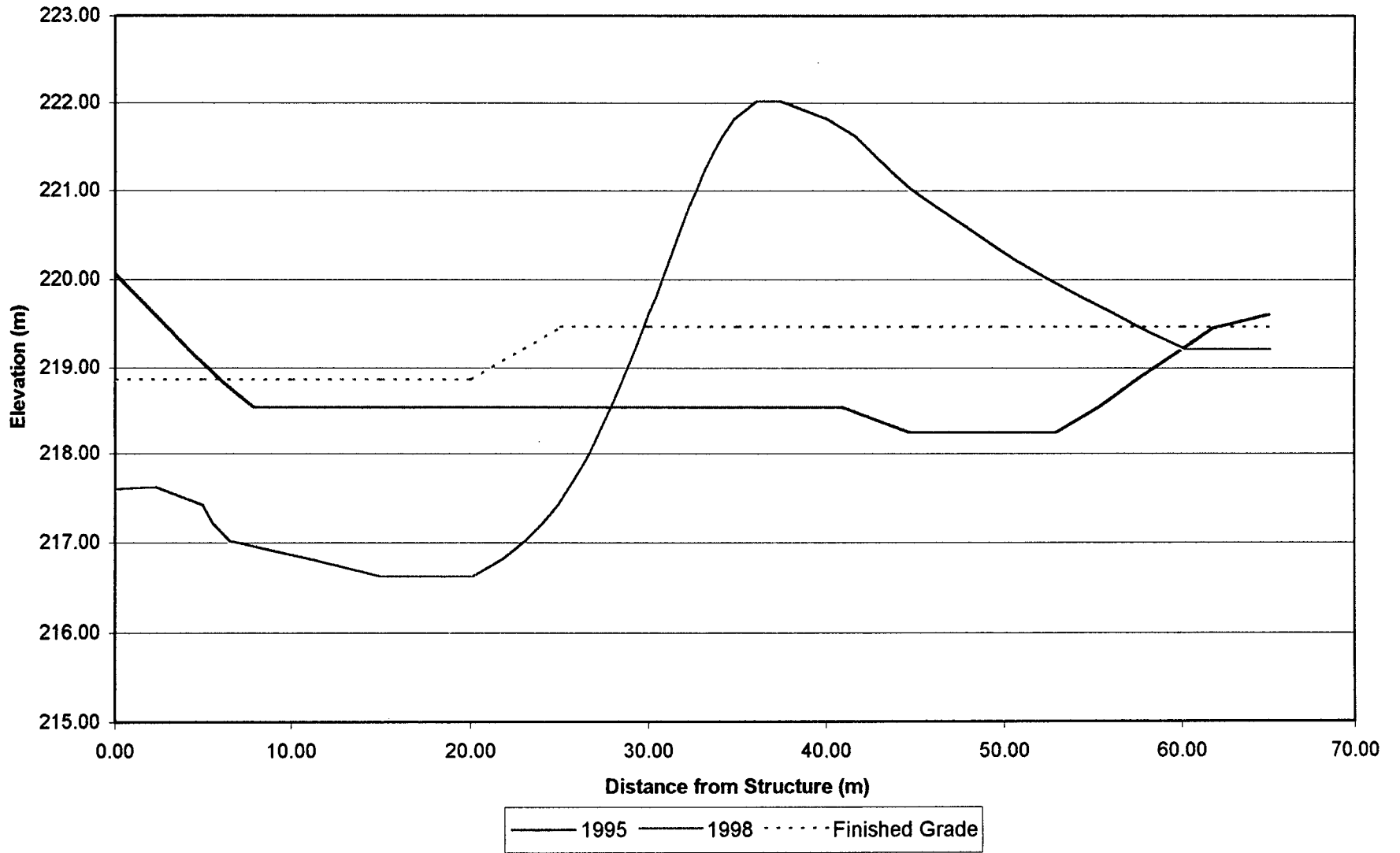
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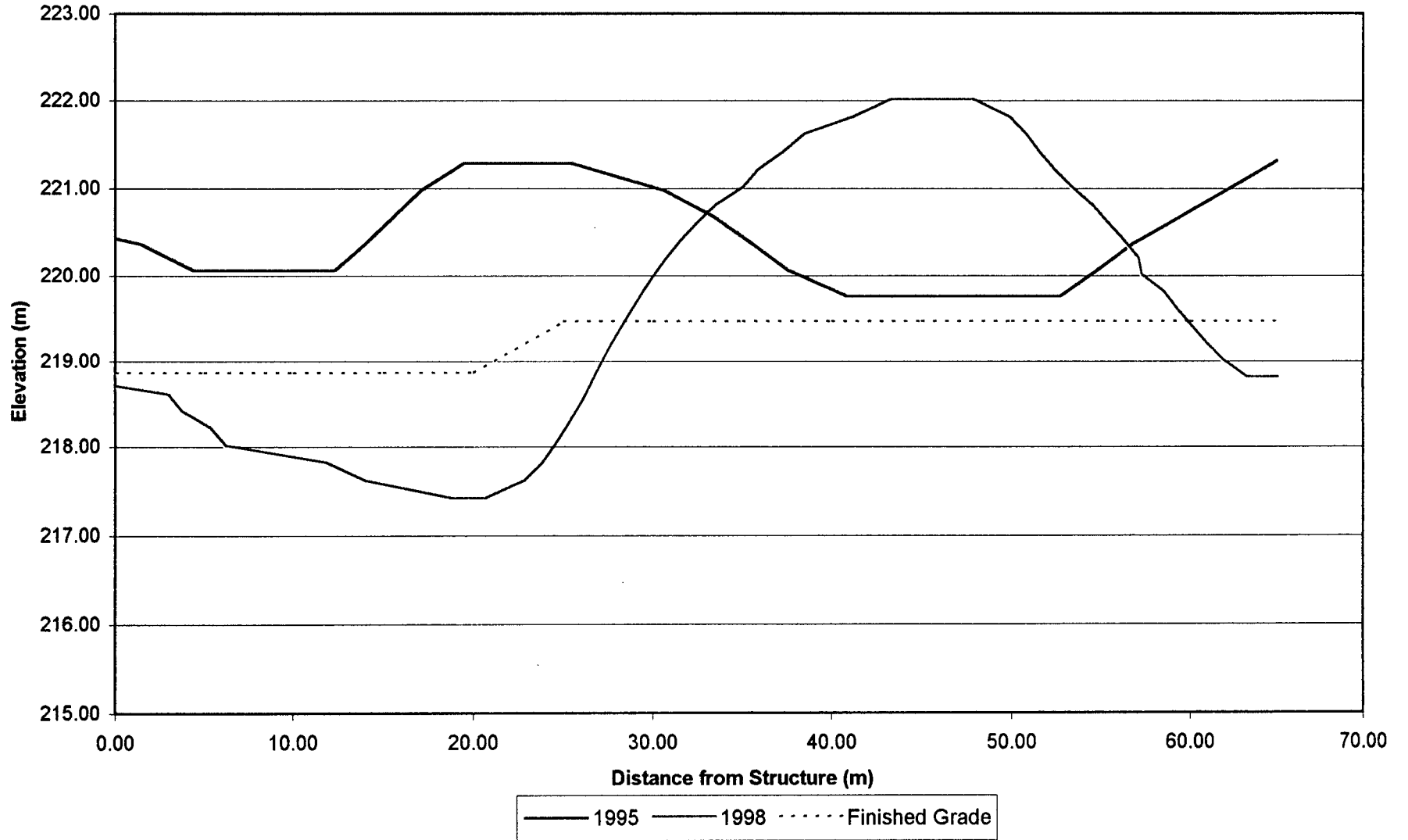
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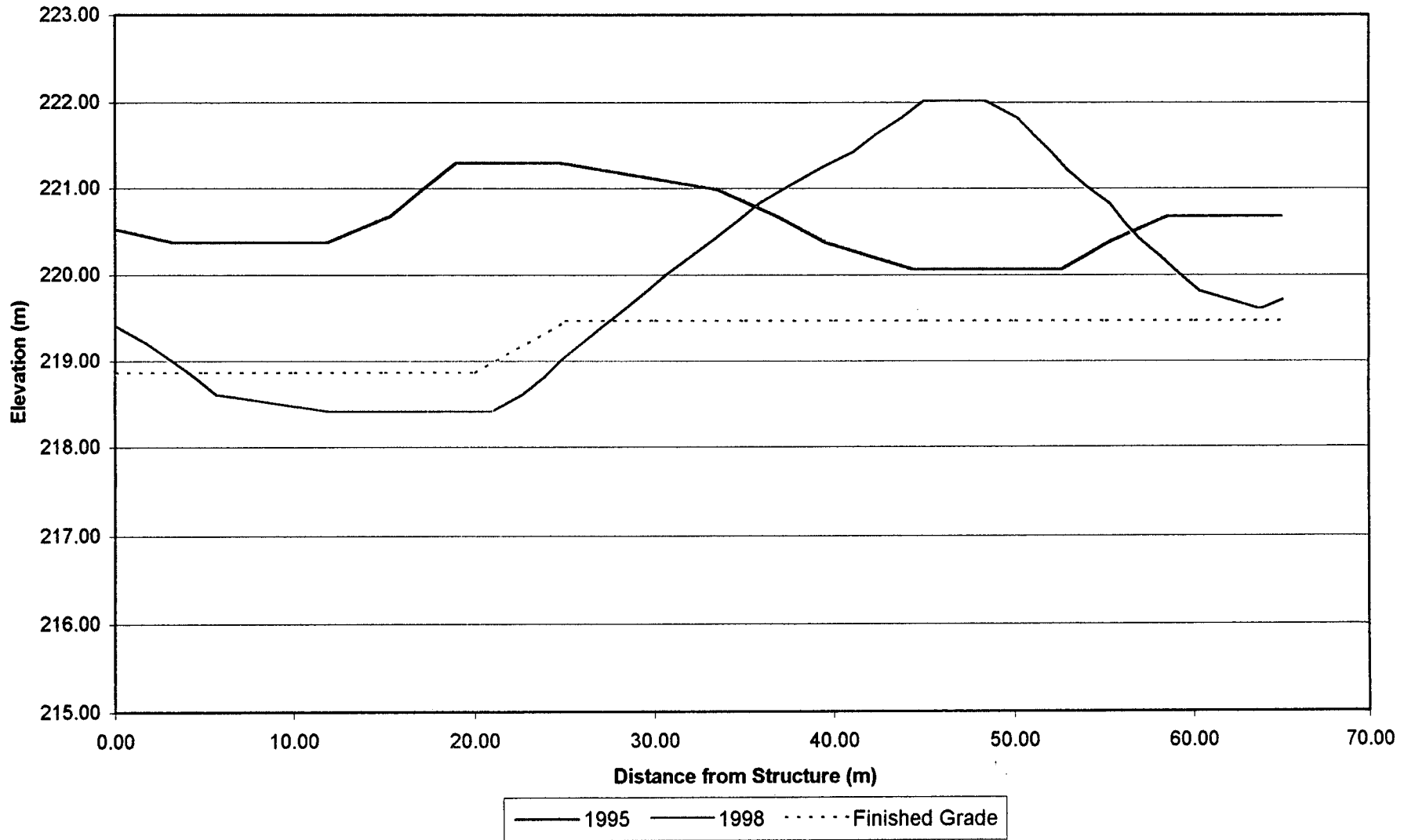
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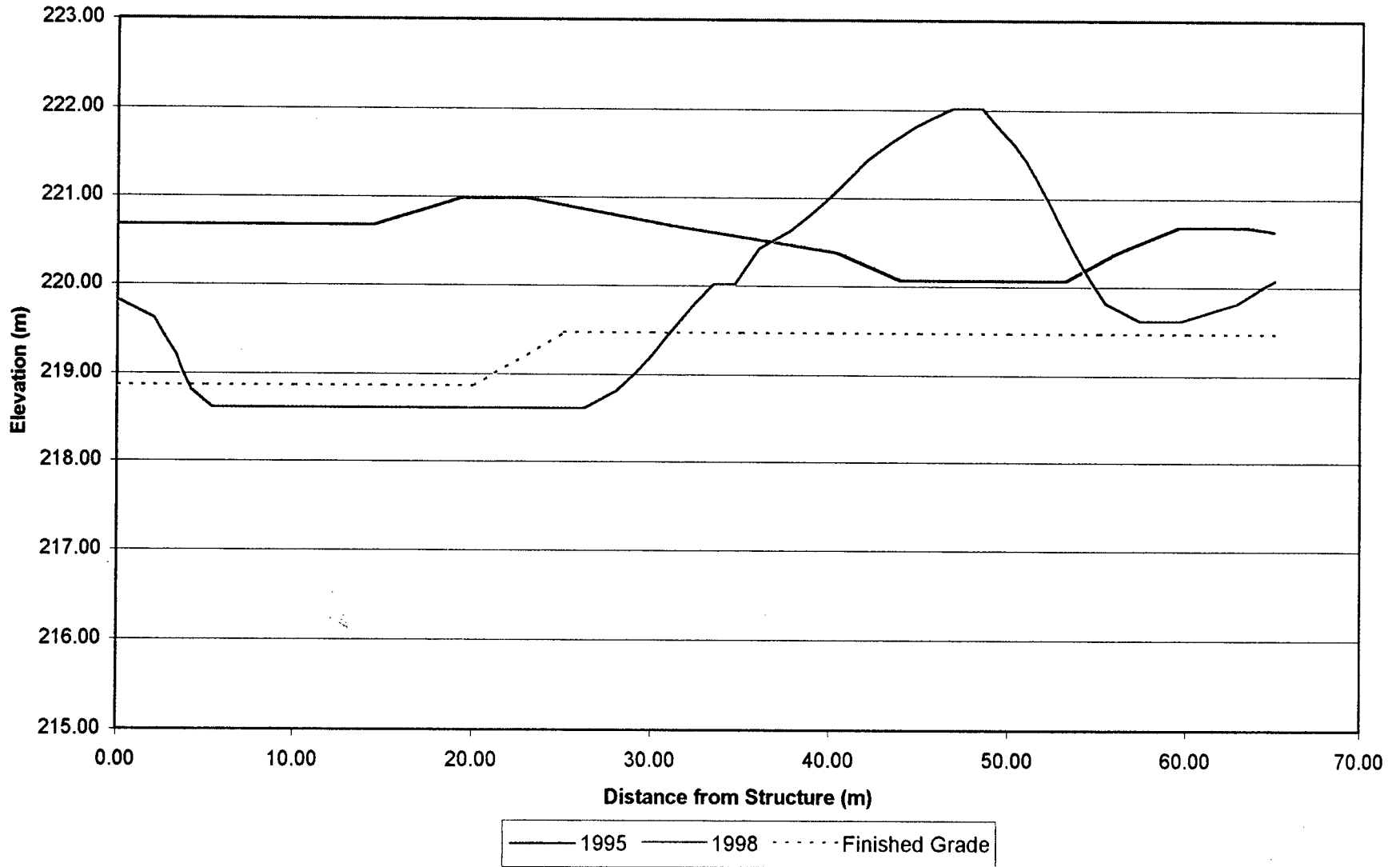
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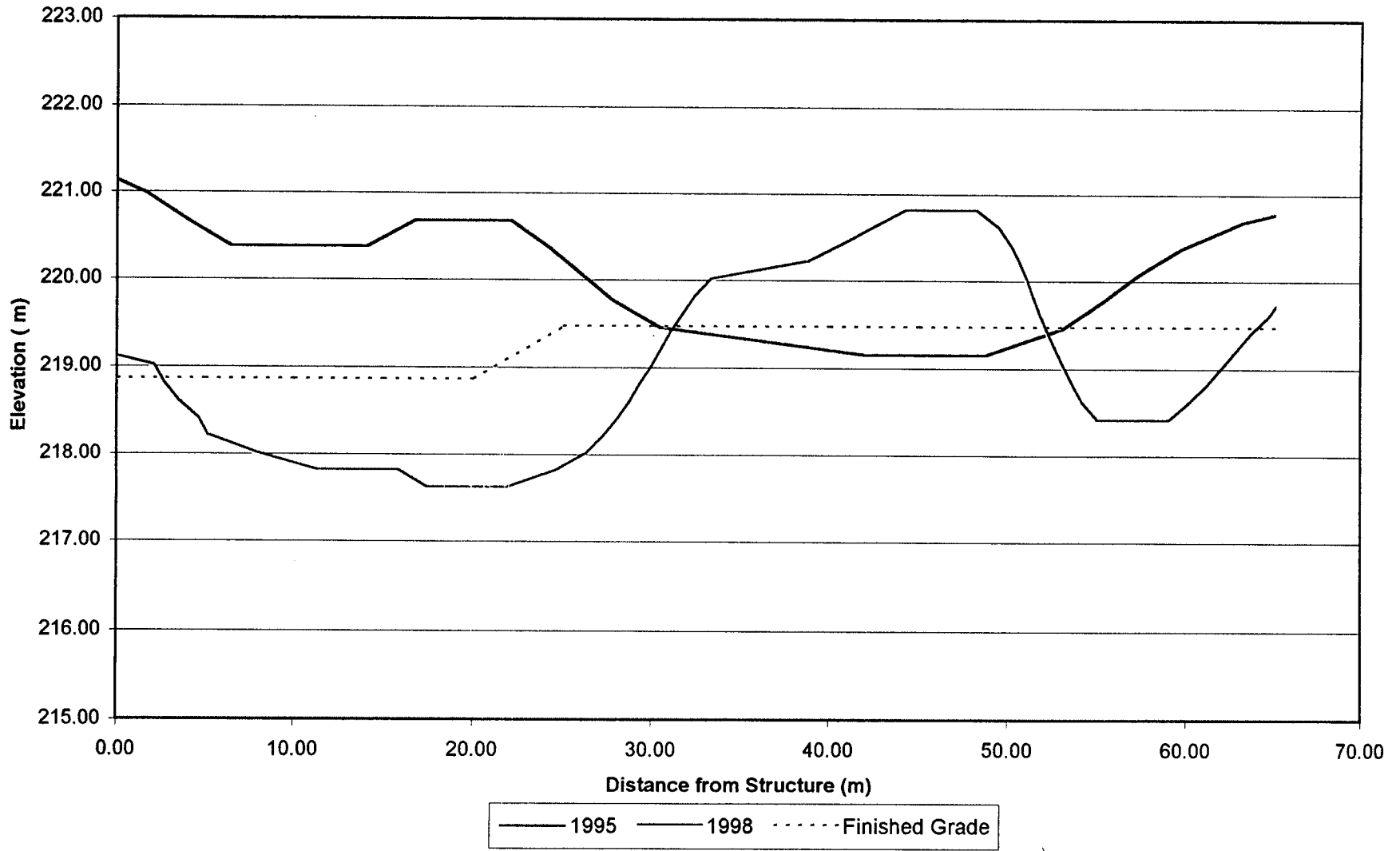
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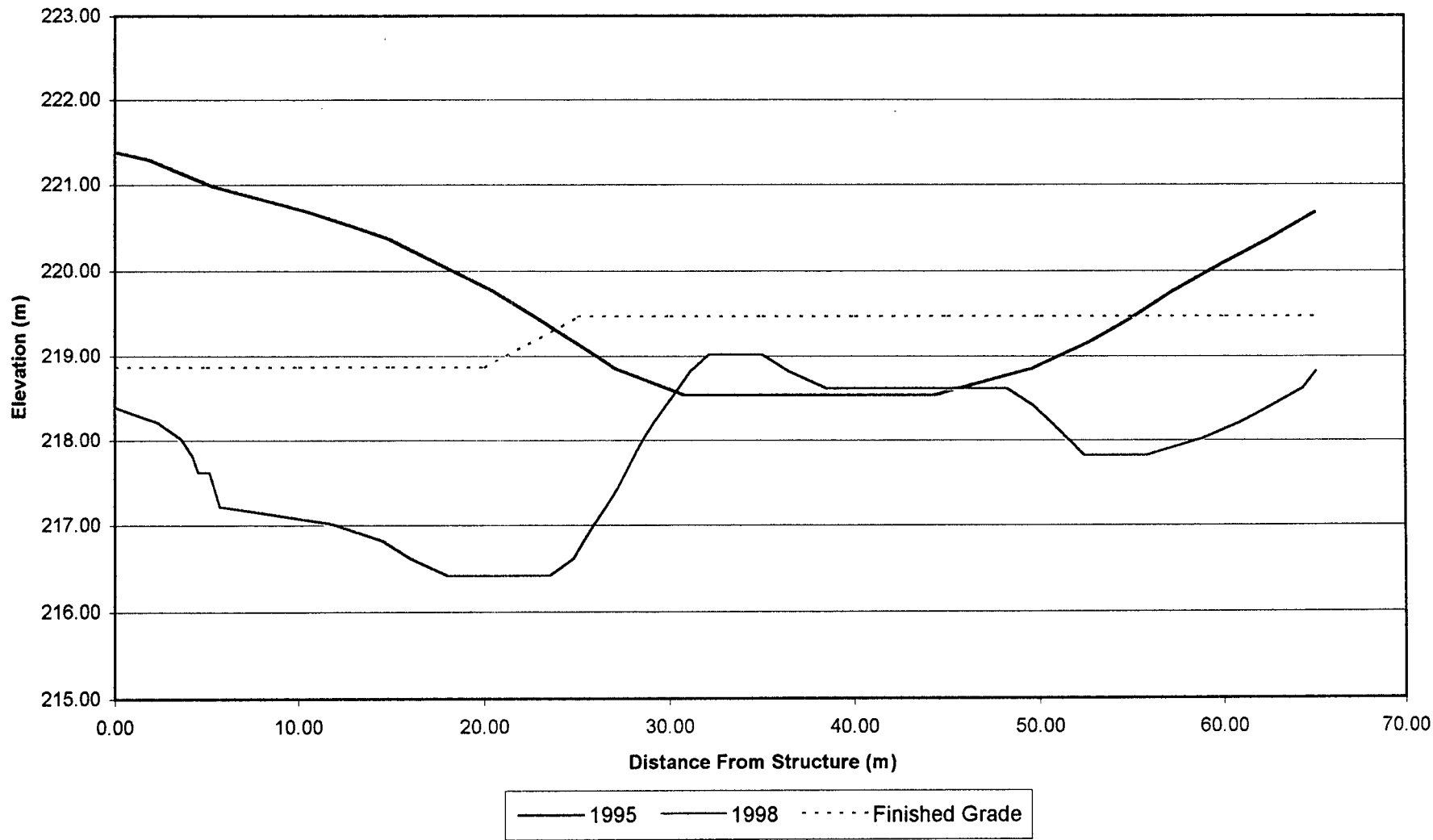
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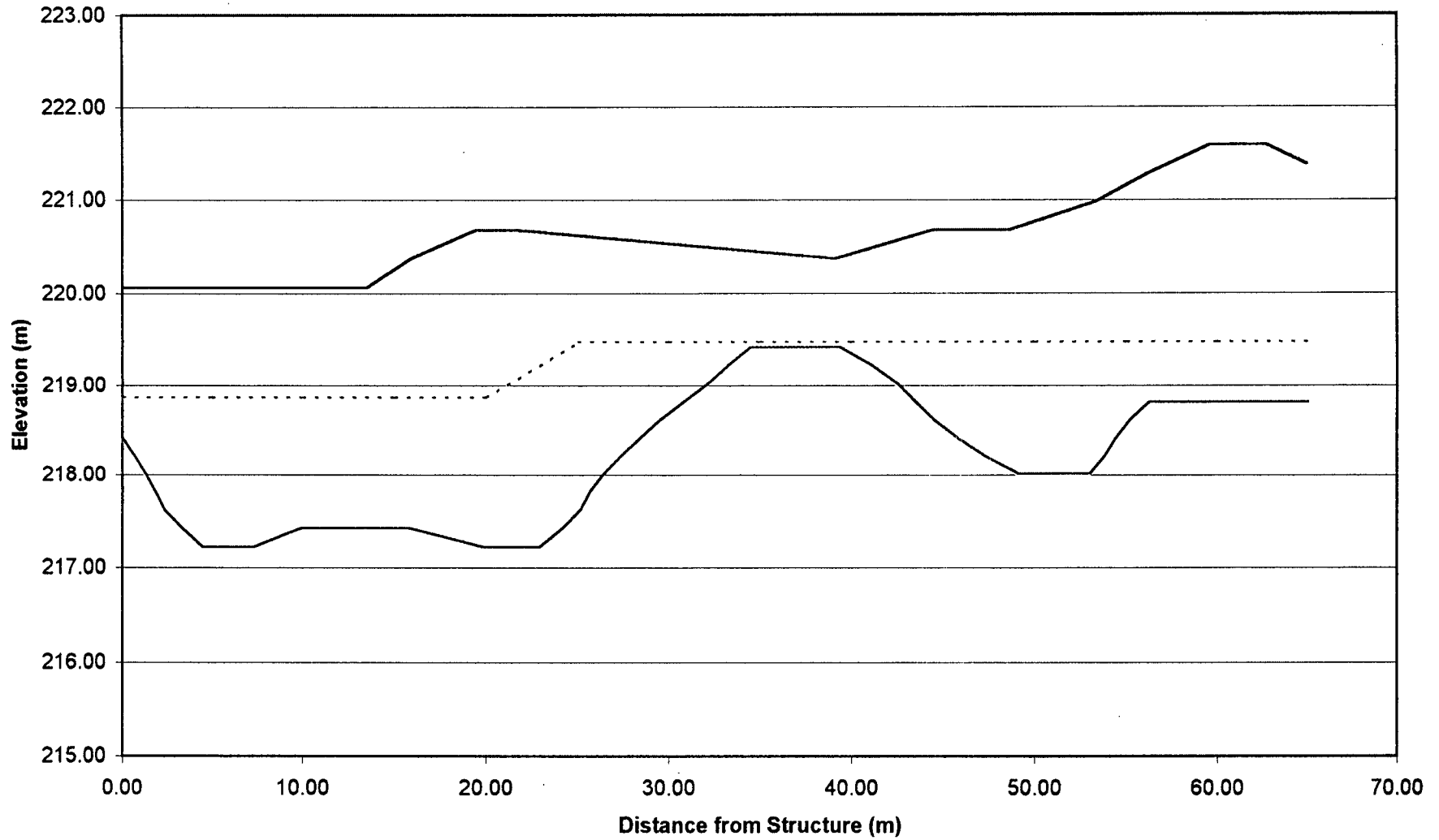
Profile # 7



Profile # 8



Profile #9



— 1995 — 1998 ····· Finished Grade