Inland Waters Directorate
Western and Northern Region

Direction générale des eaux intérieures
Région de l'ouest et du nord

SEDIMENT STATION PROFILE

MACKENZIE RIVER ABOVE ARCTIC RED RIVER

10LA003

by

W. Aitken, P.Eng.

for

Water Planning and Management Br.
Northwest Territories Programs
Inland Waters and Lands
Conservation and Protection
Yellowknife, NWT

January 1987

NWT-IW/L-WPM-0002

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SEDIMENT STATION PROFILE

This report is intended to draw together, in a single document, information relating to sediment data gathering activities on the Mackenzie River at Arctic Red River.

STATION NUMBER: 10LA003 **CLASSIFICATION:** Federal

STATION NAME: Mackenzie River above Arctic Red River

PROFILE CONTENTS: Profile Started: November 1986 by W. Aitken

Last Update: _____

1. Objectives Of Program

The objective of this station was to provide data on the sediment load contributed by the Mackenzie River to the Mackenzie Delta.

2. Station History

1972 This station was established by Water Survey of Canada with the objective of determining sediment discharge into the Mackenzie Delta.

1975 The station was discontinued.

1980 The station was reactivated. B.C. Hydro requested that the station continue to be operated and provded funding for the operation. Data were required for feasibility studies related to hydro development on the Liard River which is a major contributor of sediment to the Mackenzie River.

1985 B.C. Hydro discontinued fundind and WSC continued to operate station with joint funding from Indian and Northern Affairs Canada (INAC).

1986 INAC funding was withdrawn. WSC continued to operate the station as a federal station.

The sediment program started in 1972 with the first sample taken on July 13. The program operated during open water from 1972 until 1974 at which time it was discontinued. In 1980 the program was reactivated and has been continuous during open water since then.

3. Basin Information

The Mackenzie River Basin drains one-fifth of the total area of Canada and its area of almost 2,000,000 km^2 make it one of the world's largest river systems. The Mackenzie River system is both Canada's largest drainage area and longest river, flowing approximately 4,000 km from the Finlay River headwaters in B.C. to the Beaufort Sea. The basin includes three major lakes, two significant freshwater deltas and the world's tenth largest marine delta. The basin includes portions of British Columbia, Alberta, Saskatchewan, Yukon and Northwest Territories.

Most of the sediment at this site comes from two sources: 1) the mainstem of the Mackenzie River; and 2) the Liard River. Sediments carried by the Athabasca, Peace and Slave Rivers are settled or filtered out by the Peace Athabasca Delta, the Slave River Delta and finally by Great Slave Lake.

Commercial ventures in the basin cover almost all sectors of the Canadian economy and include hydroelectric power generation, oil and gas production, transportation, mining, agriculture, forestry, fishing, hunting, trapping and tourism.

The total drainage area above the "Mackenzie River at Arctic Red River" gauging station is estimated to be 1,660,000 km^2. The flow at this station is essentially natural. Although many small reservoirs and one relatively large one, Williston Lake, are located in the basin the total live storage of these reservoirs is dwarfed in comparison to the live storage of Great Slave Lake. This huge natural reservoir eliminates virtually any man made changes to the flow regime. The only influence of Williston Reservoir on Great Slave Lake hydrographs is the change in slope during winter; stage now rises in the period November to April. Prior to 1968 stage descreased. The mean annual discharge for the period 1973 to 1984 is 8940 m^3/s. A maximum daily discharge of 34,000 m^3/s was recorded on May 28, 1975 and a minimum daily discharge of 1680 m^3/s was recorded on December 2, 1980. The highest peak discharge recorded at this station occurred in 1975 when the sediment program was inactive. The next highest event occurred on May 23, 1985 with a maximum daily discharge of 32,900 m^3/s. The largest annual volume of water was recorded in 1974 (337,000,000 dam^3). The minimum daily discharge on record occurred on December 2, 1980 with a discharge of 1680 m^3/s. The smallest total annual flow also occurred in 1980 with a discharge of 240,000,000 dam^3.

Generally the flow at this station begins to rise in late April and peaks near the end of May. In July and August there are normally rainstorm peaks but these are rarely as large as the spring snowmelt peak.
The average annual precipitation varies greatly over the basin. Values range from 266 mm at Inuvik, 425 mm at Watson Lake, 345 mm at Uranium City, 501 mm at Hinton, 298 mm at Yellowknife and 382 mm at Fort Vermilion.

Other water quantity stations in the basin are too numerous to list here but we can summarize by saying that all stations with Water Survey of Canada station numbers starting with the digits '07' and '10' are in the basin. A similar statement can be made of the sediment stations.

4. Reach Description

The Mackenize River above Arctic Red River station is located on the left bank approximately 14 km above the community of Arctic Red River. The reach is relatively straight upstream of the gauge. The river has a very large radius bend downstream of the site which takes the flow through a 110° turn to its confluence with the Arctic Red River.

The gauge was established in 1972 and underwent no location change until 1986 when it was moved to the settlement of Arctic Red River. The sediment sampling site has remained in the same location.

Instruments are located in a standard shelter stage and record is produced in ink by an A-71 Stevens recorder activated by a manometer. The record is considered good for most years.

5. Availiable Station Data

A sediment data is published in a book called 'Sediment Data, Yukon and Northwest Territories'.

1) Bed Load

None collected to date.

2) Bed Material

1973 Two sets of bed material samples were taken. Seven samples were taken on each of July 10 and September 25, one at each bank and five at equal intervals in between. A 'Lane' sampler was used for the earlier samples and a note on the sheet indicates that the depths (up to 60 feet) are to great for this type of sampler. A 'BM-54' sampler was used on September 25.

1974 One set of seven samples was taken using a 'Shipek' type sampler.

3) Hydraulic

Discharge and sediment measurement data available from the field notes (1972 - present). Data is published in annual 'Surface Water Data' books and in the 'Historical Streamflow Summary'.

4) Dissolved Solids Data

Available for the period of record.

5) Suspended Sediment Data

Types

- suspended sediment concentration
- suspended sediment particle size

Sampling Equipment

A D-49 sampler was used from a boat for all samples except the quality control samples in 1984 and 85 which were taken using a P-61 sampler.

Single Vertical Location

Samples were taken at a float 192 m from the right bank at a point 3.8 km below the measurement section.

Sampling Procedure

Samples were taken using depth integrating procedures.

Observer

The observer is paid at a per sample rate.

Technician

Numerous technicians have taken samples.

Sampling Program

Single Vertical Samples (Sampled days)

Year	#of Sampled days
1972	3
1973	21
1974	13
1975	8
1980	33
1981	43
1982	46
1983	37
1984	67
1985	51
Total	322

Five Vertical Samples

Year	#of Sampled days
1972	0
1973	2
1974	3
1975	0
1980	2
1981	1
1982	1
1983	0
1984	1
1985	1
Total	11

Particle Size Year	Number of Single Vertical Samples	Number of Multiple Vertical Samples
1972	1	1
1973	10	1
1974	0	2
1975	2	0
1980	6	1
1981	4	0
1982	5	1
1983	5	0
1984	21	
1985	5	

Flow Range Sampled

The minimum sampled discharge was 7000 m^3/s on October 14, 1981 with a concentration of 44 mg/l. The maximum sampled discharge was 28,200 m^3/s on June 6, 1982 with a concentration of 482 mg/l. On August 12, 1974 a concentration of 9640 mg/l was sampled at a discharge of 28,000 m^3/s.

6. Conclusions

The sediment station Mackenzie River above Arctic Red River has now been operated for more than 10 years with a relatively large number of samples taken during open water periods.

An analysis of peak and total annual discharge data, when compared to the longer term station at Fort Simpson, indicate that the data at this station are representative of longer term conditions.

No samples have been taken during the period November to April. The reason for this is that observations made during this period indicate the water is clear and there for there is very little load.

7. Recommendations

1) An in depth analysis of the data should be conducted to determine if collection of additional data is beneficial.

2) Several miscellaneous samples should be taken during the November-April period to confirm the observation that the load is small.

10230

Date Due
