V.

CEPOA-EN-CW-PF 28 July 2005

SECTION 905(b) (WRDA 86) ANALYSIS
KENAI RIVER BLUFF EROSION, ALASKA

1. STUDY AUTHORITY. This General Investigations study is authorized by the U.S. House of Representatives Public Works Committee Resolution for Rivers and Harbors in Alaska, adopted 2 December 1970. The resolution states in part:

Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Number 414, 83d Congress, 2d Session; ... and other pertinent reports, with a view to determine whether any modifications of the recommendations contained therein are advisable at the present time.

The Secretary of the Army was directed in the Energy and Water Development Appropriations Act of 2002, Senate Report 107-039, to expend up to $500,000 to conduct a "special technical evaluation of bank stabilization needs along the lower Kenai River."

2. STUDY PURPOSE. The purpose of the reconnaissance study is to determine the Federal interest in participating in a cost-shared feasibility study to provide bank stabilization at Kenai. This reconnaissance study was initiated in June 2002. The purpose of this Section 905(b) Analysis is to document study findings and, if Federal interest is warranted, establish the scope of the feasibility phase.

3. LOCATION OF PROJECT AND CONGRESSIONAL DISTRICT. Kenai is located on the western coast of the Kenai Peninsula, fronting Cook Inlet. It is approximately 65 air miles and 155 highway miles southwest of Anchorage via the Sterling Highway. The population of Kenai was 7,125 in 2003. The project area is shown on the Figure 1. The study area is in the Alaska Congressional District, which has the following congressional delegation:

Senator Ted Stevens (R);
Senator Lisa Murkowski (R);
Representative Don Young (R).

4. PRIOR REPORTS AND EXISTING PROJECTS.

a. Prior Reports.

Draft "Kenai River Bluff Erosion Technical Report", Kenai, Alaska", Corps of Engineers, Alaska District, January 2005. This report assessed environmental resources at the lower Kenai River, identified the mechanisms for bluff erosion, and assessed environmental and hydrogeomorphic consequences of bluff stabilization. The technical report is in draft format at the completion of this 905(b) report.

"Kenai Coastal Trail and Erosion Control Project", Peratrovich, Nottingham, and Drage, Inc., February 2002. This report provides a design concept of bluff stabilization and a pedestrian trail along the bluff.

"Erosion at the Mouth of the Kenai River, Alaska", University of Alaska Anchorage, Orson Smith, William Lee, and Heike Merkel, April 2001. Report contains a sediment budget analysis with regard to the proposed "Kenai Coastal Trail and Erosion Control Project", PND Feb 2002.

Draft "Bluff Erosion Study, Kenai River Sedimentation Study", TAMS Engineers, November 1982. This report identified groundwater seepage from the bluff face as the primary mechanism of bluff erosion and recommended control of this seepage as the first order of work towards bluff stabilization.

"Erosion and Sedimentation in the Kenai River, Alaska", U.S. Geological Survey, 1982. This report presented an assessment of erosion and sedimentation of the entire Kenai River.

b. Existing Projects. No significant bluff stabilization projects have been constructed. Minor works, such as overland drainage containment, revegetation, and fill have been used with limited success.

5. PLAN FORMULATION.

a. Identified Problems.

(1) Existing Conditions. The town of Kenai is located along the north bank bluff of the Kenai River at its mouth in Cook Inlet. Erosion of the bluff has continued to encroach upon city, commercial, and private utilities and structures. The Kenai bluffs are 55 to 70 feet high and are made up of poorly graded sands overlying hard, over-consolidated silt and clay. A typical section of eroded bluff is shown on Figure 2. The primary mechanism of erosion is ground water seepage at the interface between sandy and silt/clay soil layers. Other erosion mechanisms include waves and river currents undermining the fractured silt/clay layer, surface runoff, wind scour, and freeze/thaw cycles. Erosion has also resulted in properties and structures being abandoned or condemned. The city has had to relocate utilities and roads and cannot move forward with planning and development of the area.

Figure 2. Typical Eroded Bluff Section

(2) Expected Future Conditions. Unless the erosion is prevented, the bluff line will continue to encroach upon properties. The city will continue to incur the high cost of utility relocations and will not be able to move forward with city planning and development of the area. Structures and properties will continue to be rendered useless and uninhabitable and lose all value. Additionally, several historical structures and archeological sites could be lost to the erosion.

(3) Problems and Opportunities. Opportunities associated with bluff stabilization include:

- Reduce repair and relocation costs of public utilities
- Reduce relocation cost of public, commercial, and private structures
- Reduce repair and relocation cost of public roads
- Allow for long-term planning and development of lands adjacent to the bluffs

b. Alternative Plans. The No Action plan was evaluated. However, the lack of bluff stabilization would result in continued economic losses and limited development opportunities. Relocation of the endangered structures was considered. However, the high cost of relocation made this alternative cost prohibitive. In addition, the erosion would continue to encroach upon utilities and structures located further inland. Several methods of stabilization were considered and are discussed below.

Regrade Bluff and Revegetate – This would be the most passive system for stabilization. The upper bluff would be cut to a flatter slope and revegetated. The alternative would not address the groundwater seepage or erosion of the lower bluff due to waves and river currents. Revegetation may stabilize the upper bluff. However, continued erosion of the lower bluff would result in sloughing of the upper bluff. This alternative was eliminated from further consideration.

Sheetpile Wall – This alternative would consist of a sheetpile wall running the length of the bluff and to the top of the silt/clay layer. The upper bluff would be graded to a flatter slope and revegetated. Groundwater seepage through the bluff face would be addressed by a series of collector wells or collector drain system. The placement of sheetpile at the present bluff toe line and use of backfill would minimize the taking of uplands for project construction.

Armor Bluff Toe, Regrade Bluff, and Collector Wells – This alternative would consist of armor rock running the length of the bluff. The rock would extend to above the high water line. The upper bluff would be graded to a flatter slope and revegetated. A grouted cut-off wall and collector wells would address groundwater seepage through the bluff face.

Armor Bluff Toe, Regrade Bluff, and Collector Drains – This alternative would consist of armor rock running the length of the bluff. The rock would extend to above the high water line. The upper bluff would be cut to a flatter slope and revegetated. A collector drain would be installed along the bluff face at the top of the silt/clay layer.

c. Selected Plan. Comparison of plans was based on a qualitative assessment. All plans would extend the length of the bluff and would provide the same level of bank stabilization. The plan "Armor Bluff Toe, Regrade Bluff, and Collector Drains" was found to be the most cost effective and became the selected plan. See Figure 3. This selection was based on the assumptions that the cost of armor rock is less than the equivalent quantity of sheetpile and that the cost of collector drains is less than the cutoff wall and collector wells. For the selected plan the upper bluff would be cut to a flatter slope and create a 10-foot bench on the top of the silt/clay layer at the face. This bench would allow for access and placement of the collector drain system. The drain would collect and channel groundwater to a series of down-drain pipes for discharge to the river.

d. Economic Analysis. Benefit categories for the with-project condition are:

Land Value – The economic analysis was based on an erosion rate of three feet per year. This rate is considered conservative (faster) than that presented by the University of Alaska. A more conservative rate was used to bracket the maximum extent of damages, which could occur in the without-project condition.

At an assumed erosion rate of three feet per year, one half-acre of uplands would be lost annually to erosion. An average value per acre was taken of lots near the bluff that are unaffected by erosion and used to calculate the lost value of lands. Twenty-nine lots have lost some or their entire footprint to erosion. Once land becomes eroded to a certain point, the resale attractiveness becomes less and less. For this analysis, it was assumed that once 50% of the land has been lost to erosion that the remaining land will have no resale value. Twenty-six lots adjacent to the bluff are approaching a loss of 50% due to erosion. The current value of these lots is $540,000 according to the city's tax assessment records. Erosion is expected to continue at its current rate. This provides an annual cost of lands lost to erosion of $42,000 per year.

Utility and Road Relocations – The city has incurred cost to relocate utilities and roads along the bluff. Additional relocations will be necessary unless bluff is stabilized. The annual cost of the relocations is $39,000.

Structure Relocations - In addition to the land eroding, the buildings that reside on those lots are at risk of the bluff's erosion. There are approximately another 20 structures that will be at risk of the erosion of the bluffs within the next 20 years. The annual cost of structure relocations ranges from $50,000 to $90,000 with an average annual cost of $70,000.

For the with-project condition an average annual savings of $151,000 would be incurred.

e. Preliminary Evaluation of Alternatives. Annual benefit of the project is $151,000. The estimated cost of the project is $10,000,000 to $15,000,000. Given an interest rate of 5-3/8 percent and a 50-year period of analysis, the annual project cost range is $609,000 to $918,000, which includes the annual operation and maintenance cost of $25,000. The benefit to cost ratio range is 0.2 to 0.3.

6. ENVIRONMENTAL ANALYSIS. Surveys in the project area to inventory birds, mammals, fish and invertebrates were conducted. The Kenai River estuary is a very biologically productive area noted for its abundant fishery resources including all 5 species of salmon. Other species include, stickleback, lamprey, eulachon, rainbow trout, Dolly Varden, juvenile marine species such as walleye pollock, Pacific cod, tom cod, sole, Pacific herring, sand lance, Pacific sandfish, sculpins, snail fish, and shrimp species. Invertebrate species sampled were limited due to the hard substrates. Uncompacted substrates on the south shore provided habitat for small clams (Telina sp.) and marine worms, which are prey for many bird species. The shoreline and wetland in the area are used seasonally for nesting, foraging and staging by a variety of gulls, waterfowl, and bald eagles. Along the face of the bluff, the most common birds were ravens, magpies, herring gulls and swallows. Harbor seals are routinely observed near the river mouth. Beluga whales were also observed.

There are the remains of two archaeological sites and four structures eligible for the National Register of Historic Places that could be impacted by continued erosion during the project's period of analysis. There are about 14 additional structures that could be impacted. The historical significance of these structures is unknown.

Feasibility level studies of bluff stabilization would be required to conduct evaluations under the Clean Water Act, National Historic Preservation Act, National Environmental Policy Act, Coastal Zone Management Act, Essential Fish habitat, Endangered Species Act, and Fish and Wildlife Coordination Act.

7. FEDERAL INTEREST. This reconnaissance analysis finds that the potential national benefits of a bluff stabilization of the Kenai River at Kenai do not outweigh the cost of the implementation. Therefore, Federal participation in a more detailed feasibility study of bluff stabilization at Kenai is not warranted at this time. However, if the local interest desires additional technical assistance it could requested through the Corps' Planning Assistance to States Program.

8. PRELIMINARY FINANCIAL ANALYSIS. Not applicable, a feasibility study is not recommended.

9. SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS. Not applicable, a feasibility study is not recommended.

10. FEASIBILITY PHASE MILESTONES. Not applicable, a feasibility study is not recommended.

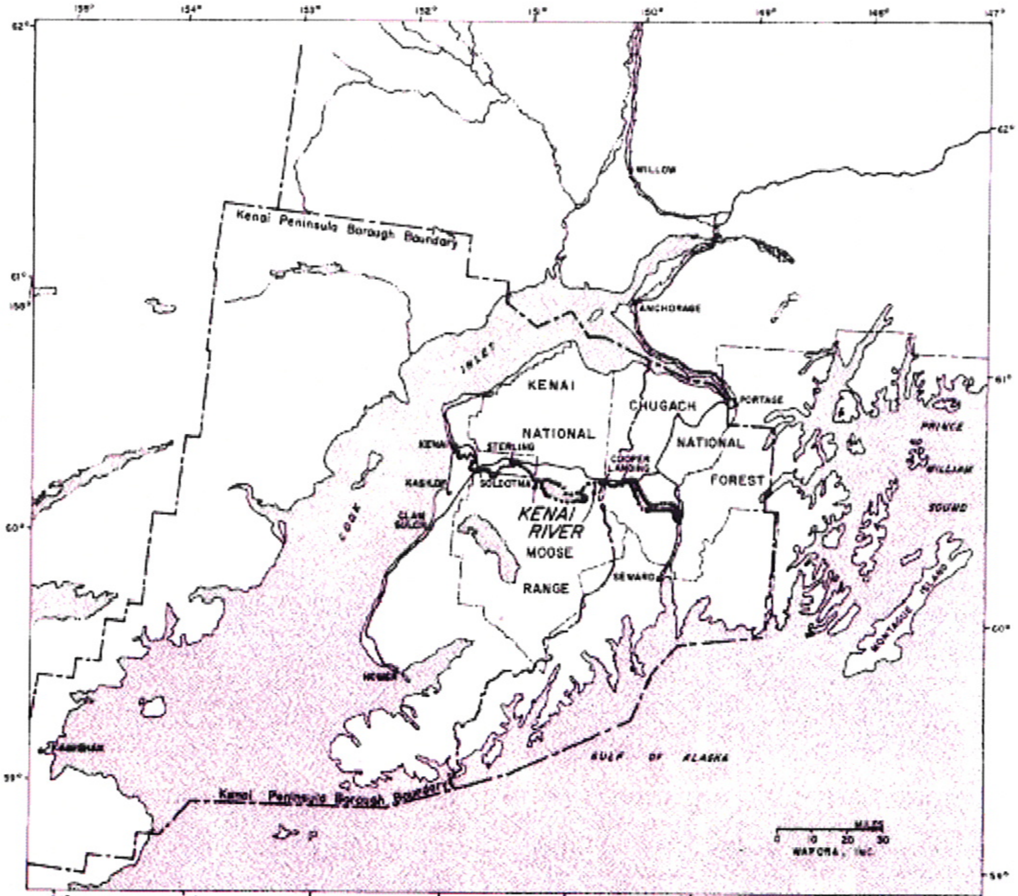
11. FEASIBILITY PHASE COST ESTIMATE. Not applicable, a feasibility study is not recommended.

12. RECOMMENDATION. The findings of this report indicate that bluff stabilization may be feasible from a technical engineering perspective. However, the amount of national economic development benefits available would not support Federal participation in a cost-shared feasibility study under existing shore protection authorities until changes in the socioeconomic or physical environment warrant a restudy of the area. If the local interest desires further technical assistance it could be pursued through additional congressional legislation. Additional studies should focus on field data collection to address erosion from groundwater seepage, identification of cultural resources, and analysis and design of bank stabilization measures.

13. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE. Not applicable, a feasibility study is not recommended.

14. VIEWS OF OTHER RESOURCE AGENCIES. Because of the funding and time constraints of the reconnaissance phase, only limited and informal coordination has been conducted with other resource agencies.

15. PROJECT AREA MAP. A map of the project area is shown on Figure 1.



REGIONAL LOCATION OF THE KENAI RIVER - FIGURE 1.

Figure 1. Location Map

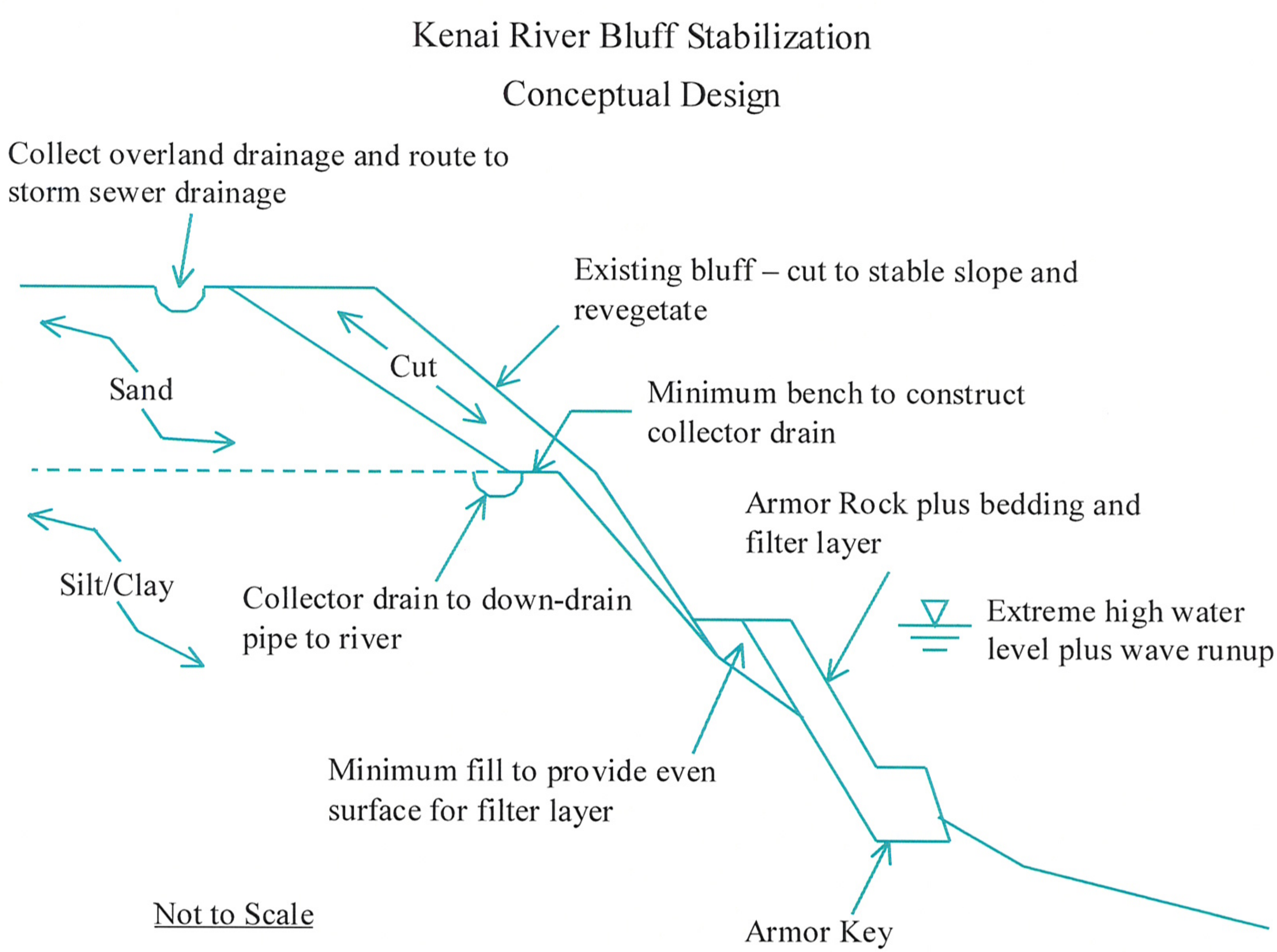


Figure 3. Selected Alternative

VI.

Rick Koch

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
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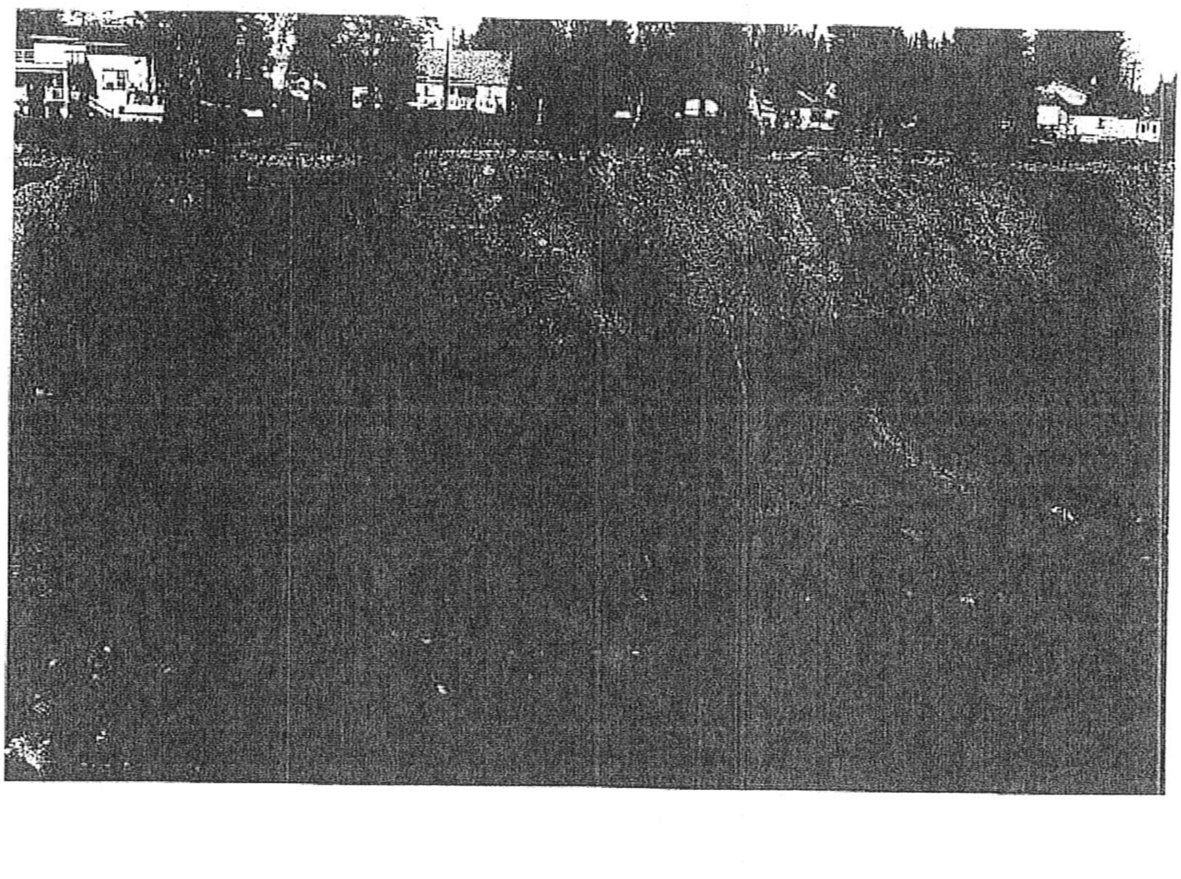
KENAI RIVER BANK EROSION TECHNICAL REPORT KENAI, ALASKA

May 2006



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SUMMARY

This report presents the findings of a technical investigation of bank erosion along the Kenai River at the city of Kenai, Alaska. The Secretary of the Army was directed in the Energy and Water Development Appropriations Act of 2002, Senate Report 107-039, to expend up to $500,000 to conduct a "special technical evaluation of bank stabilization needs along the lower Kenai River."

The city of Kenai and the lower reach of the Kenai River are located on the Kenai Peninsula, approximately 65 air miles and 155 highway miles southwest of Anchorage via the Sterling Highway. The section of riverbank being studied is along the north bank of the river, between the mouth of the river and the city.

Erosion of the bank along the Kenai River at Kenai has continued to encroach upon city, commercial, and private utilities and structures. The city has had to relocate utilities and roads, and cannot move forward with planning and development of the area along the bluff. Erosion has also resulted in properties and structures being abandoned or condemned. The steep and unstable bank is a safety risk to residents and visitors to Kenai. The city and residents currently incur an average annual loss of $151,000 due to reduced value of lands and buildings and relocation of buildings and utilities.

A number of forces contribute to the bank erosion such as wind, waves, foot traffic, overland drainage, groundwater seepage, and river currents. The primary contributor of erosion is groundwater seepage out of the bank face, which causes the piping of fine sand material from the upper bank and weakening of the lower silt/clay layer. The eroded material is initially deposited on the bluff toe where it is then subjected to further erosion from wind, waves, and river currents. Further studies and bank stabilization project designs should first address groundwater seepage.

To estimate the impacts of a stabilized bank it was assumed that the bank stabilization conceptual design by Peratrovich, Nottingham, and Drage, Inc. (PND) in their February 2002 report was the with-project condition. Primary features of this concept would consist of an armor stone layer along the lower bank with the upper bank cut to a shallower grade and revegetated. Groundwater seepage out of the bank face would be routed through a collector drain and discharged to the river. Although it is recognized that the PND design was at a conceptual level, additional analysis and design should first focus on groundwater seepage and collection.

There is the potential for direct and indirect loss of habitat from stabilization of the bank. Direct habitat loss would occur from project construction in the intertidal area and also result in a loss of potential nesting habitat for swallows if the bank grade is altered. Change of the bank grade would remove numerous spruce trees from the top of the bank. Bald eagles commonly use these trees to perch and overlook the river and associated wetlands. If the bank is cut back to a more shallow, stable slope and subsequently revegetated, it is likely that the new vegetation will provide some bird habitat. There will likely be disturbance and displacement of birds during some phases of construction. Many adverse impacts to birds can be avoided through the use of construction windows.

Hydraulic modeling was performed to compare the existing and with-project conditions. Results of the modeling indicate that the project would have minimal encroachment on the river flow path and would have an insignificant impact on river currents.

Indirect impacts would encompass effects of the erosion control project that are encountered outside the project footprint. Of particular concern are the sand dunes and the large intertidal area in front of the dunes and the sewage treatment plant. According to the sediment impact analysis, see Appendix C, the impacts to the dunes from an erosion control project are expected to be minor. Although armoring the bank would decrease the amount of sediment entering the system, this quantity is small in comparison to the overall amount of sediment contributed from other sources in the river.

Although the bluff is receding, geotechnical analyses indicate that the slope is stable and that massive slope failures are not contributing factors to the erosion. Both the sand and clay slope faces, however, are susceptible to surface raveling, sloughing, and wind and water erosion. Well flow tests were also conducted along the bluff. The tests indicate that the sand layer of the bluff is highly permeable. However, the number of tests performed was insufficient to adequately map groundwater flow patterns suitable for detailed design of a bluff stabilization project.

VII.

DRAFT SUBMITTAL

GEOTECHNICAL INVESTIGATION AND SITE CONDITIONS REPORT

KENAI RIVER BLUFF EROSION

KENAI, ALASKA

CONTRACT NO. W911KB-05-D-0004
DELIVERY ORDER NO. 0010
MODIFICATION NO. 01

Prepared for:

U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. Box 6898
Elmendorf AFB, Alaska 99506

January, 2007

R&M CONSULTANTS, INC.

5.4 Bluff Erosion

The primary cause of erosion along the bluff within the project area was interpreted to be removal of material from the toe of the bluff by river currents and wave action. This can be seen when one compares the bluff within the project area to its continuation to the west where the toe was set back from the water. Without the removal of debris and undercutting of the toe by current and wave action, the slope in that area stabilized at an angle of about 38 degrees and became vegetated. No active erosion was observed in that area. There is no reason to believe that soil conditions to the west of this project area were significantly different than those within the project area. The bluff face tends to retreat due to continuous removal of both in-place material and material sloughed off the slope face, and by undermining of the toe.

Numerous secondary processes were interpreted to be involved in the raveling and sloughing of the bluff face, including the following:

- Softening of the clay by water, particularly the water flowing off the top of the glacial till and river water along the toe of the bluff.
- Undercutting of the alluvial sand by retreat of the glacial till.
- Undercutting of glacial till by erosion of sand pockets as described in Section 5.2.6.
- Groundwater sapping undercutting the bottom of the alluvial sand along the bluff face.
- Falling trees dragging the organic mat down the slope.
- Frost action.

It appeared that the very hard clay would soften when exposed to water (slaking). In areas where the clay was exposed to standing or slow moving water it was soft. This did not occur in areas where water was observed to be actively flowing over the clay, which may have been due to flowing water carrying the clay away as it softened it. As the clay retreats, it undermines the alluvial sands above causing them to retreat.

Small local areas of what appeared to be groundwater sapping were noted along the bluff. Groundwater sapping occurs where groundwater flows out of a bank or hillslope laterally as seeps or springs and erodes soil away. This may cause the slope above to be undermined and fail. In areas along the bluff where sapping appeared to have occurred, a relatively higher rate of flow was observed. These areas were typically between 10 and 20 feet wide. The steep walled gully through which Ryan's Creek flowed may have been created by groundwater sapping. Groundwater sapping appeared to have only a locally significant effect on erosion along the bluff.

Trees that fell at the top of the bluffs were observed to drag large sections of topsoil in their root wads down the bluff, accelerating the erosion along the top of the bluff. Where trees had been cut the organic mat would lie over the slope, apparently slowing the erosion.

During the November, 2006 drilling program the lower slopes of the bluff were covered by a thick layer of ice. One afternoon it warmed into the upper 30s with the sun shining directly on the bluff face. We noted cobbles and boulders falling out of the bluff face as it thawed. Large pieces of ice also slid down the slope carrying soil with it. It appeared that a significant amount of material moved downslope during the four to five hours these conditions existed.

Debris piles were also observed along the bottom of the slopes. These consisted of a heterogeneous mixture of wet, very soft clay, sand, gravel, organic material. This material appeared to have raveled or flowed downslope from the bluff above. It also included trees that have broken off the top of the slope. Flow failures were noted in the debris slopes where they had been undercut.

Presumably, if the erosion of the toe by current and wave action stopped, the debris piles would build up. As the slope retreated back to an angle of about 35 to 40 degrees, vegetation would become established which would further stabilize the slope. The stable slope condition which occurs in the absence of toe erosion an be seen in Soil Profile SP-A.

6.0 CONCLUSIONS

The following conclusions are based on data collected from library searches, report reviews and R&M's field work and testing. Geotechnical investigations for the Kenai River Bluff Erosion Study reveal that:

1. The site is located within the Kenai Lowland portion of the Cook Inlet-Susitna Lowland physiographic province.

2. Segregated stands of primarily spruce trees are present along intermittent portions of the bluff crest. The toe of the bluff area is primarily devoid of vegetation.

3. Soils at the project site generally consist of alluvial deposits overlying glacially modified marine deposits (glacial till). The two units were separated by a thin layer of lag gravel from which a year-round flow of groundwater emerges from the bluff.

4. On the basis of currently available information, it appears that bedrock is located at a considerable depth beneath the project site. Therefore, bedrock is not expected to be involved with any construction considerations.

5. Observations and monitoring well readings indicate that there were two different groundwater aquifers within the upper 100 feet at the project area. The upper aquifer flows from the bluff at the contact between the upper alluvial deposit and the lower glacial till. Technical studies and reports have noted seeps and springs emerging from the bluff at this contact for at least the past 100 years.

6. The elevation of the lower aquifer along the face of the bluff appeared to be influenced by tides.

7. Permafrost has not been encountered, nor should it be expected, within the project area.

8. Cemented layers of sand and gravel appeared to allow the soil to stand near vertical where the cementation occurred. There was no water observed seeping from the bluff at some of these cemented locations.

9. Marine clay within the glacial till unit was plastic with an average liquid limit of 27, and a plasticity index of 11.

10. Permeability tests conducted on the alluvial material indicated a permeability in the vertical direction of about 10^{-4} ft/sec. It is likely that this value does not represent the overall permeability of the unit. The presence of gravel layers would likely result in a much higher permeability in the horizontal direction.

11. Consolidation and triaxial strength tests conducted on the glacial till material indicated that the material was hard, overconsolidated, and strong. The average dry density of the specimens was 118 pcf. The compression index C_c ranged from 0.06 to 0.07

12. Geologic logging of the bluff and the test borings indicated that the soils contain a large number of boulders. Therefore, any excavation contractor should be prepared to deal with said over-size material.

13. Contractors should also be prepared to deal with the soft, quick conditions of the soils along the tide flats (see Figure 20).

14. Within three months of the 1964 Great Alaska Earthquake, the bluff had receded as much as 20 feet within the project area. This was attributed to regional subsidence, rapid removal of sloughed debris along the toe, and undercutting by waves and the river.

15. The retreat of the bluff appears to be caused by several processes including erosion at the toe of the bluff by current and wave action, slaking of the glacial till by groundwater and surface water, groundwater sapping of the alluvial sand, and frost action.

16. It is expected that in the absence of toe erosion by current and wave action, the slope will naturally flatten to an angle between 35 and 40 degrees and become vegetated.

VIII.

Kenaitze Indian Tribe I.R.A.

255 Ames Rd.
Kenai, Alaska 99611
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Honorable Ted Stevens
United States Senate
522 Hart Building
Washington, D.C. 20510-0201
(202) 224-3004
Fax (202) 224-2354

Subject: Kenai Bank Stabilization Coastal Trail Construction Project

Wednesday, March 8, 2006

Dear Senator Stevens:

The Kenaitze Indian Tribe, IRA is proud to represent the interest of the Kenaitze people, the First People of the Kenai. Generations of the past, present and future find our hearts and homes on the Kenai. Our history is literally imbued in Old Town whether it is in memories shared by our elders of days on the mouth of the river or in artifacts buried in the eroding bluffs.

This is a very significant area to our people, and with that The Kenaitze Indian Tribe vigorously supports the City of Kenai proposed "Kenai Bank Stabilization Coastal Trail Construction Project." This is a bluff stabilization and erosion protection project that runs approximately one mile along the Kenai River from the mouth of the river. This paramount project has the following benefits:

- It will stop the damaging erosion of the coastal area near the mouth of the Kenai River.
- It will save public and private property from eroding into the Kenai River.
- It will save and protect the wetlands area around No Name Creek.

- The multi-purpose trail will provide a scenic walkway with safe, easy beach access down the bluff at several locations.
- It will provide important access points to Old Town Kenai, which is an important historic area to Kenaitze people of past, present and future generations.
- It will create long-term economic benefits for tribal and community members by enhancing Kenai's reputation as a tourist destination.
- It will show honor and respect to past and future generations whether Kenaitze or not, we are all the People of the Mouth of the River,

The Kenaitze Indian Tribe is in wholehearted support of the City of Kenai's proposed "Kenai Bank Stabilization Coastal Trail Construction Project" and encourages the United States Government to fund this historic and economically significant project.

Sincerely,

Connie Wirz
Executive Director
Kenaitze Indian Tribe

IX.

Kenai River Bluff Erosion
Cost Estimate
for
Design & Construction
Calendar Year 2010 Construction

Cost Item Description	Unit	Quantity	Unit Price	Sub-Total
Mobilization & De-Mobilization	LS	1	$ 350,000.00	$ 350,000.00
Survey	LS	1	$ 350,000.00	$ 350,000.00
Traffic Control	LS	1	$ 50,000.00	$ 50,000.00
Unclassiified Excavation	CY	325000	$ 10.00	$ 3,250,000.00
Classified Fill & Backfill	Ton	525000	$ 8.00	$ 4,200,000.00
Filter Rock	Ton	20000	$ 12.00	$ 240,000.00
Armor Rock	Ton	175000	$ 18.00	$ 3,150,000.00
Geotextile Fabric	SY	40000	$ 2.00	$ 80,000.00
36" Perforated CPEP	LF	5280	$ 75.00	$ 396,000.00
36" PCEP	LF	3600	$ 65.00	$ 234,000.00
36" End-Section	EA	30	$ 150.00	$ 4,500.00
Manhole	EA	30	$ 2,500.00	$ 75,000.00
Fence	LF	6000	$ 18.00	$ 108,000.00
Topsoil	CY	10000	$ 15.00	$ 150,000.00
Seeding	LB	1000	$ 125.00	$ 125,000.00
Trees	EA	250	$ 35.00	$ 8,750.00
Concrete Structures	EA	60	$ 2,500.00	$ 150,000.00
Crushed Aggegate Base Course	Ton	4500	$ 30.00	$ 135,000.00
Asphalt	Ton	6500	$ 70.00	$ 455,000.00
		Sub-Total		$ 13,511,250.00
		Contingency @ 20%		$ 2,702,250.00
		Sub-Total		$ 16,213,500.00
		NEPA		$ 350,000.00
		Design @ 8%		$ 1,297,080.00
		Const. Admin @ 12%		$ 1,945,620.00
		Total		$ 19,806,200.00