WRB 94-1

WATER RESOURCES THREATS ANALYSIS

Water Resources Branch

April 1994

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

Addendum to Water Resources Threats Analysis

THE FOLLOWING CORRECTIONS SHOULD BE SUBSTITUTED FOR THE SECTION ON THE KENAI NWR, PAGE 6.

Hydrologic data collection and analysis of existing data on the Kenai NWR will begin during the 1994 field season.

The threats analysis reflected high public use and development on the Kenai Refuge. There are active placer mines on Quartz Creek outside the refuge on U.S. Forest Service (USFS) land. The Swanson River and Beaver Creek oil fields operate within the Refuge boundary. There are several small logging operations near the refuge on USFS land, and there are two hatcheries located outside the refuge boundary on rivers that flow through or eventually flow through the refuge. The Kenai industrial complex is nearby. Most of the refuge rivers are crossed by roads and/or pipelines. Recreational use is extremely high. Refuge staff highlighted human wastes and recreation on the Kenai River, oil fields, and potential logging as the highest threats to refuge water resources. There are water right appropriations that have been granted to use water from the Kenai River, however they are small quantities in relation to the discharge of the river.

The Kenai NWR differs from other Alaskan refuges because of the complex mix of public uses and development that affect or have potential to affect the refuge. In addition, many of the major rivers have some historical stream gage record. The rivers in the Kenai Refuge are also more easily accessible. Thus hydrologic investigations will be less costly to complete.

WATER RESOURCES THREATS ANALYSIS

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April, 1994

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ABSTRACT

This project was conducted to identify and evaluate water resources threats to the sixteen national wildlife refuges (NWR) in Alaska in order to guide hydrologic investigations and instream water right protection. The project involved developing and defining criteria to evaluate threats to refuge water quantity and quality. Each refuge manager identified high priority rivers and evaluated water resources threats for each of those rivers. The responses were assigned weights and analyzed to determine those refuges with the highest priority needs for hydrologic data collection and subsequent filing of instream water right applications with the State of Alaska.

This analysis recommends that hydrologic data collection and water right filings over the next five years focus on the following refuges, in priority order: Yukon Flats, Kenai, Innoko, Kodiak, and Togiak. Hydrologic inventory on the Yukon Flats NWR began in FY 1993, and investigations will begin on the Kenai NWR in FY 1994.

WATER RESOURCES THREATS ANALYSIS

INTRODUCTION

Region 7 of the U.S. Fish and Wildlife Service (Service) manages sixteen national wildlife refuges in the State of Alaska, totaling 77 million acres of land and water in federal jurisdiction. The refuges range in size from the Izembek Refuge with 320,893 acres to the Yukon Delta Refuge with 21 million acres in federal jurisdiction. The Yukon Delta Refuge is the largest of the sixteen refuges and is about the size of the state of Missouri (Vandegraft, 1994). These sixteen wildlife refuges make up eighty-eight percent of the total acres in the national wildlife refuge system in the United States (USFWS, 1987). Included in the refuge system in Alaska are over 18 million acres of wilderness and seven Wild and Scenic Rivers totaling about 900 river miles (BLM, 1992).

Refuges were first established in Alaska in the early 1900's to protect seabird nesting islands. In the ensuing years, new refuges were created and additional lands were added to existing refuges. The expansion of lands culminated with the 1980 enactment of the Alaska National Interest Lands Conservation Act (ANILCA). This legislation added land to seven refuges and created nine new refuges in Alaska (USFWS, 1987). The wildlife refuge system in Alaska is shown in Figure 1.

Under ANILCA, one of the purposes of each refuge is "to ensure, to the maximum extent practicable and in a manner consistent with the purposes of each refuge, water quality and necessary water quantity within the refuge". Thus, each of the sixteen national wildlife refuges in Alaska have federal reserved water rights.

The Service has adopted water rights policy (403 FW 1-3) that states it will obtain the legal rights to use water for the management of Service lands and facilities, for the protection of endangered species, and to maintain instream flows. It is also Service policy to comply with State laws and procedures to obtain and protect water rights (USFWS, 1993).

Alaska Statute 46.15.145 allows federal agencies to file with the State of Alaska for instream water rights to protect fish and wildlife habitat, migration, and propagation as well as navigation, transportation, and recreational uses. Given this legal setting, Region 7 has established a water rights program with the goal of quantifying and filing instream water rights with the State of Alaska to protect fish and wildlife habitat on the national wildlife refuges in Alaska.

Because of the vast size of the Alaskan refuges, the immense water resources on the refuges, and the remoteness of the rivers, lakes, and wetlands this is a huge job. The Water Resources Branch (WRB) within Refuges and Wildlife designed and conducted this analysis of threats to refuge water resources to establish priorities for hydrologic investigations leading to filing instream water right applications with the State of Alaska.

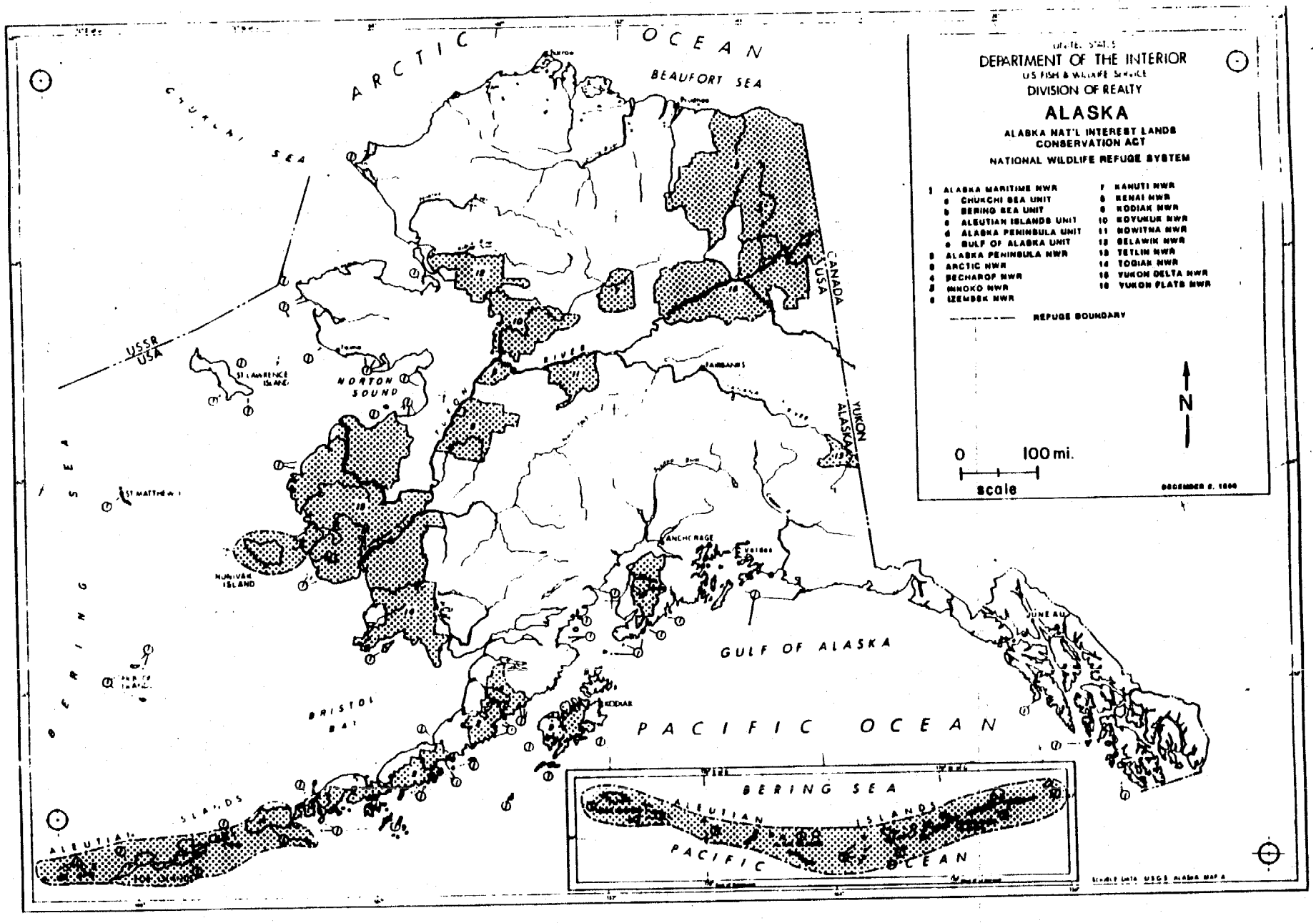

Figure 1. - National Wildlife Refuges in Alaska

METHODS

The first water resources threats analysis was conducted by Region 7 in 1985. That project resulted in a prioritized list of rivers needing instream flow quantification throughout the sixteen refuges (Bayha, 1985). The Water Resources Branch was formally organized in FY 1987. During FY 1993, the Water Resources Branch updated the 1985 analysis to reflect changes that occurred and new information that accumulated during the intervening years. In addition, because of the high cost and difficult logistics of field data collection in Alaska, it was determined to be more cost effective to conduct hydrologic investigations for large areas than to focus on individual streams in widely dispersed areas. Thus, the goal of this project was to identify refuges or parts of refuges rather than individual rivers for hydrologic investigation.

To begin the project, the 1985 water resources threats analysis was reviewed. The Water Resources Branch also reviewed an analysis completed by the Alaska Department of Fish and Game (ADF&G) in 1984 to prioritize sport fish streams for instream flow protection (ADF&G, 1984). In addition, the "Analysis of Inholdings, Acquisition Priorities and Recommendations to Reduce Impacts on Conservation Units in Alaska", completed by the federal land management agencies in 1990 was reviewed (USFWS et al., 1990). All three of these projects identified criteria that were evaluated and then weighted to prioritize and guide work.

Staff in the Water Resources Branch, the Division of Realty, and the Associate Manager's office developed the criteria used in the analysis. Several of the northern refuge managers reviewed the criteria and an early draft was used to evaluate threats to water resources on the Yukon Flats NWR to guide hydrologic data collection that began there during the summer of 1993.

Criteria were developed and defined in four major categories: threats to refuge water quantity/quality, management considerations, resource values including biologic diversity and habitat values, and public use. Definitions for each criteria were developed to rank each criteria as either high, medium, low, or none, or for some criteria a yes or no response. Definitions for each criteria were developed to be as specific as possible, however in many instances the decision to choose the appropriate rank for each criteria was based on refuge manager's professional knowledge and judgement.

After the criteria were selected and defined, a matrix form was developed and instructions were written. The criteria, instructions, form, and the 1985 list of streams were sent to each refuge manager for evaluation at the end of May, 1993. A copy of the threats analysis package can be found in Appendix A. Refuge managers were asked to identify the most important rivers on their refuge, using the 1985 list of rivers as a starting point, and to rank each of the criteria for each stream on the matrix form.

During June, 1993, each refuge manager was contacted to explain the project and to answer questions as the refuges began to identify and evaluate the rivers on their refuges. As the responses were completed and returned to the Water Resources Branch, the regional water rights coordinator talked with each

refuge manager or respondent either personally or by phone, to discuss and clarify the responses and to insure uniformity in responses to the extent possible. In addition, each refuge manager was asked to identify the highest water resources threats to the refuge and to identify the highest priority streams for hydrologic data collection.

In early August, 1993, a team was appointed to develop weights for the criteria. Team members included three staff from the Water Resources Branch, two refuge managers, and a water quality specialist from the Division of Environmental Contaminants in Ecological Services. The team met and agreed on weights for each criteria. The purpose of the weights was to insure that the resulting priorities were driven by threats to refuge resources. Biological resources were also give a high priority in the weighting process. The meeting summary documenting the rational and weights assigned to each criteria can be found in Appendix B.

A spread sheet was designed to record and sort the data. Weights were assigned to the ranked criteria for each refuge, taking into account verbal discussions with each refuge manager. The rivers and the weights for the criteria were then entered into the spread sheet.

In early September, staff in the Water Resources Branch along with the water quality specialist met to review the preliminary data. The group discussed the nature of the threats to refuge water resources, the use of the refuge manager's professional judgement to rank the criteria, and the need to be careful of relying strictly on the raw numbers from the analysis. The group looked at the data sorted in a variety of ways and agreed that a data sort based on the sum of the total scores of the top ten rivers for each refuge should be used as the basis for prioritizing hydrologic data collection. It was decided that this procedure would equalize the ranking among refuges, given that each refuge identified and evaluated a different number of rivers. It was also agreed that the decisions for prioritizing refuges should be based on the top five or six refuges, and within that group, consideration of other factors such as existing hydrologic data, logistics, and other on-going studies should help guide the final prioritization.

RESULTS

A copy of the summation of the data in each of the four major categories can be found in Appendix C. The refuge response forms and the spread sheet of weighted criteria are on file in the Water Resources Branch so that subsequent analysis of the data can be done in the future if need be.

The data were sorted based on the sum of the grand total of the top ten rivers for each refuge, and resulted in the following list of refuges and associated total points:

Yukon Delta	1315
Innoko	1230
Togiak	1087
Kenai	1085

Yukon Flats	1078	
Kodiak	1042	
Selawik	1028	
Kanuti	964	
Tetlin	955	
Koyukuk	943	
Nowitna	843	
Arctic	785	
Izembek	755	
Alaska Peninsula	404	(only 4 rivers identified)
Alaska Maritime	202	(only 4 rivers identified)

A meeting was then held including staff from the Water Resources Branch, the Chief of the Division of Realty, the Associate Manager, and the water quality specialist to discuss the results of the threats project and to recommend data collection priorities over the next five years.

It was decided at that meeting that the top ranked six refuges should be prioritized for data collection and subsequent water rights filings over the next five years. In addition, within that group of six refuges, consideration of important factors such as existing hydrologic data, logistics, and other on-going or planned studies that relate to water resources should guide the final refuge prioritization.

The group recommended deferring water resource investigations on the Yukon Delta NWR for the reasons discussed below. The remaining five refuges were prioritized as follows:

Yukon Flats (on-going)
Kenai
Innoko
Kodiak
Togiak

Hydrologic data will be collected on each of these refuges for a period of five years, contingent on funding availability. A summary of the threats on these refuges and rational for the priorities is discussed below.

Yukon Delta NWR

The Yukon Delta NWR scored the highest in the ranked summation of the ten highest rated rivers. This project identified the major threats to water resources as village water supply and waste disposal, potential diesel or gasoline spills from fuel barges, and the potential for mercury mines. In addition, there are some active placer mines on or near the Refuge and fish processing plants on the Yukon and Kuskokwim Rivers. There are many native allotments and inholdings throughout the Refuge. There is one stream gage with historical data on the Kisaralik River. Subsistence use on the Refuge is very important.

It was, however, decided to defer hydrologic data collection on this refuge for the following reasons. It is the largest and wettest refuge among all the

refuges in Alaska, with more than half of the surface covered by water. The delta is covered by innumerable ponds and lakes and extensive wetlands. The cost of conducting hydrologic data collection in this refuge would be significantly higher than other refuges due to the greater distances involved and the quantity of surface water. Also, it was agreed that the Water Resources Branch would benefit from additional experience working with new equipment and investigative techniques on smaller refuges. There is emerging high tech equipment, such as the Doppler stream gaging system, and investigative techniques, such as using Geographic Information System (GIS) mapping and data bases and synthetic aperture radar (SAR) imagery, that would greatly assist in water resource data collection on this refuge. This new equipment and these techniques will reduce costs by reducing time needed for field data collection.

Yukon Flats NWR

The Water Resources Branch began a data collection program on the Yukon Flats NWR in FY 1993 due to threats from potential oil and gas exploration and development within the Refuge. Seven stream gages were installed and operated during the 1993 field season. Two additional gages have been installed and will begin operating during the 1994 field season. Three or four additional gages will also be installed during the 1994 field season. These gages will collect five years of discharge data during open water seasons. These augment other gages operated by the U.S. Geological Survey (USGS) and the Bureau of Land Management in the general area of the refuge. Lake level elevation surveys will also be conducted as part of the over all hydrologic investigation and water right quantification project.

Kenai NWR

Hydrologic data collection and analysis of existing data on the Kenai NWR will begin during the 1994 field season, contingent on funding.

The threats analysis reflected high public use and development on the Kenai Refuge. There are active placer mines on the Kenai River and Quartz Creek, and the Swanson River and Beaver Creek oil fields are operating within the Refuge. There are several small logging operations within or near the refuge, two hatcheries within the Refuge boundary, and the Kenai industrial complex nearby. Most of the refuge rivers are crossed by roads and/or pipelines. Recreational use is extremely high. Refuge staff highlighted human wastes and recreation on the Kenai River, oil fields, and potential logging as the highest threats to refuge water resources. There are water right appropriations that have been granted to use water from the Kenai River, however they are small quantities in relation to the discharge of the river.

The Kenai NWR differs from other Alaskan refuges because of the complex mix of public uses and development that affect or have potential to affect the refuge. In addition, many of the major rivers have some historical stream gage record. The rivers in the Kenai Refuge are also more easily accessible. Thus hydrologic investigations will be less costly to complete.

Innoko NWR

Hydrologic data collection on the Innoko NWR is planned to begin during FY 1995 or FY 1996, depending on funding availability. As with all refuges, this will be a five year project.

The threats analysis revealed that the major threat to water resources on the Innoko Refuge is historic, present, and potential placer mining. All but one watershed, the North Fork of the Innoko, has historic or present mining, and this watershed has high potential for mining development due to a proposed road to Ruby. The Flat and Opher mining districts are upstream of the refuge. The Mud, Dishna, and Innoko Rivers are rated especially high for mining threats. Inholdings are a concern because of potential development of hunting and fishing lodges; fly-in fishing and hunting is also increasing. There is one existing USGS stream gage on the Yukon River near Kaltag.

The Innoko Refuge has an on-going extensive vegetation mapping and GIS program. There is an opportunity to conduct a pilot project to combine vegetation, hydrology, water rights, and wetlands with GIS. The Refuge is also beginning a pilot project using SAR imagery to accurately map water courses, water bodies, and wetlands. In addition, the Region is proposing a major contaminants study during FY 1994. The WRB will coordinate stream gaging and lake surveys with water quality data collection whenever possible.

Kodiak NWR

The Kodiak NWR will be the fourth refuge targeted for hydrologic data collection. Existing stream gage data can be used, but additional stream gages will need to be installed and operated for five years.

The threats analysis highlighted the Terror Lake Hydroelectric project as the major water development on the Refuge. There is also a salmon enhancement project on the Spiridon River and several canneries on or near the Refuge. The Refuge identified major water resources threats as potential development of native lands along the Karluk River and along other salmon streams and impacts from human use associated with fishing and hunting. A number of streams have some historical stream gage data.

Togiak NWR

The Togiak NWR is ranked as the next refuge in the group of high priority refuges for hydrologic data collection and analysis. Data collection on this Refuge will focus primarily on those parts of the refuge with historic, present, or planned mining.

The threats analysis revealed that water resources threats include a major placer mine on an inholding within the refuge on the Salmon River with tailings in the river obstructing fish passage. The mine is not presently active because the State has stopped the operation. There are a number of gravel extraction operations and several present and planned roads within the

Refuge. An additional concern is the increasing number of permanent and temporary guide camps within the Refuge.

Water Resources Threats to Other Refuges

The Selawik NWR reported limited threats to water resources quantity or quality. Public water supply and waste disposal for villages on the Selawik River and Kobuk River channels were identified. There were some gravel extraction projects identified, however the Refuge indicated no negative impacts from those operations.

The Kanuti NWR reported that there is an active placer mine on Prospect Creek upstream of the Refuge that has spilled sediment at least once. There are no active placer mines on the Refuge, however there are active mines on the Koyukuk and Jim Rivers upstream of the Refuge. Public water supply and waste disposal was identified for three villages upstream of the refuge. Transportation impacts are rated high; the Dalton highway and trans-Alaska pipeline cross all the streams on the east side of the refuge. A major concern is a potential spill from the oil pipeline. In addition, the Bettles Highway is a major winter road that crosses the Jim River and is used to truck fuel.

Transportation impacts are rated high for the Tetlin NWR also. The Alaska Highway forms the eastern edge of the Refuge, where impacts are greatest for Desper and Scottie Creeks. There are no active placer mines on the Refuge, however there are active mines upstream in Canada and in the Wrangle-St. Elias Preserve. There is also mineral potential in many of the watersheds upstream of the Refuge. The State of Alaska Tok Area Five Year Forestry Plan has undergone public review and identifies potential logging on state and private inholdings in Refuge watersheds.

The Koyukuk NWR reported that at least six villages and a number of fish camps along the Koyukuk River dump wastes directly into the river. A placer mine on the Hogatza River was active last year, however its present status is unknown. There is a planned world class hard rock gold mine on Camp Creek that would use a cyanide heap leach process to extract gold. The development is on state land and has passed the feasibility and planning stages; the company is waiting for the price of gold to increase to initiate the project. Gravel extraction on the Yukon River was rated high because extraction occurs in the winter and there may be impacts to overwintering fish. Mining is also a major threat to water resources on the Nowitna NWR. Mining has occurred on the Sulatna and Titna Rivers in the past.

The 1002 Area of the Arctic NWR has been the highest priority for the past six years and water resources inventory of six of the coastal plain rivers has been completed. On the remainder of the Arctic NWR, the major threat to water resources is potential oil and gas exploration and development. Recreation is also an important public use on some rivers in the Refuge. The Refuge has many rivers and streams, however much of the area is wilderness or is undeveloped.

The Izembek NWR reported that threats to water resources are generally low; most of entire watersheds lie within the Refuge. There has been oil and gas exploration in the Cathedral River watershed in past years, however the results were disappointing and no exploration or development is currently planned. There is a State hatchery on Russell Creek downstream from the Refuge. It is presently closed, however the hatchery facilities are still in place. Two additional hatcheries have been proposed on Bluebill and Lamprey Creeks, however these projects are not presently active.

There are many streams on the Alaska Peninsula/Becharof NWR, but most are short and originate and end on the Refuge and are therefore not threatened. The Refuge evaluated only those streams judged to have a threat to water resources. There are valid existing mining claims on a tributary of the King Salmon River that could be actively worked if the price of gold rises. Oil and gas potential on the refuge has been controversial, however the latest assessment rates the Refuge as high potential. There have been about 20 exploratory wells drilled within the Refuge, but no commercial quantities of oil have been found. Transportation corridors impacting Figure Eight Creek and Dog Salmon Creek have been identified in the state/federal Bristol Bay Comprehensive Management Plan. Because the plan has been approved, construction could begin if the price of gold and/or oil rises. Braided Creek, a tributary to the Meshik River, has a real threat from mining. There are 50 lode and placer mining claims in the watershed and the Refuge has issued permits for helicopters to work in the area. Development depends on a rise in the price of gold.

The Alaska Maritime NWR evaluated four streams on Attu and Adak, however no threats were identified for these streams. Many of the islands and mainland tracts comprising the Refuge are sea bird nesting colonies where fresh water development potential is non-existent.

DISCUSSION

This analysis of threats to water resources on the sixteen Alaskan refuges indicates that water quality threats outweigh threats to water quantity. Major water quality threats include impacts from historic, present, and potential placer mining and hard rock mineral extraction, gravel extraction, logging, contaminants from industrial developments, community waste disposal, potential pipeline oil spills, and impacts to rivers from public use associated with fishing, hunting, and recreation. Present and potential impacts to water quantity on the refuges result from hydropower projects, placer mining, oil and gas exploration and development, aquaculture, industrial water supply, and public water supply. Export of fresh water from Southeast and Southcentral Alaska currently being advocated by the State of Alaska is not considered to be a threat to refuge water resources at the present time. However if this potential industry should be successful, the situation could change.

A limitation of this threats analysis stems from the subjectivity involved in a project such as this. Evaluating the criteria required professional

knowledge and judgement on the part of refuge managers and their staff. In addition, much of the information needed to evaluate and rank the criteria is lacking, especially in the area of biological resources.

Subjectivity was also introduced in the weighting of the criteria and the ranking factors. The work group that developed the weights also relied on professional knowledge and judgement. Some judgement was also used in applying the weights to the criteria in the final analysis.

Because of the extensive use of professional judgment in this project, the results of the analysis should be used as a general guide for planning data collection and water right quantification. It is because of this inherent subjectivity that recommendations for the final ranking of the top six refuges were not dependent solely on the final numbers and rankings.

Following are recommendations for consideration in designing criteria for a future water resources threats analysis.

- Gravel extraction - Limit the rating to only those projects that impact rivers or lakes.

- Agricultural irrigation - Define this more clearly to apply to large agricultural projects, rather than household gardens.

- Logging - Define this more clearly to apply to significant size logging operations, and to exclude logging for house logs.

- Headwaters - Distinguish whether upstream headwaters are in protected or conservation lands managed by federal or state agencies or whether they are within private ownership.

- Land exchanges - This question seemed of little value.

- Accessibility for field investigation - Delete this question because the accessibility and complexity of logistics does not bear on the evaluation of threats to water resources.

- Endangered species - Request a list of the species.

- Recreational use - Define this to include sport fishing and hunting where boats are an important means of transportation and access.

In addition, it would be more efficient to provide the refuges with a disk copy of the evaluation form and ask that they complete and return the evaluation on the disk.

CONCLUSION

This water resources threats analysis was a useful project. It provided information to guide hydrologic data collection and water right filings over

the next five years. The results will assist with budgeting and assist in planning and scoping future work. The project greatly increased the Water Resource Branch's knowledge and understanding of refuge water resources, development projects, related on-going or planned studies, and major issues. It has helped initiate closer coordination on planned contaminant studies and emphasized the need to integrate the water quantity and quality data collection and management efforts. Importantly, it has broadened communication between the WRB and the refuge managers and their staff.

In addition to the threats related information, the project also yielded a list of U.S. Geological Survey stream gages and their periods of record that are located on or near the refuges. The project also established coordination with the ADF&G Instream Flow Program to identify ADF&G instream water right applications that have already been filed for river reaches upstream of refuges. Finally, as part of the project, the refuge managers have identified refuge facilities that have off stream and ground water supplies for which the Region should obtain water rights.

Development, land uses, and economics both within and around the refuges will change over time. In addition, information about resources and threats will continue to accumulate. Therefore it is recommended that another water resources threats analysis be conducted in five years. Additionally, it should be noted that the water resource investigation priorities presented in this report may change during the next five years as conditions and management priorities change.

ACKNOWLEDGMENTS

Many staff in Region 7 participated in accomplishing this project. Refuge managers and their staff in each of the Alaskan refuges identified important rivers and evaluated the threats criteria for each of them. Special appreciation is extended to Ed Merritt and Dave Stearns for assisting to develop weights for the criteria. Wayne Crayton, Biomonitoring Coordinator, was especially helpful throughout the project, providing input from the water quality perspective during a number of meetings and reviewing products of the threats analysis. Keith Bayha, Steve Lyons, and John Trawicki in the Water Resources Branch all helped develop the criteria and spreadsheet and helped guide the final analysis. Tony Booth also assisted in developing the threats criteria. Sharon Janis and George Constantino both provided guidance and support throughout the project.

REFERENCES

Alaska Department of Fish and Game, 1984. Instream flow workplan. Alaska Department of Fish and Game, Habitat Division, Anchorage, Alaska.

Bayha, K. 1985. Memorandum to Regional Directorate regarding Region 7 instream flow program. U.S. Fish and Wildlife Service, Anchorage, Alaska.

Bureau of Land Management. 1992. Alaska land distribution. Bureau of Land Managment, Alaska Region, Office of External Affairs, Anchorage, Alaska.

U.S. Fish and Wildlife Service. 1987. National wildlife refuges of Alaska. U.S. Fish and Wildlife Service, Washington, D.C.

U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, U.S. Forest Service. 1990. Alaska submerged lands act report - analysis of inholdings, acquisition priorities and recommendations to reduce impacts on conservation system units in Alaska, Anchorage, Alaska.

U.S. Fish and Wildlife Service. 1993. Fish and Wildlife Service manual, 403 FW 1-3, U.S. Fish and Wildlife Service, Washington, D.C.

Vandegraft, D. 1994. Personal communication. U.S. Fish and Wildlife Service, Region 7, Realty Division, Anchorage, Alaska.

APPENDIX A

Water Resources Threats Analysis
Instructions and Forms

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Rd.
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

TAKE PRIDE IN AMERICA

WRB

MAY 27 1993

Memorandum

To: Refuge Managers

Thru: Associate Manager, Refuges and Wildlife

From: Chief, Water Resources Branch

Subject: Water Resources Threats Analysis

The attached materials relate to the water resources threats analysis to be conducted by the Water Resources Branch to evaluate threats to water quantity and quality on refuge lands in Alaska. It is the policy of the Service to apply for and secure water rights necessary for Service facilities and programs using state laws and administrative procedures. This is a big job that will take years to accomplish and progress will depend on available funding. Region 7 has begun a program to quantify instream flows on refuge lands and to apply for instream water rights with the State of Alaska. Identifying threats to refuge waters and to water-related fish and wildlife habitat and then prioritizing refuges or portions of refuges for hydrologic studies is the first step in the process of applying for instream water rights.

An initial water-related threats analysis was conducted in 1986. That effort resulted in a ranked list of individual streams spread throughout the 16 refuges. In this present analysis, we have built upon the experience of the 1986 evaluation by refining and expanding the criteria. Several of the northern refuge managers have reviewed the criteria and we used an earlier draft to evaluate threats on the Yukon Flats Refuge where hydrologic data collection will begin this summer. Funding and logistical considerations necessitate that we set priorities for field work. This analysis will result in a priority list of refuges or portions of refuges to guide the scheduling of hydrologic investigations and subsequent filing of instream water rights.

The attached materials include instructions, the criteria, an evaluation form, and the list of streams evaluated in 1986. Feel free to add or delete streams that you feel should be evaluated. We are providing this information to you to discuss with your staff and to complete. In addition, please include additional written explanations that are necessary. Mary Lu Harle of my staff will then meet with each refuge manager to discuss the evaluation. This will ensure that one person maintains consistency throughout the evaluation process and the analysis. We will soon be contacting each refuge manager to schedule the meetings between now and July 15. In order to minimize travel costs, we plan to conduct most of the meetings in Anchorage in conjunction with other

Water Resources Threats Analysis
Instructions

The criteria listed below will be used to identify and evaluate threats to water quantity and quality on refuge lands, and to prioritize hydrologic data collection and subsequent filing of instream water rights applications on the refuges.

These instructions and evaluation forms are being transmitted to refuge managers to allow you to review the criteria, to identify the streams and their watersheds which should be evaluated in this analysis, and to complete the evaluation forms and supporting back-up information. Staff from the Water Resources Branch will then meet with each refuge manager to discuss the evaluation, and work with the Associate Manager to prioritize the work to be done. After the evaluations have been completed and analyzed, the results of the water resources threats analysis will be reported to all refuge managers.

Please apply the following criteria using existing documentation, such as federal, state, or local planning documents and reports, industry reports or permits, and the professional judgement of the refuge manager and refuge staff. The following definitions apply.

"Watershed" refers to both refuge lands and inholdings within a stream's drainage area, as well as non-refuge lands upstream of refuge boundaries.

"Present" activities include those that are presently under construction, developed, and/or operating.

"Planned" activities include those that are in the active planning stage as documented by a planning document, report, permit, or other written documentation.

"Potential" activities include those activities that are being discussed by someone who has the legal or fiscal ability to undertake the project, but for which there are no solid plans.

Activities "upstream of the watershed" are those that are within a reasonable distance, close enough to impact the refuge, as determined by the professional judgement of the refuge manager.

When completed, the evaluation form and additional pertinent comments should be approved and signed by the refuge manager.

Using the following criteria, evaluate the threats for each stream or watershed. Where more than one rank applies to a watershed, enter the highest value. Enter the appropriate letter listed below on the attached form:

H - High
M - Medium
L - Low
0 - None

Y - Yes
N - No

In addition, please explain any additional comments that might be relevant to this evaluation on a separate page.

THREATS CRITERIA

Threats to Refuge Water Quantity/Quality

Hydropower/dams

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	none present or known to be planned or potentially developed in watershed or upstream of watershed

Placer mining

High	present (active) within watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	none present or known to be planned or potentially developed in or upstream of watershed

Hard rock mineral extraction

High	present (active) within watershed and/or upstream or watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	none present or known to be planned or potentially developed in or upstream of watershed

Oil/gas exploration

High	has occurred in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential exploration in watershed or upstream of watershed
None	none has occurred or is known to be planned or to potentially occur in or upstream of watershed

Oil/gas development

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	no development has occurred or known to be planned or potentially developed in or upstream of watershed

Gravel extraction

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential extraction in watershed or upstream of watershed
None	none present or known to be planned or potentially planned in or upstream of watershed

Agriculture irrigation diversions or returns

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential irrigation in watershed or upstream of watershed
None	none present or known to be planned or potentially planned in or upstream of watershed

Logging

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential logging in watershed or upstream of watershed
None	none present or known to be planned or potentially planned in or upstream of watershed

Aquaculture (freshwater, marine, or both and including instream and out-of-stream projects)

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	none present or known to be planned or potentially planned in or upstream of watershed

Public water supply water withdrawal or return

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	none present or known to be planned or potentially planned in or upstream of watershed

Industrial water supply or returns (including refineries, fish processing plants, pulp mills, etc.)

High	present in watershed and/or upstream of watershed
Med	planned in watershed and/or upstream of watershed
Low	potential development in watershed or upstream of watershed
None	none present or known to be planned or potentially planned in or upstream of watershed

Community Sewage and/or Waste Disposal

- High — present in watershed and/or upstream of watershed in sufficient quantity to produce known problem(s)
- Med — planned in watershed and/or upstream of watershed
- Low — potential development in watershed or upstream of watershed
- None — none present or known to be planned or potentially planned in or upstream of watershed

Transportation System Impacts

- High — roads, pipelines, and/or ice roads present in watershed or upstream of watershed
- Med — roads, pipelines, and/or ice roads planned in watershed or upstream of watershed
- Low — potential development of ice roads, roads, or pipelines in watershed or upstream of watershed
- None — no ice roads, roads, or pipelines known to be planned or potentially planned in or upstream of watershed

Please list major water users whose downstream water diversions or senior water rights might affect stream flows on the refuge. In addition, list separately any other special water quality or quantity concerns related to development threats to watersheds in the refuge, such as present, planned, or potential flood control projects, community expansion, recreational facilities or development projects not listed above.

Management Considerations

Headwaters of this watershed originate upstream of refuge boundary?

- Yes
- No

National Wild and Scenic Rivers designation within this watershed?

- Yes
- No

Waterbodies flow through private inholdings in this watershed?

- Yes
- No

Portion of this watershed involved in pending land exchange?

- High — presently involved in land exchange
- Med — planned for land exchange
- Low — potential for land exchange
- None — no lands known that are planned or have potential for land exchanges

Existing stream gage data (Note: this question will be completed by the Water Resources Branch)

High 10 or more years of stream gage data available in watershed
Med 5 to 9 years of stream gage data available in watershed
Low 1 to 4 years of stream gage data available in watershed
None no known stream gage data available

Accessibility for field investigation

High Year around road access to points within watershed
Med Seasonal road access to points within watershed
Low Easily accessible via boat, fixed wing aircraft, helicopter
None Accessibility is limited, logistics difficult

List separately other special concerns related to land and water management, hydrologic and biologic data collection, or logistic concerns.

Resource Values - biological diversity and habitat values

Endangered/threatened species (aquatic oriented species listed under the Endangered Species Act)

High endangered species in or near development area known in watershed
Med endangered species threatened by planned or potential development in watershed
Low threatened species known in watershed
None no endangered or threatened species known in watershed

Anadromous fish (includes the five species of Pacific salmon, hooligan, arctic char, steelhead)

Are anadromous fish known to use habitat in the watershed during any of the following life stages: migration, spawning, rearing, and overwintering?

High high value spawning, rearing, and/or overwintering habitat
Med low value spawning, rearing, and/or overwintering habitat
Low passage only
None no species known to use the watershed

Resident Fish (includes the following species: arctic grayling, northern pike, sheefish, burbot, Dolly Varden, char, whitefish, cisco)

Are any of these resident fish known to use streams in the watershed during any part of their life stage?

Yes
No

Waterfowl

Are waterfowl known to use the watershed for migration/staging habitat?

High world class migration/staging habitat
Med good migration/staging habitat
Low marginal migration/staging habitat
None no migration/staging habitat

Are waterfowl known to use the watershed for nesting habitat?

High world class nesting habitat
Med good nesting habitat
Low marginal nesting habitat
None no nesting habitat

Are waterfowl know to use the watershed for overwintering habitat?

High world class overwintering habitat
Med good overwintering habitat
Low marginal overwintering habitat
None no overwintering habitat

Shorebirds and Raptors

Are shorebirds or raptors known to use the watershed for migration/staging habitat?

High world class migration/staging habitat
Med good migration/staging habitat
Low marginal migration/staging habitat
None no migration/staging habitat

Are shorebirds or raptors known to use the watershed for nesting habitat?

High world class nesting habitat
Med good nesting habitat
Low marginal nesting habitat
None no nesting habitat

Are shorebirds or raptors known to use the watershed for overwintering habitat?

High world class overwintering habitat
Med good overwintering habitat
Low marginal overwintering habitat
None no overwintering habitat

List separately any special habitat concerns that are related to water quality or quantity.

Public Use

Are there significant documented river reaches or lakes that are used for traditional subsistence fishing within this watershed?

Yes
No

Are there specific documented river reaches or lakes that are historically used for commercial fishing within this watershed?

Yes
No

Are there significant documented river reaches or lakes that are heavily used for sport fishing within this watershed?

Yes
No

Are there significant river reaches or lakes that are heavily used for recreational use, such as rafting or boating, within this watershed?

Yes
No

List separately any special public use issues that relate to water quality or quantity.

Finally, please include any other comments the Water Resources Branch should consider in selecting refuges or portions of refuges for hydrologic investigation.

WATER RESOURCES THREATS EVALUATION

REFUGE _____ DATE _____

REFUGE MANAGER SIGNATURE _____

CRITERIA / THREATS	STREAM/WATERSHED NAME													
Hydropower/dams (H,M,L,0)														
Placer mining (H,M,L,0)														
Hard rock mineral extraction (H,M,L,0)														
Oil/gas exploration (H,M,L,0)														
Oil/gas development (H,M,L,0)														
Gravel extraction (H,M,L,0)														
Agriculture irrigation (H,M,L,0)														
Logging (H,M,L,0)														
Aquaculture (H,M,L,0)														
Public water supply withdrawal (H,M,L,0)														
Industrial water supply (H,M,L,0)														
Community waste disposal (H,M,L,0)														
Transportation system impacts (H,M,L,0)														

MANAGEMENT CONSIDERATIONS														
Headwaters upstream of refuge (Y,N)														
Wild & Scenic River (Y,N)														
Inholdings (Y,N)														
Land exchange (H,M,L,0)														
Stream gages (H,M,L,0)														
Accessibility (H,M,L,0)														
RESOURCE VALUES														
Endangered/threatened species (H,M,L,0)														
Anadromous fish (H,M,L,0)														
Resident fish (Y,N)														
Waterfowl														
Migration/staging (H,M,L,0)														
Nesting (H,M,L,0)														
Overwintering (H,M,L,0)														
Shorebirds/Raptors														
Migration/staging (H,M,L,0)														
Nesting (H,M,L,0)														

Overwintering (H,M,L,0)															
PUBLIC USE															
Subsistence fishing (Y,N)															
Commercial fishing (Y,N)															
Sport fishing (Y,N)															
Recreation use (Y,N)															

STREAM IDENTIFICATION NUMERS 12-AUG-85 7:56:38 Page 1

ID #	STREAM NAME	REFUGE
1	Turner River	Arctic
2	Putugook Creek	Arctic
3	Clarence River	Arctic
4	Malcolm River	Arctic
5	Firth River	Arctic
6	Joe Creek	Arctic
7	Porcupine River	Arctic
8	Old Crow River	Arctic
9	Chandalar Creek	Arctic
10	Sheenjek River	Arctic
11	Christian River	Arctic
12	E. Fork Chandalar River	Arctic
13	Nth. Fk. E. Fk. Chandalar	Arctic
14	Mid. Fk. Chandalar River	Arctic
15	Sagavanirktok River	Arctic
16	Ivisak River	Arctic
17	Saviukvikpak River	Arctic
18	Small Saviukvikpak River	Arctic
19	Ivishak River	Arctic
20	Echooka River	Arctic
21	Shaviovik River	Arctic
22	Juniper Creek	Arctic
23	Kavik River	Arctic
24	Pogopuk Creek	Arctic
25	Canning River	Arctic
26	Tamayariak River	Arctic
27	Unnamed Creek # 1	Arctic
28	Katakturuk River	Arctic
29	Marsh Creek	Arctic
30	Carter Creek	Arctic
31	Sadlerochit River	Arctic
32	Kajutakrok Creek	Arctic
33	Natroarok Creek	Arctic
34	Hulahula River	Arctic
35	Okpilak River	Arctic
36	Jago River	Arctic
37	Niguanak River	Arctic
38	Kimikpaurauk River	Arctic
39	Siksik River	Arctic
40	Sikutakuvik River	Arctic
41	Angun River	Arctic
42	Kogotpak River	Arctic
43	Aichilik River	Arctic
44	Egaksrak River	Arctic
45	Kalokut River	Arctic
46	Kongakut River	Arctic
47	Yukon River	Yukon
48	Kuskokwim River	Yukon
49	Eek River	Yukon
50	Kwethluk River	Yukon
51	Kisaralik River	Yukon
52	Kasigluk River	Yukon
53	Fog River	Yukon
54	Tuluksak River	Yukon
55	Aniak River	Yukon
56	Gweek River	Yukon
57	Pikmiktalik(Johnson R) R.	Yukon
58	Johnson River	Yukon
59	Tagayarak River	Yukon
60	Iskowik River	Yukon

ID #	STREAM NAME	REFUGE
61	Kinak River	Yukon
62	Kolovinerak River	Yukon
63	Ninglick River	Yukon
64	Azun River	Yukon
65	Anerkocnik River	Yukon
66	Manokinak River	Yukon
67	Kashunuk River	Yukon
68	Kokechik River	Yukon
69	Black River	Yukon
70	Pastoliak River	Yukon
71	Pastolik River	Yukon
72	Pikmiktalik (BB) River	Yukon
73	Kogok River	Yukon
74	Anreafsky River	Yukon
75	Atchuelinguk River	Yukon
76	Kukukutuk River	Yukon
77	Talbiksok River	Yukon
78	Reindeer River	Yukon
79	Big River	Yukon
80	Eenauarak River	Yukon
81	Bogus River	Yukon
82	Discovery River	Yukon
83	Swift River	Yukon
84	Kialik River	Yukon
85	Kuguklik River	Yukon
86	Kinia River	Yukon
87	Toksook River	Yukon
88	Aphrewn River	Yukon
89	Keoklivik River	Yukon
90	Ninglikfak River	Yukon
91	Lithkealik River	Yukon
92	Kun River	Yukon
93	Kiviak River	Yukon
94	Nunavulnuk River	Yukon
95	Archuelinguk River	Yukon
96	Innoko River	Innoko
97	Iditarod River	Innoko
98	Dishna River	Innoko
99	Mud River	Innoko
100	Little Mud River	Innoko
101	N.Fk. Innoko River	Innoko
102	Magitchlie Creek	Innoko
103	Hather Creek	Innoko
104	Khotol Creek	Innoko
105	Tolstoi Creek	Innoko
106	Mastodon Creek	Innoko
107	Madison Creek	Innoko
108	Folger Creek	Innoko
109	Yetna River	Innoko
110	Netletna Creek	Innoko
111	Hammer Creek	Innoko
112	Wapoo Creek	Innoko
113	Papa Willie Creek	Innoko
114	Finland Creek	Innoko
115	Scandianavian Creek	Innoko
116	Galatea Creek	Innoko
117	Shovel Creek	Innoko
118	Sucker Creek	Innoko
119	Yukon River	Innoko
120	Yukon River	Yukon Flats

.D #	STREAM NAME	REFUGE
121	Hodzana River	Yukon Flats
122	Hadweenzic River	Yukon Flats
123	Beaver Creek	Yukon Flats
124	Birch Creek	Yukon Flats
125	Preacher Creek	Yukon Flats
126	Chandalar River	Yukon Flats
127	Porcupine River	Yukon Flats
128	Sheenjek River	Yukon Flats
129	Black River	Yukon Flats
130	Little Black River	Yukon Flats
131	Dall River	Yukon Flats
132	Christian River	Yukon Flats
133	Alfred Creek	Yukon Flats
134	Lost Creek	Yukon Flats
135	Rodgers Creek	Yukon Flats
136	Jefferson Creek	Yukon Flats
137	Discovery Creek	Yukon Flats
138	Big Creek	Yukon Flats
139	Chandalar Creek	Yukon Flats
140	Grass River	Yukon Flats
141	Sucker River	Yukon Flats
142	Frosty Creek	Izembek
143	Russell Creek	Izembek
144	Joshua Green River	Izembek
145	Trout Creek	Izembek
146	South End Creek	Izembek
147	Moffett Creek	Izembek
148	Canoe Bay River	Izembek
149	Cathedral River	Izembek
150	Lamprey Creek	Izembek
151	Moffett Springs	Izembek
152	Settlement Point Creek	Izembek
153	Mino Creek	Izembek
154	Urilia Bay River	Izembek
155	R.bet.Swanson Lag&Ottr.Pt	Izembek
156	Thin Point River	Izembek
157	Cape Lapin River	Izembek
158	Swanson River	Izembek
159	Lazeref River	Izembek
160	Ikatan River	Izembek
161	Gardiner Creek	Tetlin
162	Mirror Creek	Tetlin
163	Scottie Creek	Tetlin
164	Desper Creek	Tetlin
165	Nabesna River	Tetlin
166	Chisana River	Tetlin
167	Stuver Creek	Tetlin
168	Lick Creek	Tetlin
169	Beaver Creek	Tetlin
170	Bitters Creek	Tetlin
171	Cheslina River	Tetlin
172	Beaver Creek 2	Tetlin
173	Snag Creek	Tetlin
174	No Name Creek	Tetlin
175	Ellis Creek	Tetlin
176	Alder Creek	Tetlin
177	Moose Creek	Tetlin
178	Kalutna River	Tetlin
179	Ayakulik River	Kodiak
180	Sturgon River	Kodiak

ID #	STREAM NAME	REFUGE
181	Uganik River	Kodiak
182	Karluk River	Kodiak
183	Dog Salmon River	Kodiak
184	Deadman River	Kodiak
185	Zacher River	Kodiak
186	Upper Station River	Kodiak
187	Little River	Kodiak
188	Barling River	Kodiak
189	Spiridon River	Kodiak
190	Uyak River	Kodiak
191	Akalura River	Kodiak
192	Browns River	Kodiak
193	Humpy River	Kodiak
194	Midway River	Kodiak
195	Terror River	Kodiak
196	Toolik river	North Slope
197	Kuparuk River	North Slope
198	Colville River	North Slope
199	Kadlerosnilik River	North Slope
200	Itisillik River	North Slope
201	Chipp River	North Slope
202	Ikpikpuk River	North Slope
203	Utukok River	North Slope
204	Anakturuk River	North Slope
205	Killik River	North Slope
206	Wulik River	North Slope
207	Kivalina River	North Slope
208	Fish Creek	North Slope
209	Meade River	North Slope
210	Miluveach River	North Slope
211	Inaru River	North Slope
212	Kanektok River	Togiak
213	Goodnews River	Togiak
214	Togiak River	Togiak
215	Arolik River	Togiak
216	Kulukak River	Togiak
217	Kanik River	Togiak
218	Ungalikthluk River	Togiak
219	Matogak River	Togiak
220	Osviak River	Togiak
221	Slug River	Togiak
222	Kinegnak River	Togiak
223	Weary River	Togiak
224	Snake River	Togiak
225	Slikok River	South C-RB
226	Fritz Creek	South C-RB
227	Peters Creek	South C-RB
228	Campbell Creek	South C-RB
229	Rabbit Creek	South C-RB
230	Ship Creek	South C-RB
231	Grant Creek	South C-RB
232	Spring Creek	South C-RB
233	Lone Creek	South C-RB
234	Esker Creek	South C-RB
235	Beaver Creek	South C-RB
236	Duck River	South C-RB
237	Cottonwood Creek	South C-RB
238	Kenai River	Kenai
239	Swanson River	Kenai
240	Fox River	Kenai

ID #	STREAM NAME	REFUGE
241	Funny River	Kenai
242	Killey River	Kenai
243	Beaver Creek	Kenai
244	Kasilof River	Kenai
245	Chickaloon River	Kenai
246	Moose River	Kenai
247	Russian River	Kenai
248	Koyukuk River	Kanuti
249	South Fork Koyukuk River	Kanuti
250	Fish Creek	Kanuti
251	Kanuti-Chalatna Creek	Kanuti
252	Kanuti River	Kanuti
253	*Kanuti-Kilolitna River	Kanuti
254	Holonada Creek	Kanuti
255	Henshaw Creek	Kanuti
256	Hall Island River	Ak.Maritime
257	Cabin Cove Creek	Ak.Maritime
258	Constatine Harbor Creek	Ak.Maritime
259	Swager Creek	Ak.Maritime
260	Massacre Bay	Ak.Maritime
261	Base Creek	Ak.Maritime
262	Village Creek	Ak.Maritime
263	Happy Valley Creek	Ak.Maritime
264	Gertrude Creek	Becharof-AkP
265	Dog Salmon River	Becharof-AkP
266	Figure Eight Creek	Becharof-AkP
267	Meshik River	Becharof-AkP
268	Braided Creek	Becharof-AkP
269	Yukon River	Nowitna
270	Nowitna River	Nowitna
271	Monzonita River	Nowitna
272	Sulatna River	Nowitna
273	Titna River	Nowitna
274	Little Mud River	Nowitna
275	Big Mud River	Nowitna
276	Lost Creek	Nowitna
277	Grand Creek	Nowitna
278	Blind Creek	Nowitna
279	Klatsuta River	Nowitna
280	Bering Creek	Nowitna
281	Junckaket Creek	Nowitna
282	Koyukuk River	Koyukuk
283	Hogatza River	Koyukuk
284	Camp Creek	Koyukuk
285	Billy Hawk Creek	Koyukuk
286	Kateel River	Koyukuk
287	Gisasa River	Koyukuk
288		Koyukuk
289	Selawik River	Selawik
290	Kobuk Delta River?	Selawik
291	Cascade Creek	S.E. Ak-MH
292	Stikine River	S.E. Ak-MH
293	Greens Creek	SE Ak-WH

APPENDIX B

Meeting Summary
Assigning Weights to Threats Analysis Criteria

Water Resources Threats Analysis
Meeting Summary
Assigning Weights to the Threats Analysis Criteria

A meeting was held on August 9, 1993 to assign weights to the water resources threats analysis criteria. The following staff participated in the meeting: Keith Bayha, Wayne Crayton, Mary Lu Harle, Steve Lyons, Ed Merritt, and Dave Stearns.

Discussion first focused on the relative importance of the four general categories, which are threats, management considerations, resource values, and public use. It was agreed that threats and resource values are the most important criteria, followed by management considerations, then public use. Overall, it was agreed that the threats criteria should drive the analysis.

The following is a summary of the weights assigned to the criteria.

THREATS CRITERIA - Characteristics that are important to the threats criteria ranking include the magnitude of projects, the impacts resulting from projects, and the persistence of the impacts. To address the magnitude of projects, it was agreed that the high rank should be a range, and that Mary Lu would assign the final points based on notes from and discussions with refuge managers.

The highest possible points for criteria in this category was agreed to be 10 points. Criteria that were judged to be of lesser threat were assigned fewer points. Total possible points for this category is 93.

Hydropower/dams - These types of projects are generally large non-consumptive water users, and can have significant long term impacts to upstream and downstream resources. The team agree that the highest possible points for this criteria should be 10 points.
High = 8-10 Med = 6 Low = 3

Placer mining - The team discussed the significant impacts that can result from placer mining, including sediment from improperly designed and maintained settling ponds. Also noted were the long term nature of these impacts and the large non-consumptive use of water. The team agreed that the highest possible points for this criteria should be 10 points.
High = 8-10 Med = 6 Low = 3

Hard rock mineral extraction - The team generally agreed that the impacts from hard rock mining are less than those from placer mining. The team agreed that the highest possible points for this criteria should be 8 points.
High = 6-8 Med = 4 Low = 2

Oil/gas exploration - The team agreed that water use for oil and gas exploration is generally less than for the development phase. The team agreed that the highest possible points for this criteria should be 5 points.
High = 4-5 Med = 3 Low = 1

Oil/gas development - Discussion focused on the water requirements for oil and gas development, such as water for drilling mud, fire fighting, and secondary

recovery techniques. The team agreed that the highest possible points for this criteria should be 10 points.
High = 8-10 Med = 6 Low = 3

Gravel extraction - Discussion focused on the fact that there is no water use involved with gravel extraction, that gravel is naturally replenished, and that the effects of gravel mining along rivers are generally modified by natural processes. The team agreed that the highest possible points for this criteria should be 3 points.
High = 3 Med = 2 Low = 1

Agricultural irrigation - It was acknowledged in the discussion that there is little agricultural irrigation within or near Alaskan refuges, however it was agreed that irrigation is a large consumptive water use, and can contributed pesticides and herbicides to water bodies. The team agreed that the highest possible points for this criteria should be 10 points.
High = 8-10 Med = 6 Low = 3

Logging - The team agreed that this criteria should apply to commercial logging rather than to harvesting of house logs. The refuge managers on the team pointed out that only 60 to 80 logs are usually harvested for house logs. The team agreed that harvesting of house logs would not be considered a threat. The team noted that logging does not involve direct water use, but the impacts can be significant to water resources, including impacts from roads, clear cutting, logging techniques, and effects on riparian zones. State forest practices act regulations do help regulate these impacts. The team agree that highest possible points for this criteria should be 8 points.
High = 6-8 Med = 4 Low = 2

Aquaculture - This is generally a non-consumptive water user. It was agree that high for this criteria should be 5 points.
High = 4-5 Med = 3 Low = 1

Public water supply - Most public water supply systems in the refuges are for villages that use small amounts of surface and/or ground water. For this reason, it was agreed that the highest possible points for this criteria should be 3 points.
High = 3 Med = 2 Low = 1

Industrial water supply - These developments generally are large water users and have the potential for water contamination. It was agreed that the highest possible points for this criteria should be 8 points.
High = 6-8 Med = 4 Low = 2

Community waste disposal - Villages within the refuges have significant problems with community waste disposal and significant water-related public health problems. The villages however are small. It was agree that the highest possible points for this criteria should be 5 points.
High = 4-5 Med = 3 Low = 1

Transportation system impacts - These impacts include human impacts from roads on or adjacent to refuges, bridges and culverts, pipelines and associated

stream crossings, potential pipeline spills, and winter ice roads. It was agreed that the highest possible points for this criteria should be 8 points.
High = 6-8 Med = 4 Low = 2

MANAGEMENT CONSIDERATIONS - The team agreed that the highest value assigned to criteria in this category would be 10 points. Criteria judged to have lessor importance were assigned fewer points. The team agreed to drop the accessibility criteria from the analysis, due to the fact that data collection on a high priority stream should not be influenced by the costs associated with its accessibility. Total possible points for this category is 45 points.

Headwaters upstream of refuge - This criteria was judged to be very important because the Region is limited in its ability to manage impacts on the headwaters of streams that are off refuges. The team agreed that a yes response should be weighted 10 points.
Yes = 10 No = 0

Wild and Scenic rivers - Rivers that have been designated as Wild and Scenic have added protection mandates and added resource values. The team agreed that a designated wild and scenic river should be weighted 10 points.
Yes = 10 No = 0

Inholdings - This criteria was judged to be very important because of the potential for development on inholdings and because the Region is limited in its ability to manage development and associated impacts on inholdings. The team agreed that a yes response should be weighted 10 points.
Yes = 10 No = 0

Land exchanges - After discussion, it was agreed that if required, any detailed water rights investigations for land exchanges would be handled as special investigations. However this is an important management consideration. The team agree that a positive response should be weighted 5 points.
Yes = 5 No = 0

Stream gages - The team agreed that existing stream gage data reduced the need to collect new data. It was agreed that 0 response would be 10 points, with one point deducted for each year of stream gage data.

RESOURCE VALUES - The team members agreed that because the waterfowl and shorebirds/raptors criteria each have three sub-criteria, the total for the waterfowl and shorebirds/raptors criteria should each equal a maximum of 10 points. Total possible points for the resource values category are 43 points.

Endangered/threatened species - The Region has legal mandates to protect endangered and threatened species and their habitat. The team agreed that the highest possible points for this criteria should be 10 points.
High = 10 Med = 7 Low = 3

Anadromous fish - Management of anadromous fish is required by legal mandates and international treaties. The team agreed that the highest possible points for this criteria should be 10 points.
High = 10 Med = 7 Low = 3

Resident fish - The team recognized that resident fish are important for subsistence fishing. The team agreed that a yes response for this criteria should be weighted 8 points.
Yes = 8 No = 0

Waterfowl migration/staging - The team agreed that the highest possible points for this sub-criteria should be 4 points.
High = 4 Med = 3 Low = 1

Waterfowl nesting - The team agree that the highest possible points for this sub-criteria should be 4 points.
High = 4 Med = 3 Low = 1

Waterfowl overwintering - Overwintering is generally associated with estuarine waters rather than fresh water. The team agree that the highest possible points for this sub-criteria should be 2 points.
High = 2 Med = 1 Low = 0

Shorebird/raptor migration/staging - The team agreed that the highest possible points for this sub-criteria should be 4 points.
High = 4 Med = 3 Low = 1

Shorebird/raptor nesting - The team agreed that the highest possible points for this sub-criteria should be 4 points.
High = 4 Med = 3 Low = 1

Shorebird/raptor overwintering - The team agreed that the highest possible points for this sub-criteria should be 2 points.
High = 2 Med = 1 Low = 0

PUBLIC USE - During its discussion, the team agreed that this category is the least important of the four categories evaluated in the water resources threats analysis. The team agreed that the total possible points for this category should be 8 points.

Subsistence fishing - Because managing for subsistence fishing is a purpose of ANILCA, the team agreed that a yes response for this criteria would be weighted 3 points.
Yes = 3 No = 0

Commercial fishing - This activity is not generally allowed in the refuges, however it may be permitted by the state on rivers adjacent to refuges or on navigable waters within refuges. The team agreed that a yes response would be weighted 1 point.
Yes = 1 No = 0

Sport fishing - This is an important activity on refuges. The team agreed that a yes response be weighted 2 points.
Yes = 2 No = 0

Recreation use - This criteria generally includes boating for hunting and recreational canoeing or floating. The team agree that a yes response would be weighted 2 points.
Yes = 2 No = 0

During the discussion, the team agreed that this analysis should be driven by threats, however resource values are also of major importance. The total points assigned to each of the four categories reflects this general theme. In order to ensure that the threats and resource values criteria are given the highest priority in the analysis, the team agreed that the following equation would be used to determine the final score for each of the streams:

> FINAL SCORE = (total threats score + total resource value score) x 2 + total management consideration score + total public use score

It was further agreed that a trial would be conducted using five rivers from each refuge to determine if the weights and the equation yield useful results. The results of the trial will be provided to the team members to evaluate and a decision will then be made on whether to complete the analysis using this system, or to make adjustments.

During the meeting, the team also identified the following as potential criteria for an updated water resources threats analysis that might be conducted sometime in the future: hazardous waste sites, wilderness designation, title navigability determination, and presence of senior upstream water rights. It may be desirable in the future to include lakes in the threats analysis, and to address the magnitude, impacts, and persistence of threat criteria more clearly.

APPENDIX C

Summary of Total Weighted Criteria

1993 WATER RESOURCES THREATS ANALYSIS

REFUGE	WATERSHED NAME	SUBTOTAL THREATS	SUBTOTAL MGT CON	SUBTOTAL RES VALUE	SUBTOTAL PUB USE	GRAND TOTAL
AP	MESHIK RIVER	32	31	60	2	125
AP	BRAIDED CREEK	32	20	56	2	110
AP	DOG SALMON RIVER	12	21	64	2	99
AP	FIGURE EIGHT CREEK	12	10	46	2	70
ARC	CANNING RIVER	16	11	60	2	89
ARC	HULAHULA RIVER	16	21	44	7	88
ARC	PROCUPINE RIVER	10	27	40	5	82
ARC	KONGAKUT RIVER	16	10	52	4	82
ARC	AICHILIK RIVER	16	11	50	0	77
ARC	EGAKSRAK RIVER	16	10	50	0	76
ARC	STAINES RIVER	16	21	38	0	75
ARC	OKPILAK RIVER	16	21	38	0	75
ARC	JAGO RIVER	16	21	34	0	71
ARC	SHEENJEK RIVER	10	20	38	2	70
ARC	SALMON TROUT RIVER	10	30	28	0	68
ARC	LUPINE RIVER	10	20	36	0	66
ARC	RIBDON RIVER	10	20	36	0	66
ARC	SADLEROCHIT RIVER	16	6	42	2	66
ARC	KAJUTAKROK CREEK	16	11	38	0	65
ARC	KATAKTURUK RIVER	16	11	38	0	65
ARC	E.F. CHANDALAR RIVER	10	10	42	3	65
ARC	IVISHAK RIVER	10	20	34	0	64
ARC	KAVIK RIVER	10	20	34	0	64
ARC	FIRTH RIVER	10	10	44	0	64
ARC	KONESS RIVER	10	30	22	0	62
ARC	NIGUANAK RIVER	16	16	28	0	60
ARC	WIND RIVER	10	20	30	0	60
ARC	CLARENCE RIVER	16	20	22	0	58
ARC	OKEROKIUIK RIVER	10	11	36	0	57
ARC	JUNIPER CREEK	10	20	26	0	56
ARC	SHAVIOUIK RIVER	10	20	26	0	56
ARC	SAGAVANIRKTOK RIVER	10	10	36	0	56
ARC	ECHOOKA RIVER	10	10	36	0	56
ARC	SAVIUKVIAYAK RIVER	10	10	36	0	56
ARC	SMOKE CREEK	10	20	24	0	54
ARC	N.F.,E.F. CHANDALAR RIVER	10	20	24	0	54
ARC	CHRISTIAN RIVER	10	20	22	0	52
ARC	POGOPUK CREEK	10	20	20	0	50
ARC	JUNJIK RIVER	10	10	30	0	50
ARC	MARSH CREEK	16	11	22	0	49
ARC	UNNAMED CREEK #1	16	11	20	0	47
ARC	TAMAYARIAK RIVER	16	6	24	0	46
ARC	LAKE CREEK	10	10	24	0	44
ARC	JOE CREEK	10	10	24	0	44
ARC	OLD WOMAN CREEK	10	10	24	0	44
ARC	MID. F. CHANDALAR RIVER	10	10	24	0	44
ARC	COLEEN RIVER	10	10	24	0	44
ARC	OLD CROW RIVER	10	10	24	0	44
ARC	BOULDER CREEK	10	10	22	0	42
ARC	PASS CREEK	10	10	22	0	42
ARC	CROW NEST CREEK	10	10	22	0	42
ARC	OTTERTAIL CREEK	10	10	22	0	42
ARC	FISH CREEK	10	10	22	0	42
ARC	EAST FORK	10	10	22	0	42
ARC	RAPID RIVER	10	10	22	0	42
ARC	MONUMENT CREEK	10	10	22	0	42
ARC	ESKIMO CREEK	10	10	22	0	42
ARC	CAMPBELL RIVER	10	10	22	0	42
ARC	SIKSIK RIVER	16	11	12	0	39
ARC	KIMIKPAURAUK RIVER	16	11	12	0	39
ARC	ANGUN RIVER	16	11	12	0	39
ARC	KOGOTPAK RIVER	16	11	12	0	39
ARC	TURNER RIVER	16	10	12	0	38
ARC	CARTER CREEK	16	11	8	0	35
ARC	NATROAROK CREEK	16	11	8	0	35
ARC	PUTGOOK CREEK	16	10	8	0	34
ARC	KALOKUT RIVER	16	10	8	0	34
ARC	KALOKUT RIVER	16	10	8	0	34

1993 WATER RESOURCES THREATS ANALYSIS

REFUGE	WATERSHED NAME	SUBTOTAL THREATS	SUBTOTAL MGT CON	SUBTOTAL RES VALUE	SUBTOTAL PUB USE	GRAND TOTAL
AM	PEACEFUL R., ATTU	0	10	46	2	58
AM	FINGER BAY STREAM, ADAK	0	10	38	2	50
AM	NAVFAC CREEK, ADAK	0	10	38	2	50
AM	AIRPORT CREEK, ADAK	0	10	32	2	44
NOW	SULATNA RIVER	44	30	48	7	129
NOW	NOWITNA RIVER	4	40	56	7	107
NOW	TITNA RIVER	28	20	48	7	103
NOW	YUKON RIVER	12	20	52	8	92
NOW	SULUKNA RIVER	0	20	48	7	75
NOW	BIG MUD RIVER	0	20	48	7	75
NOW	OUR CREEK	0	20	48	0	68
NOW	LOST CREEK	0	20	48	0	68
NOW	GRAND CREEK	0	10	48	7	65
NOW	LITTLE MUD RIVER	0	20	34	7	61
NOW	SUSLATNA RIVER	0	20	34	0	54
NOW	BLIND CREEK	0	20	28	0	48
NOW	MONZONITA RIVER	0	20	28	0	48
NOW	SETHKOKNA RIVER	0	20	28	0	48
NOW	BERING CREEK	0	10	28	3	41
NOW	MASTODON CREEK	0	10	28	0	38
NOW	KLATSUTA CREEK	0	10	28	0	38
TET	NABESNA RIVER	40	31	44	3	118
TET	GARDINER CREEK	44	31	34	3	112
TET	CHISANA RIVER	40	21	44	3	108
TET	SCOTTIE CREEK	36	31	36	3	106
TET	MOOSE CREEK	20	31	42	3	96
TET	DESPAR CREEK	22	31	36	3	92
TET	MIRROR CREEK	26	31	34	0	91
TET	BITTERS CREEK	36	31	16	0	83
TET	BEAVER CREEK	30	31	16	3	80
TET	KALUTNA RIVER	4	23	42	0	69
TET	STUVER CREEK	10	20	34	0	64
TET	SNAG CREEK	26	20	16	0	62
TET	BEAVER CREEK 2	14	31	16	0	61
TET	CHESLINA RIVER	6	21	22	0	49
TET	LICK CREEK	10	20	0	0	30
TET	ALDER CREEK	6	20	0	0	26
TET	ELLIS CREEK	6	20	0	0	26
TET	NO NAME CREEK	6	20	0	0	26
YF	YUKON RIVER	58	20	68	8	154
YF	BLACK RIVER	28	30	68	7	133
YF	BEAVER CREEK	32	40	48	7	127
YF	PORCUPINE RIVER	28	20	68	7	123
YF	BIRCH CREEK	58	30	28	7	123
YF	CHANDALAR RIVER	12	20	58	4	94
YF	DALL RIVER	0	30	60	4	94
YF	HODZANA RIVER	0	20	58	4	82
YF	LITTLE BLACK RIVER	0	30	44	2	76
YF	SHEENJEK RIVER	0	20	48	4	72
YF	CHRISTIAN RIVER	0	30	40	0	70
YF	PREACHER CREEK	16	20	20	4	60
YF	BIG CREEK	16	30	8	0	54
YF	HADWEENZIC RIVER	0	20	28	4	52
YF	DISCOVERY CREEK	16	20	12	0	48
YF	GRASS RIVER	0	20	12	2	34
YF	SUCKER RIVER	0	20	12	2	34
YF	LOST CREEK	0	20	8	2	30
YF	JEFFERSON CHREEK	0	20	8	0	28
YF	RODGERS CREEK	0	20	4	0	24
YF	CHANDALAR CREEK	6	10	8	0	24
YF	ALFRED CREEK	0	20	0	0	20

1993 WATER RESOURCES THREATS ANALYSIS

REFUGE	WATERSHED NAME	SUBTOTAL THREATS	SUBTOTAL MGT CON	SUBTOTAL RES VALUE	SUBTOTAL PUB USE	GRAND TOTAL
BEC	KING SALMON RIVER	20	20	48	5	93
BEC	GERTRUDE CREEK	8	20	44	2	74
INN	INNOKO RIVER	46	31	68	8	153
INN	YUKON RIVER	54	21	68	7	150
INN	IDITAROD RIVER	40	31	68	7	146
INN	DISHNA RIVER	38	31	68	4	141
INN	TOLSTOI CREEK	20	31	60	4	115
INN	MUD RIVER	34	21	48	4	107
INN	SHAGELUK SLOUGH	32	21	48	4	105
INN	HOLIDACHUK SLOUGH	32	21	48	4	105
INN	LITTLE MUD RIVER	32	21	48	4	105
INN	N.FK. INNOKO RIVER	20	31	48	4	103
INN	FOLGER CREEK	22	31	40	4	97
INN	MADISON CREEK	20	31	40	4	95
INN	MASTODON CREEK	20	31	40	4	95
INN	KHOTOL CREEK	8	31	48	7	94
INN	YETNA RIVER	8	31	48	4	91
INN	HATHER CREEK	8	21	48	4	81
INN	NETLETNA CREEK	8	21	48	4	81
INN	PAPA WILLIE CREEK	8	21	48	4	81
INN	WAPOO CREEK	8	21	40	4	73
INN	MAGITCHLIE CREEK	8	21	40	4	73
INN	FINLAND CREEK	8	21	40	4	73
INN	SCANDANAVIAN CREEK	8	21	40	4	73
INN	GALATEA CREEK	8	21	40	4	73
INN	HAMMER CREEK	8	11	48	4	71
INN	GROUCH CREEK	8	11	48	4	71
INN	NO NAME CREEK	8	11	48	4	71
INN	SUCKER CREEK	14	11	40	4	69
INN	SHOVEL CREEK	14	11	40	4	69
IZE	JOSHUA GREEN RIVER	4	21	68	0	93
IZE	RUSSELL CREEK	20	5	54	4	83
IZE	BLUE BILL CREEK	14	10	58	0	82
IZE	LAMPREY CREEK	14	10	58	0	82
IZE	FROSTY CREEK	12	10	54	2	78
IZE	CATHEDRAL RIVER	10	10	58	0	78
IZE	TROUT CREEK	12	21	38	2	73
IZE	RIVER B/T SWANSON LAG & OTTER PT	0	20	44	0	64
IZE	NORTH CREEK	0	20	42	0	62
IZE	THIRD CREEK	12	10	38	0	60
IZE	FIFTH CREEK	12	10	38	0	60
IZE	CANOE BAY RIVER	0	11	48	0	59
IZE	LAZAREF RIVER	0	10	48	0	58
IZE	URILIA BAY RIVER	0	0	0	0	0
KAN	KOYUKUK RIVER	62	20	60	7	149
KAN	SO. FK. KOYUKUK RIVER	38	30	56	7	131
KAN	JIM RIVER	38	23	52	4	117
KAN	FISH CREEK	16	30	48	7	101
KAN	KANUTI RIVER	16	30	40	7	93
KAN	BONANZA CREEK	16	20	48	4	88
KAN	KANUTI-KILOLITNA	4	30	50	0	84
KAN	HENSHAW CREEK	0	30	46	0	76
KAN	KANUTI-CHALATNA	0	30	32	3	65
KAN	HOLONADA CREEK	4	30	26	0	60
KEN	KENAI RIVER	128	25	68	4	225
KEN	SWANSON RIVER	56	17	48	4	125
KEN	KASILOF RIVER	48	11	56	4	119
KEN	BEAVER CREEK	62	11	44	2	119
KEN	RUSSIAN RIVER	28	21	44	4	97
KEN	CHICKALOON RIVER	16	21	52	4	93
KEN	FUNNY RIVER	28	15	44	2	89
KEN	MOOSE RIVER	20	10	48	4	82
KEN	FOX RIVER	0	20	48	2	70
KEN	KILLEY RIVER	0	20	44	2	66

1993 WATER RESOURCES THREATS ANALYSIS

REFUGE	WATERSHED NAME	SUBTOTAL THREATS	SUBTOTAL MGT CON	SUBTOTAL RES VALUE	SUBTOTAL PUB USE	GRAND TOTAL
KOD	MIDWAY RIVER	2	33	72	5	112
KOD	STURGON RIVER	0	33	70	7	110
KOD	UYAK RIVER	0	35	72	2	109
KOD	BROWNS RIVER	0	33	66	7	106
KOD	KARLUK RIVER	0	28	70	7	105
KOD	AYAKULIK RIVER	0	30	68	4	102
KOD	DOG SALMON RIVER	0	31	66	4	101
KOD	SPIRIDON RIVER	8	16	72	4	100
KOD	TERROR RIVER	20	13	64	2	99
KOD	UGANIK RIVER	0	20	74	4	98
KOD	BARLING RIVER	0	33	60	5	98
KOD	ZACHER RIVER	0	20	72	2	94
KOD	HUMPY RIVER	0	33	52	4	89
KOD	AKALURA RIVER	0	31	44	4	79
KOD	DEADMAN RIVER	0	20	54	2	76
KOD	LITTLE RIVER	0	20	48	2	70
KOY	HOGATZA RIVER	16	30	60	7	113
KOY	YUKON RIVER	18	30	52	8	108
KOY	KOYUKUK RIVER	14	20	60	8	102
KOY	GISASA RIVER	0	30	60	7	97
KOY	HUSLIA RIVER	0	30	60	7	97
KOY	INDIAN RIVER	20	20	52	3	95
KOY	KATEEL RIVER	0	20	60	7	87
KOY	BILLY HAWK RIVER	0	20	60	5	85
KOY	DAKLI RIVER	0	20	60	2	82
KOY	DULBI RIVER	0	30	40	7	77
KOY	CAMP CREEK	20	20	32	0	72
KOY	LITTLE INDIAN RIVER	0	30	32	3	65
KOY	COTTONWOOD RIVER	0	20	40	4	64
KOY	PITKA RIVER	0	20	40	2	62
KOY	WOODYARD RIVER	0	20	40	2	62
KOY	NULITNA RIVER	0	20	40	2	62
KOY	HONHOSA RIVER	0	20	40	2	62
KOY	NAYUKA RIVER	0	20	40	0	60
KOY	BEAR CREEK	0	20	32	7	59
KOY	KHOTOL RIVER	0	20	34	3	57
KOY	DULBI SLOUGH	0	20	32	5	57
KOY	BISHOP CREEK	0	20	32	3	55
KOY	NATLARATLEN RIVER	0	10	40	0	50
KOY	KAIYUH RIVER	0	10	34	3	47
SEL	SELAWIK RIVER	18	30	56	8	112
SEL	KOBUK R. MELVIN CHANNEL	18	30	56	8	112
SEL	KOBUK R. RICH CHAN.	16	30	56	8	110
SEL	KOBUK R. ATTIUNIK CHAN	16	30	56	8	110
SEL	KOBUK R. EMANUIKROK CHAN.	16	30	56	8	110
SEL	KOBUK R. MUKUKSOK CHAN.	16	30	56	8	110
SEL	KOBUK R. OLIKATUK CHAN.	16	30	56	8	110
SEL	KOBUK R. RILEY CHAN.	16	30	56	8	110
SEL	MANGOAK RIVER	6	30	32	7	75
SEL	TAGAGAWIK RIVER	0	30	32	7	69
SEL	SHINILIAOK RIVER	0	30	32	5	67
SEL	SHINILIKROK RIVER	0	30	32	5	67
SEL	INGRUKSUKRUK RIVER	0	30	32	5	67
SEL	KERULUK RIVER	0	30	32	5	67
SEL	RABBIT CREEK	0	30	32	3	65
SEL	KERCHURAK RIVER	0	30	32	3	65
SEL	KUGARAK RIVER	0	20	32	7	59
SEL	KAWICHIARK RIVER	0	20	32	5	57
SEL	FISH CREEK	0	20	32	5	57
SEL	HUNT RIVER	0	20	32	5	57
SEL	EKIEK RIVER	0	20	32	5	57
SEL	SINGAURAK RIVER	2	20	32	3	57
SEL	OBLARAN RIVER	0	20	32	3	55
SEL	KUCHUK RIVER	0	20	32	3	55

1993 WATER RESOURCES THREATS ANALYSIS

REFUGE	WATERSHED NAME	SUBTOTAL THREATS	SUBTOTAL MGT CON	SUBTOTAL RES VALUE	SUBTOTAL PUB USE	GRAND TOTAL
TOG	SALMON RIVER	54	20	66	3	143
TOG	KANEKTOK RIVER	42	20	66	7	135
TOG	GOODNEWS RIVER	20	20	66	7	113
TOG	TOGIAK RIVER	20	20	66	7	113
TOG	AROLIK RIVER	18	20	66	7	111
TOG	KINEGNAK RIVER	22	20	66	0	108
TOG	WEARY RIVER	4	21	66	3	94
TOG	UNGALIKTHLUK RIVER	0	20	66	7	93
TOG	KULUKAK RIVER	0	20	66	7	93
TOG	SNAKE RIVER	4	11	66	3	84
TOG	QUIGMY RIVER	0	20	50	3	73
TOG	KANIK RIVER	0	20	50	3	73
TOG	OSVIAK RIVER	0	20	50	3	73
TOG	MATOGAK RIVER	0	20	50	3	73
TOG	SLUG RIVER	0	20	50	0	70
TOG	KURTLUK RIVER	0	20	50	0	70
YD	YUKON RIVER	80	21	74	8	183
YD	KUSKOKWIM RIVER	72	31	72	8	183
YD	ANLAK RIVER	34	31	52	7	124
YD	TULUKSAK RIVER	34	31	52	7	124
YD	KASIGLUK RIVER	34	21	60	7	122
YD	EEK RIVER	26	21	64	7	118
YD	KISARALIK RIVER	26	22	62	7	117
YD	ATCHUELINGUK RIVER	26	21	62	7	116
YD	NINGLIKTAK RIVER	14	21	74	5	114
YD	KWETHLUK RIVER	26	21	60	7	114
YD	FOG RIVER	14	31	60	7	112
YD	KOLOVINERAK RIVER	14	21	74	3	112
YD	BLACK RIVER	6	21	82	3	112
YD	TOKSOOK RIVER	14	21	68	5	108
YD	NINGLICK RIVER	14	21	68	3	106
YD	KUKUKUTUK RIVER	6	31	60	5	102
YD	APHREWN RIVER	6	21	68	5	100
YD	ANERKOCNIK RIVER	14	21	62	3	100
YD	KASHUNUK RIVER	14	21	62	3	100
YD	NUNAVULNUK RIVER	6	21	68	5	100
YD	KUGUKLIK RIVER	6	21	68	5	100
YD	ANDREAFSKY RIVER	6	31	52	7	96
YD	KOGOK RIVER	6	21	64	3	94
YD	KOKECHIK RIVER	6	23	62	3	94
YD	PIKMIKTALIK (BB) RIVER	6	21	64	3	94
YD	KINIA RIVER	14	21	54	5	94
YD	PASTOLIK RIVER	6	21	64	3	94
YD	MANOKINAK RIVER	6	21	62	3	92
YD	AZUN RIVER	6	21	62	3	92
YD	PASTOLIAK RIVER	6	21	60	3	90
YD	BIG RIVER	6	21	60	3	90
YD	KIVIAK RIVER	14	21	48	5	88
YD	DISCOVERY RIVER	6	31	44	7	88
YD	SWIFT RIVER	6	31	44	7	88
YD	KUN RIVER	6	21	54	5	86
YD	KEOKLIVAK RIVER	6	21	54	5	86
YD	ARCHUELINGUK RIVER	6	21	52	7	86
YD	TAGAYARAK RIVER	14	21	48	3	86
YD	KINAK RIVER	14	21	46	3	84
YD	ISKOWIK RIVER	14	21	46	3	84
YD	KIALIK RIVER	14	21	40	7	82
YD	LITHKEALIK RIVER	6	21	48	5	80
YD	GWEEK RIVER	14	21	32	7	74
YD	BOGUS RIVER	6	20	44	3	73
YD	JOHNSON RIVER	14	21	32	5	72
YD	PIKMIKTALIK RIVER	14	21	32	3	70
YD	EENAUARAK RIVER	6	21	40	3	70
YD	TALGIKSOK RIVER	6	21	32	5	64
YD	REINDEER RIVER	6	21	32	3	62