U.S. Army Corps of Engineers
Alaska District

Engineering Documentation Report Environmental Assessment and Finding of No Significant Impact

City Shoreline Emergency Bank Stabilization, Dillingham, Alaska

May 2009

EXECUTIVE SUMMARY

This Engineering Documentation Report describes the proposed solution to coastal erosion problems adjacent to Dillingham's small boat harbor at Dillingham, Alaska. Dillingham, with a population of about 2,370, is a major regional center in Bristol Bay and the site of a world class commercial salmon fishery. The town is 327 air miles southwest of Anchorage and 175 miles southeast of Bethel and depends on air and sea transportation.

Erosion is a constant threat to Dillingham, which is on a bluff overlooking the Nushagak River estuary. Projecting from historical data, future land loss is expected to average 0.20 acre per year. Main infrastructure in the study area that will be affected in the near future includes both private and public property, the small boat harbor mooring and launching facilities, the Bristol Alliance Fuels (BAF) facility, the city waterfront park and picnic area, and utilities.

Congress appropriated funds to the U.S. Army Corps of Engineers for Dillingham shoreline erosion control. This Engineering Documentation Report concludes the intent of Congress can be met by constructing a 950-foot-long rock revetment and a 391-foot-long breakwater along the west side of the harbor entrance and a 950-foot-long rock revetment east of the harbor entrance at an estimated initial construction cost of $12,380,000 for the West Side project and $8,180,000 for the City Dock Side project. These projects will effectively stabilize the banks that protect the small boat harbor and reduce the wave energy within the harbor that is causing erosion of the inner harbor banks and damaging the mooring facilities. This project will also protect the BAF facilities. The City of Dillingham will be responsible for providing leases, permits, lands, easements, rights-of-way, relocations, and disposal areas, estimated to cost $179,000. The city will also be responsible for future operation, maintenance, repair, replacement, and rehabilitation of the completed facility. The city agrees with the plan and agrees to provide the required real estate interests. The city also agrees to operate and maintain the completed facility. The project is environmentally acceptable and is consistent with state and regional planning.

This Engineering Documentation Report recommends construction of two rock revetments and a breakwater to stabilize the shoreline near the Dillingham Small Boat Harbor, in accordance with the authorization of Congress in Public Law (PL) 99-190 and PL 106-377.

Pertinent Project Data

Project Purpose	HSDR
Length West Side Revetment	950 LF
Length West Side Breakwater	391 LF
Length East Side Revetment	950 LF
Top Elevation of Structures	+ 32 MLLW
Cost West Side Features	$ 12,380,000
Cost East Side Features	$ 8,180,000
Benefit Cost Ratio	N/A

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ACKNOWLEDGEMENTS

This report was prepared by the staff of the Alaska District, U.S. Army Corps of Engineers in Anchorage, Alaska. The study planners were Mr. Bruce Sexauer for the West Side and Ms. Chelan Schreifels for the City Dock Side, both of the Project Formulation Section in the Civil Works Branch, Engineering Division. The project manager was Mr. David (Dave) Williams of the Civil Works Section of Project Management Division.

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Project costs for the West Side were calculated by Mr. Dennis Blackwell of the Cost Engineering Section, Engineering Services Branch, Engineering Division; Tt prepared the cost estimate for the City Dock Side. Ms. Ann Volz of Real Estate Division performed the preliminary analyses of real estate requirements for the entire study.

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Commander of the Alaska District during this study was Colonel Kevin J. Wilson.

1.0 INTRODUCTION

1.1 Authority

The issue of bank stabilization for the City of Dillingham's shoreline has been addressed through various authorities since 1986.

Section 116 of Public Law (PL) 99-190, enacted in 1986, reads as follows:

> *Sec. 116. The Secretary of the Army is directed to accomplish emergency bank stabilization work at Bethel, Dillingham, and Galena, Alaska, at full Federal cost, within available funds, at an estimated cost of $1,500,000. Such funds were previously appropriated in Public Law 99-141 (99 Stat. 564).*

The Conference Report for PL 106-377 contains the following language:

Title I, Department of Defense-Civil, Department of the Army Corps of Engineers-Civil, Operations and Maintenance, General, Page 211

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to extend the sheet pile wall on the west end of the entrance to the Dillingham, Alaska, small boat harbor, and to replace the existing wooden bulkhead at the city dock under the provisions of Public Law 99-190.*

The U.S. Senate Appropriations Committee report 103-291 on the Energy and Water Development Appropriations Bill of 1994 included the following language pertaining to Dillingham:

> *Dillingham Storm Damage Reduction — The Corps is encouraged to investigate measures to protect structures in Dillingham, Alaska threatened by an incomplete project. The committee expects the Corps to assess needs to complete the necessary repairs to the project and to itemize additional needs for submission in the next authorization process.*

U.S. Army Corps of Engineers' Headquarters and Pacific Ocean Division Guidance is as follows:

> The Alaska District is to proceed with authorized planning, engineering, and design for bank stabilization using funds from the applicable appropriation account. The Alaska District is to prepare decision documents and submit them to the ASA (Civil) through the Pacific Ocean Division for additional guidance. The Alaska District is to seek additional guidance from the Pacific Ocean Division prior to submitting a PCA or PCA amendment or making any commitment regarding contract solicitation or items of non-Federal cooperation.

Section 116 project authority has been used multiple times to construct previous projects at Dillingham and also at Bethel and Galena, Alaska.

1.2 Scope of Engineering Documentation Report

This report documents the problems and opportunities related to erosion issues in the City of Dillingham, consistent with the specific study and project authorizations listed

previously in this report. The effort for this report included multiple site visits, hydraulic design analysis, coordination with various stakeholders, and development of economic, engineering, and environmental analyses. This report summarizes the findings of the efforts and explains the recommended plan.

1.3 Previous Studies and Projects

The following studies and reports were reviewed.

1.3.1 Studies

Numerous studies have been done in the Dillingham area; 13 studies were done by the Corps, and at least three studies were done by others dating from 1960 to 2002. See Appendix A for a comprehensive list of studies.

1.3.2 Previous Projects

Previous efforts to control riverbank erosion in Dillingham include 1,600 feet of sheet-pile bulkhead at Snag Point built by the Corps of Engineers between 1995 and 1998 (USACE 1995, 1997), and about 600 feet of sheet-pile bulkhead built by the Corps immediately east of the harbor entrance and about 400 feet of riprap revetment on the east bank of the entrance channel in 1999 (USACE 1998). The timber plank and pile bulkheads built in 1983 by the city, cited in PL 106-377, were replaced by the city in 2004-2005 with an open cell sheet-pile bulkhead and will not be addressed further in this report. In addition, Bristol Alliance Fuels installed a sheet-pile wall to protect their facilities west of the harbor entrance channel.

Other private efforts to control erosion have been attempted along the west bank of the harbor entrance channel. These efforts consisted of sheet-pile and wood bulkheads that failed to withstand the energy of storm waves, and their remains offer little or no stabilization to the shoreline in this area today.

1.4 Community Description

The City of Dillingham, population 2,370 (2004 State Demographer estimate) is in southwestern Alaska, approximately 327 air miles southwest of Anchorage (see figure 1). Dillingham is not connected to other population centers by road or rail and is totally dependent on air and marine services for supplies and transportation. The Dillingham census area includes 11 small communities along the northeast edge of Bristol Bay.

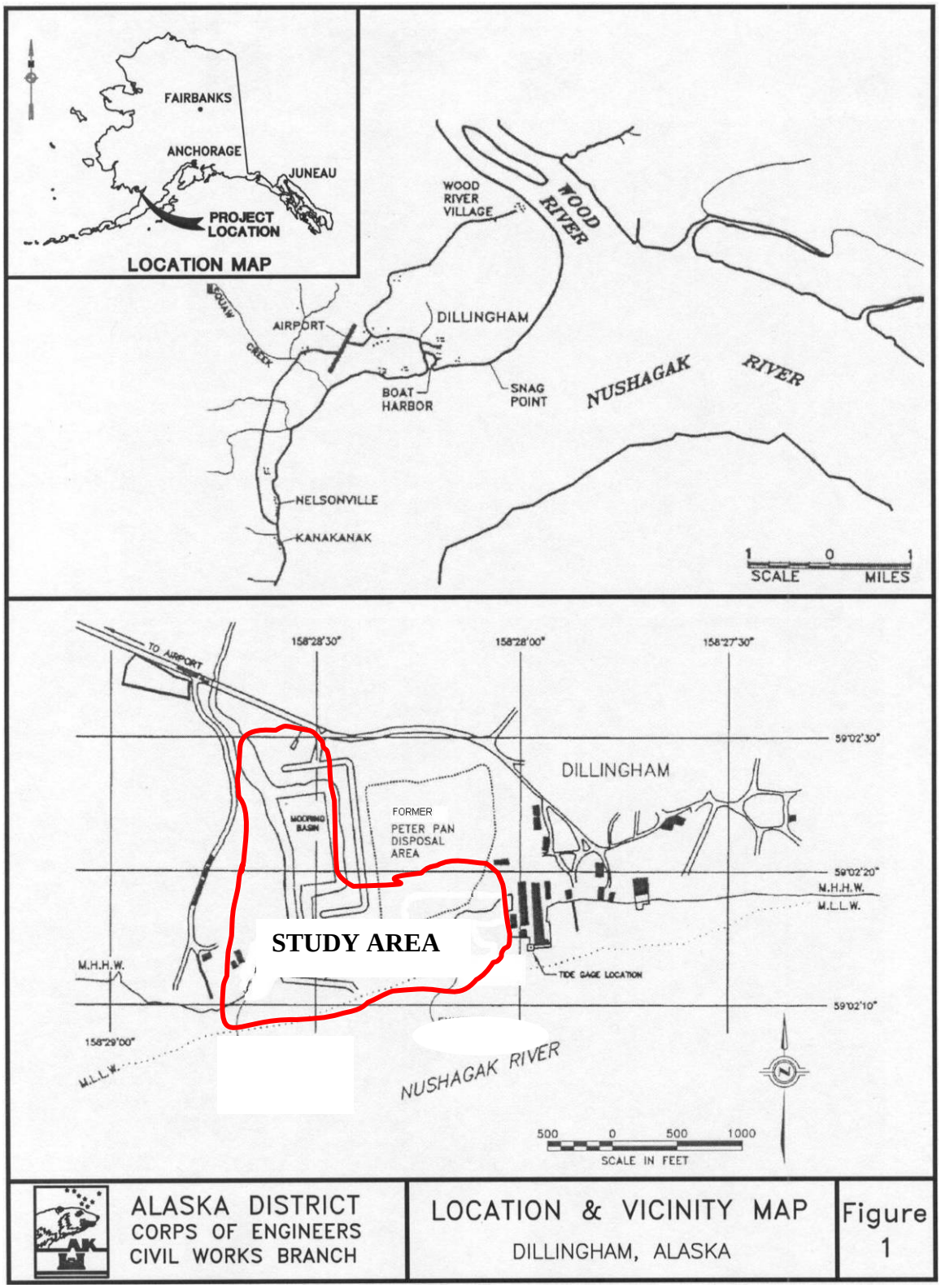

Figure 1. Project Study Area

The project study area shown in figure 1 can be considered as two separable project elements. The project sites are uniquely different in location, in the areas of the shoreline and facilities of Dillingham being protected, and different in the types of resources

benefiting from the protection. The two sites were originally analyzed in separate reports, which were later merged into one. These areas are defined as the West Side and the City Dock Side and are analyzed separately in the remainder of this report.

The West Side encompasses the eroding land within the Dillingham Small Boat Harbor and along the shoreline of the Bristol Alliance Fuel Company (BAF). The City Dock Side encompasses the eroding stretch of land that begins immediately east of the small boat harbor and existing sheet-pile wall and continues east to the Peter Pan Seafoods fish processing facility.

2.0 PLAN FORMULATION

2.1 Problems and Opportunities

The Secretary of the Army has been directed to perform emergency bank stabilization along the shoreline at Dillingham. Erosion of the bluffs along Dillingham's shoreline has been a continuous problem. To date, critical segments along 4 miles of Dillingham's eroding shoreline have been protected, but other unprotected segments of the city's shoreline continue to erode.

As recently as August 2005, storm surge has inflicted major damage to the Dillingham shoreline. The August 2005 storm washed away up to 10 feet of the shoreline, overtopped the sheet-pile seawall at the parking lot by at least 2 feet, washed parked vehicles into the harbor, and washed boats that were moored in the harbor up onto dry land. Water elevation at the time of overtopping included a tide elevation of about 20 feet MLLW. Based upon an estimated surge of 3 feet, the total height of water when the wave crest was at the wall was estimated at 23 feet MLLW.

Photo 1. Storm waves breaking over the outer banks of the harbor.

Photo 2. Storm surge in the harbor.

2.1.1 West Side

Average erosion per year for the West Side for the period of analysis from 1972 through 2001 was 10.8 linear feet, with an estimated 5.7 acres lost since 1972. The Dillingham Small Boat Harbor has historically been protected by the point of land near Scandinavian Beach. Surveys performed for the 1960 boat harbor project show Scandinavian Beach extending 700 feet from the top of the west bank, across the opening of Dillingham Harbor with a top elevation of 10 to 15 feet above MLLW. Topographic information collected in 2001 shows that this entire 700-foot section has eroded away, with the west top of bank receding by about 300 feet. In recent years, erosion along the west side of the un-stabilized bank area has progressed to an extent that it has washed away the point of land at Scandinavian Beach that protected the small boat harbor. In turn, exposure to open water has increased wave action within the harbor basin and subjected the fine soils along the inner harbor banks to erosion.

Historical documents do not mention erosion issues along the west bank of the harbor. This indicates that erosion problems likely developed over the last few decades. Since 1972 the shoreline has eroded more than 200 feet. This also led to the lowering of the beach profile by at least 10 feet vertically, thus allowing waves to enter the harbor much more freely. For example, the 1985 Dillingham, Alaska Final Detailed Project Report and Environmental Impact Statement does not mention waves entering the harbor. Since the late 1990's, waves from storms have been documented entering the harbor causing interior erosion, damage to vessels, and increasing the maintenance costs of existing harbor facilities.

The photos on the following page show the upper shoreline and bluff along Scandinavian Beach receding over time.

Numerous opportunities exist to address the erosion problems by applying bank stabilization techniques along a variety of alignments.

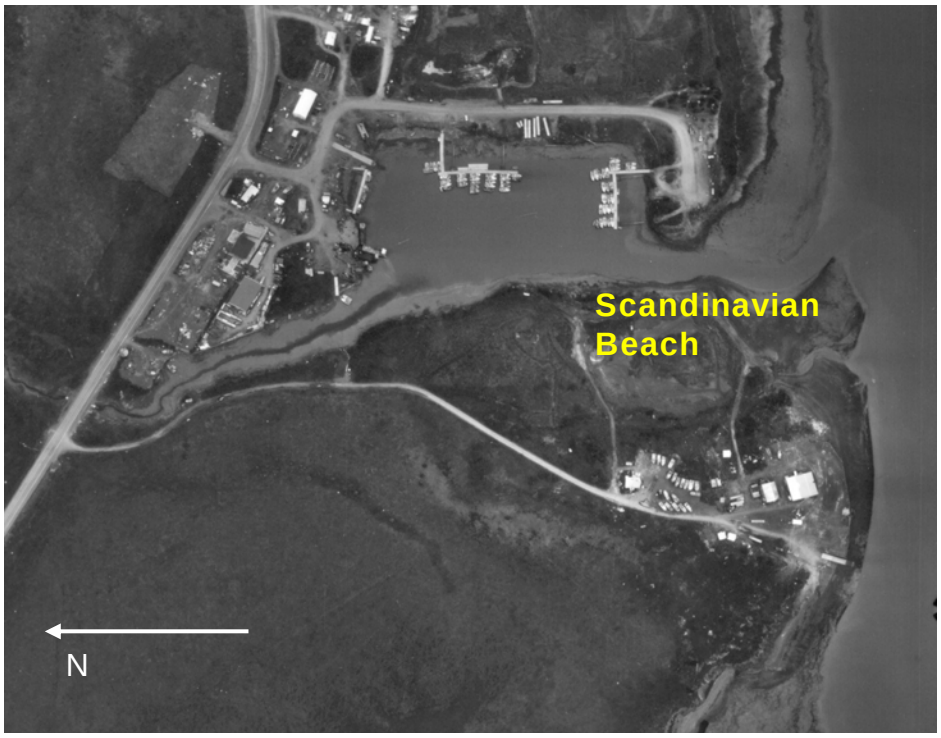

Photo 3. Scandinavian Beach in 1981.

Photo 4. Scandinavian Beach in 2001.

2.1.2 City Dock Side

The other area of immediate concern is the unprotected stretch of land between the city docks and the Corps-built sheet-pile wall. This stretch of land spans from the east terminus of the sheet-pile wall at the small boat harbor for approximately 1,000 feet east to the Peter Pan Seafoods processing plant. An average erosion rate along this 1,000-foot-long stretch has been documented, showing 4 linear feet per year from 1948 through 1967 near the project site, with an intensified rate during the period from 1963 to 1967. Up to 8 feet of erosion was documented during a single storm on August 7, 1980 (USACE, 1981 cited in City of Dillingham, Oct 1994). USACE (2001) estimated 100 feet of bank loss between 1991 and 2001. From 1972 to 2001, the erosion rate ranged from 2.4 to 7.6 feet per year. The difference represents rates at the slow and fastest points of erosion along the 1,000-foot section. During this period, an estimated 6.2 acres of land have been lost.

Historical erosion in the project area has been influenced by conditions that may not exist in the future without-project condition. The two water outfalls from the dredged material disposal area, for example, have developed channels through the near-shore vegetative cover, which have allowed more energy to arrive in the near-shore area. The vegetative cover has then been stripped in those areas by subsequent wave activity. The initial rapid erosion in these zones reflects the removal of that cover and the exposure of a more erosion resistant clay shoreline. The removal of vegetation has left the disposal area containment berm and other areas vulnerable to erosion, and some failures at the contact zone of the berm to original ground are already evident.

Photo 5. City Dock Side erosion at the park.

Photo 6. Containment berm 5 Sept. 2005.

Photos 5 and 6 show the dramatic erosion at the city park and the containment berm in 2005. The abandoned southwest outfall pipe provides a good visual indication of the extent of erosion. The berm has eroded so much that the culvert that previously protruded from the berm is now lying on the ground.

Upon initial inspection it has been determined that there are many opportunities to address the erosion problems by applying bank stabilization techniques along two alignments.

2.2 Planning Objectives and Constraints

The following objectives and constraints have been considered and were the basis for formulation of plans that would adequately address the erosion issues identified in the problem and opportunity statements.

2.2.1 Objectives

Both project elements have two main objectives: to eliminate erosion damages and to not interfere with other federal projects in the area. Both elements have features that are integrally linked with an existing Corps navigation project. Projects implemented under the authorization of Section 116 of Public Law (PL) 99-190 have used the least cost methodology to identify the recommended plan. This means that the least cost option that meets the project objectives will be the recommended plan.

West Side Objectives. In addition to erosion damages to the west bank, the ongoing erosion has caused the degradation of Scandinavian Beach and removed the natural protection previously afforded the harbor. Currently, waves and swell in excess of 4 feet enter the harbor, whereas in the originally designed harbor, the wave climate inside the

harbor was limited to 1 foot. Because of this, the West Side project has additional objectives as follows.

1. Replace the natural harbor protection that has been lost to erosion.
2. Prevent the upland contained dredged material from being released into the bay.
3. Minimize erosion impacts to the existing harbor facilities area.

City Dock Side Objectives. The primary need for the City Dock Side project is to significantly reduce the erosion threat to the existing dredged material disposal site and upland harbor facilities. If the dredged material disposal site is compromised, options for maintaining the Corps navigation project will be jeopardized. The upland harbor facilities include staging areas for the fishing fleet, a city park, and harbor parking. Because of these issues, the City Dock Side has two additional objectives as follows:

1. Maintain beach access to the tidal area as needed for dredging operations and traditional local access.
2. Allow for continued use of uplands for the park, fishing fleet, and other interests.

2.2.2 Constraints

Fisheries and the environment are always a concern to local, state, Federal, and Native stakeholders. Most important to Dillingham are commercial and subsistence fisheries, and design of project features will need to work within these environmental constraints. Constraints for the City Dock Side include additional site specific environmental concerns for marshes, traditional access to the shoreline, and ongoing operations of a regionally important industry. Being able to maintain current land and harbor practices both during construction and after completion are of critical importance. The community of Dillingham relies upon the harbor for access to the Nushagak River and Bristol Bay for importation and distribution of fuel and to maintain the commercial and subsistence fisheries. Because of this, the West Side has the following as additional constraints.

1. Projects should not adversely impact subsistence fishing activities on the beach.
2. Projects should not adversely impact salmonid habitat.
3. Projects should not hinder purposes of other Federal projects in the area.
4. Projects should not negatively impact the maintenance dredging of the harbor.

The City Dock Side is adjacent to a dredged material disposal project that abuts a salt water marsh near Peter Pan Seafoods, an important employer and industry in Dillingham. For these reasons, the City Dock Side has the following additional constraints.

1. Do not unnecessarily damage or impact the salt sedge marsh adjacent to the project area.
2. Do not impact the Peter Pan Seafoods historic district and processing plant.

2.3 Community Concerns

Dillingham residents have expressed numerous concerns about the erosion that threatens their city shoreline. Long-term erosion threatens important facilities such as the small boat harbor and fuel infrastructure. During a recent visit the city manager spoke about

the August 2005 storm; the storm surge overtopped the seawall and washed vehicles into the harbor.

Meetings were held in Dillingham with the Dillingham city manager regarding this study and subsequent project. The city manager expressed support for the study and project. The salmon fishery is of great concern to the local population, and any project would need to have minimal impacts to the fishery, both during construction and for the project life. Residents use the tidal flats to the east and west of the boat harbor entrance as subsistence set net sites. It is important that any coastal stabilization construction project be designed to minimize interference with this activity that is of both economic and subsistence importance.

2.3.1 West Side

The major concern of Dillingham residents with respect to the harbor area is that progressive erosion of the west bank of the harbor entrance has allowed wind and storm waves to have increased direct access into the harbor, causing damage to boats and harbor facilities.

The area in question is near the small boat harbor and close to a major fuel distribution center, making it a prime location for development of commercial marine supply, additional moorage, warehouses, or as a fish processing center. The current property owner, Bristol Alliance Fuel Company, has expressed a desire to keep the land accessible to the water so it can be developed for use in support of the harbor.

2.3.2 City Dock Side

The City Dock Side has been eroded so severely that the picnic pavilion's foundation and trees from the city park have been washed away. The erosion is also eating away at the base of the containment berm and the land in front of it. Loss of the city park is a concern to locals because it is the only waterfront park area in the city. In addition, this area is also used as parking for the harbor, which is important for loading and offloading vessels, performing maintenance, and other routine small boat harbor activities.

A meeting was held with the manager of the cannery, who represented Peter Pan Seafoods, the landowner, to discuss concept design and to clear up any concerns the landowner may have before the project was too far into the formulation phase. He expressed support for the project and indicated that he would cooperate with the city's efforts to obtain the necessary real estate interest as required for the project.

2.4 Existing Conditions

Dillingham's small boat harbor could be considered the backbone of the local and regional economy. It was constructed in 1960 and is a half-tide harbor. The harbor experiences extreme shoaling due to the silty waters of Nushagak Bay and must be dredged annually to maintain design depth. The harbor is used seasonally as a commercial fishing base by residents of Alaska as well as by others from outside the state. During the height of the fishing season, it is not uncommon to have vessels rafted 15 to 20 deep. The harbor basin's facilities consist of an open cell sheet-pile bulkhead dock along the north end, which is used for loading and offloading cargo, and three

seasonal floats along the north, east, and south banks, which are on swing arms to allow movement with the extreme tides. During the winter the floats are removed and stored on land.

Five species of Pacific salmon inhabit the Nushagak River estuary as juveniles and adults. Few marine mammals visit Dillingham's Nushagak Bay estuary; however, orcas and beluga whales and harbor seals are occasionally seen. Dillingham borders the southeast edge of the waterfowl rich Yukon-Kuskokwim River delta. Migratory birds and waterfowl pass through and sometimes stop in the Dillingham area. To supplement the limited economy, many residents depend on subsistence activities. Salmon, grayling, pike, moose, bear, caribou, and berries are harvested, and trapping of beaver, otter, mink, lynx, and fox provide cash income.

Most of the city is surrounded by wetlands of hydric soils and hydrophyte plants situated along the low bluffs overlooking the Nushagak River and Bay. Willow, alder, grass, and fireweed abound on riparian riverbanks, while the more elevated areas are vegetated primarily with black spruce and birch, with low to mid-level understory. As shown in figure 1, the study area lies along Nushagak Bay directly west and east of the mouth of Scandinavia Creek at the small boat harbor.

Average summer temperatures range from 37 to 66 degrees Fahrenheit. Average winter temperatures range from 4 to 30 degrees Fahrenheit. Annual precipitation is 26 inches, and annual snowfall is 65 inches. Heavy fog is common in July and August. Winds are predominantly from the southwest and have been recorded up to 60 to 70 mph between December and March. The Nushagak and Wood rivers converge in Nushagak Bay at Dillingham. The Nushagak River is ice-free from June through November. The confluence area is tidally influenced. Tides in the project area are semidiurnal, with monthly spring and neap tide cycles. Mean higher high water is 19.8 feet, and the extreme tide level is 23 feet. Additional details on annual cycles, monthly cycles, datum information, and station metadata are in Appendix A, Hydraulics.

Approximately half the permanent residents are Alaska Natives of Yup'ik (Eskimo) heritage who are affiliated with the Bristol Bay Native Corporation. The city's role as the regional center for government and services helps to stabilize seasonal employment. Most full-time, non-seasonal, and private sector jobs in the Bristol Bay region are in Dillingham. Commercial fishing for salmon and fish processing are the dominant economy of the city, and the population nearly doubles during the commercial fishing and fish-processing season. Two hundred thirty-six residents hold commercial fishing permits. Fish processors, including Icicle, Peter Pan, Trident, and Unisea, have operations near Dillingham.

2.4.1 West Side

The West Side study area encompasses the Bristol Alliance Fuels' (BAF) facilities from the terminus of the existing open cell sheet-pile dock to the mouth of Scandinavian Creek and the harbor basin, which is where erosion is of greatest concern due to the likelihood of damages. Erosion in the West Side study area has been progressing at an average of 10.8 feet per year, with an estimated 5.7 acres of land lost due to erosion from 1972 through 2001.

The city of Dillingham and BAF own the real-estate and improvements that are endangered. BAF owns the land to the west of the harbor and the fuel facilities, which supply about half of the city's avgas, unleaded gasoline, jet fuel, diesel fuel, and home heating oil.

BAF is the largest fuel facility in the Bristol Bay area. BAF is the major fuel supplier to the southwestern region of Alaska. BAF stores fuel for Crowley Marine barges so that Crowley can avoid sending large barges upriver and bottoming out in shallow spots. BAF supplies fuel to residents in the region for operating their boats and all terrain vehicles and, when the need arises, they also supply surrounding communities (such as Aleknagik, Manokotak, Clarks Point, and Koliganek).

Photo 7. Bristol Alliance Fuel facilities as seen behind the eroding bank.

In addition to the fuel facilities, a rock crushing facility operates at the BAF site. In 2003, BAF replaced their sheet-pile dock. The BAF dock is a good location for rolling on and off cargo and supports the construction industry in the region with loading and off-loading capabilities. Although the fuel facility is not currently threatened, it is expected that fuel lines used to operate the facility will become threatened within 7 years (by 2015). Damage to the BAF facility would be serious. There are other fuel providers in the area, but research has indicated that the loss of BAF would be a critical breakdown in fuel supply infrastructure, not only to Dillingham, but also to several outlying communities. The loss or severe damage of this facility would greatly impact the supply of fuel and other petrochemical supplies to the region. There would be significant life safety issues in that utilities and transportation in five communities would have their fuel supply opportunities greatly decreased. Cost for fuel in Dillingham and its outlying communities is at least double the cost in Anchorage. Any impacts to the fuel supply and storage could have a costly impact on fuel prices in the region. In addition to the economic impacts, there is the environmental concern that a spill of fuel oil or other petrochemical product would be extremely damaging to the environment, especially the highly valued salmon fishery.

2.4.2 City Dock Side

The City Dock Side study area includes an approximately 1,000-foot stretch of shoreline from the eastern terminus of the sheet-pile wall to the Peter Pan Seafoods processing plant. The uplands include a city park with a picnic area and a few pieces of playground equipment, a lost-at-sea memorial, a parking area and turnaround for the harbor, and the former east upland dredged material disposal site. The eastern edge of the project area is bounded by a vegetated salt sedge marsh that drains some local urban runoff through a small intermittently flowing channel. For the 29-year span, erosion in the City Dock Side study area has been occurring at an average rate 2.4 to 7.6 feet per year along the length of the project area for a total loss of 6.2 acres.

Photo 8. Erosion at the containment berm.

The formerly used east upland dredged material disposal site is a product of annual dredging operations at the small boat harbor as it must be dredged annually to maintain its design depth due to constant shoaling from the silt laden waters of Nushagak Bay. The upland facility reached capacity and was abandoned in 2004. Since then, in-water disposal has been used and will continue to be used for the foreseeable future.

2.5 Future Without Project Conditions

Without bank stabilization the historic rate of erosion, at high tide and during storm conditions, will continue and result in continued damages. Assuming weather, wind, and wave conditions remain reasonably constant, erosion is expected to continue as in the past in both study areas. Damages for the West Side and the City Dock Side are separable, so for the purposes of this Engineering Documentation Report, they were analyzed separately for damages, benefits, and cost. The period of analysis is 50 years. Additional information regarding future without-project conditions can be found in the environmental assessment and in the economics and hydraulics appendices.

2.5.1 West Side

The analysis for the West Side estimates the emergency installation of bank stabilization in 2015, likely under undesirable construction conditions (i.e. the winter months), at a greater cost than normal conditions. It is assumed that repair of the fuel facility and bank stabilization on private property would be at the landowners' expense. It seems unreasonable to assume that BAF would allow their facility to be damaged under the without-project condition. This fuel distribution company would expose themselves to significant regulatory intervention if they were to allow a fuel spill into Dillingham Harbor. Therefore, this study assumes that BAF would take whatever action was necessary to protect their facilities from damage.

Any damages related to the harbor system or city property would be at the city's expense.

West Side erosion is expected to continue at about the same rate as in the past. It is expected that erosion in this area would cause the entrance channel to be widened and the remnant of fast land at Scandinavian Beach, which had provided protection to the harbor, would continue to erode, exposing the inner harbor to more erosive wave action. The BAF sheet-pile wall will provide some stabilization for their property, but it will not protect against outflanking. Table 1 summarizes the without-project damages for the West Side of Dillingham Harbor.

Table 1. Summary of Dillingham Harbor Without-Project Damages for West Side

Economic Analysis Factors		
Period of Analysis:	50	years
Discount Rate:	0.04875	(FY08 Federal Discount Rate)
Price level:	April 2008	
Incremental Maintenance and Advanced Replacement		
Item:	**Present Value**	**Average Annual Damages:**
Moorage Floats:	$ 1,002,800	$ 53,900
Float Swing Arms:	5,900	300
Concrete Boat Ramps:	348,000	18,700
Harbor Bulkhead:	186,100	10,000
Total:	**$ 1,542,800**	**$ 82,900**
Land Lost to Erosion		
Average Annual Lost Acreage (years 1-9):		.194
Average Annual Lost Acreage (years 10-50):		.041
Value of Annual Lost Acreage (years 1-9):		$5,400
Value of Annual Lost Acreage (years 10-50):		$1,100
Present Value over Pd. of Analysis:		$51,900
Average Annual Equivalent Value:		**$ 2,800**
Vessel Damages due to Erosion		
Present Value over Pd. of Analysis:		$1,576,900
Average Annual Equivalent Value:		**$ 84,700**
Foregone Emergency Actions		
Expected Year of Emergency Action:		2013
Cost of Emergency Action:		$6,717,100
Present Value of Emergency Action Cost:		$4,556,200
Average Annual Equivalent Value:		**$ 244,800**
Damage Category		**Value of Damages:**
Average Annual Incremental Maintenance and Advanced Replacement		$ 82,900
Average Annual Land Lost to Erosion		2,800
Average Annual Vessel Damages due to Erosion		84,700
Average Annual Emergency Action Costs		244,800
TOTAL AVERAGE ANNUAL NED DAMAGES:		***$ 415,200***
TOTAL PRESENT VALUE OF NED DAMAGES OVER PERIOD OF ANALYSIS:		***$7,728,600***

Expected land loss for the West Side was divided into two time segments as emergency action is expected prior to 2015: 1.75 acres is expected to be lost in the initial 9 years, and 1.64 acres is expected to be lost in the subsequent 40 years for a total loss of 3.39 acres in 50 years.

West Side damages are expected in the following primary categories: continued land losses from erosion along the west end of the harbor and Scandinavian Beach; incremental maintenance and advanced replacement of the moorage floats, float swing arms, harbor bulkhead and concrete boat launch ramps; average annual vessel damages due to erosion; and emergency action costs from increased wave activity within the harbor. If unchecked, the erosion will cause damages to BAF. It is expected that with no action, the BAF fuels facility, specifically fuel lines and the facility fuel headers, will be threatened within 8 years.

2.5.2 City Dock Side

The analyses for the City Dock Side concluded that erosion is expected to continue in the area. For the City Dock Side, damages were assessed for the following categories: loss of function for existing harbor bank stabilization project, failure of Dillingham Harbor east dredged material disposal area, loss of the Dillingham City Waterfront Park, loss of the south harbor turnaround/parking area, impacts to utilities, and time delays for fishing vessels.

Expected land loss on the City Dock Side is 6 acres over the 50-year analysis period. Based upon field investigations by coastal hydraulics engineers, it is estimated that the structural integrity of the sheet-pile wall would be lost by 2015. At expected erosion rates, breach of the dredged material containment berm would likely occur within the next few years, which would result in the gradual release of the unconsolidated dredged material. The release of dredged material would be into an area highly used for departing and returning vessels from the small boat harbor, possibly causing some impact to navigation.

The city park would lose the last of its few facilities within the next few years. In its original state, the park consisted of a few park benches and a picnic shelter. The park is a popular summer activity for local residents and gathering place for social events in the community. The annual Blessing of the Fleet takes place each June and brings up to 150 people to the park. Several weddings and other social events take place at the park each year. The annual visitation is estimated to be 3,800 visitors. The usefulness of the park would be eliminated once these items have been lost to erosion.

Table 2 summarizes the without-project damages for the City Dock Side of Dillingham Harbor.

Table 2. Summary of Without-Project Damages for City Dock Side

Economic Analysis Factors		
Period of Analysis:	50	Years
Discount Rate:	0.04875	(FY08 Federal Discount Rate)
Price level:	April 2008	
Damage Category	**Average Annual Damage**	**Total Present Value**
Land Loss	$ 3,300	$ 62,000
Loss of Sheetpile Seawall	136,300	2,536,900
Loss of South Harbor Parking Lot	2,300	42,500
Impacts to Utilities	900	16,200
Launch and Retrieve Delay Costs	123,100	2,290,800
Loss of Park	24,900	463,500
TOTAL QUANTIFIED DAMAGES:	**$ 290,800**	**$ 5,411,900**
UNQUANTIFIED DAMAGES		
Economic Impacts and Public Safety Issues associated with Loss of Harbor South Parking Lot: Additional damages in the form of increased transportation costs and time delays will occur if no real estate is available within the same proximity to the harbor as the current lot. Additionally, structural modifications to the harbor moorage float system will be required to provide access to the harbors south float system and Public Works staff will require additional time/cost to place the south float system from the water when vehicular access to the south parking lot is lost.		
Public Safety Issues associated with Impacts to Utilities: These damages would also result in public safety concerns with loss of the street lights at the south end of the harbor and increased distance from the south harbor float system to relocated fire hydrant.		

After the park and sheet-pile wall were lost to erosion, the south harbor turnaround/ parking area would follow. Based upon existing erosion rates, it is estimated that the harbor would lose access and use of the south turnaround/ parking area in year 2020. The Dillingham Department of Public Works has identified several utilities that run under Harbor Road to the turnaround/parking area and would be impacted on the same schedule as identified for the turnaround/parking area (2020). These utilities include electric power lines for the street lights in the south parking lot, a phone line and telephone booth, and a waterline and fire hydrant. Delays in vessel launch and retrieval, which are associated with the loss of use of the harbor's existing south boat ramp and turnaround/parking area, would result in a reduction from two boat ramps to one. It is expected that there would be delays for commercial fishermen during their launch and retrieval process. For the purposes of this report, it is assumed that a 1 hour delay on launch and a 1 hour delay on retrieval would occur during the busy fishing season. This delay can be significant during a fishing opening when time is of the essence and commercial fishermen are working during a specific fishing window.

2.6 Alternatives

2.6.1 Developing Alternatives

According to ER 1105-2-100, bank stabilization improvements are usually structural measures including such features as beach fill, groins, seawalls, revetment, breakwaters, ,and bulkheads. Nonstructural measures, such as property acquisition, shall also be considered.

Several structural measures are typically used for shoreline stabilization and are briefly described as follows.

Armor Rock Revetments. The revetments would be constructed along the existing shoreline to secure the shoreline and protect the adjacent infrastructure from further damages.

Breakwaters. Breakwaters could be used to restore the protection of the harbor lost by the destruction of Scandinavian Beach. Breakwaters would protect docks, boat landings, vessels, and other harbor infrastructure. Constructing breakwaters could also reduce the size of the revetment needed within the harbor itself.

Sheet-Pile Wall Stabilization. This is a vertical wall installed on a cut bank to both deflect the wave attack and prevent the cut bank from collapsing. Typically made of wood or steel, the environmental conditions at Dillingham would require coated steel if pile was used.

Bioengineering Bank Stabilization. This is stabilization that uses natural and native materials to hold the slope and eliminate erosion, while providing some natural habitat for the surrounding environment. In the case of Dillingham, the upper banks of the erosion area could be an appropriate location for such features.

2.6.2 Formulation

Each measure, in order to be considered as part of an alternative, was compared against the planning criteria to determine if it suitably met the intent of the objectives and constraints.

The following alternatives were developed using suitable methodologies to examine a variety of plans to determine their effectiveness to meet the project objectives. See Appendix C Cost Analysis for the cost breakdown for each alternative, the Hydraulics Appendix for further detailed hydraulic design details, and the Economics Appendix for the detailed economic analysis.

2.6.3 Alternative Analysis

According to ER 1105-2-100, storm damage reduction benefits are categorized as wave damage reduction benefits, inundation reduction benefits, and other benefits. The primary benefit to be claimed for the two projects is reduction of current and future damages to existing structures and facilities as caused by wave action.

A preliminary cost estimate was prepared to accompany each concept design to determine which alternative decreased the greatest amount of damages for the least cost. After this alternative was identified, a more detailed cost estimate was developed for the selected alternative. The analysis, which was performed to select the most cost effective alternative, is described in the following paragraph. Detailed information can be found in the Cost Appendix.

2.6.3.1 West Side

Benefits considered during the West Side alternative analysis were the reduction of increased incremental maintenance and advanced replacement of infrastructure, a decrease in future emergency actions to protect shore side facilities, fewer damages to vessels caused by lost natural protection, a reduction in continued land losses from erosion, and prevention of the failure of the dredged material disposal area.

Alternative W1 and W1A. Alternative W1 consists of a rock revetment on both the west and east sides of the inner harbor. See figures 2 and 3 for approximate alignments. This alternative is designed to eliminate the erosion problems along the west bank and inside the harbor itself, but would not replace the protection that had been provided by the Scandinavian Beach spit before it had been eroded away. Thus, although this project would be able to claim benefits from eliminating erosion, there would still be residual damages from waves entering the harbor.

The revetments would be constructed as a three-layer system of core, secondary, and armor stone. The rock would extend up to an elevation of +32 feet MLLW with 1V:3H side slopes. From elevation +29 MLLW to elevation +32 MLLW, the slope would be graded to transition to the existing top of bank. This upper section of revetment would be planted with live willow stakes and sprigging of grasses of species common to the Dillingham area. This planting would replace vegetation lost either to erosion or during the construction of the project.

Alternative W1A consists of a combination of sheet-pile wall and rock revetment on the west side of the harbor and a rock revetment on the east side of the harbor. This alternative was prepared in response to a request by the owner of BAF. The owner wants to be able to use portions of the west bank for loading and unloading barges. Although the harbor is not currently configured to allow for this activity, the owner of BAF believes that if a riprap revetment were installed, he would have little chance of being able to use the west bank for his desired purposes.

Alternative W2. Alternative W2 consists of a rubblemound breakwater and a rock revetment on the west side of the harbor, with no bank stabilization on the east bank. See figure 4 for the approximate alignment. This alternative utilizes both a breakwater and revetment to prevent future erosion damages. The breakwater would prevent large waves from entering the harbor, thus eliminating much of the erosion problem and damages to harbor facilities and vessels. The revetment along the west bank outside the breakwater alignment is necessary to prevent erosion in the areas of the west bank still exposed to the adverse wave climate. The west bank revetment in the interior of the harbor is required to prevent further erosion from the residual wave or from the rare storms that would bring a wave in from the east. Because waves that would impact the interior west bank would be much smaller than those that are currently impacting the interior west bank, the revetment cross section for this interior section would not require material as large as that required in Alternatives W1 and W1A.

The revetments would be constructed as a three-layer system of core, secondary, and armor stone. Rock would extend up to an elevation of +32 feet MLLW with 1V:3H side slopes. From elevation +29 MLLW to elevation +32 MLLW, the slope would be graded

to transition to the existing top of bank. This upper section of revetment would be planted with live willow stakes and sprigging of grasses of species common to the Dillingham area. This planting would replace vegetation lost either to erosion or during the construction of the project.

The breakwater would be constructed using a three-layer system of core, secondary, and armor stone. The breakwater would have a crest elevation of +32 feet MLLW and have 1V:1.5H side slopes.

Alternative W3. Alternative W3 is essentially the same as alternative W2, except for including the east revetment and a somewhat different alignment for the breakwater. See figure 5 for the approximate alignment. This alternative accomplishes the same as alternative W2 but includes added protection for the east bank to prevent further erosion from the residual 1-foot wave in the harbor. This additional increment of protection would be expected to provide very little in the way of additional damages prevented. This alternative also used a different size breakwater to see if a lesser cost breakwater could be found.

The revetments would be constructed as a three-layer system of core, secondary, and armor stone. The rock would extend up to an elevation of +32 feet MLLW with 1V:3H side slopes. Where the top of the bank is at the same elevation as the revetment (+32 MLLW), the slope would be graded to transition to the existing top of bank. This upper section of revetment would be planted with live willow stakes and sprigging of grasses of species common to the Dillingham area. This planting would replace vegetation lost either to erosion or during the construction of the project.

Alternative W4. Alternative W4 is essentially the same as alternative W2 and W3, except for including the east revetment and a somewhat different alignment for the breakwater. See figure 6 for the approximate alignment. The purpose of this alternative was again to discover if a different breakwater alignment would provide protection at a lesser cost.

The revetments would be constructed as a three-layer system of core, secondary, and armor stone. The rock would extend up to an elevation of +32 feet MLLW with 1V:3H side slopes. Where the top of the bank is at the same elevation as the revetment (+32 MLLW), the slope would be graded to transition to the existing top of bank. This upper section of revetment would be planted with live willow stakes and sprigging of grasses of species common to the Dillingham area. This planting would replace vegetation lost either to erosion or during the construction of the project.

Alternative W5. Alternative W5 has the same breakwater and rock revetments on the west side of the harbor as Alternative W2 and the revetment on the east bank. See figure 7 for the approximate alignment. This alternative was added later in the analysis after Alternative W2 was found to be the most cost effective alternative. This alternative adds the east revetment to Alternative W2 to determine if the additional increment of the east revetment would be cost effective.

The revetments would be constructed as a three-layer system of core, secondary, and armor stone. The rock would extend up to an elevation of +32 feet MLLW with 1V:3H side slopes. From elevation +29 MLLW to elevation +32 MLLW, the slope would be graded to transition to the existing top of bank. This upper section of revetment would be planted with live willow stakes and sprigging of grasses of species common to the Dillingham area. This planting would replace vegetation lost either to erosion or during the construction of the project.

Alternative W6. Alternative W6 is the No-Action plan and only meets the objectives of minimizing impacts to fishing habitat and maintenance dredging of the harbor. There is no figure for this alternative.

Figure 2. Alternative W1

Figure 3. Alternative W1A

Figure 4. Alternative W2

Figure 5. Alternative W3

Figure 6. Alternative W4

Figure 7. Alternative W5

2.6.3.2 City Dock Side

Four concept alternatives for stabilizing the shoreline from future erosion in the City Dock Side study area were developed and evaluated. The four alternatives consisted of either a rock revetment or a sheet-pile bulkhead along two alternative alignments. Beach access ramps for the dredged material disposal pipeline and disposal area drainage features are included in each alternative.

This section highlights the key design parameters describing the four concept design alternatives. Both alignments extend westward from the terminus of the existing sheet-pile bulkhead. A more detailed discussion of the alignments and the associated advantages and disadvantages can be found in the Hydraulics Appendix.

Alignment 1. Alignment 1 incorporates the minimum bank stabilization necessary by installing a rock revetment that parallels the containment berm and leaves the adjacent wetlands mostly undisturbed to prevent ecosystem degradation.

Alignment 1 begins at the terminus of the existing sheet-pile bulkhead and extends east along the shoreline, wrapping around the existing dredged material containment berm, landward to the terminus, and keys into the east side of the existing containment berm. Alternatives C1 and C2 consist of this alignment.

Alignment 2. Like alignment 1, alignment 2 begins at the eastern terminus of the existing harbor sheet-pile bulkhead and spans eastward. The primary difference between the alignments is that alignment 2 ties into the westernmost dock of Peter Pan Seafoods. The purpose of this alignment was to determine if the incremental benefit seen by extending the revetment to the Peter Pan facility was worth the potential damage to the environment.

Alternative C1: Alignment 1 Rock Revetment. Alternative C1 consists of a rock revetment with the alignment 1 configuration. See figure 8 for details. This revetment would be placed at a 1V:1.5H slope utilizing a three-layer system similar to the West Side alternatives. The top elevation of the revetment would be +32 feet MLLW. The revetment would have a top width of 20 feet as needed for construction and maintenance equipment.

The City Dock Side selected alternative includes a beach access ramp adjacent to the east end of the existing sheet-pile bulkhead. This access ramp would serve as a foundation for temporary dredged material slurry lines and potentially as a public (pedestrian) access point to the beach for local subsistence and recreational activities.

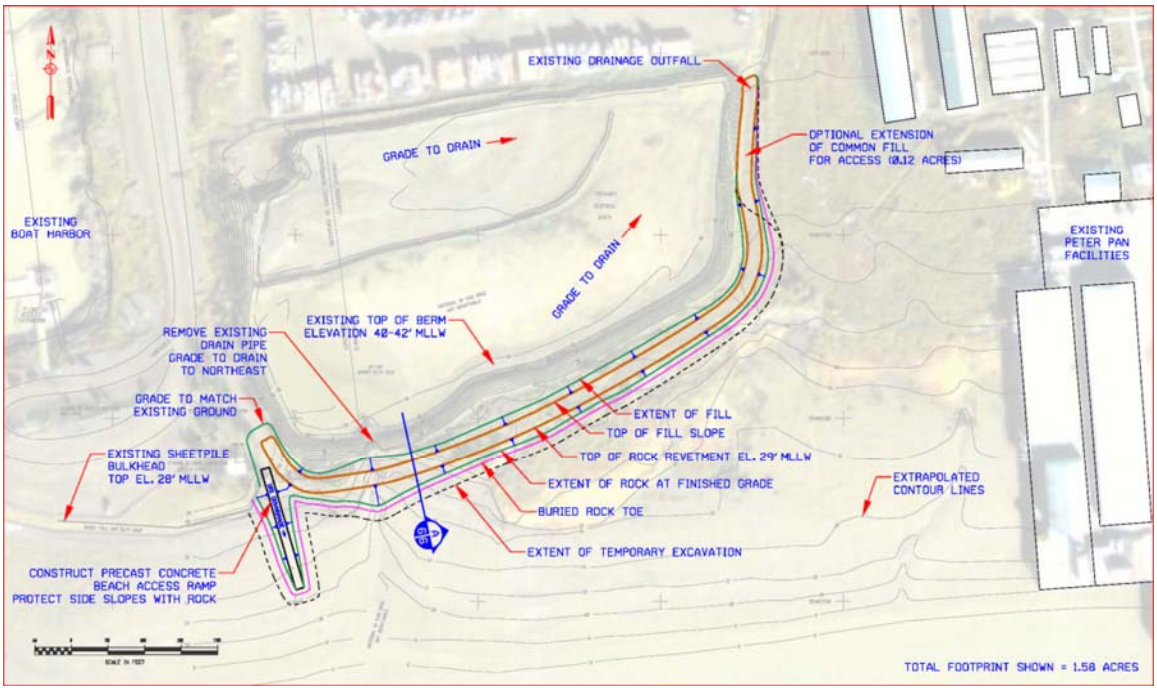

Figure 8. Alternative C1

Alternative C2: Alignment 1 Sheet-pile. Alternative C2 includes a sheet-pile bulkhead that extends along the same alignment as the revetment in Alternative C1. See figure 9 for details. The preliminary bulkhead design has a capped top at elevation 32 feet MLLW. This preliminary elevation was selected for comparison of alternatives and accounts for wave reflection at the vertical face of the sheet-pile bulkhead. The eastern terminus of the bulkhead wraps around the southeast corner of the existing containment berm and extends an additional 100 feet landward. Along this eastern reach, the bulkhead transitions to rock revetment, which is keyed into the east side of the existing containment berm.

A drainage system is included with free-draining material placed against the bulkhead and 6-inch-diameter weepholes at maximum 12-foot spacing. Safety ladders are included at regular intervals as required by City of Dillingham regulations. Fish net attachments are included at 100-foot spacing to accommodate local subsistence fishing. Corrosion protection (coal tar epoxy coating and galvanic anodes) is recommended for sheet-piles, HP-piles, and anchor rods.

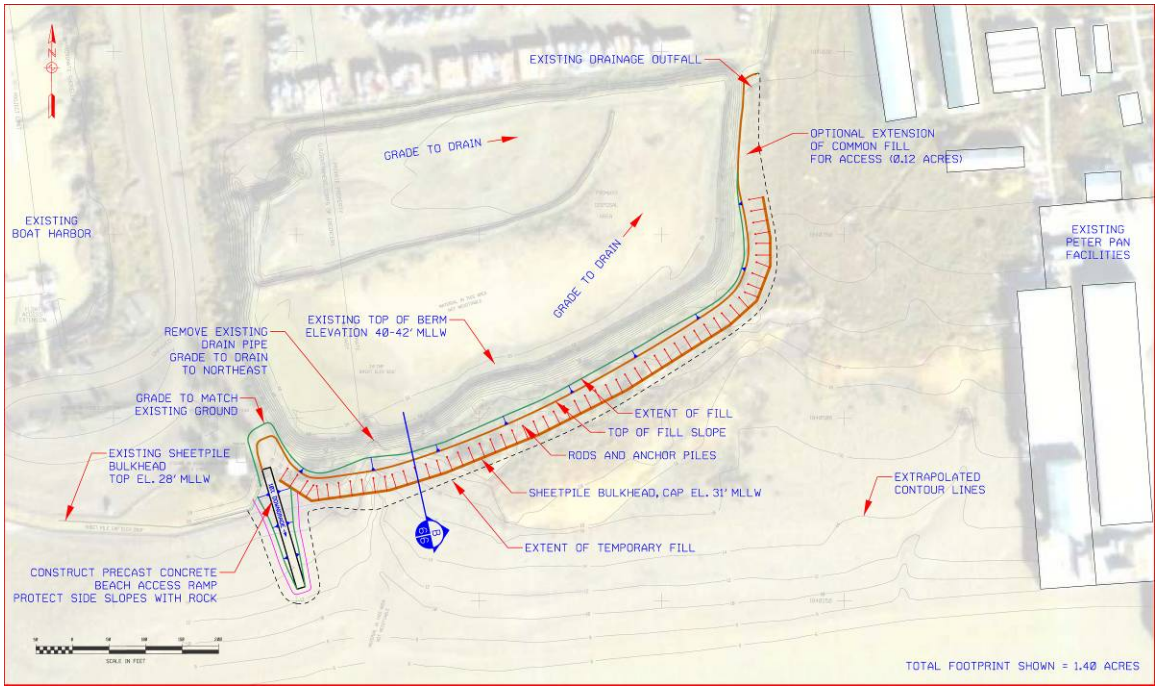

Figure 9. Alternative C2

Alternative C3: Alignment 2 Rock Revetment. Alternative C3 is a revetment similar to that of Alternative C1; the difference is the alignment. See figure 10 for details. This revetment is to be placed at a 1V:1.5H utilizing a three-layer system similar to the West Side alternatives. The top elevation of the revetment will be +32 feet MLLW. The revetment would have a top width of 20 feet as needed for construction and maintenance equipment.

The City Dock Side selected alternative includes a beach access ramp adjacent to the east end of the existing sheet-pile bulkhead. This access ramp would serve as a foundation for temporary dredged material slurry lines and potentially for serving as public (pedestrian) access to the beach for local subsistence and recreational activities.

The revetment would allow transfer of energy along its alignment. Excess energy would cause some disruption of the topography at the terminus unless dissipated. The end treatment would require further investigation if this alternative was considered further.

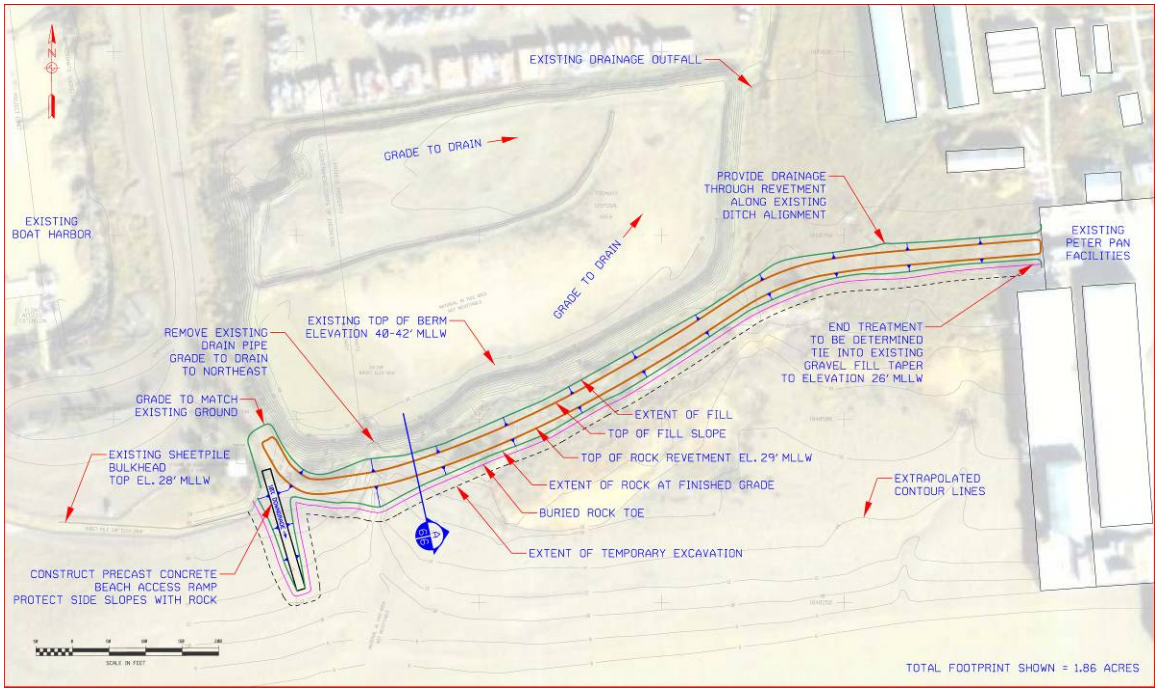

Figure 10. Alternative C3

Alternative C4: Alignment 2 Sheet-pile. This alternative follows alignment 2 and consists of sheet-pile instead of rock revetment. See figure 11 for details. This alignment crosses an existing drainage channel between the Peter Pan dock and the dredged material disposal area. A drainage culvert would be required through the proposed bulkhead in this location. The beach access ramp and disposal area drainage features are included.

As with Alternative C3, the sheet-pile alternative would transfer energy along the alignment. When bank-hardening projects terminate, the excess energy causes some disruption of the topography unless dissipated. With revetment designs, natural vegetation may be adequate to dissipate much of the energy. Vertical walls, however, conserve and transfer energy much more effectively than do laid back revetment slopes. The terminating ends of the sheet-pile would require rock revetment protection and additional structural features for energy dissipation. The end treatment would require further investigation if this alternative was considered further.

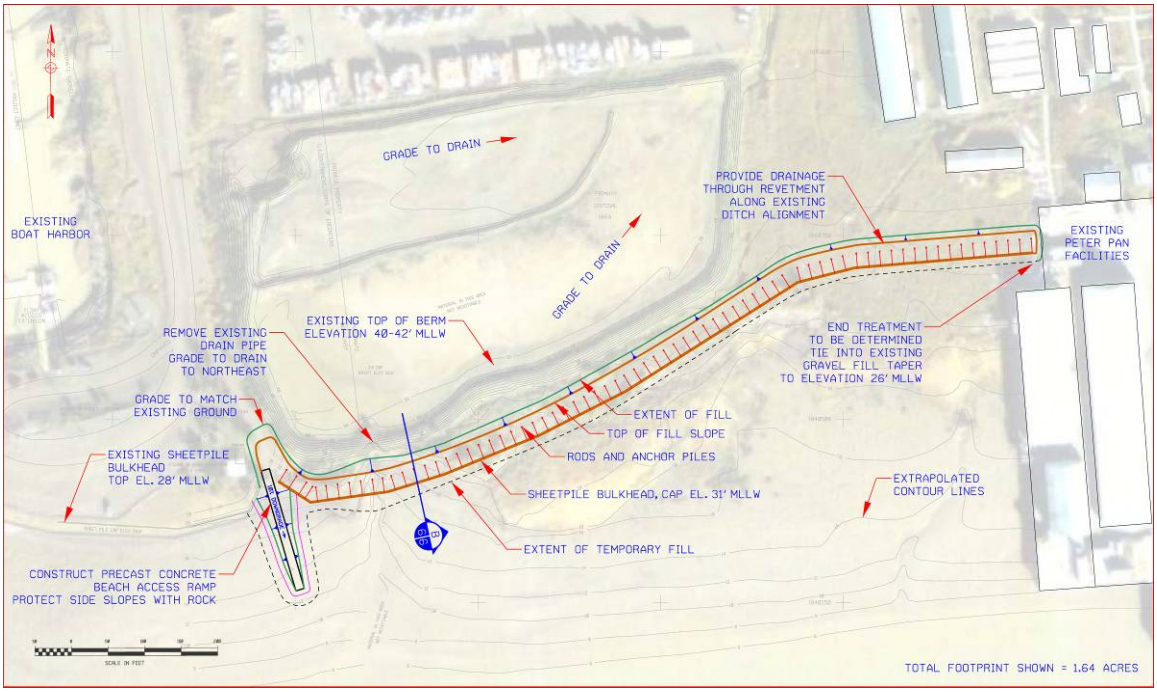

Figure 11. Alternative C4

Alternative C5: No Action. The no-action alternative assumes that erosion would continue at its current rate. Physical and financial impacts to existing facilities under this alternative are described in the Economics Appendix.

2.7 Comparison of Alternatives

The final analysis of alternatives consists of evaluating damages avoided, a benefit to cost ratio, an evaluation of the advantages and disadvantages of the materials and alignments, and comparison to determine the most cost effective alternative. Construction cost, total and average annual first cost, annual operation and maintenance, and total annual costs were developed for each alternative. The preliminary cost estimates include a 25 percent contingency to account for design uncertainties with a December 2005 price level.

In this report the most cost effective project is defined as the alternative that achieves the planning objectives in the least expensive configuration. The selected plan will be that which most cost effectively achieves the objectives listed in section 2.2.1 of this report. This section presents a discussion of the various plans and how cost effective they are at achieving the desired objectives.

2.7.1 West Side

After the initial analysis, Alternatives W1A, W3, W4 and W6 were eliminated from further consideration. W1A was eliminated because sheet-pile was deemed to be cost prohibitive when compared with the cost of riprap. Alternatives W3 and W4 were eliminated because, when the effectiveness of these alternatives was analyzed, they appeared to have identical benefits as W5. Furthermore, the costs of Alternatives W3 and W4 are much higher because they require a substantial amount of additional riprap along the revetment to prevent the same amount of damages. Alternative W5 requires less riprap armor than W3 and W4 because the breakwater is located farther out, which causes

the wave energy to be dissipated sooner, resulting in less armor needed behind the breakwater. Due to the decreased riprap armor, initial cost estimates showed that Alternative W5 had the lowest cost of the alternatives that provided identical benefits, and thus was the most logical to keep. The no action plan, Alternative W6, was eliminated because it did not meet the primary objective of significantly reducing erosion damages and protecting the harbor.

For the remainder of this report, the alternatives discussed will be Alternative W1, Alternative W2, and Alternative W5.

It is estimated that alternative W1 would effectively stop land loss from erosion on the West Side; however, it does not replace the natural protection that had been provided by Scandinavian Beach, and does nothing to reduce the damages caused by wave energy within the harbor. Arresting erosion in the harbor would eliminate the need for future emergency actions to protect the BAF facility and future repairs to the sheet-pile swing arms. This alternative also does not address the identified damages to moorage floats, concrete boat ramps, the harbor bulkhead, and vessel damages.

It is estimated that alternatives W2 and W5 would effectively halt erosion in the study area and eliminate effects of land loss and damages to near-shore harbor infrastructure. Consistent with Corps shore stabilization design standards, alternatives W2 and W5 were formulated such that wave height in the harbor would be maintained at less than 1 foot, eliminating the incremental damages to floats and vessels in the harbor. As such, each alternative as designed is expected to eliminate the identified incremental damages associated with erosion in the study area.

Costs for alternatives W1, W2 and W5 were developed to determine the NED plan or the least cost alternative. Table 3 summarizes the cost for the final array of alternatives. The fully funded cost estimate is in Appendix C.

Table 3. Cost Summary for Final Array of Alternatives West Side

Item	W1	W2	W5
Total Project Implementation Cost	$12,924,000	$8,780,000	$10,238,000
Average Annual Equivalent Cost	$694,300	$471,700	$550,000
Annual Operation and Maintenance	$64,700	$43,900	$51,200
TOTAL ANNUAL NED COST	$759,000	$515,600	$601,200

Table 4 shows the estimated benefits with Alternative W1 and W5.

Table 4. Average Annual Benefits

Category	W1 Average Annual Benefits	W5 Average Annual Benefits
Dock Floats		$53,900
Swing Arms	$300	$300
Concrete Ramps		$18,700
Bulkhead		$10,000
Land Lost to Erosion	$2,800	$2,800
Vessel Damages due to Erosion		$84,700
Foregone Emergency Actions	$244,800	$244,800
TOTAL:	**$247,900**	**$415,200**

Table 5 provides a summary of the benefits, cost, benefit to cost ratio (BC ratio), and net benefits associated with the final array of alternatives for the West Side.

Table 5. Summary of Benefits and Costs West Side

ALTERNATIVE:	AVERAGE ANNUAL NED BENEFITS	AVERAGE ANNUAL NED COST	B/C RATIO	NET BENEFITS
ALTERNATIVE W2: West Revetment with Breakwater	$415,200	$515,600	0.81	-$100,400
ALTERNATIVE W5: East &West Revetments with Long Breakwater	$415,200	$601,200	0.69	-$186,000
ALTERNATIVE W1: East &West Revetments with No Breakwater	$247,900	$759,000	0.33	-$511,100

The most cost effective plan that provides bank stabilization and replaces the natural harbor protection that had been destroyed by erosion is Alternative W2. Alternative W2 incorporates a breakwater and the minimum bank stabilization necessary. This alternative would use a breakwater to replace the wave protection that had been lost to erosion. With this protection restored, the need for armor inside the harbor would be significantly decreased.

2.7.2 City Dock Side

When comparing the two alignments, alignment 1 is environmentally preferred because it leaves the adjacent wetland mostly undisturbed of the two alignments and avoids potential wetlands issues. Alignment 2 crosses an existing drainage channel between the dredged material disposal area and the Peter Pan docks, requiring a drainage culvert through the proposed revetment and fill section in this location. The specific location and sizing of this culvert would require further evaluation if this alternative was selected for further consideration and would require development of new hydrologic and topographic data. Leaving the urban drainage area undisturbed is preferred because potentially costly hydrologic surveys of Dillingham's urban run-off would be necessary to properly design for drainage in the area. Therefore, in comparison, the alternatives along alignment 1 would be more environmentally acceptable than those along alignment 2.

Both alignments for the City Dock Side study area had equal benefits. The average annual cost per year of preventable damages is equal to the projected annual benefits and is $290,800. Based solely on the benefits or prevented damages, it was not apparent what the best alignment would be and so further analysis and comparison of the alignments was warranted to determine the best alignment and shore protection methodology.

Table 6 summarizes the City Dock Side estimated costs for each concept alternative considered. A more detailed cost table and description of the source of unit cost data are included in the cost appendix.

Table 6. City Dock Side Summary Costs for Concept Designs

Item	C1	C2	C3	C4
Total Project Implementation Cost	$5,507,000	$7,946,000	$6,181,000	$9,876,000
Average Annual Equivalent Cost	$295,800	$426,900	$332,100	$530,600
Annual Operation and Maintenance	$6,900	$37,000	$7,700	$46,500
TOTAL ANNUAL NED COST	$302,700	$463,900	$339,800	$577,100

Table 7. Estimated Benefits for City Dock Side Alternatives

Category	NED Average Annual Benefits
Land erosion	$3,300
Sheetpile seawall	$136,300
South Harbor parking lot	$2,300
South boat ramp	$900
Utility impacts	$123,100
Launch and retrieve delays	$24,900
Total:	**$290,800**

Table 8. Summary of Benefits and Costs City Dock Side

ALTERNATIVE:	AVERAGE ANNUAL NED BENEFITS	AVERAGE ANNUAL NED COST	B/C RATIO	NET BENEFITS
ALTERNATIVE C1: Alignment 1 Rock Revetment	$290,800	$302,700	0.96	-$ 11,900
ALTERNATIVE C3: Alignment 2 Rock Revetment	$290,800	$339,800	0.86	-$ 49,000
ALTERNATIVE C2: Alignment 1 Sheetpile	$290,800	$463,900	0.63	-$173,100
ALTERNATIVE C4: Alignment 2 Sheetpile	$290,800	$577,100	0.50	-$286,300

Based on the above analysis, Alternative C1 is the selected plan. None of the City Dock Side alternatives had a BC ratio greater than one so the least cost plan determined the chosen alternative. Alternative C1 appears to be the least-cost construction alternative. Using rock revetment construction instead of sheet-pile decreases the cost. In addition, this alternative consists of the shorter alignment, which makes it the cheapest of the two rock revetments. The remainder of this report will focus on Alternative C1.

2.8 Recommended Plan

Whereas in the analysis of alternatives, the price level of the computations were in December of 2005, a recent update of the cost estimates for just the preferred alternatives has been included for the remainder of the report. The cost estimates are at the October 2008 price level.

2.8.1 West Side

The recommended plan for the West Side is W2. Refer to the Hydraulics Appendix for detailed drawings. Total first cost for the West Side project is $12,380,000.

Table 9. West Side Cost Summary

Feature/Item	Alternative W2
Construction Cost	$ 12,288,000
Real Estate	$ 92,000
Total	$ 12,380,000

Figure 12. West Side Selected Plan

Alternative W2 consists of a 391-foot rubblemound breakwater and a 950-foot rock revetment on the West Side of the harbor with no bank stabilization on the east bank. See figure 12 for the approximate alignment. This alternative uses both a breakwater and revetment to prevent future erosion damages. The breakwater would prevent large waves from entering the harbor, thus eliminating much of the erosion problem and damages to the harbor facilities and vessels. The revetment along the west bank outside the breakwater alignment is necessary to prevent erosion in the areas of the west bank still exposed to the adverse wave climate. The west bank revetment on the interior of the harbor is required to prevent further erosion from residual waves or from rare storms that would bring a wave in from the east. Because waves impacting the interior west bank would be much smaller than those currently impacting it, the revetment cross section for this interior section would not require material as large as that required for Alternatives W1 and W1A.

The revetments would be constructed as a three-layer system of core, secondary, and armor stone. The rock would extend up to an elevation of +32 feet MLLW with 1V:3H side slopes. From elevation +29 MLLW to elevation +32 MLLW, the slope would be graded to transition to the existing top of bank. This upper section of revetment would be planted with live willow stakes and sprigging of grasses of species common to the

Dillingham area. This planting would replace vegetation lost either to erosion or during the construction of the project.

The breakwater would be constructed using a three-layer system of core, secondary, and armor stone. The breakwater would have a crest elevation of +32 feet MLLW and have 1V:1.5H side slopes.

2.8.2 City Dock Side

The recommended plan for the City Dock Side is C1. Refer to the Hydraulics Appendix for detailed drawings. Total present cost for the City Dock Side project is $ 8,180,000.

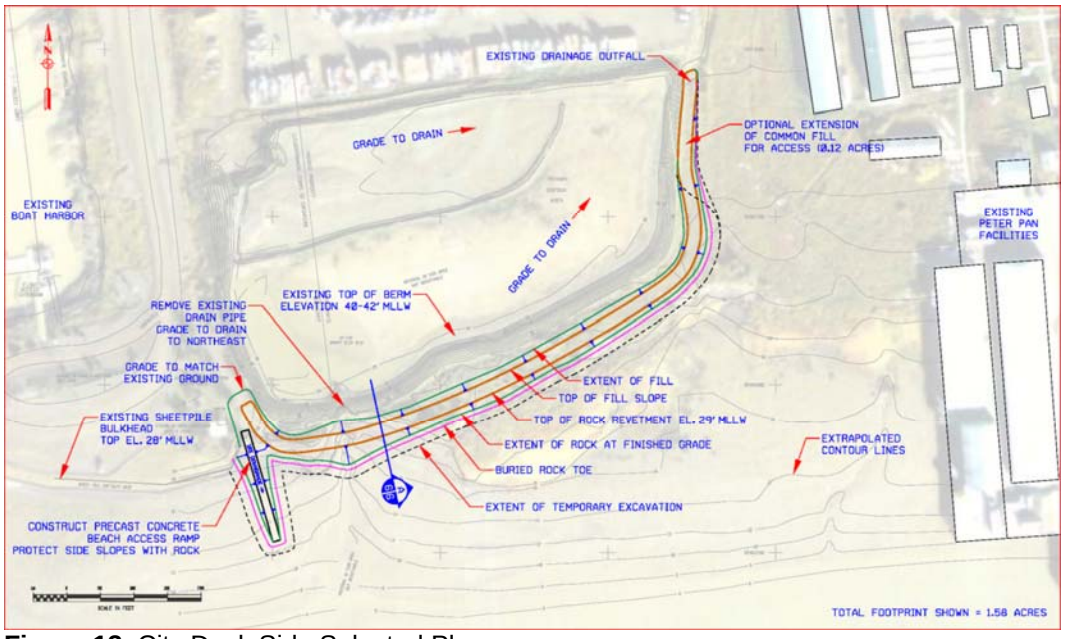

Figure 13. City Dock Side Selected Plan

Table 10. City Dock Side Cost Summary

Feature/Item	Alternative C1
Construction Cost	$8,093,000
Real Estate	$ 87,000
Total	$ 8,180,000

Alternative C1 consists of a 950-foot rock revetment with the alignment 1 configuration. See figure 13 for details. This revetment is to be placed at a 1V:1.5H slope using a three-layer system similar to the West Side alternatives. The top elevation of the revetment would be +32 feet MLLW. The revetment would have a top width of 20 feet as needed for construction and maintenance equipment.

The City Dock Side selected alternative includes a beach access ramp adjacent to the east end of the existing sheet-pile bulkhead. This access ramp would serve as a foundation for temporary dredged material slurry lines and potentially as a public (pedestrian) access point to the beach for local subsistence and recreational activities.

It should be noted that the Cost Appendix does not include the correct values for LER. The correct values are shown in the following section and have been utilized to establish the cost of the recommended project.

2.8.3 Mitigation

Mitigation for this project consists of minimizing in-water work to protect juvenile salmon as much as possible along with vegetating and contouring disturbed areas behind the revetment to minimize surface erosion from rain and overtopping waves.

Much of the revetment construction below the mean high water line would be done during lower tides when the tide flat is dewatered, but some construction on the breakwater might be necessary when the tide flats are flooded. Both the West Side and City Dock Side revetments would be built at the base of former disposal site berms. The riverbanks behind the west side revetment would be sloped to grade before construction.

Fueling of mobile equipment would take place only in a designated area removed from the water and would have sufficient spill response equipment, including absorbent materials, on hand. Equipment that cannot be moved to the designated fueling areas would be fueled on site with spill response equipment, including absorbent materials, on hand.

West Side. The West Side revetment would be planted with live willow stakes on the upper slope from approximately +29 feet MLLW to +32 feet MLLW. The Alaska Department of Fish and Game published revised guidelines for live-staking willows in 2005 (ADFG 2005). Live willow stakes of appropriate species used in this project would be collected, stored, and staked according to these guidelines. Topsoil of local origin would be included as necessary to facilitate survival of the live stakes.

Access to the West Side revetment and breakwater would be from Scandinavian Creek Road and across former wetlands that had been used for disposal of dredged sediments. Accessing the site across the former Old Western disposal site would avoid impacts to virgin wetland.

City Dock Side. The former Peter Pan disposal site behind the City Dock Side revetment would be contoured to direct water away from the revetment and through a weir where it would return to the river along a natural drainage.

Access to the City Dock Side revetment would be across the former Peter Pan disposal site from existing roads that include the harbor access road.

2.8.4 Operation and Maintenance

Whereas the expected operation and maintenance (O&M) requirements for these projects are expected to be minimal, there are tasks necessary to ensure long lasting protection for the areas of concern. Typical O&M requirements would include routine inspection of the structures and the occasional addition of armor stone to areas that are experiencing excessive wear. The West Side project has an estimated annual O&M requirement of $60,800 and the City Dock Side has an estimate annual O&M requirement of $10,000.

These amounts are based on having to replace a minimal percentage of rock every 10 to 15 years. These costs are the responsibility of the non-Federal sponsor.

2.9 Real Estate Considerations

The City of Dillingham would be required to provide all Lands, Easements, and Rights-of-Way (LER) necessary for access, construction, and operation and maintenance of the project. Per the implementation policy for this project authorization, the project is being constructed at full Federal expense; however, the sponsor would not be afforded credit for the value of the LER provided. Any lands for the project would be acquired in compliance with Public Law 91-646, as amended. Permanent and temporary easements would be needed for the project.

The project would include uplands and the riverbank below Mean High Water and an access route within Section 20, Township 13 South, Range 55 West, Seward Meridian. The preferred stabilization plan is to build a breakwater and rock revetment structure to protect the west (West Side) and east (City Dock Side) of the existing Dillingham Small Boat Harbor entrance channel and harbor.

2.9.1 West Side

The local sponsor (the City of Dillingham) will need to obtain on the West Side of the harbor two perpetual road easements and one channel improvement easement. There is one tideland area, 1.52 acres, for which the Corps has navigational servitude.

2.9.2 City Dock Side

The local sponsor will need to obtain on the City Dock Side of the harbor temporary 2-year work area easements, a perpetual channel improvement easement, a perpetual road easement, and a 2-year temporary staging area. A portion of each acquisition is owned by the city.

3.0 ACQUISITION STRATEGY

The work of constructing the recommended plan consists of placement of a rock revetment and breakwater in two separable elements in different and distinct areas. Acquisition of the construction work should be combined to avoid major costs that would be incurred for multiple procurement actions versus one. The duplicate costs that could be included are the normal mobilization and demobilization costs and costs related to the work requiring riprap of a specific quality and gradation. The lead time from having a contract award to having rock produced at a local quarry, size graded, and ready for installation could be up to a full calendar year, depending on the time of award and weather. This time includes the required lead for quarry development plan approval, shipment of explosives, clearing the quarry for the new production, blasting, sorting, and grading and shipping or stockpiling. The time for material for only one of the project elements instead of both still has the same lead time as obtaining a large amount of material. Those costs are distributed across a smaller amount of material, thus increasing the unit price of the material. Therefore, the preferred method of acquisition is to bid and award the work as one project in total.

As part of the acquisition strategy, one acquisition alternative would be for the project to seek a waiver of the continuing contract limitation, thus allowing the greatest possible flexibility for project implementation. A second, and more likely, acceptable acquisition alternative would be to award a base contract with existing funds, with a series of options that could allow for construction of separable features within the separable items.

4.0 SUMMARY OF COORDINATION, PUBLIC VIEWS AND COMMENTS

This plan was coordinated with the local land owners, the City of Dillingham, the USFWS, the Alaska Department of Fish & Game, the Alaska Department of Natural Resources, and the Alaska District Construction & Operations Division.

Significant coordination has been done with the City of Dillingham to discuss their needs and concerns regarding the proposed project. As mentioned previously in this report, a concern of the residents of Dillingham with respect to the harbor area is that the progressive erosion of the west bank of the harbor entrance has allowed wind and storm waves to have increased direct access into the harbor, causing damage to boats and harbor facilities. Concerns were stated about losing any of the already limited parking spaces. Meetings were held with the U.S. Fish and Wildlife Service, State Department of Natural Resources, and BAF to solicit their input as well. A public meeting was held in April 2006 to introduce the findings of this report and solicit any feedback.

The primary concern regarding this project is avoiding and mitigating potential impacts to the salmon fishery. The erosion rates in the study area have been of particular concern to the city as well as state and federal agencies. The city dock side area has been of great concern to the regulating fish and wildlife agencies because of the nearby former upland dredged material disposal site. The concern is that as the containment berm erodes, the erosion will eventually breach the berm, allowing the dredged materials to be released into Nushagak Bay and impact the salmon fishery. Any potential impacts to the salmon fishery are of great concern to the local community and state and federal agencies. Mitigation for this project is summarized in Section 2.8.3 of this report and is described in more detail in the Environmental Assessment.

As part of the review and approval process, this report was made available for public and agency review, which included a public meeting held in Dillingham in January 2009. Oral comments received at the public meeting were positive and supportive of the project with a few concerns raised about how the project would affect ongoing commercial activities in and around the harbor. Comments received during the public review period generally supported the project, although some expressed concerns, both at the public meeting and it writing, about effect the project might have upon commercial activities. This correspondence and our response are in the Correspondence Appendix.

5.0 CONCLUSIONS

The recommended plans meet the planning objectives through minimizing erosion impacts, decreasing the waves entering the harbor, maintaining shoreline for traditional uses, and not impacting the operations of the existing navigation project.

Projects implemented under the authority of Section 116 of Public Law (PL) 99-190, have been implemented at full Federal expense using a recommendation of the least cost that meets the project objectives. As previously mentioned, this authority has been utilized many times in the past to accomplish erosion damage reduction projects in Dillingham, Galena, and Bethel.

The studies documented in this report do indicate that construction of emergency bank stabilization at Dillingham, 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 vessels within the harbor, businesses, and existing bank protection measures and will delay the threat of long-term flanking of the community. The City of Dillingham has indicated its willingness to act as a local sponsor for the project and fulfill all the necessary local cooperation requirements.

It is the policy of the Corps of Engineers to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with use of the base flood plain and avoid inducing development in the base flood plain unless there is no practicable alternative. The only practicable alternative is to build the Dillingham Stabilization Project where the erosion is occurring, on the coastline in the water, and hence in the floodplain.

6.0 RECOMMENDATION

I hereby recommend construction of two rock revetments and a breakwater to stabilize the shoreline near the Dillingham Small Boat Harbor, in accordance with the authorization of Congress in Public Law (PL) 99-190 and PL 106-377 as generally described in this report as alternatives W2 and C1, at an estimated initial construction cost of $12,380,000 for the West Side project and $8,180,000 for the City Dock Side project. Prior to the start of construction, the non-Federal sponsor must agree to the following:

A. Provide all lands, easements, and 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 erosion control features (including all lands, easements, and rights-of-way, and relocations necessary for material disposal facilities).

B. Operate, maintain, repair, replace, and rehabilitate, at its own expense, the bank stabilization features; in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

C. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government;

D. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the erosion control features for the purpose of inspection, and, if necessary, for

the purpose of operating, maintaining, repairing, replacing, and rehabilitating the erosion control features;

E. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

F. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the erosion control features, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;

G. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, maintenance, repair, replacement, or rehabilitation of the erosion control features.

H. Assume the cost of mitigation and data recovery activities associated with historic preservation that are in excess of one percent of the authorized cost of this project.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

28 MAY 2009

Date:

James R. Stone
Lieutenant Colonel, Corps of Engineers
Acting District Commander