SITE SURVEYS FOR KUSKOKWIM RIVER BASIN SALMON ASSESSMENT PROJECTS.

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AUTHORS

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ACKNOWLEDGEMENTS

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Linda Brannian and Susan McNiel provided draft review of this report.

OEO/ADA STATEMENT

TABLE OF CONTENTS

LIST OF FIGURES

Figure **Page**

LIST OF APPENDICES

ANNUAL REPORT SUMMARY PAGE

Title: Site Surveys for Kuskokwim River Basin Salmon Assessment Projects.

Study Number FIS 00-030

Geographic Area: Kuskokwim River

Information Type: Stock Status and Trends

Issue Addressed: Salmon runs originating from tributaries of the Kuskokwim River sustain one of Alaska's largest and fastest growing subsistence fisheries. Tributaries that originate on, or flow through federal lands within the Kuskokwim River system likely contribute significant numbers of chinook, chum, sockeye and pink salmon to subsistence, commercial and recreational fisheries in the river. Historically, managers have had little escapement information about these species for much of the Kuskokwim Basin. This information is necessary to gauge effects of management actions, establish and monitor escapement goals, and to help in projecting future returns of all species of salmon.

Study Cost: **$**22,000

Study Duration: August 2000 to September 2001

Key Words: site survey, escapement assessment, escapement goals, management, resistance board weir, subsistence fishery

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EXECUTIVE SUMMARY

Fisheries managers are continually searching for ways to improve the quality of information used to assess the abundance of species in a given fishery. Fisheries management is by nature an imprecise science and much of the best information about abundance comes after the season in the form of information from escapement projects. The inseason usefulness of this information is directly related to the proximity of the project to the associated fisheries. Postseason information about escapement is very valuable for assessment of inseason management strategies and for providing information about future returns. The best and most accurate methodology currently available is via the speciated counts that weirs can provide.

Kuskokwim River, escapement coverage and therefore salmon population health assessment has been incomplete until just recently. A series of weirs have been established on major salmon producing tributaries throughout the drainage. Although coverage is still incomplete, it is improving. Objectives of this study were to list tributaries with suitable sites for salmon escapement/assessment weir projects if future funding becomes available.

Surveys were conducted beginning in June of 2000, before funding was actually received from the Federal Office of Subsistence Management. Survey startups used resources already in place through other field projects. The last survey was conducted in August of 2001. Tributaries surveyed included the Aniak River and it's major tributaries, the Holitna, Holukuk, Telequana (tributary of the Stony), Kisaralik, Kasigluk, Tuluksak, Gagaryah, and Cheneetnuk (tributaries of the Swift) rivers. Suitable sites were located on the Holitna, Tuluksak Telaquana, Holukuk, Kipchuck and Salmon (Aniak) rivers.

INTRODUCTION

Fish and game resources constitute an extremely important component of life in the Arctic-Yukon-Kuskokwim regions (AYK) of Alaska. On the Kuskokwim River, subsistence caught fish comprise a large percentage of the food consumed by the average household during the year. During the 10-year span between 1988 and 1997 the average subsistence salmon harvest was estimated to be approximately 40,000 sockeye salmon (*Oncorhyncus nerka*) 43,000 coho salmon (*O. nerka*) (Burkey et. al. 1999a) 83,000 chinook salmon (*O. tshawytscha*), and 92,500 chum salmon (*O. keta*) (Burkey et. al. 1999b).

Commercial salmon fisheries are a primary source of income for many subsistence users in the Arctic-Yukon-Kuskokwim region. Income realized from commercial fisheries is often used to augment other subsistence activities through the purchase of necessary equipment and supplies. Commercial salmon harvests for the Kuskokwim River (districts W-1 and W-2) during the period from 1988-1997 are approximately: 31,000 chinook salmon, 64,500 sockeye salmon, 450,000 chum salmon, and 545,000 coho salmon (Burkey et. al. 1999b).

Since 1960, aerial surveys have been the most cost-effective way to assess escapements in most Kuskokwim River tributaries (Burkey and Salomone 1999). The method is lacking in both reliability and precision; the former due to the narrow range of environmental conditions needed to conduct a successful survey, the latter due in part to variability between observers. Aerial surveys can provide rough indices of abundance for chinook salmon because the species is more visible from the air because of coloration and preferred spawning areas. Also, most of the fish are physically on the spawning grounds during a one-week period. Chum salmon are more difficult to detect from the air, and arrive on the spawning grounds over approximately a one-month period. Coho salmon normally arrive in upriver areas when environmental conditions preclude aerial observation.

Until recently, escapement assessment efforts on the Kuskokwim have been limited to two projects, the Aniak sonar (Palmer 2001) and the Kogrukluk (Ignatti) weir (Salomone 2001). Two resistance board weirs were operated by the USFWS in the early 1990s, one on the Kwethluk River and one on the Tuluksak River, but these projects were discontinued after only a few years because of local opposition. Counting towers have been attempted on the Kwethluk River and the Takotna River, however they never proved capable of providing data of necessary quality or good temporal coverage.

Beginning in 1996, a series of cooperative weir projects were started in the middle river area. The first projects were located on the George and Tatlawiksuk Rivers (Molyneaux et. al. 1997, Burkey et. al. 1999b). They are cooperative efforts between the Kuskokwim Native Association (KNA), ADF&G and Bearing Sea Fishermen's Association. They were originally operated as fixed picket weirs, but that design proved inferior to the resistance board weir design during high water events; both projects were converted to the latter design in 1999. Data reliability and quality collected from these projects has consistently improved, but will need several seasons of operation before a sufficient database can be accumulated for useful inseason fisheries

management.

During the 2000 season, two new resistance board weirs began operation: one on the Kwethluk River and one on the Takotna River. The Kwethluk project is a cooperative effort between the Village of Kwethluk, USFWS, and ADF&G. The Takotna project is a cooperative effort between the Takotna School District, ADF&G, and BSFA. Like the George and Tatlawiksuk projects, once these weirs become operational, full integration into the management system will require several seasons of successful operation.

While Kuskokwim River escapement coverage is at an historic high, it is still lacking in thoroughness. Several of the larger tributaries within the system have an unknown capacity for producing salmon. Little is known about Kuskokwim sockeye salmon in particular. With the dependence of the population upon fisheries resources, the quality of the information base used to manage the resource can be improved.

OBJECTIVES

1) Develop a list of candidate tributaries to survey for potential weir sites.

2) Survey tributaries by aircraft or boat to identify potential weir sites.

3) Return to promising sites and measure physical characteristics (width, depth, flow, clarity, etc.). Prioritize sites on six to 10 tributaries for development of escapement assessment weir projects over the next several seasons.

METHODS

Tributary Selection

Consultation with potential cooperators and examination of available information was used to develop a list of candidate systems. From this candidate list, a work schedule was outlined to survey the most promising drainages.

Traditional information about historical usage patterns and reliance on particular salmon species in particular fishing locations will be used in selecting tributaries to survey. For example, the village of Aniak relies on the Aniak River as a source of fish for subsistence use. ADF&G has operated a riverine sonar project on this system since 1980, but this project provides total fish counts rather than counts of each salmon species. Recent information suggests fish species composition in this system is more dynamic and complex than originally thought, so obtaining information to apportion sonar counts among species will be difficult and expensive. If a suitable location exists, a weir would be less expensive to operate and would provide more accurate species composition information than the sonar project.

Information from subsistence harvest studies and salmon aerial surveys will also be used to identify tributaries for potential weir sites. For example, documented subsistence harvests

indicate that Lime Village harvested more sockeye than chinook salmon during 1985-1997 (Burkey et. al., 1999a). Aerial survey data seem to corroborate that Stony River is a good sockeye salmon producer in the Kuskokwim River drainage (Burkey and Salomone, 1999), and conversations with National Park Service staff lend further support to this tributary being a likely place to examine for a potential weir site. In general, however, aerial surveys have mainly focused on chinook and, to a lesser degree, on chum salmon and provide limited information on sockeye and coho salmon (Burkey and Salomone, 1999).

Surveys

Once a list of tributaries has been established, they will be surveyed to locate potential weir sites. Surveys will be done from either fixed wing aircraft or small boats, and will occur between late July 2000 and early September 2001.

During initial aerial surveys, tributaries will be flown from the mouth towards the headwaters. Most survey effort will be directed towards the lower reaches of each tributary, because locating a weir as close to the mouth as possible is desirable to provide total counts of all salmon entering the tributary. When potential weir sites are identified, GPS coordinates will be recorded so crews can return at a later date by helicopter to collect physical site data.

Boat surveys will be conducted from the mouth towards the headwaters, and GPS coordinates will also be recorded for potential sites. Physical data will be collected at potential sites during the same trip to make the most efficient use of staff time.

Physical Measurements

Selection of potential weir sites will initially be based on general physical characteristics of the location. A good weir site is characterized by a broad section of river with a uniform bottom profile and substrate composed of uniform sized sediment ranging in size from fines through gravel sized particles. Water flows need to be moderate, with maximum flows of about four meters per second. Sites characterized by gently sloping banks or gravel bars are preferred because floodwaters can disperse over flatter terrain more easily and at lower velocities than if they are confined to a narrow channel at correspondingly greater velocities. Water clarity must be considered, for fish species identification.

Actual measurements will be made to quantitatively describe stream profiles at potential weir sites. This will be done by making depth and flow measurements at 10 ft (3 m) intervals across the profile of the streambed at the potential site. Measurements will be made with a Price brand model AA current meter and either a measuring tape or laser range finder. These data will be used to construct a depth profile and calculate discharge rates. All information will be recorded in Write-In-The-Rain notebooks or specially designed data form. Water clarity will be measured at the deepest point in the transect using a Secchi disk. Depth of light extinction will be recorded to the nearest 0.5 ft (~0.25 m).

Site Priorities

Once all potential sites have been selected and measured, comparisons will be made and a prioritized list developed. Selections will be made based on the following criteria: salmon productivity of the tributary, physical characteristics of the weir site, subsistence usage in the area, and potential for local cooperation. Logistical considerations based on location of the tributary will be used as a secondary factor.

RESULTS

The original operational plan called for the survey work to be completed during the summer of 2000. However, funding was not released until late in August of 2000 leaving little field time to complete the project during the season. Funds not spent in 2000 were made available to continue the work during the summer of 2001. In spite of the delay of funding, some site survey work was accomplished in the summer of 2000 by taking advantage of resources available through other projects located within the Kuskokwim basin.

Aniak River-On 26 June, 2000 personnel from the USFWS and ADF&G surveyed the Aniak River from the existing sonar camp up to a point about 10 miles above the Buckstock River confluence. The gradient, width, flow and substrate were all within acceptable parameters. However, braiding, and the amount of large woody debris pose problems and difficulties for installation and operation of a resistance board. On 27 June the same crew surveyed the lower 15 miles of river and identified three possible sites for a resistance board weir. However, these sites have problems that will require a level of engineering beyond the capabilities of our current design. The principle obstacles against working in the lower river are velocity and turbidity. Turbidity will be the most difficult to overcome.

Holitna River-From August 10-12, 2000 ADF&G personnel surveyed the lower 90 miles of the Holitna River during moderate high flow. Two marginal sites with widths of 410 to almost 600 ft (126 m to 185 m) were identified. Cross section depth ranged up to 4 ft (1.3 m) and flows up to 3 fps (1 m/s) were recorded.

Kisaralik River-On August 14-15 2000 personnel from USFWS and ADF&G surveyed the Kisaralik River up to mile 77.5. (124 rkm) Water levels were high, but some potential sites were identified in the lower 20 miles of the river. These sites will be monitored as water levels permit.

Holukuk River-On August 21, 2000 Angie Morgan (KNA), Wayne Morgan (KNA), Rep. Carl Morgan (AK Legislature) and ADF&G personnel surveyed the Holukuk River, a mainstem Kuskokwim tributary about 30 miles (48.2 rkm) upriver from Aniak. Several sites were identified in the lower five miles (8 rkm) of the river. Water levels were moderate to high, the clarity was excellent, width was between 100 to 150 ft (30 to 45 m), flows were in the 2 to 4 fps (0.6 to 1.3 mps) range, depths were in the 1.5 to 3.5 ft (0.5 to 1.1m) range (Figure 1, Appendix A1). The substrate is composed of large cobble (softball and grapefruit sized).

Kogrukluk River-On September 18, 2000 ADF&G personnel surveyed the lower Kogrukluk River above the confluence with the Chukowan River. Flow and width data were collected from two previously identified sites. Widths ranged from 170-190 ft (52-58 m), depth up to 3.5 ft (1.1m) (Figures 2 and 3, Appendices A 2 and A 3), the substrate was gravel, water levels were in the low range. This section is the most likely place to install a resistance board weir to replace the existing fixed picket weir on the Kogrukluk.

Holitna River-On September 24, 2000 ADF&G personnel and local residents Ignatti Ignatti, and Evan Ignatti surveyed the rest of the Holitna River and identified one site that was described as marginal in the Nogamut area (~rm 120, rkm193). The above site surveyed on the 18th of September is judged to be the site offering the best potential for successful installation of a resistance board weir on the Holitna River at the moment. Note: the Kogrukluk River is a tributary to the Holitna River. The current weir project is located at Holitna river mile 137 (rkm 220); the Nogamut site is located at Holitna river mile 120 (rkm120).

Kisaralik River-On September 27, 2000, personnel from USFWS and ADF&G conducted another survey on the Kisaralik River near the Nukluk hills (~rm 45 ~rkm 72). The width of the river in this location is roughly 186 ft (56 m), depths ranged from 1.9ft to 2.9ft (0.46 to 0.85 m) and velocities ranged up to 4.5ft (1.4 m) (Figure 4, Appendix A 4). The substrate is composed of large gravel grading to large cobble. Water levels at the time of the survey were in the high range for the drainage.

Tuluksak River-Several potential sites were found by USFWS and ADF&G personnel during a September survey. These sites were below the old weir site used in 1991-1994. The Kasigluk River was also surveyed and several sites were located on this small tributary.

2001

Swift River-On July 25, 2001 ADF&G personnel attempted to conduct helicopter surveys of the Gagaryah and the Cheneetnuk rivers, tributaries of the Swift River, itself a main Kuskokwim river tributary. The water was high and murky and no suitable weir sites were identified.

Stony River-On July 27, 2001 the outlet of Lake Telaquana at the headwaters of the Telaquana River, an upper tributary to the Stony River, was surveyed and a suitable site identified. River width at this site is approximately 490 ft (150 m) wide, up to 6.5 ft (2 m) deep, but with very low velocities (Figures 5 and 6, Appendices A 5 and A 6). The lake level had just risen 1.6 ft (0.5m) according to National Park Service personnel present on site. Water clarity was good, the bottom and fish being easily visible. Survey efforts for the rest of the Telaquana River system were hampered by high and turbid water.

Kipchuk and Salmon rivers-From 6-12 August 2001 ADF&G personnel surveyed the Aniak River drainage. Possible weir sites were identified at the mouths of the Kipchuck (Figure 7, Appendix A 7) and Salmon Rivers (Figure 8, Appendix A 8), both major Aniak River tributaries. A third site was identified in the mainstem Aniak River above the confluence with the Kipchuck River. However, spawning activity observed in the Aniak occurred below the confluence of the Aniak and Salmon Rivers so the utility of these sites may be minimal.

Holitna River-sites surveyed in 2000 were revisited from 12-20 August 2001 and observed under different water conditions to check for suitability. Surveys were conducted from the mouth up to the current weir site on the Kogrukluk River. The site near Nogamut (~ 20 miles, 32rkm) below the current Kogrukluk weir) was revisited and surveyed. This site has good potential for a resistance board weir and is roughly 180 m (600 ft) wide at this location (Figure 8, Appendix A 8). Approximately one half of the 300 ft (90 m) of the necessary 600 ft (180m) of material has already been constructed and is currently located at the present Kogrukluk River fixed picket weir site.

Chukowan River- The lower six miles of the Chukowan River were surveyed by ADF&G personnel during August 2001. Numerous suitable sites were located in the lower reaches. The best site was located right at the mouth of the Chukowan.

Tuluksak River site surveys during 2000 led to the successful weir installation and operation in 2001. This is a cooperative project between the FWS and the village of Tuluksak.

DISCUSSION

The initial stream survey list was developed in consultation with local entities, the USFWS and by reviewing available data to target the most productive systems within the Kuskokwim drainage. Once potential sites are catalogued the Kuskokwim Fisheries Coalition (KFC) will prioritize the list based upon biological and managerial needs to protect and manage these important salmon resources. Appendix B is a map showing site locations.

The most productive salmon systems are believed to be the Holitna and Aniak rivers. The Kogrukluk (Ignatti) weir located in the upper Holitna has been operational since the late 70s. A site located closer to the confluence with the Kuskokwim would be preferable since it would pass a higher proportion of the fish entering the drainage. A promising site exists near Nogamut at approximately river mile 120 (Appendix B site 1). If a resistance board weir can be located at this site, the additional information collected would encompass the current aerial index section for this stream as well as the Kogrukluk and Chukowan River systems. In terms of additional coverage for each species, king and coho salmon would probably see the greatest gains, while substantial spawning habitat for chum salmon still exists below the Nogamut site and would not be enumerated. This site represents the best location surveyed on the mainstem Holitna.

The Aniak River located in the middle Kuskokwim River drainage is considered a major chum salmon producer in the Kuskokwim River and has had a riverine sonar in operation since 1980. A problem with the sonar is that it can only discriminate fish targets but is not capable of distinguishing fish by species. In addition, the current project only operates through the end of July and does not extend into the coho season. The Aniak supports all five species of pacific salmon as well as resident species. Species other than chum salmon may contribute significantly to the sonar counts that are currently classified as chum salmon. Unfortunately, the Aniak system does not lend itself to the use of resistance board weirs. Spawning activity occurs in the middle river reaches, below the suitable weir sites. Suitable sites for weirs exist at the mouth of both the

major tributaries so they could be monitored individually. The biggest problems with the Aniak system are the heavy debris load (downed timber) and the dynamic nature of the multiple braids within the flood plane. In the lower section of the river where a possible site exists, turbidity, depth and fine substrate are the biggest obstacles. A resistance board weir on the Aniak is a slim prospect given current technology.

The Telaquana River flows out of Lake Telaquana and is a tributary to the Stony River, an upper Kuskokwim River tributary (Appendix B site 2). Lake Telaqauana is located within Lake Clark National Preserve and is one of the few lakes within the Kuskokwim that supports a population of sockeye salmon. Lime Village, located on the Stony River downstream from the Telaquana system, has a higher subsistence harvest of sockeye salmon than king salmon in most years. A helicopter survey was conducted in 2001 with the objective of locating a site as close to the confluence with the Stony River as possible; however, the lake outlet had the most suitable site. King and chum salmon also spawn within the Telaquana River. A weir installed at the outlet of Lake Telaquana would not be useful for chinook and chum salmon. However, the sockeye information alone would be justification to install a weir at the outlet. Logistics for a project at the Telequana lake outlet would present some challenges.

The Holukuk River a tributary of the Kuskokwim River and a salmon producer in the middle Kuskokwim River was surveyed in late August of 2000 (Appendix B site 3). Suitable sites exist in the first 5 miles (8 rkm) of the river. A proposal was developed to submit to the FSB for funding a weir project on the Holukuk, but the proposal was later withdrawn so the funding could be used for a mark and recapture project on the main stem of the Kuskokwim. The Holukuk would have been a cooperative project with KNA, ADF&G, and perhaps USFWS involved in the operation. The Holukuk is a fairly small system but does support all five species of salmon. Most notably a lake exists in the system that is thought to support sockeye salmon. This project would be worthwhile at some point in the future.

The Kisaralik-Kasigluk complex is one of the last major salmon tributaries in the lower river that has no assessment projects (Appendix B site 4). Aerial surveys are flown but these are frequently impacted by bad weather. The system contributes chinook, chum, coho and probably sockeye salmon to the subsistence, commercial, and recreational fisheries in the lower river area. It also flows through the Yukon Delta National Wildlife Refuge for most of its length. During 2001, water flows were measured at this site and will be compared to the design capability of the resistance board weirs. A major draw back is the location, since the surveyed site is above most of the chum salmon spawning areas. Water velocity could also be problematic. These obstacles reduce potential utility at this time. Additional lower river sites within the heavily braided section will be considered in the future. This system is similar to the Kanektok River in many respects and may be as difficult to bring the project to successful operational status. The Village of Quinhagak, USFWS, Bering Sea Fishermen Association, and ADF&G have been attempting to locate a weir project on the Kanektok for several years and have encountered multiple problems in the process, ranging from high turbid water, to unstable substrates, to poorly fabricated weir parts.

The Cheneetnuk and the Gagaryah Rivers were flown but not surveyed because high water hampered survey efforts (Appendix B site 5 and 6). These two systems, which are tributaries of

the Swift River, contain populations of chinook, chum and probably coho salmon. They are not major producers however, and probably should not be given a high priority.

The Chukowan River has a suitable site right at the mouth but this system will be covered by the installation of a weir at the Nogamut site on the mainstem Holitna River (Appendix B site 7).

The Eek River was also mentioned as a possible tributary for a resistance board weir. However, during a meeting with the village of Eek in the spring of 2000, it was apparent that the village did not favor a weir project. The river was subsequently dropped from consideration.

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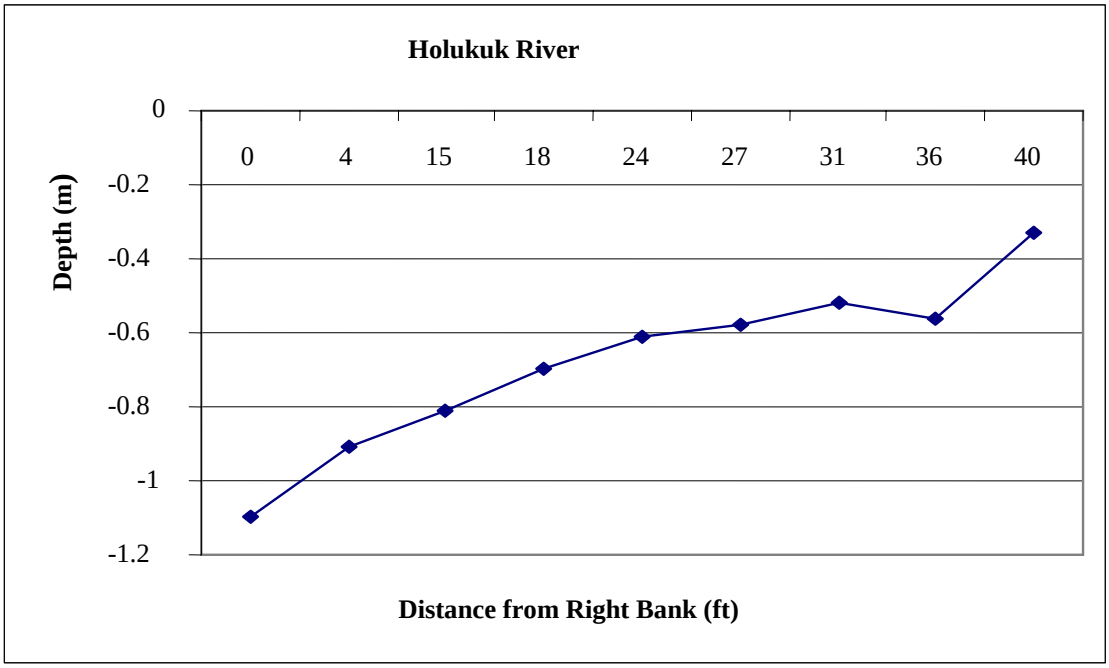


Figure 1. Channel profile of the Holukuk River.

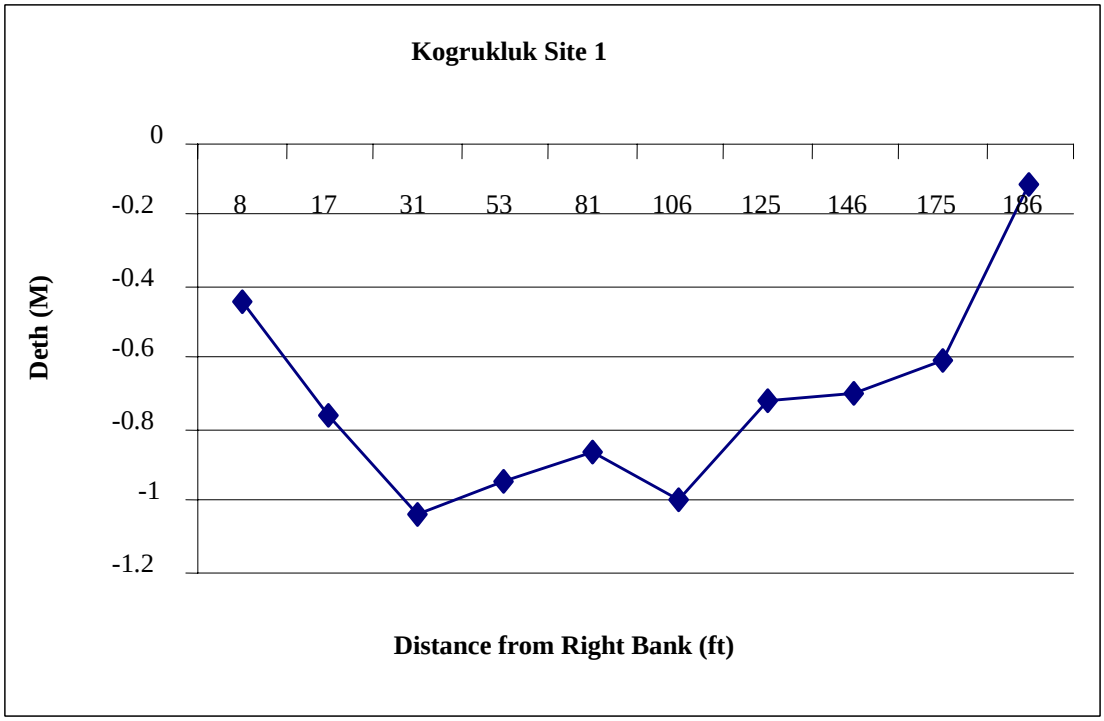


Figure 2. Channel profile for the Kogrukluk River, site 1.

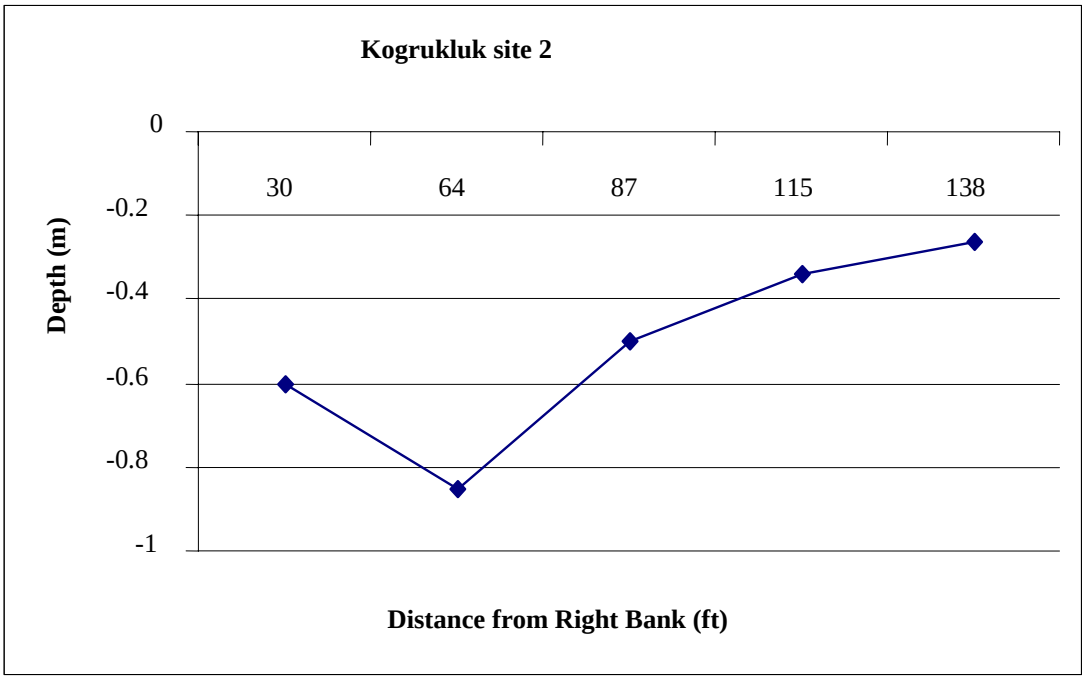


Figure 3. Channel profile for the Kogrukluk River, site 2.

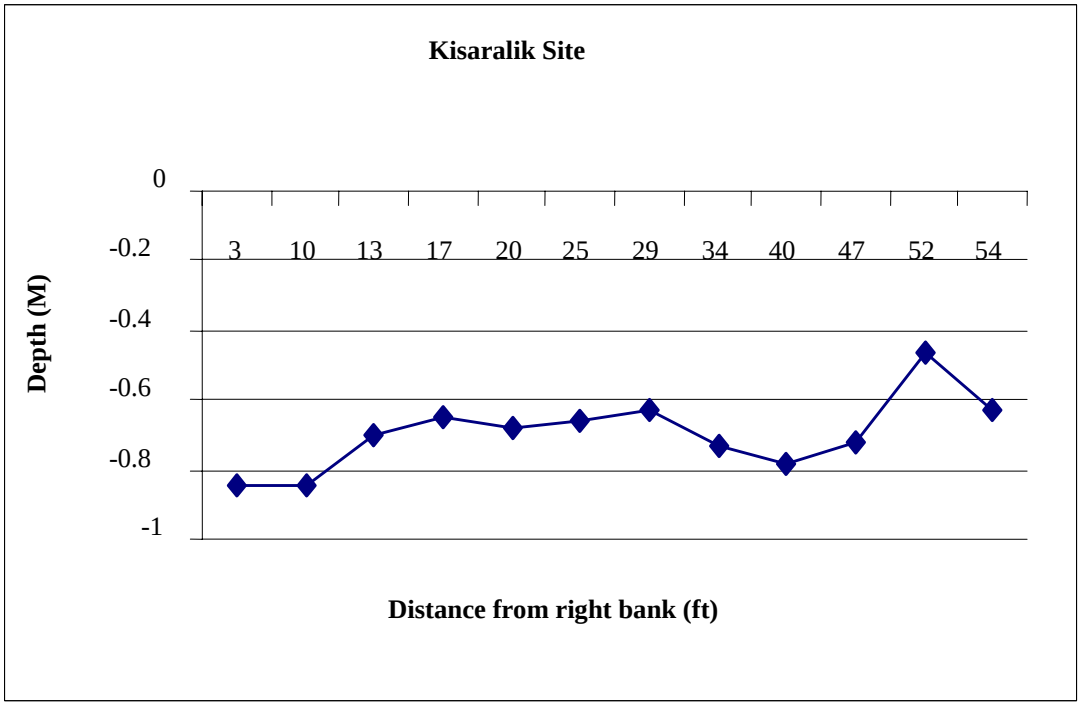


Figure 4. Channel profile for the Kisaralik River.

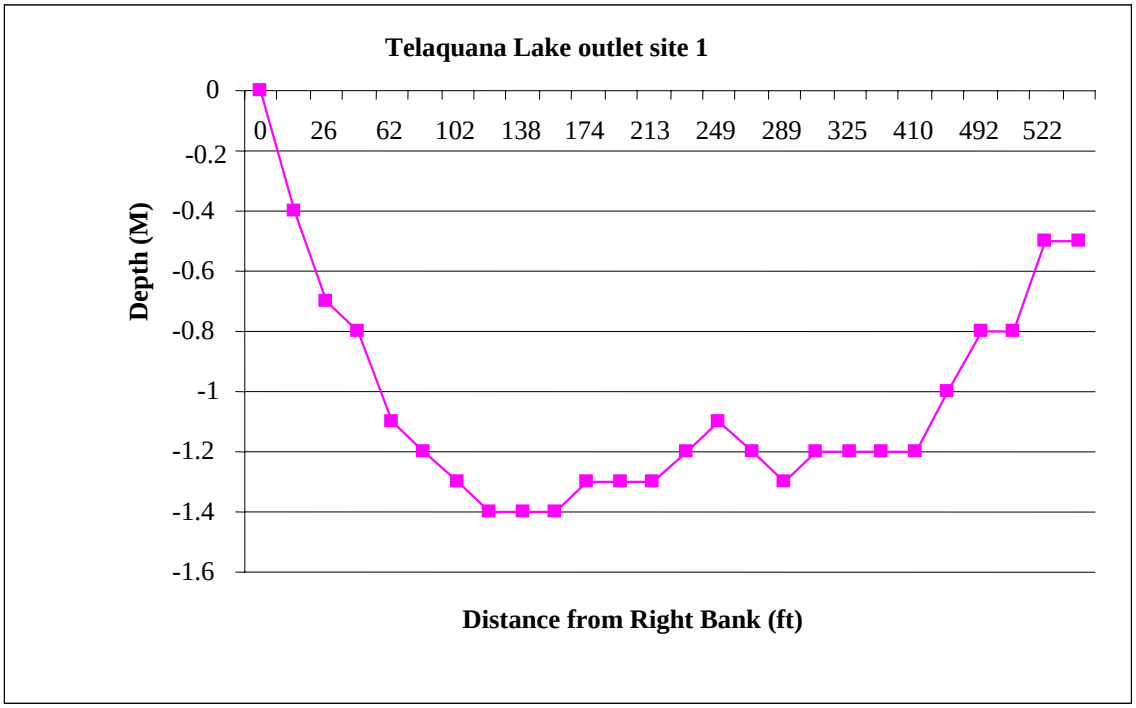


Figure 5. Channel profile for Lake Telequana outlet, site 1.

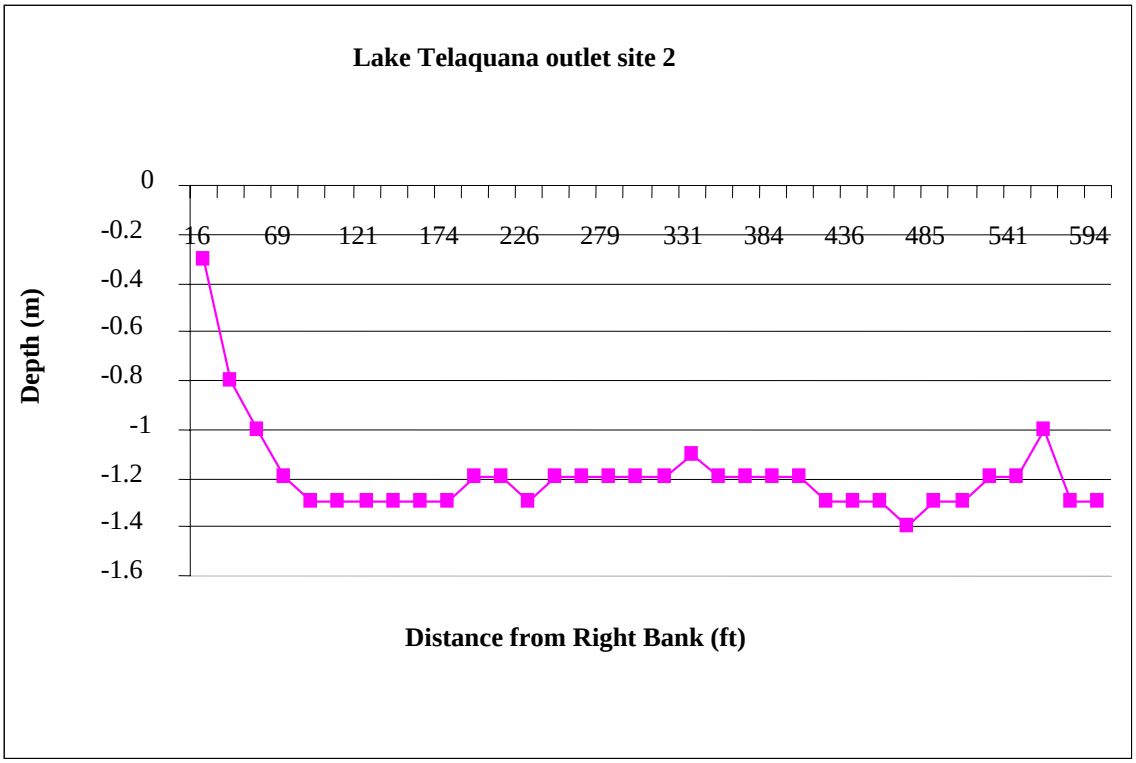


Figure 6. Channel profile for Lake Telequana outlet, site 2.

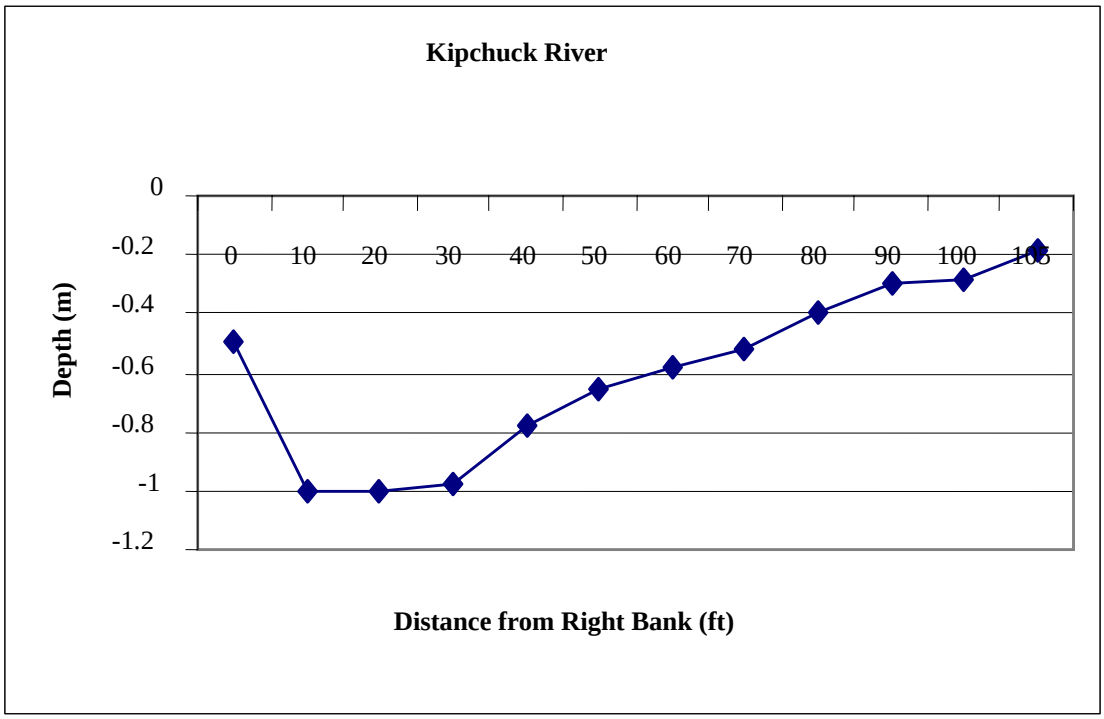


Figure 7. Channel profile for the Kipchuck River.

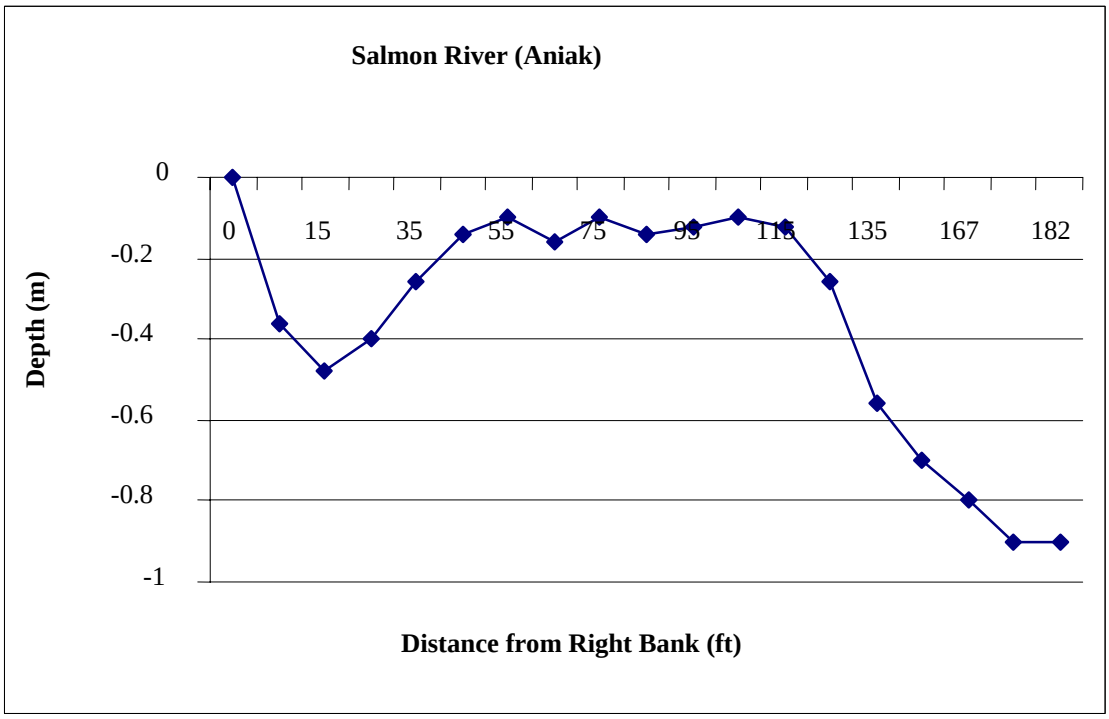


Figure 8. Channel profile for the Salmon River.

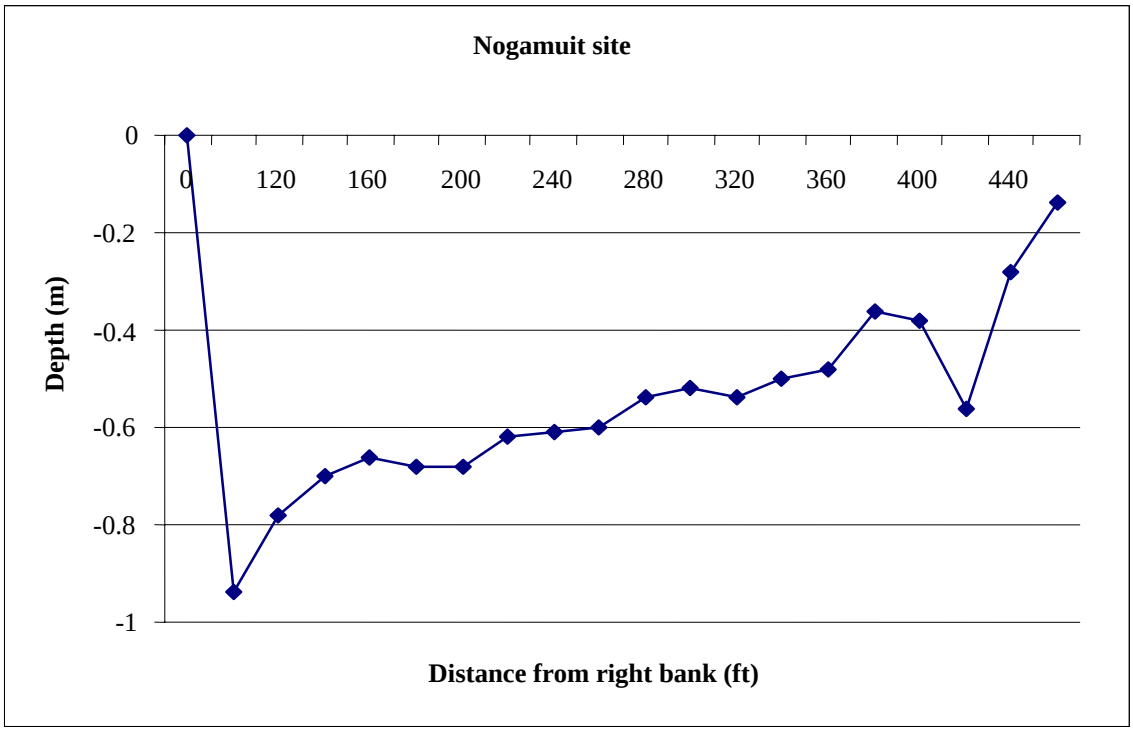
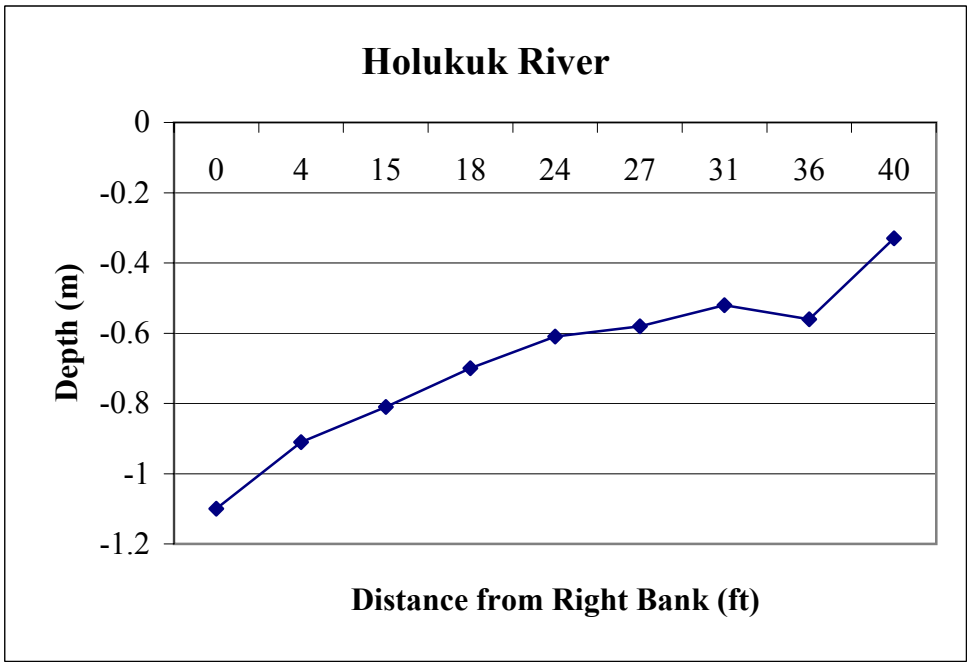


Figure 9. Channel profile for the Holitna River, near Nogamut.

Appendix A 1. Holukuk River site survey data.

Date: 8/21/2000
Crew Wayne Morgan, Angie Morgan (KNA), Carl Morgan (AK legislature)
Paul Salomone (ADF&G)
69^{O} 29'.120" N
128^{O} 28'.573" W
Comments:
Near lower end of drainage. Substrate is large cobble. Water level was near mid range.

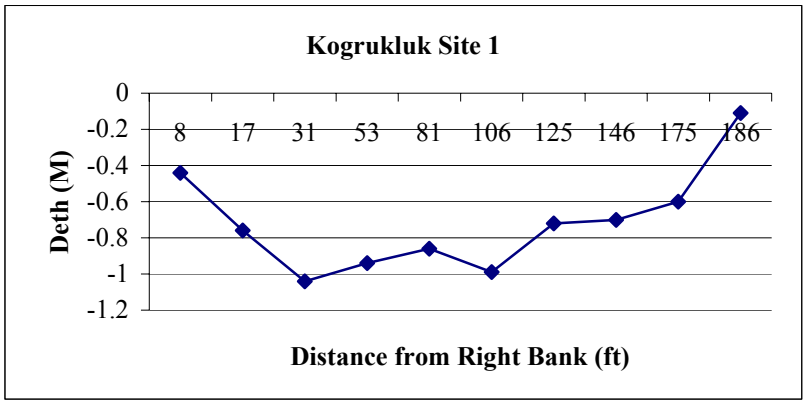
Station Number	Dist From Rt Bank (ft)	Depth	Velocity(fps)
1	0	-1.1	
2	4	-0.91	
3	15	-0.81	2.76
4	18	-0.7	
5	24	-0.61	2.3
6	27	-0.58	
7	31	-0.52	1.55
8	36	-0.56	
9	40	-0.33	0.93
10	46	-0.51	1.23



Appendix A 3. Kogrukluk River site survey data, site 1.

Date 9/18/2000
Crew Paul Salomone, Chris Shelden, Hidi Alexie (ADF&G)
60°50'450" N
157°50'782" W
Comments
Site just below present Kogrukluk River Weir.
Substrate: large gravel to small cobble, mostly consolidated.
Water level low based on todays Kogrukluk River weir level (2335)

Station Number	Dist From Rt Bank(ft)	Depth(m)	Velocity (fps)
1	8	-0.44	
2	17	-0.76	
3	31	-1.04	
4	53	-0.94	1.7
5	81	-0.86	
6	106	-0.99	1.8
7	125	-0.72	1.8
8	146	-0.7	
9	175	-0.6	1.4
10	186	-0.11	0.63
	67 feet to left bank		



Appendix A 3. Kogrukluk River site survey data, site 2.

Date 9/18/2000

Crew Paul Salomone, Chris Shelden, Hidi Alexie (ADF&G)

60°50'496" N

157°50'887W

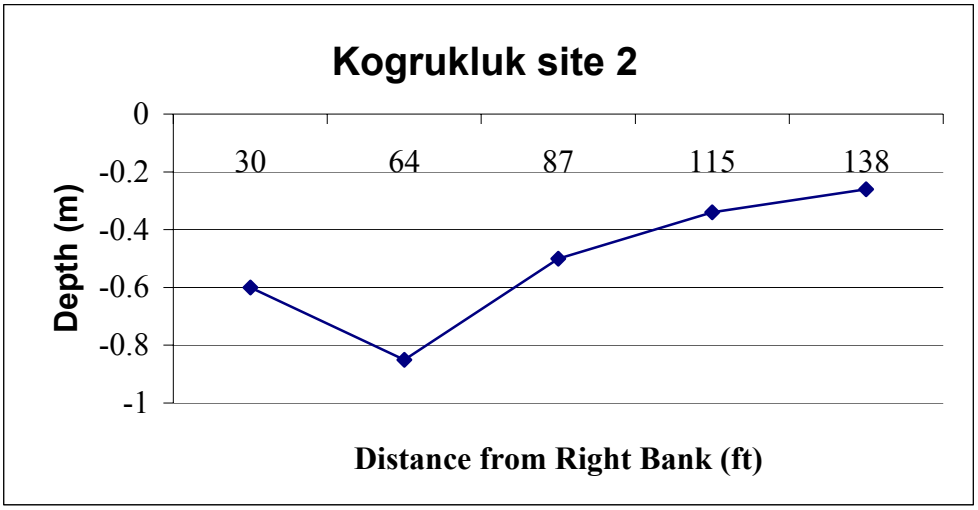
Comments

Site 300 ft below site 1

Substrate: large gravel to small cobble, mostly consolidated.

Water level low based on todays Kogrukluk River weir level (2335)

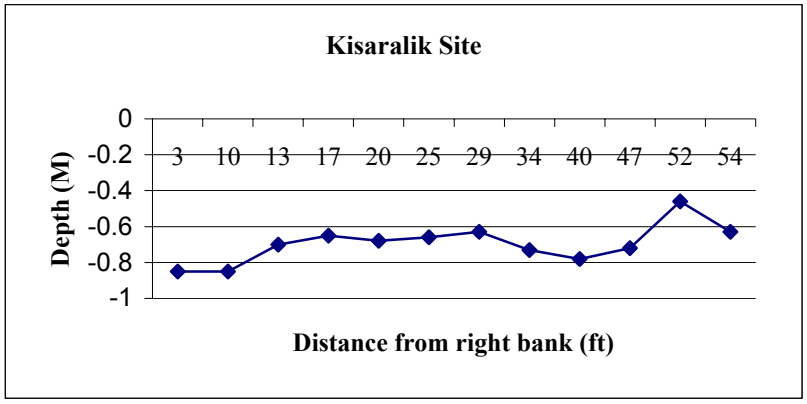
Station Number	Dist From Rt Bank(ft)	Depth(m)	Velocity (fps)
1	30	-0.6	
2	64	-0.85	4.2
3	87	-0.5	2.8
4	115	-0.34	2.14
5	138	-0.26	
	42 feet to left bank edge		



Appendix A 4.Kisaralik River site data

Date 9/27/2000
Crew Charlie Burkey, Rob Stewart, Robert Sundown
60°44'.368" N
160° 22'.279" W
Comments:
Location in the foothills near Nukluk. Water level in the moderate to high range.
Substrate composed of large gravel grading to cobble. Total width 56 m.

Station Number	Dist From Rt Bank(ft)	Depth (m)	Velocity (fps)
1	3	-0.85	0.901
2	10	-0.85	1.41
3	13	-0.7	1.36
4	17	-0.65	1.34
5	20	-0.68	1.45
6	25	-0.66	1.41
7	29	-0.63	1.24
8	34	-0.73	1.25
9	40	-0.78	1.34
10	47	-0.72	1.17
11	52	-0.46	1.00
12	54	-0.63	0.38

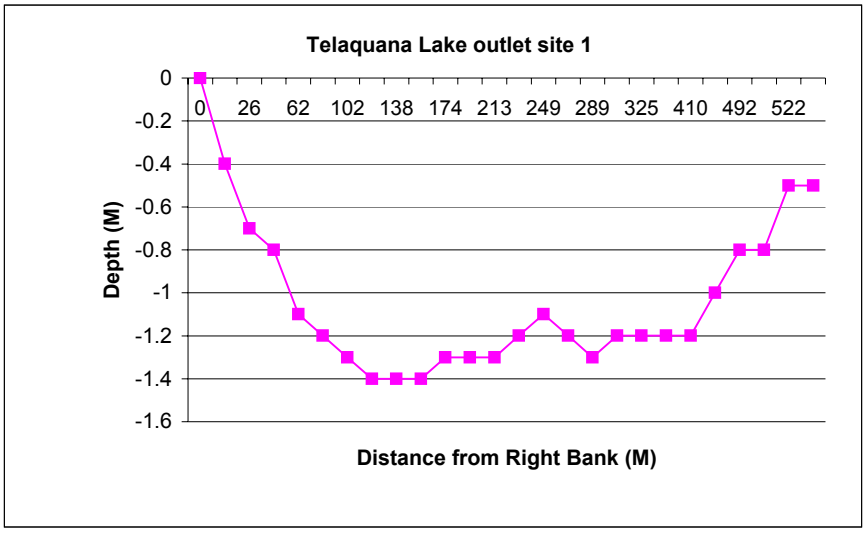


Appendix A 5. Telaquana Lake outletsite survey data, site 1.

Date 7/27/2001
Crew Larry Dubois (ADF&G) J. Mills (NPS)
60°57'86" N
154°01'62" W
Comments
75 m below outlet. Right bank low, grassey wetted area. Left Bank is small spruce and bushes. Substrate alnog right marging was large cobble and extends 20 m from shore. The rest of the transect was hard pack gravel overlaid with 1 cm of silt. Along left margin was slightly more silt and less velocity. Distances from left bank estimated using laser rangerfinder. Velocity estimated at less than 2 f/s

Station Number	Dist Fro Rt Bank(ft)	Depth(m)	Velocity (fps)*
1	0	0	
2	7	-0.4	
3	26	-0.7	
4	43	-0.8	
5	62	-1.1	
6	82	-1.2	
7	102	-1.3	
8	118	-1.4	
9	138	-1.4	
10	157	-1.4	
11	174	-1.3	
12	194	-1.3	
13	213	-1.3	
14	230	-1.2	
15	249	-1.1	
16	269	-1.2	
17	289	-1.3	
18	305	-1.2	
19	325	-1.2	
20	377	-1.2	
21	410	-1.2	
22	479	-1.0	
23	492	-0.8	
24	508	-0.8	
25	522	-0.5	
26	538	-0.5	

* velocity estimated

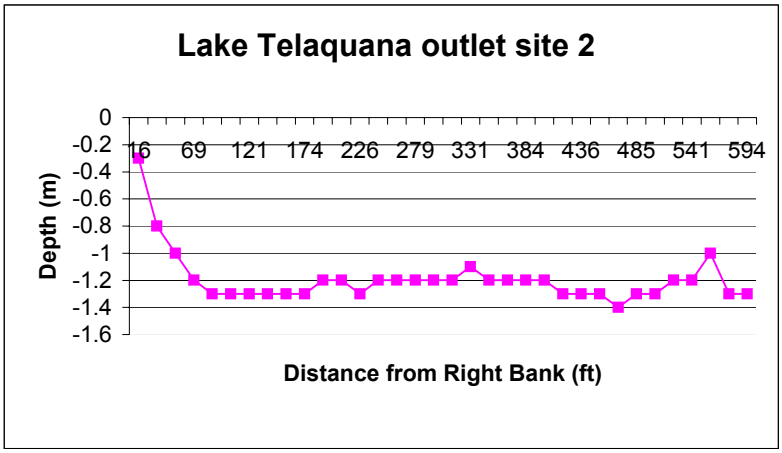


Appendix A 6. Telaquana Lake outlet site survey data, site 2.

Date 7/27/2001
Crew Larry Dubois (ADF&G), J. Miller (NPS)
60°57'86" N
154°01'62" W
Comments
125 m below outlet. Right bank low, grassey wetted area. Left Bank is small spruce and bushes. Substrate alnog right marging was large cobble and extends 20 m from shore. The rest of the transect was hard pack gravel overlaid with 1 cm of silt. Along left margin was slightly more silt and less velocity. Distances from left bank estimated using laser rangerfinder. Velocity estimated at less than 2 f/s

Station Number	Dist Fro Rt Bank(ft)	Depth(m)	Velocity (fps)*
1	16	-0.3	
2	36	-0.8	
3	52	-1	
4	69	-1.2	
5	89	-1.3	
6	105	-1.3	
7	121	-1.3	
8	141	-1.3	
9	157	-1.3	
10	174	-1.3	
11	194	-1.2	
12	210	-1.2	
13	226	-1.3	
14	246	-1.2	
15	262	-1.2	
16	279	-1.2	
17	295	-1.2	
18	315	-1.2	
19	331	-1.1	
20	348	-1.2	
21	367	-1.2	
22	384	-1.2	
23	400	-1.2	
24	420	-1.3	
25	436	-1.3	
26	453	-1.3	
27	472	-1.4	
28	485	-1.3	
29	505	-1.3	
30	525	-1.2	
31	541	-1.2	
32	558	-1.0	
33	577	-1.3	
34	594	-1.3	

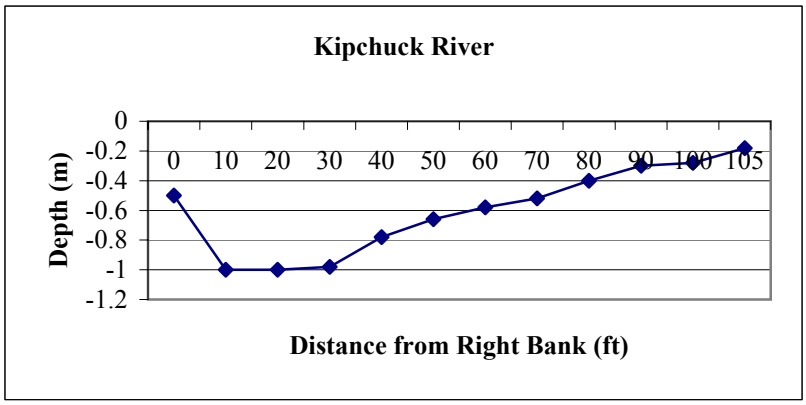
* velocity estimated



Appendix A 7. Kipchuck River (Aniak) site survey data.

Date 8/14/2001
Crew Paul Salomone, Brian Latham (ADF&G)
61°00'920" N
159°10'399" W
Comments
200 meters upriver from confluence with Aniak. Substrate: partly unconsolidated gravel much woody debris, evidence of recent high water 3-4 feet above current level
Good campsite 200 meters upriver from the weir site.

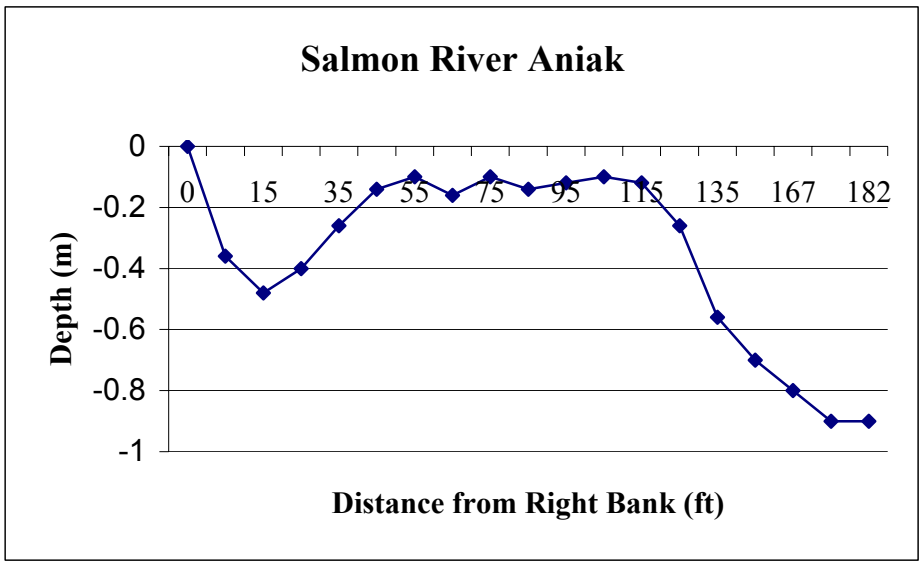
Station Number	Dist From Rt Bank(ft)	Depth(m)	Velocity (fps)
1	0	-0.5	2.5
2	10	-1	4
3	20	-1	4
4	30	-0.98	4
5	40	-0.78	3.87
6	50	-0.66	3.73
7	60	-0.58	3.27
8	70	-0.52	2.64
9	80	-0.4	3.18
10	90	-0.3	2.81
11	100	-0.28	2.7
12	105	-0.18	2.8



Appendix A 8. Salmon River (Aniak) site survey data.

Date 8/13/2001
Crew Paul Salomone, Brian Latham (ADF&G)
61°03'905" N
159°10'653" W
Comments
200 yds upstream from confluence with the Aniak, above first rifle. Substrate is large gravel gradeing to large cobble. Evidence of much rafting traffic, fire pits, footprints and toilet paper.

Station Number	Dist Fro Rt Bank(ft)	Depth(m)	Velocity (fps)
1	0	0	0
2	5	-0.36	2.01
3	15	-0.48	2.38
4	25	-0.4	1.63
5	35	-0.26	0.83
6	45	-0.14	0
7	55	-0.1	0
8	65	-0.16	3.26
9	75	-0.1	0
10	85	-0.14	3.4
11	95	-0.12	1.73
12	105	-0.1	
13	115	-0.12	1.79
14	125	-0.26	2.39
15	135	-0.56	2.55
16	145	-0.7	2.24
17	167	-0.8	2.83
18	177	-0.9	2.49
19	182	-0.9	0

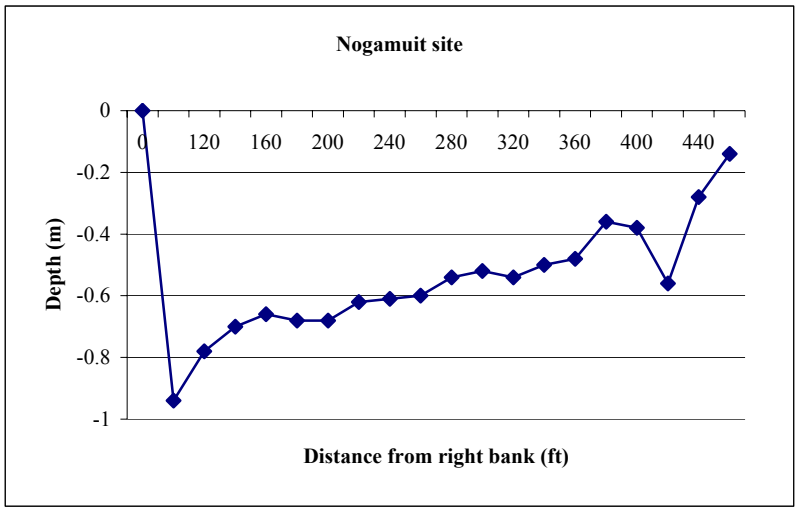


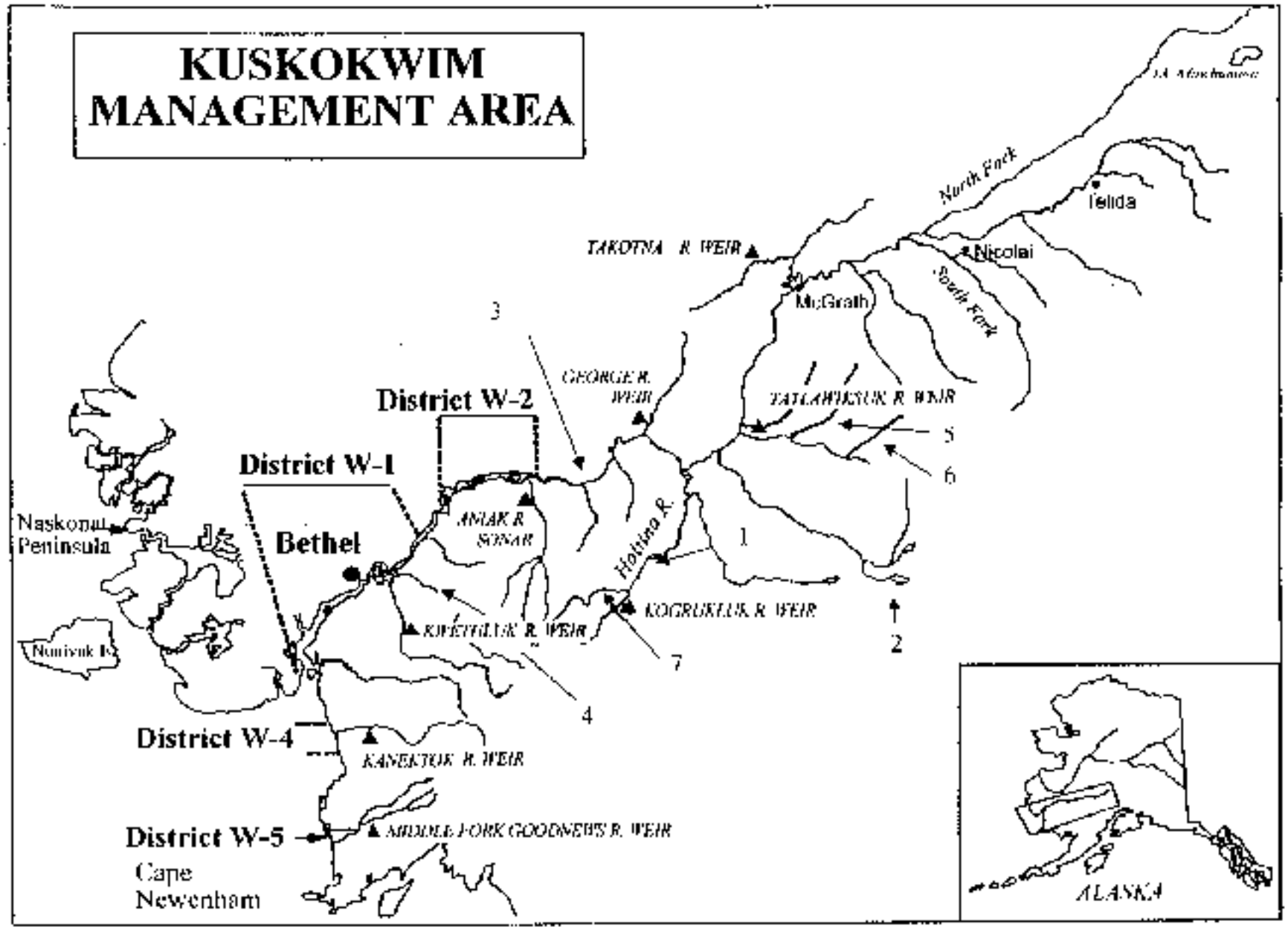
Appendix A 9. Holitna River site data.

Date 8/23/2001
Crew Paul Salomone, Brian Latham (ADF&G)
61°00'646" N
157°41'593" W
Comments
Site about 2 miles above Nogamuit. 19 miles below Kogrukluk River Weir Substrate: large gravel to small cobble, mostly consolidated. Some woody debris. Water level moderate to high based on level at the Kogrukluk weir today (2660).

Station Number	Dist From Rt Bank(ft)	Depth(m)	Velocity (fps)
1	0	0	
2	100	-0.94	3.23
3	120	-0.78	3.28
4	140	-0.7	3.59
5	160	-0.66	3.55
6	180	-0.68	3.64
7	200	-0.68	3.67
8	220	-0.62	3.64
9	240	-0.61	3.29
10	260	-0.6	3.67
11	280	-0.54	2.39
12	300	-0.52	2.47
13	320	-0.54	2.48
14	340	-0.5	2.64
15	360	-0.48	2.71
16	380	-0.36	2.42
17	400	-0.38	1.65
18	420	-0.56	1.05
19	440	-0.28	1.27
20	460	-0.14	3.39

60 feet to left bank





Appendix B. Existing projects and prioritized locations of surveyed streams.