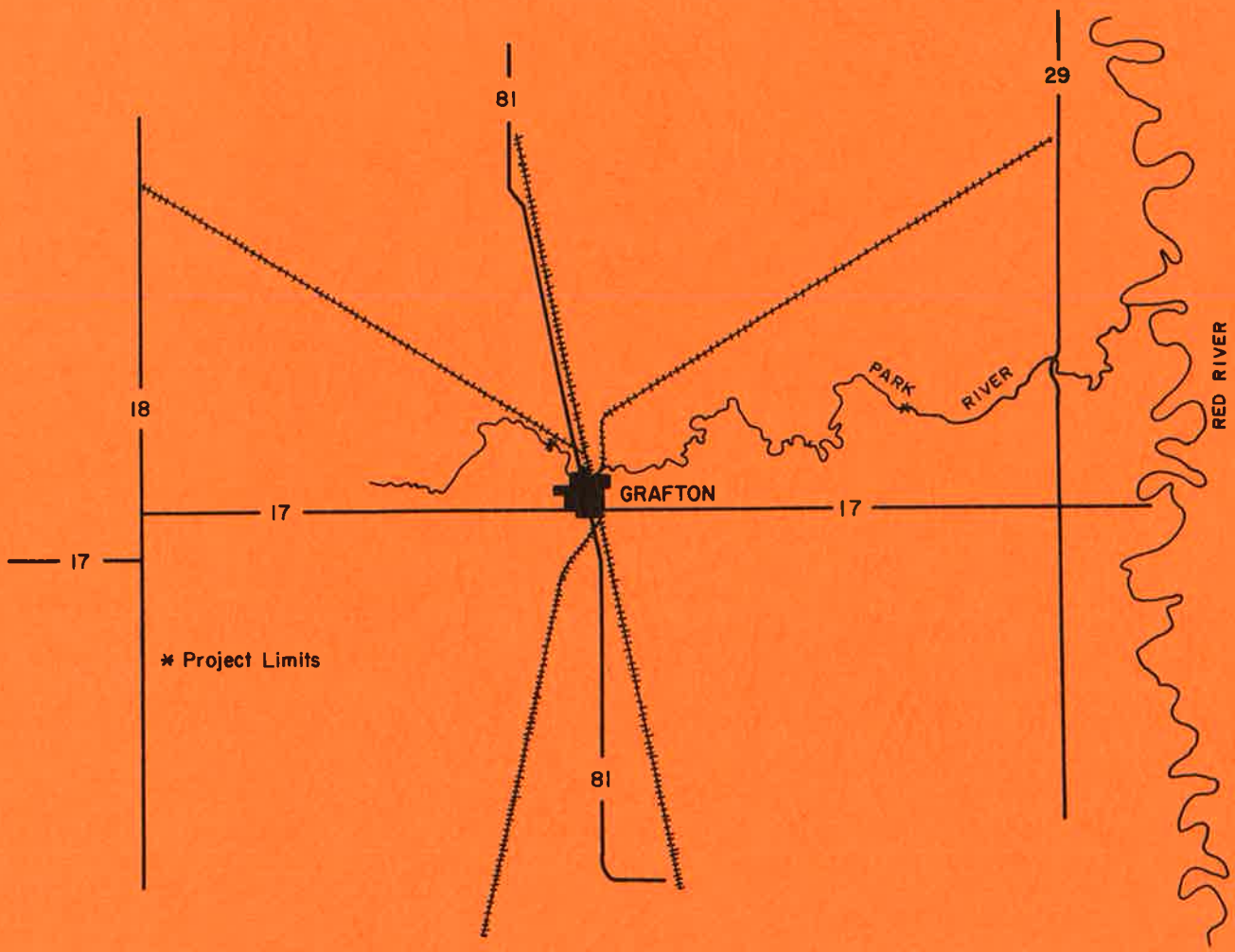
DAVE SPRY

ENGINEERING REPORT

PARK RIVER

SNAGGING AND CLEARING PROJECT

GRAFTON, NORTH DAKOTA



NORTH DAKOTA

STATE WATER COMMISSION

MAY 1980

ENGINEERING REPORT

Park River
Snagging and Clearing Project
SWC Project #662

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Walsh County Water Management Board

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I. INTRODUCTION

In accordance with the March 7, 1980 preliminary investigation agreement with the Walsh County Water Management District, an inventory and cost estimate have been completed for a snagging and clearing project on a portion of the Park River. In addition, an inventory of all bridges along the same segment of river has been compiled. The purpose of this report is to present the findings of the investigation to all interested parties for consideration and future action.

II. DESCRIPTION OF PROJECT AREA

The portion of the Park River investigated by the State Water Commission consists of 22.5 miles of river channel, beginning at the point where the channel intersects the section line common to Sections 11 and 12, Township 157 North, Range 53 West, through the city of Grafton, North Dakota, and extending to the point where the channel intersects the section line common to Sections 5 and 6, Township 157 North, Range 51 West. Attached is a map of the area which denotes the river miles. This segment of the Park River is part of the main channel and begins approximately two river miles below the confluence of the three principal headwater streams, which are the South, Middle, and North Branches of the Park River. For the next 22.5 river miles, the Park River's main channel follows a meandering course eastward across the flat bed of Glacial Lake Agassiz.

The depth of the Park River's main channel averages 15 to 20 feet, and the channel width varies from about 70 to 130 feet. The slope of the main river channel averages about 1.5 feet per mile. The capacity of the main channel averages 2,000 to 3,000 cubic feet per second (cfs).

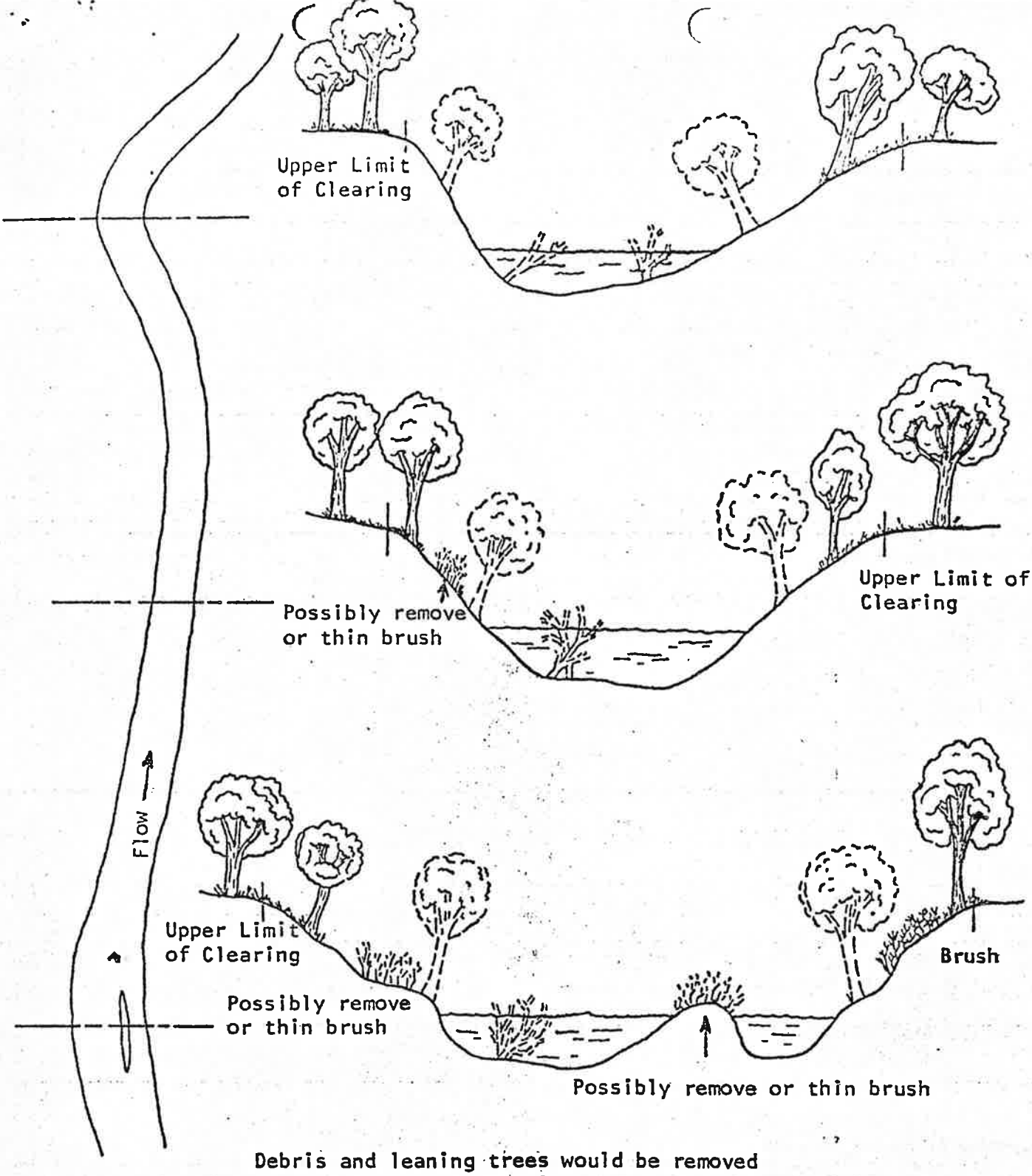
III. DESCRIPTION AND SCOPE OF WORK

The field inventory, consisting of quantity estimates, bridge measurements, and photographs of typical channel conditions, was conducted by State Water Commission personnel during the week of March 10 through 14, 1980. The project cost estimate is based on the quantities obtained in this inventory. The field records and photographs are available in the construction file. Field measurements of bridges were checked and additional bridge data was obtained from State Highway Department records and from the Flood Insurance Study for the city of Grafton which was recently issued by the Federal Insurance Administration.

For the purpose of this investigation, the scope of channel snagging and clearing work consists of the removal and disposal of all fallen and standing trees, driftwood, snags, loose stumps and trunks encountered within the primary channel between the upstream and downstream limits of the project as established earlier in this report. Additional work items included in the snagging and clearing work are the removal and disposal of fallen trees and driftwood which are lodged on the immediate bank slopes adjacent to the primary channel and the clearing and disposal of prominently leaning trees which overhang, and are in danger of falling into, the primary channel. Standing trees to be removed includes all trees located within the wetted perimeter of the primary channel and standing trees whose root systems are exposed due to undermining. All vegetation which aids in reducing bank erosion and does not interfere with streamflow should remain intact (see Figure 1).

IV. FIELD INVENTORY AND COST ESTIMATES

The results of the field inventory indicate that the river channel and bank slopes contain a sufficient amount of snags and debris so as to



Debris and leaning trees would be removed from the primary channel. In addition, some trees and brush would be removed that are on eroded banks or very low on the bank in the primary channel. The upper limit of clearing is the top of the primary bank.

EXTENT OF CLEARING AND SNAGGING TO BE DONE

Figure 1

TABLE I

Estimated Quantities

Reach	River Mile	No. of Standing Trees	No. of Fallen Trees	No. of Stumps	Cubic Yards of Snags and Debris
1	0-2	36	8	0	0
2	2-3	42	25	16	120
3	3-4	65	30	18	100
4	4-6	255	95	45	1,000
5	6-7	110	35	15	0
6	7-8	212	70	30	500
7	8-10	182	110	22	225
8	10-12	280	95	30	800
9	12-13	85	30	5	200
10	13-15	310	90	35	1,200
11	15-16	180	55	25	600
12	16-17	240	45	40	480
13	17-18	42	20	5	0
14	18-19	70	26	10	0
15	19-21	24	0	0	130
16	21-22.5	0	0	0	0
TOTALS		2,133	734	296	5,355

TABLE II-A

Cost Estimate A

Reach	No. of Standing Trees @ $12/each	Sub-Total	No. of Fallen Trees @ $9/each	Sub-Total	No. of Stumps @ $7/each	Sub-Total	Cubic Yards of Snags & Debris @ $5/c.y.	Sub-Total	Total Per Reach
1	36	$ 432	8	$ 72	0	$ 0	0	$ 0	$ 504
2	42	504	25	225	16	112	120	600	1,441
3	65	780	30	270	18	126	100	500	1,676
4	255	3,060	95	855	45	315	1,000	5,000	9,230
5	110	1,320	35	315	15	105	0	0	1,740
6	212	2,544	70	630	30	210	500	2,500	5,884
7	182	2,184	110	990	22	154	225	1,125	4,453
8	280	3,360	95	855	30	210	800	4,000	8,425
9	85	1,020	30	270	5	35	200	1,000	2,325
10	310	3,720	90	810	35	245	1,200	6,000	10,775
11	180	2,160	55	495	25	175	600	3,000	5,830
12	240	2,880	45	405	40	280	480	2,400	5,965
13	42	504	20	180	5	35	0	0	719
14	70	840	26	234	10	70	0	0	1,144
15	24	288	0	0	0	0	130	650	938
16	0	0	0	0	0	0	0	0	0
	2,133	$25,596	734	$6,606	296	$2,072	5,355	$26,775	$61,049

Contingencies (30%) $61,049 x 0.30 = $18,315 + $18,315

Grand Total $79,364

TABLE II-B

Cost Estimate B

Reach	No. of Standing Trees @ $20/each	Sub-Total	No. of Fallen Trees @ $10/each	Sub-Total	No. of Stumps @ $10/each	Sub-Total	Cubic Yards of Snags & Debris @ $10/c.y.	Sub-Total	Total per Reach
1	36	$ 720	8	$ 80	0	$ 0	0	$ 0	$ 800
2	42	840	25	250	16	160	120	1,200	2,450
3	65	1,300	30	300	18	180	100	1,000	2,780
4	255	5,100	95	950	45	450	1,000	10,000	16,500
5	110	2,200	35	350	15	150	0	0	2,700
6	212	4,240	70	700	30	300	500	5,000	10,240
7	182	3,640	110	1,100	22	220	225	2,250	7,210
8	280	5,600	95	950	30	300	800	8,000	14,850
9	85	1,700	30	300	5	50	200	2,000	4,050
10	310	6,200	90	900	35	350	1,200	12,000	19,450
11	180	3,600	55	550	25	250	600	6,000	10,400
12	240	4,800	45	450	40	400	480	4,800	10,450
13	42	840	20	200	5	50	0	0	1,090
14	70	1,400	26	260	10	100	0	0	1,760
15	24	480	0	0	0	0	130	1,300	1,780
16	0	0	0	0	0	0	0	0	0
	2,133	$42,660	734	$7,340	296	$2,960	5,355	$53,550	$106,510

Contingencies (30%) $106,510 x (.30) = $31,953

+ $ 31,953

Grand Total $138,463

impair streamflow in the channel. Table 1 summarizes the estimated quantities of standing trees, fallen trees, stumps, and cubic yards of snags and debris as reported in the field inventory for each reach. Each reach consists of one or more river miles. Table 11-A and 11-B contain cost estimates for each reach and a total estimated project cost, including contingency costs amounting to 30% of the actual construction costs. Contingency costs include variable and unforeseen costs such as increased costs for fuel and labor, accessibility to the project site, delays due to breakdown of equipment or landowner problems, administrative costs, etc.

The cost estimate from Table 11-A was derived by inflating the 1978 unit costs of a snagging and clearing project designed by the State Water Commission. The per unit price shown in Table 11-A represents an inflation factor of approximately 29%. The cost estimate from Table 11-B was derived by adjusting the per unit price upward again after consulting with the Corps of Engineers in St. Paul, Minnesota, a consulting engineering firm, and a general contractor concerning estimating snagging and clearing projects. The two widely varying estimates indicate the difficulties in estimating the actual cost of a project of this nature. Hopefully, the actual cost of the project would lie closer to the $79,364 estimate, but it is possible the costs could go as high or higher than the $138,463 estimate. On a cost per mile basis, the estimate from Table 11-A yields a cost of $3,527 per mile, while the estimate from Table 11-B yields a cost of $6,154 per mile.

V. BRIDGE INVENTORY AND HYDRAULICS

An inventory of the 12 bridges located along the 22.5 mile stretch of river is presented in Table III. The first six bridges are located in

Grafton. Sufficient data was available on these bridges to evaluate their ability to pass flood flows of various frequencies. The only information available on the last six bridges were the physical dimensions of each structure and whether or not any debris had collected under the bridge. The last six bridges are all located east of Grafton. The location of each bridge is shown on the map included in this report.

The structures that are most critical to the flooding problem in Grafton are the first six bridges located within the city. In order to prevent flood flows from being constricted and backing up behind the structure, the bridge design must allow for a sufficient waterway opening beneath the bridge deck. The area of the waterway opening is measured from abutment to abutment and from the lowest member of the bridge deck to the channel bottom. It is also important that bridge piers within the waterway opening are not constructed too close together, thereby increasing the possibility of debris or ice lodging between piers and further obstructing flow during spring runoff.

In order to evaluate the ability of the six bridges to pass flood flows, the 10-year, 50-year, 100-year, and 500-year flood flows were routed through Grafton. The corresponding volume of water resulting from each of the aforementioned flood frequencies is shown in Table IV.

TABLE IV

Flood Frequency (yr.)	Flood Flow (cfs)
10	4,600
50	12,300
100	15,800
500	25,100

At each bridge, the cross-sectional flow area was calculated for each flood frequency. From this, the water surface elevation could be determined at each structure. When the computed water surface elevation is equal to or greater

Park River Bridge
Snagging and Clearing Inventory

Bridge & Location	Overall Length	Overall Width	No. of Piers	Length Between Piers	Elev. of Lowest Bridge Chord	Elev. of Channel Bottom	Maximum Waterway Depth	Flood Frequency (yr.)	X-Sect. Area of Flow (ft^2)	Computed Water Surface Elev.
1. Kittson Ave. No. 142-09 Mile 1-2	77'	17'-9"	0	74'-2"	827.40	809.80	17.6'	10	1,401	824.57
								50	7,484	828.87
								100	9,216	829.44
								500	18,381	832.44
2. Highway 81 No. 191.79 Mile 1-2	170'	42'	2	56'-10" 56'-4" 56'-10"	828.50	811.00	17.5'	10	1,318	824.40
								50	2,134	828.05
								100	2,237	828.18
								500	18,400	832.28
3. Railroad Br. Highway 81 Mile 1-2	171'	-	2	60' 111'	827.50	812.90	14.6'	10	1,196	824.37
								50	1,773	827.89
								100	1,769	827.87
								500	26,943	832.25
4. Wakeman Ave. No. 142-09.1 Mile 2-3	86'	19'-9"	1 (Temp. Pier)	82'	825.40	807.60	17.8'	10	917	823.87
								50	5,105	827.48
								100	7,983	828.37
								500	37,663	832.17
5. Railroad Br. E. of Wakeman Mile 2-3	152'	-	9	10@15'	829.70	806.40	23.3'	10	1,683	823.47
								50	2,078	825.87
								100	2,079	826.11
								500	2,079	826.67
6. Burgamott Ave. No. 143-09.1 Mile 3-4	70'	19'-9"	0	68'	823.40	802.80	20.6'	10	1,104	822.40
								50	7,701	825.14
								100	10,036	825.75
								500	15,008	827.04

Park River Bridge
Snagging and Clearing Inventory

	Bridge & Location	Overall Length	Overall Width	No. of Piers	Length Between Piers	Depth of Deck	Debris Under Structure	Estimated Maximum Capacity (cfs)
7.	BR 144-08 Mile 7-8 Sec. 8-9	48'	20'	1	23' 24'	1'-4"	Yes	1,800
8.	BR 145-07 Mile 10-11 Sec. 3-4	57'	24'	0	55'	-	No	2,300
9.	BR 146-8.1 Mile 12-13 Sec. 10	80'	17'-8"	0	77'	1'	Yes	3,900
10.	BR 146-08 Mile 13-14 Sec. 10-11	81'	17'-8"	1	48'-6" 31'	2'-10"	No	4,000
11.	BR 148-08 Mile 16-17 Sec. 12	120'	22'	2	36' 47' 36'	3'	No	6,800
12.	BR 148-07 Mile 20-21 Sec. 1-6	87'	17'-8"	0	84'-6"	1'	No	4,400

than the elevation of the lowest bridge chord, the flow of water will be hindered and water will begin to back-up behind the structure. At this point, flooding in the vicinity of the bridge increases and the bridge begins to lose stability due to lateral loads.

In reviewing the data for the six bridges in Grafton, all of them can safely pass the 10-year flood of 4,600 cfs. The 50-year flood, though, of 12,300 cfs threatens four bridges. The bridges on Kittson Avenue, Wakeman Avenue, and Burgamott Avenue have water from one to two feet above the elevation of the lowest bridge member. Also, the railroad bridge near Highway 81 has water level with the lowest chord. These bridges may be unsafe at this flood flow. The remaining two bridges, which are the Highway 81 bridge and the railroad bridge east of Wakemen Avenue, are not threatened until the 500-year flood. The railroad bridge east of Wakeman Avenue does present a problem with nine piers on 15 foot centers. This bridge is very susceptible to log and ice jams which could contribute to flooding problems in the vicinity.

The six bridges east of Grafton were also evaluated for their unrestricted flow capacity, except the capacities are based on estimated data. The capacity figures in the table, therefore, are also estimates and given mostly for comparison of hydraulic characteristics. If these bridges did constrict or cause flood flows to back-up behind them, most of the damage in the area would be limited to agricultural fields east of Grafton. The debris, though, which is present underneath two of these bridges, should be removed as a precaution against hindering flood flow.

VI. ADDITIONAL FLOOD PROTECTION MEASURE

One other item investigated was the possibility of constructing a flood bypass channel just south of the water treatment plant that would assist in

routing flood flows through Grafton. The bypass channel would isolate a meander approximately one-half mile long which is bordered by private homes on its south bend. The proposed bypass channel is shown on the attached map. The channel would be constructed near the southern edge of Section 7, Township 157 North, Range 52 West and isolate the meander in the northwest corner of Section 18, same township and range, from peak flows of smaller floods.

The bypass channel would be from 500 to 600 feet long. Its depth and width would depend on the amount of flow it would be expected to handle. For example, if the channel was designed to help pass the 10-year flood flow of 4,600 cfs, the main river channel could be expected to handle approximately 2,000 cfs leaving the remainder, or 2,600 cfs, to be handled by the flood bypass channel. At this time, the idea is presented mostly for thought and could be pursued if the city of Grafton is receptive to the idea.

VII. CONCLUSION AND RECOMMENDATIONS

The results of the field inventory of the 22.5 mile segment on the main branch of the Park River reveals many reaches that have numerous obstructions to flow along both banks. Reach 1 through 3, which consists of the first four miles of river channel in the project and is the portion of channel which runs through the city of Grafton, contains small quantities of trees, stumps, and debris. Though the quantities are small, they should be removed, since the surrounding area along both banks contains housing and business developments.

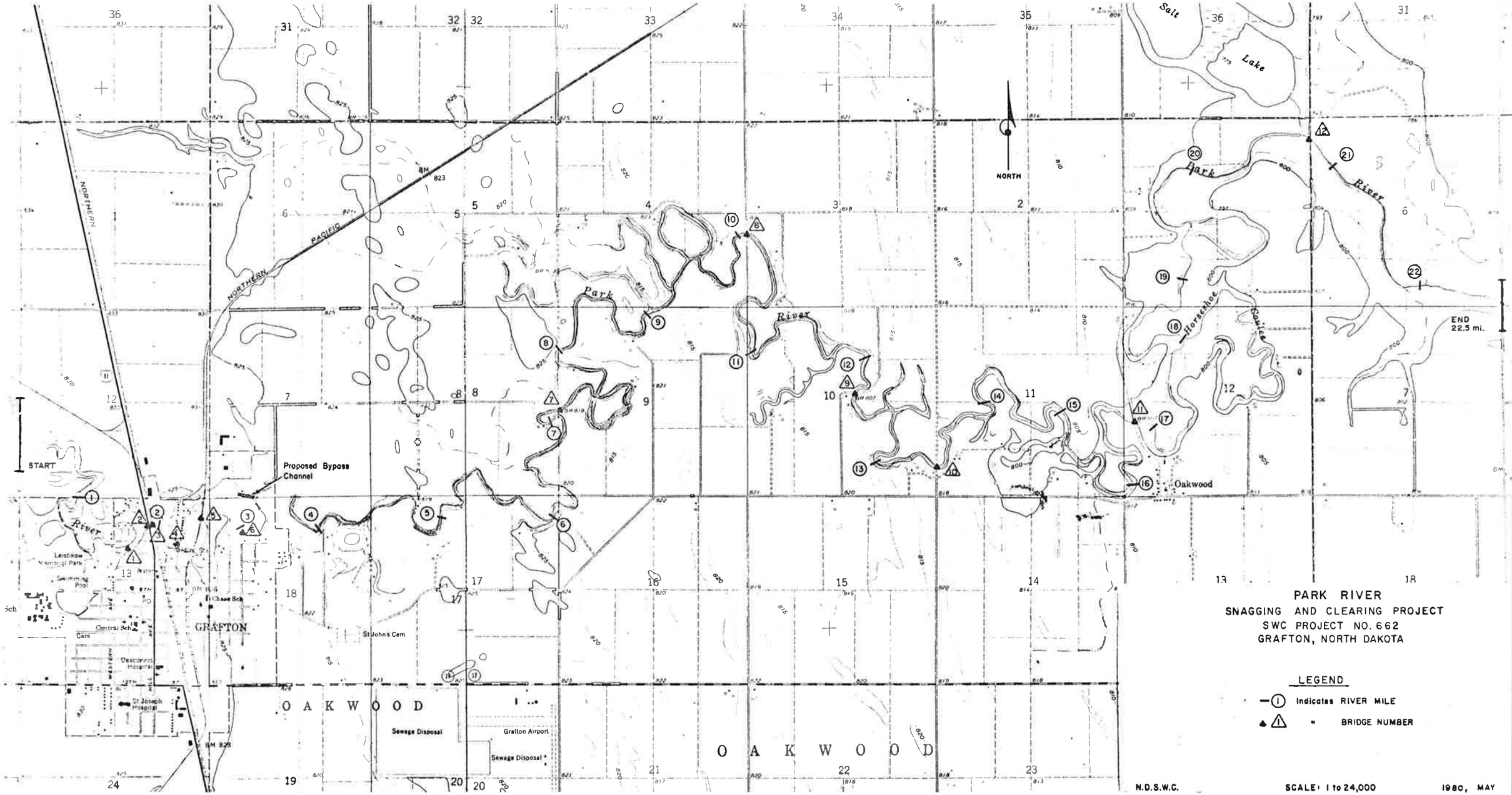
Reach 4 through 12, which starts at river mile 4 and runs through river mile 17, is the most congested stretch of channel in the project. This stretch lies immediately east of Grafton. It is very important that this 13 mile stretch of river be clear of snags and debris so as to allow water to

flow unhindered through the area. If flow is obstructed in this stretch, the backwater which would build up could threaten property within Grafton. A clear waterway east of Grafton is a critical factor in reducing flooding problems in Grafton.

The final reaches of the project, which includes Reach 13 through 16, are fairly clear of obstructions. The channel just east of the town of Oakwood could have some of the standing and fallen trees removed to provide increased protection for the town. Beyond river mile 19 the quantities of trees and snags are negligible.

Again, another flood protection measure that could be investigated further is the construction of a flood bypass channel just south of the water treatment plant. The channel could be designed to carry flood flows across the neck of a channel meander, thereby isolating a half mile section of river from low flood flow and protecting numerous structures built adjacent to the river channel.

Finally, several bridges should be studied for possible structural or waterway improvements. In the city of Grafton, the small truss bridges on Kittson Avenue, Wakeman Avenue, and Burgamott Avenue are threatened by flood flows greater than 10,000 cfs. Also, due to the deteriorating condition of the Wakeman Avenue bridge, we recommend it be replaced. The railroad bridge east of Wakeman Avenue could also cause increased flooding problems in the surrounding area due to the close spacing of piers. If the structure is not improved, equipment should be available during floods to break up an ice or log jam that may occur on the upstream side of the bridge. Bridges east of town are estimated to have rather limited capacities, especially Bridge No. 7 and 8. If they cause flooding problems or are unsafe during flood conditions, we recommend that the County Engineer be made aware of the problems and remedies to the problems be pursued.



PARK RIVER
SNAGGING AND CLEARING PROJECT
SWC PROJECT NO. 662
GRAFTON, NORTH DAKOTA

LEGEND

—(1) Indicates RIVER MILE

▲ 1 " BRIDGE NUMBER

N.D.S.W.C. SCALE: 1 to 24,000 1980, MAY

APPENDIX A

PHOTOS

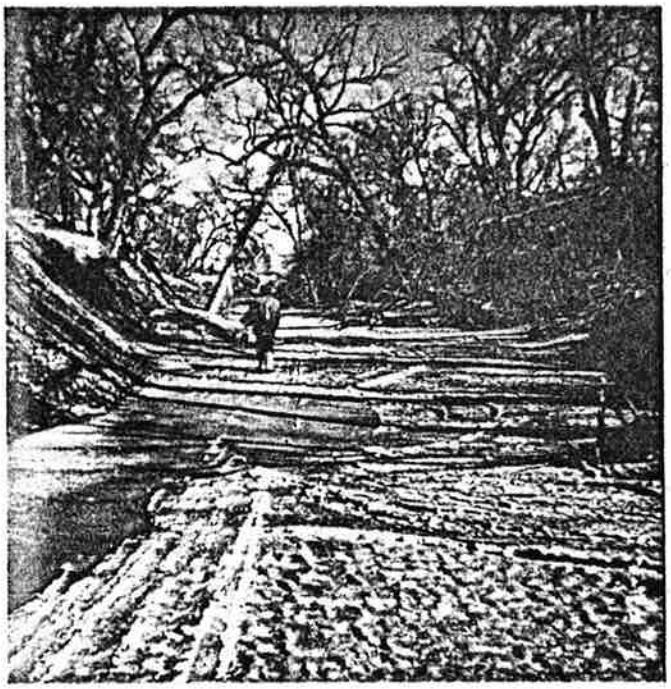


Photo 1: Debris, snags, and leaning trees in the Park River channel between mile 5 and 6.

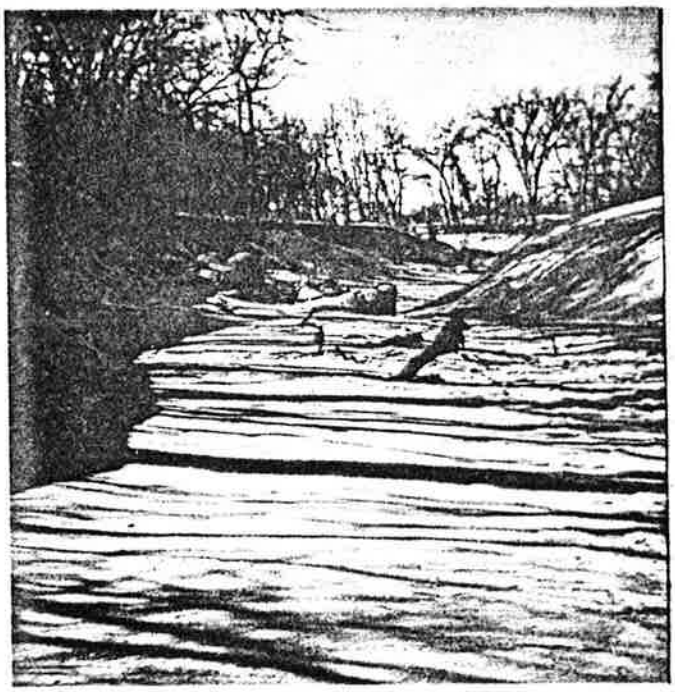


Photo 2: Stumps and debris in river channel between mile 5 and 6.

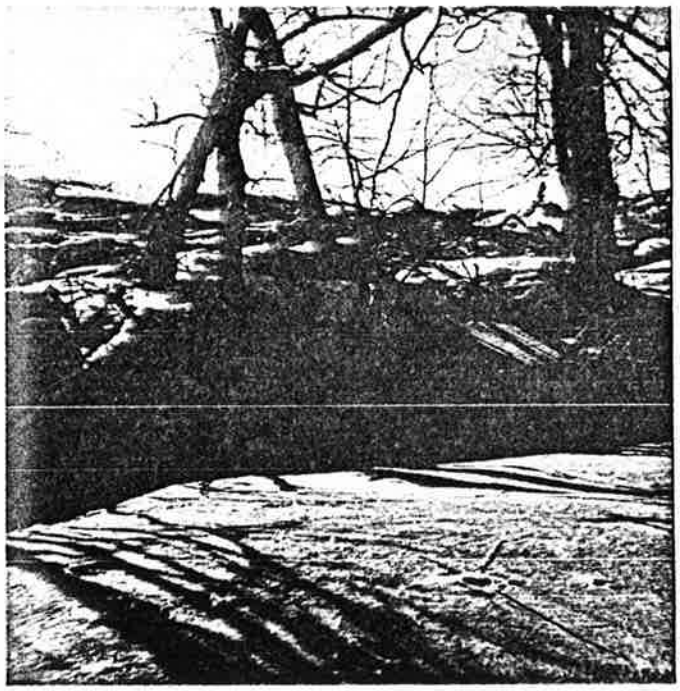


Photo 3: Debris and fallen trees on river bank between mile 5 and 6.

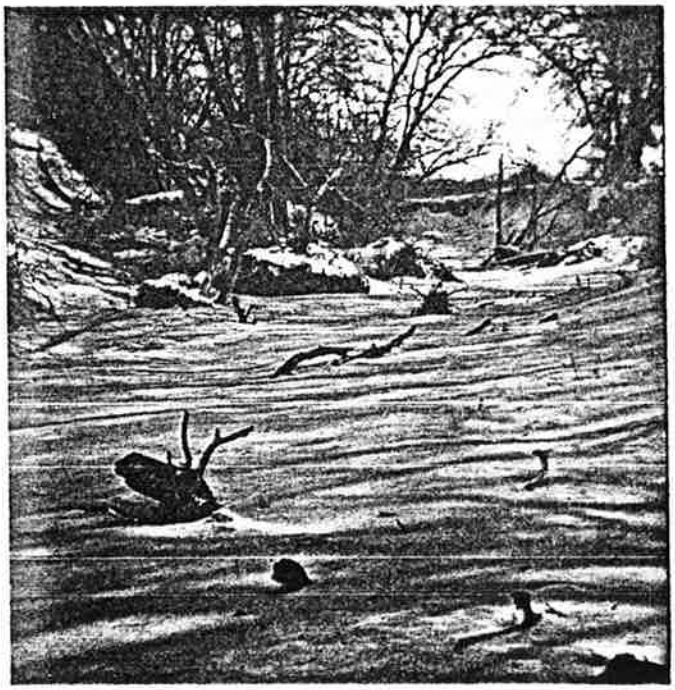


Photo 4: Embankment, with trees, which have sluffed into the river channel creating heavy block.

Photo 5: Fallen trees creating a snag in the river channel between mile 8 and 9.

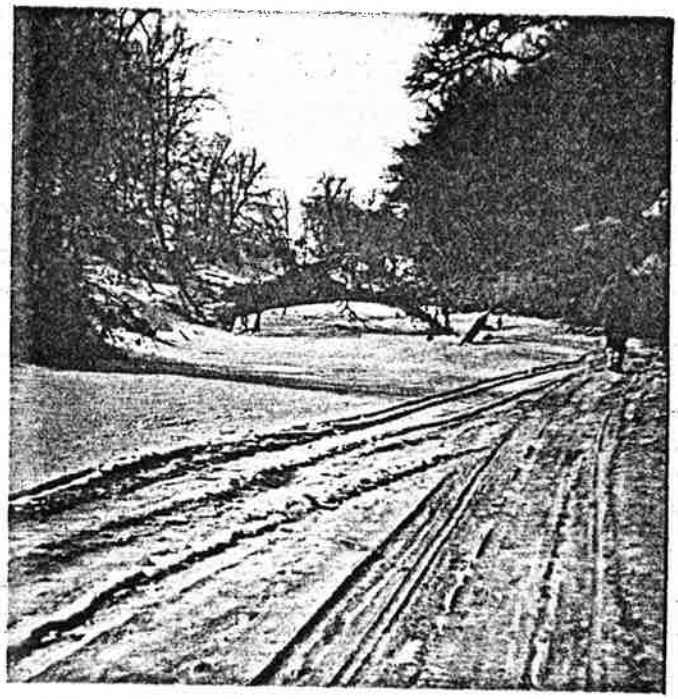


Photo 6: Debris and snag in river channel between mile 8 and 9.

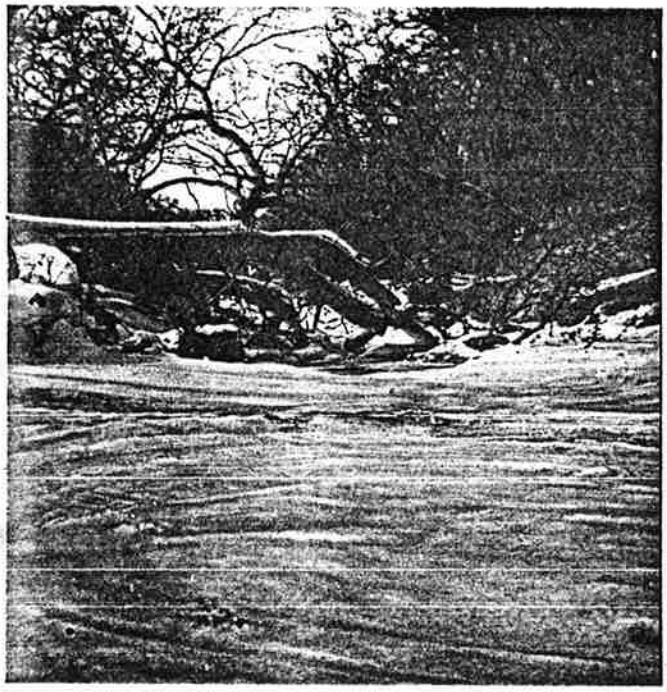


Photo 7: Heavy snag created by large fallen tree located between mile 8 and 9.

Photo 8: Trees in river channel between mile 8 and 9.

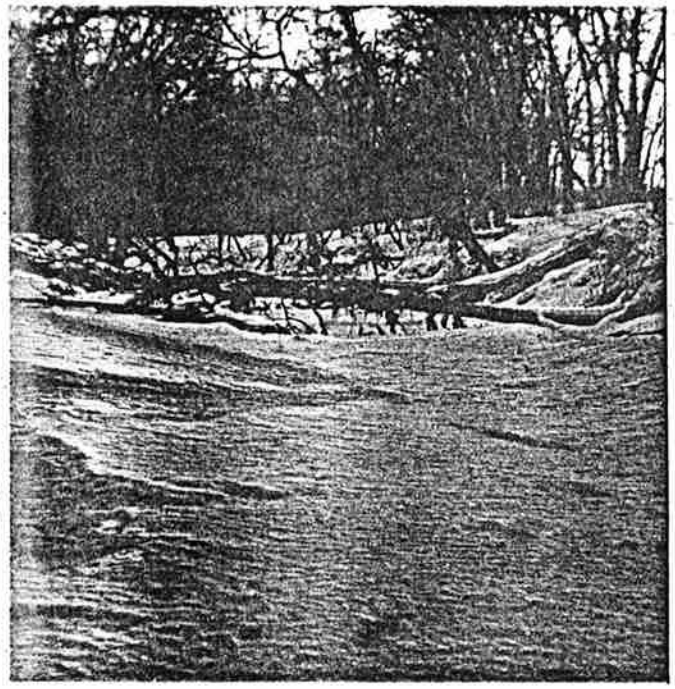


Photo 9: Several snags in the river channel created by fallen trees between mile 11 and 12.

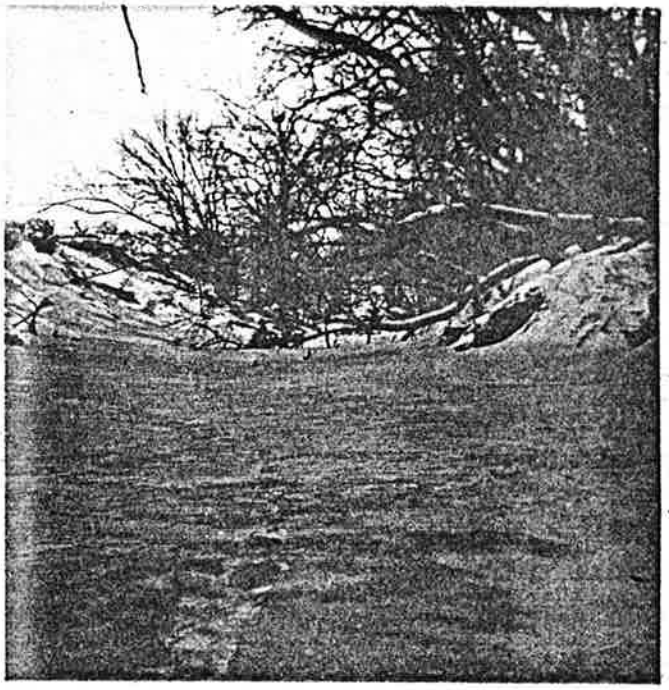


Photo 10: Leaning trees over river channel located between mile 11 and 12.

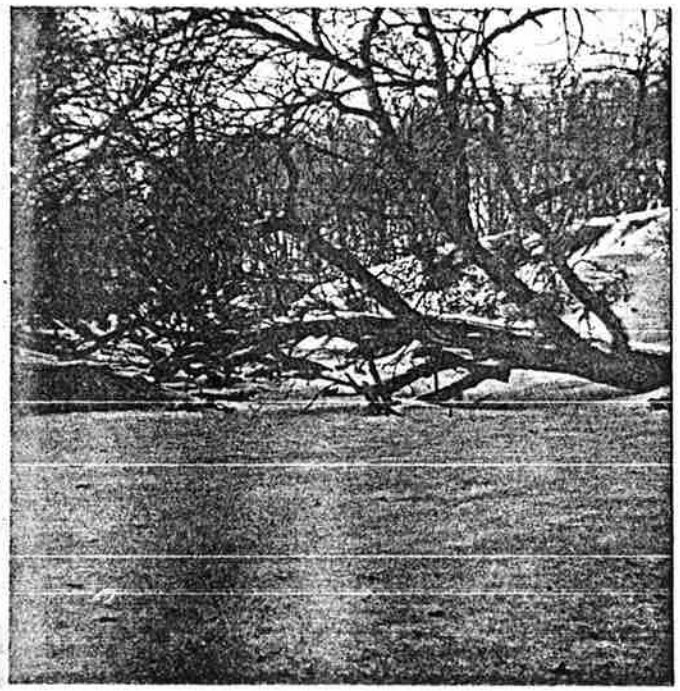


Photo 11: Large snag across river channel located between mile 12 and 13.

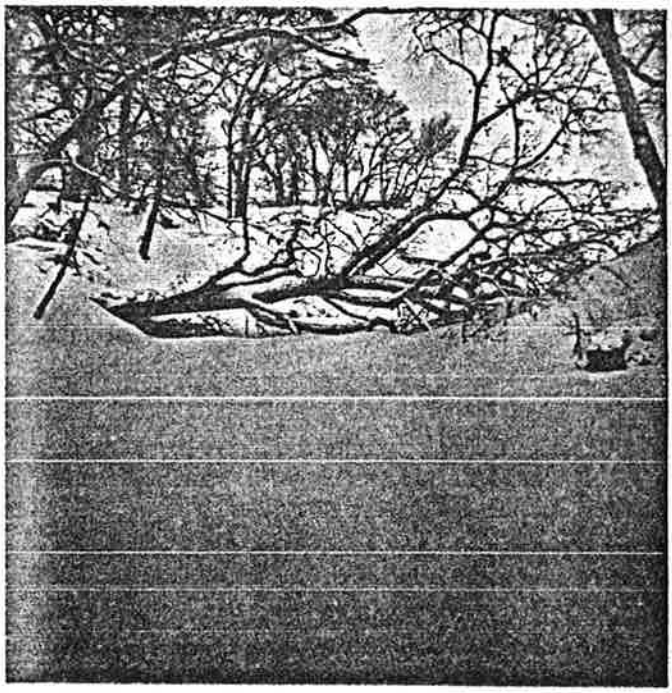


Photo 12: Another large snag blocking the river channel between mile 15 and 16.

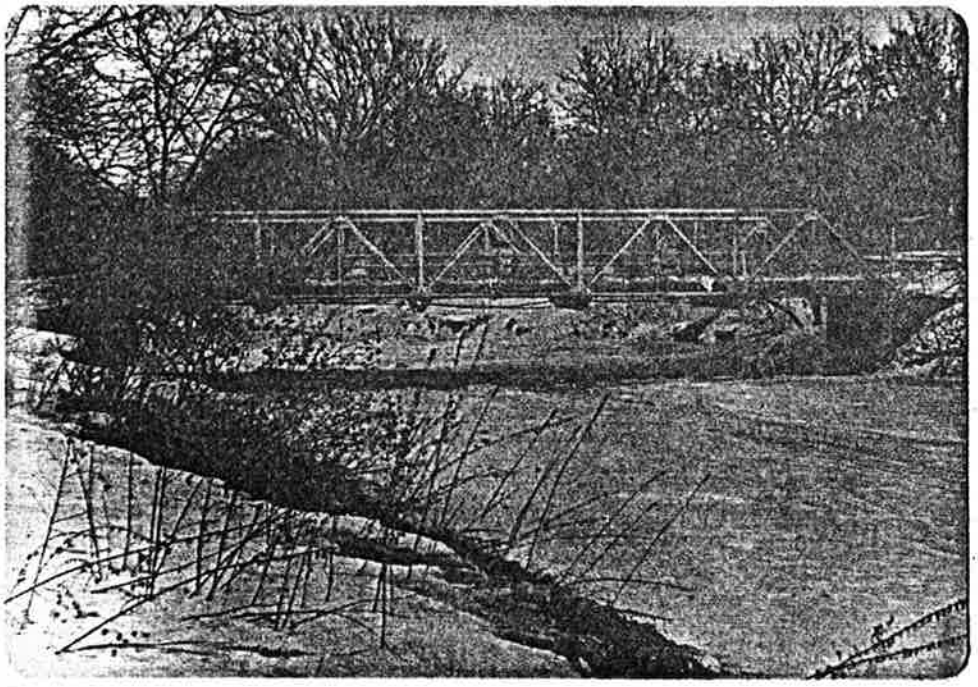


Photo 13: Kittson Avenue bridge in northwest Grafton. View of upstream side.

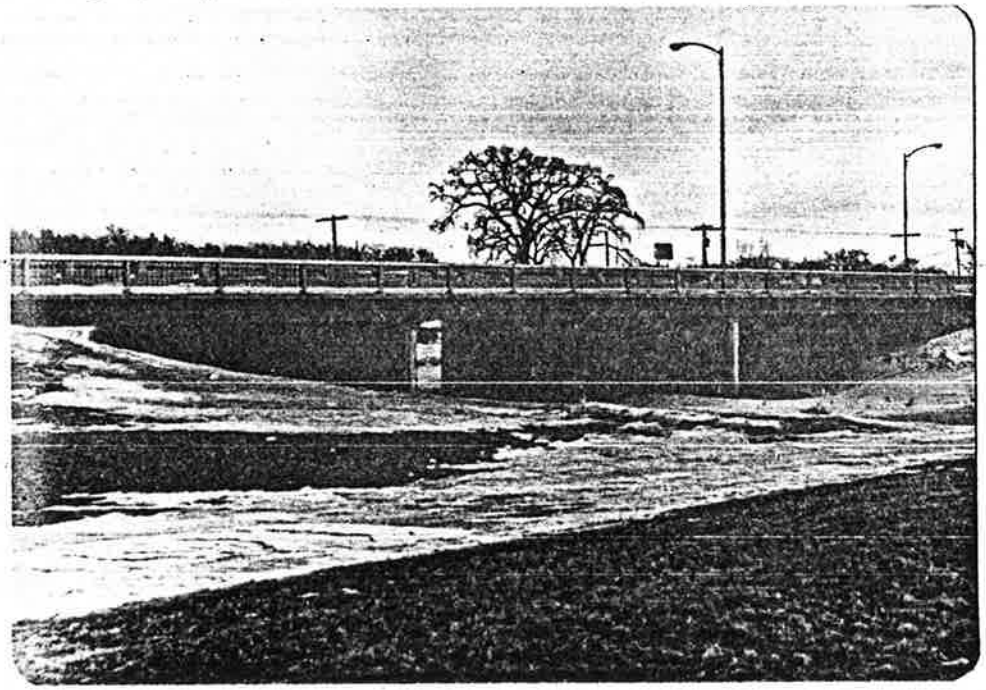


Photo 14: Highway 81 bridge in north Grafton, upstream side.

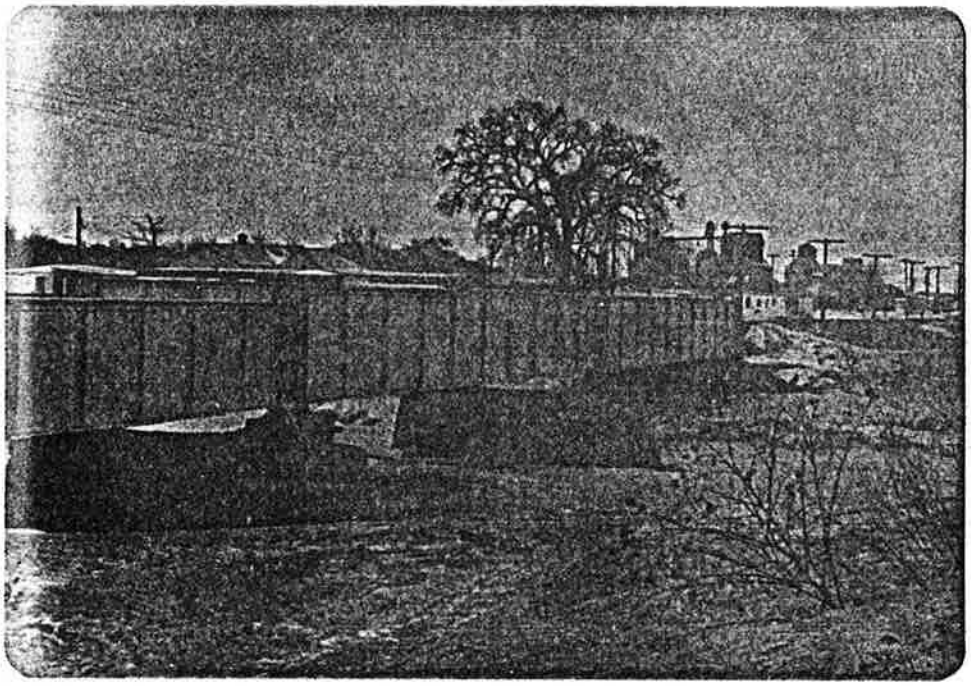


Photo 15: Railroad bridge paralleling
Highway 81 bridge.
View of downstream side.

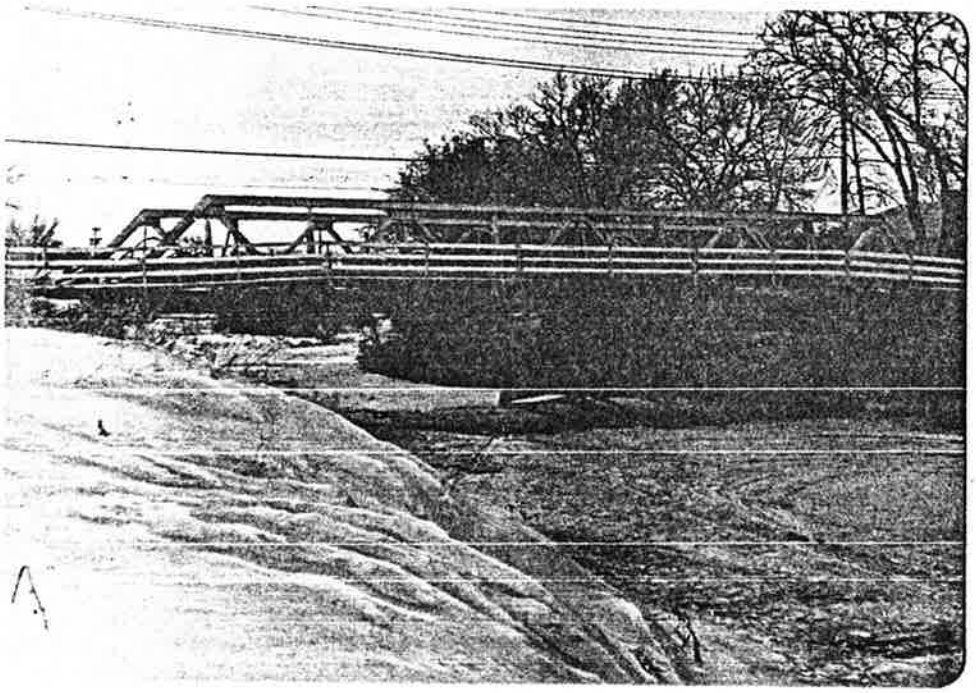


Photo 16: Downstream side of
Wakeman Avenue bridge.

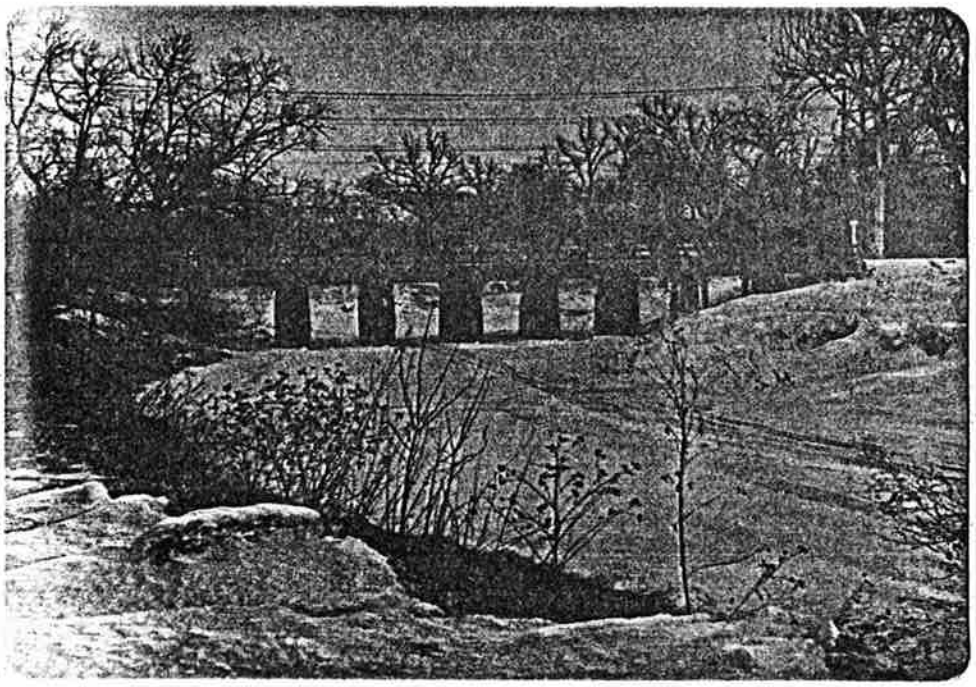


Photo 17: Timber railroad bridge
located east of Wakeman Avenue.
View is of upstream side.

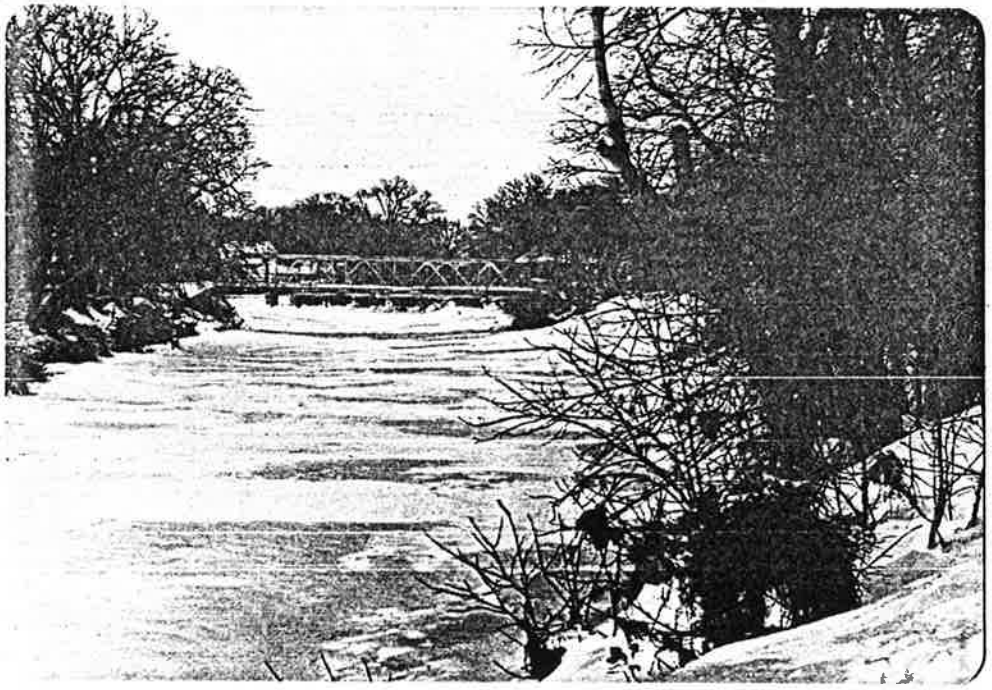


Photo 18: Burganmott Avenue bridge
located in east Grafton.
View of upstream side.

APPENDIX B

PRELIMINARY INVESTIGATION AGREEMENT

SWC Project #662
March 3, 1980

AGREEMENT

Preliminary Investigation
by the
North Dakota State Water Commission

I. PARTIES

THIS AGREEMENT is entered into by and between the North Dakota State Water Commission, hereinafter referred to as the Commission, acting through the State Engineer, Vern Fahy; and the Board of Commissioners, Walsh County Water Management District, hereinafter referred to as the Board, acting through its Chairman, Charles Zahradka.

II. PROJECT, LOCATION AND PURPOSE

The Board has requested the Commission to investigate and determine the feasibility of a snagging and clearing project on the Park River. This investigation shall extend from the point where the channel intersects the section line common to Sections 11 and 12, Township 157 North, Range 53 West, through the City of Grafton, North Dakota, to the point where the channel intersects the section line common to Sections 5 and 6, Township 157 North, Range 51 West, in Walsh County. The purpose of the investigation is to determine the condition and adequacy of the river channel and appurtenant structures, determine the needed improvements and prepare a cost estimate for the snagging and clearing operation.

III. PRELIMINARY INVESTIGATION

The parties agree that further information is necessary concerning the proposed project. Therefore, the Commission shall conduct a preliminary investigation consisting of the following:

1. Inspect that portion of the channel described in Section II of this agreement to inventory material that should be removed from the primary channel.
2. Inventory all bridges along this reach of the channel.
3. Prepare a detailed cost estimate for the project.

The investigation shall consist of only those items outlined herein. Field surveys and design work for the construction phase of this project shall not be included in this agreement.

IV. DEPOSIT - REFUND

The Board shall deposit $1,500.00 with the Commission to partially pay the costs of the investigation. Upon completion of the investigation outlined herein, upon receipt of a request from the Board to terminate the investigation, or upon a breach of this agreement by any of the parties, the Commission shall provide the Board with a statement of all expenses incurred in the investigation and shall refund to the Board any unexpended deposit funds.

V. RIGHTS OF ENTRY

The Board agrees to obtain written permission from any affected landowner allowing the Commission to enter upon their property to conduct field surveys which are required for the investigation.

VI. INDEMNIFICATION

The Board hereby accepts responsibility for and holds the Commission free from all claims and damages to public and private properties, rights or persons arising out of this investigation. In the event a suit is initiated or judgment rendered against the Commission, the Board shall indemnify it for any judgment arrived at or judgment satisfied.

VII. CHANGES TO AGREEMENT

Changes in any contractual provisions herein will not be effective or binding unless such changes are made in writing, signed by the parties, and attached hereto.

BOARD OF COMMISSIONERS
WALSH COUNTY WATER MANAGEMENT BOARD

Charles Zahradka
Chairman

March 7 1980.
DATE

NORTH DAKOTA STATE WATER COMMISSION

Vernon Fahy
State Engineer

3/4/80
DATE

Distribution
Board (1)
SWC Project #662 (1)
SWC Accountant (1)
SWC Investigation Engineer (1)