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1988–89 SUMMARY REPORT For

REVIEW OF HYDROMETRIC SURVEY DATA To 1986

For Selected Gauging Stations

In the Northwest Territories

Inland Waters and Lands
Western and Northern Region

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For Selected Gauging Stations

In the Northwest Territories

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1. INTRODUCTION

The **purpose** of this contract was to carry out an in-depth review of historical hydrometric survey data for selected gauging stations in the Northwest Territories in order to find and correct **significant errors** in the original computations; and to make recommendations for improving future data collection and computation methods to ensure that **national standards** are maintained.

Prior to 1981, data were collected and computed by the Alberta District, **Calgary** Office (and Fort Smith, Fort Simpson, Norman Wells and Inuvik NWT sub-offices) and the Manitoba Districts, **Winnipeg** Office (and Baker Lake NWT sub-office); and prior to 1967, by the Pacific and Yukon, **Vancouver** Office (and Whitehorse Yukon sub-office). This responsibility was transferred to the NWT Programs, **Yellowknife Office in 1981.** The **STREAM** computer program has been used since about 1976 and data have been collected and computed in **metric units** since about 1979.

A **pilot project** was carried out in 1986-87 to assess the need for a comprehensive data review program for NWT. The results indicated that the work should be ongoing and therefore an overall streamflow data review program was established, starting in 1987-88.

In 1988-89, the approach to data review and work progress (especially detailed concerns at specific stations) were discussed with John Fowler, Al Wilson and Scott McDonald of the NWT Office either by telephone or through written correspondence, and during two visits to Yellowknife NWT, in June and November 1988; discussions were also held with other NWT staff including Chris Heron (Yellowknife), Murray Jones (Fort Smith), Pat Wood (Fort Simpson) and Herb Wood (Inuvik). A one-day field trip was made in June to five gauging stations north of Yellowknife, mostly by aerial inspection (landed at two stations), in addition to a trip by car (in November) to the Cameron River station. This contract was also discussed with Arthur Redshaw, Chief, NWT Programs in Yellowknife regarding project management and with Doug Kirk, Headquarters, during my visit to Ottawa/Hull in July 1988, regarding approval procedures, computer use, procedures for requesting comparison hydrographs, updating temporary data files, submitting revisions, and provision of various plots and listings.

This Summary Report contains a list of the stations for the **overall data review program**; those reviewed to date; those proposed for review during the next two years; and a brief description of data review procedures and problems encountered. The extent of revisions is summarized and specific recommendations are made.

Detailed explanations are given in **Review Reports** for each station. Copies of these Reports are available from the Water Resoures Branch, NWT Programs, Yellowknife Office.

2. RECOMMENDATIONS

It is **recommended** that:

2.1 users be warned by an appropriate note under Remarks in the next Historical Streamflow Summary publication that **data should be used with discretion** (mainly because the stage-discharge relation is unstable and/or is not well-defined or because discharges are mostly estimated) for the following stations:

10HC003 Big Smith Creek near Highway No. 1 (1973-86)
10KA007 Bosworth Creek near Norman Wells (1980-86)
10KA006 Jungle Ridge Creek near the Mouth (1980-86)
10FC001 Plateau Creek near Willow Lake (1976-85)
07SB011 Pocket Lake Outflow near Yellowknife (1967-78)
10ED004 Rabbit Creek below Highway No. 7 (1978-83)
10HB001 Redstone River near the Mouth (1963-74)
10HA002 Tsichu River at Canol Road (1975-86)

2.2 **more discharge measurements** be obtained either by conventional current-meter methods or by indirect determination at all active gauging stations reviewed this year, to define the stage-discharge relation and/or the distribution of shift/backwater corrections more accurately.

2.3 **computer programs** be written (to facilitate historical data review or the annual basin review):

(a) for the **graphical and mathematical comparison** of daily and/or monthly flows at gauging stations in a basin on an upstream to downstream order, including time lag (in days), specifically for the Liard and Mackenzie Rivers and their tributaries; and

(b) to plot historical daily maximum and minimum **air temperatures** (and precipitation) at selected sites from AES data files; scale 1 mm - 1 day (366 days - same as discharge hydrographs) and 1 cm = 20°C (precipitation 1 cm = 20 mm with distinction between rain and snow).

2.4 Headquarters conduct **annual workshops** (staff training) to ensure that national standards are maintained on:

(a) **office computation** of hydrometric data, including sessions on documentation (station analysis, field reports, etc.), data review, theory of shift correction distribution (time or stage basis), BW interpretation during break-up and freeze-up, BM stability, chart interpretation (reversals, time and pen corrections, orifice movement, orifice silting/settling corrections, servomanometer malfunctions, quality checks for each chart segment, etc.), simple stage-discharge relation (overall shape, log extension, selection of scales), variable slope stage-discharge relation (2-gauge relationship), continuity from one year to the next, basin review (comparison hydrographs), etc.;

(b) **Servomanometer and Data Collection Platform** installation, maintenance and operation, including sessions on importance of setting recorder to accurate water level by instrument before and after discharge measurement, orifice line cut by ice during break-up, electrical and mechanical problems (battery, clock, gas leaks, etc.), DCP interrogation (documentation of results, timing of visits), etc.;

(c) **measurement of discharge** (open-water, boat), including sessions on safety precautions, selection of cross-section, number of verticals (5% rule), weight selection, current meter limitations, determination of mean water level for measurement, Moving-Boat measurements (Spring Field Camps), Slope-Area Method for Indirect Determination of Discharge (high-water marks, selection and verification of roughness coefficient "n") etc.; and

(d) **winter discharge measurements**, including sessions on safety precautions, very cold weather operation (equipment freezing up), problems of slush ice, vertical velocity distribution, etc.)

2.5 the computation of **annual records** be conducted **jointly** with adjacent Regional Offices for interjurisdictional rivers, i.e., the Hay, Liard and Peel Rivers, to ensure that data are **compatible.**

3. NWT DATA REVIEW PROGRAM

Listed below are the stations included in the seven-year review program, the period of record to be assessed and notes on the annual progress to date.

Sta. No.	Station Name	Review Period	(Yrs.)	Note
10FB001	Mackenzie River near Fort Providence	61-78	(18)	C(P)
10GC001	Mackenzie River at Fort Simpson	59-86	(28)	C(P)
10KA001	Mackenzie River at Norman Wells	62-86	(25)	
10LC014	Mackenzie River at Arctic Red River	72-86	(15)	
10LC002	Mackenzie River (East Channel) at Inuvik	73-86	(14)	
	. Great Slave Lake:			
07TB001	.. Emile River at Outlet of Basler Lake	78-86	(9)	C
07TA001	.. La Martre River below Outlet of Lac La Martre	75-86	(12)	C
	.. Snare River:			
07SA004	... Indin River above Chalco Lake	77-86	(10)	C
07SB009	.. Baker Creek near Yellowknife	68-82	(15)	C
07SB011	... Pocket Lake Outflow near Yellowknife	67-78	(12)	C
	.. Yellowknife River:			
07SB010	... Cameron River below Reid Lake	75-86	(12)	C
07SC002	.. Waldron River near the Mouth	78-86	(9)	C
07RD001	.. Lockhart River at Outlet of Artillery Lake	44-49, 63-86	(30)	C
07RC001	... Thonokied River near the Mouth	80-86	(7)	
07QB002	.. Snowdrift River at Outlet of Siltaza Lake	77-86	(10)	
07QD004	.. Taltson River above Porter Lake Outflow	77-86	(10)	
07QA001	.. Taltson River at Outlet of Tsu Lake	62-86	(25)	
07QD006	... Porter Lake Outflow	82-86	(5)	
07QD005	... Porter Lake Outflow above Taltson River	77-81	(5)	
	... Tazin River:			
07QC003	.... Thoa River near Inlet to Hill Island Lake	68-86	(19)	
07QC004	..... Marten River above Thoa River	77-86	(10)	
07PB002	.. Little Buffalo River below Highway No. 5	65-86	(22)	C
07PA001	.. Buffalo River at Highway No. 5	68-84	(17)	A
07OB001	.. Hay River near Hay River	29-31, 63-86	(24)	C
07UC001	. Kakisa River at Outlet of Kakisa Lake	62-86	(25)	C
	. Horn River:			
10FC001	.. Plateau Creek near Willow Lake	76-85	(10)	C
10FA002	. Trout River at Highway No. 1	69-85	(16)	B
10FB005	. Jean-Marie River at Highway No. 1	72-85	(14)	B
10ED001	. Liard River at Fort Liard	65-86	(22)	B(P)
10ED002	. Liard River near the Mouth	72-86	(15)	B(P)
10ED004	.. Rabbit Creek below Highway No. 7	78-83	(6)	C
10ED006	.. Rabbit Creek at Highway No. 7	84-86	(3)	C
10EB001	.. South Nahanni River above Virginia Falls	60-85	(26)	B
10EC001	.. South Nahanni River above Clausen Creek	59-85	(26)	B
10EB002	... Mac Creek near the Mouth	78-85	(8)	B
10EB003	... Lened Creek above Little Nahanni River	82-86	(5)	C
10EA002	... Flat River at Cantung Camp	60-62, 73-85	(16)	B
10EA003	... Flat River near the Mouth	60-85	(26)	B
10EC002	... Prairie Creek at Cadillac Mine	74-85	(12)	B
10ED003	.. Birch River at Highway No. 7	74-85	(12)	B

Sta. No.	Station Name	Review Period (Yrs.)		Note
	Mackenzie River:			
10GC002	. Harris River near the Mouth	73-85	(13)	B
10GC003	. Martin River at Highway No. 1	72-85	(13)	B
10GA001	. Root River near the Mouth	74-85	(11)	B
10GB001	. Willowlake River above Metahdali Creek	75-85	(11)	B
10GB006	. Willowlake River below Metahdali Creek	64-74	(11)	B
10GB005	.. Metahdali Creek above Willowlake River	76-85	(10)	B
10HB003	. Wrigley River near the Mouth	76-85	(10)	B
10HB005	. Redstone River 63 km above Mouth	74-86	(12)	C
10HB001	. Redstone River near the Mouth	63-74	(12)	C
10HB004	.. Silverberry River near Little Dal Lake	80-86	(7)	D
	. Keele River:			
10HA002	.. Tsichu River at Canol Road	75-86	(12)	C
10HA003	.. Twitya River near the Mouth	80-86	(7)	D
10HC003	. Big Smith Creek near Highway No. 1	73-86	(14)	C
10JC003	. Great Bear River at Outlet of Great Bear Lake	61-86	(26)	
	.. Great Bear Lake:			
10JD002	... Whitefish River near the Mouth	77-86	(10)	D
10JD001	... Haldane River near the Mouth	75-86	(12)	D
10JE001	... Sloan River near the Mouth	76-86	(11)	D
10JA002	... Camsell River at Outlet of Clut Lake	63-86	(24)	D
10JA004	.... Acasta River above Little Crapeau lake	80-86	(7)	D
10JB001	... Johnny Hoe River above Lac Ste. Therese	69-86	(18)	D
10KA006	. Jungle Ridge Creek near the Mouth	79-86	(7)	C
10KA005	. Seepage Creek at Norman Wells	74-78	(5)	C
10KA007	. Bosworth Creek near Norman Wells	80-86	(7)	C
10KA003	. Bosworth Creek at Norman Wells	73-79	(7)	C
10KB001	. Carcajou River below Imperial River	76-86	(11)	D
10KC001	. Mountain River below Cambrian Creek	74-86	(13)	D
10LD002	. Jackfish Creek near Fort Good Hope	80-86	(7)	D
10LA002	. Arctic Red River near the Mouth	68-86	(19)	D
10LA004	.. Weldon Creek near the Mouth	77-86	(10)	D
10MC002	. Peel River above Fort McPherson	69-86	(18)	D
10MC007	. Rat River near Fort McPherson	81-86	(6)	D
10LC003	. Rengleng River below Highway No. 8	72-86	(15)	D
	. Campbell Creek:			
10LC009	.. Cabin Creek above Highway No. 8	80-86	(7)	D
10LC007	.. Caribou Creek above Highway No. 8	75-86	(12)	D
10LC010	. Boot Creek near Inuvik	81-86	(6)	D
	Arctic Ocean Drainage:			
	Liverpool Bay:			
10ND002	. Trail Valley Creek near Inuvik	77-86	(10)	D
10ND001	. Hans Creek near Inuvik	77-86	(10)	D
10ND003	. Zed Creek near Inuvik	78-82	(5)	D
10NC001	. Anderson River below Carnwath River	69-84	(16)	A
10NA001	.. Carnwath River below Andrew River	82-86	(5)	
10OC001	Inman River near the Mouth	75-76, 78-86	(11)	
10PB001	Coppermine River at Outlet of Point Lake	65-86	(22)	
10PC001	. Kendall River near Outlet of Dismal Lakes	69-86	(18)	
10PC002	.. Atitok Creek near Dismal Lakes	79-86	(8)	
10QA001	Tree River near the Mouth	69-86	(18)	
10QC001	Burnside River near the Mouth	76-86	(11)	

Sta. No.	Station Name	Review Period	(Yrs.)	Note
10QC002	Gordon River near the Mouth	77-86	(10)	
10QD001	Ellice River near the Mouth	71-84	(14)	A
10RA001	Back River below Beechy Lake	77-86	(10)	
10RC001	Back River above Hermann River	62-84	(20)	A
10RA002	. Baillie River near the Mouth	78-86	(9)	
10SB001	Hayes River above Chantrey Inlet	71-86	(16)	
	Arctic Islands Drainage:			
10TF001	Freshwater Creek near Cambridge Bay	70-86	(17)	
10TA001	Big River above Egg River	75-81, 83-86	(11)	
10VC002	Mecham River near Resolute	71-78	(8)	
10VC001	Allen River near the Mouth	71-86	(16)	
10UF001	Duval River near Pangnirtung	74-83	(10)	
10UH002	Apex River at Apex	73-86	(14)	
10UH001	Sylvia Grinnel River near Frobisher Bay	71-86	(16)	
10UB001	Marcil Creek near Arctic Bay	78-83	(6)	
10UE001	Tulugak River on Broughton Island	73-83	(9)	
	Hudson Bay Drainage:			
06QA001	Lorillard River above Daly Bay	78-86	(9)	
06MB001	Quoich River above St. Clair Falls	72-86	(15)	
	Baker Lake Basin:			
06LA001	. Kazan River at Outlet of Ennadai Lake	65-86	(22)	
06LC001	. Kazan River above Kazan Falls	65-86	(22)	
06LC003	.. Siurac Creek near Outlet to Kazan River	79-86	(8)	
06LC002	.. Kunwak River below Princess Mary Lake	77-86	(10)	
06MA002	. Qinguo Creek near Baker Lake	69-78, 81-86	(16)	
06JC002	. Thelon River above Beverley Lake	70, 72-85	(15)	B
06MA003	. Thelon River above Baker Lake	73-82	(10)	A
06JB001	.. Hanbury River above Hoare Lake	72-86	(16)	
06KC003	.. Dubawnt River at Outlet of Marjorie Lake	68-78	(10)	B
06KC001	.. Dubawnt River below Marjorie Lake	60-67	(4)	B
06MA004	. Akkutuak Creek near Baker lake	78-86	(9)	
06MA005	. Prince River near Baker Lake	79-86	(8)	
06NB002	Ferguson River below O'Neil Lake	79-86	(8)	
06HD002	Tha-Anne River below South Menik Lake	78-85	(8)	
06HD001	. Kognak River below Mountain Lake	77-86	(10)	
06HB002	Thlewiaza River below Sealhole Lake	78-86	(9)	

A - Review Completed in 1986-87: 5 stations, 77 station-years
B - Review Completed in 1987-88: 19 stations, 264 station-years
C - Review Completed in 1988-89: 22 stations, 250 station-years
D - Review Proposal for 1989-90: 22 stations, 245 station-years
P - Preliminary Report only

Note: Stations with less than **5 years** of discharge records or those established since 1983 are **not** included in this Review Program.

Total Review Program	**: 119 stations (1535 station-years)**
Total Reviewed to 1988-89	: 46 stations (591 station-years)
Proposed Program for 1989-90	: 22 stations (245 station-years)
Proposed Program for 1990-91	: 15 stations (280 station-years)
Proposed Program for 1991-92	: 21 stations (246 station-years)
Proposed Program for 1992-93	: 15 stations (173 station-years)

3.1 **Review Proposal for 1989-90**

The following stations are recommended for review in 1989-90 to complete the assessment of data on **tributaries to the Mackenzie River** below Great Slave Lake (except the Liard and the Great Bear Rivers):

Sta. No.	Station Name	Review Period (Yrs.)
10JA004	Acasta River below Little Crapeau Lake	80-86 (7)
10LA002	Arctic Red River near the Mouth	68-86 (19)
10LC010	Boot Creek near Inuvik	81-86 (6)
10LC009	Cabin Creek above Highway No. 8	80-86 (7)
10JA002	Camsell River at Outlet of Clut Lake	63-86 (24)
10KB001	Carcajou River below Imperial River	76-86 (11)
10LC007	Caribou Creek above Highway No. 8	75-86 (12)
10JD001	Haldane River near the Mouth	75-86 (12)
10ND001	Hans Creek near Inuvik	77-86 (10)
10LD002	Jackfish Creek near Fort Good Hope	80-86 (7)
10JB001	Johnny Hoe River above Lac Ste. Therese	69-86 (18)
10KC001	Mountain River below Cambrian Creek	74-86 (13)
10MC002	Peel River above Fort McPherson	69-86 (18)
10MC007	Rat River near Fort McPherson	81-86 (6)
10LC003	Rengleng River below Highway No. 8	72-86 (15)
10HB004	Silverberry River near Little Dal Lake	80-86 (7)
10JE001	Sloan River near the Mouth	76-86 (11)
10ND002	Trail Valley Creek near Inuvik	77-86 (10)
10HA003	Twitya River near the Mouth	80-86 (7)
10LA004	Weldon Creek near the Mouth	77-86 (10)
10JD002	Whitefish River near the Mouth	77-86 (10)
10ND003	Zed Creek near Inuvik	78-82 (5)

22 stations (245 station-years)

3.2 Review Proposal for 1990-91

Preliminary Review Reports were prepared for the following stations in 1987-88 and 1988-89:

Sta. No.	Station Name	Review Period (Yrs.)
10ED001	Liard River at Fort Liard	65-85 (21)
10ED002	Liard River near the Mouth	72-85 (14)
10FB001	Mackenzie River near Fort Providence	61-78 (18)
10GC001	Mackenzie River at Fort Simpson	59-86 (28)

Computer-generated **comparison hydrographs** (and manually-computed monthly and annual **mathematical comparisons**) for stations on the Liard and Mackenzie Rivers indicate many periods of **negative ungauged inflow** and/or periods that are not in reasonable agreement, especially during break-up and freeze-up.

The review (revision) of streamflow data for stations (listed below) on the main stem of the Liard and Mackenzie Rivers **should therefore be carried out as a unit** to ensure compatibility of final results. This should include an examination, either in-house or under contract, of the records for five stations (listed below) in the upper Liard River basin which are operated by the **Pacific and Yukon Office**, to support the review of data for the lower Liard River stations in the NWT.

Stations operated by the **NWT Programs Office:**

Sta. No.	Station Name	Review Period (Yrs.)
10FB001	Mackenzie River near Fort Providence	61-78 (18)
10GC001	Mackenzie River at Fort Simpson	59-86 (28)
10KA001	Mackenzie River at Norman Wells	62-86 (25)
10LC014	Mackenzie River at Arctic Red River	72-86 (15)
10LC002	Mackenzie River (East Channel) at Inuvik	73-86 (14)
10ED001	Liard River at Fort Liard	65-86 (22)
10ED002	Liard River near the Mouth	72-86 (15)
10JC003	Great Bear River at Outlet of Great Bear Lake	61-86 (26)

8 stations (163 station-years)

Stations operated by the **Pacific and Yukon Office:**

Sta. No.	Station Name	Review Period (Yrs.)
10BE001	Liard River at Lower Crossing	65-86 (22)
10BE005	Liard River above Beaver River	68-86 (19)
10CD001	Muskwa River near Fort Nelson	78-86 (9)
10CC002	Fort Nelson River above Muskwa River	78-86 (9)
10CC001	Fort Nelson River at Fort Nelson	65-78 (14)

5 stations (73 station-years)

A review of data **prior to 1965** for the above five stations, along with data prior to 1965 for Liard River at Fort Liard (10ED001), is not suggested at this time because of the time involved.

It is also strongly recommended that a **computer program** be written in 1989 for use in 1990-91 for an automated **mathematical comparison** of all data collected from these stations to ensure consistency in published records.

To complete the NWT program, the review of another **7 stations (117 station-years)** in the Arctic Ocean or Hudson Bay Drainage should also be included.

The **total NWT program for 1990-91 would be 15 stations (280 station-years)** - not including the recommended five upper Liard River stations in the Pacific and Yukon Region.

4. LIST OF REVIEW REPORTS

4.1 1986-87 Program

4.1.1 **Final Review Reports** were completed for:

Sta. No.	Station Name	Review Period	(Yrs.)
10NC001	Anderson River below Carnwath River	69-84	(16)
10RC001	Back River above Hermann River	62-84	(20)
07PA001	Buffalo River at Highway No. 5	68-84	(17)
10QD001	Ellice River near the Mouth	71-84	(14)
06MA003	Thelon River above Baker Lake	73-82	(10)
	TOTALS (5 stations)		(77)

4.1.2 **Preliminary Review Reports** were prepared for:

Sta. No.	Station Name	Review Period	(Yrs.)
06KC003	Dubawnt River at Outlet of Marjorie Lake	60-84	(25)
10EA003	Flat River near the Mouth	60-84	(25)
10EC001	South Nahanni River above Clausen Creek	59-84	(25)
10EB001	South Nahanni River above Virginia Falls	60-84	(25)
06JC001	Thelon River above Beverly Lake	70-84	(15)
	TOTALS (5 stations)		(115)

4.2 1987-88 Program

4.2.1 **Final Review Reports** were completed for:

Sta. No.	Station Name	Review Period	(Yrs.)
10ED003	Birch River at Highway No. 7	74-85	(12)
06KC003	Dubawnt River at Outlet of Marjorie Lake	68-78	(10)
06KC001	Dubawnt River below Marjorie Lake	60-67	(4)
10EA002	Flat River at Cantung Camp	60-85	(16)
10EA003	Flat River near the Mouth	60-85	(26)
10GC002	Harris River near the Mouth	73-85	(13)
10FB005	Jean-Marie River at Highway No. 1	72-85	(14)
10EB002	Mac Creek near the Mouth	78-85	(8)
10GC003	Martin River at Highway No. 1	73-85	(13)
10GB005	Metahdali Creek above Willowlake River	76-85	(10)
10EC001	Prairie Creek at Cadillac Mine	74-85	(12)
10GA001	Root River near the Mouth	74-85	(11)
10EC001	South Nahanni River above Clausen Creek	59-85	(26)
10EB001	South Nahanni River above Virginia Falls	60-85	(26)
06JC002	Thelon River above Beverly Lake	70-85	(15)
10FA002	Trout River at Highway No. 1	69-85	(16)
10GB006	Willowlake River above Metahdali Creek	75-85	(11)
10GB001	Willowlake River below Metahdali Creek	64-74	(11)
10HB003	Wrigley River near the Mouth	76-85	(10)
	TOTALS (19 stations)		(264)

4.2.2 **Preliminary Review Reports** were prepared for:

Sta. No.	Station Name	Review Period	(Yrs.)
10ED001	Liard River at Fort Liard	65-85	(21)
10ED002	Liard River near the Mouth	72-85	(14)
	TOTALS (2 stations)		(35)

4.3 1988-89 Program

4.3.1. **Final Review Reports** were completed for:

Section No.	Sta. No.	Station Name	Review Period	(Yrs.)
5.3.1	07SB009	Baker Creek near Yellowknife	68-82	(15)
5.3.2	10HC003	Big Smith Creek near Highway No. 1	73-86	(14)
5.3.3	10KA003	Bosworth Creek at Norman Wells	73-79	(7)
5.3.4	10KA007	Bosworth Creek near Norman Wells	80-86	(7)
5.3.5	07SB010	Cameron River below Reid Lake	75-86	(12)
5.3.6	07TB001	Emile River at Outlet of Basler Lake	78-86	(9)
5.3.7	07OB001	Hay River near Hay River	63-86	(24)
5.3.8	07SA004	Indin River above Chalco Lake	77-86	(10)
5.3.9	10KA006	Jungle Ridge Creek near the Mouth	79-86	(7)
5.3.10	07UC001	Kakisa River at Outlet of Kakisa Lake	62-86	(25)
5.3.11	07TA001	La Martre River below Outlet of Lac La Martre	75-86	(12)
5.3.12	10EB003	Lened Creek above Little Nahanni River	82-86	(5)
5.3.13	07PB002	Little Buffalo River below Highway No. 5	65-86	(22)
5.3.14	10FC001	Plateau Creek near Willow Lake	76-85	(10)
5.3.15	07SB011	Pocket Lake Outflow near Yellowknife	67-78	(12)
5.3.16	10ED006	Rabbit Creek at Highway No. 7	84-86	(3)
5.3.17	10ED004	Rabbit Creek below Highway No. 7	78-83	(6)
5.3.18	10HB005	Redstone River 63 km above Mouth	75-86	(12)
5.3.19	10HB001	Redstone River near the Mouth	63-74	(12)
5.3.20	10KA005	Seepage Creek at Norman Wells	74-78	(5)
5.3.21	10HA002	Tsichu River at Canol Road	75-86	(12)
5.3.22	07SC002	Waldron River near the Mouth	78-86	(9)
		TOTALS (22 stations)		(250)

4.3.2 **Preliminary Review Reports** were prepared for:

Sta. No.	Station Name	Review Period	(Yrs.)
10FB001	Mackenzie River near Fort Providence	61-78	(18)
10GC001	Mackenzie River at Fort Simpson	59-86	(28)
	TOTALS (2 stations)		(46)

5. SUMMARY OF REVISIONS

One should be careful when using **percentage differences** to indicate or to assess the extent of revisions, e.g., a revision from 400 to 100 is -75% but one from 100 to 400 is +300% (a "minus" revision can never be more than 100%) - yet the mathematical difference is 300 in both cases. Also, a revision of -40% at low flow may "appear" to be more significant than a -10% revision at high flow, when actually much more water is involved during high-water periods.

Review Reports were completed for 22 stations (250 station-years). A revision of some type (including deletion and extension) was made to 72 station-years of data, involving 7248 days and 301 months.

Preliminary Review Reports for the Mackenzie River near Fort Providence (10FB001) and Mackenzie River at Fort Simpson (10GC001) are included in Section 6 of this Summary Report. **Comparison Hydrographs** were used extensively to assess the compatibility of the data and indicate **negative ungauged inflow** on numerous occasions and/or periods of flow that are not in reasonable agreement. It was agreed with the Yellowknife Office that the data for stations on the main stem of the Liard and Mackenzie Rivers should be **reviewed as a unit** (see Section 3.2).

An **important feature** of this Review is that "short" periods of **missing daily discharges** were estimated to complete the records for 15 years for 10 stations; 6 of these estimates were to **1981 data** (see Section 5.2.2).

Data for the 2 stations on the Redstone River, as well as the 2 stations on Rabbit Creek and Bosworth Creek, were **"mixed up"** and files were corrected. **Name changes** were recommended (and approved by the Yellowstone Office) for 6 stations.

There were 10 **"breaks in continuity"** of data from one year to the next, involving **9 stations**, the most significant being the revisions for:

(a) 10KA007 **Bosworth Creek near Norman Wells** (1980-86)

January 1982: revised by -68% from 0.425 to 0.136 m^3/s

1982 Mean: revised by -5% from 0.853 to 0.812 m^3/s

(b) 07SA004 **Indin River above Chalco Lake** (1977-86)

December 1982: revised by +42% from 1.64 to 2.33 m^3/s

1982 Mean: revised by + 2% from 5.80 to 5.89 m^3/s

(c) 07UC001 **Kakisa River at Outlet of Kakisa Lake** (1962-86)

April 1979: revised by -64% from 9.60 to 3.45 m^3/s

1979 Mean: revised by - 5% from 44.0 to 41.8 m^3/s

(d) 07TA001 **La Martre River below Outlet of Lac La Martre** (1975-86)

December 1985: revised by +65% from 19.5 to 32.1 m^3/s

1985 Mean: revised by + 4% from 34.8 to 40.1 m^3/s

(e) 07SC002 **Waldron River near the Mouth** (1978-86)

April 1981: revised by -61% from 1.21 to 0.467 m^3/s

1981 Mean: revised by - 4% from 3.53 to 3.39 m^3/s

Highlights of other significant revisions are:

(a) 10HC003 **Big Smith Creek near Highway No. 1** (1973-86)

- a revision of some type was made to 11 of the 14 years of data
- zero flow revised for 5 years
- shape of winter recession revised for 10 years

May 1974: revised by -10% from 48.5 to 43.5 m^3/s

1974 Mean: revised by -5% from 8.77 to 8.34 m^3/s

June 1975: revised by +61% from 7.63 to 12.3 m^3/s

September 1977: revised by +64% from 0.473 to 0.774 m^3/s

March 1982: revised from 0 to 0.250 m^3/s

April 1985: revised by +300% from 0.074 to 0.296 m^3/s

- the mean annual discharge for 1974-86 was revised by -12% from 6.35 to 5.59 m^3/s

(b) 07OB001 **Hay River near Hay River** (1963-86)

- a revision of some type was made to 12 of the 24 years of data
- the 1966 maximum daily discharge was revised by +19% from 521 to 620B m^3/s

June 1971: revised by +25% from 111 to 139 m^3/s

November 1979: revised by -40% from 63.5 to 37.9 m^3/s

March 1982: revised by -77% from 1.85 to 0.433 m^3/s

January 1986: revised by +34% from 6.00 to 8.06 m^3/s

- the mean annual discharge for 1964-86 was unchanged at 104 m^3/s (compensating revisions)

(c) 10KA006 **Jungle Ridge Creek near the Mouth** (1980-86)

- two discharge measurements were not used in 1983

May 1983: revised by +5% from 1.79 to 1.88 m^3/s

August 1983: revised by -78% from 0.427 to 0.093 m^3/s

1983 Mean: revised by -30% from 0.512 to 0.357 m^3/s

(d) 070B002 **LIttle Buffalo River below Highway No. 5** (1965-86)

- wrong HQ table used in 1983

September 1983: revised by -67% from 0.413 to 0.137 m^3/s

(e) 10HB005 **Redstone River 63 km above Mouth** (1974-86)

- a revision of some type was made to 6 of the 13 years of data
- HW HQ revision and Shift Correction distribution for 1980 to 1985
- maximum discharges revised by about -20%
- mean annual discharge for 1980 to 1986 was revised by -9% from 194 to 177 m^3/s

5.1 Types and Extent of Revisions

Following is a summary of the various **type of revisions** and the approximate number of years involved:

(a) discrediting records (see Section 5.2.1)

(b) completing missing records (see Section 5.2.2)

(c) "break in continuity" (10 cases for 9 stations)

(d) "spikes" (2 days, 2 years, 2 stations)

(e) bracketted means changed to daily discharges (2 years, 1 station)

(f) winter recession (22 years, 7 stations)

(g) shift or backwater distribution/interpretation (13 years, 4 stations)

(h) hydrograph shape, timing of peak and magnitude of flows during break-up (10 years, 7 stations)

(i) estimated periods revised (5 years, 2 stations)

(j) gauge heights one day out of order (1 year, 1 station)

(k) LW/HW stage-discharge curve revisions (14 years, 3 stations)

(l) wrong HQ table (1 year, 1 station)

(m) zero flow revised (14 years, 4 stations)

(n) discharge measurement not used (6 years, 5 stations)

(o) historical minimum daily discharge revised (3 years, 3 stations)

5.2 Deletion and Extension of Data

5.2.1 Deletion of Data

In some cases, discharge data were **discredited** mainly because insufficient basic data are available to produce reliable results suitable for distribution to users. Revisions (deletions) were made to 2 stations (249 days, involving 11 months and 4 years). Data were **deleted** for the following:

(a) 07OB001 **Hay River near Hay River** (1963-86)
- 14 months (3 years - 1929 to 1931)
- daily discharges, mostly estimated (442 days)
- the period 1929 to 1931 was not included in the original "review period" of 1963 to 1986 (24 years) and therefore it is **not included** in the tabulation of revisions (deletions) shown above

(b) 10KA003 **Bosworth Creek at Norman Wells** (1974-79)

(i) 3 months (23 days) in 1973
- estimated daily discharges
- 1973 was not included in the original "review period" of 1974 to 1979 (6 years) and therefore it is **not included** in the tabulation of revisions (deletions) shown above

(ii) 1 month (1 day) in 1974
- **zero flow** deleted

(iii) 5 months (118 days) in 1977
- **zero flow** deleted

(c) 07PB002 **Little Buffalo River below Highway No. 5** (1965-86)
- 5 months (2 years - 1973 and 1984)
- **zero flow** deleted (130 days)

5.2.2 Extension of Data

Missing daily discharges for "short" periods of record were **estimated** to give a complete block of data for certain stations. Revisions (extensions) were made to 10 stations (1548 days, involving 61 months and 15 years). It is noted that estimates **for 1981** were made to 6 stations.

Data were **estimated** for the following:

(a) 07SB009 **Baker Creek near Yellowknife** (1968-82)
- 61 days (2 months in 1973)
- this completed a block of data for 1972 to 1982

(b) 10HC003 **Big Smith Creek near Highway No. 1** (1973-86)
- 470 days, involving 20 months and 4 years
- 5 periods in 1975 to 1977 and 1981

(c) 10KA007 **Bosworth Creek near Norman Wells** (1980-86)
- 189 days, involving 7 months and 2 years (1980-81)

(d) 07SA004 **Indin River above Chalco Lake** (1977-86)
- 290 days, involving 10 months in 1981
- revisions to 1981 data were made by the Yellowknife Office about 1983 but **inadvertently** were not entered on the master FLOW file

(e) 10KA006 **Jungle Ridge Creek near the Mouth** (1980-86)
- 147 days, involving 5 months in 1981

(f) 07UC001 **Kakisa River at Outlet of Kakisa Lake** (1962-86)
- 46 days, involving 2 months in 1971
- 69 days, involving 3 months in 1981

(g) 10EB003 **Lened Creek above Little Nahanni River** (1982-86)
- 28 days, involving 1 month in 1983

(h) 07SB011 **Pocket Lake Outflow near Yellowknife** (1967-78)
- 1489 days, involving 50 months and 9 years
- mostly estimated **zero flow**
- this is **not included** in the tabulation of revisions (extensions) because of the large number of days involved which were mostly zero and which would give **misleading importance** if added to the total number of days revised (extended)
- data for this station are considered **poor**

(i) 10ED006 **Rabbit Creek at Highway No. 7** (1984-86)
- 45 days, involving 2 months in 1986

(j) 10HB005 **Redstone River 63 km above Mouth** (1974-86)
- 118 days, involving 5 months in 1981
- this completed a block of data for 1980 to 1986

(k) 07SC002 **Waldron River near the Mouth** (1978-86)
- 85 days, involving 4 months in 1980

5.3 Summary of Revisions and Recommendations for Each Station

A summary of the **revisions** that were made for each station is given in this section. Highlights of the **recommendations** for each station are also included. Detailed explanations are provided in individual **Review Reports.** The stations are reported in **alphabetical** order (see Section 4.3.1 for the complete list of stations).

5.3.1 07SB009 **Baker Creek near Yellowknife** (1968-82)

Maximum instantaneous discharges were extracted for 5 years (not previously published).

Missing daily discharges for November 1 to December 31, 1973 were estimated to complete the records for the year and for the period of record for 1972 to 1982.

The **mean annual discharge** for 1972 to 1982 was revised by -2% from 0.149 to 0.146 m^3/s due to the extension of records for 1973.

It is **recommended** that:

(a) the **name of the station** be changed from Baker Creek Main Stem near Yellowknife to "Baker Creek near Yellowknife" (the term "Main Stem" implies that there are other unmeasured channels of Baker Creek, which is not the case; and also, this does not agree with the other station on Baker Creek - 07SB013).

Note: This has already been approved by Yellowknife and the HYDEX file was updated in January 1989.

5.3.2 10HC003 **Big Smith Creek near Highway No. 1** (1973-86)

The estimated **maximum daily discharge** for the period of record from 1974 to 1986 was revised by -36% from 266E to 170E m^3/s (May 18, 1974).

Missing daily discharges for 1975, 1976, 1977 and 1981 **were estimated** to give a complete block of records from 1974 to 1986; 470 daily discharges were estimated, involving 20 months of data for the 4 years.

A **revision of some type** was made to 11 of the 14 years of data from 1973 to 1986. Revisions, including estimates of missing data, were made to 1623 daily discharges, involving 62 months of the 11 years of data. More than one type of revision could apply to any one year or even within a month.

(a) missing daily discharges, 4 years (1975, 1976, 1977 and 1981)
(b) zero flow revised, 5 years (1978 and 1981 to 1984)
(c) shape of winter recession, 10 years (1973 to 1978 and 1982 to 1985)
(d) discharge measurement not used (1976)
(e) HQ curve revision (1974, 1975)
(f) estimated flows revised (1974, 1984)
(g) shift correction distribution revised (1977)
(h) "break in continuity" (1982)

Summary of revisions to **minimum daily discharges**:

1974: revised by - 1% from 0.187B to 0.185B m^3/s
1975: revised by -12% from 0.153B to 0.134B m^3/s
1976: 0.159B m^3/s (not previously published)
1977: 0.038B m^3/s (not previously published)
1978: revised from 0B to 0.002B m^3/s
1979: not revised from 0.010B m^3/s
1980: not revised from 0.120B m^3/s
1981: 0.100B m^3/s (not previously published)
1982: revised from 0B to 0.220B m^3/s
1983: revised from 0B to 0.010B m^3/s
1984: revised from 0B to 0.010B m^3/s
1985: revised by +883% from 0.030B to 0.295B m^3/s
1986: not revised from 0.245B m^3/s

5.3.2 10HC003 (continued)

Summary of significant revisions (above 10%) to **monthly mean discharges:**

May 1974: revised by -10% from 48.5 to 43.5 m^3/s
June 1975: revised by +61% from 7.63 to 12.3 m^3/s
July 1976: revised by +23% from 1.47 to 1.81 m^3/s
Oct. 1976: revised by +20% from 0.625 to 0.753 m^3/s
Sept 1977: revised by +64% from 0.473 to 0.774 m^3/s
Oct. 1977: revised by +50% from 0.519 to 0.777 m^3/s
Nov. 1977: revised by +15% from 0.405 to 0.466 m^3/s
Dec. 1977: revised by -36% from 0.211 to 0.136 m^3/s
Jan. 1978: revised by -45% from 0.022 to 0.012 m^3/s
Mar. 1982: revised from 0 to 0.250 m^3/s
Jan. 1983: revised by +56% from 0.097 to 0.151 m^3/s
Feb. 1983: revised from 0 to 0.049 m^3/s
Mar. 1984: revised from 0 to 0.013 m^3/s
Apr. 1985: revised from 0.074 to 0.296 m^3/s

Summary of revisions to **annual mean discharges:**

1974: revised by -5% from 8.77 to 8.34 m^3/s
1975: 5.50 m^3/s (not previously published)
1976: 3.92 m^3/s (not previously published)
1977: 3.67 m^3/s (not previously published)
1978: unchanged at 3.79 m^3/s
1979: not revised from 3.93 m^3/s
1980: not revised from 4.44 m^3/s
1981: 2.76 m^3/s (not previously published)
1982: revised by +1% from 8.36 to 8.45 m^3/s
1983: revised by +0.2% from 4.48 to 4.49 m^3/s
1984: unchanged at 10.8 m^3/s
1985: revised by +0.2% from 4.74 to 4.75 m^3/s
1986: not revised from 7.84 m^3/s

The **mean annual discharge** for the period of record was revised by -12% from 6.35 to 5.59 m^3/s.

5.3.2 10HC003 (continued)

It is **recommended** that:

(a) the following note be added under Remarks in the next Historical Streamflow Summary publication: **"Flows during high water, winter periods and estimated periods should be used with discretion"**,

(b) **more discharge measurements** be obtained at various stages during the year, especially the open-water periods to define the daily shift correction distribution more accurately,

(c) any observations (measurements) of **"no flow"** or very low flow be **documented**, e.g., number of holes drilled (and if any overflow), water in section, snow cover, etc.,

(d) the **elevation of zero flow** be obtained at least once a year during open-water periods and especially after high-water flows, and

(e) a **new HQ Curve** be drawn using the latest HW measurements (see Composite Curve Sheet for selection of scales).

5.3.3 10KA003 **Bosworth Creek at Norman Wells** (1973-79)

The 23 estimated daily discharges in 1973 were **deleted** and records for 1973 are now reported as **"miscellaneous measurements only".**

It is unlikely that the flow would go to zero (nil). Therefore, the published values of **"zero" were deleted**, i.e., February 26, 1974, January 1 to April 21, 1977 and December 25 to 31, 1977 (119 days).

There are **no recommendations.**

5.3.4 10KA007 **Bosworth Creek near Norman Wells** (1980-86)

The **symbol R** (Revised) was entered on the FLOW file by Ottawa in 1985 to alert magnetic tape users that data had been added to this station and **not** that data had been revised as shown in the 1986 Historical Streamflow Summary publication, i.e., discharge data for 1980 to 1984 were moved from 10KA003 to 10KA007.

Daily discharges for October 19 to 31, 1980 were revised and daily discharges for **November 1, 1980 to May 8, 1981 were estimated** to complete the records for 1981 and for the period of record. Daily discharges for **June 24 and 25, 1981** were revised (HQ Curve revision). Daily discharges for **October 19, 1981 to May 14, 1982** were revised because the **wrong date** was used for the November 1981 measurement (should be November 16 not November 6), and a major **"break in continuity".** Daily discharges for **April 1 to June 3, 1983** were revised because of a different interpretation during break-up and a HW HQ revision.

The maximum daily discharge for 1981 was revised by +65% from 7.26 to 12.0E m^3/s (not previously published) and **for 1983** by -31% from 15.3 to 10.5E m^3/s.

A total of 476 daily discharges were revised (extended), involving 20 months and 3 years.

5.3.4 10KA007 (continued)

Summary of significant revisions to **monthly mean discharges:**

November 1981: by +40% from 0.189 to 0.265 m^3/s

December 1981: by +696% from 0.024 to 0.191 m^3/s

January 1982: by -68% from 0.425 to 0.136 m^3/s

May 1983: by -30% from 3.84 to 2.70 m^3/s

The **annual mean discharge** for 1982 was revised by -5% from 0.853 to 0.812 m^3/s and for 1983 by -13% from 0.767 to 0.671 m^3/s. The **mean annual discharge** for the period of record from 1981 to 1986 was revised by -8% from 0.694 to 0.641 m^3/s.

It is **recommended** that:

(a) the following note be added under Remarks in the next Historical Streamflow Summary publication: **"The stage-discharge relation is not well-defined and data should be used with discretion"**,

(b) **more discharge measurements** be obtained to define the daily shift correction distribution more accurately,

(c) the **elevation of zero flow** be obtained at least once a year, especially after high-water flows, and

(d) the **records be examined again** if the 1981 recorder charts are found and/or when extreme high-water measurements have been obtained.

5.3.5 07SB010 **Cameron River below Reid Lake** (1975-86)

No revisions were made to daily discharges.

Three **maximum instantaneous discharges** were extracted (for 1976, 1977 and 1982) - not previously published.

It is **recommended** that:

(a) **more discharge measurements** be obtained to define the LW range of the HQ relation and/or **to confirm** that open-water conditions exist year-round (which has been assumed in recent years),

(b) the **elevation of zero flow** be obtained,

(c) **new numbers be assigned** to revised HQ Curves used since 1984 (see Explanation of Revisions), and

(d) **records be examined** again after a more thorough discussion has been carried out among technical staff regarding the reliability of **discarded** discharge measurements (and gauge heights).

5.3.6 07TB001 **Emile River at Outlet of Basler Lake** (1978-86)

Daily discharges for January 1 to 17, 1981 were revised to correct the **"break in continuity"** from 1980 to 1981. **Daily discharges for October 1, 1981** to **February 9, 1982 were revised** (different shift correction distribution). The **mean discharge** for January 1981 was revised by -2% from 10.5 to 10.3 m^3/s, for December 1981 by -7% from 10.4 to 9.72 m^3/s and for January 1982 by -2% from 10.0 to 9.78 m^3/s. The **maximum daily discharge** for 1981 was revised by-5% from 11.0E m^3/s on January 1 to 10.4 m^3/s on January 22.

The **annual mean discharge** for 1981 was revised by -1% from 8.93 to 8.84 m^3/s. The **mean annual discharge** for the period of record for 1979 to 1986 was unchanged at 15.4 m^3/s.

It is **recommended** that:

(a) the **location of the orifice be documented** on the field description and that the point at which water level checks are to be obtained is **physically identified**,

(b) **the slope** in the drawdown reach be determined at various stages at the outlet to confirm the sensitivity of the water level checks,

(c) the **elevation of zero flow** be obtained for use as a guide in drawing the low-water range of the stage-discharge relation,

(d) **more discharge measurements** be obtained to define the HQ relation more accurately, especially in the LW range and during winter periods to confirm that there is no backwater when there is an ice cover on the lake, and

(e) sufficient **DCP readings** be plotted for overlapping chart record to confirm their compatibility.

5.3.7 070B001 **Hay River near Hay River** (1929-31, 1963-86)

Daily discharge data for July 1929 to March 1930 and September 1930 to April 1931 (442 days) were deleted from the FLOW file and **"miscellaneous measurements only"** are now reported for 1921, 1929 to 1931 and 1952.

A **revision of some type** was made to 12 of the 24 years of record from 1963 to 1986. Revisions were made to 832 days and 42 months.

(a) bracketted means were re-computed to show daily discharges (2 years-1964, 1965)
(b) bracketted mean shown as max daily (1 year - 1965)
(c) "break in continuity" (1985-86)
(d) gauge heights 1 day out of order (2 weeks in 1970)
(e) computation error - "spike" - one in 1967
(f) winter discharge measurement "adjusted" because of low velocities (1974 historical minimum)
(g) winter recession (shape) - 5 years (1965-66, 1973-74, 1982)
(h) Shift/BW interpretation during break-up - 4 years (1966, 1967, 1973, 1974)
(i) Shift correction distribution (straight-line distribution from open water to ice conditions) - 1974 and 1986
(j) BW interpretation during freeze-up (3 years, November 1973, October 1974, November 1979)
(k) estimated period revised from straight-line interpolation to logarithmic recession - June 1966
(l) estimated periods revised, based on comparison hydrographs (July 1970, June 1971)

Maximum instantaneous discharges for 3 years (1967, 1968 and 1986) were deleted from the PEAKS file (occurred during break-up and considered invalid).

Summary of revisions to maximum daily discharges:

1965: by +6% from 708B to 750B m^3/s
1966: by +19% from 521 to 620B m^3/s
1967: by -6% from 957 to 900B m^3/s
1973: by +9% from 595 to 650E m^3/s
1974: by +5% from 1180 to 1240A m^3/s

5.3.7 070B001 (continued)

Summary of revisions to minimum daily discharges:

1965: by +77% from 1.61 B to 2.85 B m^3/s

1966: by +114% from 0.566B to 1.21 B m^3/s

1974: by +49% from 0.195B to 0.290B m^3/s *

1982: by +44% from 0.278B to 0.400B m^3/s

* - formerly historical minimum

Summary of significant revisions (more than 10%) **to monthly means:**

Dec. 1964:	by +15%	from	8.99	to 10.3	m^3/s
Mar. 1966:	by +53%	from	0.816	to 1.25	m^3/s
May 1966:	by +12%	from	316	to 354	m^3/s
June 1971:	by +25%	from	111	to 139	m^3/s
Nov. 1974:	by -14%	from	33.2	to 28.4	m^3/s
Nov. 1979:	by -40%	from	63.5	to 37.9	m^3/s
Mar. 1982:	by -77%	from	1.85	to 0.433	m^3/s
Apr. 1982:	by -50%	from	2.73	to 1.37	m^3/s
Jan. 1986:	by +34%	from	6.00	to 8.06	m^3/s
Oct. 1986:	by +23%	from	48.0	to 58.9	m^3/s
Nov. 1986:	by +16%	from	21.3	to 24.8	m^3/s

Summary of revisions to annual mean discharges:

1964: unchanged at 102 m^3/s

1965: unchanged at 71.3 m^3/s

1966: by +4% from 61.3 to 63.9 m^3/s

1967: by -0.3% from 93.3 to 93.0 m^3/s

1970: by -1% from 49.2 to 48.9 m^3/s

1971: by +4% from 52.0 to 54.3 m^3/s

1973: unchanged at 124 m^3/s

1974: by +1% from 157 to 158 m^3/s

1979: by -1% from 166 to 164 m^3/s

1982: by -1% from 59.3 to 58.9 m^3/s

1985: by -1% from 159 to 158 m^3/s

1986: by +2% from 132 to 134 m^3/s

The **mean annual discharge** for the period of record for 1964 to 1986 was **unchanged** at 104 m^3/s.

5.3.7 07OB001 (continued)

It is **recommended** that:

(a) **more discharge measurements** be obtained to define the Backwater Correction interpretation more accurately during break-up and freeze-up; more discharge measurements are also required during open-water periods to define the stage-discharge relation because of the radical channel and control change (scour) that occurred during the 1985 break-up,

(b) the **elevation of zero flow** be obtained annually (especially after high-water),

(c) **any problems** encountered during measurements or visits be documented, e.g., ice jams, orifice movement, low velocities during winter measurements, slush, etc.; and that any unusual computation problems be explained in the Station Analysis, e.g., basis for BW interpretation during ice jams and shift correction distribution, and

(d) **annual consultations** be held with the Calgary Office regarding **basin review** (compatibility) of data prior to publication.

5.3.8 07SA004 **Indin River above Chalco Lake** (1977-86)

Daily discharges for 1981 were originally computed by Yellowknife BUT revisions were required to October 18 to December 31 because of a **"break in continuity".** These revisions were submitted by Yellowknife about 1983 and appeared on the master FLOW file. However, the acceptable **daily discharges for January 1 to October 17, 1981 were inadvertently** not entered on the master FLOW file. Similarly, daily discharges for **November 8 to December 31, 1982** were revised by Yellowknife about 1983, again because of a "break in continuity", but the master FLOW file was not updated. These 344 daily discharges for 1981 and 1982 are now to be included in the master FLOW file.

The mean discharge for **December 1982** was revised by +42% from 1.64 to 2.33 m^3/s and the **mean for 1982** by +2% from 5.80 to 5.89 m^3/s.

The **mean annual discharge** for the period of record for 1978 to 1986 was revised by -5% from 7.47 to 7.13 m^3/s, mainly due to the inclusion of the 1981 data.

It is **recommended** that:

(a) the point at which WL checks are to be obtained be **physically identified** and that the feasibility of moving the orifice "into the lake" be evaluated, and

(b) **more discharge measurements** be obtained during open-water periods to confirm that the HQ relation is stable and also that **more verticals** be used during these measurements.

5.3.9 10KA006 **Jungle Ridge Creek near the Mouth** (1979-86)

Missing daily discharges for January 1 to May 27, 1981 were estimated to complete the records for the year and for the period of record for 1980 to 1986.

Daily discharges for April 19 to December 27, 1983 were revised because of a different interpretation during break-up, chart interpretation, daily shift correction distribution (also two discharge measurements were not used in the original computations) and winter recession. **The symbol E** was added to May 27 and 28. The maximum daily discharge was revised by +29% from 6.69 to 8.63 E m^3/s on May 27 and the maximum instantaneous by +29% from 6.83 to 8.78 E m^3/s. The mean discharge for May was revised by +5% from 1.79 to 1.88 m^3/s and for August by -78% from 0.427 to 0.093 m^3/s. The **mean discharge for 1983** was revised by -30% from 0.512 to 0.357 m^3/s.

Daily discharges for October 3 to November 17, 1984 and October 9 to November 7, 1985 were revised to show a smoother winter recession. The mean discharge for October 1984 was revised by -18% from 0.260 to 0.214 m^3/s and for October 1985 by -22% from 0.192 to 0.150 m^3/s.

Revisions were made to 476 daily discharges (including the estimation of 147 daily discharges in 1981), involving 18 months and 4 of the 7 complete years of record from 1980 to 1986.

It is **recommended** that:

(a) the following note be added under Remarks in the next Historical Streamflow Summary publication: "**Stage-discharge relation is not well-defined and data should be used with discretion**",

(b) the **standard period** be changed from "April to November" to "All Year"
Note: This has already been approved by Yellowknife and the HYDEX file will be updated in 1989,

(c) **more discharge measurements** be obtained to define the daily Shift and BW Corrections more accurately, and

(d) the **elevation of zero flow** be obtained at least once a year.

5.3.10 07UC001 **Kakisa River at Outlet of Kakisa Lake** (1962-86)

Revisions were made to 312 daily discharges for 4 years:

(a) Shape of hydrograph during **break-up** (1966 - 31 days)

(b) Shape of **ascending limb** (1974 - 27 days)

(c) **"Break in continuity"** from December 1978 to January 1979 (also discharge measurement results not used originally) - 1979 (136 days)

(d) **BW interpretation**, 1979-80 (118 days)

The **historical minimum daily discharge** was revised by +32% from 0.208B to 0.275B m^3/s on December 17, 1980.

The available **maximum instantaneous discharges** now represent the peak of the seiche effect on Kakisa Lake (6 were not previously published and 3 were revised).

Missing daily discharges for 1971 (46 days) and 1981 (69 days) were estimated to give a complete block of annual records from 1964 to 1986.

Annual mean discharges were revised as follows:

1966: by +5% from 45.4 to 47.7 m^3/s

1974: by -0.3% from 36.5 to 36.4 m^3/s

1979: by -5% from 44.0 to 41.8 m^3/s

1980: by -1% from 4.42 to 4.37 m^3/s

The **mean annual discharge** for 1964 to 1986 was revised by **-5%** from 40.6 to 38.4 m^3/s.

It is **recommended** that:

(a) **more discharge measurements** by obtained to define the distribution of shift and backwater corrections more accurately,

(b) the stage-discharge Curve No. 5 be **re-drawn** to eliminate "plus" BW corrections due to ice or weeds,

(c) the **elevation of zero flow** be obtained annually, and

(d) **a report** be prepared on the effect of **seiche** on Kakisa Lake and on **ice jams** at the outlet, on the flows below Kakisa Lake (supported by up-to-date field data) to document these unusual events that occur nearly every year.

5.3.11 07TA001 **La Martre River below Outlet of Lac La Martre** (1975-86)

The **maximum instantaneous discharge** for 1977 was extracted from the SAVE file as 29.2 m^3/s at 02:45 MST on July 1 - not previously published.

The data for November 17 to December 31, 1985 were revised by the Yellowknife Office in February 1987 using a different interpretation of the winter recession and to correct the **"break in continuity"** from 1985 to 1986. However, this revision **inadvertently** had not been submitted as a revision to the master FLOW file at Ottawa. The mean discharge for November was revised by +30% from 24.8 to 32.4 m^3/s and for December by +65% from 19.5 to 32.1 m^3/s. The **mean discharge for 1985** was revised by +4% from 34.8 to 40.1 m^3/s and the **mean annual discharge** for the period of record from 1977 to 1986 was unchanged at 25.9 m^3/s.

It is **recommended** that:

(a) since **bench mark** instability is a problem, that the following alternatives be considered to improve the reliability of the records:
   (i) obtain more discharge measurements
   (ii) instal stable bench marks
   (iii) relocate the station, and

(b) the **name of the station** be changed from "below Outlet of Lac La Martre" to "above Portage Rapids" which is a more specific geographical description.

5.3.12 10EB003 **Lened Creek above Little Nahanni River** (1982-86)

Daily discharges for June 1 - 28, 1983 were estimated by hydrograph comparison with Mac Creek and Flat River to give a complete block of records from 1982 to 1986.

The **mean annual discharge** for the period of record for 1983 to 1986 was revised by -2% from 0.757 to 0.740 m^3/s due to the extension of data for 1983.

It is **recommended** that:

(a) the **name of the station** be changed from "near South Nahanni River" to "above Little Nahanni River".

Note: This has already been approved and the HYDEX file was updated by Yellowknife in August 1988.

(b) since the **stage-discharge relation** is very sensitive and unstable, and is subject to shifting, that **more measurements** be obtained to define the HQ relation (or shift correction distribution) more accurately; usually only 10 to 15 verticals were used during open-water measurements which may account for some of the "scatter" - in any case, at least 20 verticals should be used for open-water measurements,

(c) the **elevation of zero flow** be obtained at least annually and especially after high water, and

(d) different scales be selected for **plotting** HQ curves (now too "flat")- see Composite Curve Sheet.

5.3.13 07PB002 **Little Buffalo River below Highway No. 5** (1965-86)

The **standard period** was changed from "May to October" to "All Year". The **annual** maximum and minimum extremes were identified where applicable.

The shape of the **ascending limb** during break-up was revised **for 1970 and 1979** - revisions were made to 19 daily discharges. The mean discharge for May 1979 was revised by **-20%** from 15.0 to 12.0 m^3/s.

"Zero flow" as published for two winter periods (1973 and 1984) was deleted from the FLOW file (130 days). "Zero flow" as published for August 23 to 27, 1982 was revised to show some flow.

The **most significant revision** was made to 128 open-water daily discharges for June 8 to October 13, 1983 because the **wrong HQ table** was used in the STREAM program. The mean discharge for August was revised by **-58%** from 0.481 to 0.204 m^3/s and for September by **-67%** from 0.413 to 0.137 m^3/s.

It is **recommended** that:

(a) **more discharge measurements** be obtained to define the daily shift correction distribution more accurately,

(b) **observations of "zero flow"** be documented, e.g., number of holes drilled and where (during winter), observations at Little Buffalo Falls, if any water at gauge, etc.; and since the stage-discharge relation is very sensitive in the LW range and is affected by weeds and debris, that the **elevation of zero flow** be determined at least once a year, and

(c) the feasibility of completing "all year" records for 1966 to date should be evaluated, and this work completed, if shown to be practical.

5.3.14 10FC001 **Plateau Creek near Willow Lake** (1976-85)

All **maximum instantaneous discharges** were deleted from the **PEAKS** file (1979 to 1984).

It is unlikely that the flow would be "zero" during summer. Therefore, 62 daily discharges during 1979, 1980 and 1981 were revised to show at least some flow. The annual mean discharges were **unchanged.**

The **symbol E** was added to 8 daily discharges in 1976, 1977, 1983 and 1984.

Missing periods were not estimated mainly because of the variability of flow and incompatibility with adjacent stations.

This station was **discontinued** in February 1986.

It if **recommended** that:

(a) since the data base barely meets national standards, mainly because of a poorly-defined stage-discharge relation and questionable gauge height records during high water, the following note be added under Remarks for the next Historical Streamflow Summary publication: **"The stage-discharge relation is unstable and data should be used with discretion".**

5.3.15 07SB011 **Pocket Lake Outflow near Yellowknife** (1967-78)

According to the records, there was **no flow during 1978** and therefore this is now included in the FLOW file.

Missing daily discharges for 1967 to 1974 were estimated to complete the records for the period of record from 1967 to 1978. Data for about 37 months were estimated at zero flow except for 3 days (April 26 to 28, 1970) which were estimated at 0.001 m^3/s.

It is **recommended** that:

(a) considering the small amount of water involved, that more accurate instrumentation and techniques should have been used and discharges should have been expressed to more significant figures to be more meaningful (also, seepage through and/or around the weir structure is not well-defined),that the following note be added under Remarks in the next Historical Streamflow Summary publication to caution users regarding the reliability of the data: **"Flows were mostly estimated and data should be used with discretion"**, and

(b) the **station files** for Pocket Lake (07SB008) and Pocket Lake Outflow (07SB011) be **consolidated.**

5.3.16 10ED006 **Rabbit Creek at Highway No. 7** (1984-86)

The **maximum instantaneous discharge for 1986** was extracted from the SAVE file and entered on the PEAKS file.

Missing daily discharges for June 1 to July 15, 1986 were estimated to complete the records for 1984 to 1986.

The **mean annual discharge** for the period of record was revised by +57% from 0.274 to 0.430 m^3/s due to the extension of records for 1986.

It is **recommended** that:

(a) since records were collected at two different locations on Rabbit Creek from 1978 to date, the location change in 1984 be well-documented and that ALL station files (including name changes) **properly identified:**
10ED004 (1978 to 1983), below Highway No. 7
10ED006 (1984 to date), at Highway No. 7
Note: The name changes have already been approved by Yellowknife and the HYDEX file at Ottawa will be updated in 1989.

(b) since the **stage-discharge relation** is unstable, sufficient **discharge measurements are required annually** to define the daily Shift Correction distribution reliably, and

(c) the **elevation of zero flow** be obtained at least annually and that any observations (or computations) of "**no flow**" are fully documented, and

(d) **beaver** activity be documented.

5.3.17 10ED004 **Rabbit Creek below Highway No. 7** (1978-83)

The **date** of the maximum instantaneous discharge for 1978 was revised from 4.19B m^3/s at 2200 MST on April 30 to 4.19 m^3/s at 0500 MST on May 30.

The **"zero" flows** as published during the summer months for 1980 to 1983 were revised to show at least some flow (43 daily discharges were revised).

The symbol E was added to 5 daily discharges above 10 m^3/s in 1979 and 1982 (also the maximum instantaneous discharges for 1979 and 1982).

The **mean annual discharge** for the period of record for 1978 to 1983 was revised by only +0.2% from 0.418 to 0.419 m^3/s.

It is **recommended** that:

(a) since records were collected at two different locations on Rabbit Creek from 1978 to date, that the location change in 1984 be well-documented and that ALL station files (including name changes) **properly identified:**
10ED004 (1978 to 1983), below Highway No. 7
10ED006 (1984 to date), at Highway No. 7
Note: The name changes have already been approved by Yellowknife and the HYDEX file at Ottawa will be updated in 1989.

(b) the following note be added under Remarks for the next Historical Streamflow Summary publication: **"Flows above 10 m^3/s were estimated and should be used with discretion".**

5.3.18 10HB005 **Redstone River 63 km above Mouth** (1974-86)

PEAKS and FLOW file data from September 1974 to December 1983 were **moved** from 10HB001 to 10HB005.

The **most significant revision** was made to the **HW HQ Curves** used from 1980 to 1985. Maximum discharges for 1980, 1982 and 1984 were revised by about -20%. **Other significant revisions** of over +50% were made to the monthly mean discharges during **winter recession periods** for 1980 and 1981.

Missing daily discharges for January 1 to May 8, 1981 **were estimated** to complete the records for the year and for the period 1980 to 1986. The **mean annual discharge** for the period 1980 to 1986 was revised by -9% from 194 to 177 m^3/s.

The **maximum instantaneous discharge** as published for 1978 was deleted from the PEAKS file and the maximum daily was deleted on the FLOW file as the maximum for the year (higher flows occurred during the period of missing record in July and August). The maximum instantaneous discharges for 1983 and 1985 were deleted from the PEAKS (peaks probably occurred during estimated periods in June).

Minimum daily discharges are now shown for 1979 and 1981.

A **revision of some type** was made to 6 of the 13 years of record.

The following **revisions** were made to **1160 daily discharges** (involving 43 months) from 1980 to 1985:

1980: July 21 and October 1 to December 31 (93 days)
- revisions to **HW HQ relation** (using Curve No. 7) and shape of **winter recession**

1981: January 1 to December 31 (365 days)
- January 1 to May 8 were **extended** to complete the records for the year
- May 9 to October 26 (revision to HQ Curve and shift correction distribution)
- October 27 to December 31 (shape of winter recession and **"break in continuity"** from December 1981 to January 1982)

5.3.18 10HB005 (continued)

1982: May 14 to December 5 (206 days)
- shape of **ascending limb** in May
- revision to HQ Curve and S.C. distribution; and winter recession

1983: June 2 to October 31 (152 days)
- revision to HQ Curve and S.C. distribution; and winter recession

1984: May 11 to November 17 (191 days)
- revision to HQ Curve and S.C. distribution; and winter recession

1985: May 25 to October 24 (153 days)
- using HQ Curve No. 7 without shift corrections and a revised winter recession

The following **revisions** were made to **maximum daily discharges:**

1976: symbol E added to 926 m^3/s
1978: 991E m^3/s was deleted
1980: by -16 % from 1420 to 1190 m^3/s
1981: by +0.4% from 464 to 466 m^3/s
1982: by -20 % from 2420 to 1930 m^3/s
1984: by -19 % from 1950 to 1580 m^3/s
1985: by - 5 % from 1230 to 1170E m^3/s

The following **revisions** were made to **minimum daily discharges:**

1979: 9.40B m^3/s (not previously published)
1981: 18.0 B m^3/s (not previously published)

The following **revisions** were made to **maximum instantaneous discharges:**

1978: 1080E m^3/s was deleted
1980: by -19% from 1620 to 1320 m^3/s
1981: by +1% from 568 to 573 m^3/s
1982: by -21% from 2740 to 2170 m^3/s
1983: 1620 m^3/s was deleted
1984: by -20% from 2410 to 1920 m^3/s
1985: 1340 m^3/s was deleted

5.3.18 10HB005 (continued)

The following **significant revisions** (above 10%) were made to **monthly mean discharges:**

Oct. 1980: +30% from 80.7 to 105 m^3/s
Nov. 1980: +61% from 28.0 to 45.0 m^3/s
Dec. 1980: +71% from 17.2 to 29.4 m^3/s
Sept 1981: +23% from 103 to 127 m^3/s
Oct. 1981: +54% from 60.8 to 93.5 m^3/s
Nov. 1981: +44% from 41.6 to 59.9 m^3/s
May 1982: -11% from 327 to 291 m^3/s
July 1982: -14% from 520 to 478 m^3/s
Aug. 1982: -12% from 650 to 575 m^3/s
Sept 1982: -12% from 334 to 293 m^3/s
Oct. 1982: +50% from 87.5 to 131 m^3/s
Nov. 1982: +19% from 41.7 to 49.8 m^3/s
Aug. 1983: -13% from 423 to 369 m^3/s
June 1984: -12% from 564 to 497 m^3/s
Oct. 1984: +19% from 108 to 129 m^3/s

The following **revisions** were made to **annual mean discharges:**

1980: by +3% from 133 to 137 m^3/s
1981: 110 m^3/s (not previously published)
1982: by -7% from 237 to 220 m^3/s
1983: by -6% from 181 to 171 m^3/s
1984: by -6% from 195 to 184 m^3/s
1985: unchanged at 207 m^3/s

The **mean annual discharge** for 1980-86 was revised by -9% from 194 to 177 m^3/s, mainly due to the extension of data for 1981.

It is **recommended** that:

(a) since records were collected at **two different locations** on the Redstone River from 1963 to date, that ALL station files (including computerized files: HYDEX, SAVE, PEAKS and FLOW) be **properly identified:**
10HB001 (October 1963 to August 1974), near the Mouth
10HB005 (September 1964 to date), 63 km above Mouth

(b) **more discharge measurements** be obtained to define the HQ relation more accurately, especially LW (below 2.5 m, 150 m^3/s) and HW extremes and the shift correction distribution; slope-area measurement, or other **indirect determinations**, are required to obtain the flows during HW (above 4.5 m, 1000 m^3/s),

(c) the **elevation of zero flow** be obtained at least annually, especially after HW,

(d) the extent of **slush problems** encountered during winter measurements be documented,

(e) **records be reviewed again** when discharge measurements at LW and HW extremes have been obtained, and

(f) **records be examined again** after the Review of the Carcajou and Mountain Rivers has been completed, especially winter periods from 1978 to 1983.

5.3.19 10HB001 **Redstone River near the Mouth** (1963-74)

PEAKS and FLOW file data for September 1974 to December 1983 were moved from 10HB001 to 10HB005.

The symbol A was added to 16 days and the symbol B to 3 days. The symbol B was deleted for 16 days in 1967 and 13 in 1968. The symbol E was added to 6 days in 1970 and 4 in 1971.

The measured discharge of 385A m^3/s on July 8, 1966 was published for the wrong day and the one for July 15, 1969 (502A m^3/s) was added to the FLOW file.

The minimum daily discharges for 1969, 1973 and 1974 were considered valid for the year (not previously published).

The maximum daily discharge of 527 m^3/s on July 17 as published for 1965 may not be the peak for the year and therefore was deleted as the maximum for 1965 (the symbol H, to indicate a valid maximum daily, was deleted from the FLOW file).

The symbol E was added to the daily discharges for July 6 and 7, 1968 and the maximum instantaneous discharge for 1968 was deleted because the HQ relation is not only unstable but is also not defined in the HW range. Also, the chart record and the high-water mark are not in agreement.

It is **recommended** that:

(a) since records were collected at **two different locations** on the Redstone River from 1963 to date, that all station files (including computerized files: HYDEX, SAVE, PEAKS and FLOW) **be properly identified:**
10HB001 (October 1963 to August 1974), near the Mouth
10HB005 (September 1974 to date), 63 km above the Mouth

(b) since the **data base barely meets national standards**, the following note be added under Remarks for the next Historical Streamflow Summary publication: **"Stage-discharge relation is unstable and not defined, and records are incomplete. Data should be used with discretion."**

5.3.20 10KA005 **Seepage Creek at Norman Wells** (1974-78)

There were **no revisions to daily discharges.**

The **maximum instantaneous discharge** for 1975 was **deleted** from the PEAKS file and the **symbol E** was added to the daily discharges for May 4 to 6, 1975 (high water). The **maximum instantaneous discharge** for 1976 was extracted from the STREAM output (not previously published).

No recommendations were made.

5.3.21 10HA002 **Tsichu River at Canol Road** (1975-86)

The daily discharge for December 12, 1984 was revised by -26% from 0.390B to 0.290B m^3/s because of a keypunching error **("spike").** The mean discharge for December was revised by -1.5% from 0.269 to 0.265 m^3/s and the mean discharge for 1984 was **unchanged** at 3.63 m^3/s.

Daily discharges for January 1 to May 25, 1986 were revised to show "smoother" winter flows, consistent with other years. The mean discharge for March was revised by +48% from 0.085 to 0.126 m^3/s and the minimum daily discharge by +120% from 0.056B to 0.123B m^3/s. The mean discharge for 1986 was revised by +0.3% from 3.70 to 3.71 m^3/s.

The **mean annual discharge** for the period of record from 1976 to 1986 was unchanged at 3.38 m^3/s.

It is **recommended** that:

(a) the following note be added under Remarks for the next Historical Streamflow Summary publication: **"Stage-discharge relation is not well-defined; flows above 30 m^3/s should be used with discretion"**,

(b) **more discharge measurements** be obtained to define the high-water stage-discharge relation and the shift/backwater corrections more accurately,

(c) another **bench mark** be installed above 3.5 m, and

(d) **records be reviewed again** when high-water measurements above 2.5 m have been obtained.

5.3.22 07SC002 **Waldron River near the Mouth** (1978-86)

Various types of revisions (including extension of records for 1980) were made to 823 daily discharges from 1980 to 1983 involving 30 months of data. **Highlights** are as follows (see Summary of Revisions for more details):

1980: January 1 to October 31 (305 days)
- **LW HQ Curve revision** January 1 to April 22
- February mean revised by -33% from 1.41 to 0.949 m^3/s
- March mean revised by -41% from 1.18 to 0.702 m^3/s
- April 23 to July 16 (not previously published - 85 days)

1981: January 1 to December 24 (358 days)
- **LW HQ Curve revision** January 1 to May 5 (also **"break in continuity"** in January)
- February mean revised by -46% from 1.32 to 0.719 m^3/s
- March mean revised by -53% from 1.21 to 0.572 m^3/s
- April mean revised by -61% from 1.21 to 0.467 m^3/s
- June mean revised by +8% from 9.48 to 10.2 m^3/s
- Annual mean revised by -4% from 3.53 to 3.39 m^3/s

1982: September 26 to December 31 (97 days)
- **measured discharge not used** in original computations
- November mean revised by +34% from 2.78 to 3.73 m^3/s
- Annual mean revised by +4% from 4.22 to 4.39 m^3/s

1983: January 1 to 21 and April 21 to June 6 (67 days)
- **measured discharge not used** in original computations
- May mean revised by +9% from 0.386 to 0.400 m^3/s
- Annual mean was unchanged at 8.41 m^3/s
- minimum daily * revised by +8% from 0.350E to 0.378E m^3/s

  * - also historical minimum for 1979-86

The **mean annual discharge** for the period of record for 1979 to 1986 was revised by -6% from 6.82 to 6.40 m^3/s, mainly due to the extension of records for 1980 and revisions to 1981 data.

It is **recommended** that:

(a) **the orifice be moved** "into the lake" and the point at which water level checks are to be obtained by instrument be **physically identified**, and

(b) **more discharge measurements** be obtained to define the HQ relation more accurately and to confirm that there is no BW during winter periods.

6. MACKENZIE RIVER PRELIMINARY REPORTS

6.1 10FB001 **Mackenzie River near Fort Providence** (1961-78)

This station was operated by the Calgary Office (Fort Smith sub-office) in 1958 and miscellaneous discharge measurements were obtained from 1958 to 1960. **Daily discharges** are available for periods of varying length for 1961 and 1962, continuous from June 1, 1963 to December 31, 1973 and periods of varying length (mostly June to October) from 1974 to 1978. "Stage records only" have been obtained since 1979.

This station is located on the left bank, 1.3 km above the ferry crossing on Highway No. 3 and 14 km above Fort Providence. Flows have been "regulated" since 1968.

Gauge height records were obtained from a Stevens analog recorder activated by a **servomanometer.**

Discharge measurements were obtained by boat or from an ice cover below the gauge. **Slush** problems were usually encountered during winter measurements.

The **stage-discharge relation** is not well-defined and discharge measurements plot in about a 15% band. No measurements were obtained in 1973 or 1974 and only one or two each year from 1975 to 1978. Two breakwater structures were built about 1973 to dock the Providence ferry which no doubt affected the HQ relation.

A revision of some type will be required to most years. It was agreed with the Yellowknife Office that the standard period be changed to "All Year". The following note should be added under Remarks in the next Historical Streamflow Summary publication: "**Stage-discharge relation is not well-defined and data should be used with discretion**".

6.2 10GC001 **Mackenzie River at Fort Simpson** (1959-86)

This station was operated by the Calgary Office (Fort Smith and Fort Simpson sub-offices) from 1959 to 1980. This responsibility was transferred to the Yellowknife Office in 1981 (Fort Simpson sub-office). Data have been collected and computed in metric units since 1979.

Gauge height records were obtained from a manual gauge from 1938 to 1964 and from an analog recorder activated by a **servomanometer** since 1965. The first discharge measurement was obtained in 1959 and daily discharges are available for periods of varying length from 1938 to 1964 and continuous from January 1, 1965 to date. The gauge was moved several times from 1938 to date. A **detailed map** (scale, 1:25 000) is required showing these locations and also a chronological description of all installations and changes (types of gauges, bench marks, triangulation baseline, etc.), e.g., the gauge was moved from the right bank to the left on August 3, 1974, 1/2 mile upstream (slope, 1.09 ft).

Discharge measurements were obtained by boat or from an ice cover at or near the gauge. **Slush** problems were usually encountered during winter measurements; these measurements should be examined by technical staff to determine whether any "adjustments" should be made because of debatable distribution of velocity observations and effect of slush.

The **stage-discharge relation** is fairly well-defined by discharge measurements in a 10% band. However, no open-water measurements were obtained in 1967, 1980, 1981, 1983 and 1985 to 1987 and HQ Curve No. 5 was used without shift corrections from 1978 to 1987. A **simple** stage-discharge relation is probably not applicable at this station during break-up and high-water periods; **variable slope** at any given gauge height appears to be a major factor in the determination of discharges (unsteady flow) and the use of a "two-gauge relationship" should be evaluated. More detailed explanations on the subject of slope-stage-discharge relations are given in Chapter 11 of U.S. Geological Survey Water-Supply Paper 2175 (Volume 2).

6.3 Negative ungauged inflow

Computer-generated **Comparison Hydrographs** were used extensively in this Review to assess the compatibility of data for the Liard and Mackenzie Rivers. Various combinations of stations were plotted, e.g., Mackenzie River at Norman Wells and Mackenzie River at Fort Simpson individually and also the flows for "Norman Wells" **minus** "Fort Simpson" (without any adjustment for lag). Numerous **inconsistencies** such as negative ungauged inflow were identified. Flows during some winter periods (including the ascending limb during break-up and winter recession after freeze-up) were not always in reasonable agreement. These hydrographs also illustrate the sensitivity and variability of the flows within these basins, including tributaries, they also expose obvious errors such as "breaks in continuity" and keypunching errors ("spikes").

A **mathematical comparison** of monthly and annual means was also carried out for some stations to illustrate the magnitude of any differences. However, this was done manually and of course should be automated to facilitate data review.

A **revision of some type** will be required to nearly every year of record from 1960 to 1986 for at least one (in some years, all) of the stations on the Liard and Mackenzie Rivers in the NWT.

Negative ungauged inflow can be attributed to several factors:

(a) natural causes such as time lag, channel losses, channel or bank storage, evaporation, ice formation, ice jams
(b) estimated periods or BW interpretations
(c) freeze-up (ice formation, slush, "recovery")
(d) break-up (ice jams, BW, HW marks, shape of ascending limb, timing of peak and shape of descending limb)
(e) shape of winter recession
(f) levelling accuracy (BM stability, permafrost, WL surging)
(g) accuracy of winter measurements (slush, low velocities, cold temperatures)

(h) accuracy of HW measurements
- fast velocities, shallow depth
- sounding weight (oversounding)
- number of verticals (more than 5% in one panel)
- accuracy of mean gauge height (surging)

(i) accuracy of slope-area measurements
- value of "n", number of cross-sections
- HW profile, stability of streambed

(j) accuracy of Moving-Boat measurements
- mean gauge height, surging, standing waves

(k) stability of HQ relation
- LW and HW extension
- number and accuracy of measurements
- shift correction distribution (time or stage basis)

(l) chart interpretation (accuracy of digitizing)
- setting pen to gauge height
- time corrections, clock stoppage, reversals
- orifice movement (settling correction)
- distribution of pen correction
- accuracy of chart trace, chart scale
- orifice (silted, slush or ice)
- nitrogen leaks, loose gears, orifice line severed
- interpretation of mean of questionable chart trace ("painting", "stepping")

6.4 Recommendations

It was agreed with the Yellowknife Office that the main-stem stations on the Liard and Mackenzie Rivers should be **reviewed as a unit** (see Section 3.2 for a Review Proposal for 1990-91).

It is also **recommended** that:

(a) **Slope-Area** measurements be obtained to confirm the HW extension at all stations and that more conventional current-meter discharge measurements be obtained to define the Shift and Backwater Corrections more accurately and also to define the roughness coefficient (n),

(b) two gauges be established at Liard River near the Mouth (10ED002) and Mackenzie River at Fort Simpson (10GC001) to evaluate the applicability of a "**two-gauge relationship**" to determine discharges under variable slope conditions,

(c) a station be established on the Mackenzie River **above the confluence** of the Liard and Mackenzie Rivers to obtain a better understanding of the flow characteristics at all stages on these two rivers,

(d) the **time lag** be determined for various stages for all stations on the Liard and Mackenzie Rivers (and a report written), and

(e) **computer programs** be written for a mathematical "summation" comparison of historical monthly and annual mean discharges and for an annual basin review for all stations in the NWT on the Liard and Mackenzie Rivers and their tributaries.

7. DATA REVIEW PROCEDURES

7.1 **General Procedures:** from WRB Manual of Hydrometric Data Review Procedures (Fifth Edition, 1980).

(a) Obtain appropriate comparison hydrographs and listings from the master data files at Ottawa (HYDEX, FLOW and PEAKS).

(b) Obtain appropriate historical climate data (air temperature and precipitation) from Yellowknife (AES, Downsview).

(c) Assemble all available basic field and office data for the station(s) under review.

(d) Prepare Station History.

(e) Convert gauge heights and discharges on List of Measurements form from imperial to metric and vice versa (data have been collected and computed in metric units since 1979-80).

(f) Prepare Composite Curve Sheets - imperial and metric - tabulate period of use, and annual range of stage during open water.

(g) Plot climate data on comparison hydrographs (to be used as worksheets).

(h) Plot discharge measurements (metric units) on comparison hydrographs.

(i) Examine data year by year, especially peaks - compare with other stations - spot check daily values.

(j) Discuss proposed revisions or extensions with Yellowknife.

(k) Extend and/or revise data - prepare data update forms.

(l) Submit updates for temporary data files at Ottawa.

(m) Check plots and listings from updated temporary data files.

(n) Prepare Review Report.

(o) Some of the items mentioned above may be carried out concurrently.

(p) Final approval by Yellowknife.

(q) Master files updated by Ottawa - revised daily listings will be sent automatically to Yellowknife by Ottawa.

(r) Explanation in Revisions File by Yellowknife.

(s) Revisions and extensions published by Ottawa in next Historical Streamflow Summary publication.

7.2 Factors Affecting Review Process

(a) **Description File** is incomplete
- latest Station Description is not up-to-date
- chronological documentation of changes in Station History is incomplete or missing (no field reports), e.g., installation changes (shelters, cableways, BMs), location changes, BM stability (permafrost), DCPs, etc.
- latest drainage area and map co-ordinates appear up-to-date but date of digitizing and scale of map are not given on summary sheet
- more photos needed

(b) **Work Files** prior to early seventies incomplete or missing and existing files are not easy to access (have to be taken apart to look at data)
- Station Analysis usually available but usually incomplete, e.g., basis for estimates not given, missing gauge height periods and reasons not given
- distribution of daily shift corrections and BW interpretation not included

(c) Major **hydrologic events** are not documented
- e.g., floods and HW marks
- slope-area computations or reports not available
- break-up activity, freeze-up (and "recovery")

(d) Data have been collected and computed in **metric units** since 1979
- data often have to be converted from imperial to metric and vice versa (gauge heights and discharges on List of Measurements, HQ tables, daily gauge heights and daily discharges)

(e) Continuous graphical **gauge height records** usually obtained during open-water periods, including HW periods in the South Nahanni River Basin
- usually no observer
- gauge height records usually not obtained during winter periods
- records for the Northern and Eastern Arctic prior to 1983 usually incomplete during break-up, especially at peaks (landings often impossible because fixed-wing aircraft were used - no documentation on this, especially on river ice conditions)
- stilling well (float) installations were replaced by servomanometer systems mainly because of frozen intake problems
- Winnipeg-type pressure gauge also being replaced by servomanometer mainly because of recorder malfunction and chart interpretation problems (small scale, reversals, "painting", setting WL accurately on chart)
- servomanometer problems related to orifice line, mechanical and electrical malfunctions, gas leakage, accuracy of setting WL readings on chart
- some chart interpretations debatable, e.g. accuracy of setting WL on chart (large pen corrections), reversals; quality checks of digitizing not shown on each chart segment
- "multiple-file" folders a good idea for storing charts

(f) **Stage-discharge relation** in early years usually not well-defined (insufficient measurements), especially at extremes; although this has improved for some stations in recent years
- BW effect during break-up not well-defined by discharge measurements
- Shift corrections not well-defined for unstable controls; shift correction distribution is debatable (also tabulation of daily corrections usually not available)
- period of use usually not stated on HQ curves and tables, although this is usually shown on Station Analysis

(g) Accuracy of **winter measurements** is debatable at times because of very cold weather and slush ice conditions
- usually not enough measurements during winter periods, even in recent years

(h) **Basis for Revisions and Estimates:**

- difficult to estimate in advance, the time required to complete revisions or missing periods
- bracketted means (which were used before mid-sixties) were changed to daily discharges from hydrographs
- **comparison hydrographs** were used extensively but are not to the same scale as WRB forms, therefore time-consuming when plotting measurements and comparing hydrographs
- climate data from nearest AES station
- high water marks
- new interpretation of BW effect and shift corrections
- shape, timing and magnitude of flows during break-up
- logarithmic recession (not arithmetic interpolation) during winter periods
- new interpretation of HQ curves based on more recent data, however, still insufficient measurements to fully substantiate revisions in some cases
- recent **Spring Field Surveys invaluable** (more should be carried out)

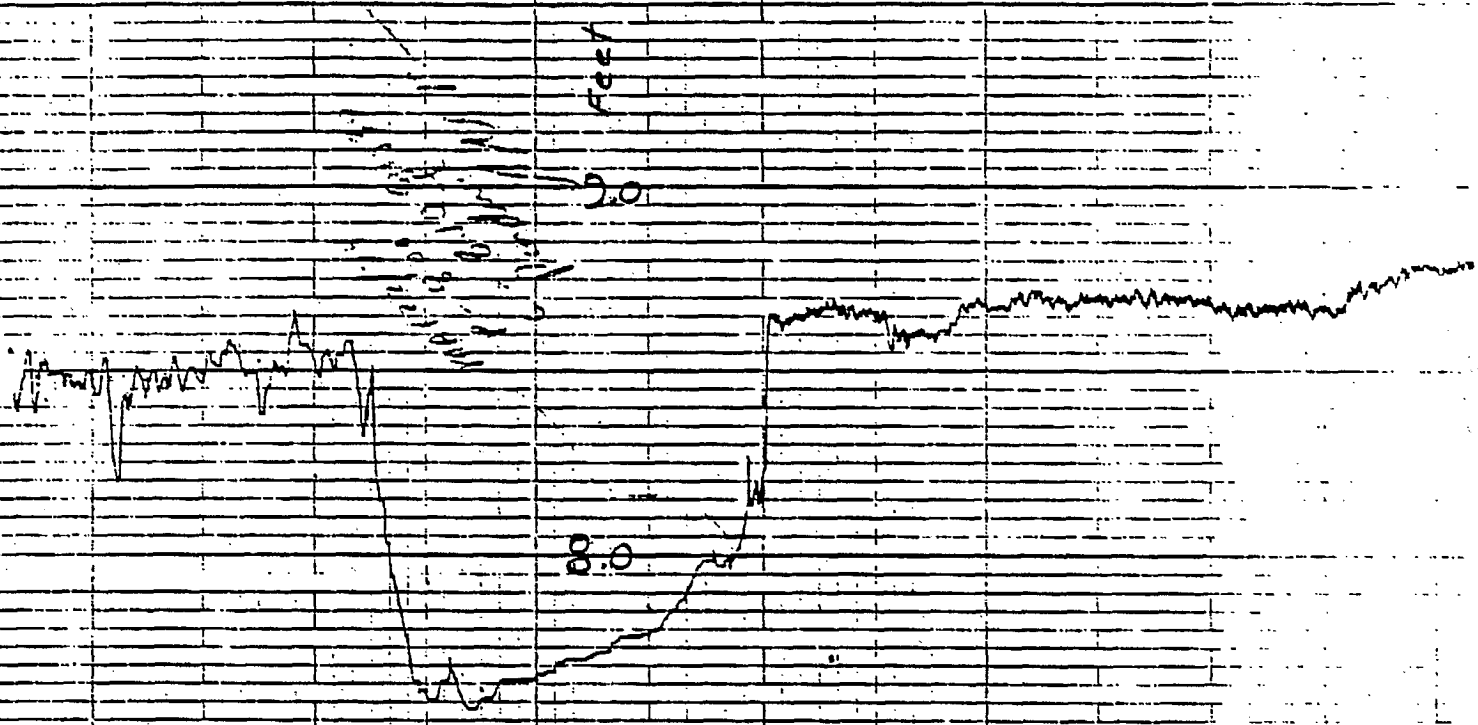
(i) **Operational Constraints**

- computer software inadequate, especially for comparison hydrographs and basin review
- shortage of funds for field trips (discharge measurements) and instrumentation
- shortage of staff (trained technicians) to carry out data reviews

MADE IN CANADA BY MAITLAND CHARTS LTD

21 MAY 22 2E

OTUCOOL
KAKISA RIVER
Example of Ice Jam
at outlet of Kakisa Lake
May 1974



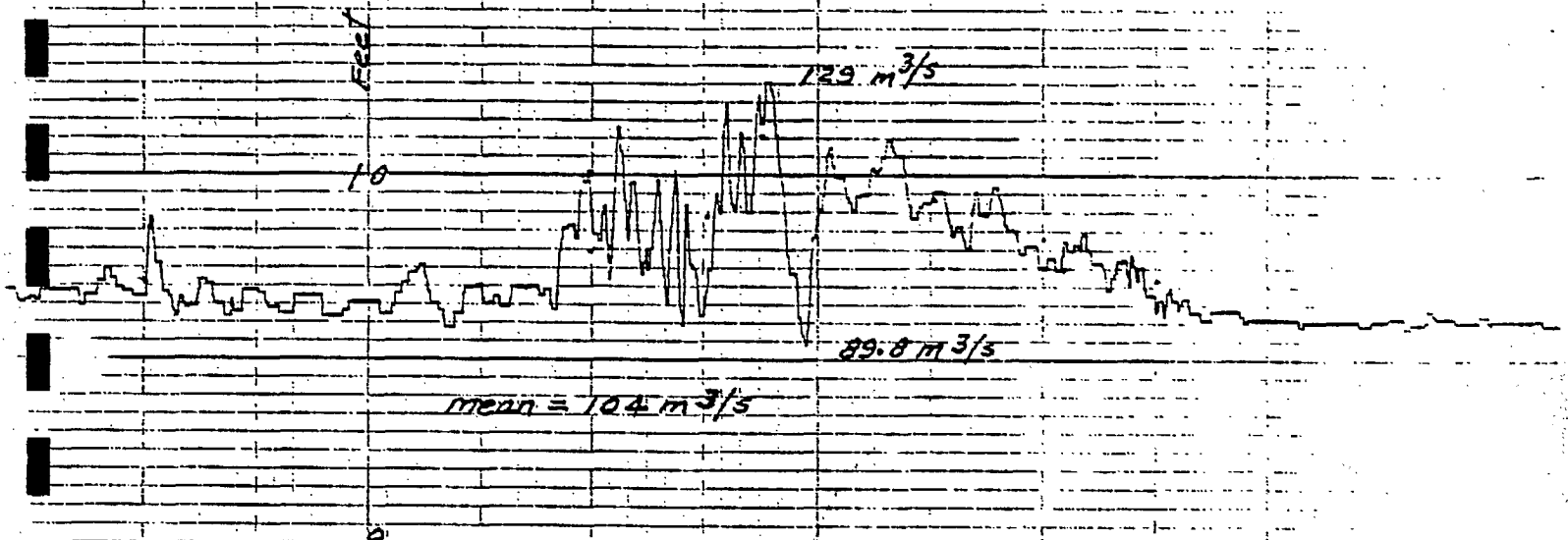
8.25
+ 10 SE
8.35
- .06 P
8.29

8.40
+ 10 SE
8.50
- .07 P
8.43

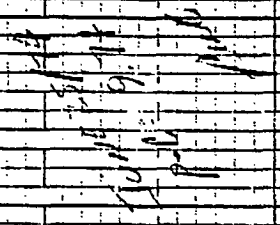
8.31
+ 10 SE
8.41
- .06 P
8.35

23 JUNE 24 25 26

OTUCOOI
KAKISA RIVER
Example of Seiche Effect
on Kakisa Lake
June 1974

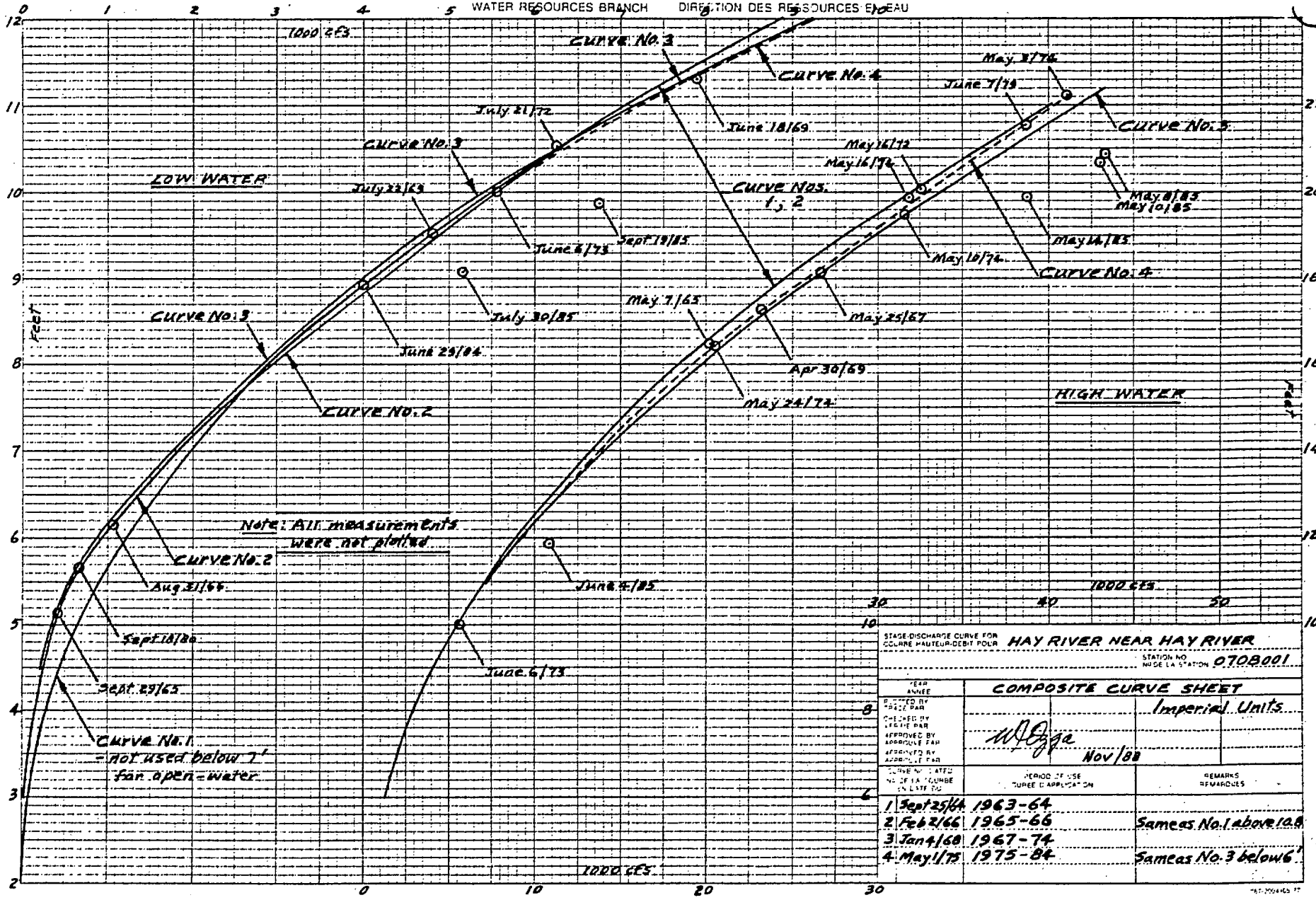


9.71/ 9.80/ 9.83/ 9.61/



DEPARTMENT OF FISHERIES AND THE ENVIRONMENT
WATER RESOURCES BRANCH

MINISTERE DES PECHES ET DE L ENVIRONNEMENT
DIRECTION DES RESSOURCES EN EAU



STAGE-DISCHARGE CURVE FOR / COURBE HAUTEUR-DEBIT POUR: HAY RIVER NEAR HAY RIVER

STATION NO / NO DE LA STATION: 07OB001

COMPOSITE CURVE SHEET

Imperial Units

PLOTTED BY / TRACE PAR:
CHECKED BY / VERIFIE PAR: W.J. Ozga
APPROVED BY / APPROUVE PAR: Nov/88
APPROVED BY / APPROUVE PAR:

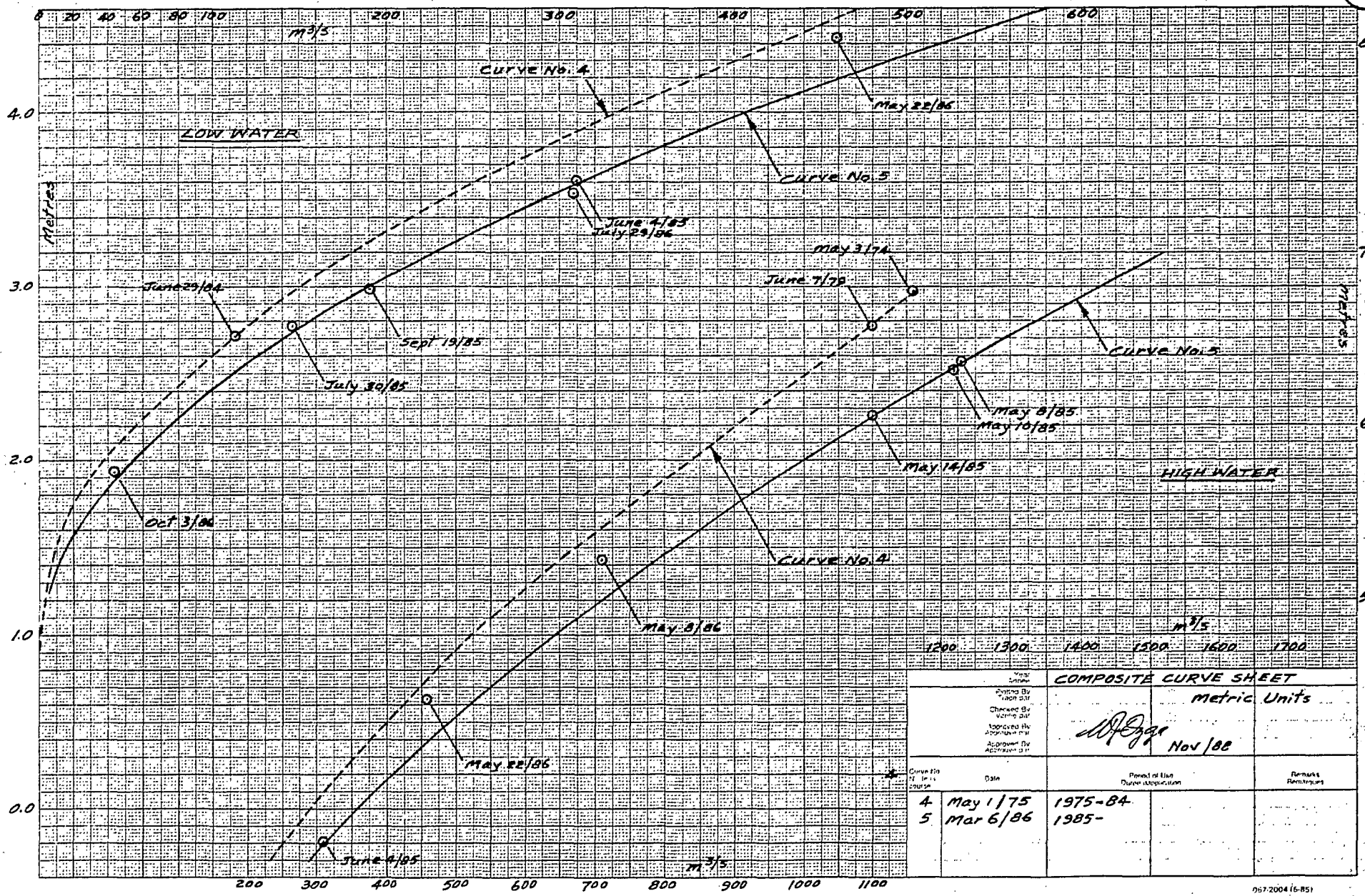
CURVE NO. / DATE / NO DE LA COURBE / DATE	PERIOD OF USE / DUREE D'APPLICATION	REMARKS / REMARQUES
1 Sept 25/64	1963-64	
2 Feb 2/66	1965-66	Same as No. 1 above 10.8
3 Jan 4/68	1967-74	
4 May 1/75	1975-84	Same as No. 3 below 6'

19

Environment Canada
Water Resources Branch

Environnement Canada
Direction des ressources en eau

Station HAY RIVER NEAR HAY RIVER 07OB001



Year Année	COMPOSITE CURVE SHEET	
Plotted By Tracé par		Metric Units
Checked By Vérifié par		
Approved By Approuvé par	Nov/88	
Approved By Approuvé par		

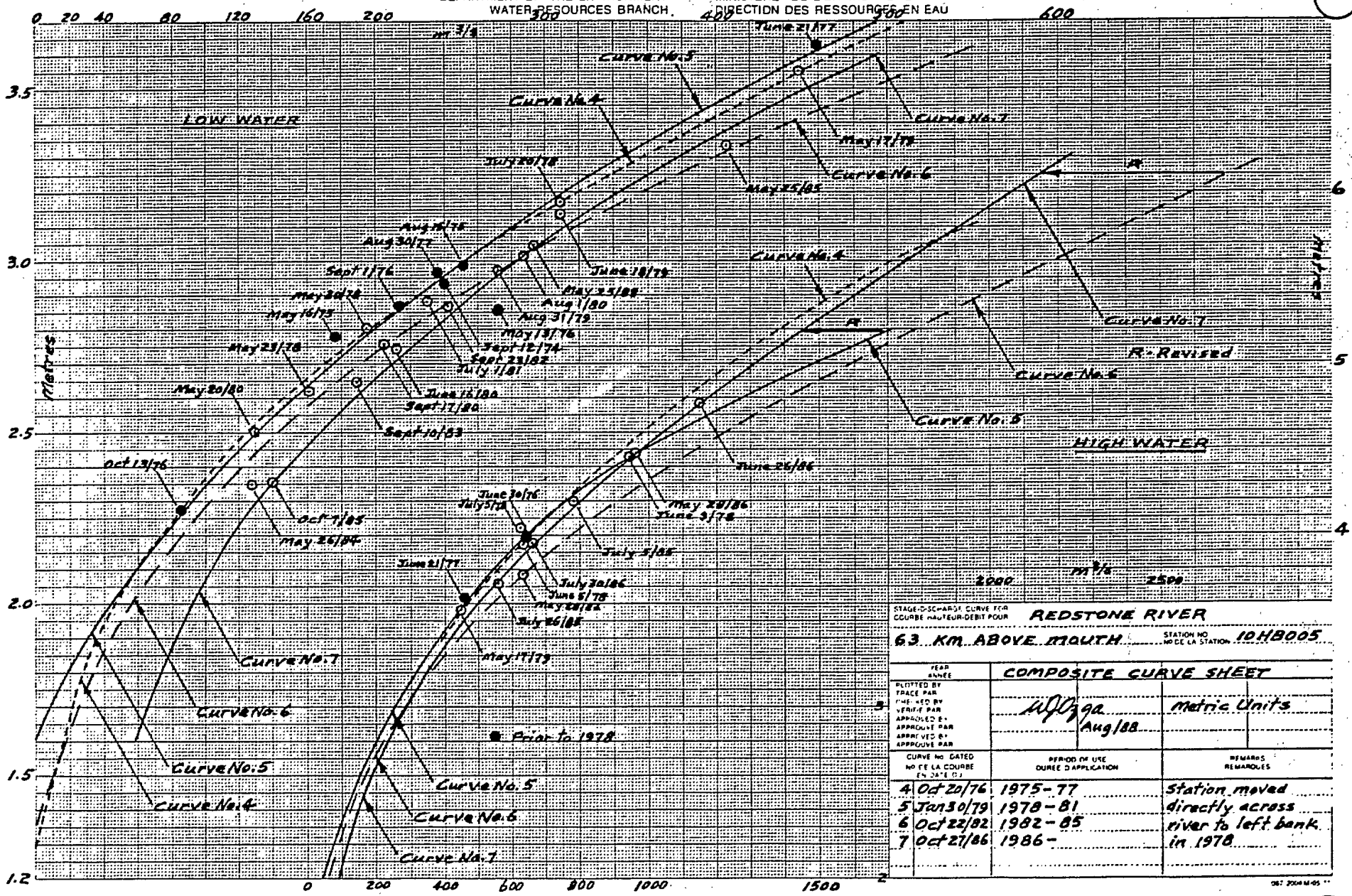
Curve No. of this course	Date	Period of Use Durée d'application		Remarks Remarques
4	May 1/75	1975-84		
5	Mar 6/86	1985-		

067-2004 (6-85)

62

DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

MINISTERE DE L'ENVIRONNEMENT
DIRECTION DES RESSOURCES EN EAU



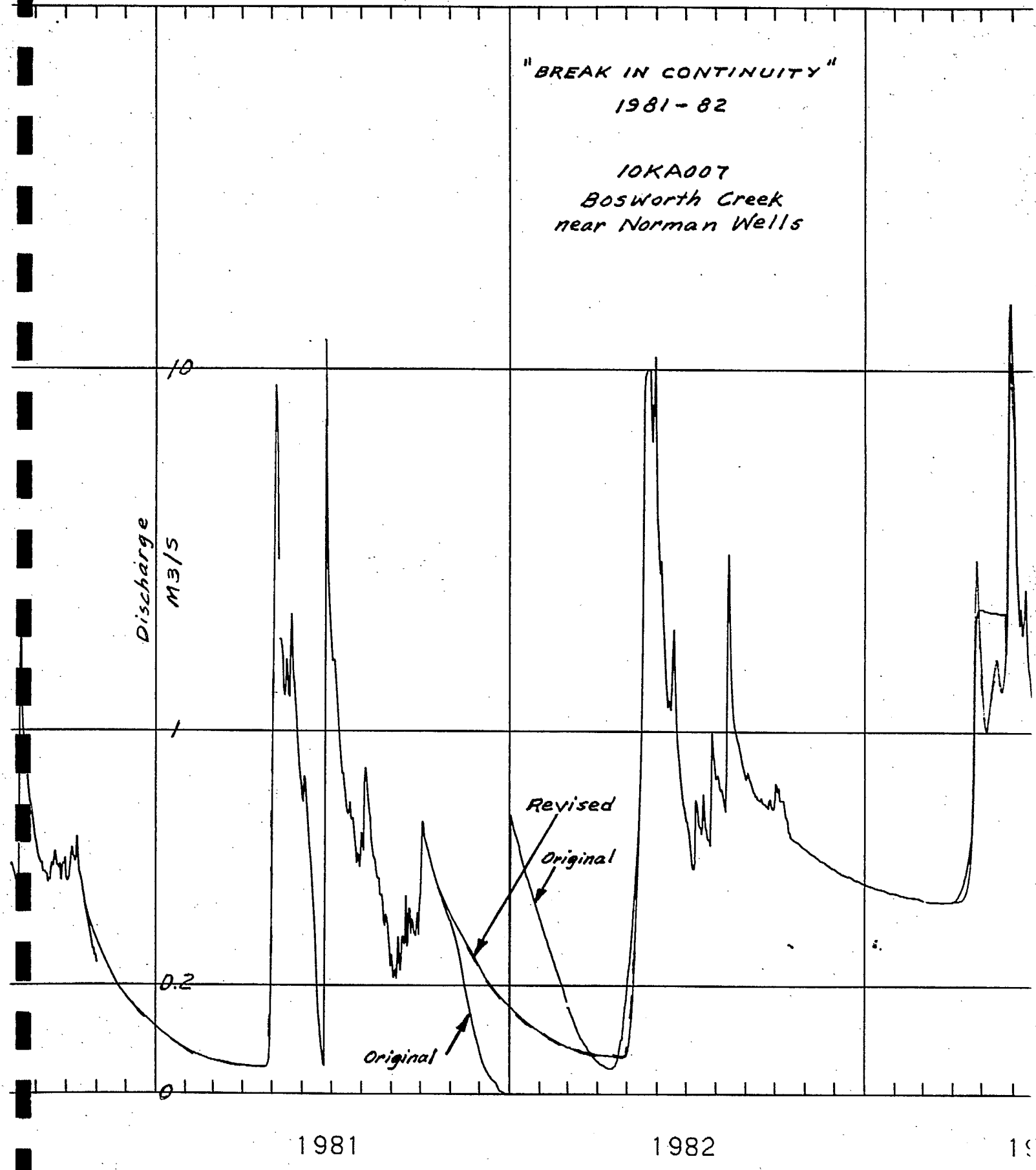
STAGE-DISCHARGE CURVE FOR
COURBE HAUTEUR-DEBIT POUR **REDSTONE RIVER**

63 KM ABOVE MOUTH STATION NO / NO DE LA STATION **10HB005**

YEAR / ANNÉE	COMPOSITE CURVE SHEET		
PLOTTED BY / TRACÉ PAR			
CHECKED BY / VÉRIFIÉ PAR	WDG	ga	Metric Units
APPROVED BY / APPROUVÉ PAR		Aug/88	
APPROVED BY / APPROUVÉ PAR			

CURVE No DATED / NO DE LA COURBE EN DATE DU	PERIOD OF USE / DURÉE D'APPLICATION	REMARKS / REMARQUES
4 Oct 20/76	1975-77	Station moved
5 Jan 30/79	1978-81	directly across
6 Oct 22/82	1982-85	river to left bank
7 Oct 27/86	1986-	in 1978

63


"BREAK IN CONTINUITY"
1981 - 82
10KA007
Bosworth Creek
near Norman Wells
Discharge
M3/S
10
1
0.2
0
Revised
Original
Original
1981
1982

SUMMARY OF MEANS AND EXTREMES

BEFORE REVISIONS

INDIN RIVER ABOVE CHALCO LAKE - STATION NO. 07SA004

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1977	---	---	---	---	---	---	---	---	2.57	2.32	2.12	1.51	---	1977
1978	1.08	0.789	0.490	0.346	1.15	14.3	14.4	6.54	3.44	3.12	2.67	1.88	4.20	1978
1979	1.33	1.03	0.797	0.617	6.75	34.9	15.0	5.57	3.17	2.41	1.99	1.42	6.24	1979
1980	1.06	0.804	0.588	0.467	8.81	16.3	7.92	3.31	1.98	2.21	2.33	1.71	3.96	1980
1981	---	---	---	---	---	---	---	---	---	---	3.91	3.77	---	1981
1982	2.22	1.25	0.748	0.528	2.94	25.8	15.4	7.65	4.79	3.70	2.82	1.64	5.80	1982
1983	1.76	1.30	0.837	0.431	0.386	17.6	21.7	12.3	9.41	9.62	8.76	5.62	7.51	1983
1984	3.22	2.05	1.34	1.09	12.8	56.7	33.1	15.6	9.82	7.87	4.77	2.64	12.6	1984
1985	1.77	1.42	1.15	0.975	16.0	37.9	18.6	14.2	8.85	6.34	4.68	3.46	9.64	1985
1986	2.12	1.54	1.12	0.766	6.21	55.7	21.3	9.36	6.37	5.03	4.81	3.26	9.79	1986
MEAN	1.82	1.27	0.854	0.653	6.58	32.4	18.4	9.32	5.60	4.74	3.89	2.69	7.47	MEAN

LOCATION - LAT 64 23 20 N DRAINAGE AREA, 1 520 km²
LONG 115 01 16 W NATURAL FLOW

INDIN RIVER ABOVE CHALCO LAKE - STATION NO. 07SA004

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (m³/s)	MAXIMUM DAILY DISCHARGE (m³/s)	MINIMUM DAILY DISCHARGE (m³/s)	TOTAL DISCHARGE (dam³)	YEAR
1977	---	---	---	---	1977
1978	21.9 AT 20:50 MST ON JUN 22	20.2 ON JUN 24	0.323B ON APR 26 *	132 000	1978
1979	43.9 AT 09:1A MST ON JUN 6	43.8 ON JUN 6	0.568B ON APR 28	197 000	1979
1980	---	17.6E ON JUN 14	0.394B ON APR 15	125 000	1980
1981	---	---	---	---	1981
1982	33.6 AT 19:00 MST ON JUN 14	33.1 ON JUN 14	0.488B ON APR 25	183 000	1982
1983	37.7 AT 09:32 MST ON JUN 27	36.2 ON JUN 27	0.330B ON MAY 21	237 000	1983
1984	74.5 AT 10:02 MST ON JUN 8 *	74.0 ON JUN 8 *	1.05 B ON APR 20	398 000	1984
1985	49.5 AT 21:22 MST ON MAY 31	49.3 ON MAY 31	0.860B ON MAY 6	304 000	1985
1986	68.4 AT 19:45 MST ON JUN 5	68.0 ON JUN 6	0.501B ON MAY 8	309 000	1986
				236 000	MEAN

B - ICE CONDITIONS
E - ESTIMATED
* - EXTREME RECORDED FOR THE PERIOD OF RECORD

AFTER REVISIONS

WATER SURVEY OF CANADA
JAN 01 1989 PAGE 3
YELLOWKNIFE, NWT

INDIN RIVER ABOVE CHALCO LAKE — STATION NO. 07SA004

MONTHLY AND ANNUAL MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	YEAR
1977	---	---	---	---	---	---	---	---	2.57	2.32	2.12	1.51	---	1977
1978	1.08	0.759	0.490	0.346	1.15	14.3	14.4	6.54	3.44	3.12	2.67	1.88	4.20	1978
1979	1.33	1.03	0.797	0.617	6.75	34.9	15.0	5.57	3.17	2.41	1.99	1.42	6.24	1979
1980	1.06	0.804	0.588	0.467	8.81	16.3	7.92	3.31	1.98	2.21	2.33	1.71	3.96	1980
1981	1.10R	0.826R	0.656R	0.633R	1.89 R	8.66R	15.6 R	7.54R	3.72R	3.53R	3.91	3.77	4.35R	1981
1982	2.22	1.25	0.746	0.528	2.94	25.8	15.4	7.65	4.79	3.70	3.18R	2.33R	5.89R	1982
1983	1.76	1.30	0.837	0.431	0.386	17.6	21.7	12.3	9.41	9.62	8.76	5.62	7.51	1983
1984	3.22	2.05	1.34	1.09	12.8	56.7	33.1	15.6	9.82	7.87	4.77	2.64	12.6	1984
1985	1.77	1.42	1.15	0.975	16.0	37.9	18.6	14.2	8.85	6.34	4.68	3.46	9.64	1985
1986	2.12	1.54	1.12	0.766	6.21	55.7	21.3	9.36	6.37	5.03	4.81	3.26	9.79	1986
MEAN	1.74R	1.22 R	0.858R	0.650R	6.33 R	29.8 R	18.1 R	9.12R	5.41R	4.62R	3.92R	2.76R	7.13R	MEAN

LOCATION - LAT 64 23 20 N DRAINAGE AREA, 1 520 KM2
LONG 115 01 16 W NATURAL FLOW

R - REVISED SINCE JAN 01 1989

WATER SURVEY OF CANADA
JAN 01 1989 PAGE 3
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INDIN RIVER ABOVE CHALCO LAKE — STATION NO. 07SA004

ANNUAL EXTREMES OF DISCHARGE AND ANNUAL TOTAL DISCHARGE FOR THE PERIOD OF RECORD

YEAR	MAXIMUM INSTANTANEOUS DISCHARGE (M3/S)	MAXIMUM DAILY DISCHARGE (M3/S)	MINIMUM DAILY DISCHARGE (M3/S)	TOTAL DISCHARGE (DAM3)	YEAR
1978	21.9 AT 20:50 MST ON JUN 22	20.2 ON JUN 24	0.3238 ON APR 26 *	132 000	1978
1979	43.9 AT 09:18 MST ON JUN 6	43.8 ON JUN 6	0.569B ON APR 28	197 000	1979
1980	---	17.6E ON JUN 14	0.394B ON APR 15	125 000	1980
1981	19.1R AT 06:16 MST ON JUL 9	18.8R ON JUL 9	0.537R8 ON APR 30	137 000R	1981
1982	33.6 AT 19:00 MST ON JUN 14	33.1 ON JUN 14	0.488B ON APR 25	186 000R	1982
1983	37.7 AT 09:32 MST ON JUN 27	36.2 ON JUN 27	0.330B ON MAY 21	237 000	1983
1984	74.5 AT 10:02 MST ON JUN 8 *	74.0 ON JUN 8 *	1.05 B ON APR 20	398 000	1984
1985	49.5 AT 21:22 MST ON MAY 31	49.3 ON MAY 31	0.860B ON MAY 6	304 000	1985
1986	68.4 AT 19:45 MST ON JUN 5	68.0 ON JUN 6	0.501B ON MAY 8	309 000	1986
				225 000R	MEAN

B - ICE CONDITIONS
E - ESTIMATED
* - EXTREME RECORDED FOR THE PERIOD OF RECORD
R - REVISED SINCE

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