WATER RESOURCE INVENTORY AND ASSESSMENT, ARCTIC NATIONAL WILDLIFE REFUGE

Progress Report

April 1989

Region 7
U.S. Fish and Wildlife Service
Department of the Interior
PROGRESS REPORT

WATER RESOURCE INVENTORY AND ASSESSMENT
ARCTIC NATIONAL WILDLIFE REFUGE

1988 Stream Discharge Gaging Data

Steven M. Lyons

Fisheries Management Services
Water Resource Branch
Fish and Wildlife Service
U.S. Department of the Interior
Anchorage, Alaska

April 1989
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PROGRESS REPORT
WATER RESOURCE INVENTORY AND ASSESSMENT
ARCTIC NATIONAL WILDLIFE REFUGE
1988 Stream Discharge Gaging Data

Introduction

This progress report is intended to provide an accounting of the accomplishments made during the first year of a multi-year water resource inventory in the 1002 area of the Arctic National Wildlife Refuge. It is also intended to extend the available stream discharge and water temperature data to resource specialists for consideration in other inventory or management activities. This data represents the hydrologic conditions for only one point in time. Thus, it is premature to attempt any hydrologic analysis or comparisons. Additional years of data collection are required before any characterization of the hydrologic regime is appropriate.

The 1002 area of the Arctic National Wildlife Refuge is located in a remote area of Alaska adjacent to the Beaufort Sea. Because of its remoteness, logistical problems, small populace of the area, harsh climatic characteristics, and lack of competitive water uses in the past, there has been little interest by either state or federal agencies to measure the water yield and flood frequencies in the 1002 area (Appendix A). The nearest stream gaging station (US Geological Survey gage #15908000, Sagavanirktok River) is located 80 miles west of the Canning River. Because the Sagavanirktok River is larger than any river within the 1002 area, the data base for this river cannot be extrapolated to streams and rivers in the 1002 area for water availability and flood characteristics.

Childers, et al. (1977) reported the only hydrologic data for the 1002 area. The data reported was a reconnaissance level investigation of the rivers, springs, aufeis fields, and lakes of the north slope, including the 1002 area. The data reported by Childers includes channel characteristics, watershed basin characteristics and estimated flood characteristics of the Canning River, Marsh Creek, Sadlerochit River, Hulahula River, Jago River, and Okerokvik River. Childers also reported discharge rates and selected water quality parameters for the Katakturuk River Spring, Sadlerochit Spring, Hulahula River Spring, and Okerokvik River Spring. Six lakes were sampled for water quality and some data for ice thickness and total lake depth were reported.
With the potential for oil and gas exploration and development in the 1002 area of the Arctic National Wildlife Refuge, an inventory and assessment of water resources is needed for refuge streams. The objectives of this years activities was to initiate a program to quantify the water yield and seasonal stream discharge of the watersheds making up the 1002 area of the Arctic National Wildlife Refuge. A secondary objective was to measure surface water temperatures at stream discharge gaging sites.

**Methods**

The Water Resources Branch initiated a stream gaging network, consisting of 8 stream gaging stations in the 1002 area in 1988 (Figure 1). Stream discharge data was collected at four sites on the Tamayariak River and one site each on the Akutoktak River, Iktiylariak Creek, Sadlerochit River, and Sadlerochit Spring Creek. Because the Tamayariak River is hydrologically diverse and has abundant fish and wildlife resources, four stream gages were installed on this watershed.

The parameters measured at each gaging site were water depth and water temperature, except for the Akutoktak River where only water depth was measured. Water depth and water temperature were measured at 15 minute intervals utilizing submerged pressure and temperature probes attached to a computerized field recorder. Water depth was measured to the nearest 0.01 foot and temperature to the nearest 0.1 degree centigrade. The field recorder summarizes this data automatically at the end of each 24 hour period into a report and provides the 24 hour average depth, maximum depth, time of maximum depth, minimum depth, time of minimum depth, 24 hour average temperature, maximum temperature, time of maximum temperature, minimum temperature, and time of minimum temperature. This report is stored in a computer chip which can later be downloaded onto a computer.

Throughout the data collection period, biweekly visits to each site were made to collect calibration data. Calibration data included stream discharge and water surface elevation. Through a log-log correlation analysis of stream depth (x) and stream discharge (y), correlation equations were obtained for each stream gage. More than one equation usually exists for each gaging site. As water depth changes the hydraulic radius changes, and a different equation is required to represent the relationship between water depth and stream discharge. Using the correlation equations developed, water depth data recorded by the stream gages was converted to stream discharge. The calibration data were collected using standard stream discharge measurement procedures (Buchanan and Somers 1969, Lyons 1988).
Figure 1.--The 1002 area of the Arctic National Wildlife Refuge with stream gage locations and known springs.
Results

All stream gaging stations were operating by July 20, 1988 and were in service until September 27 or 28, 1988. The only exception is the Sadlerochit Spring Creek gage, which was left to operate throughout the winter. A problem with a loose connector on the Sadlerochit River stream gage resulted in the loss of data from July 28, 1988 through August 15, 1988. A similar problem occurred at the Tamayariak River gage in August. It appeared that an animal pulled or tripped over the cable that connects the probe with the recorder. This resulted in the loss of the temperature data for August 11 and 12, 1988.

For the seven streams where depth data was retrieved, stream discharge was highly correlated with water depth (Table 1). Correlation coefficients ($r^2$) ranged from 0.966 to 0.999.

Appendix B displays the stream discharges obtained for the 1988 field season, except for Sadlerochit Spring Creek. The daily average discharge, time of maximum discharge, maximum discharge, time of minimum discharge, and minimum discharge for each day is listed for each gage. Also listed is the monthly average discharge, monthly maximum discharge, and monthly minimum discharge.

Appendix C lists the temperature data for each site except Sadlerochit Spring Creek and Akutoktak River. This data includes daily average temperature, time of maximum temperature, maximum discharge, time of minimum temperature, and minimum temperature.

Discussion

Fiscal Year 1988 was the first year of a multi-year water resource inventory program designed to quantify stream discharge rates, discharge frequency distribution, average monthly water yields, and flood frequencies and sizes within the 1002 area of the Arctic National Wildlife Refuge. During spring breakup some problems were encountered in the placement of the water pressure probe used to measure water depth. Concrete anchors were designed to allow for the placement of the pressure probes during the high spring breakup flows of future years.

The stream gaging station which was planned for the Canning River was not installed because the collection of the calibration data from an inflatable boat was not considered to be safe. The installation of a stream gage in the Canning River will require a permanent cableway with cable car.
Table 1.--Stream gage locations and correlation equations for converting stream depth (X) to stream discharge (Y).

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<td>Akutoktak River</td>
<td>Center sec. 36, T.6N., R.33E.</td>
<td>$y = 0.791e^{2.418x}$</td>
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<td>Itkilyariak Creek</td>
<td>SE1/4NW1/4 sec. 15, T.6N., R.31E.</td>
<td>$y = 0.965e^{1.783x}$</td>
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| Sadlerochit River        | NW1/4SW1/4 sec. 31, T.4N., R.32E. | $(x \geq 2.2\text{ft}); y = 43.25e^{1.04x}$
   |                        | $(x < 2.2\text{ft}); y = 10.32e^{1.66x}$   | 0.998  |
| Sadlerochit Spring Creek | NE1/4NW1/4 sec. 36, T.4N., R.31E. | data not given, still operating |        |
| Tamayariak River         | SW1/4NE1/4 sec. 35, T.6N., R.26E. | $(x \geq 1.05\text{ft}); y = 27.25e^{1.26x}$
   |                        | $(x \leq 1.05\text{ft}); y = 0.090e^{6.68x}$ | 0.982  |
| Tamayariak River, Lower West Fork | NW1/4NW1/4 sec. 12, T.7N., R.25E. | $(x \geq 1.93\text{ft}); y = 5.94e^{1.46x}$
   |                        | $(x \leq 1.93\text{ft}); y = 0.090e^{2.44x}$ | 0.998  |
| Tamayariak River, Middle Fork | Center sec. 12, T.7N., R.25E. | $(x \geq 2.81\text{ft}); y = 0.39e^{1.49x}$
   |                        | $(x \leq 2.81\text{ft}); y = 0.0000000007e^{8.638x}$ | 0.999  |
| Tamayariak River, Upper West Fork | W1/2W1/2 sec. 33, T.6N., R.25E. | $(x \geq 1.76\text{ft}); y = 0.82e^{2x}$
   |                        | $(x \leq 1.76\text{ft}); y = 0.000e^{5.76x}$ | 0.995  |
The purpose of the stream gage on the Itkilyariak Creek was to quantify the discharge from the melting aufeis field located in the lower Sadlerochit Spring Creek. However, a suitable gaging site could not be located immediately below the aufeis field. The gaging site used in 1988 is too far downstream to meet the purpose of the gaging effort. This gage will not be installed in 1989 and the equipment moved to an unnamed tributary 2.4 miles upstream from the Itkilyariak Creek gaging site. The new proposed gaging site is located in the NW1/4SE1/4 sec. 28, T.6N., R.31E.

Statistical or hydrologic analysis of this data can not be conducted until a minimum of five years of data is contained in the data base. The past year (1988) was a good example of why a five year data base is necessary to develop a hydrologic description of the 1002 area. The climate from January through July 1988 was significantly drier and slightly warmer than the previous 38 years of record for Barter Island (University of Alaska-Fairbanks 1986, National Oceanic and Atmospheric Administration 1988). Precipitation during this period of time was 57 percent below normal. August 1988 was a very wet month compared to the 38 year average, with precipitation 66 percent above normal. September was again below normal, receiving only 55 percent of the long term average. From January 1988 through September 1988, precipitation was 76 percent below normal. However, if these watersheds are primarily groundwater fed systems, the local climatic conditions may not have a significant effect on the annual water yield. Several years of data are necessary to make such determinations.
References


APPENDIX A

Glossary of Hydrologic Terms
Glossary of Hydrologic Terms

Aufeis: An ice feature that is formed by water overflowing onto a surface, such as river ice or gravel deposits, and freezing, with subsequent layers created by water overfloving onto the ice surface itself and freezing.

Discharge rate: The rate of flow, or volume of water flowing in a given stream at a given place and within a given period of time, expressed as cubic feet per second.

Discharge regime: The discharge pattern over a period of time.

Flood frequency: The probable frequency of recurrence of a flood event, expressed as the 10-year flood, 25-year flood, 100-year flood, etc.

Flood magnitude: The peak discharge of specified flood frequency.

Hydraulic radius: The ratio of the water cross-sectional area to the wetted perimeter.

Water yield: The total outflow of water from a watershed, expressed in units of acre-feet or gallons.
APPENDIX B

Surface water discharge records
ARCTIC NATIONAL WILDLIFE REFUGE

Akutoktak River

Location: Lat 60°49'58"N, long 143°46'50"W, in center sec. 36, T.6N, R.33E., 0.6 miles upstream from the confluence with the Okpilak River, 20.8 miles south-southwest of Kaktovik, Alaska.

Drainage Area: 97.1 mi², of which 66.0 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.


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Akutoktak River

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**TOTAL** 648

**AVERAGE** 25 28.3 20.8

**MAXIMUM** 89 95.1 74.1

**MINIMUM** 6 8.9 4.7

**ACRE FT** 1,286
ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

Location: Lat 69° 52'35", long 144° 22', in SE1/4 NW1/4 sec. 15, T.6N., R.31E., 6 miles upstream from the confluence with the Sadlerochit River, 24 miles southwest of Kaktovik, Alaska.

Drainage Area: 120.4 mi², of which 39 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.


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Itkityariak Creek

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ACRE FT 7,675
## ARCTIC NATIONAL WILDLIFE REFUGE

**Itkilyariak Creek**

**September 1986**

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ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

Location: Lat 69° 38', Long 144° 22' 50", in NW1/4SW1/4 sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

Drainage Area: 520.1 mi², of which 517.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi² depending on existing climatic conditions.

Remarks: This is a 6th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.


| JULY 1988 |
|------------------|------------------|------------------|------------------|------------------|
| AVE. DAILY DISCH. | TIME OF MAX DISCH. | MAX DISCH. | TIME OF MIN DISCH. | MIN DISCH. |
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| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |
| 21 | 846 | 0 | 938.2 | 2315 | 754.7 |
| 22 | 702 | 0 | 754.7 | 2330 | 652.8 |
| 23 | 607 | 0 | 652.8 | 2345 | 558.9 |
| 24 | 520 | 0 | 558.9 | 2345 | 483.4 |
| 25 | 454 | 30 | 483.4 | 2345 | 431.3 |
| 26 | 385 | 0 | 431.3 | 2045 | 366.0 |
| 27 | 342 | 0 | 372.2 | 2345 | 315.0 |
| 28 | | | | |
| 29 | | | | |
| 30 | | | | |
| 31 | | | | |
| TOTAL | | | | |
| AVERAGE | 551 | 598.8 | 508.9 |
| MAXIMUM | 846 | 938.2 | 754.7 |
| MINIMUM | 342 | 372.2 | 315.0 |
| ACRE FT | 7,649 | | | |
### ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

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**TOTAL** 7,316
**AVERAGE** 271 289.1 256.7
**MAXIMUM** 660 716.6 632.9
**MINIMUM** 76 87.2 70.2
**ACRE FT** 14,512
ARCTIC NATIONAL WILDLIFE REFUGE
Tamayariak River

Location: Lat 69°49'58", long 145°33'10", in SW1/4NE1/4 sec. 35, T.6N., R.26E., 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 136.1 mi², of which 56.8 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 5th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.


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**TOTAL**: 9687

**AVERAGE**: 312

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**MINIMUM**: 120

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**ARCTIC NATIONAL WILDLIFE REFUGE**

**Tamayariak River, Middle Fork**

Location: Lat 69° 58'33", long 145° 46'44", in the center sec 12, T.7N., R.25E., 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 61.3 mi² of which 0.79 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.

Extremes: Maximum Discharge, 617.5 cfs Sept. 5, 1988; Minimum Discharge, 1.2 cfs August 6-7, 1988.

### JULY 1988

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ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

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TOTAL 1449

AVERAGE 56

MAXIMUM 445

MINIMUM 6

ACRE FT 2873
Middle Fork of the Tamayariak River

Gaging Station – 1988

Average Daily Discharge in CFS

Gaging Period

ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

Location: Lat 69°58'50"N, long 145°47'40"W, NW1/4NW1/4 sec 12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 98.14 mi², of which 5.55 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.


JULY 1988

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**TOTAL:** 3525  
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**MAXIMUM:** 392  
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ARCTIC NATIONAL WILDLIFE REFUGE
Tamayariak River, Lower West Fork

SEPTEMBER 1988

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TOTAL 1689
AVERAGE 65 85.7 48.5
MAXIMUM 364 495.8 180.4
MINIMUM 18 22.1 13.9
ACRE FT 3349
ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

Location: Lat 69°49'58", long 145°55'15", in the center W1/2W1/2 sec 33, T.6N., R.25E., 13.9 miles upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 49.2 mi², of which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: This is a 4th Order drainage. Discharge records are initiated during break-up and discontinued at freeze-up of each year.


JULY 1988

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### ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

**AUGUST 1988**

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**Maximum** 271  
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**TOTAL** 890
**AVERAGE** 34 48.2 27.3
**MAXIMUM** 240 276.3 192.8
**MINIMUM** 4 5.2 2.5
**ACRE FT** 1764
APPENDIX C

Surface water temperature records
ARCTIC NATIONAL WILDLIFE REFUGE

Itkilyariak Creek

Location: Lat 69° 52' 35", long 144° 22', in SE1/4NW1/4 sec. 15, T.6N., R.31E., 6 miles upstream from the confluence with the Sadlerochit River, 24 miles southwest of Kaktovik, Alaska.

Drainage Area: 120.4 mi², of which 39 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 14.9 °C, July 28, 1988; Minimum Temperature 0.7 °C, September 26, 1989.

**JULY 1988**

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ARCTIC NATIONAL WILDLIFE REFUGE

Itkillyariak Creek

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MAXIMUM  11.5  14.4  9.8
MINIMUM  2.8   4.0  1.7
## ARCTIC NATIONAL WILDLIFE REFUGE

### Itkiliyak Creek

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**AVERAGE** 2.3  3.6  1.2  
**MAXIMUM** 3.9  6.5  2.5  
**MINIMUM** 0.7  1.2  0.5
Itkilyariak Creek
Water Temperature Readings

Ave. Daily Water Temp. Deg. C

Summer 1988

Average Daily
ARCTIC NATIONAL WILDLIFE REFUGE

Sadlerochit River

Location: Lat 69°38', long 144°22’50", in NW1/4SW1/4 sec. 31, T.4N., R.32E., 0.5 miles below the Wilderness boundary, 37.5 miles southwest of Kaktovik, Alaska.

Drainage Area: 520.1 mi², of which 177.5 mi² is located within the Arctic National Wildlife Refuge Wilderness Area. Glaciers account for 2.3 percent of the drainage area or about 11.8 mi depending on existing climatic conditions.

Remarks: Temperatures were recorded at 15 minute intervals.

Extremes: Maximum Temperature 14.9° c, July 28, 1988; Minimum Temperature -0.1° c, September 27, 1988.

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MAXIMUM: 12.1° c
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### Arctic National Wildlife Refuge

**Sadlerochit River**

**August 1988**

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**Minimum** 2.8  3.5  2.0
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Sadlerochit River
Water Temperature Readings

Ave. Daily Water Temp. Deg. C

Summer 1988
Average Daily
ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River

Location: Lat 69° 49' 38", long 145° 33' 10", in SW1/4 NE1/4 sec. 35, T. 66N., R. 26E., 11.8 miles upstream from the confluence of the West Fork, Tamayariak River, 53 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 136.1 mi², of which 56.8 mi² is located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals. A malfunction occurred Aug. 11-12, 1988.


JULY 1988

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### ARCTIC NATIONAL WILDLIFE REFUGE

**Tamayariak River**

**SEPTEMBER 1988**

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**MAXIMUM** 3.7 6.8 2.1

**MINIMUM** 0.0 0.5 -0.1
Main Tamayariak River
Water Temperature Readings

Ave. Daily Water Temp. Deg. C


Summer 1988
Average Daily
ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

Location: Lat 69° 58' 33", Long 145° 46' 44", in the center sec 12, T.7N., R.25E., 0.4 miles upstream from the confluence with the West Fork Tamayariak River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 61.3 mi², of which 0.79 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.


JULY 1988

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ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Middle Fork

AUGUST 1988

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### ARCTIC NATIONAL WILDLIFE REFUGE

*Tamayariak River, Middle Fork*

**SEPTEMBER 1988**

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**AVERAGE** | 1.5 | 3.0 | 0.5 |
**MAXIMUM** | 3.3 | 6.1 | 2.0 |
**MINIMUM** | 0.0 | 0.3 | 0.0 |
Middle Fork Tamayariak River
Water Temperature Readings

Daily Water Temp. Deg. C

Summer 1998
--- Average Daily---
ARCTIC NATIONAL WILDLIFE REFUGE

Tamayarvik River, Lower West Fork

Location: Lat 69° 58' 30" N, Long 145° 47' 40" W, NW1/4NW1/4 sec 12, T.7N., R.25E., 1.5 miles upstream from the confluence with the Tamayarvik River, 54 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 98.1 mi², of which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.


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ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Lower West Fork

AUGUST 1988

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Tamawayak River, Lower West Fork

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**MAXIMUM** 3.0 5.7 1.8

**MINIMUM** -0.1 0.2 -0.1
Lower West Fork Tamayariak River

Water Temperature Readings

Ave. Daily Water Temp. Deg. C


Summer 1988

Average Daily
ARCTIC NATIONAL WILDLIFE REFUGE

Tamayariak River, Upper West Fork

Location: Lat 69° 49'58", long 145° 55'15", in the center W1/2W1/2 sec 33, T.6N., R.25E., 13.9 miles upstream from the confluence with the Tamayariak River, 61.1 miles west-southwest of Kaktovik, Alaska.

Drainage Area: 49.2 mi², of which 5.6 mi² are located within the Arctic National Wildlife Refuge Wilderness Area.

Remarks: Temperatures were recorded at 15 minute intervals.


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Tamayariak River, Upper West Fork

**AUGUST 1988**

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**AVERAGE** 1.6 3.2 0.5  
**MAXIMUM** 3.6 6.8 2.2  
**MINIMUM** 0.0 0.1 0.0
Upper West Fork of the Tamayariak River

Water Temperature Readings

Daily Water Temp. Deg. C

Summer 1988

Average Daily