UNPUBLISHED REPORT

THE PHYSICAL AND HYDROLOGIC CHARACTERISTICS OF THE GULKANA RIVER, SOUTH CENTRAL ALASKA

by: Mark Inghram and Stan Carrick

State of Alaska
Department of Natural Resources
Division of Geological and Geophysical Surveys

October 1983

CONTENTS

FIGURES

TABLES

INTRODUCTION

According to Federal Law, rivers are defined as navigable when they are used, or are susceptible to being used, in their ordinary conditions as highways for commerce over which trade and travel are, or may be, conducted in the customary modes of travel and trade on water (Kloenhamer, 1979). Determining the susceptibility of a river to navigation involves many factors. These factors include legal definitions, historical use, and future use. The physical characteristics of the watershed and of the river itself are factors in determining navigability.

The purpose of this paper is to describe the physical and climatic characteristics of the West Fork and the main stem Gulkana Rivers. Emphasis will be placed on describing those parameters that affect and determine the hydrological properties of the rivers, as well as describing the hydrology of the rivers themselves. All information presented here will be limited to factual, observable, measurable, or calculable parameters of the West Fork and Gulkana Rivers and their watersheds. The interpretation of the hydrological facts for these two rivers in terms of the rivers' "navigability" is beyond the scope of this paper.

The following pages are divided into three basic sections. The first section is an area description of the watershed. This discussion includes the watershed's physical and geomorphic features, geology, climate, and a summary and review of available hydrological information. The second section is a field reconnaissance report, with a mile by mile river log taken from field observations. The third section, the trip diary, briefly describes the trip logistics.

AREA DESCRIPTION

The Gulkana River is the third largest basin tributary of the Copper River watershed in Southcentral Alaska (U.S. Army Corps of Engineers, 1950). From its headwaters at Summit Lake, the Gulkana River flows south through Paxson Lake and is joined by its two main tributaries, the Middle Fork and West Fork of the Gulkana, before flowing into the Copper River about 10 miles north of Glennallen, Alaska (fig. 1). Table 1 gives the pertinent watershed characteristics for the Gulkana River and its tributaries.

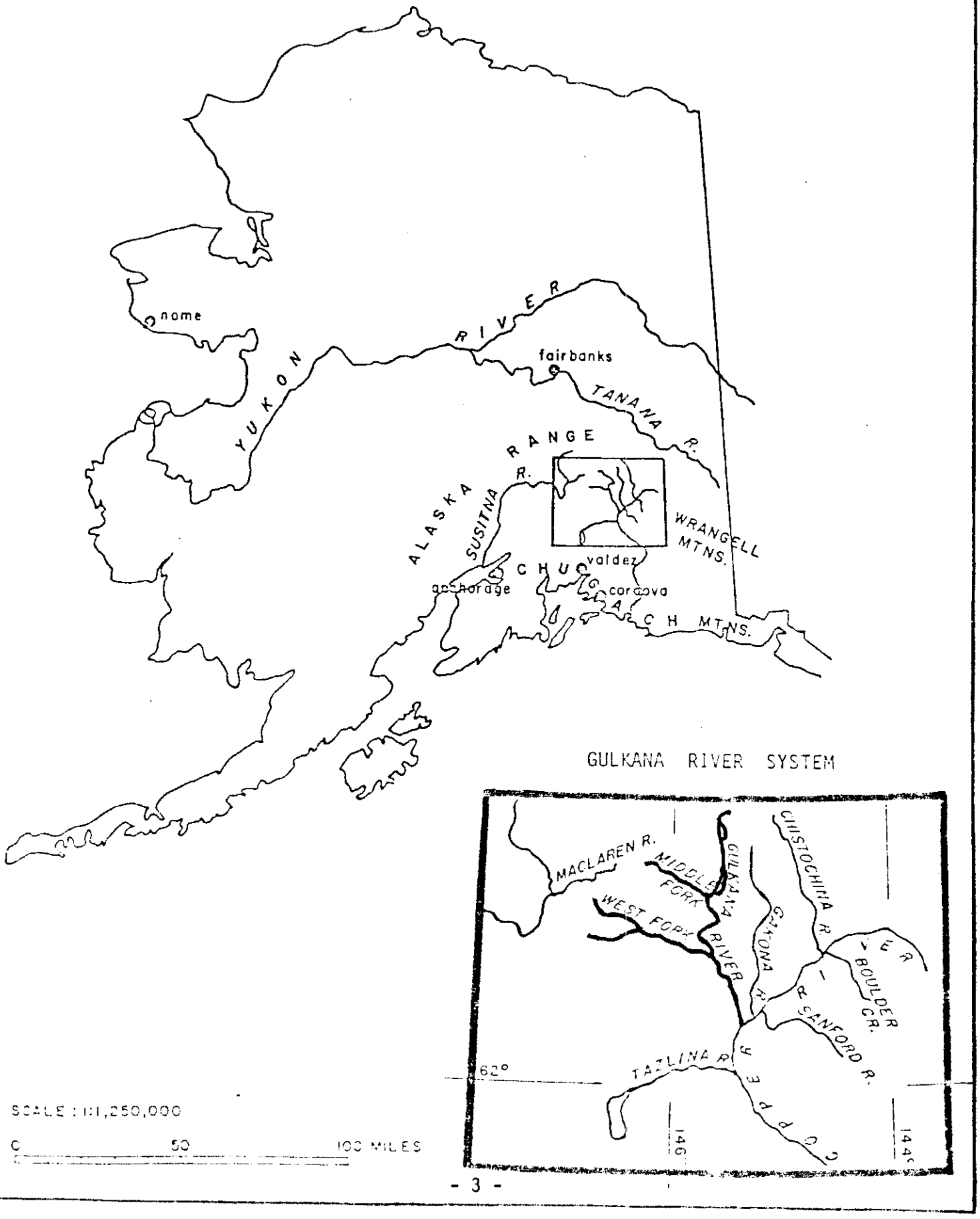
TABLE 1: Gulkana River Watershed Characteristics (Grumman, 1975; Lyle, 1980; and USGS, 1982)

Watershed Area	2140 sq mi
Main Channel Length[1]	103 mi
Main Channel Gradient	24 ft/mi
Elevation at Summit Lake	3210 ft
Elevation at Copper River Confluence	1300 ft
Area of Lakes and Ponds	15 - 20%
Area of Forests	25 - 30%
Middle Fork Watershed Area	240 sq mi
Middle Fork Channel Length[2]	45 mi
Middle Fork Channel Gradient	18 ft/mi
West Fork Watershed Area	935 sq mi
West Fork Channel Length (South Branch)	85 mi
West Fork Channel Gradient (South Branch)	6.5 ft/mi

1 Taken from Summit Lake to the confluence with the Copper River, including Paxson Lake

2 Taken from the headwaters 10 mi southwest of Dickey Lake; From Dickey Lake length is approximately 25 miles

The Gulkana River basin consists of three main physiographic regions as described by Wahrhaftig (1965). In the northern third of the basin, rounded


nome
YUKON RIVER
fairbanks
TANANA R.
ALASKA RANGE
SUSITNA R.
WRANGELL MTNS.
valdez
CHUGACH MTNS.
anchorage
cordova
GULKANA RIVER SYSTEM
MACLAREN R.
MIDDLE FORK
GULKANA RIVER
WEST FORK
GAKONA R.
CHISTOCHINA R.
BOULDER CR.
SANFORD R.
TAZLINA R.
62°
146°
144°
SCALE 1:1,250,000
0
50
100 MILES

east-trending ridges of 3,500 - 5,500 ft in altitude make up the Gulkana Uplands. Numerous lakes occupy glacier scoured basins and morainal depressions. Spruce-hardwood forests dominate the lower sections of the Gulkana Uplands, while tundra is found at higher altitudes north and west of the Middle Fork.

The second physiographic region, the Lake Louise Plateau, lies west of Crosswind Lake and south of the West Fork. This rolling upland region is 2,200 - 3,500 ft in altitude and has glacial moraine and stagnant-ice hummocky topography. The many lakes of the region occupy morainal depressions or abandoned meltwater channels. A lowland spruce-hardwood forest covers most of the Lake Louise Plateau.

The Copper River Lowland is the third main physiographic region in the Gulkana River basin, and it parallels the river south of the confluence with the West Fork. The lowland is a 1,000 - 2,000 ft plain entrenched by the Gulkana and Copper River valleys. Lakes dotting the smooth plain are generally small and are of permafrost thaw origin. Spruce-hardwood forests dominate the countryside, while bog and muskeg areas also exist.

Geology

The Gulkana River basin lies within the Pacific Mountain System. The bedrock in the region is chiefly metamorphosed volcanic rock around 300 million year old, or younger, poorly-consolidated sedimentary rocks (Wahrhaftig, 1965).

Bedrock exposures are uncommon, however, because glacial deposits overlie much of the basin. Four times in the last half million years glaciers advanced and retreated over the Copper River basin leaving behind moraine and

drift deposits. During the same time, a large glacial lake covered much of the Copper River lowlands resulting in the deposition of hundreds of feet of silt (Selkregg, 1974). Stretches of the West Fork and main stem of the Gulkana River have cut through these thick glacial lakes deposits, exposing high, steep bluffs.

Permafrost occurs in the Gulkana River basin as described by Ferrians (1965). In the Gulkana Uplands north of the West Fork, bedrock and glacial moraine and drift deposits exist close to the surface and the permafrost is discontinuous. Throughout most of the rest of the Gulkana basin the fine-grained glacial lake deposits predominate and the area is underlain by moderately thick to thin permafrost up to 150 ft deep. Permafrost is generally absent close to any sizeable waterbodies.

Climate

The entire Gulkana River basin is within the continental climate zone. Summers are warm, winters are quite cold, winds are generally light, and annual precipitation is low. Table 2 summarizes some of the sparse climatic data available for the region.

TABLE 2: Climatic Data - Gulkana River Region (Selkregg, 1974; USGS, 1982)

Location	Summer Temp. Range (°F)	Winter Temp. Range (°F)	Extremes (°F)	Precip. Inches	Snowfall Inches
Paxson Lake	35 to 63	-27 to34	-58 to 89	17	109
Gulkana	42 to 68	-16 to 35	-65 to 91	11	47
Slana	36 to 69	-12 to 36	-51 to 93	18	74
Copper Center	39 to 69	-22 to 27	-74 to 96	10	39
Sourdough	-	-	-	17	80

During the summer months, the Aleutian low pressure system dominates the Copper River basin weather as it circulates in from the Gulf of Alaska to the southeast. Consequently, over half of the annual precipitation falls during the months of June through September. In winter, the Aleutian low is replaced by high pressure from the interior resulting in clear skies, radiational cooling, and four months with average minimum temperatures below zero.

Even with the influence of the Aleutian low, precipitation is generally light over most of the Gulkana Basin because the Chugach Mountains to the south serve as an effective barrier that moderates incoming storms. The higher northern part of the Gulkana River basin receives more precipitation due to orographic effects, though the amounts are not as significant as in mountainous areas. Thunderstorms occur on the average of five days each summer according to the Environmental Data Service (1980).

Hydrology

The Gulkana River is the only major Copper River tributary not glacier-fed (Feulner and others, 1972). Whereas glaciers augment streamflow during the summer months in other Copper River streams, the Gulkana River and its tributaries rely primarily on rainfall to supply streamflow. Therefore, the Gulkana River exhibits more variation in annual streamflow than other major Copper River tributaries.

The hydrologic regime in the Gulkana River basin is mainly affected by precipitation, permafrost, and the general geology. Precipitation most strongly affects area streamflow through snowmelt runoff and late summer rains; otherwise precipitation is light and a minor contributor to streamflow. The existence of permafrost inhibits soil infiltration and groundwater movement promoting higher surface runoff to streams and lakes. Finally, the

local geology is dominated by glacial deposits in the form of morainal depressions and fine-grained sediments that, when combined with the widespread permafrost, result in the presence of numerous lakes and ponds. The larger lakes in the Gulkana basin (e.g. Paxson Lake) tend to mitigate peak flows during snowmelt and late summer rainstorms. However, many of the smaller lakes in the basin are not part of an integrated drainage network so they serve to intercept precipitation that might otherwise significantly contribute to the streamflow. Generally speaking then, streamflow in the Gulkana River basin shows more variability than glacier-fed systems, though peak flows are reduced by the presence of numerous lakes and ponds.

During a typical year, streamflow in the Gulkana River basin streams will be low in winter months when groundwater (reduced by the existence of permafrost) contributes the majority of flow. As warm temperatures return in April and May, snowmelt results in increased flows that eventually peak in late May or June. Floods produced by spring snowmelt generally remain at or near peak for a few days. After the snow has melted, streamflow rapidly decreases in July, then follows a more gradual decline until November.

Streams generally freeze up in November and flows take another sharp drop to winter low levels. Lakes freeze earlier than streams, normally in October, and breakup later, usually in May. Table 3 summarizes streamflow data for the Gulkana River at the Sourdough bridge, 33 miles upstream of the river mouth.

TABLE 3: Mean Monthly and Mean Annual Streamflow for the Gulkana River in cubic feet per second or cfs (U.S.G.S. 1973-1978)

January	263	July	1554
February	252	August	1108
March	263	September	892
April	306	October	787
May	3498	November	402
June	3098	December	287
		ANNUAL	1063

The data indicates the highest flow of the year occurs in May, while the low flow takes place in February. The highest daily flow recorded at Sourdough during the six years of record was 9,120 cfs on June 2, 1977, and the lowest recorded flow was 200 cfs during the winter of 1974 (U.S.G.S, 1973-1978).

References

Environmental Data Service, 1980, Local climatological data, Gulkana, Alaska: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 3 p.

Ferrians, O.J., 1965, Permafrost map of Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-445, 1:250,000 scale, 1 sheet.

Feulner, A.J., Childers, J.M., and Norman, V.W., 1972, Water Resources of Alaska: U.S. Geological Survey, Water Resources Division, Alaska District, p. 203-215.

Grumman Ecosystems, 1975, Report on navigability of streams tributary to the Copper River and Prince William Sound, Alaska: Grumman Ecosystems Corporation, p. 41.

Kloenhamer, L.N., 1979, The history of title navigability in America and its application to the State of Alaska: Western Interstate Commisssion for Higher Education, Boulder, CO., 43 pp.

Lyle, George, 1980, The physical characteristics of the Gulkana River: State of Alaska, Department of Natural Resources, 111 p.

National Oceanic and Atmospheric Administration, 1983, Local Climatological Data, Monthly Summary, Gulkana, Alaska, June, 1983.

Selkregg, L.L., 1974, Alaska Regional Profiles, Southcentral Region: University of Alaska, Arctic Environmental Information and Data Center, 346 p.

U.S. Army Corps of Engineers, 1950, Harbors and Rivers of Alaska Survey Report, Interim Report No. 3, Copper River and Gulf Coast, Alaska, 125 p.

U.S. Geological Survey, 1973-1978, Water Resources Data for Alaska: Annual Report Series, 6 vol.

_____, 1982, Streamflow/basin characteristics file retrieval: U.S. Geological Survey, Water Resources Division, Alaska District.

Wahrhaftig, C., 1965, Physiographic Divisions of Alaska: U.S. Geological Survey Professional Paper 482, 52 p.

FIELD RECONNAISSANCE REPORT

The purpose of the river log section is to summarize the findings of the Gulkana River field reconnaissance. The South Branch from Lake # 10, West Fork, and main stem from the confluence with the West Fork to the Richardson Highway Bridge, were floated from June 22-27, 1983. Division of Geological and Geophysical Surveys (DGGS) hydrologists recorded the observed physical characteristics of the river using a river log format. For the log, the river is divided into reaches, each representing a section of the stream with similar physical, geomorphic, and hydrologic features.

The features under consideration include primarily channel and flow characteristics. Regional and watershed characteristics, as well as vegetation, are also noted. For each reach the location, river mileage (taken from the mouth), and weather are specified. Additionally, observations on channel pattern, bed and bank material, width, depth (at the thalweg, or deepest point across the river), surface flow velocity, and bank and channel stability were noted. Several discharge measurements were made. A river discharge measurement is the volume of water passing a point on the river in a set unit of time. In the U.S., discharge is commonly reported as the number of cubic feet of water moving past a point in a second (cubic feet per second, or cfs). A discharge measurement commonly entails metering the velocity of flow in a minimum of 20 sections across the width of the river.

All distances will be given in miles or feet, and velocities in miles per hour. Bed and bank material sizes are described using the American Geophysical Union's size classification (see Appendix 1). Turbidity represents the relative clarity of the water expressed in nephlometric turbidity units (NTU). The murkier the water, the higher the turbidity and

number of NTU's. Directions on the river (left or right) are made facing downstream.

Photographs of each reach were taken, and points of interest were noted on U.S. Geological Survey 1:63,360 (inch to the mile) topographic maps. The following descriptions will give the reach number and time spent floating or motoring, then each reach will be discussed separately with photo and map references.

At the Gulkana airport there was a total monthly precipitation of .69 in., which is .78 in. below normal (NOAA, 1983). All but .09 in. occurred on or before June 10, 1983. On June 27, the final day of the float trip, .09 in. of precipitation was recorded and the remaining three days of the month were dry. Temperatures varied from 3° - 10°F above normal for the period of the float trip.

Due to the lack of precipitation and warm sunny weather both during and ten days prior to the float trip it would be expected that our investigation was conducted during a period of lower than average stream flow for the period.

The following stream reach and lake descriptions are presented in the order taken. Several lakes and tributaries are described, and these descriptions appear in the text in the chronological order observed.

River Reach and Lake Descriptions

LAKE #10, 06-22-83
Lake #10 is located at approximately mile 84.2 on the West Fork mileage scale. The lake is about 2 miles long by 3/4 miles wide. Lilypad like vegetation characterizes the near shore shallow areas; no significant topography is found immediately adjacent to the bank. Banks are covered by grasses, sedge tussock, and black spruce along with willow and isolated deciduous trees. The maximum observed depth was 14 feet near the southern part of the lake. The water was clear with a turbidity reading of 1.2 NTU. See Gulkana C-6; and photo 1, Appendix 2.

CHANNEL, between Lake #10 and Lake #9, 06-22-83
A short reach, extending from the outlet of Lake #10 at West Fork mile 84.2, downstream .7 miles to Lake #9, at mile 83.5. This reach is a meandering reach varying in width from 6 to 100 feet, and depths from 1 - 3 feet with some pools up to 5 feet deep. The banks are all made of silt sized material and covered with grass. The streambed is composed of materials from silt to boulder in size with gravel predominating. No channel bars were found. Maximum velocity measured near the inlet to Lake #9 was 2.5 feet per second (fps) or 1.7 mph. Discharge at that site was measured at 18.2 cfs. The water temperature was 60°F. See Gulkana C-6; and photo 2, Appendix 2.

LAKE #9, 06-22-83
Lake #9 is located between mile 83.5 and 81.8 on the West Fork mileage scale. The lake is very similar in appearance to Lake #10. The vegetation, topography, and general character remained the same as Lake #10, however, it was 1.8 mile long by 1.5 miles wide and depths were never measured in excess of 3 feet. Additionally the water color appeared browner, more influenced by tannic acids, a probable result of the channel connecting Lake #10 to Lake #9. See Gulkana C-6; and photo 3, Appendix 2.

REACH #1. 06-22-83, 1210 - 1500, 5.3 miles (81.8 - 76.5)
This reach began at the outlet for Lake #9 at mile 81.8, and extends downstream to mile 76.5. Generally, this reach is a low gradient, slow, meandering stream. Bank vegetation is similar to that observed in Lake #10 upstream, including grasses to waterline, sedge tussock, black spruce along with willow, and isolated deciduous trees. Lily pads existed in protected side channel areas. The channel was generally 50 to 100 feet in width, but in places narrowed to 30 feet. Depths were generally 3 to 4 feet, with some shallower riffle areas at mile 79 and 78.1. Surface velocity was estimated at less than 1 fps (less than .7 mph). The channel appeared stable within its banks. Many ice scars were seen on trees approximately 3 feet higher than stage, which was at or near bankfull. Meandering increased downstream and turbidity was low. Reach was largely motored. See Gulkana C-6; and photo 4, Appendix 2.

REACH #2. 06-22-83, 1500 - 1700, 4.0 miles (76.5 - 72.5)
This reach exhibits an increased gradient, narrower channel with tighter meanders, and greater incision than Reach # 1. The channel was 30 to 60 feet in width, with depths usually 2 - 5 feet, with occasional pools to 6 feet. The immediate banks were grass covered, and made up largely of sand to silt sized material. Some organic debris was noted. Streambed material consisted

primarily of gravel to cobble sized material, with occasional larger boulders. See Gulkana C-6; and photo 5, Appendix 2.

REACH #3. 06-22-83, 1700 - 1725, 1.75 miles (72.5 - 70.8)
This reach ends at Headwaters Lake, and is characterized as wider and slower. Lakelike side bays are found, and meander bends seem more gentle. The meandering channel varies between 75 to 125 feet wide, and is usally between 3 - 5 feet in depth. The banks were composed of sand and silt, and covered to the waterline with grasses. Bed material was finer than those found upstream, mainly sand and silt. Some organic debris was seen. See Gulkana C-6; and photo 6, Appendix 2.

HEADWATERS LAKE. 06-22-83
Headwaters Lake is located between mile 70.8 and 69.8. The lake is about 1 mile long and, at a maximum, .5 miles wide. Bed material was mostly silt in size. Generally, the lake was shallow, in the 1 to 3 foot range, with a grassy shoreline, and aquatic vegetation that occasionally comes to the surface. See Gulkana C-6 and C-5; and photo 7, Appendix 2.

REACH #4. 06-23-83, 0815 - 1345, 8.8 miles (69.8 - 61.0)
This reach began at the outlet for Headwaters Lake at mile 69.8 and is a 50 to 75 foot wide channel meandering between grass covered sand to silt sized particle banks. The bed material was composed largely of gravel and sand. Depths were generally 3 - 7 feet, however, pools up to 10 feet were measured. Water velocity was measured at 1 fps (.7 mph). At mile 64.2, a sweeper blocked the channel. The water was clear and measured 14 NTU. Discharge was measured (mile 69.5) at 122 cfs. Ice scars up to 4 - 5 feet over current stage were observed. See Gulkana C-5; and photos 8 - 9, Appendix 2.

REACH #5. 06-23-83, 1345 - camp, 8.3 miles (61.0 - 52.7)
Reach #5 is a meandering channel between 50 to 75 feet wide and 1 - 4 feet deep. Generally, this reach exhibits more of a classic pool and riffle development than upstream. First evidence of point-bars were also noted. Bank materials varied from silt to gravel. Bed materials ranged from gravel to cobbles, with some boulders. Surface velocity estimates were 2 - 3 fps (1.5 - 2.0 mph). Additionally, surface velocity was measured at 2.5 fps, at mi 53.25. Water temperature was 69°F and pH was 7.95. The stage at the time of travel was about 6 in. below bankfull. Some active channel shifting was found between miles 57 - 55. A meander cut-off was found at mile 54.8, which created a log jam. Discharge was measured at 133.4 cfs at mile 53.2. See Gulkana C-5; and photos 10 - 11, Appendix 2.

NORTH BRANCH. 06-24-83 (52.7)
The North Branch channel near the confluence of the North Branch and West Fork was 75 feet wide and generally not more than 2.5 feet deep. Bed material was mostly gravel to cobble in size. Ice scars approximately 3 feet over stage were seen. A discharge measurement was made .8 miles above the confluence. At that site discharge was measured at 102 cfs, maximum flow velocity was measured at 2.1 fps (1.4 mph). The water was clear, with temperature at 55°F. See Gulkana C-5; and photo 12, Appendix 2.

REACH #6. 06-24-83, 1000 - 1220, 4.7 miles (52.7 - 48.0)
This reach begins at the confluence of the North Branch and West Fork at mile 52.7. The channel here is meandering, 50 to 150 feet wide, and 4 - 8 feet

deep. Banks are made of sand to gravel sized material, generally covered with grass, but occasionally raw, with some minor organic debris. Bed materials vary from gravel to cobbles, with some boulders. Occasional small channel bars, bare or covered with grass, are found. Surface velocity was estimated at 2 - 2.5 mph. Cutbanks exhibit some active cutting. Generally, this reach was wider and slower than the one above. Bankfull discharge was 2 - 3 feet over current stage. See Gulkana C-5; and photo 13, Appendix 2.

REACH #7. 06-24-83, 1220 - 1615, 7.0 miles (48.0 - 41.0)
In this reach the channel becomes more incised, with higher gradient and more frequent riffles. At current stage, the meandering channel's width was 50 - 100 feet and depth was 2 - 4 feet. Bank materials are silt to gravel in size and covered by grass and willow or are raw and cut. Streambed material is mostly cobbles, with some boulders. Occasional channel bars with small amounts of grass and some minor amounts of debris were observed. Surface velocity was estimated at 2 - 3 mph. A few minor differences in the channel were noted in comparison with the Gulkana C-5 map. See Gulkana C-5; and photo 14, Appendix 2.

REACH #8. 06-24-83, 1615 - 1830, 6.0 miles (41.0 - 35.0)
Reach extends downstream to just above Victor Creek, at mi 35. Generally, a decreased gradient reach in comparison with upstream, with fewer boulders and slightly greater depths due largely to the presence of pools. At current stage, the width of the meandering channel varied from 50 to 100 feet with an average depth of 2 - 4 feet and pools 5 - 6 feet deep. Banks were made of material silt to gravel in size and were approximately 40 percent raw, 60 percent covered with grass and willow. Occasional minor organic debris was noted on the banks. Streambed material was made of gravel to cobble sized particles, with some boulders, and some sand on point bars. A channel bifurcation occurs at mile 37, resulting in about equal sized channels. The two channels do not reconnect for approximately .5 miles. Ice scars were seen about 4 - 5 feet over current stage. See Gulkana C-5; and photo 15, Appendix 2.

REACH #9. 06-24-83, 1830 - 2000, 3 miles (35.0 - 32.0)
Generally a slower, deeper reach than the one upstream, with a few riffles. The meandering channel is 100 - 200 feet wide and 3 - 4 feet deep with pools to 7 feet. Surface velocity is approximately 2 mph. Banks are made of silt to gravel sized particles and are about 50 percent raw and 50 percent covered in grass and willow. The streambed consists of mainly gravel with 20 percent cobbles and occasional boulders. Sand is found on point bars and active cutting is going on outside banks. Bankfull flows appear to be 1.5 - 2 feet higher than current stage. Most of the reach was motored. See Gulkana C-5 and C-4; and photo 16, Appendix 2.

REACH #10. 06-25-83, 0830 - 1400, 15.5 miles (32.0 - 16.5)
The river in this long reach is homogenous, completely losing its riffle reaches, with depths consistently above 3 feet. The extremely meandering stream varies from 75 to 100 feet wide. Banks are made of silt to gravel sized particles and are usually raw and appear easily eroded. Bankfull flows were estimated at 1 - 2 feet above current stage as evidenced from grass line. Surface velocity was fairly slow at 1 - 1.5 mph. Deciduous vegetation becomes more dominant. See Gulkana C-4; and photo 17, Appendix 2.

FISH CREEK. 06-25-83, mile 18.2
The channel near the confluence was 25 feet wide and up to 5 feet deep. The bed was made of silt sized particles. The banks were grass covered to the waterline and were slumping into the water. A discharge measurement was made about 1 mile up Fish Creek above the confluence with the West Fork. At this site discharge was measured at 101.4 cfs with a maximum surface velocity of 1.7 fps (1.2 mph). The water temperature was measured at 67°F. See Gulkana C-4; and photo 18, Appendix 2.

REACH #11. 06-25-83, 1400 - camp, 16.5 miles (16.5 - 0)
In this reach the channel becomes less meandering and varies between 75 - 150 feet in width, with 2 - 5 foot depths. Bankfull flows were estimated at 1 - 2 feet over current stage. Banks were composed of sand to cobble sized material and were about 50 percent raw and 50 percent covered in grass and willows. Streambed material was mostly gravel and cobble sized with up to 20 percent boulders. Small channel bars were noted. Surface velocity was measured .5 mi above the confluence with the main fork at 1.9 fps or 1.3 mph. Discharge at this site was measured at 446.2 cfs. See Gulkana C-4; and photo 19, Appendix 2.

GULKANA RIVER, MAIN STEM. 06-26-83, 06-27-831, 39 miles (42.5 - 3.5 main stem mileage scale)
The entire traveled portion of the main stem of the Gulkana River was classified as one reach. The meandering river varied between 125 - 150 feet wide and averaged 3 feet deep. Banks were made of mostly cobbles and the remainder sand and silt sized particles. Roughly 65 percent of the banks were raw and 35 percent vegetated. Some banks were undercut and there was little organic debris. The streambed material was largely cobble in size with occasional boulders. Channel bars were present with sparse grass cover and little to no organic debris. The water was clear with a turbidity measurement of 4 NTU (mile 27.5). Frequent point bars were noticed as were the riffle/pool nature of the stream. See Gulkana C-4, B-4, and B-3; and photos 20 - 22, Appendix 2.

GULKANA TRIP DIARY

The Gulkana River in the Copper River Basin of Southcentral Alaska was examined by state personnel from June 22-27, 1983. The purpose of the trip was to gather physical, hydrologic, and historical information which would be used in litigation on Gulkana River navigability. Federal personnel were invited to accompany the state personnel in their field investigations, but declined.

A total of five state employees were involved in the trip. Two DGGS hydrologists, Mark Inghram and Stan Carrick, made most of the observations contained in this report. Two other DGGS hydrologists, Roger Clay and Ed Collazzi, took measurements and observations at specific survey sites for use in other DGGS projects. Some of their results are included in the reach descriptions. Sheila Evans Hanson, a DRD historian, also floated the river. It was her responsibility to observe and record any information of historical interest. Altogether, a total of 123.2 river miles were floated during the six day float trip. Two Avon Adventurer (13' long) inflatable rafts were used on the trip. Each boat was equipped with a rowing frame, 10' oars, and an outboard motor.

The following is a daily account of activities during the trip.

06-21-83: We left the Eagle River office at approximately 9:00 am; and arrived at Sportsman Flying Service at Tolsona Lake at approximately 12:00 noon. Two vehicles were driven; one was left at Tolsona Lake and the other shuttled up to the Richardson Highway Bridge over the Gulkana River, the end point of the river trip. A Cessna 185 on floats was chartered to move all personnel and gear the 40 miles from Tolsona Lake to Lake #10 (a name given

the lake by the charter pilot, Ron Salmon). The weather was partly cloudy with temperatures in the 60's. A total of four flights were required to get all gear and personnel to the starting point at Lake #10. That evening camp was set, and the boats were inflated and assembled for departure the following morning.

06-22-83: Camp was broken and we were underway by 8:30 am. Sheila went with Roger and Ed downstream to Lake #9, where a survey was made. Mark and Stan motored around Lake #10 for nearly 2 hours making observations and taking measurements and photographs. The channel between Lake #10 and Lake #9 was narrow in places. The 10' long oars proved cumbersome in the narrowest parts of the reach, requiring us to walk and guide the boat. Both boats were again together at the head of Lake #9 at approximately 11:30 am.

At roughly 4:00 pm, while in Reach #2, Sheila noticed some scrap wood on the right bank at mile 73.3. We stopped to investigate and found it to be the remains of an old wooden boat. Measurements and photographs were taken.

Camp was made that night near the outlet of Headwaters Lake, at mile 69.8. A total of 14.5 miles were covered during the day. The weather throughout the day was clear, sunny, and warm.

06-23-83: Camp was broken and we were underway by 8:15 am. Sheila switched boats today and floated with Mark and Stan. Ed and Roger made a survey roughly .2 miles downstream of the camp site.

At mile 56.8, in Reach #5 on the left bank, an abandoned cabin was noticed. We stopped in order to allow Sheila time to investigate. Again, measurements and photographs were taken.

One sweeper and one log jam were encountered during the day. The first, a sweeper at mile 64.2, was a recently downed spruce that just barely blocked the entire width of the river. A Sandvik-brand brush axe was used to remove the top of the tree and clear a path. The delay took roughly 10-15 minutes. A log jam was found at mile 54.5. Ed put on waders and cleared enough of the jam in 15 minutes to allow the boats to be pulled through. Camp was made a few hundred yards downstream from mile 53.3 where Roger and Ed did a survey. A total of 16.5 miles were traveled during the day with clear, sunny, and warm weather prevailing.

06-24-83: Camp was broken and we were again on the river by 8:30 am. In a little more than .5 miles we arrived at the confluence of the North Branch and South Branch. Roger and Ed went about .8 miles up the North Branch from the confluence to conduct a survey. Sheila went on the opposite right bank to examine an abandoned cabin, which was roughly 150 yards downstream. Again, measurements and photos were taken to document the cabin. The remainder of the day Sheila traveled with Ed and Roger. Camp was set that night at mile 29.1. A total of 24.2 miles were traveled during the day with clear, sunny, and warm weather.

06-25-83: Camp was broken and we were floating by 8:30 am. Sheila traveled with Mark and Stan. At mile 18.5 we stopped to investigate a logging operation on the left bank. Roughly 2-3 acres had been thinned of hemlock and spruce.

At mile 18.2 we arrived at the confluence of Fish Creek and the West Fork. Fish Creek was ascended about 1 mile. At about 1 mile above the confluence, Ed and Roger conducted a survey.

Roughly a mile further down the West Fork, at mile 17.2, a second logging operation was seen on the left bank. We again stopped to allow Sheila time to investigate. Photographs and measurements were taken to document the site.

One additional survey site was done by Roger and Ed about .5 miles above the confluence of the West Fork and Main Stem. Camp was set that night at the confluence at mile 0. Other campers could be seen across the river from our site. Several jet unit boats were there. A total of 29.1 miles were traveled during the day with weather clear, sunny, and warm.

06-26-83: Camp was broken and we started floating down the Main Stem at roughly 8:20 am. A different mileage scale was in use on the Main Stem. This scale started at the confluence of the Gulkana River and Copper Rivers. Sheila counted a total of 37 boats of various types during the day. At mile 23.1 on the left bank a cabin was spotted. We stopped to investigate. Again, photographs and measurements were taken for documentation.

We stopped at the Sourdough Campground at mile 33.5. Water supplies were refilled and we talked with an ADF&G employee who was working there. Many boats and campers were at the campground.

Camp was set that night at mile 14.5. A total of 28 miles were traveled during the day with weather clear, sunny, and warm.

06-27-83: The final day of the float started at 8:30 am. During the day Sheila counted 8 boats. We arrived at the Richardson Highway Bridge at noon. We ended our trip at the bridge and packed up our gear in the truck left there 6 days earlier. The weather on this day was overcast, rainy, and windy.

APPENDIX 1. PARTICLE SIZE CLASSIFICATION: Grade Scale developed by American Geophysical Union, Subcommittee on Sediment Technology

SIZE Millimeters	Microns	Inches	CLASS
4,000-2,000		160-80	Very large boulders
2,000-1,000		80-40	Large boulders
1,000-500		40-20	Medium boulders
500-250		20-10	Small boulders
250-130		10-5	Large cobbles
130-64		5-2.5	Small cobbles
64-32		2.5-1.3	Very coarse gravel
32-16		1.3-0.6	Coarse gravel
16-8		0.6-0.3	Medium gravel
8-4		0.3-0.16	Fine gravel
4-2		0.16-0.08	Very fine gravel
2.00-1.00	2,000-1,000		Very coarse sand
1.00-0.50	1,000-500		Coarse sand
0.50-0.25	500-250		Medium sand
0.25-0.125	250-125		Fine sand
0.125-0.062	125-62		Very fine sand
0.062-0.031	62-31		Coarse silt
0.031-0.016	31-16		Medium silt
0.016-0.008	16-8		Fine silt
0.008-0.004	8-4		Very fine silt
0.004-0.0020	4-2		Coarse clay
0.0020-0.0010	2-1		Medium clay
0.0010-0.0005	1-0.5		Fine clay
0.0005-0.00024	0.5-0.24		Very fine clay

Source: Ven Te Chow, 1964. Handbook of Applied Hydrology, McGraw Hill.

APPENDIX 2: Photographs of river reaches and lakes

1. Lake #10. Starting point of float trip mile 84.2; preparing for departure.

2. Channel between Lake #10 and Lake #9, at mile 83.8. Photo is taken looking upstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)

3. Lake #9, near outlet, mile 82.

4. Reach #1, mile 77. Photograph is taken looking downstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)

5. Reach #2, mile 74.6. Photograph is taken looking downstream.

6. Reach #3, mile 71.5. Photograph is taken looking downstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)

7. Headwaters Lake, near outlet, approximately mile 70.

8. Reach #4, mile 67.9. Photograph is taken looking upstream.

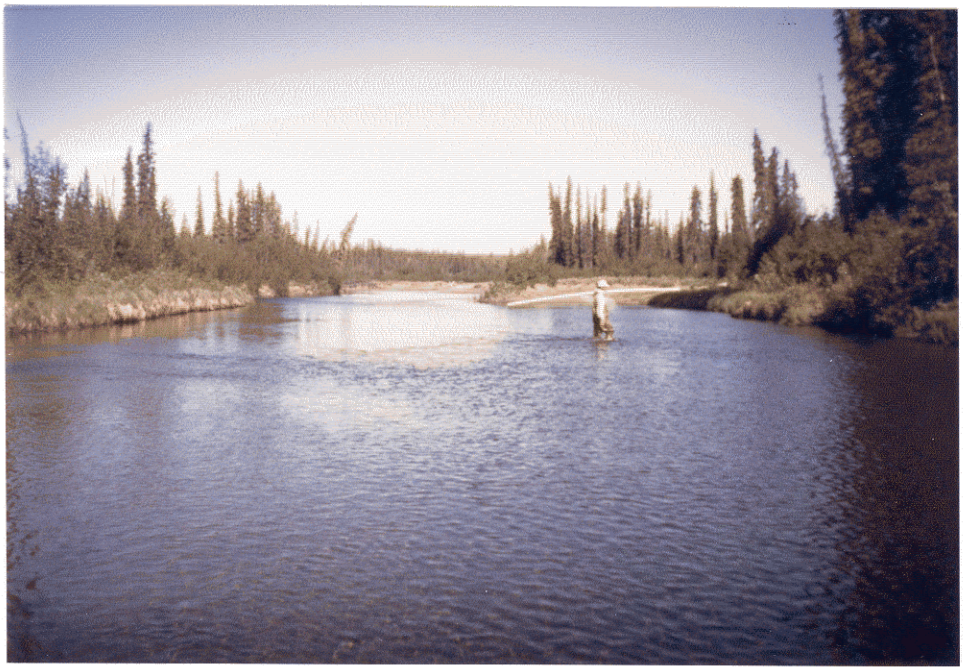
APPENDIX 2: Photographs of river reaches and lakes (continued)

9. Reach #4, mile 64.2. Chopping sweeper to clear channel.

10. Reach #5, mile 59.8. Photograph is taken looking upstream. Note small riffle.

APPENDIX 2: Photographs of river reaches and lakes (continued)

11. Reach #5, mile 54.5. Log jam.



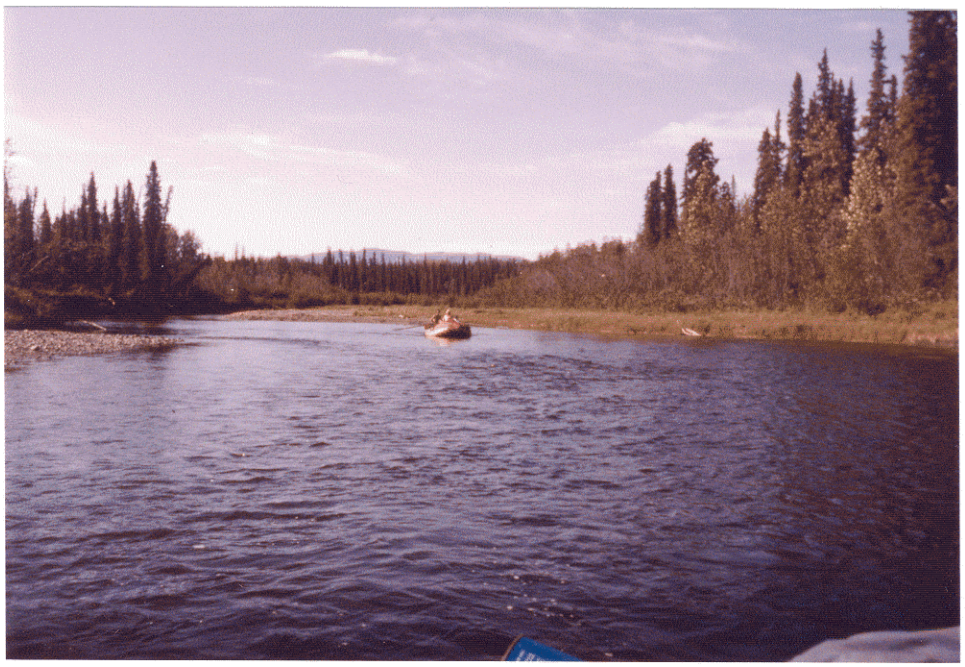
12. North Branch Channel. Photograph is taken at gaging site .8 miles upstream on the North Branch from its confluence with the West Fork.

APPENDIX 2: Photographs of river reaches and lakes (continued)

13. Reach #6, mile 50.3. Photograph is taken looking downstream.

14. Reach #7, mile 44.7. Photograph is taken looking downstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)



15. Reach #8, mile 40.0. Photograh is taken looking upstream.

16. Reach #9, mile 33.5. Photograph is taken looking downstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)

17. Reach #10, mile 28.1. Photograh is taken looking upstream.

18. Fish Creek, channel and survey section. Photograph is taken looking upstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)

19. Reach 11, mile 0.5. Channel and survey site. Photograph is taken looking downstream.

20. Gulkana River, Main Stem, mile 33.0. Note Sourdough Bridge (USGS gage site). Photograph is taken looking downstream.

APPENDIX 2: Photographs of river reaches and lakes (continued)

21. Gulkana River, Main Stem, mile 22. Note high banks. Photograph is taken looking downstream.

22. Gulkana River, Main Stem, mile 3.4. Photograph is taken looking downstream of the Richardson Highway Bridge. Mile 3.4 was the ending point of the float trip.