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EMERGENCY BANK STABILIZATION
LETTER REPORT
GALENA, ALASKA

July 2002

SUMMARY

This report recommends the construction of emergency bank stabilization measures along the Yukon River at Galena, Alaska. The Secretary of the Army was directed in the Energy and Water Development Appropriations Act of 2001, as enacted by Section 1(a)(2) of P.L. 106-377, Conference Report 106-988, to use $3,000,000 to continue the emergency bank stabilization in accordance with the same terms and conditions as Section 116 of P.L. 99-190 of 1985.

Galena is located on the north bank of the Yukon River approximately 270 air miles west of Fairbanks and 325 air miles north-northwest of Anchorage. Galena serves as the hub for transportation, government, and commercial services for the western Interior region of Alaska. Access to Galena is only by water or air. Commercial fishing, seasonal construction work, and mining contribute to the economy of the region.

Bank erosion continues to encroach upon the community of Galena. This continued erosion threatens the residences and businesses and increases the risk of failure of the existing bank protection measures. Long-term erosion threatens to create a short-circuit (flanking) of the Yukon River and isolate the community. Bank stabilization measures along this reach of the river would delay the threat of long-term bank erosion to residences, businesses, existing bank protection measures, and the community as a whole.

During the bulk of the time required to prepare this letter report, there was a possibility of the Federal-funding limit being raised from $3,000,000 to $6,000,000 in the fiscal year 2003 Federal budget. Therefore, the alternatives were evaluated based on a $6,000,000 limit. The recommended plan (Alternative 3 – riprap) was presented in two sections; Section 1 based on $3,000,000 and Section 2 based on the second $3,000,000. Section 1 of the recommended plan would stabilize 810 ft of bank in the vicinity of Galena. The bank stabilization would consist of the placement of 129,600 ft^2 of filter fabric, 4,200 yd^3 of filter stone, and 12,600 yd^3 of armor rock. The total project area would be about 3.5 ac. Collectively, Sections 1 and 2 would stabilize 1,800 ft of bank, which would consist of 288,000 ft^2 of filter fabric, 9,300 yd^3 of filter stone, and 28,000 yd^3 of armor rock. The total project area would be 7.9 ac.

In this letter report, several alternatives were evaluated for providing bank stabilization. These alternatives varied in construction material; articulated concrete mattress, sheetpile wall, riprap, and bendway weirs. Alternative 3 (Riprap) was selected as the recommended plan because it provided the most bank protection, was technically feasible, and environmentally acceptable. Section 1 of Alternative 3 has a total project cost (excluding cost of the letter report and PCA) of $2,890,000 and an equivalent annual cost of $395,000. Including the annual maintenance of $2,000, the total annual cost is $397,000. Sections 1 and 2 of Alternative 3 have a total project cost of $5,910,000 and an equivalent annual cost of $808,000. Including the annual maintenance cost of $3,000, the total annual cost is $811,000. The non-Federal cost for both funding limits is $5,000 of which $2,500 is administrative and $2,500 is the cost of LERR. This project is considered an emergency action; therefore, 10-year project life was used for calculation of annual costs in lieu of the typical 50-year project life.

PERTINENT DATA

Recommended Plan (Alternative 3 - Riprap)

	Section 1 -$3,000,000 funding limit	Section 2 – Second $3,000,000 funding limit	Total - Sections 1 & 2
Area (ac)	3.5	4.4	7.9
Length (ft)	810	990	1,800
Top elevation (ft)	125	125	125
Toe elevation (ft)	90	90	90
Filter Fabric (ft^2)	129,600	158,400	288,000
Filter stone (yd^3)	4,200	5,100	9,300
Armor stone (yd^3)	12,600	15,400	28,000

Section 1 Construction Costs[a]

Item	Federal ($)	Non-Federal ($)	Total ($)
Surveys	30,000	–	30,000
PED	150,000	–	150,000
Supervision and Administration	200,000	–	200,000
Construction	2,498,000	–	2,498,000
LERR Administration	7,500	2,500	10,000
LERR Acquisition	–	2,500	2,500
Total Project Cost	2,885,000	5,000	2,890,000
Letter Report and PCA	90,000	–	90,000
Total Project and Study Cost	2,975,000	5,000	2,980,000
Annual Project Cost[b]			395,000
Annual O&M Cost			2,000
Total Average Annual Cost			$397,000

[a] Based on a Federal funding limit of $3,000,000 (Section 1)

[b] Basic assumptions: (1) October 2002 price level (FY 02 CRF 6 1/8%); (2) 10-year project life

PERTINENT DATA

Section 1 and 2 Construction Costs[a]

Item	Federal ($)	Non-Federal ($)	Total ($)
Surveys	30,000	–	30,000
PED	309,000	–	309,000
Supervision and Administration	412,000	–	412,000
Construction	5,147,000	–	5,147,000
LERR Administration	7,500	2,500	10,000
LERR Acquisition	–	2,500	2,500
Total Project Cost	5,905,000	5,000	5,910,000
Letter Report and PCA	90,000	–	90,000
Total Project and Study Cost	5,995,000	5000	6,000,000
Annual Project Cost[b]			808,000
Annual O&M Cost			3,000
Total Average Annual Cost			$811,000

a Based on a Federal funding limit of $6,000,000 (Sections 1 and 2)

[b] Basic assumptions: (1) October 2002 price level (FY 02 CRF 6 1/8%); (2) 10-year project life

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CONVERSION TABLE FOR SYSTEM INTERNATIONAL (METRIC) UNITS

Units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To obtain
cubic yards (yd^3)	0.7646	cubic meters (cm)
acre (ac)	0.4049	hectare (ha)
fahrenheit degrees (^OF)	*	celsius degrees (^OC)
feet (ft)	0.3048	meters (m)
feet per second (fps)	0.3048	meters per second (mps)
inches (in)	2.5400	centimeters (cm)
knots (international)	0.5144	meters per second (mps)
miles (U.S. statute – mi)	1.6093	kilometers (km)
miles (nautical – mi)	1.8520	kilometers (km)
miles per hour (mph)	1.6093	kilometers per hour (kph)
pounds (mass – lb)	0.4536	Kilograms (kg)

To obtain Celsius (^OC) temperature readings from Fahrenheit (^OF) readings, use the following formula: C = (5/9)(F - 32).

1.0 STUDY AUTHORITY

The Secretary of the Army was directed in the Energy and Water Development Appropriations Act of 2001, as enacted by Section 1(a)(2) of P.L. 106-377, Conference Report 106-988, to use $3,000,000 to continue the emergency bank stabilization in accordance with the same terms and conditions as Section 116 of P.L. 99-190 of 1985.

> *"The Secretary of the Army, acting through the Chief of Engineers, is directed to use $3,000,000 of the funds appropriated herein for additional emergency bank stabilization measures at Galena, Alaska under the same terms and conditions as previous emergency bank stabilization work undertaken at Galena, Alaska pursuant to section 116 of Public Law 99-190."*

At the time of preparation of this letter report, the Federal-funding limit may be raised to $6,000,000 in the fiscal year 2003 Federal appropriation.

2.0 STUDY PURPOSE

The purpose of this study is to prepare a decision document and present recommendations for providing emergency bank stabilization measures along the Yukon River at Galena, Alaska. This project is a General Construction Project that has a maximum allowable Federal authorization of $3,000,000. This Federal limit may be raised to $6,000,000 in the fiscal year 2003 Federal appropriation. To ensure that the maximum extent of environmental impacts of the study alternatives was evaluated, each alternative was configured and evaluated with the Federal limit of $6,000,000. Once this decision document is approved and a Project Cooperation Agreement has been signed, a construction contract will be prepared to implement the recommended plan.

3.0 PROJECT LOCATION

Galena is located on the north side of the Yukon River approximately 270 miles west of Fairbanks and 325 miles north-northwest of Anchorage. Access to Galena is only by water or air. The location and general vicinity of Galena is shown on Figure 1.

4.0 PROBLEMS AND OPPORTUNITIES

4.1. Problems Due to Erosion

Bank erosion continues to encroach upon the community of Galena. This continued erosion threatens the residences and businesses and increases the risk of failure of the existing bank protection measures. Long-term erosion threatens to create a short-circuit (flanking) of the Yukon River and isolate the community. Bank stabilization measures along this reach of the river would delay the threat of long-term bank erosion to residences, businesses, existing bank protection measures, and the community as a whole.

4.2. Bank Erosion Process

The thawing of the permafrost layer along the bank primarily controls the bank erosion process of the Yukon River in the region of Galena. Relatively little erosion occurs during the breakup flood period. Ice blocks lodged along the banks form a protective boundary from the ice being carried downriver by the main channel. Thus, little bank erosion is attributed to ice movement. Also, water temperatures remain low during breakup because of the large volume of ice carried by the river. The rising water level and ice block solar radiation to the bank, which further prevents thawing. After breakup water levels subside, the bank temperature increases due to solar radiation and warmer water temperature. The thawed bank sections then become unstable and susceptible to erosion and sloughing caused by near-shore currents and wave action.

5.0 EXISTING AND FUTURE CONDITIONS

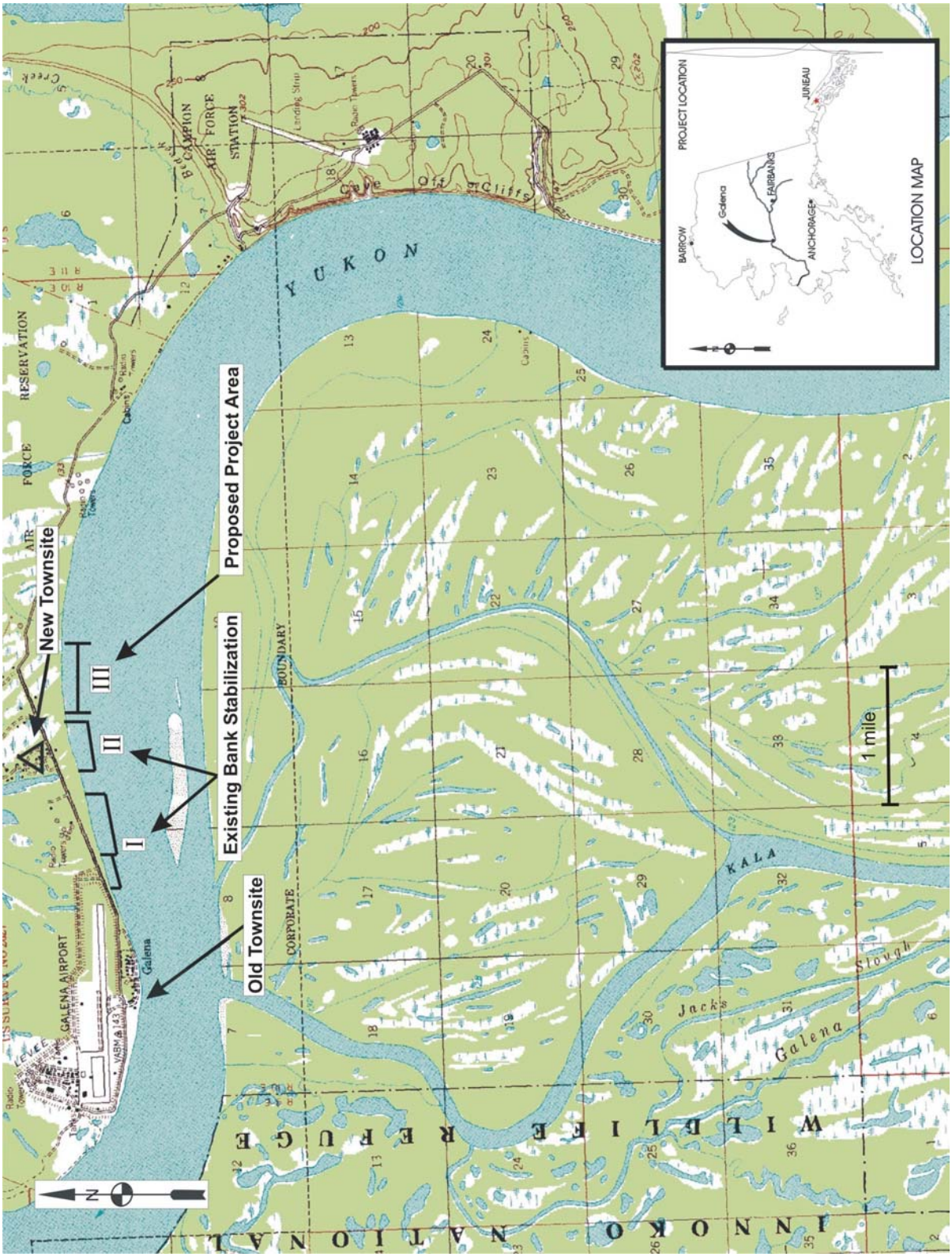
5.1. Existing Conditions

Current population is 675 residents of which about two-thirds are Alaska Natives. The socio-economic conditions have not changed significantly since the 1986 report was published. Galena still serves as the transportation, government, and commercial center for the western Interior. Federal, state, city, and village government jobs dominate, but Galena has many other jobs in air transportation and retail businesses. Other season employment includes construction work and BLM fire fighting. Although the Air Force Station was closed in 1993, the Galena School district is currently using the facilities as a boarding school.

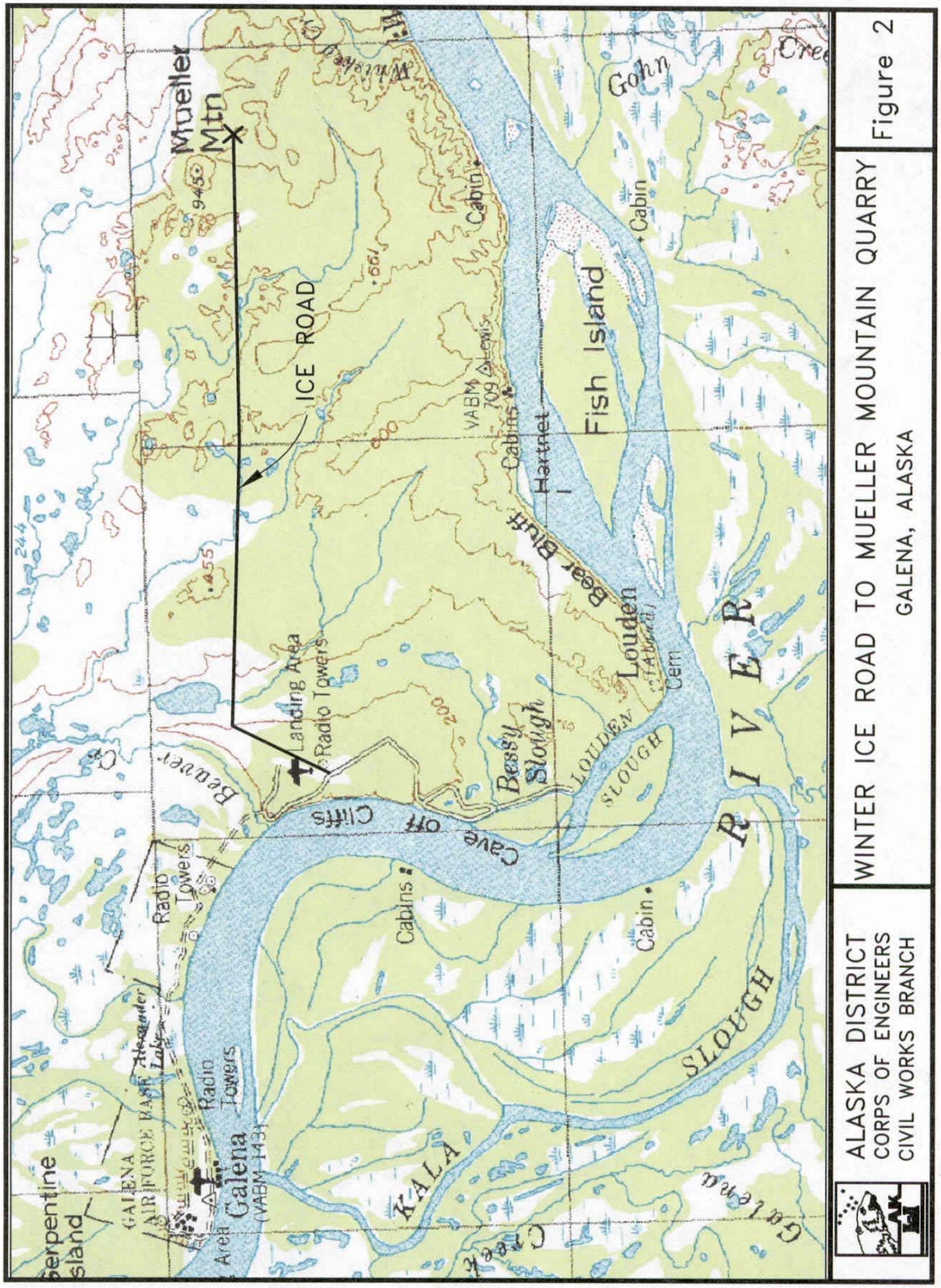
Different interests constructed the existing bank stabilization at Galena. The first project was constructed in the U.S. Air Force in 1959-1960 and consisted of semi-circular sheetpile cells. Barrels (55-gallon drums) filled with sand and gravel were placed behind and above the sheetpile wall. Total length of this project was 275 feet. The second project, Phase I, was constructed by the state of Alaska in the early 1980s. Phase I consisted of riprap placed along the bank from the upstream extent of the sheetpile wall and extended 2,500 feet upstream. The U.S. Army Corps of Engineers constructed the most recent project, Phase II, in 1987. Phase II consisted of riprap placed along 1,400 feet of river bank, beginning at a distance about 800 feet upstream of Phase I. The Phase II riprap extended from the top of the bank, about elevation 125 feet, to elevation 90 feet. The source of rock for both riprap phases was the Mueller Mountain quarry, which is located 15 miles east of Galena. Access to the quarry from Galena by heavy construction equipment was by a winter ice road. Location of the quarry and winter access route is shown on Figure 2.

5.2. Future Conditions

The Corps' 1986 report indicated that about 37,000 linear feet of bank stabilization would be necessary to completely control the erosion along the river bank at Galena. However, there was no economically justified means of protecting this reach. Without additional bank stabilization measures the riverbank will continue to erode and encroach upon the community. Continued erosion will increase the risk of damage to residences, businesses, and existing bank protection measures.



Galena Location Map and Existing Bank Stabilizations Projects



Mueller Mountain Quarry and Winter Access Road

6.0 PLAN FORMULATION

6.1. Planning Criteria

6.1.1. Engineering Criteria

The alternatives should be adequately designed to provide bank stabilization at Galena, not create a hazard to navigation, and minimize the influence on river flow patterns.

6.1.2. Economic Criteria

All alternatives considered to meet project needs should be presented in quantitative terms. The alternative selected as the recommended plan must maximize the net contribution to the national economic development (NED) while adhering to the engineering, economic, environmental, and social criteria.

6.1.3. Environmental Criteria

Environmental considerations include identifying forms of aquatic life and wildlife that might be impacted by an alternative's implementation, minimizing disruption of the area's natural resources, and using measures to protect or enhance existing environmental values.

6.1.4. Social Criteria

Alternatives considered must minimize adverse social impacts and must be consistent with state, regional, and local land use and development plans, both public and private. The selected alternative must be acceptable to the non-federal sponsor.

6.2. Federal Funding Limit

To ensure that each alternative's environmental impacts were fully evaluated, all alternatives were configured to provide the maximum amount of bank stabilization without exceeding the possible Federal cost limit of $6,000,000. The scope of the recommended plan was also configured based on the actual Federal funding limit of $3,000,000.

6.3. Descriptions of Alternatives

The alternatives evaluated for providing bank protection upstream of the Phase II reach are described below. The alternatives were configured to provide the maximum amount of bank protection without exceeding the Federal cost limit of $6,000,000. A physical comparison of the alternatives is provided in Table 1.

Alternative 1 – Articulated Concrete Matt (ACM). The matt unit consists of concrete blocks wired together to form 4- by 25-foot sections. A one-inch gap between each block would afford the section flexibility to conform to the unevenness of the bank and bank settlement. The sections would have a four-foot overlap to ensure continuity and would extend from the top of bank, about elevation 125 feet, to elevation 90 feet. Filter fabric and filter stone would be placed to minimize the movement of fine material within the bank. Grading would be necessary to provide an even slope for placement of the filter material and the ACM. About 960 feet of bank would be protected using ACM. Planimetric and cross-section views of are shown in Figures 3 and 4.

Alternative 2 – Sheetpile Wall. This alternative would consist of driving 40-foot lengths of sheetpile along the river's bank. Thermal piles 40 feet long would be placed behind the sheetpile wall, 20 feet on center, to maintain the permafrost lenses behind the wall. The wall would be anchored to deadman piles to minimize the risk of buckling or overturning. Insulation would be placed behind the wall for a distance of 20 feet and a depth of three feet to inhibit thawing from seasonal temperature changes. Riprap would be placed along the toe of the wall to prevent undermining of the wall due to toe scour. About 1,300 feet of bank would be protected using sheetpile. Planimetric and cross-section views of this alternative are shown in Figures 5 and 6.

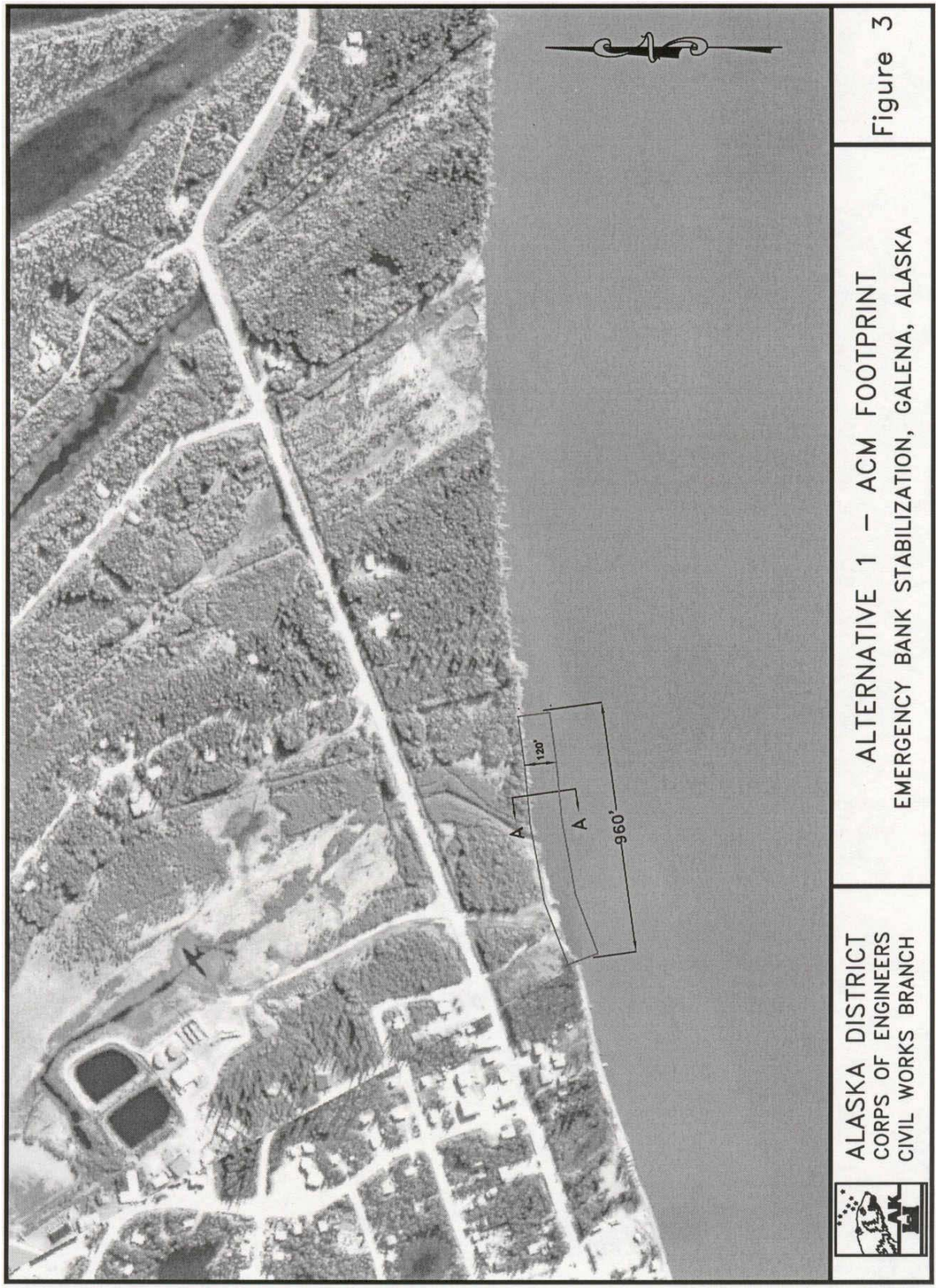
Alternative 3 – Riprap. This alternative would consist of a three-foot thick layer of riprap extending from the top of bank, about elevation 125 feet, to elevation 90 feet. Filter fabric and filter stone would be placed to minimize the movement of fine material within the bank. Grading would be necessary to provide an even slope for placement of the filter material and riprap. The riprap design is the same as that used for the previous project at Galena, which has functioned properly with minimal maintenance.

Several sources of rock are located within the general vicinity of Galena. Due to the marshy terrain between the quarry and project site, transportation of rock would occur during the winter and would require construction of a winter ice road. For cost estimating purposes, it was assumed that the Mueller Mountain quarry would provide the riprap for this project. About 1,800 feet of bank would be protected using riprap. Planimetric and cross-section views of this alternative are shown in Figures 7 and 8.

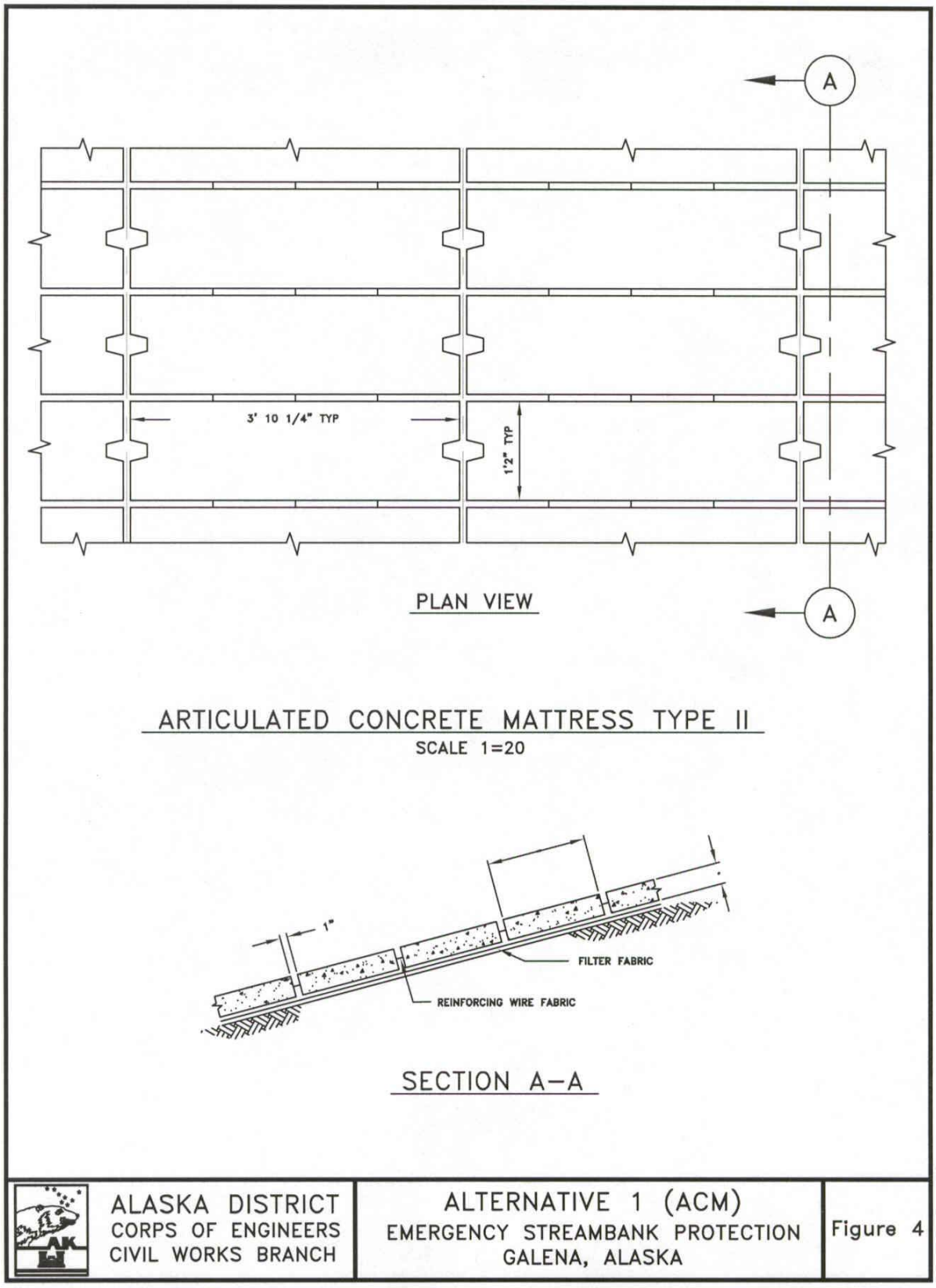
Alternative 4 – Bendway Weirs. Bendway weirs are a series of low-level rock sills, angled 20 to 30 degrees upstream, that extend from the outside riverbank to the river's main flow path. The weirs would be high enough to redirect a significant portion of the flow and primary current away from the outside bank yet low enough to allow normal river traffic to pass over them unimpeded. Redirection of the primary current would reduce the bank erosion due to shear velocity. However, the erosion process along the Yukon River is primarily controlled by the freeze thaw cycles of the permafrost layer along the bank. The weirs would not reduce wind and wave induced bank scour and subsequent sloughing of thawed overhanging sections. Therefore, the weirs were determined not to be technically feasible, and a quantitative evaluation of this alternative was not conducted.

6.4. Various Alternative Configurations

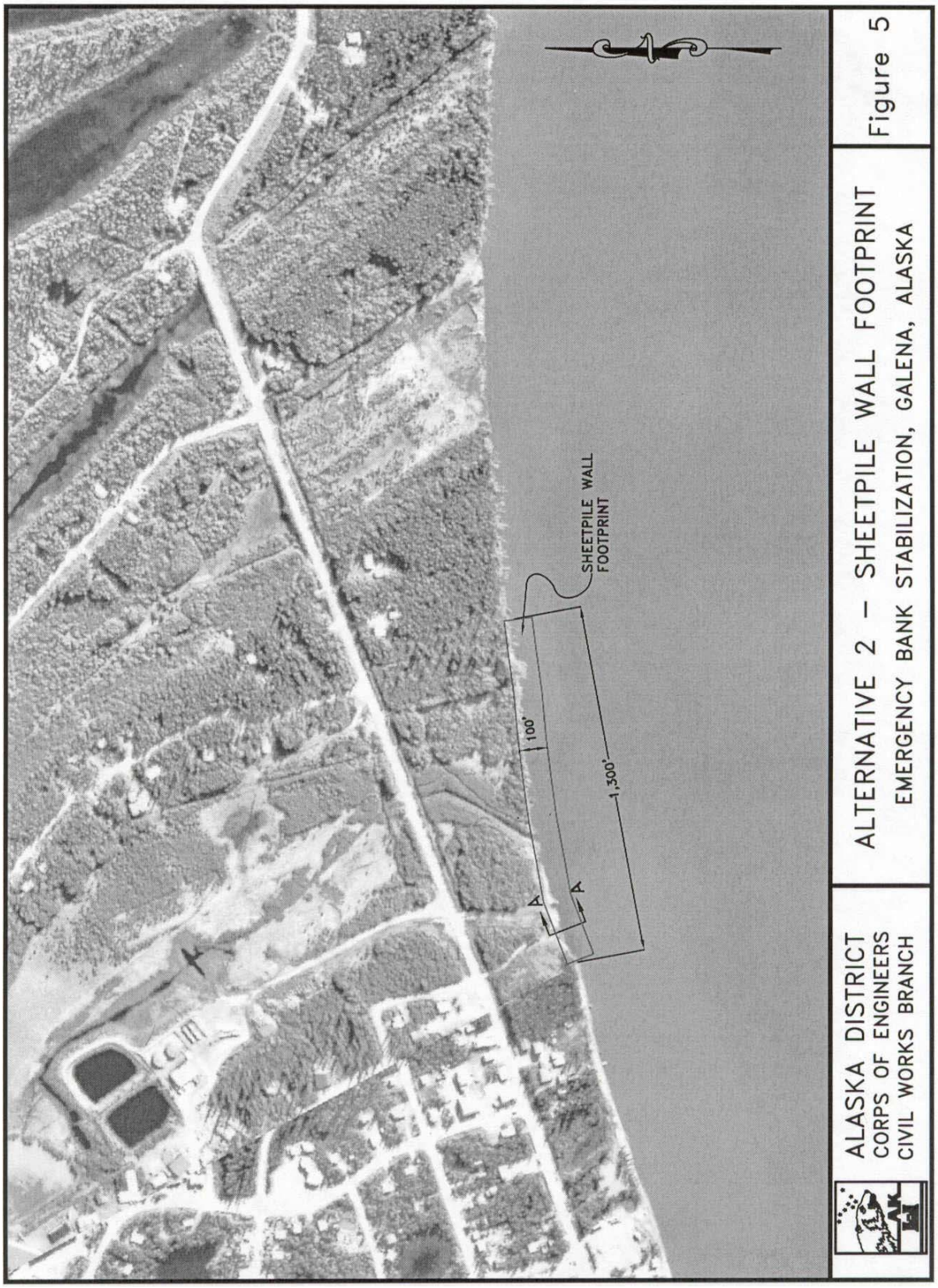
Various project lengths were developed for each alternative to ensure that the alternatives were compared on an equal basis. Alternative 1 was configured to not exceed the Federal funding limit, which provided a maximum 960 feet of bank protection. Alternatives 2 and 3 were then configured to provide 960 feet of bank protection and the corresponding project cost and benefits were compared. This process was repeated for Alternatives 2 and 3. A summary of the project cost and benefit for the alternatives is provided in Table 3.



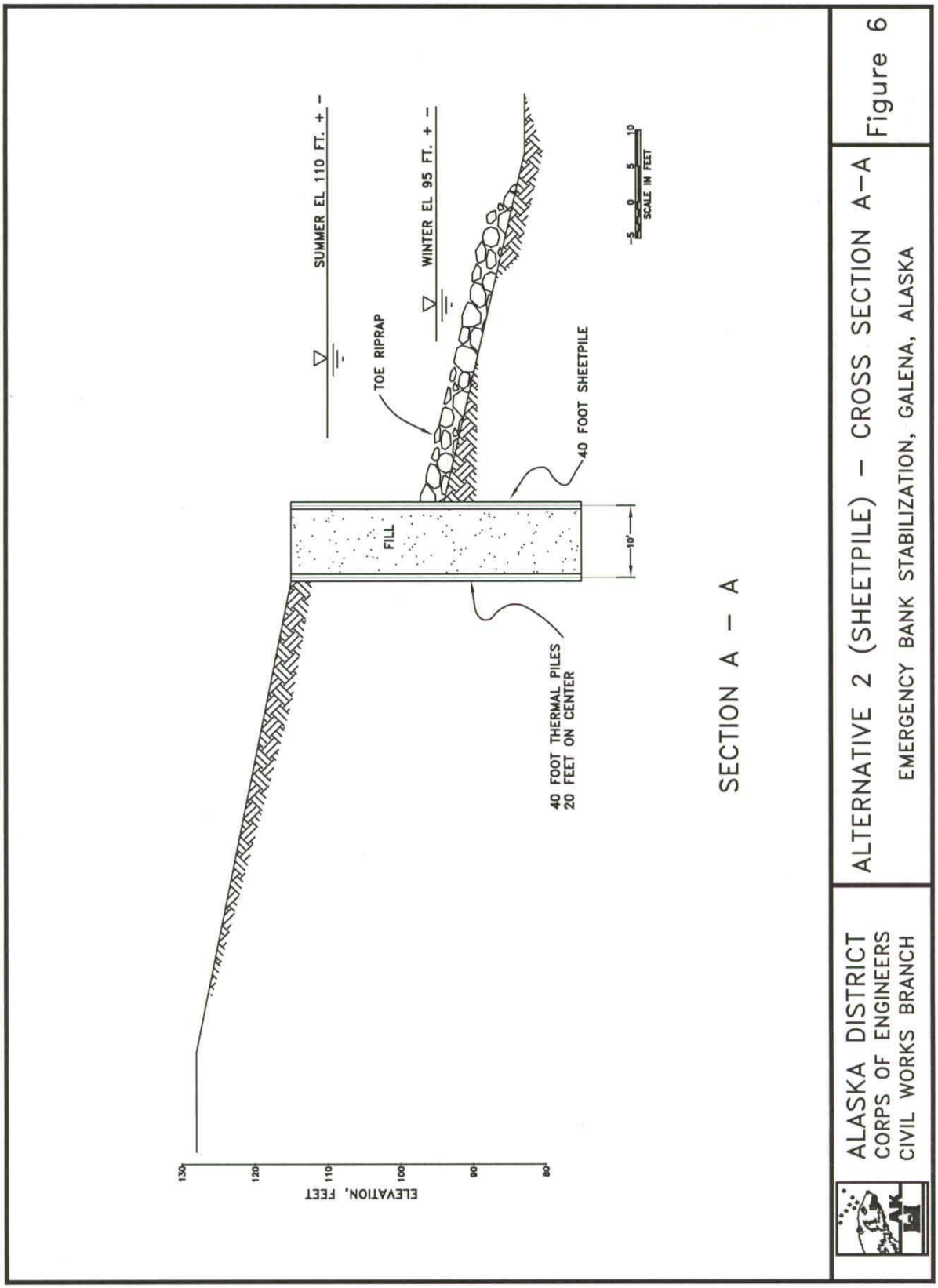
Alternative 1 – Articulated Concrete Matt (ACM) Footprint



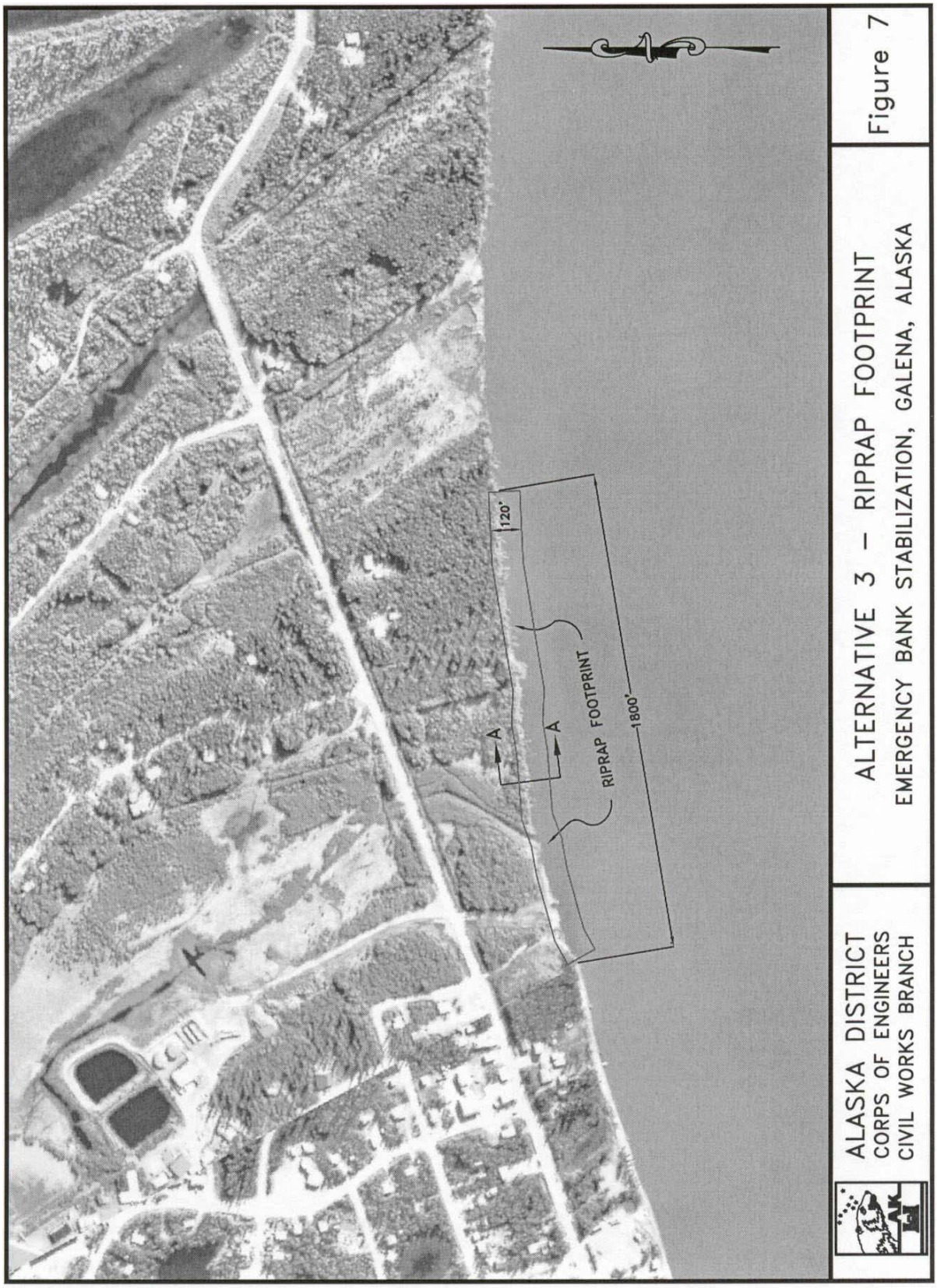
Alternative 1 – Articulated Concrete Matt (ACM) Plan View and Cross-Section



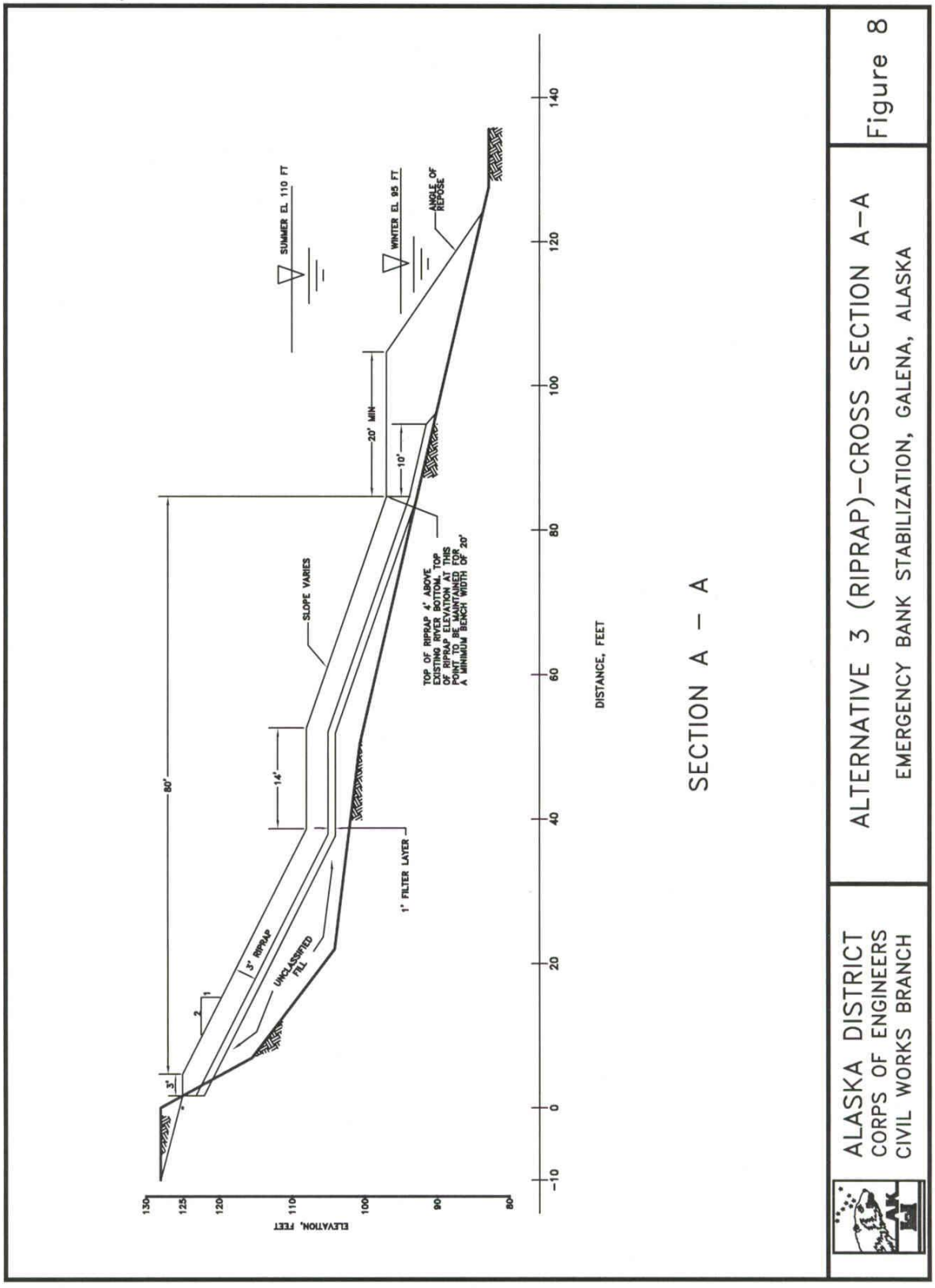
Alternative 2 – Sheetpile Wall Footprint



Alternative 2 - Sheetpile Wall Cross-Section



Alternative 3 – Riprap Footprint



Alternative 3 – Riprap Cross-Section

7.0 COMPARISON OF ALTERNATIVES

7.1. Physical Comparison of Alternatives

Physical comparison of the alternatives was based on providing the maximum amount of bank stabilization along the Yukon River without exceeding the proposed Federal limit of $6,000,000. The physical comparison of the alternatives was necessary to fully evaluate to environmental impacts of an alternative based on its maximum project size. An economic evaluation of the alternatives is included in Section 7.3. The economic evaluation includes a comparison of the alternatives based on providing the same amount of bank stabilization.

Alternative 1 (ACM) would provide the least amount of bank protection (960 feet) due to its high prefabrication and shipment cost. Alternative 2 (Sheetpile Wall) would only provide 1,300 feet of bank protection due to its high cost of materials, installation, and shipment. Alternative 3 (Riprap) would provide the greatest amount of bank protection (1,800 feet).

All alternatives would be constructed using land-based equipment. Construction would occur during the winter to make use of the low water level. The physical characteristics and cost of the alternatives are shown in Tables 1 and 2. Summary of the project costs and benefits is provided in Table 3. Cost estimates in MCACES format are provided in Appendix A.

Table 1. Physical Characteristics of Alternatives (based on $6,000,000 Federal Limit)

	Alternative 1 (ACM)	Alternative 2 (Sheetpile Wall)	Alternative 3 (Riprap)	Alternative 4 (Bendway Weirs)
Filter Fabric (ft^2)	153,000	79,000	288,000	
Filter Stone (yd^3)	5,000	2,000	9,300	
ACM (ft^2)	134,000	—	—	
Thermal Pile (each)	—	66	—	
Sheetpile (ft^2)	—	52,700	—	Not technically feasible
Riprap (yd^3)	—	5,900	28,000	
Upland area impacted[a] (acre)	0.7	0.9	1.2	
Area impacted above summer water level – el. 110 ft (acre)	0.9	1.5	1.7	
Area impacted below summer water level – el. 110 ft (acre)	2.6	1.8	5.0	
Length of Bank Protection (ft)	960	1,300	1,800	

[a]Upland area defined as the area extending landward from the top of bank.

Table 2. Cost Comparison of Alternatives ($6,000,000 Federal Limit)

	Unit Price	Unit of Measure	Alternative 1 (ACM)	Alternative 2 (Sheetpile Wall)	Alternative 3 (Riprap)
Letter Report			80,000	80,000	80,000
Project Cooperation Agreement			10,000	10,000	10,000
Subtotal			90,000	90,000	90,000
Topographical Survey			30,000	30,000	30,000
Construction Contract					
Mob and Demob	$275,000	ls	275,000	275,000	275,000
Site Clearing	$0.17	ft^2	30,900	31,300	58,100
Earth Work	$5.06	yd^3	387,400	223,200	728,600
Filter Fabric	$0.40	ft^2	61,200	31,600	115,200
Filter Stone	$83.36	yd^3	413,700	162,600	778,000
ACM	$23.30	ft^2	3,121,700	——	——
Thermal Pile	$9,242	each	——	608,400	——
Sheetpile	$46.90	ft^2	——	2,470,100	——
Riprap	$83.36	yd^3	——	487,800	2,334,100
Subtotal			$4,290,000	$4,290,000	$4,289,000
Construction Contingency	20%		858,000	858,000	858,000
Total Construction Contract			$5,148,000	$5,148,000	$5,147,000
Contract Documents					
Preconstruction, Engineering, and Design	6%		308,900	308,900	308,800
Supervision & Administration	8%		411,800	411,900	411,800
			$721,000	$721,000	$721,000
Contract Award + Construction			$5,869,000	$5,869,000	$5,868,000
LERR Administration			10,000	10,000	10,000
LERR Acquisition			1,000	1,000	2,000
Total Project Cost			$5,910,000	$5,910,000	$5,910,000
Total Project and Study Cost (Letter Report, Survey, Contract Award, + Construction)			$6,000,000	$6,000,000	$6,000,000
Length of Bank Protection (ft)			960	1,300	1,800
Cost/linear feet of bank protection			$6,160/lft	$4,550/lft	$3,280/lft

7.2. Environmental Evaluation of Alternatives

The Yukon River is the largest river in Alaska and serves as a major migration corridor for chinook, chum, and coho salmon as well as sheefish, Bering cisco, and broad whitefish from mid-June through August. The proposed project area does not provide rearing or spawning habitat for the salmon or resident fish species. Waterfowl are common on the Yukon River during the spring, summer, and fall. Passerines, game birds, and raptors are also common. Common mammals of the area include lynx, snowshoe hare, shrews, voles, wolves, beaver, black bear, moose, and fox. The small amount of riparian habitat removed and the winter schedule would result in minimal impact to fish migration, birds, or mammals in the project area, the quarry area or in the winter ice road corridor. No threatened or endangered species or cultural resources are in the project area. The revegetation of the riprap on the upper bank would re-establish the riparian habitat and mitigate for some of the losses. An environmental assessment and Finding of No Significant Impact are provided with the letter report.

7.3. Economic Evaluation of Alternatives

7.3.1. Social-Economic Conditions

In 1985, the Army Corps of Engineers responded to a Congressional directive to review previous bank stabilization work performed at Galena, evaluate current problems and needs of the community related to bank stabilization, compile and assess all available means of bank stabilization determined feasible regarding engineering practicality, and perform an economic evaluation of each viable alternative to ascertain whether or not further Federal involvement should be recommended. Although the study concluded that there was no economic justification for any bank stabilization at Galena, through the Corps of Engineers' Civil Works Program, the report provided valuable information. Some of the data from the 1985 study is used to determine the without-and with-project conditions for the current economic analysis and evaluation.

Conditions in Galena have not changed substantially since the report was published in 1986. The population has grown from 630 to 675. About two-thirds are Alaska Natives. Galena continues to be a regional transport center, which serves the surrounding villages of the Yukon-Koyukuk area, including Ruby, Nulato, Koyukuk, Kaltag, Hughes, and Huslia. The State-owned airport provides year-round access to Galena. Barge access is from mid-May through mid-October.

There have been some economic changes and shifts in employment. For example, the Air Force no longer dominates the area; military presence has been replaced by other federal, state, and local government jobs. In addition to deployed tactical operations, the Air Force base provides Alaska Air National Guard troop ferrying support for Bureau of Land Management summer fire fighting. Federal, state, city, and village government jobs dominate, but Galena has many other jobs in air transportation and retail businesses. Gold mines that have closed have been replaced with other mining exploration and natural resource ventures. Seasonal employment, such as construction work, BLM fire fighting, and mining, provide other sources of income. Although the Air Force Base was closed in 1993, the Galena School district currently uses the facilities as a boarding school. The Chugach Development Corporation maintains the base facilities under contract.

7.3.2. Current Study

To determine whether there is any Federal interest in a bank stabilization project at Galena, a benefit-to-cost ratio (BCR) must be computed to satisfy the civil works program requirements for feasibility studies. The economic criteria used for Federal water resources planning require a plan to be identified that produces the greatest contribution to the National Economic Development (NED) plan. The NED plan is defined as the plan providing the greatest net benefits as determined by subtracting annual costs from annual benefits. The Corps of Engineers' policy requires recommendation of the NED plan unless there is adequate justification to do otherwise. Because the bank stabilization project is authorized under Public Law (P.L.) 99-190, Section 116, Stat. 1318, it provides an economic evaluation to quantify NED benefits of the alternatives, then proceeds to a least-cost evaluation to select the recommended plan. The recommended plan provides the most cost effective means of bank protection by comparing the net NED benefits generated by each alternative.

7.3.3.Without-Project Conditions

Without a project, severe river erosion will continue to encroach the community of Galena. This continued erosion increases the risk of failure of the existing bank protection measures. Long-term erosion threatens to create a short-circuit of the Yukon River and has the potential to isolate the community.

In that 1986 report, the average erosion rate was the total footage of stream bank lost since the first measurement, divided by 32 years of record (1946 through 1978). A value of 15.3 feet per year was the average landward erosion rate for this period. This can be thought of as a 15.3-foot swath of land extending landward from the top of bank and extending along the riverbank. Although current project alternatives have a 10-year life cycle, the erosion rate of 15.3 feet per year is still valid and is used in the evaluation of these alternatives.

To completely control the erosion problem in Galena, as indicated in the 1985 study, construction of approximately 37,200 feet (7 miles) of bank stabilization would be necessary along the riverbank. Without bank protection, about 150 feet would be lost to erosion along the 7-mile riverbank during the 10-year life cycle of the proposed project. Current land values along the riverbank average $5 per square foot. Although no structures are in immediate danger (short-term), if the riverbank goes unprotected, it is predicted that erosion would claim some residential houses and a main street (Campion Road) that will cut off access to the Galena Airport and the new and old town sites over a 50-year project life. However, for this evaluation a 10-life cycle was used to evaluate each alternative. If no federal action is taken, then it is estimated that $2,846,000 (15.3 ft x $5/ft^2 x 37,200 ft) in land erosion would be lost each year.

7.3.4. With-Project Conditions

With a Corps project, these measures would delay the threat of long-term erosion. Three alternatives were evaluated for providing bank protection without exceeding the Federal cost limit: Alternative 1 uses Articulated Concrete Matt to protect 960 feet of bank; Alternative 2 is consists of a Sheetpile Wall to protect 1,300 feet of riverbank; Alternative 3, Riprap to protect 1,800 feet of bank. The with-project costs for all three alternatives are approximately $5,910,000 over the 10-year life of the project. Amortized at 6.125 percent, this is an average

annual cost of $807,742. Below are descriptions of each alternative and the estimated project savings (benefits) and costs.

- **Alternative 1.** Articulated Concrete Matt (ACM) would protect about 960 feet of bank. Without this protection, 960 feet of land would be lost to erosion if corrective action were not taken. This represents $73,440 (15.3 x $5 x 960) in project benefits. Net project benefits would be ($734,302) [$73,440 - $807,742] with a BCR of 0.09 to 1.0. The project would cost $5,910,000 or $6,160 per linear foot.

- **Alternative 2.** Sheetpile Wall would protect about 1,300 feet of bank. Without this project, 1,300 feet of land would be lost to erosion if corrective action were not taken. This represents $99,450 (15.3 x $5 x 1,300) in project benefits. Net project benefits would be ($708,292) [$99,450 - $807,742] with a BCR of 0.12 to 1.0. The project would cost $5,910,000 or $4,550 per linear foot.

- **Alternative 3.** Riprap would protect about 1,800 feet of bank. Without this protection, 1,800 feet of land would be lost to erosion if corrective action were not taken. This represents $137,700 (15.3 x $5 x 1,800) in project benefits. Net project benefits would be ($670,042) [$137,700 - $807,742) with a BCR of 0.17 to 1.0. The project would cost $5,910,000 or $3,280 per linear foot.

Because there are three different without-project conditions, the economic evaluation also compares the uses of each type of construction material proposed for each level (linear feet) of protection. This procedure is done (adjusted) to evaluate the cost of materials for each project length. This adjustment was necessary to show the cost of each alternative as if the project goes forward using one material type for each project length. The costs to protect the bank using three lengths (960 LF, 1,300 LF, and 1,800 LF) is shown below for each alternative and amortized at 6.125 percent over the 10-year life of the project:

- **Alternative 1.** To protect 960 LF of bank using ACM (960 x $6,160) would cost $5,913,600; average annual costs, $808,234. To protect 1,300 LF would cost $8,008,000 with an average annual cost of $1,094,483; 1,800 LF would cost $11,088,000 with an average annual cost of $1,515,438.

- **Alternative 2.** To protect 960 LF of bank using Sheetpile (960 x $4,550) would cost $4,368,000 with an average annual cost of $596,991. To protect 1,300 LF of bank would cost $5,915,000 with an average annual cost of $808,425; 1,800 LF would cost $8,190,000 with an average annual cost of $1,119,358.

- **Alternative 3.** To protect 960 LF of bank would cost $3,148,800 (960 x $3,280) with an average annual cost of $430,358. To protect 1,300 LF would cost $4,264,000 with an average annual cost of $582,777; 1,800 LF would cost $5,904,000 with an average annual cost of $806,922.

Table 3 provides a benefit-cost comparison of the alternatives and construction materials. Alternative that would provide the most bank stabilization protection is Alternative 3, Riprap (1,800 ft) at the least cost of $3,280 per linear foot. The BCR is 0.17 to 1.0.

Table 3. BCR Comparison of Project Lengths (LF) by Construction Material

Alternative	With-Project Cost [1/] (Adjusted)	Ave Annual Cost [2/] (Adjusted)	With-Project Benefits [3/]	Net Benefits [4/] (Negative)	BCR [5/]
ACM					
960 LF	$ 5,910,000	$ 807,742	$ 73,440	($734,302)	.09
1,300 LF	8,008,000	1,094,483	99,450	(995,033)	.09
1,800 LF	11,088,000	1,515,438	137,700	(1,377,738)	.09
Sheetpile Wall					
960 LF	$ 4,368,000	$ 596,991	$ 73,440	($523,551)	.12
1,300 LF	5,910,000	807,742	99,450	(708,292)	.12
1,800 LF	8,190,000	1,119,358	137,700	(981,658)	.12
Riprap					
960 LF	$ 3,148,000	$ 430,358	$ 73,440	($356,918)	.17
1,300 LF	4,264,000	582,777	99,450	(483,327)	.17
1,800 LF	5,910,000	807,742	137,700	(670,042)	.17

[1/] Construction material cost per linear feet x LF of project (alternative) = adjusted with-project costs.

[2/] Adjusted with-project costs amortized at 6.125 percent over a 10-year project life.

[3/] 15.3 ft x $5/ft^2 x LF of project = with-project benefits.

[4/] Project savings (benefits) minus adjusted without-project average annual costs

[5/] With-project benefits divided by adjusted average annual costs = BCR to 1.0.

8.0 SELECTION OF RECOMMENDED PLAN

Alternative 3 (Riprap) was selected as the recommended plan because it maximized the net NED benefits for providing bank stabilization, was technically feasible, and environmentally and socially acceptable. Physical characteristics and costs of this plan based on the $3,000,000 and $6,000,000 Federal funding limits are shown in Tables 5 and 6.

8.1. Plan Components

The recommend plan would consist of a three-foot thick layer of riprap extending from the top of bank, about elevation 125 feet to elevation 90 feet. Filter fabric and filter stone would be placed to minimize the movement of fine material within the bank. Grading of the bank would be necessary to provide an even slope for placement of the filter material and riprap. The riprap design is the same as that used for the previous project at Galena, which has functioned properly with minimal maintenance.

Preparation of the site would primarily consist of the removal of woody debris such as spruce, birch, and willow trees, low-lying brush, and highly organic soils. Trees would be stockpiled and made available to the public for personal use. Small debris would be hauled to the city landfill and burned. The site work would also consist of grading of the bank to provide an even slope for placement of the filter material and riprap.

Several sources of rock are located within the general vicinity of Galena. For cost estimating purposes, it was assumed that the Mueller Mountain quarry would provide the riprap for this project. Because of the marshy terrain between the quarry and project site, transportation of rock would occur during the winter and would require construction of a single-lane winter ice road. The ice road would be about 8 miles long. About 1,800 feet of bank would be protected using riprap. Planimetric and cross-section views of the recommended plan are shown in Figures 7 and 8.

8.2. Utility Relocations

A fuel line and hose connection is located near the project area at the downstream end of the project and is used to off load fuel barges. These features are set back far enough from the top of bank that they will not be impacted by the project. No utility relocations are required to construct the recommended plan.

8.3. Real Estate

The land involved in the project is located along the north bank of the Yukon River, City of Galena, Alaska. The project will begin from where the Phase II project constructed by the Corps of Engineers in 1987 ends and extend east approximately 1,800 feet upstream. The recommended plan includes backfill and grading of the bank to achieve an even slope for placement of riprap material. Riprap will be placed from the top of the bank to below mean high water. Real estate interest necessary for construction of either Section 1 or Sections 1 and 2 are considered equal because of the minimal project area and close proximity of the sections.

The Non-Federal sponsor, City of Galena, will be required to provide all lands, easements, relocation, and right-of-ways (LERR) necessary for construction, operation, and maintenance of the project. The project is being constructed at full-Federal expense; therefore, the City will not be afforded credit for the value of the LER provided. Any lands acquired for the project will be accomplished in compliance with Public Law 91-646, as amended.

Real estate requirements for the project are:

a. A 10-year easement for construction and subsequent maintenance of the rock revetment, estimated at 3 acres. Under the terms of the project cooperation agreement, the City will only be required to maintain the project for a period of 10 years. Standard estate number 8 has been changed from an easement in perpetuity to a 10-year temporary easement consistent with Non-Federal Sponsor's obligations under the agreement. The non-standard estate has been approved by the District Chief of Real Estate under authority of Para 12-10, Chapter 12, ER 405-1-12.

b. A 1-year temporary easement for access and staging areas, standard estate number15, estimated at approximately 1 acre.

No relocation assistance benefits IAW Public Law 91-646 will be required for this project. No utilities or facilities relocation are anticipated for this project.

Initial information indicates the uplands (fast lands) needed for the project are owned in fee by the City of Galena. This is sufficient interest for construction, operation, and maintenance of the project. Approximately 5 acres of project lands are below the mean high water line of the Yukon River are owned by the State of Alaska, Department of Natural Resources. It has been determined that navigation servitude is available for this project and, therefore, the City will not need to provide any real estate interest for project lands below the line of mean high water. An informal value estimate was prepared for this report. The value of lands and related expenses for the project are estimated as follows:

Table 4. Real Estate Costs

Item	Federal	Non-Federal
Lands		$2,500
Administrative, Non-Federal Lands	$7,500	$2,500
TOTAL	$7,500	$5,000

The Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability is attached. A schedule of one (1) month is estimated to complete certification of lands for this project

8.4. Consultation Requirements

The project alternatives and the recommended plan were evaluated during this study and a FONSI was signed _____ 2002. An environmental assessment was prepared with the finding that the project is not likely to have an adverse effect on the biological resources at Galena.

8.5. Public Coordination

The city of Galena has been an integral part of the study process during the development of this report and its recommendation. The city of Galena has stated their preference for the recommended plan.

8.6. Federal and Non-Federal Costs

Given the possibility of the Federal-funding limit being raised to $6,000,000 during the preparation of this report, the recommended plan was presented based on the two funding limits. This Federal limit may be raised to $6,000,000 in the fiscal year 2003 Federal budget. The Federal and non-Federal costs were determined for Section 1 ($3,000,000 funding limit) and Sections 1 and 2 ($6,000,000 funding limit) of the recommended plan. To ensure that the maximum environmental impacts of the study alternatives were evaluated, each alternative was configured and evaluated with the Federal limit of $6,000,000.

Cost sharing is based on the terms and conditions provided by Section 116 of PL 99-190. Project cost are a 100% federal cost with exception of LERR and administrative LERR, which are local costs. The total project and study cost for Section 1 ($3,000,000 limit), including the cost of $80,000 for this letter report and $10,000 for the PCA, is $2,980,000. The Federal cost is estimated to be $2,976,000, which includes the cost of $150,000 for PED and $2,498,000 for construction of the recommended plan. The non-Federal cost is $5,000 of which $2,500 is administrative and $2,500 is the cost of LERR.

The total project and study cost for Sections 1 and 2 ($6,000,000 limit), including the cost of $80,000 for this letter report and $10,000 for the PCA, is $6,000,000. The Federal cost is estimated to be $5,996,000, which includes the cost of $309,000 for PED and $5,147,000 for construction of the recommended plan. The non-Federal cost is $5,000 of which $2,500 is administrative and $2,500 is the cost of LERR.

Once this decision document is approved and a project cooperation agreement has been signed, a construction contract will be prepared to implement the recommended plan.

Table 5. Physical Characteristic and Cost of Recommended Plan (Section 1)

	Quantity	Unit	Unit Price	Total Cost
Topographical Survey	1	ls	$30,000	30,000
Construction Contract				
Mob and Demob	1	ls	$275,000	275,000
Site Clearing	3.5	ft^2	$0.17	26,200
Earth Work	64,800	yd^3	$5.06	327,900
Filter Fabric	129,600	ft^2	$0.40	51,800
Filter Stone	4,200	yd^3	$83	350,100
Riprap	12,600	yd^3	$83	1,050,300
Subtotal				$2,081,300
Construction Contingency			20%	416,300
Total Construction Contract				$2,497,600
Contract Documents				
Preconstruction, Engineering, and Design			6%	149,900
Supervision & Administration			8%	199,800
				$349,700
Contract Award + Construction				$2,847,000
Real Estate Land				2,500
Real Estate Administration				10,000
Total Project Cost (Contract Award, Construction, + Real Estate)				$2,890,000
Annual Cost (6 1/8% at 10 years)				$395,000
Annual Operation and Maintenance[a]				$2,000
Total Annual Cost				$397,000
Length of Bank Protection (ft)				810

[a]Replacement of 2% of the armor stone every 5 years, biennial inspections

Table 6. Physical Characteristic and Cost of Recommended Plan (Sections 1 and 2)

	Quantity	Unit	Unit Price	Total Cost
Topographical Survey	1	ls	$30,000	30,000
Construction Contract				
Mob and Demob	1	ls	$275,000	275,000
Site Clearing	342,000	ft^2	$0.17	58,100
Earth Work	144,000	yd^3	$5.06	728,600
Filter Fabric	288,000	ft^2	$0.40	115,200
Filter Stone	9,334	yd^3	$83.36	778,000
Riprap	28,000	yd^3	$83.36	2,334,100
Subtotal				$4,289,100
Construction Contingency			20%	857,800
Total Construction Contract				$5,147,000
Contract Documents				
Preconstruction, Engineering, and Design			6%	308,800
Supervision & Administration			8%	411,800
				$720,600
Contract Award + Construction				$5,868,000
Real Estate Land				2,500
Real Estate Administration				10,000
Total Project Cost (Contract Award, Construction, + Real Estate)				$5,910,000
Annual Cost (6 1/8% at 10 years)				$808,000
Annual Operation and Maintenance[a]				$3,000
Total Annual Cost				$811,000
Length of Bank Protection (ft)				1,800

[a]Replacement of 2% of the armor stone every 5 years, biennial inspections

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1. Conclusions

The economic analyses conducted as a part of this study show that the recommended emergency bank stabilization is not economically justified with a benefit-to-cost ratio of 0.17. However, the studies documented in this report do indicate that construction of emergency bank stabilization at Galena, as described in the recommended plan, is technically feasible and environmentally and socially acceptable. Construction of the recommended plan will provide immediate bank stabilization thereby reducing the risk of damage to residences, businesses, and existing bank protection measures and will delay the threat of long-term

flanking of the community. The city of Galena has indicated its willingness to act as a local sponsor for the project and fulfill all the necessary local cooperation requirements.

9.2. Recommendations

As directed by Congress, I recommend that the emergency bank stabilization measures at Galena be constructed in accordance with the plans described herein. Federal financial participation is limited to funds appropriated or that may be appropriated for the project. Currently, Federal participation is limited to $3,000,000 as appropriated in the Energy and Water Development Appropriations Act of 2001, as enacted by Section 1(a)(2) of P.L. 106-377. The estimated total project cost and study cost for Section 1 is $2,980,000. The total project cost (cost to construct the recommended plan) is $2,890,000, which includes the Federal cost of $2,498,000 for construction. Total non-Federal cost is $5,000, which includes $2,500 for LERR administrative and $2,500 for LERR.

Total project and study cost for Sections 1 and 2 is $6,000,000. Total project cost is $5,910,000, which includes a Federal cost of $5,906,000 for construction. Total non-Federal cost is $5,000, which includes $2,500 for LERR administrative and $2,500 for LERR.

The recommendation is made with the provision that prior to the start of construction, non-Federal interests shall agree to:

A. Provide all lands, easements, rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project;

B. Accomplish without cost to the United States all alterations and relocations of buildings, roads, bridges, and other existing structures or utilities made necessary by construction of the project;

C. Maintain and operate the project works after completion without cost to the United States of a minimum of 10 years after completion of construction of the project, in accordance with regulations prescribed by the Secretary of the Army;

D. Hold and save the United States free from damages due to construction of the project, not to include damages due to the fault or negligence of the United States or its contractors;

E. Comply with Section 601 of Title VI of the Civil Rights Act of 1964 (PL 88-352) and all applicable provisions of Section 210 and 305 of the Uniform Relocation Assistance and Land Acquisition Policy Act of 1970 (PL 91-646).

Date _____

Colonel, Corps of Engineers
District Engineer