Agency: Commerce, Community and Economic Development
Grants to Municipalities (AS 37.05.315)
Grant Recipient: North Slope Borough **Federal Tax ID:** 92-0042378

Project Title: **Project Type:** Maintenance and Repairs

North Slope Borough - Critical Infrastructure Protection

State Funding Requested: $6,000,000 **House District:** 40 / T
Future Funding May Be Requested

Brief Project Description:

This project will provide funding for the design and permitting of revetment to protect essential infrastructure in Barrow and Point Hope.

Funding Plan:

Total Project Cost:	$80,000,000
Funding Already Secured:	($0)
FY2014 State Funding Request:	($6,000,000)
Project Deficit:	$74,000,000

Funding Details:
No funds have been appropriated in prior years.

Detailed Project Description and Justification:

This project will provide beginning funding for the design, permitting, and construction of revetment to protect essential infrastructure in Barrow and Point Hope.

The North Slope Borough has an established beach nourishment program, however more permanent solutions need to be pursued in order to continue providing critical services to residents. The extended periods of open water and increased number of severe storms are overtaking current efforts, leading to flooding of low lying areas, and potential permanent damage to assets essential in provision of public services.

Revetment off the coast of Barrow will provide additional protection to the coast line, reducing flood related damage and protecting public and private property. The 12-foot option was determined as the best course of action based on the 100 year storm mark, where in 1963 12-foot swells did significant damage to the city.

Revetment off of Point Hope will be used to protect the airport and runway. The airport provides the only year-round access to Point Hope. The airport is essential for the transport of goods, services, residents and for the provision of emergency medical services.

The value of the North Slope Borough owned assets potentially protected by the revetment in Barrow is estimated at over $600 million dollars. This amount does not include the cost of providing services through alternate means (water, sewer, etc.) that would be required in an event generating surf similar to the 1963 storm.

The value of protected private assets in the same area exceeds $600 million dollars.

For use by Co-chair Staff Only:
$1,700,000
Approved
2:01 PM 5/9/2013

Contact Name: Staff to Rep. Nageak
Contact Number: 4653473

Project Timeline:

Design and construction in the amount shown will require a 2 - 3 year period.

Entity Responsible for the Ongoing Operation and Maintenance of this Project:

North Slope Borough

Grant Recipient Contact Information:

Name:	John Bitney
Title:	State Government Liaison
Address:	326 4th Street, Mendenhall #308
	Juneau, Alaska 99801
Phone Number:	(907)317-0038
Email:	john.bitney@north-slope.org

Has this project been through a public review process at the local level and is it a community priority? [X] Yes [ ] No

Contact Name: Staff to Rep. Nageak
Contact Number: 4653473

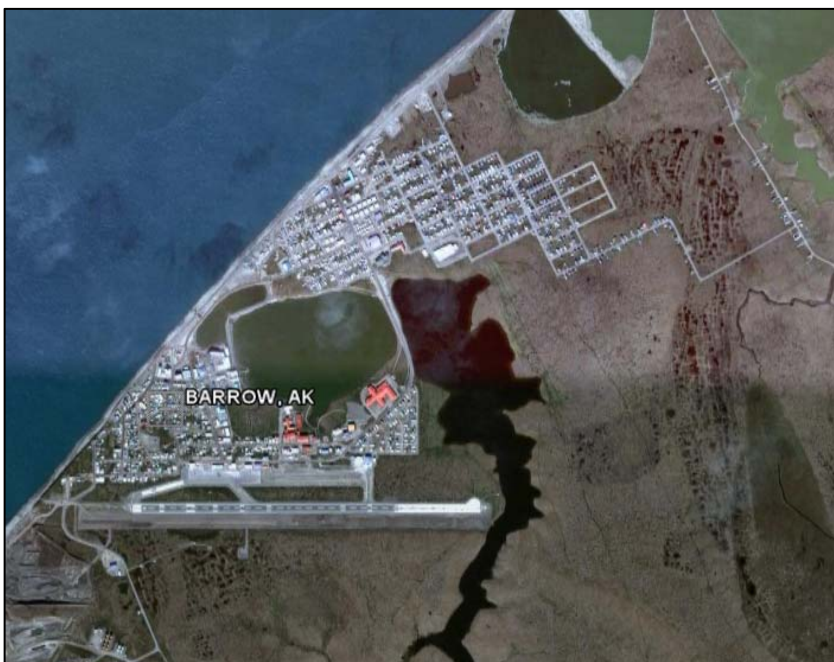
For use by Co-chair Staff Only:

2:01 PM 5/9/2013

U.S. Army Corps
of Engineers
Alaska District

Barrow, Alaska

Coastal Storm Damage Reduction
Technical Report



Appendix B – Real Estate Plan

March 2007

Technical Report
Barrow, Alaska, Storm Damage Reduction

Appendix B – Draft Real Estate Plan

NOTE:

This Appendix was originally created as the Draft Real Estate Plan (REP) for an early version of the Draft Integrated Interim Feasibility Report and Environmental Impact Statement for Coastal Storm Damage Reduction at Borrow, Alaska. That document underwent Independent Technical Review. As a result of that review, basic hydraulic and economic analyses were redone, with the result that no alternative yielded positive National Economic Development benefits greater than the costs of implementing that alternative. Since there is no Federal action proposed in this Technical Report, there is no need for a formal Real Estate Plan. However, since the draft REP had compiled information on real estate, it is included for information only

REAL ESTATE PLAN
BARROW STORM DAMAGE REDUCTION PROJECT
BARROW, ALASKA
26 March 2007

1. Purpose

This study was authorized by a resolution adopted 2 December 1970 by the House Public Works Committee. The resolution, known as the "Rivers and Harbors in Alaska" resolution, reads 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 reports of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Numbered 414, 83rd Congress, 2nd Session…and other pertinent reports, with a view to determining whether any modifications contained herein are advisable at the present time…*

The purpose of this study is to determine the Federal interest in providing storm damage reduction, flood damage reduction and navigation improvements at Barrow, Alaska; to identify a non-federal sponsor willing to share in the cost of the feasibility study; and to develop a Project Management Plan (PMP) for a feasibility-level study.

Barrow, the northern most community in North America and the economic center for the North Slope Borough, is located on the Arctic Ocean about 750 miles (mi) north of Anchorage, Alaska. Barrow is a first-class city with about 4,400 residents. The North Slope Borough, which includes almost all of Alaska north of the 68th Parallel, has a population of about 9,600 persons spread over 95,000 mi^2, an area about the size of the state of Oregon. The majority of residents are Inupiat Eskimos. Barrow is located on a southwest-northeast coastline of the Chukchi Sea about 10 mi southwest of Point Barrow, the northernmost point of land in Alaska (Figure 1). Point Barrow is located on a spit fronting Elson Lagoon and marks the boundary between the Chukchi Sea on the west and the Beaufort Sea on the east.

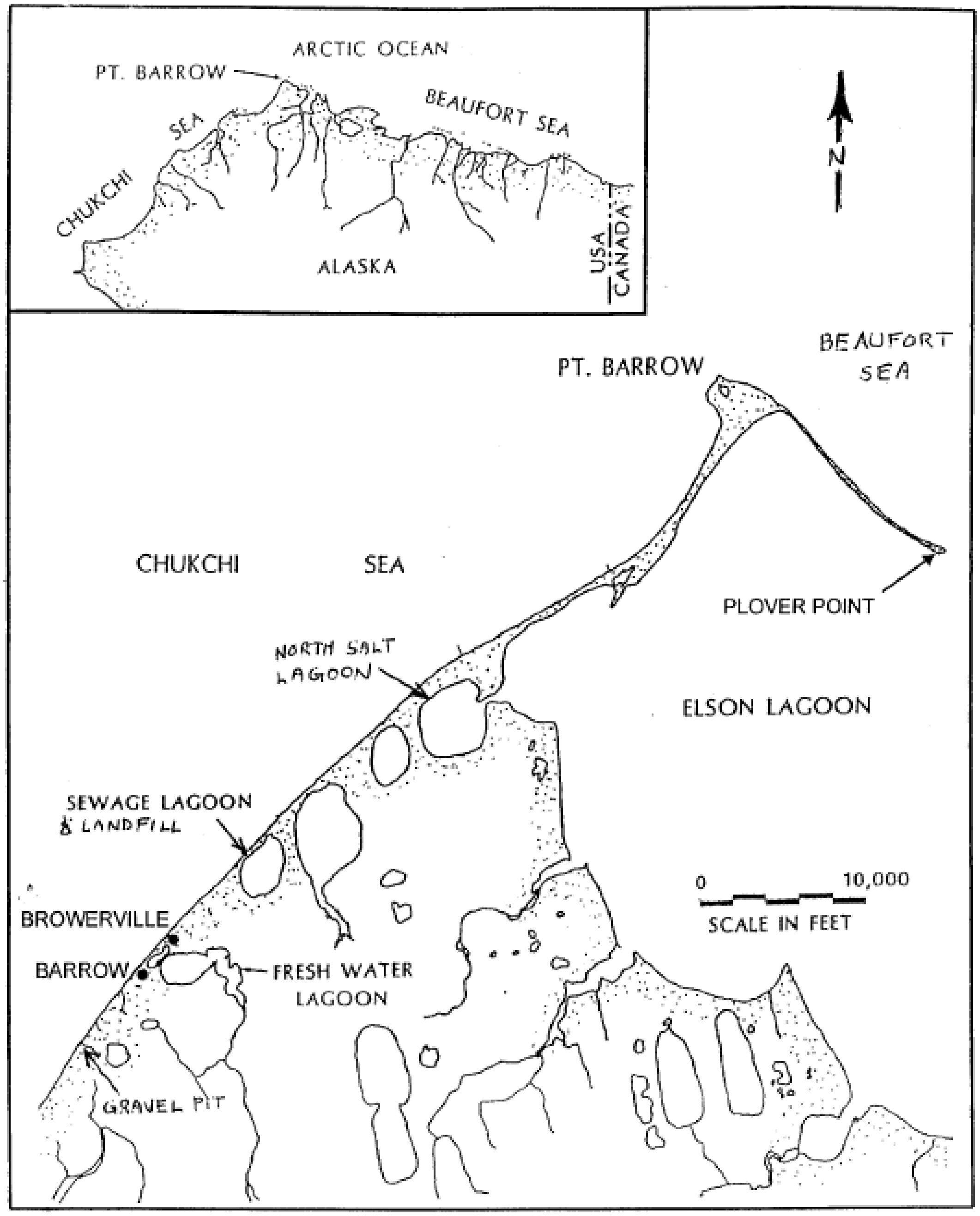


FIGURE 1. LOCATION MAP

2. Project Description

For the purposes of this study, the protection plan includes the entire 25,000 foot-long shoreline under attack, including Barrow, Browerville, and the sewage lagoon/landfill area. The construction of shore protection at the sites shown on figure 3 combined with the placement of nourishment and wave absorption beach fill shown at locations on the same figure should protect the City of Barrow, the sewage lagoon, and the landfill from erosion.

3. Real Estate Requirements for the Project:

Summary of Required Real Estate Interests for Storm Damage Reduction Revetment:

Project Feature	Areas Required	Owner	Estate Minimum
Revetment	14.62 acres	Municipal Public Private (5 lots)	Perpetual easement

A temporary construction staging area might be required but has not been identified at this time.

4. Within an existing Federal Project

There are no existing, authorized Corps of Engineers (Corps) or other Federal water projects within the proposed project area.

5. Federally/Government Owned Land included

There is no federally owned land included in the project area. There is local government land included in the project area.

6. LER below MHW/OHW – availability of Navigation Servitude

Navigation servitude is available however the MHW is 0.40 ft. Since it appears the project will lie entirely above MHW, navigation servitude may not need to be exercised.

7. Map of Project area is Attached as Exhibit A.

8. Potential flooding induced by construction, operation or maintenance of project

The intent of the project is to control flooding to low lying areas affected by storm surges.

9. Real Estate and Administrative Cost Estimate:

Table II
Federal project portions

Item	Federal	Local	Subtotal	Total
Administration	$50,000	$50,000	$000	$000
Real Estate Cost (Land)	-0-	$95,000	-0-	-0-

10. Relocation Assistance (PL 91-646)

There are no relocation assistant benefits anticipated for this project.

11. Mineral Activity

There is no known mineral activity occurring within the lands required for the project.

12. Non-Federal sponsor's acquisition experience: Assessment attached as Exhibit B.

13. Real Estate Acquisition Schedule:

Activity	COE	NFS
	Initiate – Complete	Initiate - Complete
Execution of PCA	1 day	
Formal transmittal of final ROW drawings to LS and instruction to acquire LER	1 week after PCA	
Mapping, legal descriptions, title evidence		3 months (minimum)
Conduct appraisals, negotiations & closing		6-9 months
Certify availability of LER for construction	1 week upon receipt of NFS certification	1 week upon completion of acquisition

14. Relocations (Facilities and Utilities)

There are no known facilities and/or utilities that will have to be relocated.

15. Environmental / HTW

There are no known hazardous and/or toxic waste on the land required for the project.

16. Known or Anticipated Support or Opposition of Landowners in project area

Based upon available information, landowner support appears to be good.

17. Other RE issues relevant to planning, design, or implementation of the project

Another alternative may be considered for relocation of the town.

U.S. Army Corps
of Engineers
Alaska District

Barrow, Alaska

Coastal Storm Damage Reduction
Technical Report

Appendix C -- Cost Estimate

September 2008

APPENDIX C

COST ESTIMATE

Technical Report
for
Barrow, Alaska
Coastal Storm Damage Reduction

1.0 INTRODUCTION

This Cost Estimating Appendix describes the technical cost aspects of the Barrow Coastal Storm Damage Reduction study.

1.1 HISTORY

For the Preliminary Draft Interim Feasibility Report, the alternatives selected for further consideration consist of combinations of two initial alternatives, Coastal Dike and Bluff Revetment. The Coastal Dike portion was a 8,700-foot-long rock dike, with a crest of +20.5 ft (as shown in Figure 49 in Hydraulic Appendix), constructed of approximately 67,500 cubic yard (cy) of armor rock, 48,300 cy of B rock, 18,000 cy of core rock, and an estimated construction cost of $46.6 million. The Bluff Revetment portion was a 2,000-foot-long rock dike, with a top of rock of +15.0 ft (as shown in Figure 48 in Hydraulic Appendix), constructed of approximately 11,300 cy of armor rock, 10,000 cy of B rock, 3,400 cy of core rock and an estimated construction cost of $12.1 million. The two "action" alternatives considered were (1) Coastal Dike with full Bluff Revetment for 10,700-foot-long rock protection with an estimated construction cost of $53.3 million (full Coastal Dike cost but deleted MOB/DEMOB and 'Const. Temporary Dock' from Bluff Revetment costs), and (2) Coastal Dike with partial Bluff Revetment for 9,300-foot-long rock protection with an estimated construction cost of $48.8 million (full Coastal Dike cost but deleted MOB/DEMOB and 'Const. Temporary Dock' from Bluff Revetment costs and took 30% of remainder of Bluff Revetment costs). The quantities, cost and time calculations included gross cost estimates for providing public access to the shore, means of interior drainage through the dike, means of mitigating cultural concerns, and construction of maintenance material stockpile. They did not include provisions for possible changes in dike and/or bluff protection design (primarily rock size change) based on ice studies that were being performed at the time.

During the Independent Technical Review (ITR) phase, it was determined that: 1) the "modeling" method used to determine storm impacts overstated the impacts and benefits realized by the alternatives, and 2) understated the costs because low mobilization/demobilization, material, equipment, overtime, material placement, work duration, and escalation costs.

Post-ITR, the "modeling" method was revised, and 16 different alternatives were evaluated in an attempt to find a coastal flood and erosion protection method that had an acceptable cost-benefit ratio. They included protecting the coast to 4 different heights by either stone dike or beach nourishment, protecting the bluff along 3 different 'reaches' by stone dike, and 5 other options.

1.2 PROJECT COST SUMMARY

PRELIMINARY DRAFT INTERIM FEASIBILITY REPORT (PRE-ITR):

	Coastal Dike w/ full Bluff Revetment	Coastal Dike w/ partial Bluff Revetment
Construction Cost	$39.5 million	$36.3 million
Cultural Mitigation	$ 0.7 million	$ 0.7 million
Real Estate	$ 0.2 million	$ 0.2 million
Planning & Design	$ 4.0 million	$ 3.6 million
Construction Management	$ 3.2 million	$ 2.9 million
TOTAL	$47.6 million	$43.6 million
Stockpile Maint. Material	$ 7.0 million	$ 6.3 million

Specific Assumptions:

- Coastal Dike with full Bluff Revetment is 10,700 feet long constructed of approximately 78,800 cy of armor rock, 58,300 cy of B rock, and 21,400 cy of core rock. *{NOTE: Dike design change may affect quantities and project cost.}*
- Coastal Dike with partial Bluff Revetment is 9,300 feet long constructed of approximately 70,900 cy of armor rock, 51,300 cy of B rock, and 19,100 cy of core rock. *{NOTE: Dike design change may affect quantities and project cost.}*
- The gravel material will be obtained from local sources with a ten mile maximum haul distance.

TECHNICAL REPORT (POST-ITR):

Alternative No & Description	Const Costs	Total Initial Costs
#1 – Revetted Berm Sized for Waves (to 8’)	$ 19.506M	$ 24.591M
#2 – Revetted Berm Sized for Waves (to 10’)	$ 26.818M	$ 32.790M
#3 – Revetted Berm Sized for Waves (to 12’)	$ 45.845M	$ 53.876M
#4 – Revetted Berm Sized for Waves (to 14’)	$ 79.482M	$ 91.350M
#5 – Beach Nourishment to 8’ (Trns 27-31.5)	$ 23.166M	$ 28.488M
#6 – Beach Nourishment to 10’ (Trns 24.6-31.5)	$101.771M	$115.059M
#7 – Beach Nourishment to 12’ (Trns 22-33)	$219.535M	$244.387M
#8 – Beach Nourishment to 14’ (Trns 22-43)	$732.469M	$806.969M
#9- Revetted Berm for Ice (Transect 22-42)	$163.580M	$183.522M
#10- Revetment, Transect 17-22	$ 30.626M	$ 36.786M
#11- Revetment, Transect 22-24.625	$ 17.130M	$ 21.887M
#12- Revetment, Transect 22-27	$ 24.668M	$ 30.345M
#13- Revetted Berm for Ice (Transect 22-27)	$ 41.534M	$ 48.830M
#14- Beach Nourishment (Transect 22-27)	$124.560M	$139.867M
#15- Non-Structural (Elevate 10/Relocate 24)	$ 33.834M	$ 42.123M
#16- Fill Tasigrook Lagoon	$ 23.505M	$ 28.801M

Specific Assumptions:

- Alternates #1-9 would protect Transects ranging from 27-31.5 for 8' contour up to 22-43 for 14' contour, with varying quantities of materials and construction durations from 2 – 17 years.
- Alternates #10-14 would protect Transects ranging up to 17-27, with varying quantities of materials and construction durations of 2 years for each Alternatives #10-13 and 5 years for Alternative #14.
- Alternative #15 involves raising 10 buildings and relocating 24 buildings.
- Alternative #16 involves filling Tasigrook Lagoon to 8' contour.
- The gravel material for Alternative #1-15 will be obtained from the quarry in Nome. The distance to transport these materials is estimated to be 600 sea miles one way from the jobsite. The gravel material for Alternative #16 will be obtained from a local quarry near Barrow.

1.3 COST ESTIMATE GENERAL ASSUMPTIONS

- The work is to be performed from the beach using earthmoving equipment.
- The rock materials will be provided from the quarry in Nome. The distance to transport these materials is estimated to be 600 sea miles one way from the jobsite.
- All equipment will be transported from Seattle to the job site, an assumed 3,287 sea miles.
- Crew will work 12 hours/day, 7 days/wk, for 4.5 months/yr for 2-17 years starting about 15 May each year.

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #1 - Transect 27 - 31.5 Level of Protection = 8' Contour
LOCATION: Barrow, AK

DISTRICT: Alaska District
P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,536	907	20%	5,443		4,536	907	5,443			4,536	907	5,443
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		106	21	20%	127		106	21	127			106	21	127
16 00 81	EXCAVATION		202	40	20%	242		202	40	242			202	40	242
16 00 81	CONSTRUCT GRAVEL FILL		1,313	263	20%	1,576		1,313	263	1,576			1,313	263	1,576
16 00 81	CONSTRUCT CORE ROCK		1,569	314	20%	1,883		1,569	314	1,883			1,569	314	1,883
16 00 81	CONSTRUCT B ROCK		3,917	783	20%	4,700		3,917	783	4,700			3,917	783	4,700
16 00 81	CONSTRUCT A ROCK		4,433	887	20%	5,320		4,433	887	5,320			4,433	887	5,320
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		179	36	20%	215		179	36	215			179	36	215
	TOTAL CONSTRUCTION COSTS ===>		16,255	3,251	20%	19,506		16,255	3,251	19,506			16,255	3,251	19,506
01---	LANDS AND DAMAGES	1.7%	322	64	20%	386		322	64	386			322	64	386
30---	PLANNING, ENGINEERING & DESIGN	10.3%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	1,720	344	20%	2,065		1,720	344	2,065			1,720	344	2,065
30---	CULTURAL MITIGATION	1.0%	195	39	20%	234		195	39	234			195	39	234
	TOTAL PROJECT COSTS ========>		20,492	4,098	20%	24,591		20,492	4,098	24,591			20,492	4,098	24,591
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #2 - Transect 24.625 - 31.5, Level of Protection = 10' Contour — DISTRICT: Alaska District

LOCATION: Barrow, AK — P.O.C.: Cost Estimator - John T. Dudgeon

	CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007						AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,536	907	20%	5,443		4,536	907	5,443			4,536	907	5,443
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		163	33	20%	196		163	33	196			163	33	196
16 00 81	EXCAVATION		309	62	20%	371		309	62	371			309	62	371
16 00 81	CONSTRUCT GRAVEL FILL		1,989	398	20%	2,387		1,989	398	2,387			1,989	398	2,387
16 00 81	CONSTRUCT CORE ROCK		2,381	476	20%	2,857		2,381	476	2,857			2,381	476	2,857
16 00 81	CONSTRUCT B ROCK		5,962	1,192	20%	7,154		5,962	1,192	7,154			5,962	1,192	7,154
16 00 81	CONSTRUCT A ROCK		6,734	1,347	20%	8,081		6,734	1,347	8,081			6,734	1,347	8,081
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		274	55	20%	329		274	55	329			274	55	329
	TOTAL CONSTRUCTION COSTS ===>		22,348	4,470	20%	26,818		22,348	4,470	26,818			22,348	4,470	26,818
01---	LANDS AND DAMAGES	1.4%	372	74	20%	446		372	74	446			372	74	446
30---	PLANNING, ENGINEERING & DESIGN	7.5%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	2,305	461	20%	2,766		2,305	461	2,766			2,305	461	2,766
30---	CULTURAL MITIGATION	1.1%	300	60	20%	360		300	60	360			300	60	360
	TOTAL PROJECT COSTS ========>		27,325	5,465	20%	32,790		27,325	5,465	32,790			27,325	5,465	32,790
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #3 - Transect 23 - 33, Level of Protection = 12' Contour

LOCATION: Barrow, AK

DISTRICT: Alaska District

P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		6,805	1,361	20%	8,166		6,805	1,361	8,166			6,805	1,361	8,166
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		260	52	20%	312		260	52	312			260	52	312
16 00 81	EXCAVATION		537	107	20%	644		537	107	644			537	107	644
16 00 81	CONSTRUCT GRAVEL FILL		3,361	672	20%	4,033		3,361	672	4,033			3,361	672	4,033
16 00 81	CONSTRUCT CORE ROCK		4,035	807	20%	4,842		4,035	807	4,842			4,035	807	4,842
16 00 81	CONSTRUCT B ROCK		10,428	2,086	20%	12,514		10,428	2,086	12,514			10,428	2,086	12,514
16 00 81	CONSTRUCT A ROCK		12,311	2,462	20%	14,773		12,311	2,462	14,773			12,311	2,462	14,773
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		467	93	20%	560		467	93	560			467	93	560
	TOTAL CONSTRUCTION COSTS ===>		38,204	7,641	20%	45,845		38,204	7,641	45,845			38,204	7,641	45,845
01---	LANDS AND DAMAGES	0.8%	387	77	20%	464		387	77	464			387	77	464
30---	PLANNING, ENGINEERING & DESIGN	4.4%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	3,828	766	20%	4,593		3,828	766	4,593			3,828	766	4,593
30---	CULTURAL MITIGATION	1.0%	478	96	20%	574		478	96	574			478	96	574
	TOTAL PROJECT COSTS ========>		44,897	8,979	20%	53,876		44,897	8,979	53,876			44,897	8,979	53,876
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #4 - Transect 22 - 43, Level of Protection = 14' Contour DISTRICT: Alaska District
LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

ACCOUNT NUMBER	FEATURE DESCRIPTION		CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07 OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED ESTIMATE FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		9,072	1,814	20%	10,886		9,072	1,814	10,886			9,072	1,814	10,886
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		496	99	20%	595		496	99	595			496	99	595
16 00 81	EXCAVATION		985	197	20%	1,182		985	197	1,182			985	197	1,182
16 00 81	CONSTRUCT GRAVEL FILL		6,232	1,246	20%	7,478		6,232	1,246	7,478			6,232	1,246	7,478
16 00 81	CONSTRUCT CORE ROCK		7,477	1,495	20%	8,972		7,477	1,495	8,972			7,477	1,495	8,972
16 00 81	CONSTRUCT B ROCK		19,034	3,807	20%	22,841		19,034	3,807	22,841			19,034	3,807	22,841
16 00 81	CONSTRUCT A ROCK		22,054	4,411	20%	26,465		22,054	4,411	26,465			22,054	4,411	26,465
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		885	177	20%	1,062		885	177	1,062			885	177	1,062
	TOTAL CONSTRUCTION COSTS ===>		66,235	13,247	20%	79,482		66,235	13,247	79,482			66,235	13,247	79,482
01---	LANDS AND DAMAGES	0.6%	476	95	20%	571		476	95	571			476	95	571
30---	PLANNING, ENGINEERING & DESIGN	2.5%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	6,519	1,304	20%	7,822		6,519	1,304	7,822			6,519	1,304	7,822
30---	CULTURAL MITIGATION	1.1%	896	179	20%	1,075		896	179	1,075			896	179	1,075
	TOTAL PROJECT COSTS ========>		76,126	15,225	20%	91,351 (91,350)		76,126	15,225	91,351			76,126	15,225	91,351
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #5 - Beach Nourish. Transect 27 - 31.5 Level of Protection = 8' Contour
DISTRICT: Alaska District

LOCATION: Barrow, AK
P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,369	874	20%	5,243		4,369	874	5,243			4,369	874	5,243
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC				20%										
16 00 81	EXCAVATION				20%										
16 00 81	CONSTRUCT GRAVEL FILL		14,878	2,976	20%	17,854		14,878	2,976	17,854			14,878	2,976	17,854
16 00 81	CONSTRUCT CORE ROCK				20%										
16 00 81	CONSTRUCT B ROCK				20%										
16 00 81	CONSTRUCT A ROCK				20%										
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		58	12	20%	70		58	12	70			58	12	70
	TOTAL CONSTRUCTION COSTS ===>		19,305	3,861	20%	23,166		19,305	3,861	23,166			19,305	3,861	23,166
01---	LANDS AND DAMAGES	1.4%	322	64	20%	386		322	64	386			322	64	386
30---	PLANNING, ENGINEERING & DESIGN	8.6%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	2,013	403	20%	2,416		2,013	403	2,416			2,013	403	2,416
30---	CULTURAL MITIGATION	0.4%	100	20	20%	120		100	20	120			100	20	120
	TOTAL PROJECT COSTS ========>		23,740	4,748	20%	28,488		23,740	4,748	28,488			23,740	4,748	28,488
	BEACH RENOURISHMENT		10,995	2,199	20%	13,194		10,995	2,199	13,194			10,995	2,199	13,194

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #6 - Beach Nourish. Transect 24.625 - 31.5 Level of Protection = 10' Contour DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		17,475	3,495	20%	20,970		17,475	3,495	20,970			17,475	3,495	20,970
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC				20%										
16 00 81	EXCAVATION				20%										
16 00 81	CONSTRUCT GRAVEL FILL		67,276	13,455	20%	80,731		67,276	13,455	80,731			67,276	13,455	80,731
16 00 81	CONSTRUCT CORE ROCK				20%										
16 00 81	CONSTRUCT B ROCK				20%										
16 00 81	CONSTRUCT A ROCK				20%										
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		58	12	20%	70		58	12	70			58	12	70
	TOTAL CONSTRUCTION COSTS ===>		84,809	16,962	20%	101,771		84,809	16,962	101,771			84,809	16,962	101,771
01---	LANDS AND DAMAGES	0.4%	372	74	20%	446		372	74	446			372	74	446
30---	PLANNING, ENGINEERING & DESIGN	2.0%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	8,302	1,660	20%	9,962		8,302	1,660	9,962			8,302	1,660	9,962
30---	CULTURAL MITIGATION	0.4%	400	80	20%	480		400	80	480			400	80	480
	TOTAL PROJECT COSTS ========>		95,883	19,177	20%	115,059		95,883	19,177	115,059			95,883	19,177	115,059
	BEACH RENOURISHMENT		77,837	15,567	20%	93,404		77,837	15,567	93,404			77,837	15,567	93,404

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #7 - Beach Nourish. Transect 22 - 33 Level of Protection = 12' Contour DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		45,962	9,192	20%	55,154		45,962	9,192	55,154			45,962	9,192	55,154
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC				20%										
16 00 81	EXCAVATION				20%										
16 00 81	CONSTRUCT GRAVEL FILL		136,400	27,280	20%	163,680		136,400	27,280	163,680			136,400	27,280	163,680
16 00 81	CONSTRUCT CORE ROCK				20%										
16 00 81	CONSTRUCT B ROCK				20%										
16 00 81	CONSTRUCT A ROCK				20%										
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		584	117	20%	701		584	117	701			584	117	701
	TOTAL CONSTRUCTION COSTS ===>		182,946	36,589	20%	219,535		182,946	36,589	219,535			182,946	36,589	219,535
01---	LANDS AND DAMAGES	0.2%	387	77	20%	464		387	77	464			387	77	464
30---	PLANNING, ENGINEERING & DESIGN	0.9%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	17,723	3,545	20%	21,267		17,723	3,545	21,267			17,723	3,545	21,267
30---	CULTURAL MITIGATION	0.3%	600	120	20%	720		600	120	720			600	120	720
	TOTAL PROJECT COSTS ========>		203,656	40,731	20%	244,387		203,656	40,731	244,387			203,656	40,731	244,387
	BEACH RENOURISHMENT		223,753	44,751	20%	268,504		223,753	44,751	268,504			223,753	44,751	268,504

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #8 - Beach Nourish. Transect 22 - 43 Level of Protection = 14' Contour DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		131,081	26,216	20%	157,297		131,081	26,216	157,297			131,081	26,216	157,297
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC				20%										
16 00 81	EXCAVATION				20%										
16 00 81	CONSTRUCT GRAVEL FILL		478,317	95,663	20%	573,980		478,317	95,663	573,980			478,317	95,663	573,980
16 00 81	CONSTRUCT CORE ROCK				20%										
16 00 81	CONSTRUCT B ROCK				20%										
16 00 81	CONSTRUCT A ROCK				20%										
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		993	199	20%	1,192		993	199	1,192			993	199	1,192
	TOTAL CONSTRUCTION COSTS ===>		610,391	122,078	20%	732,469		610,391	122,078	732,469			610,391	122,078	732,469
01---	LANDS AND DAMAGES	0.1%	476	95	20%	571		476	95	571			476	95	571
30---	PLANNING, ENGINEERING & DESIGN	0.3%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	58,758	11,752	20%	70,509		58,758	11,752	70,509			58,758	11,752	70,509
30---	CULTURAL MITIGATION	0.1%	850	170	20%	1,020		850	170	1,020			850	170	1,020
	TOTAL PROJECT COSTS ========>		672,475	134,495	20%	806,969		672,475	134,495	806,969			672,475	134,495	806,969
	BEACH RENOURISHMENT		604,901	120,980	20%	725,881		604,901	120,980	725,881			604,901	120,980	725,881

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #9 - IVU Revetment Transect 22 - 43, Level of Protection = 14' Contour DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

	CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007						AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		18,145	3,629	20%	21,774		18,145	3,629	21,774			18,145	3,629	21,774
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		579	116	20%	695		579	116	695			579	116	695
16 00 81	EXCAVATION		1,341	268	20%	1,609		1,341	268	1,609			1,341	268	1,609
16 00 81	CONSTRUCT GRAVEL FILL		8,242	1,648	20%	9,890		8,242	1,648	9,890			8,242	1,648	9,890
16 00 81	CONSTRUCT CORE ROCK		10,110	2,022	20%	12,132		10,110	2,022	12,132			10,110	2,022	12,132
16 00 81	CONSTRUCT B ROCK		28,112	5,622	20%	33,734		28,112	5,622	33,734			28,112	5,622	33,734
16 00 81	CONSTRUCT A ROCK		67,867	13,573	20%	81,440		67,867	13,573	81,440			67,867	13,573	81,440
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		1,921	384	20%	2,305		1,921	384	2,305			1,921	384	2,305
	TOTAL CONSTRUCTION COSTS ===>		136,317	27,263	20%	163,580		136,317	27,263	163,580			136,317	27,263	163,580
01---	LANDS AND DAMAGES	0.3%	476	95	20%	571		476	95	571			476	95	571
30---	PLANNING, ENGINEERING & DESIGN	1.2%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	13,246	2,649	20%	15,896		13,246	2,649	15,896			13,246	2,649	15,896
30---	CULTURAL MITIGATION	0.5%	896	179	20%	1,075		896	179	1,075			896	179	1,075
	TOTAL PROJECT COSTS ========>		152,935	30,587	20%	183,523 (183,522)		152,935	30,587	183,523			152,935	30,587	183,523
	STOCKPILE MATERIAL FOR MAINTENANCE		14,889	2,978	20%	17,867		14,889	2,978	17,867			14,889	2,978	17,867
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		19,173	3,835	20%	23,008		19,173	3,835	23,008			19,173	3,835	23,008

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #10 - Bluff Revetment Transect 17 - 22 DISTRICT: Alaska District
LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

	CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007						AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,536	907	20%	5,443		4,536	907	5,443			4,536	907	5,443
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		150	30	20%	180		150	30	180			150	30	180
16 00 81	CONSTRUCT FILL		767	153	20%	920		767	153	920			767	153	920
16 00 81	CONSTRUCT GRAVEL FILL		1,932	386	20%	2,318		1,932	386	2,318			1,932	386	2,318
16 00 81	CONSTRUCT CORE ROCK		2,316	463	20%	2,779		2,316	463	2,779			2,316	463	2,779
16 00 81	CONSTRUCT B ROCK		6,714	1,343	20%	8,057		6,714	1,343	8,057			6,714	1,343	8,057
16 00 81	CONSTRUCT A ROCK		8,751	1,750	20%	10,501		8,751	1,750	10,501			8,751	1,750	10,501
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		356	71	20%	427		356	71	427			356	71	427
	TOTAL CONSTRUCTION COSTS ===>		25,522	5,104	20%	30,626		25,522	5,104	30,626			25,522	5,104	30,626
01---	LANDS AND DAMAGES	1.0%	307	61	20%	368		307	61	368			307	61	368
30---	PLANNING, ENGINEERING & DESIGN	6.5%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	2,610	522	20%	3,132		2,610	522	3,132			2,610	522	3,132
30---	CULTURAL MITIGATION	0.7%	217	43	20%	260		217	43	260			217	43	260
	TOTAL PROJECT COSTS ========>		30,656	6,131	20%	36,787 (36,786)		30,656	6,131	36,787			30,656	6,131	36,787
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #11 - Bluff Revetment Transect 22 - 24.625 DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

	CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007						AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,536	907	20%	5,443		4,536	907	5,443			4,536	907	5,443
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		74	15	20%	89		74	15	89			74	15	89
16 00 81	CONSTRUCT FILL		249	50	20%	299		249	50	299			249	50	299
16 00 81	CONSTRUCT GRAVEL FILL		940	188	20%	1,128		940	188	1,128			940	188	1,128
16 00 81	CONSTRUCT CORE ROCK		1,134	227	20%	1,361		1,134	227	1,361			1,134	227	1,361
16 00 81	CONSTRUCT B ROCK		3,211	642	20%	3,853		3,211	642	3,853			3,211	642	3,853
16 00 81	CONSTRUCT A ROCK		3,971	794	20%	4,765		3,971	794	4,765			3,971	794	4,765
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		160	32	20%	192		160	32	192			160	32	192
	TOTAL CONSTRUCTION COSTS ===>		14,275	2,855	20%	17,130		14,275	2,855	17,130			14,275	2,855	17,130
01---	LANDS AND DAMAGES	1.9%	321	64	20%	385		321	64	385			321	64	385
30---	PLANNING, ENGINEERING & DESIGN	11.7%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	1,530	306	20%	1,836		1,530	306	1,836			1,530	306	1,836
30---	CULTURAL MITIGATION	0.7%	113	23	20%	136		113	23	136			113	23	136
	TOTAL PROJECT COSTS ========>		18,239	3,648	20%	21,887		18,239	3,648	21,887			18,239	3,648	21,887
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #12 - Bluff Revetment Transect 22 - 27 DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

	CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007						AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,536	907	20%	5,443		4,536	907	5,443			4,536	907	5,443
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		128	26	20%	154		128	26	154			128	26	154
16 00 81	CONSTRUCT FILL		249	50	20%	299		249	50	299			249	50	299
16 00 81	CONSTRUCT GRAVEL FILL		1,582	316	20%	1,898		1,582	316	1,898			1,582	316	1,898
16 00 81	CONSTRUCT CORE ROCK		2,209	442	20%	2,651		2,209	442	2,651			2,209	442	2,651
16 00 81	CONSTRUCT B ROCK		5,286	1,057	20%	6,343		5,286	1,057	6,343			5,286	1,057	6,343
16 00 81	CONSTRUCT A ROCK		6,321	1,264	20%	7,585		6,321	1,264	7,585			6,321	1,264	7,585
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		246	49	20%	295		246	49	295			246	49	295
	TOTAL CONSTRUCTION COSTS ===>		20,557	4,111	20%	24,668		20,557	4,111	24,668			20,557	4,111	24,668
01---	LANDS AND DAMAGES	1.5%	381	76	20%	457		381	76	457			381	76	457
30---	PLANNING, ENGINEERING & DESIGN	8.1%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	2,133	427	20%	2,560		2,133	427	2,560			2,133	427	2,560
30---	CULTURAL MITIGATION	0.9%	217	43	20%	260		217	43	260			217	43	260
	TOTAL PROJECT COSTS ========>		25,288	5,058	20%	30,346 (30,345)		25,288	5,058	30,346			25,288	5,058	30,346
	STOCKPILE MATERIAL FOR MAINTENANCE		14,150	2,830	20%	16,980		14,150	2,830	16,980			14,150	2,830	16,980
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		16,844	3,369	20%	20,213		16,844	3,369	20,213			16,844	3,369	20,213

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #13 - Bluff Protection for IVU,Transects 22 - 27 DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		4,536	907	20%	5,443		4,536	907	5,443			4,536	907	5,443
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC		145	29	20%	174		145	29	174			145	29	174
16 00 81	CONSTRUCT FILL		264	53	20%	317		264	53	317			264	53	317
16 00 81	CONSTRUCT GRAVEL FILL		2,053	411	20%	2,464		2,053	411	2,464			2,053	411	2,464
16 00 81	CONSTRUCT CORE ROCK		2,520	504	20%	3,024		2,520	504	3,024			2,520	504	3,024
16 00 81	CONSTRUCT B ROCK		6,894	1,379	20%	8,273		6,894	1,379	8,273			6,894	1,379	8,273
16 00 81	CONSTRUCT A ROCK		16,832	3,366	20%	20,198		16,832	3,366	20,198			16,832	3,366	20,198
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		1,368	274	20%	1,642		1,368	274	1,642			1,368	274	1,642
	TOTAL CONSTRUCTION COSTS ===>		34,612	6,922	20%	41,534		34,612	6,922	41,534			34,612	6,922	41,534
01---	LANDS AND DAMAGES	0.9%	381	76	20%	457		381	76	457			381	76	457
30---	PLANNING, ENGINEERING & DESIGN	4.8%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	3,483	697	20%	4,179		3,483	697	4,179			3,483	697	4,179
30---	CULTURAL MITIGATION	0.5%	217	43	20%	260		217	43	260			217	43	260
	TOTAL PROJECT COSTS ========>		40,693	8,139	20%	48,831 (48,830)		40,693	8,139	48,831			40,693	8,139	48,831
	STOCKPILE MATERIAL FOR MAINTENANCE		14,889	2,978	20%	17,867		14,889	2,978	17,867			14,889	2,978	17,867
	DIKE REPAIRS & RESTOCKPILING EVERY 5 YEARS		19,173	3,835	20%	23,008		19,173	3,835	23,008			19,173	3,835	23,008

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #14 - Bluff Beach Nourish. Transect 22 - 27 DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		21,844	4,369	20%	26,213		21,844	4,369	26,213			21,844	4,369	26,213
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC				20%										
16 00 81	CONSTRUCT FILL				20%										
16 00 81	CONSTRUCT GRAVEL FILL		81,372	16,274	20%	97,646		81,372	16,274	97,646			81,372	16,274	97,646
16 00 81	CONSTRUCT CORE ROCK				20%										
16 00 81	CONSTRUCT B ROCK				20%										
16 00 81	CONSTRUCT A ROCK				20%										
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		584	117	20%	701		584	117	701			584	117	701
	TOTAL CONSTRUCTION COSTS ===>		103,800	20,760	20%	124,560		103,800	20,760	124,560			103,800	20,760	124,560
01---	LANDS AND DAMAGES	0.3%	381	76	20%	457		381	76	457			381	76	457
30---	PLANNING, ENGINEERING & DESIGN	1.6%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	10,125	2,025	20%	12,150		10,125	2,025	12,150			10,125	2,025	12,150
30---	CULTURAL MITIGATION	0.2%	250	50	20%	300		250	50	300			250	50	300
	TOTAL PROJECT COSTS ========>		116,556	23,311	20%	139,867		116,556	23,311	139,867			116,556	23,311	139,867
	BEACH RENOURISHMENT		69,225	13,845	20%	83,070		69,225	13,845	83,070			69,225	13,845	83,070

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #15 - Non-Structural Options (Raising & Relocating 32 Structures) DISTRICT: Alaska District

LOCATION: Barrow, AK P.O.C.: Cost Estimator - John T. Dudgeon

		CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007					AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
020301	MOB/DEMOB		4,966	993	20%	5,959		4,966	993	5,959			4,966	993	5,959
020347	STRUCTURE RAISING - 10		3,542	708	20%	4,250		3,542	708	4,250			3,542	708	4,250
020347	STRUCTURE RELOCATING - 24		19,687	3,937	20%	23,624		19,687	3,937	23,624			19,687	3,937	23,624
	TOTAL CONSTRUCTION COSTS ===>		28,195	5,639	20%	33,834		28,195	5,639	33,834			28,195	5,639	33,834
01---	LANDS AND DAMAGES	4.1%	1,396	279	20%	1,675		1,396	279	1,675			1,396	279	1,675
30---	PLANNING, ENGINEERING & DESIGN	7.4%	2,500	500	20%	3,000		2,500	500	3,000			2,500	500	3,000
31---	CONSTRUCTION MANAGEMENT	8.0%	2,907	581	20%	3,488		2,907	581	3,488			2,907	581	3,488
30---	CULTURAL MITIGATION	0.3%	105	21	20%	126		105	21	126			105	21	126
	TOTAL PROJECT COSTS ========>		35,103	7,021	20%	42,123		35,103	7,021	42,123			35,103	7,021	42,123

Summary of Cost for Barrow Structures Raise & Relocate

	#	Address	Type	Stories	SF/floor (field trip)	SF/floor (GIS)	Piles Needed	Pile Cost	Relocate Cost	RE, PED, CM, & Cultural Costs	Total
		Structures in Barrow Neighborhood									
Relocate 1	912	Stevenson St.	Res	1-1/2		816	20	59,019	$1,024,594	$243,795	$1,327,408
Relocate 2	914	Stevenson St.	Res	1	440	506	13	36,598	$1,024,594	$243,795	$1,304,987
Relocate 3	916	Stevenson St.	Res	1		1,070	27	77,390	$1,024,594	$243,795	$1,345,780
Relocate 4	920	Stevenson St.	Res	1		970	24	70,157	$1,024,594	$243,795	$1,338,547
Relocate 5	924	Stevenson St.	Res	2		460	12	33,271	$1,024,594	$243,795	$1,301,660
Relocate 6	926	Stevenson St.	Res	1	house 875	918	23	66,396	$1,024,594	$243,795	$1,334,786
Relocate 7	930	Stevenson St.	Res	1	940	832	21	60,176	$1,024,594	$243,795	$1,328,566
Relocate 8	936	Stevenson St.	**Com**	2	2,500	3,028	76	219,007	$1,130,674	$243,795	$1,593,477
Relocate 9	476	Egasak St.	**Res-apartm**	2	2,400	1,738	43	125,705	$1,130,674	$243,795	$1,500,174
Relocate 10	470	Egasak St.	Res	2		428	11	30,956	$1,024,594	$243,795	$1,299,345
Relocate 11	940	Stevenson St.	**Res-apartm**	2	750	908	23	65,673	$1,130,674	$243,795	$1,440,143
Relocate 12	950	Egasak St.	**Res-apartm**	2	1,000	1,232	31	89,107	$1,130,674	$243,795	$1,463,577
Relocate 13	489	Egasak St.	Res	1		1,379	34	99,739	$1,024,594	$243,795	$1,368,129
Relocate 14	491	Egasak St.	**Res**	2		2,017	50	145,884	$1,130,674	$243,795	$1,520,354
Relocate 15	493	Egasak St.	Res	1		872	22	63,069	$1,024,594	$243,795	$1,331,459
Relocate 16	730	Nachik St.	**Pub**	1		4,308	108	311,586	$1,130,674	$243,795	$1,686,055
Relocate 17	739	Nachik St.	Com	1		1,561	39	112,903	$1,024,594	$243,795	$1,381,292
Relocate 18	970	Stevenson St.	**Res-apartm**	3	2,025	1,637	41	118,400	$1,130,674	$243,795	$1,492,869
Relocate 19	744	Nachik St.	Res	1-mobile	825	1,094	27	79,126	$1,024,594	$243,795	$1,347,515
Relocate 20	978	Egasak St.	Res	1		885	22	64,010	$1,024,594	$243,795	$1,332,399
Relocate 21	976	Stevenson St.	**Res/Com**	2	1,650	1,722	43	124,548	$1,130,674	$243,795	$1,499,017
Relocate 22	980	Stevenson St.	**Com/Res**	2	1,700	1,938	48	140,170	$1,130,674	$243,795	$1,514,640
Raise 1	1209	Agvik St.	Res		769	989	25	71,532	$419,241	$243,795	$734,568
Raise 2	983	Stevenson St.	Res		925	833	21	60,249	$419,241	$243,795	$723,284
Relocate 23	989	Stevenson St.	Res	2	400	604	15	43,686	$1,024,594	$243,795	$1,312,075
Relocate 24	1092	Kiogak St.	Res	1-1/2	625	663	17	47,953	$1,024,594	$243,795	$1,316,342
Raise 3	1093	Kiogak St.	Res	1	875	1,008	25	72,906	$419,241	$243,795	$735,942
Raise 4	1089	Kiogak St.	Res	2	600	1,339	33	96,846	$419,241	$243,795	$759,882
Raise 5	1128	Hopson St.	Res	2		506	13	36,598	$419,241	$243,795	$699,633
Raise 6	1126	Hopson St.	Res	2	1,050	789	20	57,066	$419,241	$243,795	$720,102
Raise 7	3022	Simmonds St.	Res	2	700	869	22	62,852	$419,241	$243,795	$725,888
Raise 8	3026	Simmonds St.	Res	1	1,200	1,150	29	83,176	$419,241	$243,795	$746,212
Raise 9	3206	Simmonds St.	Res	1		623	16	45,060	$419,241	$243,795	$708,096
Raise 10	3419	Stevenson St.	Com	2		11,334	283	819,758	$824,274	$243,795	$1,887,827

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE Feasibility Study, DATED: JAN 2008

PROJECT: Barrow Erosion Control Feasibility Alternative #16 - Fill Isatquaq Lagoon, Level of Protection = 8' Contour — DISTRICT: Alaska District

LOCATION: Barrow, AK — P.O.C.: Cost Estimator - John T. Dudgeon

			CURRENT MCACES ESTIMATE PREPARED: JAN 2008 EFFECTIVE PRICING LEVEL: OCT 2007				AUTHORIZ./BUDGET YEAR: 2007 EFFECT. PRICING LEVEL: 1 OCT 07				FULLY FUNDED ESTIMATE				
ACCOUNT NUMBER	FEATURE DESCRIPTION		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
16 00 01	MOB/DEMOB		2,131	426	20%	2,557		2,131	426	2,557			2,131	426	2,557
16 00 99	PLACEMENT OF GEOTEXTILE FABRIC				20%										
16 00 81	EXCAVATION				20%										
16 00 81	CONSTRUCT GRAVEL FILL		17,420	3,484	20%	20,904		17,420	3,484	20,904			17,420	3,484	20,904
16 00 81	CONSTRUCT CORE ROCK				20%										
16 00 81	CONSTRUCT B ROCK				20%										
16 00 81	CONSTRUCT A ROCK				20%										
16 00 99	PROVIDE TOPOGRAPHIC SURVEYING		37	7	20%	44		37	7	44			37	7	44
	TOTAL CONSTRUCTION COSTS ===>		19,588	3,918	20%	23,506		19,588	3,918	23,506			19,588	3,918	23,506
01---	LANDS AND DAMAGES	1.4%	322	64	20%	386		322	64	386			322	64	386
30---	PLANNING, ENGINEERING & DESIGN	8.5%	2,000	400	20%	2,400		2,000	400	2,400			2,000	400	2,400
31---	CONSTRUCTION MANAGEMENT	8.0%	2,040	408	20%	2,449		2,040	408	2,449			2,040	408	2,449
30---	CULTURAL MITIGATION	0.2%	50	10	20%	60		50	10	60			50	10	60
	TOTAL PROJECT COSTS ========>		24,000	4,800	20%	28,801		24,000	4,800	28,801			24,000	4,800	28,801
	BEACH RENOURISHMENT				20%										

U.S. Army Corps
of Engineers
Alaska District

Barrow, Alaska

Coastal Storm Damage Reduction
Interim Feasibility Report

Appendix D -- Economic Analysis

August 2008

BARROW, ALASKA
COASTAL STORM DAMAGE REDUCTION
FEASIBILITY STUDY

ECONOMIC APPENDIX

prepared for:

Alaska District

U.S. Army Corps of Engineers

prepared by:

Tetra Tech Inc.

1925 Post Alley

Seattle, Washington

August 2008

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1.0 Introduction

Barrow, AK is the northern most community in the United States, lying north of 71 degrees north latitude (figure 1). Barrow is the economic, social, and cultural center for the North Slope Borough (NSB), which includes almost all of Alaska north of the 68th Parallel and has a population of about 6,900 persons[1] spread over 89,000 square miles, an area about the size of the state of Oregon. Barrow, incorporated in 1958, is a first-class City with about 4,200 residents[2], accounting for over half of the Borough's population.

Figure 1: State of Alaska Location Map

Barrow has been faced with storm damage and erosion problems for decades. A number of damage reduction measures have been tried by local entities in the past at Barrow with varying degrees of success. NSB studies in the 1980's culminated in the NSB's formal Beach Nourishment Program, authorized in 1991. That program was planned as an 8 year beach nourishment period, using a specially-built, barge-mounted dredge to remove materials from offshore of Barrow and place them on the beach. The NSB took delivery of the dredge, shore barge, and dredge tender in 1995. Numerous operational complications, including extensive damage to the dredge in the August 2000 storm, resulted in termination of the program without achievement of program objectives. It is estimated that approximately $27 million was spent over the decade on the NSB's Beach Nourishment Program.

Coastal flooding and erosion continue to threaten residential and commercial structures and community infrastructure in Barrow. The NSB is committed to continuing their current flood fighting practices, which include annual construction and repairs for push up gravel beach berms that provide limited protection to the beach frontage road (Stevenson Street) and development in its vicinity. Additionally, the NSB is participating with the Corps of Engineers in this feasibility study of alternative solutions to flooding and erosion problems in Barrow. This report documents economic analyses performed as part of the feasibility study.

[1] 2005 State Demographer estimate.
[2] 2005 State Demographer estimate.

2.0 Economic Study Area

Barrow is located on the Chukchi Sea coast, 10 miles south of Point Barrow from which it takes its name. It lies 725 air miles from Anchorage and encompasses 18.4 sq. miles of land and 2.9 sq. miles of water. The climate of Barrow is arctic. Annual precipitation is light, averaging 5 inches, annual snowfall is 20 inches. Temperatures range from -56 to 78 degrees Fahrenheit, with an average temperature of 40 degrees Fahrenheit during summer. The sun does not set between May 10th and August 2nd each summer, and does not rise between Nov. 18th and January 24th each winter. The daily minimum temperature is below freezing 324 days of the year. Prevailing winds are easterly and average 12 mph. The Chukchi Sea is typically ice-free from mid-June through October.

The primary focus of the economic study of coastal flooding and erosion damages is in the neighborhoods of Barrow and Browerville, which are the two most developed areas in the City (figure 2). The developed portions of Barrow/Browerville contain both residential and nonresidential structures and most of the City's infrastructure. As a regional provider of services for communities throughout the North Slope Borough, economic effects of flooding and erosion damages in Barrow may also impact these outlying communities and these impacts are addressed in this report.

3.0 Socioeconomic Characteristics

Barrow has the largest population in the NSB and is the economic center of the region. Borough, state, and federal agencies are the largest employers in the City. Numerous businesses provide support services to oil field operations. Tourism and arts and crafts provide some cash income. Seven residents hold commercial fishing permits. Subsistence production is an important component of the local economy and social structure as many residents rely upon subsistence food sources. Whale, seal, polar bear, walrus, duck, caribou and grayling and whitefish are harvested from the coast or nearby rivers and lakes for local subsistence.

Barrow is located in the North Slope Census Area. The following paragraphs summarize population, housing, income, and employment statistics for Barrow. Most of the information is based upon data from the 2000 U.S. Census. More recent data from the State of Alaska is provided where available as noted in the following sections.

3.1 Population

Review of U.S. Census records shows that Barrow witnessed a steady increase in population over the period 1900-2000. The State of Alaska estimates the population of Barrow in 2005 at 4,199, down 8.3% from the 2000 census count of 4,581. Figure 3 shows the population change in Barrow over the period 1880-2005.

The most recent detailed demographic data for Barrow is from the 2000 census. At that time, 64% of the population was reported as Alaska Native alone (57%) or in combination with one or more races (7%). Of the remaining population, the largest racial groups were reported as white (21%) and Asian (9%). Table 1 provides a summary of the racial composition of the Barrow population in 2000.

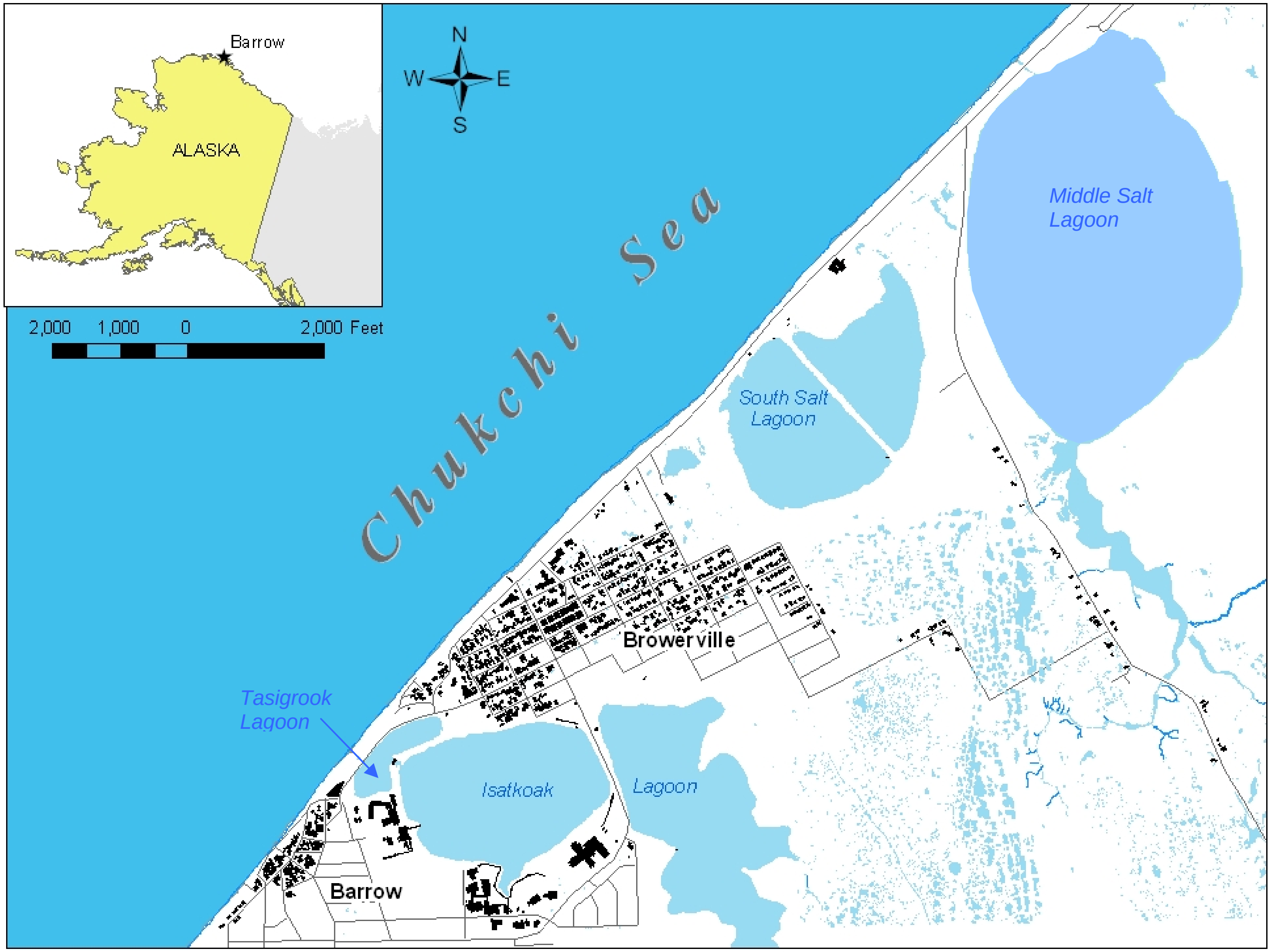

Figure 2: Economic Study Area

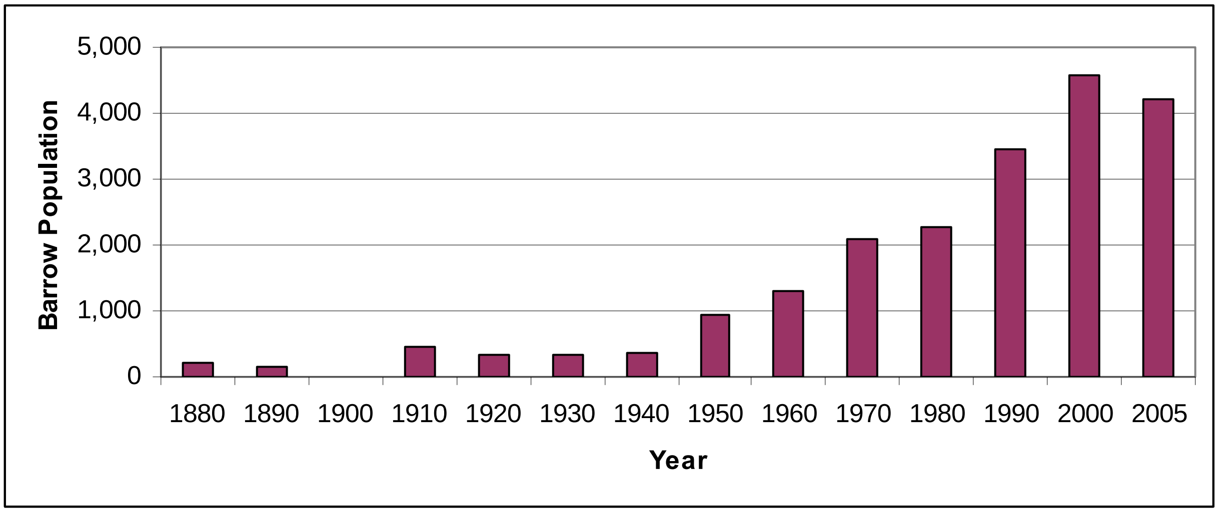

Figure 3: Population Change in Barrow 1880-2005

Table 1: Population by Race

Population in 2005: (Alaska State Demographer estimate)	4,199	
Population in 2000: (2000 U.S. Census)	4,581	
Racial Composition (2000 population):		
One Race Only:	4,191	91%
White:	1,000	22%
Alaska Native or Amer. Indian:	2,620	57%
Black:	46	1%
Asian:	431	9%
Hawaiian Native:	62	1%
Other Race:	32	1%
Two or More Races:	390	9%
All or Part Alaska Native/Indian:	2,933	70%
Hispanic Origin (Any Race):	153	3%
Not Hispanic (Any Race):	4,428	97%

The gender of Barrow's population in 2000 was approximately 52% male and 48% female. Approximately 40% of Barrow's population in 2000 was under the age of 20; with 51% between the ages of 20 and 54 and 9% over the age of 54. Barrow's median age was reported as 28.8. Table 2 provides a summary of Barrow's 2000 population statistics by gender and age.

Table 2: Population by Gender and Age

Male:	2,369	52%
Female:	2,212	48%
TOTAL POPULATION (2000):	4,581	100%
Age 4 and under:	450	9.8%
Age 5 - 9:	455	9.9%
Age 10 - 14:	508	11.1%
Age 15 - 19:	409	8.9%
Age 20 - 24:	262	5.7%
Age 25 - 34:	633	13.8%
Age 35 - 44:	816	17.8%
Age 45 - 54:	628	13.7%
Age 55 - 59:	168	3.7%
Age 60 - 64:	95	2.1%
Age 65 - 74:	97	2.1%
Age 75 - 84:	49	1.1%
Age 85 and over:	11	0.2%
Median Age:	28.8	
Pop. Age 18 and over:	2,901	63%
Pop. Age 21 and over:	2,720	59%
Pop. Age 62 and over:	212	5%

3.2 Housing

Barrow's 2000 population was grouped into 1,371 households and the City included 1,620 total housing units. The average household size was 3.27 persons. Table 3 summarizes the 2000 Census data related to housing and household characteristics in Barrow.

Table 3: Housing/Household Characteristics

Total Housing Units:	1,620	
Owner-Occupied Housing:	559	35%
Renter-Occupied Housing:	812	50%
Vacant Housing:	249	15%
Total Households:	1,371	
Average Household Size:	3.27	
Family Households:	942	69%
Average Family Household Size:	3.91	
Non-Family Households:	429	31%

During the 2000 Census, approximately 45% of the households in Barrow were sampled to collect additional data. Data from this sample characterizing Barrow's housing stock is presented in table 4.

Table 4: Housing Structure Types

Single Family (Detached):	954	59%
Single Family (Attached):	53	3%
Duplex:	171	11%
3 or 4 Units:	95	6%
5 to 9 Units:	50	3%
10 to 19 Units:	140	9%
20 plus Units:	123	8%
Trailers/Mobile Homes:	34	2%
TOTAL STRUCTURES:	1,620	100%

3.3 Employment and Income

Of the 4,581 people living in Barrow in 2000, approximately 67% were considered as being in the potential work force. Of the potential workforce, 65% were reported as employed. The remaining 35% were split with 9% reported as unemployed and 26% reported as not seeking work. The largest employer was government, accounting for 1,176 of the 1,986 jobs in 2000 (59%). Table 5 summarizes the employment statistics for Barrow from the 2000 Census. Figure 4 presents a breakdown of employment in Barrow by category.

Table 5: Employment

Total Potential Work Force (Age 16+):	3,069	
Unemployed (Seeking Work):	290	9%
Adults Not in Labor Force (Not Seeking Work):	793	26%
Total Employment:	1,986	65%
Breakdown of Employed Labor Force:		
Private Wage & Salary Workers:	765	39%
Self-Employed Workers (in own not incorporated business):	43	2%
Government Workers (City, Borough, State, Federal):	1,176	59%
Unpaid Family Workers:	2	0.10%

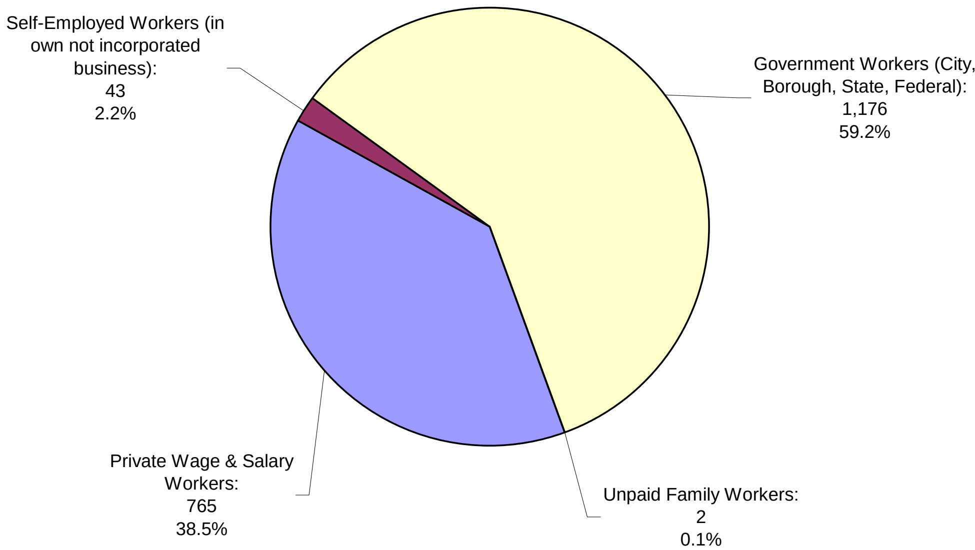

Figure 4: Employment by Employment Category

Table 6 presents the breakdown of the 2000 Barrow employed workforce by industry. The industry category of Education, Health, and Social Services accounts for the most jobs, followed by Public Administration. Combined, these two industry categories account for approximately 59% of the jobs in Barrow.

Table 6: Employment by Industry

Education, Health & Social Services:	718	36.2%
Public Administration:	447	22.5%
Transportation, Warehousing & Utilities:	167	8.4%
Other Services (Except Public Administration):	136	6.8%
Retail Trade:	123	6.2%
Construction:	103	5.2%
Professional, Scientific, Management, Administrative & Waste Mgmt:	85	4.3%
Finance, Insurance, Real Estate, Rental & Leasing:	62	3.1%
Arts, Entertainment, Recreation, Accommodation & Food Services:	57	2.9%
Agriculture, Forestry, Fishing & Hunting, Mining:	38	1.9%
Information:	38	1.9%
Manufacturing:	9	0.5%
Wholesale Trade:	3	0.2%
TOTAL EMPLOYMENT:	1,986	100.0%

Barrow's Per Capita Income was reported at $22,902 in the 2000 Census (1% higher than the state average of $22,660). Adjusted to 2007 prices using the USA Social Security Administration National Average Wage Index, the Per Capita Income is estimated at $27,024 (an 18% increase over the six year period). Table 7 presents summary income data for Barrow.

Table 7: Income

Per Capita Income: (Reported in 2000 Census)	$22,902
Median Household Income: (Reported in 2000 Census)	$67,097
Median Family Income: (Reported in 2000 Census)	$68,203
Per Capita Income: (Adjusted to 2007 Prices*)	$27,024
Median Household Income: (Adjusted to 2007 Prices*)	$79,174
Median Family Income: (Adjusted to 2007 Prices*)	$80,480
Persons in Poverty: (Reported in 2000 Census)	390
Percent Below Poverty: (Reported in 2000 Census)	8.60%
**Adjusted to 2007 prices using USA Social Security Administration National Average Wage Index.*	

3.4 Regional Emergency Services

As the political and economic hub of the NSB, Barrow provides important services to other communities in the Borough. In February 2006, the US Army Corps of Engineers (COE) and NSB hired ASCG, Incorporated to research and document the extent of dependence the various communities in the NSB have on services from Barrow and what would happen if Barrow were unable to provide these services due to a destructive storm event or other disaster.

The study area included the NSB communities of Barrow, Anaktuvuk Pass, Atqasuk, Kaktovik, Nuiqsut, Point Hope, Point Lay and Wainwright (figure 5). The study inventoried critical services currently provided to these other villages by Barrow and examined potential alternatives for obtaining services elsewhere should Barrow service providers be unable to deliver them. The study also compared the costs, availability and consequences of providing those critical services from other communities such as Nome, Kotzebue, Fairbanks or Anchorage as compared to Barrow. The emergency infrastructure systems in Barrow that were identified as currently supporting operations in the named villages include:

- Search and Rescue
- Law enforcement
- Fire Support
- Health Care
- Communication
- Cargo Delivery

Each NSB village was analyzed to determine its capacity to respond to emergencies on a short- or long-term basis. While the villages do have their own Search and Rescue building, police station, public works building, fire station and village health clinic, they are equipped to handle only limited emergency needs. Four alternate communities were identified and analyzed as alternatives for providing emergency support services to NSB communities should Barrow be unable to provide such support. The four communities (Anchorage, Fairbanks, Kotzebue and Nome) were chosen because of their capability to provide emergency services and their relative proximity to the North Slope.

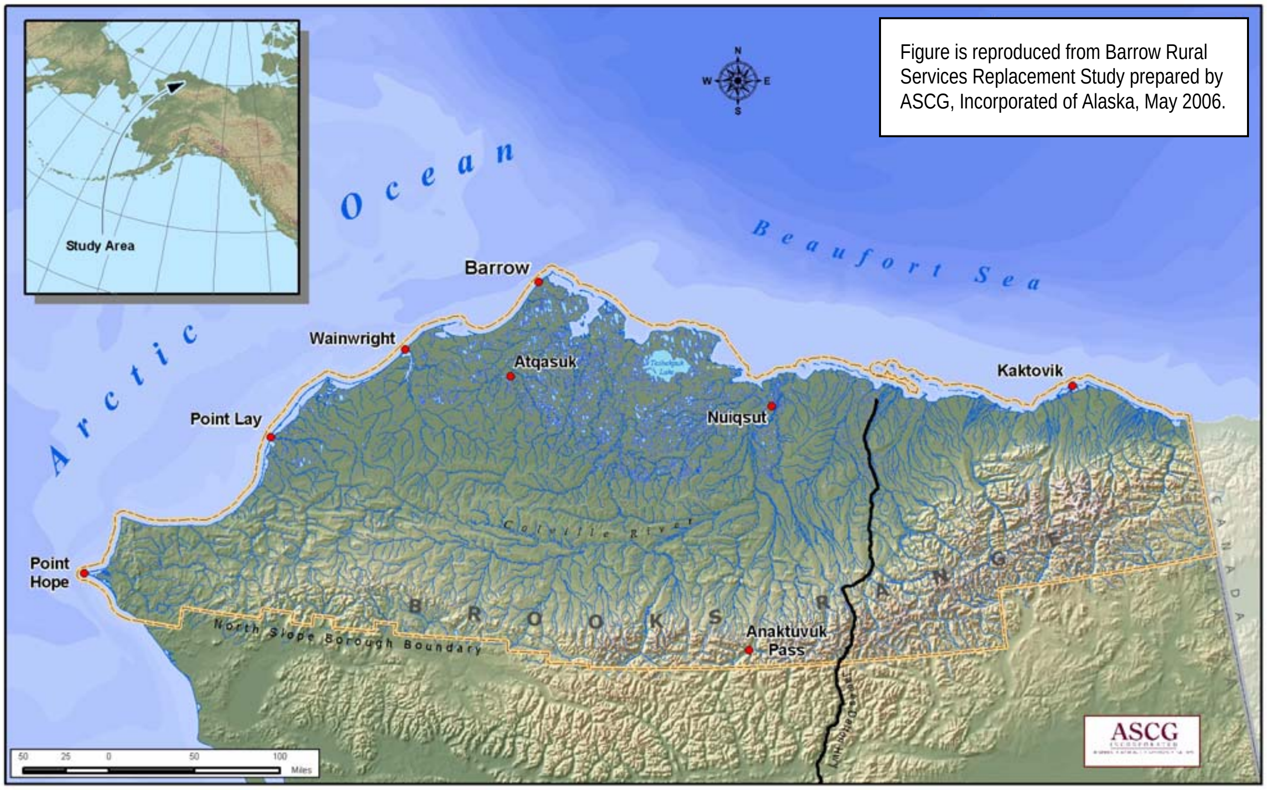

Figure 5: North Slope Borough Communities Served by Barrow

Distances between the alternate service centers and the NSB communities are presented in table 8. Distance between Barrow and each community is less than the distances between the villages and the other alternate service centers with the exception that Nome and Kotzebue are closer to Point Hope than is Barrow. Distance becomes critical when delivering emergency services, particularly in the arctic environment of the North Slope.

Table 8: Distances between NSB Communities and Alternate Service Centers

NSB Communities	Distance from Alternate Service Centers (miles)				
	Barrow	Anchorage	Fairbanks	Nome	Kotzebue
Anaktuvuk Pass	248	483	253	453	299
Atqasuk	58	674	463	462	279
Nuiqsut	154	624	381	547	371
Kaktovik	316	644	384	694	528
Point Hope	315	696	571	267	150
Point Lay	182	696	526	366	197
Wainwright	87	709	510	446	267
Source: Barrow Rural Services Replacement Study, ASCG, Inc., May 2006.					

While each of the alternate service centers could provide all or most of the critical services, the practicality and response time to deliver these services were determined to be problematic due to a number of factors including:

- Distance to NSB communities and inability to respond in a timely manner
- The potential for response personnel and aircraft to be unavailable when needed in emergency situations because of needs in the areas that they regularly serve
- Inability of available aircraft to land at many of the NSB's small airstrips
- Unfamiliarity with the area, which would impede response in poor weather conditions

The findings of the study demonstrate that the villages are highly dependant on service providers in Barrow to deliver both critical and non-critical services. The study also concluded that alternate service centers such as Anchorage, Fairbanks, Nome, and Kotzebue would be unable to approximate this same level of service.

3.5 Recreation

Traditional recreation activities and opportunities in Barrow are limited due to the nature of life in the community. From November to June, the shoreline is iced in. The daily minimum temperature is also below freezing 324 days of the year. When the ice recedes, the community focuses on subsistence activities that support their daily lives. Whaling seasons occur in June and September, while fish camps focus on salmon and whitefish in Elson Lagoon. When the beach is free of ice, some recreational beach combing and walking occurs both by the local population and tourists.

There is a small salmon stream southwest of Barrow that supports a small run of chum salmon in August that is reported to be visited by a small number of locals. In the winter, people hunt inland for furbearers, caribou, ptarmigan, and under-ice fishing. Some hunting for seals and polar bear also take place. The cold and windy weather in December through February places some limits on the distance people can travel safely from Barrow, but residents will take advantage of nice weather to travel by snow machine. These months are popular times to socialize, hold gatherings, and travel.

3.6 Subsistence Production

Subsistence is extremely important to the community in Barrow. Seventy percent of the population is Alaskan Native (primarily Inupiat Eskimo) and practice a subsistence lifestyle. Traditional marine mammal hunts and other subsistence practices are an active part of the culture. Bowhead, gray, killer and beluga whales migrate near Barrow each summer. The harvesting of whales (primarily Bowhead) in Barrow is intrinsic to its way of life.

The community gathers for the kick-off of the whaling season with an annual festival that celebrates this lifestyle. There are two seasons for whaling in Barrow – spring and fall. For spring whaling people place camps out on the ice near leads where the whales are expected to appear. When a whale is spotted, they launch skin boats and paddle to pursue the whale. Then the whale is hauled onto the ice where it is butchered. The meat and *maktak* (skin and blubber) is brought back to Barrow using snow machines. Fall whalers use aluminum or fiberglass boats with motors on the open ocean. The crews come and go daily, rather than make camps. Struck whales are hauled back to Barrow and pulled onto the beach. Spring whaling is the most important. More crews participate in spring whaling and it is considered safer. It's also the more costly and involves more investment. Captains are expected to provide food and shelter for crews out on the ice. They must get women relatives or elders to sew seal skins to cover the boats and sew parka covers. All whaling captains – spring and fall – supply boats, fuel, motors, darting guns, ammunition, bombs, block and tackle, ropes and floats, CB/VHF/satellite radios, etc. Spring whaling captains also provide tents, snow machines and sleds, and host feasts at *Nalukataq* (whaling festival) and *Apugautituq* ("bringing up the boat" celebration where the successful crew's and captain's families serve a modest meal of fermented whale meat, soup, cake, and tea to visitors).

Seal, polar bear, walrus, duck, caribou, grayling and whitefish are also harvested from the coast and nearby rivers and lakes. Wild foods, furs, clothing, construction, arts, crafts, furs and other products are traditionally traded among households through extensive, non-commercial, kinship-based networks. Coastal resources such as whale meat, seal oil, herring and halibut commonly are shared inland, while inland resources such as moose and caribou are shared toward the coast.

Areas of the beach are used for subsistence access. Boats are launched using a portable mat on the beach and small boat trailers. There are approximately 50 boats ranging in size from 16-22-feet that use the mat for subsistence use. After whales are harvested, the boats haul them onto the beach using any available beach area. The whales are then cut up for distribution within the community. Subsistence activities have typically been extremely adaptable to changes on the beach since there is no preference to where the whales are brought up.

The Alaska Department of Fish and Game (ADFG) reports that the per capita annual harvest of wild foods within NSB is approximately 434 pounds per person. Subsistence activity is significantly higher in the smaller communities outside the regional hub community of Barrow. ADFG data show a range of subsistence production in NSB from a low of 289 pounds per person in Barrow to a high of 890 pounds per person in Point Lay. Table 9 summarizes ADFG harvest data for Barrow.

Table 9: Barrow Average Annual Subsistence Harvest

Estimated Per Capita Subsistence Harvest (pounds):	289
Fish Percentage of Subsistence:	13.6%
Land Mammals Percentage of Subsistence:	24.6%
Sea Mammals Percentage of Subsistence:	58.3%
Birds Percentage of Subsistence:	3.4%
Plants and Berries Percentage of Subsistence:	0.2%
Source: Alaska Department of Fish and Game Department of Subsistence, Community Subsistence Information System.	

Price data was collected in Barrow for a market basket of potential substitute food items for use in estimating the value of the subsistence harvest as a source of food. Items in the market basket included fresh, frozen, and processed beef, reindeer, pork, poultry, and fish. The average price for the items in the market basket in 2007 prices came to $7.36 per pound resulting in an estimated substitute value of approximately $8.9 million in 2007. Table 10 presents the data used in the estimation of the value of substitute food products.

Table 10: Value of Substitute Food Products

Estimated Current Barrow Population:	4,199
Estimated Per Capita Subsistence Harvest, Barrow (usable pounds):	289
Estimated Total Subsistence Production, 2007 Barrow (usable pounds):	1,213,500
Average Cost per Pound for 2007 Market Basket of Substitute Foods: [a]	$7.36
Estimated Annual Monetary Value of Substitute Food Products, Barrow: [b]	$8,931,400

[a] Based upon 2007 prices for a market basket of fresh, frozen, and processed beef, reindeer, pork, poultry, and fish available locally in Barrow.
[b] This estimate only serves as a proxy value for the economic value of subsistence production as a source of food. Subsistence lifestyles provide other cultural, social, and health benefits that are not captured in this estimate.

It is stressed that the estimate of Subsistence Value presented in Table 10 only serves as a proxy value for the economic value of subsistence production as a source of food. Subsistence lifestyles provide other significant non-monetary cultural, social, and health benefits that are not captured in this estimate.

The State of Alaska Department of Health and Social Services reports that subsistence consumption of fish and marine mammals provide valuable sources of protein, energy and other important nutritional components such as heart-healthy omega-3 long chain polyunsaturated fatty acids in addition to providing important cultural and economic benefits (AKH&SS, 2007). The Alaska Native Science Commission (ANSC) reports that studies have shown that eating subsistence foods is correlated to better health. In addition to its nutritional values, an important health aspect of subsistence foods is the energy people expend while harvesting them. The activities surrounding hunting, fishing, gathering and preserving subsistence foods contribute to an active lifestyle. Physical activity is important in preventing obesity. Obesity is associated with increased risk of heart disease, diabetes, and other medical conditions. For subsistence participants, the process of nourishing involves the body, the mind and the spirit. While the latter factors are not measured as easily as is physical health, they are just as important. The practice of obtaining subsistence foods gives a person healthy food, exercise, fresh air, a chance to be with family members and friends, and something to share. These contributions are tangible examples of important cultural and social values of subsistence activities. (ANCS, 2007)

3.7 Utqiagvik Village Archeological Site

The Utqiagvik Village Site is an historic/archeological site in northwestern Barrow. The Utqiagvik Village Site has been occupied for over 2,500 years and at one time covered a large portion of what is now Barrow. The remaining archeological site has been set aside by the City and is the last portion of the former Utqiagvik Village Site along the coast that has not been redeveloped. The site is eligible for the National Register of Historic Places. The site suffers occasional damage/loss from coastal erosion of the Barrow bluff.

3.8 Historic Flooding and Erosion Damages

Structures and community infrastructure in Barrow are vulnerable to impacts from coastal flooding. The shoreline is most susceptible to storm activity in the months of August through October, the typical open water period. From November through July, there is generally enough ice present to have a dampening effect on wave generation. The storms that impact the coast during the open water season are typically fast moving storms from the north and northwest that last between 24 to 48 hours, but can extend up to 96 hours. Photos of past floods and flood fighting activity are provided as figures 6-9.

In October of 1963 a strong cyclonic storm passed near Barrow and caused extensive damage; primarily from flooding. The 1963 storm blew gusts up to 73 knots over an ice-free ocean. Seawater is reported to have moved 400 feet inland in parts of Barrow. The reported damages totaled $25,090,000 in 2007 dollars, including:

- Extensive erosion
- Damages to 32 homes
- Flooded roads
- Loss of fuel oil
- Damage to a radio tower
- Contamination of the water supply for several months
- Discontinuation of utility service

With its effects intensified by the ice-free ocean, this was the most severe storm on record to hit Barrow. The maximum water elevation was 11 to 12 feet and, according to NARL researchers, the event generated the equivalent of 20 years of sediment transport and erosion. Fifteen homes were destroyed and 17 more were damaged. About 70 percent of the airstrip at the Naval Arctic Research Laboratory was destroyed along with 4 aircraft, 6 buildings and many supplies, stores and scientific equipment. The foundations of the Camp's buildings were also eroded causing structural damage. The city's power lines and the power plant were down, fuel was lost and the water supply was contaminated with salt water. Furthermore, roads were flooded and badly eroded and a timber bridge floated away.[3]

Historical data from storm surges and flooding events in Barrow are limited. Other notable storms before and after the 1963 storm are as follows[456]:

- <u>September 1954</u>: Water elevations reached between 9 and 10 feet, washing water over the beach and a helium tank from the community nearly to the Point.

- <u>October 1954</u>: Minor damage occurred with a maximum water elevation of 9.5 feet.

- <u>September 1968</u>: A maximum water elevation of 8.5 feet was reached and caused $50,000 in damages (not adjusted for inflation). The road between Barrow and the City dump was severely eroded and a bridge was damaged.

- <u>September 1970</u>: Minor damage occurred with an unknown water elevation.

- <u>December 1977</u>: Barrow's gas well runway partially flooded with 6 to 18 in. of water rising through a crack in the ice. Rising water also lifted the pack ice at Barrow and persistent winds drove it as much as 30 yards inland. A maximum water elevation of 3.5 feet was reached.

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[3] Becker, R. Jr., et. al. (August 1981). *Storm Surge Climatology and Forecasting in Alaska.* Environment and Natural Resources Institute: Alaska State Climate Center. University of Alaska, Anchorage. Fathauer, Theodore F. 1978. A forecast procedure for coastal floods in Alaska. NOAA Technical Memorandum NWS AR-23. 27 pp.; Brunner, R., et. al. (August 2001). *Big Storms*. Seminar – Integrated Assessment of the Impacts of Climate Variability on the Alaskan North Slope Coastal Region; Barrow. University of Colorado. Retrieved 06/19/2007 from: http://nome.colorado.edu/HARC_noframes/poster1/Barrow_poster_new_html.html

[4] Ibid.

[5] Brunner, R., et. al. *Presentation: Coastal Erosion, Flooding, and Hazards Near Barrow, Alaska.*

[6] Cassano, L., et. al. (August 2003). *Recent Strong Wind Events in Barrow: Forecast, Meteorology, and Responses.* Seminar – Integrated Assessment of the Impacts of Climate Variability on the Alaskan North Slope Coastal Region; Barrow.

- September 1978: A maximum water elevation of 5 feet occurred causing between $5,000 and $50,000 (not adjusted for inflation) in damages to the road between the Naval Arctic Research Laboratory and Barrow.

- September 1986: There is not much data available about this event, but there were apparently two different storms during this month. The Leavitt House had to be moved and large sections of land were lost to erosion along with archaeological remains.

- August 2000: This was the second most devastating storm in Barrow's recorded history, again with heightened effects from the lack of sea ice. The NSB Disaster Coordinator reported $7.7 million in damages (unadjusted for inflation) mainly to a barge that was dredging offshore for beach nourishment. The barge was damaged when it was grounded on the shoreline, damaging the bottom of the vessel beyond salvageable repair. The dredging operation was suspended after the storm, not only because of the damages sustained, but also because of the inability of the operation to produce gravel of sufficient quality for use on the beach. Most of this occurred to a beach nourishment dredge that was ripped from its anchors and washed ashore. There were also 36 private homes and 4 NSB housing units that sustained roof and siding damages.

- October 2002: This storm caused more widespread flooding than the storm in August 2000 due to the dynamics of the sustained winds and heavy surf. Waves reached a peak of about 14 feet. Heavy equipment had to be used to build up the existing sea walls and protect the fresh water lagoon. Some roads were damaged and a power outage occurred.

- July 2003: There were two storm events during this month, both with minor damages. Some road damage occurred, but was limited as sand and gravel berms were reinforced to reduce flooding and erosion.

Figure 6: Barrow Flood Damage Example

Figure 7: 1963 Flooding of Homes and Fish Racks

3.9 Annual Storm Protection and Road Repairs

3.9.1 Berm Building

Over the past 10 years berm building has been the first protection against storms for the community. These berms are gravel mounds with a top elevation of generally 13-15 feet in height and placed at the crest of the beach as a protection measure against rising water from storm surge and wave attack. The NSB normally uses lower grade material since they have a limited supply of gravel. The higher quality gravel is used to maintain the community's roads. Although the material is of a lower grade, the material still costs about the same per cubic yard as the higher quality gravel ($37/cubic yard) due to the cost to extract the material from the gravel pit. On average approximately 15,000 cubic yards of gravel are placed annually to protect the community at a materials cost of $548,000. Labor and fuel account for another $19,000, for a total of $567,000 annually in 2007 prices.

The storms that hit the community generally range in length from 3-5 days. When the storms are larger, the berms do not last very long, often gone after 8-10 large waves. When the berms are reinforced and/or rebuilt during storm conditions, D7/D8 dozers are operated in the salt water (figure 8). The NSB has stated that although the berms provide limited flooding and erosion protection during larger storms, they would continue doing what they could to keep the berms in place, even if that means continued operation of the dozers in the water. When the dozers are operated this way additional maintenance is required to keep this equipment in order. Due to the corrosive nature of the salt the electrical systems are the hardest to keep in working order. The dozers must routinely be steam cleaned to keep salt off, while the electrical connections are shrink-wrapped to prevent salt from entering the connections.

Figure 8: Dozers Rebuilding Beach Berm during Storm

Figure 9: Heavy Equipment Operations during Storm

3.9.2 Shoreline Road Maintenance

Stevenson Street is adjacent to the shoreline and is susceptible to direct storm attack. Figure 10 shows the location of Stevenson Street along the shoreline of Barrow. During the 2000 storm, water flooded overtop of Stevenson Street and four sections of the roadway were lost (approximately 200 yards in length) costing approximately $330,000 in 2007 prices to repair. It is estimated that the road needs to be repaired about every 3 years as a result of storm damages, or approximately $110,000 annually (in 2007 prices). Stevenson Street provides an important transportation connection to Pt. Barrow, where fish camps used for subsistence harvesting are located at Elson Lagoon. The subsistence-harvesting season for salmon, whitefish, and other types of fish all occur during open water periods, which also have the highest possibility of storm events.

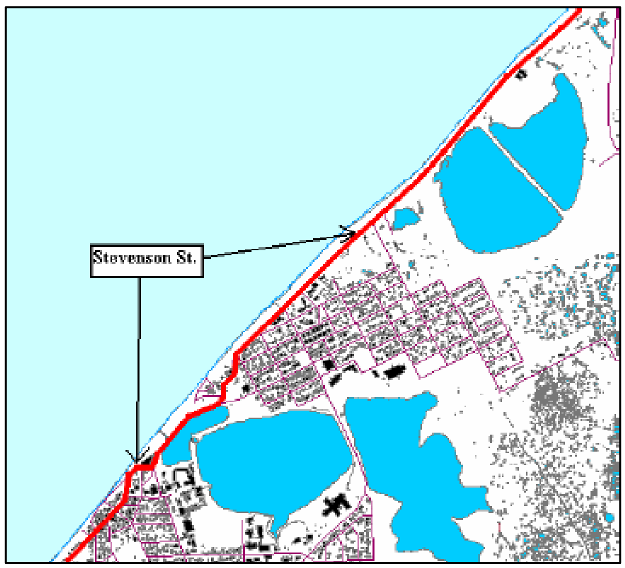

Figure 10: Location of Stevenson Street

3.9.3 Summary of Annual Berm Building and Road Repair Costs

The estimated annual cost for berm construction and maintenance and road repairs under existing conditions is approximately $677,000 in 2007 prices. In the without project condition this cost will continue until a project is put in place that controls wave activity and protects the roads from erosive forces during storm events.

4.0 System of Accounts for Project Evaluation

The U.S. Water Resources Council's Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) identify a system of four accounts for evaluating and documenting the effects of proposed plans. These four accounts are the National Economic Development (NED), Regional Economic Development (RED), Other Social Effects (OSE), and Environmental Quality (EQ) accounts. Effects that fall within three of these accounts (NED, RED, and OSE) are addressed in the following sections of this economic appendix. Evaluation of NED effects is required by Corps planning regulations and all economic development projects require identification of the NED plan as the alternative plan that maximizes net benefits (the difference in project costs and benefits). For this analysis, a set of preliminary alternatives was identified and their NED effects were evaluated to support plan screening and identification of a set of final plans for further consideration. For the set of final plans, effects in all four accounts were evaluated and are documented in this report.

5.0 Period of Analysis, Discount Rate, and Price Level

The evaluation of economic conditions under with- and without-project conditions documented in this appendix was based upon a fifty-year period of analysis beginning in the base year of 2010. The base year is defined as the year that significant project benefits will begin to accrue. All costs and benefits are presented in October 2007 prices. Costs and benefits are converted to their equivalent values in the base year using the FY07/08 Federal discount rate for water resources implementation studies of $4^{7}/_{8}$% as published in Economic Guidance Memorandum 07-01 and 08-01. Similarly, costs/benefits presented as average annual costs are amortized over a fifty year period of analysis using the discount rate.

Economic analyses performed are consistent with pertinent Corps regulations and guidance including:

- Principles and Guidelines for Water and Related Land Resources Implementation Studies
- U.S Army Corps of Engineers Planning Guidance Notebook (Engineer Regulation ER1105-2-100)
- Planning - Risk Analysis for Flood Damage Reduction Studies (Engineer Regulation ER-1105-2-101)
- Risk-Based Analysis for Flood Damage Reduction Studies (Engineer Manual 1110-2-1619)

6.0 Future Without Project NED Evaluation

The P&G defines beneficial effects in the NED account as increases in the economic value of the National output of goods and services from a plan; the value of output resulting from external economies caused by a plan; and the value associated with the use of otherwise unemployed or underemployed labor resources. In the case of the Barrow Coastal Storm Damage Reduction study, potential beneficial NED effects are possible by reduction of damages from flooding and erosion that would be expected to occur without a project. The analytical framework identified in the P&G and further defined in Corps planning regulation (Engineer Regulation 1105-2-100) require that beneficial NED effects be determined by comparing expected future conditions without a project to the various alternative future conditions that would be expected to occur with implementation of an array of alternative projects.

6.1 Categories of Potential Damages

The primary categories of potential damages in Barrow are erosion damages to the bluff in the neighborhood of Barrow, erosion damages to the beach flood protection berm and shoreline roadways[7], and damages from coastal storms in the eastern portion of the neighborhood of Barrow and in the neighborhood of Browerville. Specific categories of potential damages evaluated include:

- Erosion Damages to
    - Land
    - Structures
    - Archeological Site (Utqiagvik Village Site)
    - Beach Berm and Shoreline Roadway

[7] In this analysis, the expected annual costs associated with beach berm construction and maintenance and the roadway repairs associated with storm erosion damages as documented in Section 3.9 are accounted for as erosion damages as the maintenance and repair costs incurred are a result of upland erosion from coastal storms.

- Flooding Damages to
    - Structures and Contents
    - Water Supply
    - Spillway and Associated Utilities
    - Utilidor and Associated Utility Service

6.2 Future Without-Project Coastal Erosion Damages

Results of engineering studies and review of historic damages identified two primary sources of erosion damages in the study area. These damages include damages from wind and waves to the bluff in the Barrow area and costs associated with the ongoing construction and repair of the beach berms and beach frontage road (Stevenson Street) in the northeastern part of the neighborhood of Barrow and in Browerville.

6.2.1 Expected Bluff Erosion Damages

Historic erosion along the bluff in Barrow was studied as part of the feasibility study's engineering analysis and is documented in the Engineering Appendix. The erosion analysis identified two reaches of the study area that were each characterized by different historic erosion patterns, referred to in this report as Erosion Zones 1 and 2. Erosion Zone 1 extends southwestward from the beach in front of the western end of the lagoon to Okoksik Street. Erosion Zone 2 extends southwestward from Okoksik Street to the bluff in front of the northeastern end of the airport runway. Erosion Zone 1 was found to have an expected future erosion rate of 2.2 feet per year, resulting in inland movement of the bluffline by 110 feet over the 50-year period of analysis in Zone 1. Erosion Zone 2 was found to have a future without project expected annual landward erosion rate of 1.02 feet per year. At this annual rate, erosion is expected to move the bluff line inland by 51 feet over the 50-year period of analysis in Zone 2. The result of the erosion in both zones would be damages associated with the loss of land, structures, and cultural and historic resources. Figure 11 shows the expected zone of bluff retreat (erosion) over the 50-year period of analysis.[8]

[8] The area shown in figure 11 is limited to the erosion prone areas in the western portion of the study area (southwest of the lagoon). Other areas to the east (Browerville) are not shown in this figure.

Figure 11: Expected 50-Year Erosion in the vicinity of Barrow

To estimate expected erosion losses, 5 polygons within each zone were developed in GIS that corresponded to the areas of expected erosion area in five 10-year increments: Years 1-10, 11-20, 21-30, 31-40, and 41-50 of the period of analysis. For each time increment, the area of land and number of houses lost or condemned were identified and assigned a damage value. Damages were totaled for each 10-year increment and converted to their present value in the base year from the midpoint in each increment. The results of the analysis of future without project erosion damages are presented in the following sections for each damage category.

Land Damages

As a result of continued bluff erosion, the total extent of lost land over the 50- year period of analysis is estimated at 7.43 acres. Valuation of lost land was based upon an average cost of $100,000 per acre; the average of the values of land per acre for parcels within the 50-year erosion zone. Estimated land damages from erosion over the 50-year period of analysis have a total present value of $283,000. The equivalent average annual damage is $15,000. Table 11 summarizes the expected land damages from erosion.

Table 11: Land Damages from Erosion

Item:	**Erosion Zone Increment**					
	Years 1-10	**Years 11-20**	**Years 21-30**	**Years 31-40**	**Years 41-50**	**Total (Years 1-50)**
Area of Land Lost (acres):	1.50	1.49	1.47	1.46	1.51	7.43
Value of Land Lost (2007 prices):	$151,000	$150,000	$148,000	$147,000	$152,000	$747,000
Present Value:	$119,000	$73,000	$45,000	$28,000	$18,000	$283,000
Average Annual Damages:						$15,000

Structural Damages

As a result of continued bluff erosion, it is estimated that 31 structures in the neighborhood of Barrow would be condemned. Condemnation was assumed to occur whenever any of two conditions occurred:

1) Once any part of a structure intersected with the eroded bluff line, or
2) Once over 50% of the area of the structure's parcel was lost[9]

Valuation of erosion damages to structures was based upon the estimated depreciated replacement cost of each structure. It was assumed that all contents of value would be removed and not damaged by erosion. It was also assumed that no future development would occur in the identified erosion zone over the period of analysis.

[9] Parcel sizes containing structures within the erosion zone varied from a low of .04 acres to a high of .88 acres with an average size of .14 acres).

Continued erosion over the period of analysis is expected to result in loss or condemnation of 31 structures in the Barrow neighborhood of the study area. Estimated structure damages from erosion over the 50-year period of analysis have a total present value of $4,735,000. The equivalent average annual damage is $254,000. Table 12 summarizes the expected structure damages from erosion.

Table 12: Structure Damages from Erosion

Item:	Erosion Zone Increment					
	Years 1-10	Years 11-20	Years 21-30	Years 31-40	Years 41-50	Total (Years 1-50)
Number of Condemned Structures:	4	10	8	3	6	31
Value of Condemned Structures (2007 prices):	$864,000	$4,170,000	$3,619,0000	$1,182,000	$5,860,000	$15,695,000
Present Value:	$681,000	$2,042,000	$1,101,000	$223,000	$688,000	$4,735,000
Average Annual Damages:						$254,000

Archeological Site

The Utqiagvik Village Site falls in part within the 50-year erosion zone. The site is periodically impacted by bluff erosion that can result in artifacts, the remains of semi-subterranean houses, and occasional human remains being uncovered. More on the site is presented in Section 3.6. The non-monetary cultural value associated with the archeological site is not included in this NED analysis.

6.2.2 Expected Beach Berm and Roadway Costs

Sections 3.9.1 through 3.9.3 describe annual costs associated with damages and repairs to beach berms and the shoreline roadway. In the current without project condition these costs ($677,200 in 2007 prices) are expected to continue on an annual basis until a project is put in place that controls wave activity and protects the road during storm events. Over the 50-year period of analysis, this annual cost has a total present value of $12.6 million dollars.

6.2.3 Expected Utilidor Damages

The Barrow Utilidor is a heated underground utility corridor that provides utility service to parts of the study area. The system went into operation in 1984 and currently includes approximately 3.3 miles of utilidors in Barrow and Browerville, containing 11 miles of water, sewer, and force mains, as well as electrical conduit and communications cable. Erosion is expected to result in failure of the Utilidor at the west end of Agvik Street within 25 years. The resultant damage is estimated to have a present value of $1.4 million and an average annual value of $75,000.

6.2.4 Summary of Expected Coastal Erosion Damages

Total expected annual erosion damages in the study area are estimated at $1,021,000, including the above described damages to lands, structures, the beach berm, roadways, and the utilidor. Table 13 summarizes the present values of erosion damages for each category over the period of analysis and their average annual equivalent values.

Table 13: Summary of Expected Erosion Damages

Damage Category	Present Value	Average Annual Value
Land Loss	$283,000	$15,000
Structure Condemnation	$4,735,000	$254,000
Beach Berm Construction/Repairs and Roadway Repairs	$12,604,000	$677,000
Utilidor Damages	$1,399,000	$75,000
Total	$19,021,000	$1,021,000

6.3 Future Without-Project Coastal Storm Damages

Coastal flooding in Barrow's neighborhoods of eastern Barrow and Browerville is expected to continue under without project conditions. Categories of expected flood damages include damages to structures and contents in the study area.

To evaluate without project flood damages, the Corps' Beach-fx risk based economic model was applied. Beach-fx is a Monte Carlo-based, event-driven coastal storm damage assessment model developed by the Corps Institute for Water Resources (IWR) and Engineering Research and Development Center's (ERDC) Hydraulic Laboratory. The model facilitates the planning and evaluation of coastal protection projects within a GIS framework. Application of the model allowed the study team to move away from the typical frequency-based, deterministic evaluation approach and towards an event-driven approach. The event approach uses a database of plausible storms in a Monte Carlo based model to evaluate the economic consequences of storm driven impacts on upland development. The methods and results of the analysis of future without project flooding damages are presented in the following sections for each damage category.

6.3.1 Expected Damages to Structures and Contents

Barrow Structural Inventory

A structural database was developed by ASCG, Inc. for NSB and the Alaska District that included 1,000 structures located either within or near the 20 foot contour line. The database included data from a land survey conducted by ASCG during 2004-2005 to record elevations of structures and facilities. The land survey portion focused on developing an accumulation of survey points to help assess flood risk for each dwelling, commercial building, and structure within the potential floodplain. Elevations of each structure were taken at three specific points: the ground elevation, first floor elevation, and the elevation where the building utilities connect to the service barrel (12 to 16 inches below the top of the utility box).

In 2006, a supplemental field inspection was performed on a sample of 112 of these structures to include both residential and nonresidential structures in both Barrow and Browerville. Characteristics such as building use, condition, type, construction material, and general description were recorded for use in structure valuation and to confirm data from the 2004-2005 survey.

Developable land within the coastal floodplain in the study area is largely built out. It was assumed that future development in the coastal floodplain would be limited and that any future development within the floodplain would be constructed above the damage-initiating elevation for that specific area.

Structure Categories

Based on field observations and database descriptions, structures were assigned to one of four categorical groups: Commercial, Public, Residential, and Outbuilding.

Structure Valuation

Structures were assigned values as a function of the estimated first floor square footage (taken from the GIS database) and estimated value per square foot by use, class and type from Marshall and Swift Valuation representing comparative costs for Anchorage, Alaska. The Marshall and Swift Valuation Database does not compile local multipliers for Barrow so these Anchorage-based values needed to be adjusted to represent the significant costs of getting construction materials to Barrow. Data from the 2006 Construction Cost Survey, prepared by the Alaska Department of Labor and Workforce Development for the Alaska Housing Finance Corporation (AHFC) was used to determine an adjustment factor. The AHFC survey data showed that home construction in Barrow cost 215% of that in Anchorage; an adjustment factor of 2.153. This factor was applied to the square footage values to determine values for the sample of 112 structures. For the remaining structures in the study area, the average value per square foot by category (see table 14) was assigned to each structure's square footage. Field survey observations were used to apply applicable depreciation adjustments to estimated structure replacement values.

Table 14: Average Structure Depreciated Replacement Value per Square Foot (Sq Ft)

CATEGORY	SAMPLE	TOTAL SQ FT	TOTAL VALUE	VALUE PER SQ FT
Commercial	16	62,234	$12,303,212	$198
Public	19	61,621	$15,284,573	$248
Residential	72	135,061	$24,130,348	$179
Outbuilding	5	2,254	$57,922	$26

First Floor Elevations

Damages to both structures and contents are a function of depth of water relative to the first floor elevations. While a large number of structures lie within the 20 foot contour line, many are elevated above the ground level and would be at risk from only the rarest storm events as presented in table 15.

Table 15: Structures and Depreciated Replacement Value by First Floor Elevation

CATEGORY	FIRST FLOOR ELEVATION	NUMBER OF STRUCTURES	TOTAL DEPRECAITED STRUCTURE VALUE
Commercial	Under 15 Feet	13	$ 5,831,000
	Under 18 Feet	20	$ 6,367,000
	Under 20 Feet	25	$ 11,186,000
Public	Under 15 Feet	9	$ 7,327,000
	Under 18 Feet	22	$ 14,136,000
	Under 20 Feet	35	$ 65,399,000
Residential	Under 15 Feet	38	$ 6,945,000
	Under 18 Feet	146	$ 31,824,000
	Under 20 Feet	247	$ 55,539,000
Outbuilding	Under 15 Feet	60	$ 281,000
	Under 18 Feet	160	$ 723,000
	Under 20 Feet	213	$ 944,000
Total	Under 15 Feet	120	$ 20,383,000
	Under 18 Feet	348	$ 53,049,000
	Under 20 Feet	520	$ 133,068,000

Depth-Damage Functions

Estimated damages were determined based on flood depth relative to first floor elevation. For residential structures, depth-damage functions were taken from Economic Guidance Memorandum 04-01, which estimates both structure and content losses as a percentage of structure value. Non-residential depth damage functions were based on local surveys completed by ASCG and combine both structure and content losses as a percentage of total structure value. The depth damage functions applied in the study for estimation of flood damages to structures and contents are presented in table 16. The non-residential damage function can exceed 100% of the structure value for severe floods because of the content values of commercial inventories.

Table 16: Depth Damage Function

DEPTH ABOVE FIRST FLOOR (feet)	RESIDENTIAL (% of structure value)		NON-RESIDENTIAL (% of structure value)	OUTBUILDINGS	
	STRUCTURE	CONTENT	STRUCTURE + CONTENT	STRUCTURE	CONTENT
-3	0%	0%	0%	0%	0%
-2	2.5%	2.4%	2.5%	0%	0%
-1	8.0%	5.3%	8.0%	0%	0%
0	13.4%	8.1%	18.3%	7.0%	0.0%
1	23.3%	13.3%	37.0%	16.3%	17.2%
2	32.1%	17.9%	53.2%	24.7%	27.5%
3	40.1%	22.0%	68.0%	27.7%	33.3%
4	47.1%	25.7%	75.0%	29.6%	36.1%
5	53.2%	28.8%	81.1%	30.9%	38.8%
6	58.6%	31.5%	86.5%	39.8%	43.2%
7	63.2%	33.8%	91.1%	42.8%	47.7%
8	67.2%	35.7%	95.1%	43.3%	60.0%
9	70.5%	37.2%	98.4%	44.8%	60.0%
10	73.2%	38.4%	101.1%	45.8%	60.0%

Incorporation of Uncertainty in Economic Parameters

As noted above, the Corps' Beach-fx model was applied for estimating storm damage with uncertainty. The following economic parameters were incorporated into the model, including both the most likely values and their relative uncertainty statistics:

a) Residential Structure Depth Damage function- triangular distribution based on uncertainties found in Economic Guidance Memorandum (EGM) 04-01, Generic Depth-Damage Relationships for Residential Structures. No specific identification of uncertainty in depth-damage for non-residential structures was provided.
b) Residential Content Depth Damage function- triangular distribution based on uncertainties in EGM 04-01
c) First Floor Elevation- triangular distribution with a range of plus or minus 0.3 feet. Based on topographic and survey detail.
d) Structure Value- triangular distribution based on a function of potential error in square footage and range of M&S values per sq ft. On average, this uncertainty accounted for plus or minus 11% of the structure value.
e) Time to Rehabilitate/Rebuild- triangular distribution with a most likely value being one –year with a minimum of ½ year and a maximum of two-years.

Coastal Storm Damage Analysis

The Beach-fx model uses Monte Carlo simulation to generate probability distributed data that integrates both engineering and economic relationships to determine the impacts and damages of a storm passing a shoreline. Water surface elevations were modeled by the Corps' ERDC Coastal Hydraulics Laboratory using the SBEACH model and converted to Beach-fx Storm Response Database files for use in the damage assessment. Economic damage elements were spatially developed representing structure and content value, first floor elevations, and type categorizations with uncertainties for structural analysis. These were then linked to the storm elevation data with uncertainty in the model based by lot, reach and profile. Separate reaches were required to represent the unique profile and storm elevations for different events from reach to reach. Figure 12 shows the delineation of the study reaches for the coastal storm damage analysis.[10]

Damages were then estimated as a function of estimated water surface elevations for a series of storms relative to the first floor elevation for structures and contents or the identified damaging elevation for utility infrastructure. In the model, the damage functions determine the percent damage for individual storms relative to the value of structures and infrastructure at risk. As the series of storms are run in the Monte Carlo simulation, the damageable property is limited to the time of the last damaging storm and the time to rebuild parameter in the model. The present value of all these losses due to storms is evaluated over a 50-year period of analysis to determine average annual equivalent damages.

The Beach-fx model reports damages by reach in terms of mean, standard deviation, maximum and minimum values based on a summary of individual simulations for the number of iterations run in the model. For Barrow, 150 iterations were run to create a sample of storm damages over a 50-year period of analysis. For the without project damages, the present value of the estimated storm damages for both structures and contents combined over the 50-year period of analysis is shown in table 17, which also presents the estimated average annual equivalent coastal storm damages to structures and contents for all reaches. The total estimated annual damages to structures and contents have a mean expected value of $58,900.

[10] The reach designations were defined for the study's hydraulic model (SBEACH). The hydraulic study reaches include additional reaches to the southwest and northeast of the reaches shown in Figure 9. These reaches were included in the hydraulic model to define boundary conditions and for the study of littoral beach erosion processes. A limited subset of the reaches (24-49) were included in the economic analysis because they comprised the area containing economic damages in the study area and were within the area considered for potential protective measures. Additionally some reaches were combined during iteration of the modeling, which results in non continuous numbering for the reaches (there are no reaches 27, 30, 33, 35, 37, 41, 44, 46, and 48).

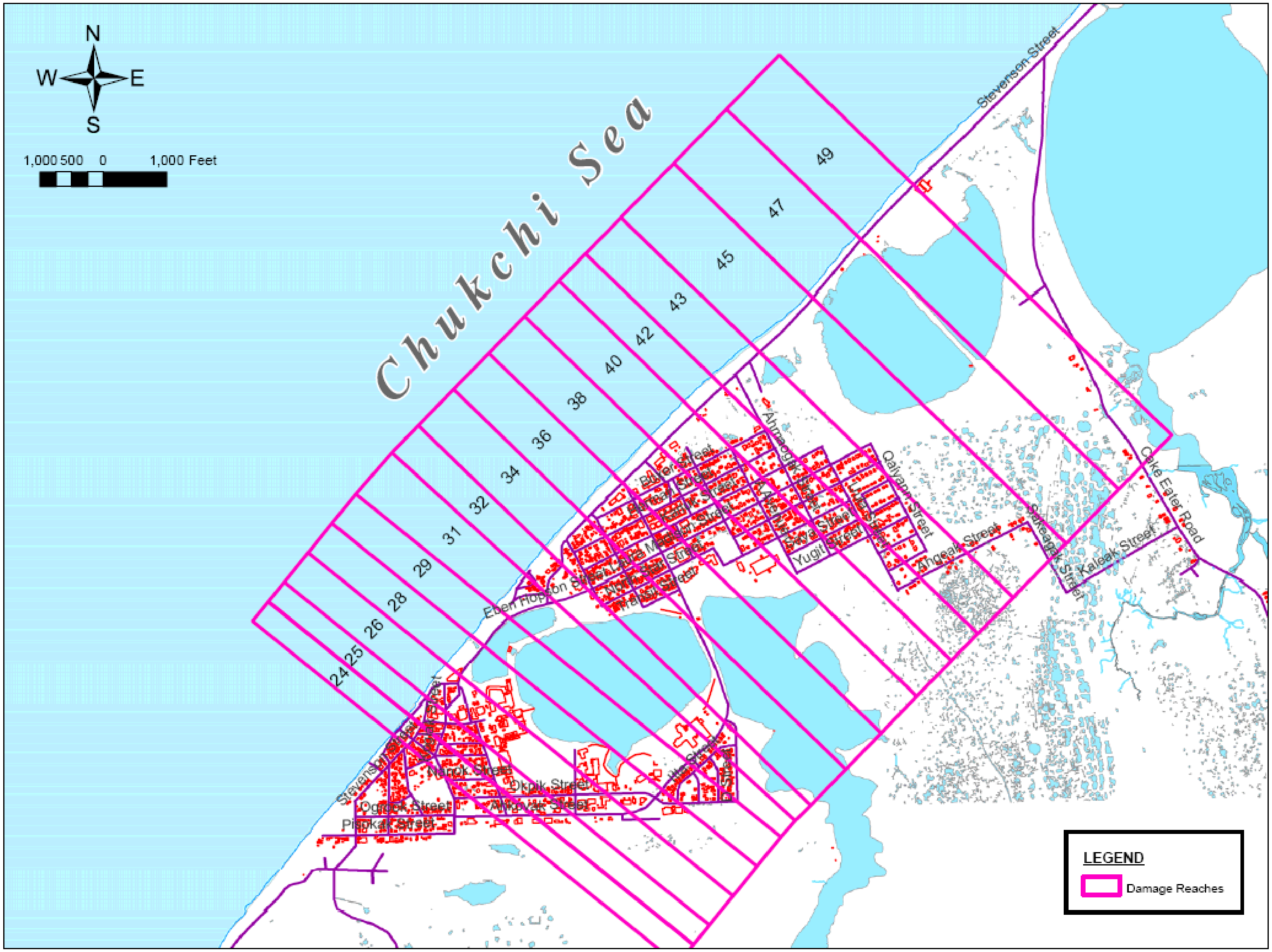

Figure 12: Coastal Flood Damage Economic Model Study Reaches

Table 17: Without Project Coastal Storm Damage to Structures and Contents

REACH	STORM DAMAGES PRESENT VALUE			
	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
24	$142,000	$167,600	$1,004,900	$0
25	$137,600	$96,200	$621,900	$0
26	$364,700	$226,600	$1,293,000	$0
31	$84,500	$76,800	$403,400	$0
32	$51,700	$51,800	$267,100	$0
34	$700	$1,900	$17,200	$0
36	$63,900	$107,400	$802,800	$0
38	$4,400	$12,900	$128,800	$0
40	$80,800	$171,100	$1,047,100	$0
42	$153,200	$241,000	$1,269,200	$0
43	$12,800	$7,900	$38,200	$0
TOTALS	$1,096,300	$1,161,200	$6,893,600	$0
REACH	**AVERAGE ANNUAL EQUIVALENT DAMAGES**			
	MEAN	**STANDARD DEVIATION**	**MAXIMUM**	**MINIMUM**
24	$7,630	$9,000	$53,990	$0
25	$7,390	$5,170	$33,410	$0
26	$19,590	$12,170	$69,460	$0
31	$4,540	$4,130	$21,670	$0
32	$2,780	$2,780	$14,350	$0
34	$40	$100	$920	$0
36	$3,430	$5,770	$43,130	$0
38	$240	$690	$6,920	$0
40	$4,340	$9,190	$56,250	$0
42	$8,230	$12,950	$68,180	$0
43	$690	$420	$2,050	$0
TOTALS	$58,900	$62,370	$370,330	$0

6.3.2 Expected Storm Damages to Utilities and Infrastructure

ASCG, Inc. prepared a report in September 2005 for the North Slope Borough and the Alaska District that documented their analysis of the monetary impacts resulting from loss or damage to utility infrastructure in the study area, including:

- Water Supply
- Tasigrook Dam Spillway and Utilities that Cross Lagoon at Spillway
- Utilidor/Buried Utilities

The Barrow Utilities and Electric Cooperative provides Barrow with water, sewer, and electric service. The City's water source is the upper portion of Isatkoak Lagoon. Water is taken from the lagoon, run through the treatment plant's nanomicrofiltration process and distributed to residents. Utility line and pipes are either direct-buried or contained in an underground utilidor system, which has portions adjacent to the beach. Most residents are hooked up to the system. However, some still rely on truck-based water delivery and sewage removal from home storage tanks. The NSB is responsible for solid waste disposal, road improvements, and emergency operations during storms, floods, and other disasters. South Salt Lagoon is divided in half, with the western half being used for the second year of sewage pond storage and the eastern half the old Barrow landfill, which is in the process of being closed. The new landfill will be located upland, about five miles southeast of Barrow.

Water Supply

The ASCG Study identified the damage initiating elevation for the water supply to be at 10’ msl at the outflow pipes form Isatkoak Reservoir at Ahkovak Street. The feasibility study’s engineering analyses found that the potential range of water surface elevations as simulated by the study’s SBEACH model are not expected to result in damages to the City’s water supply system.

Spillway and Associated Utilities

It is expected that the spillway would undergo damage when water surfaces in the area exceed 8 feet. The study’s hydraulic model (SBEACH) predicts that water surfaces can exceed 8’ in the reach with the spillway although only under low frequency storm events. The damage function applied for estimating damages was based upon 5% damage between 8 and 9 feet, 50% damage between 9 and 10 feet, and 100% damage with an 11’ or higher water surface elevation. The damage function and SBEACH data were integrated within the Beach-fx model to estimate expected damages to the spillway over the period of analysis. The total estimated annual damages to the spillway are estimated to have a mean expected value of $67,400.

Utilidor

It is expected that the utilidor would undergo damage when water surfaces in the area exceed 10 feet. The study’s hydraulic model (SBEACH) predicts that water surfaces can exceed 10’ although only under low frequency storm events. Maximum utilidor damages from any flood event were identified at approximately $4.5 million. The damage function applied for estimating damages was based upon 6% of the maximum damage at 12 feet water surface elevation, 40% damage at 14.5 feet, and 62% damage at 16’. The damage function and SBEACH data were integrated within the Beach-fx model to estimate expected damages to the spillway over the period of analysis. Damages never exceeded 49% of the maximum value in any iteration of the flood simulations in Beach-fx. The total estimated annual damages to the Utilidor over the period of analysis were estimated to have a mean expected value of $31,000. No flood damages were included for any periods after year 25 where the erosion analysis predicts damage to the utilidor to avoid double counting (see **Section 6.2.3**).

6.3.3 Summary of Coastal Storm Damages

Total expected annual coastal storm damages from flood inundation in the study area are estimated at $157,300, including the above described damages to structures and their contents, the spillway and associated utilities, and the utilidor. Table 18 summarizes the present values of coastal storm damages for each category over the period of analysis and their average annual equivalent values.

Table 18: Summary of Expected Coastal Storm Damages

Damage Category	Present Value	Average Annual Value
Structures and Contents	$1,096,300	$58,900
Spillway and associated Utilities	$1,254,000	$67,400
Utilidor	$577,900	$31,000
Total	$2,928,200	$157,300

6.4 Summary of Future Without-Project NED Damages/Costs

The evaluation of economic damages associated with coastal storm damages and erosion in the study area identified total expected annual damages of $1,178,300, including expected coastal storm/flooding damages to structures and their contents and erosion damages to the NSB's system of coastal storm protection beach berms, the beach frontage road, and lands and improvements located within the predicted erosion zone atop the bluff in Barrow. Table 19 provides a summary of the expected annual without project damages from coastal flooding and erosion in the study area.

Table 19: Summary of Expected Annual Damages

DAMAGE CATEGORY	ESTIMATED ANNUAL DAMAGE	% OF TOTAL
Average Annual Coastal Storm Damages	$157,300	13%
Average Annual Erosion Damages[11]	$1,021,000	87%
Total Expected Annual Damages	$1,178,300	100%

7.0 Future With-Project Conditions for Alternatives

In conducting the Barrow Coastal Storm Damage Reduction Study, several evolving iterations of plan formulation, evaluation, and comparison were conducted. In each iteration of this planning process, economic analysis was conducted to identify the potential economic benefits of alternative plans. The plan formulation process is documented in the main text of the feasibility report, and summarized in this appendix.

First, an array of five initial alternatives were developed by the study team for evaluating their effectiveness and efficiency at addressing identified coastal flooding and erosion damages in the study area. The alternatives considered included:

a) No Action[12]
b) Construction of a Revetted Berm to protect areas susceptible to coastal flooding

[11] Erosion damages include expected annual costs associated with loss/repair of beach berms and erosion damage to Stevenson Street.

[12] The "No Action" alternative involves no federal action to address identified flooding and erosion problems in the study area. As documented in Sections 3.9.3 and 6.2.2, it is assumed that the NSB will continue with their annual flood fighting practices of beach berm building and repair of erosion damages to the beach frontage road in the absence of a federal project.

c) Construction of a Bluff Protection revetment to protect areas susceptible to bluff erosion
d) Combination of the Revetted Berm and Bluff Protection revetment to provide protection for the entire study area
e) Non-Structural Building Raise alternative to evaluate the effectiveness of elevating at-risk structures above expected coastal flood elevations

The economic methodologies applied for estimating without project conditions were reapplied to reflect the level of protection afforded by each of the alternatives to calculate damages reduced. Review of initial analyses identified the need to look at a wider range of configurations of these structural and non structural measures. The initial alternatives were refined and modified to allow for a more detailed analysis of the costs and benefits associated with different heights, lengths and configurations of the measures identified in the initial alternatives. Three additional alternatives were added to evaluate the costs and benefits of: a) constructing the Revetted Berm and Bluff Protection alternatives to better withstand ice (Ivu) forces, b) Beach Nourishment, and c) Filling the Lagoon.

The resultant final set of alternatives is presented in Table 20 and each alternative is described in the following paragraphs. Descriptions of the different configurations of the final alternatives include a reference to transects that each protects. A map of the transects is provided as Figure 13 for reference. A more detailed description of alternatives is presented in the main text of the feasibility report.

Table 20: Alternatives

ALTERNATIVES	CONFIGURATION	
	PROTECTION LENGT	H
No Action	not applicable	not applicable
	Protection to +8' Contour (Transects 27-31.5)	1,800 lf
	Protection to +10' Contour (Transects 24.6-31.5)	2,745 lf
	Protection to +12' Contour (Transects 22-33)	4,800 lf
Revetted Berm Sized for Waves	Protection to +14' Contour (Transects 22-43)	8,750 lf
	Protect Bluff Transects 17-22	2,000 lf
	Protect Bluff Transects 22-24.6	1,040 lf
Revetment	Protect Bluff Transects 22-27	2,000 lf
	Protection to +14' Contour (Transects 22-42)	8,750 lf
Revetted Berm Sized for Ice	Protect Bluff Transects 22-27	2,000 lf
	Protection to +8' Contour (Transects 27-31.5)	1,800 lf
	Protection to +10' Contour (Transects 24.6-31.5)	2,745 lf
	Protection to +12' Contour (Transects 22-33)	4,800 lf
	Protection to +14' Contour (Transects 22-43)	8,750 lf
Beach Nourishment	Protect Bluff Transects 22-27	2,000 lf
Non-Structural Plan	Protect 34 Structures (Raise 10 / Relocate 24)	not applicable
Lagoon Fill	Fill Tasigrook Lagoon (~ Transects 27-32)	not applicable

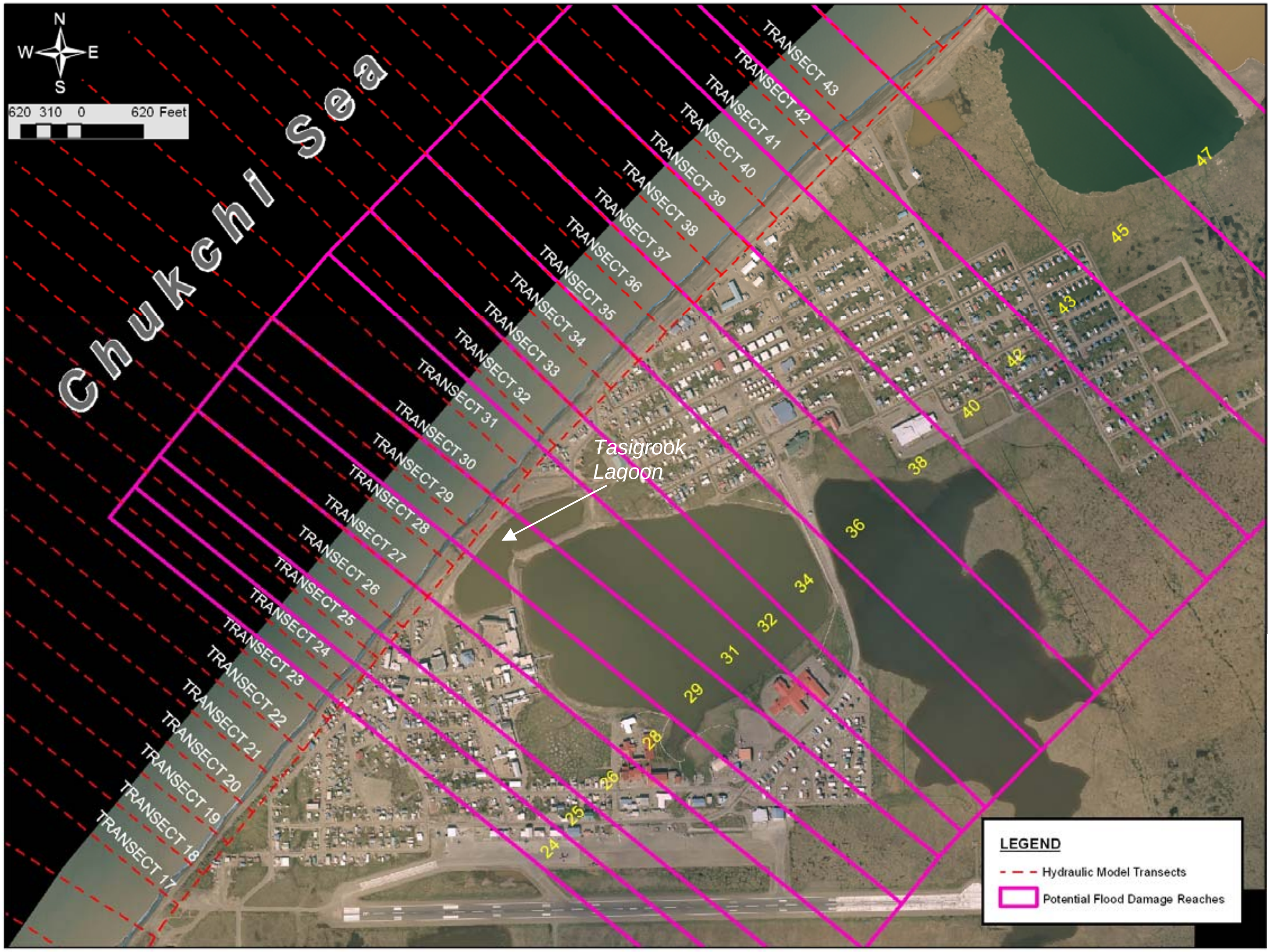

Figure 13: Shoreline Transects

7.1 No Action

The No-Action Alternative would not include any potential coastal storm protection or erosion protection measures in the study area other than those already proposed and accounted for in the determination of future without project conditions. Damages would be expected to continue as described in section 6 of this report and summarized in table 18.

7.2 Revetted Berm Sized for Waves

This alternative would construct a new revetted berm between the shore side roads and the beach above the high tide mark for the purpose of reducing flood and erosion damages in the study area east of the Barrow Bluff. The top elevation of the rock structure would be set at +14.0 feet (ft.) based on the hydraulics, tide, wind, and wave analyses for all lengths of the revetted berm. Different levels of damage reduction could be achieved by varying the length of shoreline protected. For protection to the contour elevation +8.0, +10.0, +12.0, and +14 ft, the revetted berm would be 1,800 ft., 2,745 ft., 4,800ft., or 8,750 ft. long, respectively.

The total initial project cost is estimated to have a present value ranging from $43 to $118 million depending on the alternative level of protection. Including annual O&M costs, the alternative Revetted Berm configurations had an average annual cost ranging from $10 to $14 million. Damages prevented (benefits) ranged from $.68 to $1.1 million (a reduction of 57 to 91%, respectively of total estimated damages in study area). None of the revetted berm configurations resulted in positive net benefits, the highest benefit to cost ratio was .09 to 1, and residual annual damages ranged from $108,900 to $501,300 as summarized in table 21.

Table 21: Alternative Configurations of Revetted Berm Sized for Waves Alternative

ALTERNATIVE CONFIGURATION	TOTAL COST (PV)	ANNUAL COST	ANNUAL BENEFITS	NET ANNUAL BENEFITS	BC RATIO	RESIDUAL ANNUAL DAMAGES
Protection to +8' Contour (Transects 27-31.5)	$43,186,000	$10,082,000	$677,000	-$9,405,000	0.07	$501,300
Protection to +10' Contour (Transects 24.6-31.5)	$51,787,000	$10,544,000	$805,900	-$9,738,100	0.08	$372,400
Protection to +12' Contour (Transects 22-33)	$75,296,000	$11,807,000	$1,025,800	-$10,781,200	0.09	$152,500
Protection to +14' Contour (Transects 22-43)	$118,006,000	$14,101,000	$1,069,400	-$13,031,600	0.08	$108,900

7.3 Revetment

This alternative is intended to provide bluff erosion protection to reaches along the Barrow neighborhood shoreline west of the west end of the revetted berm described in Section 7.2. Each of these revetment options could be combined with the revetted berm option whose west end coincides with the revetment otpion's east end. The revetment top elevation of the rock would be set at +19.0 foot (ft.) or the existing elevation of the top of the bluff, whichever is lower. The sole purpose would be to prevent erosion of the bluff with resulting damages to the structures, roads, utilities, public facilities and the cultural historic site. Different levels of damage reduction could be achieved by varying the length of bluffline protected. The east end of the revetment varies by which, if any, of the revetted berm options is assumed to be implemented. This transition zone ranges from transect #27 westward to transect #22. The west end of the revetment could be located at either transect #22 or transect #17. The bluff protection lengths under consideration are either 2,000 ft. or 1,040 ft. long.

The total initial project cost is estimated to have a present value ranging from $40 to $56 million depending on the alternative level of protection. Including annual O&M costs, the alternative Revetment configurations had an average annual cost ranging from $9.9 to $10.8 million. Damages prevented (benefits) ranged from $.04 to $.31 million (a reduction of 3 to 26%, respectively of total estimated damages in study area). None of the Revetment configurations resulted in positive net benefits, the highest benefit to cost ratio was .03 to 1, and residual annual damages ranged from $873,100 to $1,138,700 as summarized in table 22.

Table 22: Alternative Configurations of Revetment Alternative

ALTERNATIVE CONFIGURATION	TOTAL COST (PV)	ANNUAL COST	ANNUAL BENEFITS	NET ANNUAL BENEFITS	BC RATIO	RESIDUAL ANNUAL DAMAGES
Protect Bluff Transects 17-22	$55,980,000	$10,769,000	$39,600	-$10,729,400	0.004	$1,138,700
Protect Bluff Transects 22-24.6	$40,349,000	$9,929,000	$200,700	-$9,728,300	0.02	$977,600
Protect Bluff Transects 22-27	$49,223,000	$10,406,000	$305,200	-$10,100,800	0.03	$873,100

7.4 Revetted Berm Sized for Ice

This alternative provides a more substantial alternative design than the Revetted Berm and Revetment designs to protect against future damage to the project from ice runup (ivu) events that periodically occur in the study area. The more substantial design uses larger rock than included in the Revetted Berm and Revetment alternatives that is expected to require less periodic rock replacement (maintenance) following an ivu event. The alternative alignments would be the same as described above for the Revetted Berm and Revetment configurations.

Initially, only two Revetted Berm Sized for Ice configurations were evaluated (protection to the +14 foot contour elevation and protection of transects 22-27 for cost comparison to the Revetted Berm and Revetment configurations that provided the same level of protection (and same level of benefits). Because the cost of the Revetted Berm Sized for Ice was higher than the cost of the Revetted Berm and the Revetment alternatives that provided the same level of benefit, no further configurations of the Ivu Revetment were analyzed. Costs and benefits of the two evaluated Revetted Berm Sized for Ice configurations are listed in table 23.

The configuration providing protection to the +14’ contour resulted in a $9 million reduction of annual net benefits and the configuration to protect bluff transects 22-27 resulted in a $2 million reduction of annual net benefits of when compared to the Revetted Berm and Revetment alternatives of the same alignments, respectively.

Table 23: Alternative Configurations of Revetted Berm Sized for Ice Alternative

ALTERNATIVE CONFIGURATION	TOTAL COST (PV)	ANNUAL COST	ANNUAL BENEFITS	NET ANNUAL BENEFITS	BC RATIO	RESIDUAL ANNUAL DAMAGES
Protection to +14' Contour (Transects 22-42)	$265,794,000	$23,114,000	$1,069,400	-$22,044,600	0.05	$108,900
Protect Bluff Transects 22-27	$69,523,000	$12,570,000	$305,200	-$12,264,800	0.02	$873,100

7.5 Beach Nourishment

The beach nourishment alternative provides another alternative means to obtain reduction in storm caused erosion and flood damages. Beach nourishment involves both an initial placement of gravel materials in selected reaches along the shoreline but also periodic nourishment of those materials. The reaches considered coincide with those considered for the all the Revetted Berm configurations and Bluff Protection for Transects 22-27 configuration for cost comparison. The Beach Nourishment configurations evaluated were found to provide the same level of benefits as the Revetted Berm and Bluff Protection alternatives of the same alignment.

The total initial project cost is estimated to have a present value ranging from $30 million to $1.2 billion depending on the alternative level of protection. Including annual O&M costs, the alternative Beach Nourishment configurations had an average annual cost ranging from $5.3 to $92.6 million. Damages prevented (benefits) ranged from $.68 to $1.1 million (a reduction of 57 to 91%, respectively of total estimated damages in study area). None of the beach nourishment configurations resulted in positive net benefits, the highest benefit to cost ratio was .13 to 1, and residual annual damages ranged from $108,900 to $501,300 as summarized in table 24.

The Beach Nourishment configuration providing protection to the +8’ contour resulted in a $4.7 million increase in annual net benefits over the Revetted Berm +8’ configuration, however the net annual benefits were still negative ($-4,712,000). All other configurations of the Beach Nourishment Alterative that were evaluated resulted in a further reduction in net benefits when compared to the Revetted Berm and Bluff Protection alternative configurations of the same alignment.

Table 24: Alternative Configurations of Beach Nourishment Alternative

ALTERNATIVE CONFIGURATION	TOTAL COST (PV)	ANNUAL COST	ANNUAL BENEFITS	NET ANNUAL BENEFITS	BC RATIO	RESIDUAL ANNUAL DAMAGES
Protection to +8' Contour (Transects 27-31.5)	$29,885,000	$5,389,000	$677,000	-$4,712,000	0.13	$501,300
Protection to +10' Contour (Transects 24.6-31.5)	$140,019,000	$12,307,000	$805,900	-$11,501,100	0.07	$372,400
Protection to +12' Contour (Transects 22-33)	$329,553,000	$31,458,000	$1,025,800	-$30,432,200	0.03	$152,500
Protection to +14' Contour (Transects 22-43)	$1,242,545,000	$92,619,000	$1,069,400	-$91,549,600	0.01	$108,900
Protect Bluff Transects 22-27	$157,899,000	$31,225,000	$305,200	-$30,919,800	0.01	$873,100

7.6 Non Structural

This measure identified 34 structures that would receive storm caused erosion and/or flood damages during the 50-year study period. To reduce/eliminate these damages, structures would either be relocated to flood/erosion free land (24) or would be raised (10) to place the first floor elevation above the damage elevation. This measure would eliminate 87% of the flood damages to structures and contents in the study area. Floods would continue to occur but damages to structures and contents would be reduced.

The buildings are currently supported on pile foundations. Raised buildings would have a new pile support system installed to bring the structure up to the required height. The utility services for each of the structures would be disconnected, the structure temporarily moved aside, a new pile foundation installed, the structure placed on the new foundation, and the utilities reconnected. No work would be performed along the beach.

Relocated buildings would be disconnected from utilities, moved on City streets using transporters to a new vacant site where a new pile foundation had been constructed, placed on the new pile foundation, and the utilities reconnected. To further reduce risk to human life and health, a flood evacuation plan would be developed during Preconstruction Engineering and Design for residents in the floodplain.

The total initial project cost is estimated to have a present value of $44 million. Including annual O&M costs, the non-structural alternative had an average annual cost of $2.4 million. Annual damages prevented (benefits) are estimated at $213,000[13] (a reduction of 18% of total estimated damages in study area). The non-structural alternative resulted in negative net benefits (-$2.2 million annually), the benefit to cost ratio was .09 to 1, and residual annual damages were estimated at $965,000 as summarized in table 25.

Table 25: Non-Structural Alternative

ALTERNATIVE CONFIGURATION	TOTAL COST (PV)	ANNUAL COST	ANNUAL BENEFITS	NET ANNUAL BENEFITS	BC RATIO	RESIDUAL ANNUAL DAMAGES
Protect 34 Structures	$44,189,000	$2,374,000	$212,950	-$2,161,050	0.09	$965,350

7.7 Lagoon Fill

The lagoon fill alternative provides another means to obtain reduction in storm caused erosion and flood damages to the Barrow water supply dam. This alternative was originally proposed by local residents during coordination meetings in Barrow. This alternative would provide storm damage reduction benefits by eliminating damages associated with the existing spillway and the recurring damages to the low point in the road fronting the lagoon; as well as addressing local environmental concerns associated with Tasigrook Lagoon, which has been used for sewage waste storage in the past.

This measure would provide storm damage reduction by filling Tasigrook Lagoon, the body of water between Eben Hopson Road and the water supply dam, with suitable material up to elevation +8.0 MSL. The Lagoon has an approximate length of 1,700 feet and a nominal width of 400 feet. The lagoon is estimated to have a surface area of about 665,734 square feet (15-16 acres) and have a bottom elevation near sea level. Thus the fill would be an average of eight-feet-deep. The required fill volume, including a

[13] Breakdown in average annual benefits between relocating 24 structures and raising 10 structures is as follows:
Relocate ($191,000) + Raise ($22,000) = $213,000

25% contingency, would be about 260,000 cy. The measure would be constructed by obtaining suitable materials in available commercial sources in Barrow and transporting them by truck to the lagoon, where the materials would be spread to design elevations to drain seaward.

The total initial project cost is estimated to have a present value of $30 million. Including annual O&M costs, the alternative has an average annual cost of $1.6 million. Annual damages prevented (benefits) are estimated at $744,000 (a reduction of 63% of total estimated damages in study area). The non-structural alternative resulted in negative net benefits (-$878,600 annually), the benefit to cost ratio was .46 to 1, and residual annual damages were estimated at $433,900 as summarized in table 26.

Table 26: Fill Lagoon Alternative

ALTERNATIVE CONFIGURATION	TOTAL COST (PV)	ANNUAL COST	ANNUAL BENEFITS	NET ANNUAL BENEFITS	BC RATIO	RESIDUAL ANNUAL DAMAGES
Fill Lagoon (~ Transects 27-32)	$30,214,000	$1,623,000	$744,000	-$878,600	0.46	$433,900

8.0 Summary of NED Effects of Alternatives

Sections 6 and 7 of this report documented the results of economic modeling of future without- and with-project conditions. As reported in Section 7, none of the various configurations of alternatives evaluated were found to provide positive net benefits or a BC Ratio equal to or greater than unity. The Fill Lagoon alternative had the least negative annual net benefits (-$878,600) and the highest BC Ratio (.46) of the alternatives evaluated. Tables 27 – 29 provide consolidated summaries of all the alternatives' Benefits, Costs, and Benefit-Cost analysis, respectively.

Table 27: Summary of NED Coastal Storm Damage Reduction Benefits of Alternatives

ALTERNATIVE	WITHOUT PROJECT AVERAGE ANNUAL FLOOD DAMAGES	AVERAGE ANNUAL FLOOD DAMAGES REDUCED	AVERAGE ANNUAL RESIDUAL FLOOD DAMAGES	WITHOUT PROJECT AVERAGE ANNUAL EROSION DAMAGES	AVERAGE ANNUAL EROSION DAMAGES REDUCED	AVERAGE ANNUAL RESIDUAL EROSION DAMAGES	TOTAL ANNUAL DAMAGES	TOTAL ANNUAL DAMAGES REDUCED		RESIDUAL ANNUAL DAMAGES
REVETTED BERM (WAVES)										
Protection to +8' Contour (Transects 27-31.5)		$0	$157,300		$677,000	$344,000		$677,000	57%	$501,300
Protection to +10' Contour (Transects 24.6-31.5)		$24,400	$132,900		$781,500	$239,500		$805,900	68%	$372,400
Protection to +12' Contour (Transects 22-33)		$43,600	$113,700		$982,200	$38,800		$1,025,800	87%	$152,500
Protection to +14' Contour (Transects 22-43)		$87,200	$70,100		$982,200	$38,800		$1,069,400	91%	$108,900
BEACH NOURISHMENT										
Protection to +8' Contour (Transects 27-31.5)		$0	$157,300		$677,000	$344,000		$677,000	57%	$501,300
Protection to +10' Contour (Transects 24.6-31.5)		$24,400	$132,900		$781,500	$239,500		$805,900	68%	$372,400
Protection to +12' Contour (Transects 22-33)		$43,600	$113,700		$982,200	$38,800		$1,025,800	87%	$152,500
Protection to +14' Contour (Transects 22-43)	$157,300	$87,200	$70,100	$1,021,000	$982,200	$38,800	$1,178,300	$1,069,400	91%	$108,900
Protect Bluff Transects 22-27		$0	$157,300		$305,200	$715,800		$305,200	26%	$873,100
REVETTED BERM (ICE)										
Protection to +14' Contour (Transects 22-42)		$87,200	$70,100		$982,200	$38,800		$1,069,400	91%	$108,900
Protect Bluff Transects 22-27		$0	$157,300		$305,200	$715,800		$305,200	26%	$873,100
REVETMENT										
Protect Bluff Transects 17-22		$0	$157,300		$39,600	$981,400		$39,600	3%	$1,138,700
Protect Bluff Transects 22-24.6		$0	$157,300		$200,700	$820,300		$200,700	17%	$977,600
Protect Bluff Transects 22-27		$0	$157,300		$305,200	$715,800		$305,200	26%	$873,100
NON-STRUCTURAL										
Protect 34 Structures		$36,550	$120,750		$176,400	$844,600		$212,950	18%	$965,350
FILL LAGOON										
Fill Lagoon (~ Transects 27-31.5)		$67,400	$89,900		$677,000	$344,000		$744,400	63%	$433,900

Table 28: Summary of NED Costs of Alternatives

(All Values in October 2007 Prices, 4.875% Interest Rate, 50 Year Period of Analysis)

ALTERNATIVE	PROJECT COSTS	INTEREST DURING CONSTRUCTION	INVESTMENT COSTS	INTEREST & AMORTIZATION	OPERATION & MAINTENANCE	TOTAL ANNUAL COSTS
REVETTED BERM (WAVES)						
Protection to +8' Contour (Transects 27-31.5)	$41,571,000	$1,615,000	$43,186,000	$2,320,000	$7,761,000	$10,082,000
Protection to +10' Contour (Transects 24.6-31.5)	$49,770,000	$2,017,000	$51,787,000	$2,782,000	$7,761,000	$10,544,000
Protection to +12' Contour (Transects 22-33)	$70,856,000	$4,440,000	$75,296,000	$4,045,000	$7,761,000	$11,807,000
Protection to +14' Contour (Transects 22-43)	$108,331,000	$9,675,000	$118,006,000	$6,340,000	$7,761,000	$14,101,000
BEACH NOURISHMENT						
Protection to +8' Contour (Transects 27-31.5)	$28,488,000	$1,397,000	$29,885,000	$1,606,000	$3,783,000	$5,389,000
Protection to +10' Contour (Transects 24.6-31.5)	$115,059,000	$24,960,000	$140,019,000	$7,522,000	$4,785,000	$12,307,000
Protection to +12' Contour (Transects 22-33)	$244,369,000	$85,184,000	$329,553,000	$17,704,000	$13,754,000	$31,458,000
Protection to +14' Contour (Transects 22-43)	$806,969,000	$435,576,000	$1,242,545,000	$66,752,000	$25,867,000	$92,619,000
Protect Bluff Transects 22-27	$139,867,000	$18,032,000	$157,899,000	$8,483,000	$22,742,000	$31,225,000
REVETTED BERM (ICE)						
Protection to +14' Contour (Transects 22-42)	$201,390,000	$64,404,000	$265,794,000	$14,279,000	$8,835,000	$23,114,000
Protect Bluff Transects 22-27	$66,698,000	$2,825,000	$69,523,000	$3,735,000	$8,835,000	$12,570,000
REVETMENT						
Protect Bluff Transects 17-22	$53,767,000	$2,213,000	$55,980,000	$3,007,000	$7,761,000	$10,769,000
Protect Bluff Transects 22-24.6	$38,867,000	$1,482,000	$40,349,000	$2,168,000	$7,761,000	$9,929,000
Protect Bluff Transects 22-27	$47,326,000	$1,897,000	$49,223,000	$2,644,000	$7,761,000	$10,406,000
NON-STRUCTURAL						
Protect 34 Structures	$42,123,000	$2,066,000	$44,189,000	$2,374,000	$0	$2,374,000
FILL LAGOON						
Fill Lagoon (~ Transects 27-31.5)	$28,801,000	$1,413,000	$30,214,000	$1,623,000	$0	$1,623,000

Table 29: Benefit Cost Analysis

ALTERNATIVE	AVERAGE ANNUAL COSTS	AVERAGE ANNUAL BENEFITS	NET BENEFITS	BC RATIO
REVETTED BERM (WAVES)				
Protection to +8' Contour (Transects 27-31.5)	$10,082,000	$677,000	-$9,405,000	0.07
Protection to +10' Contour (Transects 24.6-31.5)	$10,544,000	$805,900	-$9,738,100	0.08
Protection to +12' Contour (Transects 22-33)	$11,807,000	$1,025,800	-$10,781,200	0.09
Protection to +14' Contour (Transects 22-43)	$14,101,000	$1,069,400	-$13,031,600	0.08
BEACH NOURISHMENT				
Protection to +8' Contour (Transects 27-31.5)	$5,389,000	$677,000	-$4,712,000	0.13
Protection to +10' Contour (Transects 24.6-31.5)	$12,307,000	$805,900	-$11,501,100	0.07
Protection to +12' Contour (Transects 22-33)	$31,458,000	$1,025,800	-$30,432,200	0.03
Protection to +14' Contour (Transects 22-43)	$92,619,000	$1,069,400	-$91,549,600	0.01
Protect Bluff Transects 22-27	$31,225,000	$305,200	-$30,919,800	0.01
REVETTED BERM (ICE)				
Protection to +14' Contour (Transects 22-42)	$23,114,000	$1,069,400	-$22,044,600	0.05
Protect Bluff Transects 22-27	$12,570,000	$305,200	-$12,264,800	0.02
REVETMENT				
Protect Bluff Transects 17-22	$10,769,000	$39,600	-$10,729,400	0.004
Protect Bluff Transects 22-24.6	$9,929,000	$200,700	-$9,728,300	0.02
Protect Bluff Transects 22-27	$10,406,000	$305,200	-$10,100,800	0.03
NON-STRUCTURAL				
Protect 34 Structures	$2,374,000	$212,950	-$2,161,050	0.09
FILL LAGOON				
Fill Lagoon (~ Transects 27-31.5)	$1,623,000	$744,000	-$878,600	0.46

9.0 Regional Economic Development Effects of Alternatives

The RED account displays changes in the distribution of regional economic activity as a result of each alternative plan. Regional income and employment are commonly applied measures of regional economic activity. The absolute level of effects is of less importance than the relative impact on the region.

The positive effects of a plan on a region's income are equal to the sum of the NED benefits that accrue to that region, plus transfers of income to the region from outside the region. The positive effects of a plan on regional employment are directly parallel to the positive effects on regional income. The primary types of positive regional impacts associated with the final alternatives involve short term employment and income gains associated with project construction. In the longer term, the final alternatives have the potential to positively affect income and employment stability in the community, economic growth, and tax revenues. The relative potential effects of each alternative on RED are summarized in the following paragraphs.

9.1 No Action Alternative

With the No Action alternative, expected coastal storm/flood damages would likely result in negative employment and income impacts in the study area. Based upon survey data collected by the North Slope Borough, businesses and government agencies with facilities at risk of coastal storm damage employ approximately 210 people in the study area. The 210 employees account for approximately 11% of Barrow's total of 1,986 jobs as reported in the 2000 U.S. Census. Approximately 75% of the 210 at-risk jobs are in the public sector and approximately 25% are in commercial establishments. At the average reported hourly wage of $22.06 and assuming an average workday of 6 hours per day, the value of income of employees in at-risk facilities is estimated at approximately $28,000 per day (assuming a five day work week: ~$557,000 per month; ~$6,688,000 per year). A large potential risk to employment and income in the study area is loss of the utility services provided by the underground utilidor. As noted previously in the NED analysis, the utilidor is subject to flooding in extreme events and is estimated to be impacted by erosion within 25 years. The risk of coastal storm damage serves as a disincentive for businesses to invest in the community, further reducing the potential for future employment and income growth in Barrow.

9.2 Revetted Berm Alternatives

In the short term, the study area is expected to experience positive income and employment effects from construction of this alternative. Construction is expected to occur from June to October for two to four annual construction seasons depending on the length of berm. The construction crew is expected to be made up of approximately 15 members, including Field Superintendent, Construction Quality Assurance Manager, equipment operators, and general laborers. Opportunities for direct local employment associated with project construction are possible but expected to be limited. Secondary positive employment and income impacts are expected to result from the crew's demand for lodging, groceries, food, entertainment, automobile rental/service/supply, health care, and payment of taxes.

Over the longer term, this alternative would reduce the risk of coastal flooding and erosion in Barrow and the associated negative employment and income effects described above for the No Action Alternative. The alternative would also reduce the existing disincentive for business investment in Barrow due to the current risk of potential storm damages. Out of pocket expenses of businesses and residents associated with coastal storm damage repairs and rehabilitation would be reduced, resulting in more disposable income, increased earnings, increased demand for local goods and services, and an increased tax base. Collectively, these positive income and employment effects are expected to result in a more stable, growing economy in Barrow than with the No-Action Alternative.

For the four alternative lengths of the revetted berm evaluated, positive employment and income effects would increase as the length and associated extent of protected economic infrastructure increases. This applies to both the short term and long term effects cited above. All configurations except the "Protect to 8' Contour" alignment protect against the expected future erosion damage to the utilidor and the associated potential interruptions to utility services that would have negative employment and income effects in the study area.

Additional configurations of the revetted berm alternatives designed to better withstand ice forces associated with an ivu event were developed as part of the study. Because these configurations of the berm were found to provide the same storm damage reduction benefits as other berm configurations of the same alignment, but at a higher cost, the configuration sized for ice was not considered further.

9.3 Revetment Alternative

In the short term, the revetment alternative is expected to provide positive local employment and income effects in the study area as a result of project construction. Construction is scheduled to occur from June to October for two annual construction seasons. The expected construction crew and opportunities for direct and secondary local employment would be similar to that described for the revetted berm alternative.

Over the longer term, the revetment alternative would reduce the risk of erosion damages in the neighborhood of Barrow, including the significant residential and commercial infrastructure at risk between Egasak and Stevenson Streets. The alternative would reduce the existing disincentive for long term business investment in the Barrow neighborhood due to the current risk of coastal erosion. Erosion-related expenses to businesses and residents associated with property losses, real estate devaluation, moving expenses and temporary residential shelter would be reduced, resulting in more disposable income, increased earnings, increased demand for local goods and services, and an increased tax base. As with the revetted berm alternative, these positive income and employment effects are expected to result in a more stable, growing economy in Barrow than with the No-Action Alternative.

For the three alternative lengths of the revetment structure evaluated, positive employment and income effects would increase as the length and associated extent of protected economic infrastructure increases. This applies to both the short term and long term effects cited above. Only the configuration that protects transects 22-27 would protect against the expected future erosion damage to the utilidor and the associated potential interruptions to utility services that would have negative employment and income effects in the study area.

9.4 Beach Nourishment Alternative

A beach nourishment alternative was developed to provide the same levels of protection as each configuration of the revetted berm for cost comparison purposes. Because the cost of the beach nourishment alternative was generally higher than that of the revetted berm alternative, the beach nourishment alternative was not considered further.

9.5 Non-Structural Alternative

The non structural alternative involves the relocation of 24 structures in the bluff erosion zone in the neighborhood of Barrow and elevation of ten other structures to the east of the Barrow bluff that were found to be the most significant source of flood damages over the period of analysis.

In the short term, the non-structural alternative is expected to provide positive local employment and income effects in the study area as a result of project construction. Construction is scheduled to occur for two annual construction seasons. Although the cost of this alternative is lower than for the revetted berm or bluff protection alternatives, there could be more opportunities for direct local employment as more local labor could be utilized for the types of construction required.

Over the longer term, the non-structural protection alternative would reduce the risk of erosion damages in the neighborhood of Barrow, including the significant residential and commercial infrastructure at risk between Egasak and Stevenson Streets by relocating structures to safe land although to a lesser extent than the bluff protection alternative as some at risk structures were determined to not be movable and would be lost to erosion. Similarly, erosion-related expenses to businesses and residents associated with property losses, real estate devaluation, moving expenses and temporary residential shelter would be reduced, resulting in more disposable income, increased earnings, increased demand for local goods and services, and an increased tax base. As with the revetted berm alternative, these positive income and employment effects are expected to result in a more stable, growing economy in Barrow than with the No-Action Alternative although to a lesser degree.

The non-structural alternative would not protect against the expected future erosion damage to the utilidor and the associated potential interruptions to utility services that would have negative employment and income effects in the study area. It also would not reduce the recurring damages to the roadway fronting the lagoon.

9.6 Fill Lagoon Alternative

The lagoon fill would provide storm damage reduction benefits by eliminating damages associated with the existing spillway and the recurring damages to the low point in the road fronting the lagoon; as well as addressing local environmental concerns associated with Tasigrook Lagoon, which has been used for sewage waste storage in the past.

In the short term, the Fill Lagoon alternative is expected to provide positive local employment and income effects in the study area as a result of project construction. Construction is scheduled to occur for two annual construction seasons. Like the Non-Structural alternative, the cost of this alternative is lower than for the revetted berm or bluff protection alternatives, however there could be more opportunities for direct local employment as more local labor could be utilized for the types of construction required.

Over the longer term, the non-structural protection alternative would reduce the risk of recurring erosion damages to the roadway fronting the lagoon by allowing it to be relocated back from the beach and reduce the flood damages associated with the spillway and its associated utilities. These positive income and employment effects are expected to result in a more stable, growing economy in Barrow than with the No-Action Alternative.

The non-structural alternative would not protect against the expected future erosion damage to the utilidor and the associated potential interruptions to utility services that would have negative employment and income effects in the study area.

10.0 Other Social Effects of Alternatives

10.1 Life, Health and Safety

The final alternatives have the potential to affect personal health and safety, including risk of injury and mortality. They also have the potential to affect the safety of property and the risk of property damage. Such damages have profound effects on quality of life for local residents. Additionally, the alternatives have the potential to affect life, health and safety of not only local residents, but also residents of outlying smaller communities throughout the North Slope Borough that depend on Barrow for emergency response. The relative effects expected with each final alternative are described below.

- **No Action Alternative:** The No Action Alternative poses risks to personal safety and mortality by not addressing the current risks of coastal storm damages and erosion in the study area. Frigid flood waters during storms in the study area result in unusually dangerous conditions. Additionally, the current practices of flood fighting during storms place equipment operators in extremely hazardous conditions to protect the community. As documented in this technical appendix, the community faces risk of damage to personal property, including residential and non-residential structures and their contents. The flooding and the risk of flooding negatively impact the quality of life of local residents. While local medical facilities and emergency response resources are not expected to be physically impacted by coastal flooding and erosion, localized coastal storms may fully occupy local emergency response personnel and limit their ability to serve regional outlying communities within the North Slope Borough. Expected erosion damage to the beach frontage roadway could result in hazardous road conditions during storms.

- **Revetted Berm Alternatives:** This alternative (either configuration sized for waves or for ice) would reduce the identified risks to personal safety and mortality associated with coastal flooding and flood fighting activities. The alternative would also reduce coastal storm damages to property. The magnitude of these positive effects increases as the length of the alignment increases. With the alignments that extend westward, risk to human health and safety associated with coastal erosion creating unstable bluffs in Barrow and risks to the safety of property along the Barrow Bluff erosion zone would improve relative to those conditions with the No Action Alternative. The improved safety of the local community in eastern Barrow and in Browerville resulting from the revetted berm alternative would result in an increased quality of life for residents. The alternative would reduce the safety risk associated with damage to the beach frontage roadway. The decreased risk of local coastal flood emergencies would reduce the likelihood that Barrow would not be able to provide emergency response services to other NSB communities during periods of coastal storms in Barrow.
- **Revetment Alternative:** This alternative would reduce the risk to human health and safety associated with coastal erosion creating unstable bluffs in Barrow. Safety risks to local residents along the Barrow Bluff erosion zone would improve relative to those conditions with the No Action Alternative. The magnitude of these positive effects would increase as the length of the alignment increases. The improved safety of the local community in eastern Barrow and in Browerville resulting from the bluff protection alternative would result in an increased quality of life for residents. Protection of the utilidor from erosion damage would reduce the potential losses human health and safety risks that would be associated with an interruption in utility service. The decreased risk of property and infrastructure losses would reduce the likelihood that Barrow would not be able to provide emergency response services to other NSB communities during periods of coastal storms in Barrow.
- **Beach Nourishment Alternative:** The effects on life, health and safety associated with this alternative are expected to be similar to those presented for the revetted berm alternative.
- **Non-Structural Alternative:** While this alternative would reduce coastal flooding damages to property, human health and safety risks would remain as residents in elevated homes could potentially be surrounded by dangerous low temperature floodwaters. The alternative would significantly reduce health and safety risks along the Barrow bluff by relocating movable structures to safer stable land. However some non-movable structures would remain in the erosion zone and the unstable bluff could present a human health and safety risk. The alternative would not protect the utilidor from projected erosion damage resulting in health and safety risks associated with an interruption in utility service. Required floodfighting and evacuation activities would be expected to present health and safety risks to emergency personnel and could reduce the likelihood that Barrow would not be able to provide emergency response services to other NSB communities during periods of coastal storms in Barrow.
- **Fill Lagoon Alternative:** This alternative would reduce the safety risk associated with recurring damage to the beach frontage roadway. The alternative would also provide health and safety benefits by capping the lagoon which was formerly used for sewage disposal. The decreased risk of property and infrastructure losses would reduce the likelihood that Barrow would not be able to provide emergency response services to other NSB communities during periods of coastal storms in Barrow.

10.2 Educational Opportunities

No flooding or erosion damages are expected to directly impact school facilities in Barrow. Interruption of utility service associated with flooding or erosion damage to the utilidor could impact ability to provide school services depending on the extent of damage to the utilidor and the resulting level and duration of service interruption.

The following alternatives do not provide protection to the utilidor and therefore have the potential to negatively impact educational opportunities:

- **No Action Alternative**
- **Non-Structural Alternative**
- **Fill Lagoon Alternative**

Alternative configurations of the following alternatives can provide protection to the utilidor:

- **Revetted Berm Alternatives**
- **Revetment Alternative**
- **Beach Nourishment Alternative**

10.3 Recreational Opportunities

As noted in **Section 3.5**, are primary traditional recreational opportunity affected by the final alternatives is recreational beach combing[14]. The relative effects expected with each alternative are described below.

- **No Action Alternative:** With the No-Action Alternative, future opportunities for recreational beach combing are expected to remain in the study area.
- **Revetted Berm Alternatives:** With this alternative, beach combing opportunities are expected to be similar to without project conditions except that the project could pose potential risks to human health and safety during beach combing where exit from the beach would be limited to the beach access locations or climbing over the coastal dike/revetment. Recreational participation would be expected to decline as a result of the potential hazard and the limited access. The diversity of the beach combing opportunities would not be impacted significantly as the beach would remain wide along the majority of the project alignment.
- **Revetment Alternative:** Beach combing opportunities along the western extension of the project footprint would be limited because of the narrow beach in this area that would be largely occupied by the bluff protection revetment.
- **Beach Nourishment Alternative:** The effects on recreational opportunities associated with this alternative are expected to be similar to those presented for the revetted beach alternative.
- **Non-Structural Alternative:** With the Non-Structural Alternative, future opportunities for recreational beach combing are expected to remain in the study area.

[14] Additional recreational benefit is associated with subsistence activities. Subsistence is addressed in Sections 3.6 and 11.5.

- **Fill Lagoon Alternative:** With the Fill Lagoon Alternative, future opportunities for recreational beach combing are expected to remain in the study area. Additionally, there is potential for using the land created by the capped lagoon area for local recreational purposes.

10.4 Subsistence

As noted in **Section 3.6**, subsistence is extremely important to the community in Barrow. Sixty-four percent of the population is Alaskan Native (primarily Inupiat Eskimo) and practice a subsistence lifestyle. Traditional marine mammal hunts and other subsistence practices are an active part of the culture. The relative effects on subsistence activities expected with each final alternative are described below.

- **No Action Alternative:** With the No-Action alternative, future opportunities for subsistence participation are expected to remain in the study area. Although past storm erosion damages to Stevenson Street have impeded eastward connectivity to Pt. Barrow, where fish camps used for subsistence harvesting are located at Elson lagoon, a new alternative connector road is planned for construction that will address the issue.

Opportunities to participate in subsistence activities are not expected to be limited or improved from without project conditions by any of the action alternatives evaluated. Beach access for fishing boats would be maintained.

10.5 Cultural Opportunities

Cultural opportunities affected by the alternatives include loss of/damages to portions of the Utqiagvik Village Archeological Site in Barrow and fishing/whaling activities. The relative effects expected with each final alternative are described below.

- **No Action Alternative:** With the No-Action alternative, cultural resources and opportunities would be negatively impacted by the expected damages to the Utqiagvik Village archeological site in Barrow. Cultural activities associated with fishing/whaling are expected to continue as present.
- **Revetted Berm Alternatives:** This alternative would not result in protection of losses/damages to the Utqiagvik Village Site archeological site in Barrow and thus would exhibit the same expected losses of cultural opportunities associated with damage to the site as with the No Action alternative. While the ability of the local community to participate in customary fishing and whaling is not expected to be limited by the project, certain local customs and traditions associated with the Whaling festival would be impacted.
- **Revetment Alternative:** The alignment of the bluff protection revetment Protecting Transects 17-22 is the only configuration of any of the alternatives that would protect the Utqiagvik Village Site archeological site in Barrow and the associated cultural resources and cultural opportunities. It is assumed that the construction and any required maintenance of the project in the vicinity of the Utqiagvik Village Site would be from the water side of the site to ensure that no negative impacts to resources at the site occur.
- **Beach Nourishment Alternative:** The effects on cultural opportunities associated with this alternative are expected to be similar to those presented for the revetted beach alternative.
- **Non-Structural Alternative:** The effects on recreational opportunities associated with this alternative are expected to be similar to those presented for the revetted berm alternative.

- **Fill Lagoon Alternative:** The effects on recreational opportunities associated with this alternative are expected to be similar to those presented for the revetted beach alternative.

10.6 Population

The final alternatives have the potential for affecting the local population size in Barrow by influencing net migration. Additionally, conditions associated with the alternatives could result in the displacement of people and businesses. The relative effects expected with each final alternative are described below.

- **No Action Alternative:** Because the No Action Alternative would not reduce the risk or occurrence of coastal flooding and erosion in the study area, some local residents could be expected to migrate to safer communities following damaging and threatening coastal storms. Additionally, the local flood risk might preclude businesses from establishing in Barrow limiting employment opportunities that could attract new residents. Residences could be displaced by condemnation, especially in the Barrow bluff erosion zone.
- **Revetted Berm Alternatives:** This alternative would result in reduction of the flood risk in eastern Barrow and eastern Browerville and its effect as an incentive for outmigration from the community and a disincentive for establishment of business enterprises. Since a stable growing economy is more likely to provide an incentive for new residents to settle in Barrow, the population might be expected to increase with this alternative. The magnitude of these positive effects increases as the length of the alignment increases. While project construction is not expected to result in any displacement of homes and businesses, displacement by condemnation in the area of the Barrow bluff erosion zone would continue with this alternative for erosion prone areas not protected.
- **Revetment Alternative:** The bluff protection alternative would result in a reduction of the erosion damage risk in the Barrow neighborhood. The magnitude of these positive effects increases as the length of the alignment increases. Depending on the alignment, displacement by condemnation in the area would continue with this alternative for erosion prone areas not protected. The alternative would serve to reduce expected erosion damages and their effect as an incentive for outmigration from the community and a disincentive for establishment of business enterprises. The magnitude of these positive effects increases as the length of the alignment increases. Since a stable growing economy is more likely to provide an incentive for new residents to settle in Barrow, the population might be expected to increase with this alternative. While project construction is not expected to result in any displacement of homes and businesses, displacement by condemnation in the area of the Barrow bluff erosion zone would continue with this alternative for erosion prone areas not protected.
- **Beach Nourishment Alternative:** The effects on population associated with this alternative are expected to be similar to those presented for the revetted berm alternative.
- **Non-Structural Alternative:** This alternative would reduce coastal flooding damages to property by elevating frequently flooded structures. The alternative would also relocate movable structures from the bluff erosion zone in the neighborhood of Barrow to safer stable land. The alternative would serve to reduce expected flooding and erosion damages and their effect as an incentive for outmigration from the community and a disincentive for establishment of business enterprises although to a lesser extent that either bluff protection, revetted berm, or beach nourishment alternatives.
- **Fill Lagoon Alternative:** This alternative would not be expected have a direct effect on population in the study area relative to the condition described for the No-Action Alternative.

10.7 Aesthetics

The final alternatives have the potential to affect aesthetic resources in the study area. The relative effects expected with each final alternative are described below.

- **No Action Alternative:** Under the no action alternative the project area is already occupied by beach berms for coastal storm protection. These berms are gravel mounds generally anywhere from 6-8 feet in height and placed at the crest of the beach (top elevation of berm is approximately 12' - 15'above msl) as a protection measure against rising water from storm surge and wave attack.
- **Revetted Berm Alternatives:** This alternative would result in a coastal dike with a top elevation of approximately 14'; a 5'- 8' increase in elevation over the existing berm's typical top height. The increased height of the protective structure would adversely affect the viewshed from low-lying areas in the study area; particularly those closest to the shoreline. The visual effect from the beach side of the dike/revetment would be more pronounced because the structure would result in more isolated perspective with no view of the transitional zone to upland areas.
- **Revetment Alternative:** The visual effect of the bluff protection alternative would be less pronounced than the revetted berm as the protection would not extend far beyond the existing top of bluff if at all.
- **Beach Nourishment Alternative:** The aesthetic effects associated with this alternative are expected to be similar to those presented for the revetted berm alternative. However, the smaller unit size of the nourishment materials relative to the revetment materials could result in a relatively more natural appearance than with the revetted berm.
- **Non-Structural Alternative:** The site of relocated structures from the bluff area would be expected to remain as open space which would be a positive aesthetic affect in the area. Elevating structures would not be expected to have a dramatic aesthetic impact as most structures in the study area are already elevated.
- **Fill Lagoon Alternative:** This alternative would result in a pronounced change to the existing landscape in the center portion of the study area. Filling the lagoon would modify the existing waterbody to upland. The newly created land would still be fronted by the sea the north and by the water supply lagoon to the south. Previous discussion of this alternative with local officials indicated the potential for the filled site to serve as a public recreation resource which could provide positive aesthetic and recreational benefits for the community.

11.0 Summar y of Effects

The NED, RED, and OSE effects documented in the previous sections are summarized in table 30.

Table 30: Summary of Economic/Social Evaluation of Final Alternatives

EVALUATION ACCOUNT:	EVALUATION CATEGORY:	ALTERNATIVES								
		NO ACTION	REVETTED BERM		REVETMENT		BEACH NOURISHMENT		NON STRUCTURAL	FILL LAGOON
NED	Average Annual Coastal Flooding Damages Reduced	$0	+8’ +10’ +12’ +14’ Ivu 14’	$0 $24,400 $43,600 $87,200 $87,200	17-22 22-24.6 22-27 Ivu 22-27	$0 $0 $0 $0	+8’ +10’ +12’ +14’ 22-27	$0 $24,400 $43,600 $87,200 $0	$36,550	$67,400
	Average Annual Erosion Damages Reduced	$0	+8’ +10’ +12’ +14’ Ivu 14’	$677,000 $781,500 $982,200 $982,200 $982,200	17-22 22-24.6 22-27 Ivu 22-27	$39,600 $200,700 $305,200 $305,200	+8’ +10’ +12’ +14’ 22-27	$677,000 $781,500 $982,200 $982,200 $305,200	$176,400	$677,000
	Total Average Annual Damages Reduced	$0	+8’ +10’ +12’ +14’ Ivu 14’	$677,000 $805,900 $1,025,800 $1,069,400 $1,069,400	17-22 22-24.6 22-27 Ivu 22-27	$39,600 $200,700 $305,200 $305,200	+8’ +10’ +12’ +14’ 22-27	$677,000 $805,900 $1,025,800 $1,069,400 $305,200	$212,950	$744,400
	Average Annual Residual Damages	$1,178,300	+8’ +10’ +12’ +14’ Ivu 14’	$501,300 $372,400 $152,500 $108,900	17-22 22-24.6 22-27 Ivu 22-27	$1,138,700 $977,600 $873,100 $873,100	+8’ +10’ +12’ +14’ 22-27	$501,300 $372,400 $152,500 $108,900 $873,100	$965,350	$433,900
	Average Annual Cost	$0	+8’ +10’ +12’ +14’ Ivu 14’	$10,082,000 $10,544,000 $11,807,000 $14,101,000 $23,114,000	17-22 22-24.6 22-27 Ivu 22-27	$10,769,000 $9,929,000 $10,406,000 $12,570,000	+8’ +10’ +12’ +14’ 22-27	$5,389,000 $12,307,000 $31,458,000 $92,619V $31,225,000	$2,374,000	$1,623,000
	Net Annual Benefits	$0	+8’ +10’ +12’ +14’ Ivu 14’	-$9,405,000 -$9,738,100 -$10,781,200 -$13,031,600 -$22,044,600	17-22 22-24.6 22-27 Ivu 22-27	-$10,729,400 -$9,728,300 -$10,100,800 -$12,264,800	+8: +10’ +12’ +14’ 22-27	-$4,712,000 -$11,501,100 -$30,432,200 -$91,549,600 -$30,919,800	-$2,161,050	-$878,600
	BC Ratio	not applicable	+8’ +10’ +12’ +14’ Ivu 14’	0.07 0.08 0.09 0.08 0.05	17-22 22-24.6 22-27 Ivu 22-27	0.004 0.02 0.03 0.02	+8’ +10’ +12’ +14’ 22-27	0.13 0.07 0.03 0.01 0.01	0.09	0.46

EVALUATION ACCOUNT:	EVALUATION CATEGORY:	ALTERNATIVES					
		NO ACTION	REVETTED BERM	REVETMENT	BEACH NOURISHMENT	NON STRUCTURAL	FILL LAGOON
RED	Employment and Income Effects	Lost jobs, income, and economic opportunity from storm damages and flood risk. Flood and erosion risk to utilidor is expected to result in future utility service interruption and associated employ-ment and income impacts. Risk of coastal storm damage remains a disincentive for business investment in comm-unity.	Reduction of lost jobs and income that are associated with No Action Alternative. Improved Employment and Income stability and Economic Growth. Reduced out-of-pocket expenses for damage repairs. Short term positive employment and income effects of project construction (2 to 4 construction seasons depending on berm length).	Reduction of lost jobs and income that are associated with No Action Alternative. Reduced out-of-pocket expenses for damage repairs, relocations, and temporary/replacement housing. Improved Employment and Income stability and Economic Growth. Short term positive employment and income effects of project construction (2 construction seasons).	A beach nourishment alternative was developed to provide the same levels of protection as each configuration of the revetted berm for cost comparison purposes. Because the cost of the beach nourishment alternative was generally higher than that of the revetted berm alternative, the beach nourishment alternative was not considered further.	Structure relocations and elevations would present short term opportunities for local employment and income (2 seasons). Reduced out-of-pocket expenses for damage repairs, relocations, and temporary/replace ment housing. Improved Employment and Income stability and Economic Growth. Residual flood and erosion risk to utilidor is expected to result in future utility service interruption and associated employment and income impacts.	Construction would present short term opportunities for local employment and income (2 seasons). Residual flood and erosion risk to utilidor is expected to result in future utility service interruption and associated employment and income impacts.

EVALUATION ACCOUNT:	EVALUATION CATEGORY:	ALTERNATIVES					
		NO ACTION	REVETTED BERM	REVETMENT	BEACH NOURISHMENT	NON STRUCTURAL	FILL LAGOON
OSE	Life, Health, and Safety	Risks of injury and mortality from coastal flooding and unstable bluffs. Dangerous flood fighting conditions.	Reduction in risks of injury and mortality from coastal storms and flood fighting. Longer alignments partially address safety concerns associated with eroding bluffs in Barrow. New safety concerns with limited exit points from beach with coastal dike.	Reduction in risk to human heath and safety associated with coastal erosion and the resultant unstable bluffs in Barrow. Protection of utilidor would protect against future utility interruption from erosion and that associated impacts on human health and safety.	A beach nourishment alternative was developed to provide the same levels of protection as each configuration of the revetted berm for cost comparison purposes. Because the cost of the beach nourishment alternative was generally higher than that of the revetted berm alternative, the beach nourishment alternative was not considered further.	Residual risk for emergency personnel and residents of elevated structures in situations of evacuation during high water. Reduction in health and safety risks along Barrow Bluff with relocations.	Potential health benefits of capping past sewage disposal site. Reduced frequency of emergency flood fight activities.
	Educational Opportunities	No direct effects.	No direct Effects.	No direct Effects.		No direct Effects.	No direct effects.
	Recreational Opportunities	Primary recreational activity associated with project area is beach walking/ combing.	Project conditions would encroach on beach (primarily in the narrow beach in the vicinity of Barrow bluff).	Project encroachment on narrow beach in the vicinity of Barrow bluff.		No direct effect expected.	No direct effect expected.
	Subsistence Opportunities	No expected change in opportuni-ties for subsistence participation.	No expected change in opportunities for subsistence participation.	No expected change in opportunities for subsistence participation.		No expected change in opportunities for subsistence participation.	No expected change in opportunities for subsistence participation.
	Cultural Opportunities	Expected damages to cultural resources at Utqiagvik Village Archeologic al Site as a result of beach erosion.	Same as with No Action.	Protection of cultural resources at Utqiagvik Village Archeological Site as a result of beach erosion with western alignment.		Same as with No Action.	Same as with No Action.

EVALUATION ACCOUNT:	EVALUATION CATEGORY:	ALTERNATIVES					
		NO ACTION	REVETTED BERM	REVETMENT	BEACH NOURISHMENT	NON STRUCTURAL	FILL LAGOON
OSE	Population	Population expected to remain at current levels or diminish over time due to expected limitations on employ-ment and income opportun-ities	The cited constraints on population growth under no action would be reduced with this alternative. Population could be expected to grow over time due to increased employment and income opportunities	Similar effect as with Revetted Berm alternative.	A beach nourishment alternative was developed to provide the same levels of protection as each configuration of the revetted berm for cost comparison purposes. Because the cost of the beach nourishment alternative was generally higher than that of the revetted berm alternative, the beach nourishment alternative was not considered further.	Similar effect as with Revetted Berm alternative.	No direct effect expected.
	Aesthetics	Viewshed impaired by coastal storm protection berms on beach with approximate top elevation of 13-15 feet above sea level	Viewshed impairment increases with larger structure for coastal dike (design top elevation ~20'). Increased negative aesthetic impact on views and scenery from both Ocean side and land side viewpoints	The visual effect of the bluff protection alternative would be less pronounced than the revetted berm as the protection would not extend far beyond the existing top of bluff if at all.		The site of relocated structures from the bluff area would be expected to remain as open space which would be a positive aesthetic affect in the area. Elevating structures would not be expected to have a dramatic aesthetic impact as most structures in the study area are already elevated.	A change to the existing landscape in the center portion of the study area. Converting lagoon to open space could serve as a public recreation resource which could provide positive aesthetic and recreational benefits for community.

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U.S. Army Corps
of Engineers
Alaska District

Barrow, Alaska

Coastal Storm Damage Reduction Interim Feasibility Report

Appendix E – Draft Fish & Wildlife Coordination Act Report

September 2008

Interim Feasibility Report
Barrow, Alaska, Storm Damage Reduction

Appendix E – Draft Fish and Wildlife Coordination Act Report

NOTE:

This Appendix was originally created as the Draft Fish and Wildlife Coordination Act Report (CAR) to go with an early version of the Draft Integrated Interim Feasibility Report and Environmental Impact Statement for Coastal Storm Damage Reduction at Borrow, Alaska. It describes the preliminary alternatives and one tentatively selected for recommendation in the early draft report. That document underwent Independent Technical Review. As a result of that review, basic hydraulic and economic analyses were redone, with the result that no alternative yielded positive National Economic Development benefits greater than the costs. Therefore, the report was modified to reflect recommendation of the “No Action” alternative. Since there is no Federal action proposed in this report, there is no need for a Fish and Wildlife Coordination Act Report. However, since the draft CAR had compiled information on the natural, cultural, and social conditions of the Barrow area and the potential impacts of various alternatives, which may be useful for future planning, it is presented in this appendix.

BARROW COASTAL STORM DAMAGE REDUCTION STUDY, BARROW ALASKA

Draft Fish and Wildlife Coordination Act Report

Submitted to:
Alaska District
U.S. Army Corps of Engineers
Anchorage, Alaska

U.S. Fish and Wildlife Service
Fairbanks Fish and Wildlife Field Office
101 12th Ave, Rm. 110
Fairbanks, Alaska 99701

10 July 2007

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INTRODUCTION

The community of Barrow is located on the Chukchi Sea coast approximately 10 miles from Point Barrow, the northernmost point in Alaska. Barrow is situated on coastline that runs in a northeast and southwest direction and this orientation leaves the community susceptible to storms from the north and west. Storm events that occur during the open water period (August through October) have the greatest potential to cause erosion and flooding in Barrow. These storms are generated by fast moving weather systems and typically last between 24 and 48 hours, but can last up to 96 hours.

Since the 1960s, representatives of Barrow have expressed considerable concern about erosion of the coastline. As a result of this concern, the North Slope Borough has made multiple attempts to control erosion and flooding in the Barrow area. The largest of which was a beach nourishment program started in 1995 and terminated in 2001. Other attempts to curb erosion have included geotextile sack revetments, a filled utilidor seawall, placement of tar barrels, construction of sacrificial dikes, and placement of geotextile tubes. Most recently, seawall type structures using geotextile bags encased in wire baskets (HESCO Concertainer) were installed along a portion of the Barrow coastline known as the bluff and in front of the sewage lagoon. The Corps' evaluation is that the structures have been effective but have the potential to erode the fronting beach. This erosion would be mitigated by the placement of armor rock.

Due to concerns expressed by the North Slope Borough, the U.S. Army Corps of Engineers (Corps) began investigating methods to control erosion and flooding in the Barrow area. This investigation has resulted in development of several alternative approaches to the erosion and flooding problems in Barrow and these alternatives are collectively referred to as the Barrow Coastal Storm Damage Reduction Study, Barrow Alaska. This report constitutes the U.S. Fish and Wildlife Service draft Fish and Wildlife Coordination Act Report on the U.S. Army Corps of Engineers' proposed Barrow Coastal Storm Damage Reduction Project. The purpose of the report is to provide the Corps of Engineers with information regarding fish and wildlife resources and to identify the potentially significant impacts to these resources associated with this project.

This report is prepared in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661 et seq.). This document constitutes the draft report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act.

The following report is based on information provided by the Corps of Engineers, a literature review, and an assessment of the potential impacts to fish and wildlife resources.

PROJECT AREA

The city of Barrow is located on a triangular landmass bound by the Chukchi Sea on the west and Elson Lagoon and the Beaufort Sea on the east. It is approximately 725 air miles north of Anchorage. Barrow is the economic center of the North Slope Borough and the northernmost community in the United States. The community has a population of 4,199, of which 64% are Alaska Natives. Many residents continue to rely on subsistence foods including whale, seal, walrus, duck, caribou, and fish. The state-owned Wiley Post-Will Rogers Memorial Airport provides year-round access to the community. Marine and land transportation also provide access on a seasonal basis.

The climate of Barrow is arctic, characterized by low annual precipitation (averaging 5 inches) and temperatures that range from -56 to 78 degrees Fahrenheit. The daily minimum temperature is below freezing 324 days of the year. Barrow is in an area of semi-diurnal tides, with two high-tides and low-tides each lunar day. Tidal range is only 0.4 feet from Mean Higher High Water to Mean Lower Low Water. The Barrow landscape is characterized by low relief, ice-wedge polygons, oriented lakes, and drained lake basins (Bunnell et al. 1975). The southwestern end of the community is fronted by coastal bluffs. These bluffs taper off and the northeastern section of the community is fronted by low-lying beach. Located to the northeast of the community is a large gravel spit that forms Point Barrow. Point Barrow is a major barrier to ice movement and as a result, the coastline near Barrow is subject to the forces of ice more than most regions.

BIOLOGICAL RESOURCES

Information on the biological resources is derived from Bunnell et al. 1975 (vegetation/habitat), Bee and Hall 1956 (wildlife species), Alaska Department of Fish and Game 1986 (wildlife species) and National Oceanic and Atmospheric Administration 1987 (wildlife species) unless otherwise noted.

Vegetation/Habitat

The landscape of the Barrow area is characterized by low relief and is dominated by ice-wedge polygons, shallow lakes, and drained lake basins. Vegetation type varies along a moisture gradient ranging from drier upland meadow communities through wet meadows and marshes to emergent vegetation. Drier communities are dominated by northern woodrush, arctic cinquefoil, willow, wideleaf polargrass, arctic bluegrass, and witch's hair lichen. Wet meadows and marches are dominated by water sedge, cotton grass, Fisher's tundragrass, chickweek, felt lichen, and mosses. Species such as pendantgrass, buttercups, and mosses are found in the wettest areas.

Mammals

Small mammals in the project area include shrews, brown lemmings, collard lemmings, red-backed vole, ermine, and least weasel. Other terrestrial mammals likely to be encountered in the area include caribou, arctic fox, red fox, brown bear, musk ox, and wolf.

The presence of marine mammals along the Chukchi and Beaufort coastlines is often dependent on the movement of sea ice. Animals such as bowhead whale, grey whale, beluga whale, pacific walrus, ribbon seal, bearded seal, and spotted seal follow the seasonal movement of the sea ice. As ice retreats northward in spring, belugas move to summering areas in the Chukchi and Beaufort Sea. Bowhead whales move past Barrow while traveling to summer feeding areas in the Amundsen Gulf and the Canadian Beaufort Sea. Most walruses in the arctic are found on the southern edge of the pack ice west of Barrow. Polar bears may be found in the project vicinity year round. Polar bears are associated with shore-fast and drifting pack ice along the Chukchi, Beaufort, and northern Bering Sea coasts. In summer, polar bears typically concentrate along the southern edge of the drifting pack ice. Like polar bears, ringed seals are highly ice-adapted mammals and regularly inhabit fast ice.

Birds
The tundra surrounding Barrow provides breeding and post-breeding habitat for a large variety of birds. Twenty-two species of birds are regular breeders and 13 species are occasional breeders in the Barrow area (Pitelka 1974). By in large, breeding birds arrive in the Barrow area in May and early June. Many species including phalaropes, jaegers, and terns migrate over land while other species such as eiders, long-tailed duck, and glaucous gulls follow leads northward (reviewed by Divoky 1984).

A significant portion of the breeding birds in Barrow are shorebirds (Pitelka 1974). Species of shorebirds breeding regularly in the area include Golden plover, ruddy turnstone, pectoral sandpiper, white-rumped sandpiper, and dunlin (Pitelka 1974). During the nesting period in June and July, shorebird activity is centered in tundra habitats, however, by August littoral habitats (gravel beaches, mudflats, and slough edges) becomes a major foraging area for many shorebirds (Connors et al. 1979). Use of littoral habitats through the course of summer varies among species. Some species, such as Golden Plovers continue to use tundra habitats whereas ruddy turnstones become heavily dependant on littoral habitats (Connors et al. 1979).

Common species of tundra-nesting ducks found in the Barrow area include, king eider, Steller's eider, spectacled eider, long-tailed duck, and pintail (Pitelka 1974). Ducks migrate into the area in late May and early June. Female ducks and their broods may remain on the tundra into September before moving into marine waters. In years with high numbers of brown lemming, pomarine jaegers, snowy owls, and short-eared owls may also nest on tundra in the Barrow area (Pitelka et al. 1955)

Fish
Fish species occupying the marine and fresh waters near Barrow include pink salmon, chum salmon, capelin, rainbow smelt, saffron cod, starry flounder, Arctic cod, Pacific sand lance, Arctic sculpin, Arctic grayling, least cisco, and broad whitefish. Seine hauls conducted in 2004 and 2005 captured a high percentage of juvenile capelin and Arctic cod in the nearshore waters near Barrow (Johnson and Thedinga 2004, Thedinga and Johnson 2006), suggesting that this in an important rearing area.

Marine invertebrates
Marine invertebrate species found in the vicinity of Barrow include arthropods (e.g., opossum shrimp, large crangonid shrimp, amphipods, and copepods) and mollusks (e.g., chalky macoma, Greenland cockle, and Iceland cockle).

Subsistence use
Information in the following section is derived from Alaska Department of Fish and Game (2001), and Braund et al. (1993).

The ADF&G Community Profile Database (2001) Harvest Survey for Barrow for 1989 shows the greatest volume of subsistence resource use was marine mammals, followed by land mammals, fish, and birds and eggs.

The availability of marine mammals is generally associated with the edge of pack ice. Hunting for the majority of marine mammals begins in March or April as leads open in the Chukchi Sea and continues through October. Between 1987 and 1990, marine mammals represented 55% (by weight) of the total subsistence harvest. Of that, bowhead whale accounted for 69% and walrus accounted for 16% of the total marine mammal harvest. Nearly half (46% by weight) of the marine mammal harvest takes place in either May or October.

Terrestrial mammals, primarily caribou and moose, make up roughly 30% of the subsistence harvest. Caribou are an important subsistence resource and account for 88% of the total harvest of terrestrial mammals. Fish rank third in total pounds harvested (11%). Whitefish (including, but not limited to broad whitefish, humpback whitefish, round whitefish, and least cisco) account for approximately 77% of the total fish harvest. Birds make up about 4% of the total subsistence harvest. Geese (white-fronted, brant, and snow goose) and eiders (common and king) represent a significant portion of the total bird harvest (59% and 37%, respectively).

Threatened and Endangered Species

Marine Mammals
Bowhead whales, listed as endangered under the Endangered Species Act of 1973, could be sighted in the project area. This species is not under the jurisdiction of the Fish and Wildlife Service.

Plants
There are no plants listed as threatened or endangered in the project area.

Birds
The proposed project is within the breeding range of two threatened eider species: Steller's eider (*Polysticta stelleri*) and spectacled eider (*Somateria fischeri*).

Steller's eider

The Steller's eider is the smallest of the four eider species. The Alaska-breeding population of Steller's eider was listed as threatened on June 11, 1997 due to a decrease in the species nesting range (within Alaska) and reduced numbers of Steller's eiders nesting in Alaska.

Steller's eiders breed along the coast of the Arctic Ocean in Russia and, to a lesser extent, Alaska (reviewed by Fredrickson 2001, Jones 1965). In Alaska, Steller's eiders breed in two areas: western Alaska on the Yukon-Kuskokwim delta (Y-K delta), and in northern Alaska. Historically, Steller's eider was considered a common breeding bird on the Y-K delta (Kertell 1991). In the years from 1975-1994, no Steller's eider nests were detected in western Alaska, and it was theorized that a breeding population of Steller's eiders had abandoned the Y-K delta (Kertell 1991). More recent data suggests that this species continues to breed on the Y-K delta, but at low densities (Flint and Herzog 1999). In northern Alaska, Steller's eiders historically occurred from Wainwright east across the Arctic Coastal Plain to Demarcation Point, near the United States-Canada Border (Brooks 1915, Quakenbush et al. 2002). In recent decades, most sightings of Steller's eiders have occurred east of Point Lay and west of the Colville River, with the highest densities near Barrow (Quakenbush et al. 2002).

Steller's eiders still regularly occur near Barrow, although abundance and nesting effort varies among years. For example, ground-based surveys conducted in the vicinity of Barrow have calculated pair densities (males/km^2) ranging from 0 to 0.98 (Rojek 2006). Steller's eiders do not nest annually. In seven years (1999-2005), only 1999, 2000, and 2005 were considered 'nesting' years (Rojek 2006). This periodic non-breeding may be related to number and species of avian predators present on the breeding grounds (Quakenbush and Suydam 1999).

In years that eiders nest, hens may choose nest sites that are within a few square kilometers of other Steller's eiders (Rojek 2006). Initiation dates are typically in the first half of June (Quakenbush et al. 1995). In the vicinity of Barrow, low-centered polygons, low (indistinct flat-centered) polygons, or in drained lake basins are important habitats for nesting (Quakenbush et al. 1998). Ponds with emergent grasses (*Carex* spp. and *Arctophila fulva*) are used for brood rearing (Rojek 2006 and Quakenbush et al. 1998).

After the breeding season, Steller's eiders migrate to molting areas along on the Russian Chukchi and Bering seacoast, near St. Lawrence Island, and in lagoons, principally Nelson Lagoon and Izembek Bay, along the Alaska Peninsula (Kistchinski 1973, Fay 1961, Jones 1965, and Petersen 1981).

<u>Spectacled eider</u>

The spectacled eider is a medium-sized sea duck. The entire population was listed as threatened on May 10, 1993, due to population declines on the Y-K delta.

Spectacled eiders breed in Alaska and in arctic Russia (reviewed by Petersen et al. 2000). In Alaska, there are two breeding populations: a population that nests in western Alaska on the Y-K delta, and a population nesting across the North Slope. From the early 1970's to the early 1990's, the breeding population of spectacled eiders in western Alaska declined by 96% (Stehn et al. 1993). The northern population is thought to have declined, although survey data are not conclusive (Petersen et al. 2000).

Spectacled eiders occur in low density across the North Slope (Larned et al. 2003) and regularly occur in the vicinity of Barrow. Nest sites tend to be located near water on small islands and peninsulas, pond shorelines, and dry areas in wet meadows (Anderson et al. 1999). Ponds with emergent vegetation may be important brood rearing habitat (Warnock and Troy 1992). Males spend little time on the breeding grounds and depart near the start of incubation (Petersen et al. 1999). Those males present on breeding grounds east of Barrow apparently make little use of marine habitats in the Beaufort Sea and move directly to the Chukchi Sea (TERA 2003). Departure of females from the breeding grounds is dependant on the success or failure of the breeding attempt. Females with broods may remain on the breeding grounds into September (Petersen et al. 1999).

After leaving the breeding grounds, spectacled eiders migrate to molting and staging areas off the coast of Alaska (Ledyard Bay and eastern Norton Bay) or off the coast of Russia (Petersen et al. 1999). The winter range of the spectacled eider is restricted to polynyas (areas of open water surrounded by sea ice) and open leads south of St. Lawrence Island in the Bering Sea (Petersen et al. 1999).

TECHNIQUES FOR REDUCING EROSION AND FLOODING

The Corps investigation was initiated to address potential methods of reducing coastal erosion and flooding in the Barrow area. The following shore protection techniques have been outlined by the Corps and are placed in two categories: techniques that limit bluff erosion and options reducing the threat of flooding. Although some options may serve both purposes, they are considered separately. Background information regarding the various techniques was derived from Corps documents and Burcharth and Hughes (2002).

Bluff (coastline) protection

The bluffs near Barrow are comprised of fine sand, silt, and organic materials bound by ice. Wave action on the face and at the base of the bluffs cause localized melting of the permafrost and niching at the toe. The bluffs have little inherent strength, thus melting of the permafrost leaves the bluff susceptible to slumping and block failure. Slumping occurs when permafrost melts and the thawed material flows down the face of the bluff. This material is then washed away during high water events. Block failure occurs when the base of the bluff erodes to the point where the frozen material is no longer capable of supporting the weight of the bluff and a section collapses.

<u>*Revetment*</u>
A revetment is a structure designed to protect a segment of coastline from waves and strong currents. Revetments are often constructed by placing erosion resistant materials, such as rock, concrete or asphalt, directly on an existing slope, embankment or dike. Construction of revetments in Barrow would protect the bluffs from the major erosion sources of slumping and block failure. Materials considered for revetment included rock, super sacks, and articulated concrete mats. Factors that might prevent the construction of a revetment along the bluffs include the cost of the construction materials, susceptibility of the revetment to ice forces, and the difficulties of construction and maintenance.

<u>*Beach nourishment*</u>
Beach nourishment involves placing loose material (e.g. sand and gravel) on an eroded section of beach to compensate for the lack of natural beach material. Successful beach nourishment requires placement of material that is as coarse as or coarser than the existing beach material. Because the materials (loose sand and gravel) used for beach nourishment are easily eroded this option may require frequent maintenance. Beach nourishment would protect the toe of the bluffs, but would not address the slumping issues associated with melting permafrost.

Seawalls
Seawalls are structures typically constructed to prevent or alleviate overtopping and flooding due to storm surges and waves. These structures can also stop or reduce erosion landward of the seawall. Materials used in the construction of a sea wall could include sheetpile, timber, pipe, concrete or a wire basket/geotextile system. A seawall in Barrow would provide protection for the bluff face. However, it is possible that waves breaking on the seawall face could erode the beach fronting the seawall eventually resulting in failure of the structure.

Offshore breakwaters
Offshore breakwaters are structures built parallel to the shore, just seaward of the shoreline, in shallow water. The breakwaters reflect and dissipate incoming wave energy, thus reducing wave heights and reducing shore erosion. Materials that could be used in the construction of the breakwater include rock or concrete. Breakwaters placed seaward of the bluffs would lessen the wave energy impacting the beach and the base of the bluff, but would not address the melting permafrost. Any breakwater structures placed along the Barrow coastline would have to be designed to withstand the forces of sea ice.

Groins
Groins are narrow structures, usually constructed perpendicular to the shoreline, that reduce the amount of material lost from a beach due to longshore transport. Materials commonly used in the construction of groins include sheetpile, armor stone, or gabions (i.e., cylinders filled with stone). Installation of a groin system would limit the movement of longshore sediment and build up a beach. However, due to the limited longshore transport of beach material, the groins would be only marginally effective.

Flood protection

The area of Tasigarook Lagoon and the northeast low-lying beach along the coast are susceptible to flooding. Community infrastructure along this section of coastline includes roads, utilidor, sewage lagoon, and an existing landfill. Flooding occurs during storms that generate surges greater than eight feet.

Dike
Dikes are onshore structures usually built as a mound of fine materials, such as sand, clay, or gravel. Construction of a dike on the seaward side of the coastal road or incorporated as a base for the road would protect the low lying areas of Barrow and Browerville from flooding. The raised road/dike system would need to be designed to withstand both waves and sea ice. Primary disadvantages of the raised road/dike include the need for post storm maintenance and large project footprint.

Beach nourishment
The use of beach nourishment as a flood protection measure has not been used in Alaska.
The intent of beach nourishment is to increase beach elevation and reduce run up potential of the waves. Because the materials (loose sand and gravel) used for beach nourishment are easily eroded this option may require frequent maintenance.

Seawalls
Construction of a seawall in Barrow would be used for flood protection in a manner similar to a dike. A seawall would require less land for construction because it is a vertical structure. The primary concern with seawalls is erosion of the seabed in front of the structure due to increased wave reflection that leads to failure of the structure.

ALTERNATIVES

The Corps evaluated the advantages and disadvantages of each shoreline protection structure listed in the previous section and determined that not all options would be appropriate for the Barrow Coastal Storm Damage Reduction Project. Specifically seawalls, beach nourishment, breakwaters, and groins were dropped from further analysis. Construction of a seawall would protect the bluff and raise the inland coast elevation to withstand flooding. Seawalls were dismissed because of the potential for increased beach erosion at the base of the structure. Beach nourishment was initially considered by the Corps because it would return the beach to its original width before it was used as a material source, protect the toe of the bluffs, and raise the beach elevation. The Corps concluded that the beach is reaching equilibrium since beach sand mining ended therefore beach nourishment is no longer needed. Breakwaters would reduce the waves impacting the base of the bluff, but are susceptible to ice damage and have the potential to limit sediment transported outside the project area thus increasing the potential for erosion. Groins would help build the beach by retaining sediments being transported along the coastline, but given the limited amount of longshore sediment transport, groins are not likely to be effective.

The alternatives listed below were retained for further consideration by the Corps:

Alternative 1 – No action
This alternative could result in continued erosion, flooding, and damage to community infrastructure and residential housing units.

Alternative 2 – Non-structural alternative
The Corps will consider non-structural alternatives including moving buildings away from the coastline and areas prone to flooding. Hardened protection in selected areas of the utilidor will also be considered as an element of this alternative.

Alternative 3 – Proposed alternative: Construction of a revetment and dike
The Corps has narrowed the structural alternatives to a rock revetment and dike design to protect the beach bluffs and to provide flood protection for low lying areas. This alternative will protect the coastal bluffs south of Barrow and would also protect the low lying areas adjacent to Browerville. The revetment would be composed of gabion-like (i.e., wire mesh lined with geotextile) blocks filled with sand, gravel fill, core rock, medium sized rock, and armor rock. Sand filled geotextile bags will be place against the bluff face on top of the rock revetment. The revetment will be designed to allow beach access. Flood protection for the lowland beach area will consist of a dike. The height of the dike has yet to be determined, but it is possible it will be designed to protect against storm surge and wave run-up to the 16 foot elevation. Sand and gravel fill will most likely be obtained from the UIC gravel pit. Core sized rock and larger rock

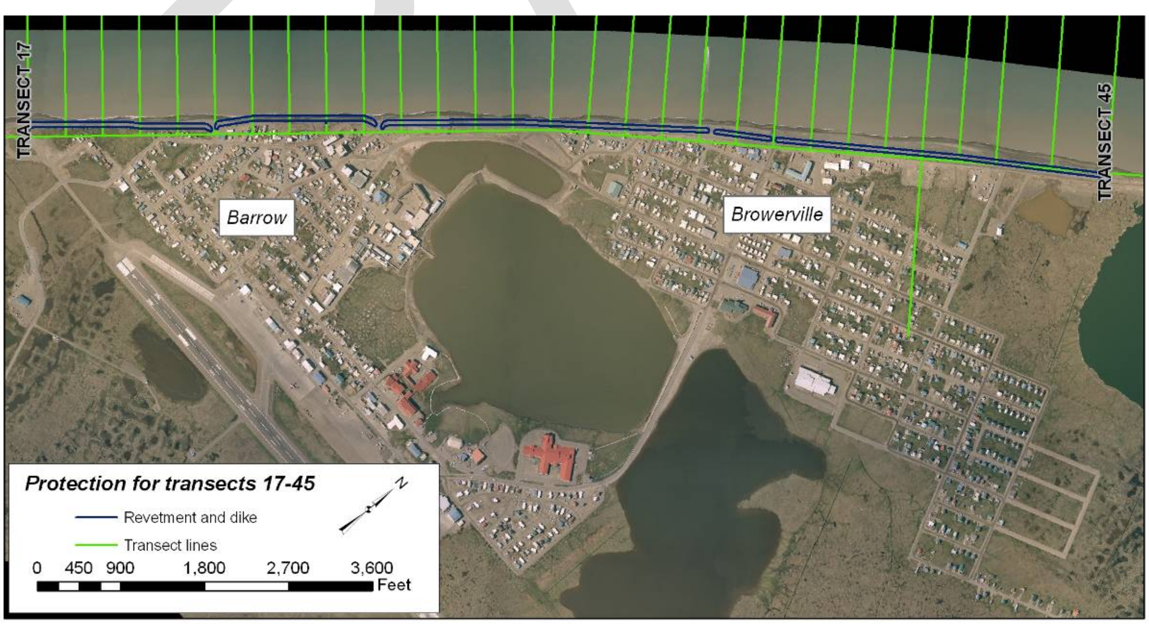
will likely be imported from the Cape Nome quarry. Barges would be beached and unloaded by a front-end loader. The current construction scenario calls for 28 barge loads of material to be delivered across two open-water seasons.

The Corps has preliminary designs for a revetment and dike, however, the length of shoreline that would be protected has yet to be finalized. Currently, the Corps is considering three possible construction alternatives. In the description of these three construction alternatives, the Barrow coastline has been divided into transects:

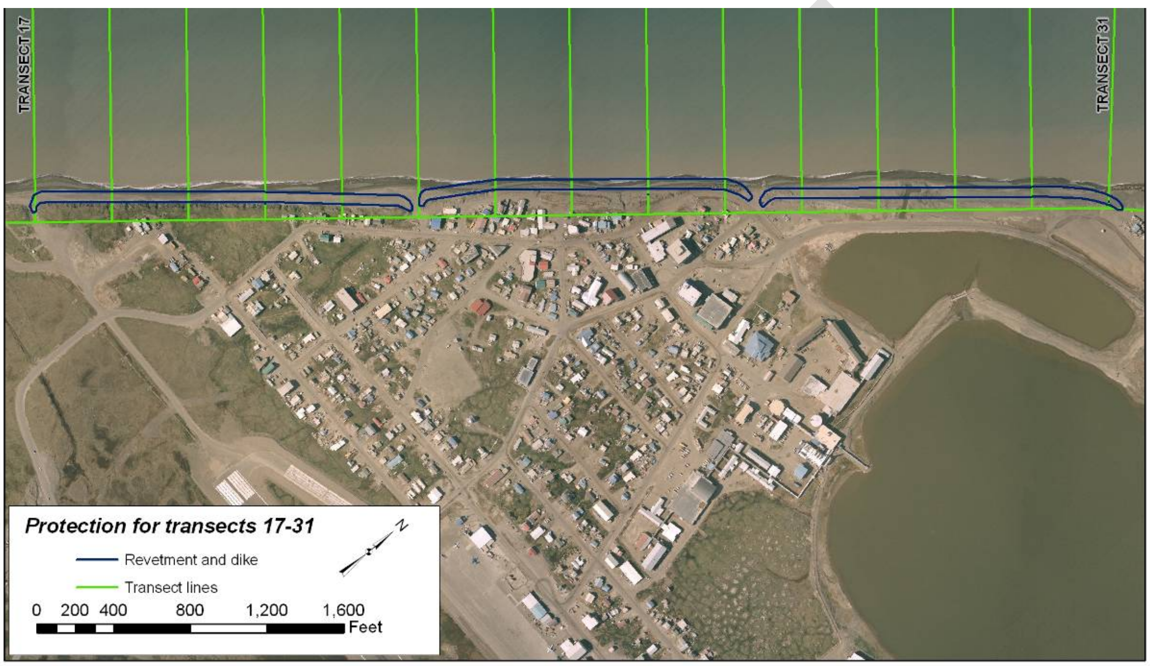
- Transect 17 is the area of coastline directly west of the Wiley Post-Will Rogers Memorial Airport runway.
- Transect 26.25 is a section of coastline near the junctions of Eben Hopson St. and Stevenson St. near the southwest edge of Tasigarook Lagoon.
- Transect 31 is a section of coast near Brower St.
- Transect 45 is a section of coast southwest of the sewage lagoon and northeast of Ahmaogak St.

Alternative 3a – Protection for transects 17-45

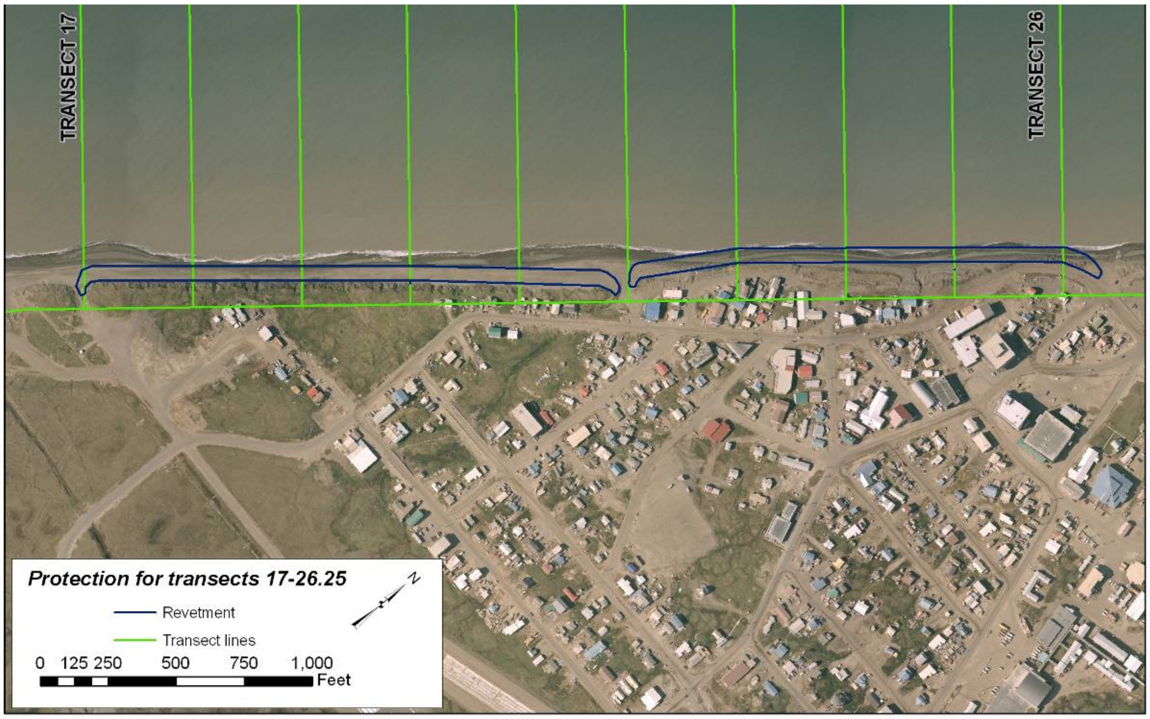
This alternative would protect the bluffs fronting Barrow by constructing a revetment between transect 17 and 26.25 and provide flood protection for Browerville by constructing a dike between transect 26.25 and 45. Construction of this alternative would require approximately 107,900 cubic yards (cy) of rock from Cape Nome quarry and 241,400 cy of sand and gravel from Barrow area material sites.



<u>*Alternative 3b – Protection for transects 17-31*</u>
Protect the bluffs by constructing a revetment between transect 17 and 26.25 and protect Tasigarook Lagoon from flooding by constructing a dike between transect 26.25 and 31. Construction of this alternative would require approximately 62,700 cy of rock from Cape Nome quarry and 157,600 cy of sand and gravel from Barrow area material sites.



Alternative 3c – Protection for transects 17-26.25
Protect the bluff by constructing a revetment between transect 17 and 26.25. No dike would be constructed. Construction of this alternative would require approximately 44,300 cy of rock from Cape Nome quarry and 129,400 cy of sand and gravel from Barrow area material sites.



PROJECT IMPACTS

Alternative 1 - No action
Under this alternative erosion of the coastline and flooding associated with storm events would be allowed to continue. Although these natural processes would not be expected to significantly impact biological resources, that are presumably adapted to a dynamic coastal environment, the potential impacts on community infrastructure could have negative consequences for the surrounding biological resources. For example, if erosion and flooding events compromised the utilidor, various contaminants could enter adjacent waters, and could affect fish, birds, benthic organisms, and marine mammals.

Alternative 2 - Non-structural alternative
This alternative would involve relocation of threatened structures and hardening vulnerable sections of the utilidor. Relocation of structures is unlikely to have significant impacts to fish and wildlife resources provided that structures are moved to existing gravel pads or previously

disturbed areas. Similarly, hardening of the utilidor is not expected to have significant impacts on fish and wildlife resources provided that the hardening does not increase the footprint of the utilidor. Alternatively, relocation of structures and hardening of the utilidor may require placement of gravel in previously undisturbed areas, resulting in direct loss of valuable migratory bird habitat and potential nesting and brood-rearing habitat for threatened Steller's and spectacled eiders. Furthermore, placement of fill and relocation of structures may decrease habitat value of surrounding wetlands due to increased levels of disturbance.

Alternative 3 - Construction of revetment and dike
Under this alternative, sections of the bluff would be protected from erosion by placement of a revetment between 17 and 26.25. This structure would include geotextile sand bags placed against the bluff face on top of the rock revetment. Construction of the revetment to protect the bluffs might decrease the habitat value for some shoreline invertebrate species and could diminish feeding opportunities for some shorebirds. Impacts to fish and wildlife may also result from the use of geotextile bags as a component of the revetment. Geotextile bags are susceptible to damage from ice or other forces. Once the material is torn, the sand can escape and geotextile material can be transported out to sea or deposited on beaches elsewhere. The loose geotextile material becomes a hazard for seabirds, marine mammals, and other wildlife due to risk of entanglement. Although construction of the revetment may reduce the habitat value along a portion of the coastline, it would not be expected to have a significant effect on fish or wildlife.

The Corps may also construct a dike to protect low lying areas from flooding. The dike would start at transect 26.25 and end at or before transect 45. This structure might decrease the habitat value for some shoreline invertebrate species and could reduce feeding opportunities for some shorebirds. Construction of a dike is not expected to have significant impacts on fish and wildlife provided that the project footprint is limited to the beach and previously disturbed areas.

Activities associated with project construction

Underwater Noise
Increased underwater noise would result from barge traffic transporting materials to the project site. Underwater noise can cause pronounced short-term behavioral reactions and temporary local displacement in cetaceans (Richardson and Würsig 1997). Exposure to underwater noise can also alter behavior in diving birds. For example, Ross et al. (2001) demonstrated that underwater recordings of boat engines could reduce predation by common eiders at mussel farms by 50% to 80%. As with birds, the effects of anthropogenic underwater noise on fish are not well understood. Underwater noise, such as that associated with seismic surveys, can affect fish distribution, local abundance, and catch rates (Engås et al. 1996). Smith et al. (2004) concluded that noise exposure could produce a significant reduction in hearing sensitivity in goldfish. This suggests that loud sounds, such as boat traffic, can have a detrimental effect on hearing in fish. Additionally, exposure to ship noise can elicit a stress response (e.g. increased levels of cortisol) in fishes regardless of their hearing sensitivity (Wysocki et al. 2006). While there may be some temporary behavioral changes in marine mammals, birds, and fish in response to the noise from barge traffic associated with this project, the long-term impacts to fitness are probably not measurable.

Seawater turbidity

Beaching of material barges and construction of a barge ramp/road may result in a temporary increase in seawater turbidity. Schamel et al. (1979) suggest that increased turbidity could obscure food items for loons, seaducks, phalaropes, and gulls. Additionally, increased turbidity could directly affect prey species of birds. Marine invertebrates can be negatively impacted by increased turbidity and sedimentation. Additionally, some fish species could be impacted by increases in turbidity. Arctic cod, and important forage fish, are tolerant of widely ranging turbidities during the open water season (Craig et al. 1982), thus the species is not likely to be impacted by increased turbidity. Presumably other fish species found in the nearshore environment would also be tolerant of widely varying turbidity. Given that it is likely that seawater condition would return to pre-construction conditions at the end of the construction season, therefore the Service does not expect long-term impacts to fish and wildlife.

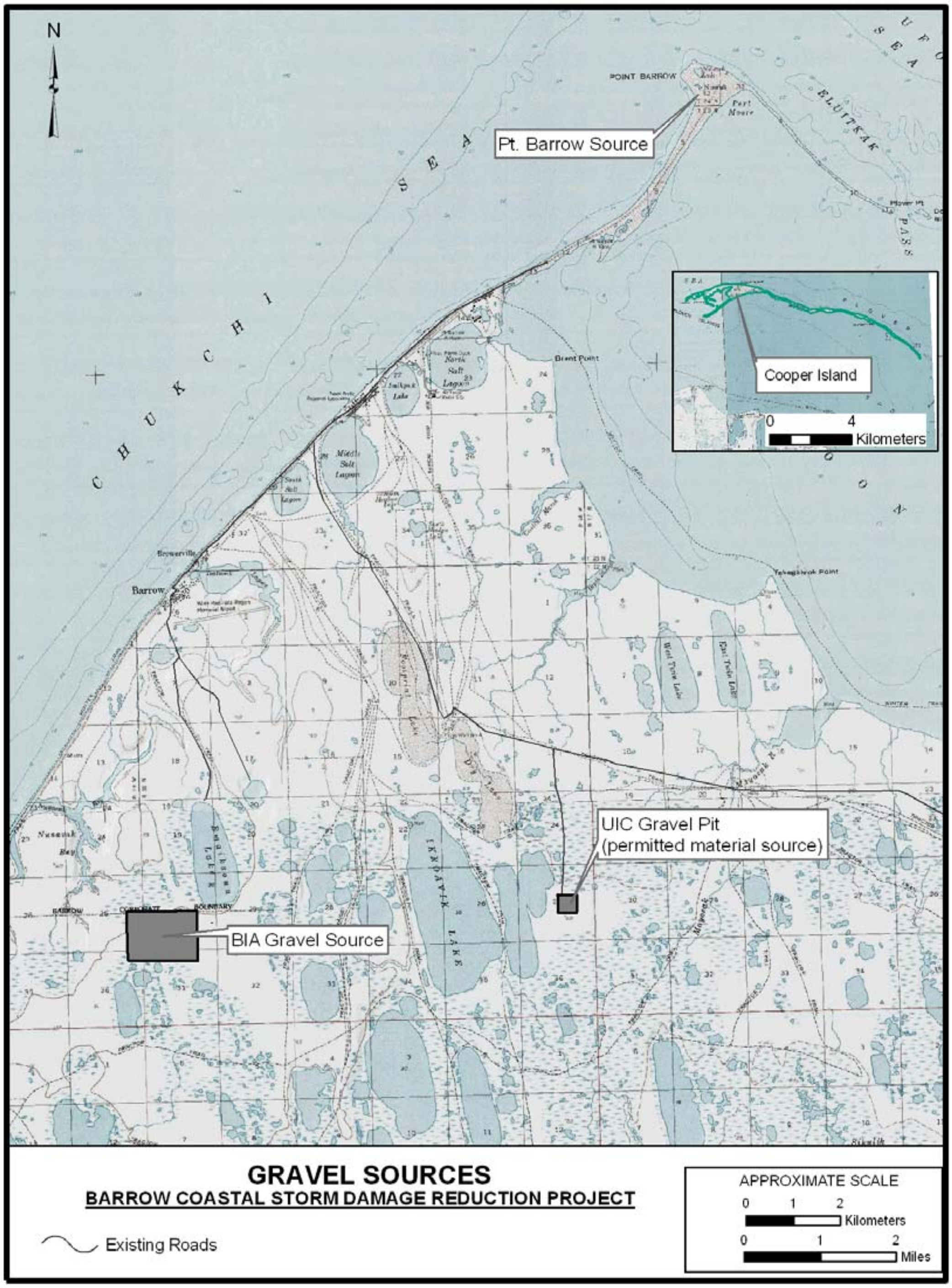
DEVELOPMENT OF NEW MATERIAL SOURCES

If large amounts of gravel are required for the project, particularly beyond existing sources, the most significant environmental effects of the project may be a result of mine site development. For this reason, we have examined potential mine sites, the process for recovering material, and the resources potentially impacted at each site.

Point Barrow

The Point Barrow source is within a gravel accretion zone. Extraction of material would not require removal of overburden. Material mined at the site would be trucked down the beach to the construction site. Of the three potential material sources, it would be the least costly to develop.

In general, shorebird densities are usually lower on gravel beaches than in other types of littoral habitats (Connors 1984). However, some shorebird species such as ruddy turnstones, sanderlings, and red phalarope often use gravel beaches in late summer (Connors 1984). Water bird species shown to favor gravel beach areas in Barrow include king eider, long-tailed duck, arctic tern, glaucous gull, and Sabine’s gull (Smith and Connors 1993). The potential material source was surveyed in August 2005 to determine use by post-breeding shorebirds and waterfowl (Hoffman 2005). Hoffman observed approximately 65 sea ducks (common eider, king eider, and long tail ducks) foraging in waters southwest of the proposed gravel excavation site. Shorebirds were not encountered during the survey; however use of this area by post-breeding shorebirds has been documented by other researchers. Development of this material site would result in a loss of shorebird habitat and, depending on the time of year material is excavated, could result in increased seawater turbidity.


N
Pt. Barrow Source
Cooper Island
0 4 Kilometers
UIC Gravel Pit
(permitted material source)
BIA Gravel Source
GRAVEL SOURCES
BARROW COASTAL STORM DAMAGE REDUCTION PROJECT
Existing Roads
APPROXIMATE SCALE
0 1 2 Kilometers
0 1 2 Miles

Bureau of Indian Affairs (BIA) site

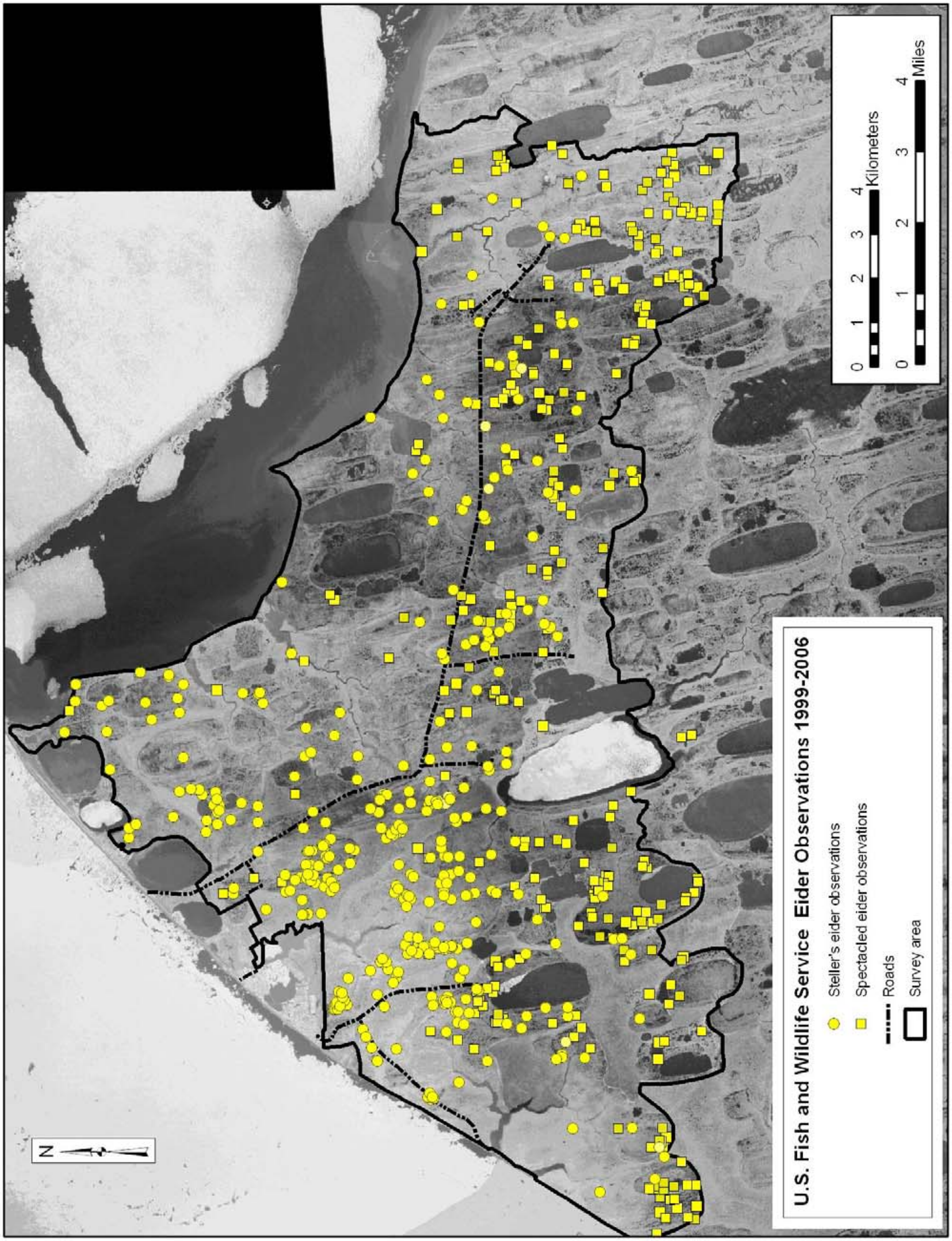
The BIA Prospect site is an onshore tundra site that is a southern extension of a deposit currently used for construction projects in the Barrow area. The general conclusion from exploration activity conducted in 2004 is that the prospect contains about two million cy of usable sand and gravel (U.S. Army Corps of Engineers 2005). Extraction of this material will require the removal of overburden in volumes approximately equal to the volume of material extracted. Material would be extracted during winter and an ice road would be constructed to transport material from the quarry to the beach.

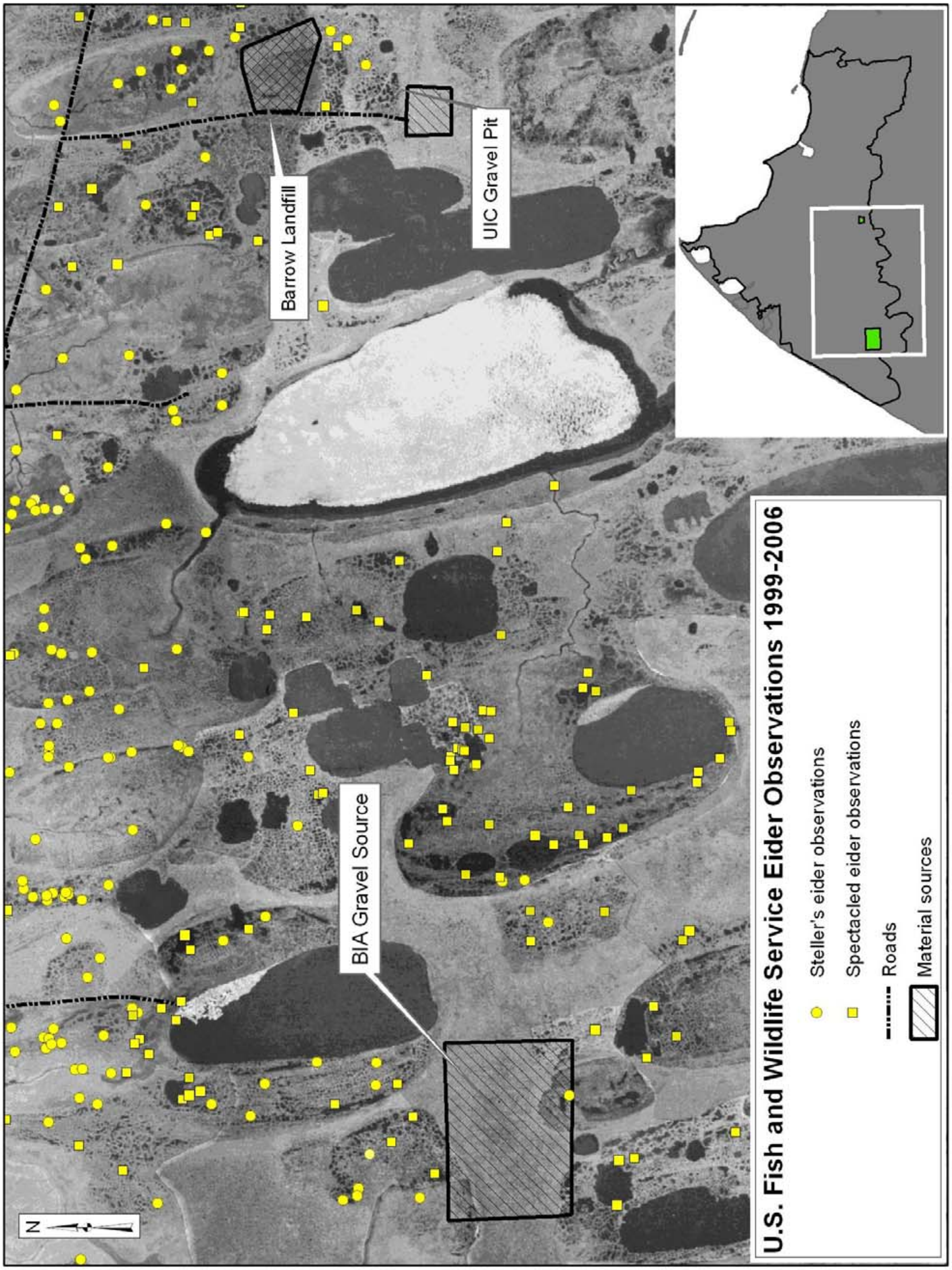
This site was surveyed in June 2005 to assess habitat use by breeding birds (Hoffman 2005). In this survey, Lapland longspurs were the most common birds, followed by pectoral sandpipers. Other birds sighted included dunlin, red phalarope, and white-fronted goose. In addition, both Steller's eiders and spectacled eiders, listed as threatened under the Endangered Species Act, are known to nest in the vicinity of this proposed gravel site. Development of this material site would result in a direct loss of valuable migratory bird habitat and potential nesting and brood-rearing habitat for threatened Steller's and spectacled eiders. The Service is concerned with the cumulative loss of wetland habitats in the Barrow area due to the potential impact of this loss on the recovery of Steller's eiders.

Cooper Island site

Cooper Island is a barrier island 30 miles from Barrow, in the Plover Island group north of Elson Lagoon. Gravels are accreting and eroding on a yearly basis. The Cooper Island site contains more than two million cy of useable clean sand and gravel (U.S. Army Corps of Engineers 2005). Granular soils extend from the island surface to the elevation of the surrounding ocean surface. The removal of overburden will not be required for the extraction of sand and gravel. Material would be barged to the construction site.

The island is known to support traditional uses including hunting, camping, trapping, and is used as a stopover for vessels. Cooper Island is also the site of a long term black guillemot and horned puffin nesting study. The waters along the Plover Island chain may be important feeding areas for post breeding birds moving westward (Divoky 1984) and an area important for molting long-tailed duck (ADFG 1986). Development of this material site would result in a direct loss of bird nesting and staging habitat. Furthermore, the barge traffic associated with transporting sand and gravel off the island may disturb feeding and molting birds. In addition to potentially impacting birds, increased barge traffic may disrupt migrating bowhead whales.


U.S. Fish and Wildlife Service Eider Observations 1999-2006
Steller's eider observations
Spectacled eider observations
Roads
Survey area
0 1 2 3 4 Kilometers
0 1 2 3 4 Miles
N


U.S. Fish and Wildlife Service Eider Observations 1999-2006
Steller's eider observations
Spectacled eider observations
Roads
Material sources
BIA Gravel Source
Barrow Landfill
UIC Gravel Pit
N

RECOMMENDATIONS

The Service provides the following recommendation for minimizing the potential impacts of the Barrow Coastal Storm Damage Reduction Project on fish and wildlife:

1. If possible, sand and gravel should be taken from existing permitted material sites. If gravel is needed beyond what currently exists within permitted sites, additional consultation with the Service, including Section 7 consultation, will be needed. We recommend the Corps avoid developing the BIA material site due to its potential value as Steller's eider nesting habitat. We also recommend the Corps avoid use of Cooper Island as a material site due to potential impacts to post-breeding and staging shorebirds and seaducks. Of the three potential material sites considered, we believe the Point Barrow site to have the fewest impacts to fish and wildlife. However, the Service recognizes that Point Barrow is considered part of an archeological site and that development of this material site may not be possible due to its cultural significance. If any of these three material sites are deemed necessary for the project, operation and reclamation plans should be developed in collaboration with the Service and other resource agencies.

2. Should relocation of structures be needed, we recommend that those structures be placed on existing gravel pads or in previously disturbed areas.

3. Staging areas for construction materials should be designated prior to construction. The Service recommends that staging areas be located on existing gravel pads or in previously disturbed areas.

As this project proceeds through its final design phase, the Service may have further recommendations for minimizing impacts to fish and wildlife.

SUMMARY

The Service believes the Barrow Storm Coastal Damage Reduction Study, as currently proposed, will have minimal impacts on fish and wildlife, and will not likely affect threatened Steller's and spectacled eiders provided that:

1) Construction of the dike and revetment can be accomplished using existing, permitted material sites, and,

2) Relocation of threatened structures does not result in the construction of gravel pads in previously undisturbed areas.

Development of new gravel sources could potentially have the most significant impact to trust resources. If construction of the revetment and dike require either 1) a permit modification to expand an existing material site or 2) development of a new material site, it is possible that formal endangered species consultation will be necessary. Similarly, if relocation of threatened structures or construction of the dike requires placement of gravel in previously undisturbed areas, formal consultation may be necessary. The Corps is advised to contact the Fairbanks Fish and Wildlife Field Office (Larry Bright 907-456-0324 or Ted Swem 907-456-0441) when construction plans have been formalized to determine if further review and/or consultation will be needed.

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U.S. Army Corps of Engineers
Alaska District

Barrow, Alaska

Coastal Storm Damage Reduction Interim Feasibility Report

Appendix F – August 2006 Public Meeting

August 2008

1

BARROW COASTAL STORM DAMAGE
REDUCTION FEASIBILITY STUDY
BARROW PUBLIC MEETING—August 23, 2006

A public meeting was held in Barrow, Alaska on August 23, 2006 to discuss the status of the Barrow Coastal Storm Damage Reduction Feasibility Study being conducted jointly by the Corps of Engineers (COE) and the North Slope Borough (NSB). This is a summary of the public meeting made from a video taken by the NSB during the meeting. The sound quality was not always sufficient to allow a precise record of what was said. This document is not a verbatim transcript of the entire meeting, but is intended to reflect the discussions held during the meeting. The usual meeting procedure was for discussion to occur in English in about 20-to-40-second-long segments, followed by translation into Inupiat. Questions/concerns by attendees were provided in either English or Inupiat and translated into the other language, before a response was made in both languages. For ease of reading, this entire document is presented in English and has been edited where useful to clarify meaning. Locations in the text where Inupiat translation took place are shown by ##. Explanatory notes are shown in *italics*. A powerpoint presentation was shown during the meeting. [Slide 1] identifies what slide is on the screen at that point in the meeting. The power point presentation is available at the following web site:
http://www.poa.usace.army.mil/en/cw/barrow/barrow_index.html.

The study team members present during the meeting were:

Michael D. Stotts (Mike), North Slope Borough, Project Study Coordinator
Forest Brooks, (Forest) Corps of Engineers, Planner
Dennis Blackwell, (Dennis), Corps of Engineers Cost Engineer
Dee Ginter, (Dee), Corps of Engineers, Hydraulic Engineer
Ridge Robinson (Ridge), Tetra Tech (Corps contractor), Economist
Kurt Keilman (Kurt), Tetra Tech, (Corps contractor), Economist

(Mike): [Slide 1] I am Michael Stotts, NSB Department of CIPM. Tonight we have with us the Army COE visiting Barrow regarding the Barrow Coastal Storm Damage Reduction Study. Feel tree to ask any questions of the speaker. We will have an interpreter tonight, James Patkopak. We want to pass on as much information as possible. The radio talk show this afternoon was fun. This project is ongoing, in its third year. Feel free to interrupt the speaker this evening with questions, suggestions, and comments. We will take it slow tonight. It's not like there are hundreds of people here. We want to do our job. The Army Corps wants to do their job. The main point is to get as much information across as possible. There's some food and some pop. If I can ask the kids not to run around and to stay out of the Museum areas. Before we start, I would like to ask Genelle Okpeaha to open us up with a prayer.

(Genelle): Let us all stand. Thank you, Lord. ##. For this time, Lord, you are providing our guide. Give us wisdom, understanding, and knowledge. Lord, we thank You. You say ask in Your Name. We are asking in Your Name, Guide us. Lead us in Jesus, we beg You. We ask You right now this evening to guide us. Lead us in Jesus' Name. We beg you, Lord. Thank you for this time. Bless all the people here, Lord Jesus. We thank you for everything you do, everything you will do. In Jesus Name, we ask you. Amen. ##.

(Mike): Thank you, Genelle. James, I want you to welcome everyone tonight. ##.

Thank you, James. At this time, I want to introduce Forest Brooks, the Planner from the Corps study team, who can introduce the rest of the team present. ##.

(Forest): Thank everyone for coming out tonight. It's a beautiful day in Barrow, a beautiful day in Paradise. I know it's hard to be inside on an evening like this. We appreciate your coming out. We want to be able to talk with you to find out your concerns. I will now introduce the members of our study team present. Up front we have Dennis Blackwell, the cost engineer on the team. He will be writing your comments down on the board, so we can be sure we understand your concerns accurately when we get back to Anchorage. In the back is Dee Ginter, the hydraulic engineer on the team. She will be operating the computer and projector tonight. Over to my right are two from Tetra Tech, an economic consultant, Ridge Robinson and Kurt Keilman. We started out with an in-house economist, but he was a cheesehead and took a job is Wisconsin. Tetra Tech will be finishing up the economic analysis, which he started. ##.

Our purpose tonight [Slide 2] is to discuss our studies, where we are now, and update you on our progress since the last public meeting. We've been coming every summer to update you. Right now, many of the technical studies have been completed. We are looking at possible measures which will get combined into alternatives. Those will be compared to identify those that will go into a final report and environmental impact statement. We want community input: Are we looking at the right place? Is the project high enough? Long enough? Is it the right design? ##.

We have the results of technical studies to date [Slide 3]. We have completed an analysis of the possible beach erosion. We had originally thought that there was a big beach erosion problem. The analysis indicates the beach is relatively stable but we feel there is bluff erosion and flooding problem during severe storms at the lagoons and toward Browerville. We will be talking about two areas. The bluff area from the Top of the World to near airport runway is likely to experience erosion during severe storm events. Flooding will occur from the Top of the World going northeast during severe storm events. ##.

The general result of our studies is that the beach is stable. During last 50 years, the beach has eroded some, with most in the 60's to 70's, when material was used for upland purposes. So, large beach nourishment has been dropped from active consideration. The beach nourishment we talked about 1 or 2 years ago won't happen. Portions of the community are susceptible to bluff erosion and flooding. Our focus will be to provide erosion protection for the bluff and flood protection to the northeast.

Bluff lines in 1948 and 2003 are shown on this slide [Slide 4]. The University of Colorado determined that there's 1 foot/year average erosion in this time frame. They also looked at the shoreline from 1948 to 2003 and determined that loss of beach is shown [Slide 5]. There has been loss of approximately 50' of beach since 1948. Evaluation of the loss indicates that most of the loss occurred when material was removed from the beach to support construction of the airport runways. This occurred between 1954 and 1974. Since that time, the beach has returned to a stable condition. ##.

Photos of the beach during these time frames are posted in the room on the table to my right. The photos comparing 1948 and 1954 show a relatively stable beach. The photos comparing 1954 and 1974 show general beach retreat, primarily we think due to excavation and removal of beach material for a number of upland purposes, such as the airport. The photos comparing 1974 and 2003 again show a relatively stable beach, which we expect to continue into the future. Dee's computer modeling analyses confirm the expectations for a relatively stable beach in the future. ##.

There is still potential for floods and flood damage during severe storms in the Barrow area. I want to explain some terms that we are going to use to determine how high flood waters are [Slide 6]. Still water level is the level of ocean without tides. Then we factor in tides. *Barrow tides are very small*. This gives the ocean level. We also use computer models to find storm surge on top of the tide. In Mississippi, they had a storm surge of 28 feet during Hurricane Katrina. Oceans have waves. Near shore, the wave breaks. After the wave breaks, you have wave setup, which forms a relatively constant water level. Then you have wave run up, which is the rush of the water up the beach after it reaches the shoreline. We use this elevation to describe the highest elevation of flood, but, at that elevation, there would be intermittent water, not solid water. ##.

If we look at work that's been done and talk about the 50-yr storm event [Slide 7] of tide plus surge plus set up, the elevation is 8 ft above mean sea level and run-up would add an additional 5 feet. The maximum height of the 50-yr flood would be 13 feet above mean sea level. The level and duration of the flooding at the individual houses would depend on their location. So, you wouldn't have complete flooding all the time. As you move inland, the flooding would be less severe. For the 100-yr [Slide 8], the corresponding levels are 10 ft and 15 feet. ##.

Dennis has asked me to point out that the flood of 1963 is roughly approximate to a 50 yr flood. Last year, University of Colorado had a photo with a green line that approximates where contours of this flood were.

(*Audience*):
Which direction is the gravel migrating? It appears to be migrating toward Pt. Barrow. Is that the right direction, that most of the sand is heading toward? ##.

(*Forest*):
About 10,000 CY of material per year moves along the beach in front of the town toward Point Barrow. ##.

(*Audience*):
How do you determine what's a 50 year event or a 100 year event? ##.

(*Dee*):
A 20 year wind and wave hindcast was conducted at the Waterways Experiment Station in Mississippi. They supplemented with specific storms back to 1954. Then they determined return intervals using statistical analysis. ##.

(*Audience*):
How does movement of 10,000 CY of gravel affect the storm forecast? ##.

(*Forest*):
The 10,000 CY is not really a big quantity in beach movement, so doesn't have much effect on the erosion or flooding. It is a relatively small number. ##.

(*Audience*):
How did you determine yellow and red lines and how does it compare to the 1963 flood? For some of us who lived here during the flood, how did you determine where those lines are?

(*Forest*):
The lines on the map are contour lines and represent specific elevations. Through studies we have determined that we expect the ocean level is going to be about 10 feet and the run up will be about 5 feet above that for a total of 15 feet. Lines reflect elevation 10 foot and 15 foot contour lines for current conditions. Land has changed since 1963, so flooding would be different too. ##.

(Audience):
##.

(Forest):
Now that the problems have been identified, bluff erosion and flood damages, we will talk about solutions [Slide 9]. There's two prime ideas, first, provide protection to bluff by providing a revetment. For flooding, we want to replace the temporary dike built by the Borough that is currently refurbished on a regular bas that with a more permanent structure. ##.

The west part of town has an erosion problem [Slide 10]; the eastern part of town a flooding problem. In between these areas is a transitional zone that starts as an erosion area and gradually drops in elevation and becomes a flooding area. This slide shows the type of structure that would be used to protect the western part of Barrow [Slide 11]. The particular slide reflects a location somewhere west of the Top of the World Hotel. The design provides a core using a Concertainer system with rocks placed where the waves will be hitting the bluff. Rocks will be placed over the core to provide protection from the waves. Backfill will be placed along the face of the bluff to reshape the bluff. The height of the bluff will vary depending on the location. The surface of the bluff will be covered with supersacks to take ocean spray and rainfall and runoff. ##.

(*Audience*):
The last boat ramp we had some years that were concrete almost got swallowed by the sand. How will the rocks on top work with all the sand moving around? This is pretty heavy weight stuff. ##. *There was concern from the questioner that the rocks would not be stable. The concrete ramps got covered by sand and there was concern that this was because of the weight of the concrete or it could be from the storm. There was concern that the current design would suffer a similar problem and the rocks would sink into the sand.*

(***Dee)***:
To take care of placing larger material on finer sand, we build it up with varying sizes of material. On top of the beach material there is a very fine layer. We'd put little bigger material on top of the sand and a little bit bigger material on top of that layer. The intent is not to put large material on top of fine material and then have the fine material wash out. That's why it is built in different size layers. The HESCO Concertainers *(that are at the center)* have geotextile fabric inside with a very tight weave to hold in the finer material.

(*Audience*):
How long should the geotextile fabric last?

(*Dee*):
It should last a long time, it is very protected by rock on outside and only serves the purpose of providing core material. Rock out in front will protect it from ice and people, anything that could damage it. The supersack area will need maintenance because people will walk on them, and they'll suffer from ice gouging. But the supersacks only protect from overland runoff. It's up above where wave run-up will be. We're trying to insulate the slope so permafrost isn't melting. We are also going to protect the slope from damage due to runoff and people walking over it.

(*Audience*):
So the top is the beach? *This question concerns what the top of the section represents.*

(*Dee*):
The top represents the top of the bluffs. This transect is at the airport where there are high bluffs.

(*Audience*):
How about the beach? Can we walk the beach anymore? Is this going to cover the whole beach? *(This question expresses concern about the potential loss of beach in front of the structure. The beach serves as a recreational area and provides access along the entire waterfront. The diagram looks like it will cover the entire beach.)*

(*Dee*):
It will go down to waterline in some areas. This will mostly occur along the bluff. In Browerville, where they have a very wide beach you will have beach left to drive on. Only in bluff area where we're trying not to cut into bluff because they are archaeologically sensitive. We would normally cut into the bluff to get a stable slope and add the armor protection on the front. We are trying to stay away from it because it is archaeological sensitive. We're building core with HESCO Concertainers, putting rocks out in front and then backfilling with gravel to insulate the bank and keep it from melting. ##.

(*Audience*):
As far as the archeology, I was looking at this and looking back at how they built the seawall. How are you going to build this? Where is the construction equipment going to be?   On top?

(*Dee*):
From the beach.

(*Audience*):
Are you going to be able to reach that because that was what they told us at Point Hope and when they went to build it, they had to work from the top? If you build it from the top, you will have to put heavy equipment on an archeological site.   This puts the archaeological site at risk. When the supersacks go, you will probably have to replace them from the top especially if there is a storm. This leaves the site exposed to a lot of danger. So you may want to think about doing a proper mitigation and putting rock up there. Otherwise, I think you are putting it at continuing risk every time you repair it. How are you going to place supersacks? Maybe you should put rock on top to protect the archaeological site. You wouldn't need to do as much maintenance. ##.

(***Forest***):
We will take that concern into account when we decide how this will be done and how things would have to be maintained over time. One of the things we were trying to avoid was cutting into the bluff and taking out part of the archeological site. Our concern discussed at our team meetings was whether we can we build this structure from the waterside. We feel the work can be done from the waterside, but we will continue to work on the details. If this remains our design, we need to take care of operational maintenance without impacting the archaeological site. ##.

(***Dennis***):
We looked at it. We can get cranes with a long enough reach that once we put the baskets in. We can fill in behind them and set the sacks. It gets back to the reach of a crane. You will have to work the rock from the beach side and get a crane with a long enough reach. ##.

(***Audience***):
Where has this been tested? Where you put the fine gravel so it will not get washed out?

(***Dee***):
This is the way we build our breakwaters. Nome and Homer are built like this. We always build revetments coarser as we go up.

(***Audience***):
Is this the first for an arctic site?

(***Dee***):
No, we had a project in Shishmaref last year.

(***Audience***):
That is not the arctic. So it has never been done up here?

(***Dee***):
No

(***Audience***):
The sand is always sheared from underneath. You talk about the wave going up. Ice, what we call ivu, along the beach will shear from bottom and lift up the rock. Your presentation is based on waves going over. You are trying to prevent the waves from going over and bringing the erosion (*fine material*) out. You think this is going to hold it? It hasn't been proven up here. Let's say this is an ivu. The ocean going above will not bring it out. That's true. (*The ocean going over the rocks will not bring out the fine material.*) The ocean (*ice*) will shear under and lift and bring it up.

(***Dee***):
So ice will gouge underneath and bulldoze it up?

(***Audience***):
Yes! ##.

(***Dee***):
How deep do they usually bulldoze down into there under the toe of the revetment?

(***Audience***):
This season the ivu was brought up. That sand you see built up between here and Scare Cliff, which was done by shearing and lifting up of the huge evue that came ashore by the ocean.

(***Dee***):
I wonder if they (*rocks at the toe of the revetment*) just couldn't be buried?

(*Audience*):
Have you done studies of icebergs? Ice build up? (*There was concern that the design would not withstand the forces of ice.*

(*Dee*):
Once we come up with the final design, we'll construct a little model and have the Cold Regions Lab (*the Corps of Engineers, Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire)* run ice up on it and see how it performs. ##.

(Glen Sheehan, Director of the Barrow Arctic Science Consortium):
Mayor, isn't it correct that one of the things you are pointing out is that the ice might be just lying on beach. When it is on the beach, the water goes under the ice. It's not a question of how deep the ice gouges when it comes in but it's what the open water does to that ice afterwards?

(Audience):
Yes.

(*Audience*):
When you say zero, is that the sea level?

(*Forest*):
That would be a calm sea level. Yes, that would be an average sea level.

(*Audience*):
When you have a storm, is that zero where the riptide is? The riptide will undercut your material and tear it apart. Anybody ever heard of riptide?

(*Forest*):
Yes

(*Audience*):
Undercut?

(*Dee*):
We have the toe out there. The main protection is slope you see there. If toe erodes, it will start launching itself, and slide down until it stabilizes. *(Using the slide, Dee pointed to the toe and showed how the rock would react as the fine material was washed out)*

(*Audience*):
You said you had membrane under that slope. The riptide is going to wash out the gravel from underneath.

(*Dee*):
There's no membrane (under the toe), just a core material. If it erodes it will fill in itself.

(*Audience*):
Where are you going to get rock material around here?

(*Dee*):
Nowhere. This material will have to be imported. Right now we are looking at our source of import being Nome. We are looking at a stockpile of material being here so repairs could be made. We would always have stock pile here so we can be ready to make repairs.

(*Audience*):
How about from the mountain, from Atigun Pass area? ##. *(Atigun Pass is located about 170 miles south of Prudhoe Bay on the Dalton Highway that runs from Prudhoe Bay to Fairbanks. There is no road connection to Barrow.)*

(***Forest***):
The cost estimate is based on using existing commercial sources for Corps projects. Contractors have flexibility on where they'll be getting the material. So if it's cost effective to get material from a closer source, then the contractor would have that opportunity. We don't think it'd be cost effective to get material from the pass vs. bringing the material from Nome by barge.

(***Audience***):
Have you heard of jetties? Like they use in California? They put those jetties on a beach with them and when a storm comes around, the jetty just builds up the beach.

(***Forest***):
We are familiar with jetties. You have identified the good aspects of a jetty. It traps sand on one side, but on other side of a jetty you get an increase of erosion because you've stopped the littoral drift. Beach grows on one side, but erodes on other side. If you put a row of jetties you often will get a beach that looks like a set of saw blades. Good in certain incidences, but has down sides.

(***Audience***):
Difficult to understand the entire comment but the individual pointed out that one year there was something along the beach that acted like a jetty. The jetty was only 200 to 300 feet long. When the storm came, it built up sand on both sides of the jetty.

(***Forest***):
Sometimes, the effect depends on topography, currents, but generally when you interrupt the beach, it grows on one side, and erodes on other side.

(***Audience***):
Do you use those barges, the 400-foot barges and bring them in, fill them up, and sink them? The beach would build up around the barges. When it comes time to move them you could just pump the water or gravel out and move them. ##.

(Audience):
##.

(***Audience***):
How big are the rocks going to be 2' in diameter or larger?

(***Dee***):
They are going to be about 3 ft.

(***James***):
They say that the rocks will be too small for up here. They have to be bigger. Everybody take a note on that. (*This was a serious concern among the audience.*)

(Forest):
Dennis, Bigger Rock!

(***Audience***):
The conditions in Shishmaref and Nome are different than up here. The pressure ridges are smaller and the currents are not as strong as up here. You don't see ice coming up against the land like here. The smaller boats have harsher conditions here with the ice regarding the build-up on the beach. Bigger boats are better than smaller boats. ##.

(***Dee***):
That's why we want to go to the CRREL when we have a final design to run the model into ice so that rock is sized adequately. Rock will be expensive portion of this.

(*Audience*):
Difficult to understand the question because of interfering sounds in the room but the question concerned how to model the ice conditions.

(*Dee*):
They'll model a sheet of ice.

(*Audience*):
Will it be a full size model?

(*Dee*):
No. We will have a reduced size model. ##.

(Audience):
##.

(*James*):
Translator interpreted the question: Sheldon is suggesting that if COE built a barrier island all along the coast out far away from the shoreline, it would probably work.

(*Dee*):
We would have difficulty getting enough material to build up a barrier island. Bringing enough material from Nome would be quite the undertaking. When we were looking at beach nourishment, one biggest stumbling block is getting material we could use. A barrier island would need an enormous amount of material to construct. ##.

(*Audience*):
After the project is complete, will you have a monitoring system? Will you let the residents know if it is moving? Will you come up here to check on this periodically?

(*Forest*):
In general, for a COE dike-like project, the COE and local sponsor (*North Slope Borough*) cost share to build the project. The local sponsor (*North Slope Borough*) will operate and maintain the dike. As part of the project, the COE will develop an Operations and Maintenance Manual for the specific project.   We will give the Manual to the local sponsor and it will tell them what they should do, how often they should do it, what to look for, what may show project distress. Plus we do periodic inspections on project we are involved with. The local sponsor does an inspection every year. We review their inspection and if things didn't look right, we would come our and do our own inspection. There is a process to monitor the project and it is tailored to the specific location and design of the project. ##.

This slide [Slide 12] shows the Homer spit project showing rock on the beach, similar to wide portion of the beach after the project would be completed.

Next photo [Slide 13] shows Nome, which shows a narrow beach. Some of the beach might look like this in the narrow areas after the project is completed. ##.

(*Audience*):
Is the rock in the picture the same size rock that will be used in Barrow?

(*Dee*):
I will look it up in my notes and tell you after the meeting. *Dee talked with him after the meeting. The rock used at Nome is much larger than the rock currently in the design for Barrow.*

(*Forest*):
Moving on beyond the bluff, this slide [slide 14]shows the general design of the dike towards the eastern part of Barrow towards Browerville. Because the land behind is a lower elevation you do not have the gravel fill or supersacks. We will consider comments you've made about the bluff part to be applicable to this part of the project.

We don't have to go back through those again. This includes the issue of the ivu and the size of the rock being too small. If you have new concerns or ideas about this particular project, please ask.

(*Audience*):
How much land is there going to be on the beach side? Is there enough room to drive ATVs on the beach?

(*Forest*):
From lagoon to the east there will be room. The beach is wider there. The design will cover the area where the sand is piled up now. You will be able to drive up and down and walk on the beach. We have a slide that shows an aerial view with a footprint coming up in a few minutes. ##.

This slide [Slide 15] shows the entire area that we are looking at, the revetment on the beach, bluff and dike to east of there. There are four locations *(shown by yellow arrows) that* will have breaks in the levee for boat launch ramps, vehicle access, etc. The first cross section was for the beginning of the bluff, the 2nd was for the end of the bluff. From lagoons east, driving along will be quite possible. Near the beginning of the bluff to the 1st access point you probably will not be able to drive. At the west end of the project, you may or may not be able to drive on the beach. ##.

This slide [Slide 16] shows potential impacts. Assuming successful design, minimal environmental impacts to beach habitat and wildlife along beach are expected. The biggest impacts would be if we put in a borrow pit. This is confirmed by the draft Coordination Act Report by the US Fish and Wildlife Service. It would potentially have adverse impact stellar eiders. But since we feel the project could be built using commercial sources, that particular concern goes away. The things that might get damaged by flooding in town include the dam protecting the water supply, parts of the utilidors, structures, archeological sites and parts of utility system. This could include water, sewer and electrical. If the project were constructed and we could stop some of the bad flooding damages from happening, we feel that it will result in positive social and economic effects because money spent now because of flooding can be spent elsewhere. The biggest impacts we have seen include: narrowing beaches, limiting beach access, and a permanent visual block to the sea. Right now, the project we are considering has the same height as the temporary structure constructed by the borough. They build them up, the waves drive them down and they get built up again. If we build the project, this becomes a permanent situation. Hydraulic studies we have done so far, indicate there would not be a be beach problem as a result of building the project. ##.

(*Audience*):
Have you factored in global warming issues? With global warming, things are melting more, that part of our land could be under water because of global warming issues. Have you taken that factor into account? Sometimes when people come up here to have meetings, they say Barrow will be all under water. *##. (The individual was concerned about the potential increase in water level resulting from global warming and wanted to make sure this issue had been considered as part of the project.)*

(*Forest*):
Up to this point we have not directly considered that. However in the study plan put together with the North Slope Borough, it is one of the things we want to look at. Right now we're working to develop a design that will work under the current conditions. Once we do that and identify the costs and the potential benefits if that design given the current weather conditions, then we'll perform a sensitivity analysis or a more elaborate analysis as to possible potential future conditions. Lots of people have different ideas of what global warming will do. These ideas range from much warmer, stay the same or even another ice age. ##.

(*Audience*):
I know in the past there were a lot of issues about gravel. It looks like there is still a certain amount of gravel needed. Are we getting it all from one UIC pit?

(*Forest*):
Two years ago we thought we would need 2 million CY, for beach nourishment. Now we're talking about ¼ to 1/2 million CY. Last month Dennis came up with one of our geotechnical engineers. They visited the existing pits around here and have spoken with the UIC people. In the future, there should be enough gravel material available in existing commercial pits. Rock is not available in this area and will still have to come some distance away. ##.

This slide [Slide 17] shows the estimated costs. Each piece, bluff protection and flood protection, looks like it will cost about 30 million dollars. The total project ranges from 50-70 million dollars. The price range depends on how high we build the rock. Cost sharing between the Federal government and the non-Federal sponsor uses a complicated formula. I discuss this with you individually if want more info. But it looks like the federal share is about 60%, and local share will be about 40% of the construction cost. ##.

So far we have talked about structural measures. This means building something that would prevent stuff happening. We will also look at what we call non structural measures [Slide 18]. These might include items such as relocating structures, raising roads, modify the utilidors to prevent flooding, participate in the federal flood insurance program and develop flood hazard mitigation plan. Know that a lot of you participated in survey. People were asked about their houses and what contents they had in them that might get damaged. We surveyed the commercial property so we could determine where the damages were going to come from during certain levels of flooding. You may be able to eliminate those centers of damage by doing something other than building a dike all the way along the beach. May be able to reduce damage by moving those things and see what non structural measures can be done. See if better bang for buck from this or combination of structural and nonstructural. We will be working with the North Slope Borough on these options. As you see, the cost of structural project is very big, going to be very difficult to justify economically under COE policy. We will develop a lot of info and do our best to alleviate flooding and erosion problems that you do have. ##.

(*Audience*):
They now have gravel berms along the beach areas. At times the water builds up behind them. Will the dike project be trapping water that needs to be pumped out? *The concern was that flood water would get over the dike and not be able to get back to the ocean. The individual wanted to know if we were going to pump the water out.*

(*Forest*):
That's a minor design detail that would be incorporated into the design once we have the major design done. Once the major items are worked out, we then go back and take care of drainage problems that dike might cause. We would find most cost effective way on a site by site basis. We would try to avoid pumping, because it is a costly way to solve the problem. ##.

(*Audience*):
We have a lot of hunters around here. Right now we have all these gravel berms. Are you going to make ways for some areas to be low for the hunters to go to and from the ice during winter whaling and seal hunting?

(*Forest*):
Right now just four gaps in the levee for access to the beach [Slide 15], but are interested in needs that exist, how many other places would you need to have access across the rock. We would be interested in any additional access you might need. You could provide us the information or talk with Mike at the NSB so that we can get the info. We could put access in, if there is a need, almost anywhere but we want to put them in the most beneficial places, not just all over the place.

(*Audience*):
Why don't you ask the whaling captains association for guidance on where they are taking the whaling vessels in and out of the water, if that's where they feel they need to get to the beach.

(*Forest*):
We have met with some of whaling captains. The design here is in response to what they said. Obviously, we didn't talk to all of the whaling captains, but those that came to meetings gave us these four locations. We have no good way of knowing ourselves. So if anyone has any additional input, we encourage you to get with Mike and let him know what the needs are so he can forward them to us for incorporation into any design that we might build. ##.

(*Audience*):
What about that drainage outfall by the lagoon? Will it be left open?

(***Forest***):
The drainage thru the lagoon area will be taken care of after the big design is done. We will see what makes works best given the conditions at that location. We will deal with those types of things based on what the big design is. You look at what makes most sense to accommodate drainage, access across or along. We have not looked at those details to date but will take them into account as we proceed with design

(***Audience***):
Will the access areas shown be weak points in the dike? We don't want to worry about that. If we ask for more is it going to be bad?

(***Forest***):
The best idea would be to have none. Right now with the current design, the NSB will have to go out and dump sand in the holes. It's less work than what they do now. If you would like to spend more money, we could have formal flood gates like New Orleans but those are expensive and we are trying to keep the costs down and balance things. Yes. You can add more but you don't want too many. That's why we were asking if these are the best locations. Vehicle access is different than people access. People can access by go over the rocks with metal or wooden stairs over the rocks. Vehicles can not do that. You don't have space for road ramps. ##.

(***Audience***):
There was a discussion on the location of the current access points. It was pointed out that the current locations are based on where the whaling captains live. This makes it easy for them to access the beach.

(***Forest***):
It would be ideal to have no slots. We realize the need for access to the beach for whaling and hunting. There is a need for some access to the beach so you can move boats and vehicles and such so you need to come to a compromise between the two extremes.

(***Audience***):
You said the dike would be 6' high?

(***Forest***):
The height of the dike depends on where you are [Slide 14]. Right now we have shown that the dike would go up to 16 ft if we say sea level is zero. That is not to say the dike would be 16 ft above ground level. In some areas is would 5', in some areas it would be less and some areas it would be more. In front of Brower's Café, it will be about 3 ft above land. The height varies.

(***Audience***):
You will create a lot of snow drifts on the land. Do you have any drainage for the water to go when the snow starts melting? ##.

(***Forest***):
The study team has not specifically talked about drainage from snow drifts. That is a good point. We will consider it during design. ##.

(***Audience***):
Mentioning snow and snow fences, you may have noticed that the snow drifts that are persisted by snow fences are causing thermocarsting and permafrost melting do that needs to go into considerations as well.

(***Forest***):
Thank you. That's why we come to the community and have public meetings so you can point out factors that we not have thought of. We don't live in the same area or climate as you. This is the type of information we were hoping we would get by coming and talking with you.

(***Audience***):
I see the beach material is contiguous under the whole structure. *The audience was looking at the cross section of the dike.*

(***Forest***):
It would be whatever material the existing ground would be. The material would vary depending on the location along the dike. This is the existing ground. We will build on top of that. The drawing is an oversimplification, and the material will be whatever is there now.

(Audience):
The road end that's close to the bingo hall, with a little bit of drainage, about a foot wide flow in a very short time will cut a trench about 3 ft deep. This material is like sugar. It doesn't stand up to anything. So when I see this, the wave action and the retreating of the beach, when you get to this material it goes away. I'm not very optimistic about this. Sorry. ##.

(***Forest***):
We're interested in your comments to poke holes in what we have done so far so we can try to do a good job and hopefully come up with something that works [Slide 15]. That is why we come to town and ask questions. In tying in this specific site here, a potential alternative might be to either abandon the road completely or move somewhere else or move the dike and have the dike and the road be one. Those are other possibilities that we may get into depending on where the damages are and how we can best attack those problems. This dike all the way along the beach may not be the best solution. One size doesn't fit all. We are pretty certain that something like the dike, at least in the portion will be necessary to keep the bluff from going away. If we only had buildings along the bluff, then it would be one thing. But the archeological site adds another element that complicates things and makes it difficult to look at things strictly from an economic aspect. You have the social and cultural factors that go with the site. The site may be worth protecting in its own right.

(***Dee***):
Where is this area you are talking about? *(This refers back to the erosion due to runoff from rain.)*

(***Audience***):
Talking about the area near the bingo hall. *The exact location of the problem was identified on the map, 739 Stevenson Street. There was a discussion to insure the COE knew exactly where the location. The COE was invited to come look at the situation. Dee met with the individual the next day at the bingo hall to see the erosion problem that had been identified.*

Note: The video tape was changed here. A short part of the meeting was not recorded.

(***Forest***):
You can look at our website, www.poa .usace.army.mil [Slide 19]. Click on "Civil Works and Planning" and Select "Barrow Coastal Storm Damage Reduction". We update the site from time to time and when we get back to Anchorage, we will add this presentation to it. My phone number is 907-753-2627. Lizettte Boyer is our environmental coordinator if you would like to talk to her about environmental questions. We're at the last slide [Slide 20], which is comments or questions.

(***Audience***):
There was a concern raised about ice migrating along the shore and the project design helping the ice move up and into town. Is there a way you can design the dike like a saw tooth to break up the ice, so it doesn't push ice into town? ##.

(***Dee***):
We're trying to make a more vertical face for the ice to hit, so it doesn't have a ramp to run up into town. We are trying to compromise between having a nice slope to dissipate the wave energy versus trying to stop the ice from coming in. As far as the saw tooth, we can look into that. My concern is that it will extend the length of the project as we go in and out which would require more rock.

(***Audience***):
There was a discussion [Slide 14] on the movement of sea ice along the coast. Pressure ridges [Slide 15] form along the coast and can migrate ¼ mile inland. Making a saw tooth shape dike along the beach would break up the ice.

(*Dee*):
Is it riding up there now? Is that what the ice is doing right now?

(*Audience*):
Yes, in the low lying area. Right around the bluff area it stops. Sheet ice migrates in on low lying. Flat ice forms along the beach. It is very strong. Once it starts migrating in, it will use dike as ramp into Browerville.

(*Dee*):
What we're trying to do is provide a vertical face [Slide 14] to hit first before it rides up and over into the community. We will look at that more closely. ##.

(*Dee*):
When the sea ice rides up, does it bulldoze the existing berms? Are the berms gone?

(*Audience*):
When the ice rides up, the small rock you have will not stop it. It is just going to ride right over it.

(*Dee*):
I was talking about the dirt berms you have out there right now that the NSB puts up.

(*Audience*):
You need some kind of mechanism to break up the ice before it starts migrating up. ##.

(*Audience*):
Can we look at the 50-yr slide again [Slide 7]? You said you would have to deal with the structures, possibly moving the ones that are in danger of being flooded?

(*Forest*):
Moving them would be one thing to look at. In non-structural, it might be that you can flood proof them in place. We have to look at each location on a structure by structure basis. What works at your house may not work at your neighbors because of a lot of factors. All houses are not the same. Relocating them is one thing; flood proofing it, raising it, or doing something else to it on its existing lot is another thing to look at. Those are the types of things we will look at as we continue to work on the project.

(*Audience*):
In 1970 we tried all this right here. All this area *(Barrow beachfront identified on the map and the area of Browerville southeast of the road with the AC Commercial and the Eskimo gas station)* is restricted under BIA. We tried moving from one side of lagoon, but couldn't. There were 22 residences that would not relocate because of restricted lots. Not one individual accepted. (*The Borough tried to relocate individuals in 1970. There were 22 individuals along the bluff that would not move because of the restricted lot status.)*

(*Forest*):
That is one of the problems with non-structural solutions. What makes sense for community as whole may not make sense for individuals and that where you run into trouble with it. Understanding those specific details, when we move into non-structural solutions might help us to understand things that have happened in the past and help us mold what we are proposing. We can avoid or acknowledge those problems in the future and how we may be able to get around them.

(*Audience*):
Could the idea that James had about putting the dike out serve multiple purposes? Possibly beach nourishment. *(This goes back to the saw tooth dike layout that would break up the ice and could possibly provide beach nourishment.)*

(***Forest***):
It could. Building structures in the surf zone is an art not a science. We estimate the best that we can but it would be best if you can avoid building something in that area and dealing with it otherwise.

(***Audience***):
It's not deep there. (*This refers to the fact that the water in the area where the saw tooth dike would be constructed is not very deep.)*

(***Forest***):
We realize that, but you still need a large volume of rock to create an offshore beam. This solution would have higher construction costs than the current solution, and justifying it economically is less likely than other alternatives. ##.

(***Audience***):
The off shore berm could provide multiple benefits. It could help with beach nourishment and the ivu (ice movement).

(***Audience***):
That's one of things you noted, Dennis?

(***Dennis***):
Yes.

(***Audience***):
I think money should not be a problem. We are using federal money and the government has the money to pay.

(***Forest***):
Unfortunately unless Congress tells us otherwise with special legislation, we have to develop a project using normal policies. One of the major things we have to follow is that the total net benefits to the nation have to exceed the total costs of the project. In general, we have to follow that criteria and that is one of the toughest things for us to get past in developing a project.

(***Audience***):
I would like to see you guys go all the way, not half way.

(***Forest***):
Some of us wish that we could do a lot more than we often do. We balance a lot of factors in developing and designing water resource projects. We have to do our best to provide for the communities, but we have to follow the rules Congress makes. If money wasn't a factor, we could solve any problem in the world. But unfortunately money is a factor. ##.

(***Audience***):
On that one slide [Slide 15] where you have the branches, the four arrows, you mentioned something about New Hampshire to do your model.

(***Forest***):
New Hampshire is where our Cold Regions Lab is located. That's where the model will be built.

(***Audience***):
Can they do the model with what Charlie was talking about to break up the ice? (*A short discussion showing the saw tooth dike layout on the map followed.)*

(*Forest*):
If you put what Charlie was talking about you wouldn't be able to drive on the beach anywhere. There are downsides to doing that depending on what impact that might have on sediment transport along the beach. It is difficult to say exactly what it would do.

(*Audience*):
I was wondering if you could put that as a model in New Hampshire or wherever this place is to see what effects you might come up with. You guys mentioned there is a place where you can do this kind of modeling. You have all these types of models you try out with the ice.

(*Dee*):
The main use of doing the model at the Cold Regions Lab would be to verify the rock size to make sure the ice won't move the rocks around. We're definitely going to think about doing a zigzag type footprint out there. We have to make sure that we don't interrupt the sediment transport and we would have to check on the increase in the amount of rock we would use out there. If it looks like it is feasible, we'll take a look at it.

(*Audience*):
Can you do the model to see what possible effects it might have? ##.

(*Dee*):
Does the ice *(ivu)* come in at an angle or straight along the beach? If it was a zigzag design configuration, would the rock get caught by the ice sheets? Would it get knocked down?

(*Audience*):
It comes in straight.

(*Audience*):
Sometimes as its moving it changes direction.

(*Audience*):
For the $70 million cost, it is no problem for the feds to put up the $50 million. But the local source is going to mean the local government region will have to come up with $20 million. That is where the problem is.

(*Forest*):
It may look easy to get money on the Federal side, but there's a lot of hoops to go thru to justify a project to Congress under the normal procedures. Sometimes it seems like it is easier for the local sponsor to come up with their share. It works both ways. We both have trouble coming up with money to fund water resource projects. Think about how much money they are talking about for Katrina to rebuild New Orleans. Do you rebuild it or not? How do you rebuild it? How much money do you want to spend? There is not enough money to build a perfect job there. It's always a balance between money, resources, costs, benefits, damages, the environment, cultural factors. It gets complicated. ##.

Thank you for coming out today. It's a beautiful night in Paradise in Barrow. I don't know how you could have a better day in Barrow than today. It's been pouring down rain recently—we've been washing away in the Anchorage area. On behalf of the Corps of Engineers study team and the NSB personnel, Thank you for coming, taking the time to be with us, to providing us input. If you think of things in the future, call us, write us, talk to Mike. We're getting to the stage where I will say good-bye. Maybe Mike has something else he wants to do.

***(Mike)*:**
I have no comment on the matter. Again, I am Michael Stotts of the NSB Department of CIPM. This is one of the projects, which I'm involved in. Regardless of money, Regardless of plans, I have ordered up a storm on or about October 22nd to get us thinking about a seawall. But in all seriousness, this is a serious matter. We all know the shoreline in Barrow is eroding-eroding rather rapidly. Many of us can remember a beach that was hundreds of yards out there. Thank each and every one of you for coming out tonight to see the plans-to see the program. I want to ask you to join me in thanking James Patkopak for translating. I can't speak fluently, like James. I know it isn't easy to take technical words and technical jargon and put it in your brain and come out in Inupiat language. But I am sure I know in the Inupiat language, it is easier to understand.

Mike handed out door prizes to attendees that were collected/provided by the North Slope Borough.

NOTE: During the Fall of 2006, seawalls built out of Concertainers during the summer of 2006 at Kivalina and Wainwright were severely damaged. Wave action directed against the Concertainer was able to wash the interior material out, causing partial to complete failure of the Concertainer seawall. The use of Concertainer units as an integral part of the Barrow revetment design was reconsidered by the COE during design review in the winter 2006-2007. As discussed in Appendix A, the final design of the revetted berm and the bluff revetment used various sizes of armor rock and did not include Concertainers.

BARROW COASTAL STORM DAMAGE REDUCTION FEASIBILITY STUDY
KBRW-AM RADIO BROADCAST—August 23, 2006

During the afternoon before the evening public meeting, KBRW-AM broadcast an hour-long radio show, beginning at 1:30 PM, that discussed the Barrow Feasibility Study being conducted jointly by the Corps of Engineers (COE) and the North Slope Borough (NSB). Calls were requested from the radio audience. This document is not a verbatim transcript of the radio show, but documents the information discussed during the radio show. Generally, the information was first spoken in 20-to-40-second-long English segments and then was translated into Inupiat. Locations in the text where Inupiat translation took place are shown by ##. Supplemental clarifying information is shown in [*italics*]. Those present and participating included:

James Patkopak (James), KBRW show host and translator.
Michael d. Stotts (Mike), NSB, Project Study Coordinator, panel moderator
Forest Brooks (Forest), COE, Planner
Mark Rosenberry (Mark), ASCG (NSB contractor),
Dee Ginter (Dee), COE, Hydraulic Engineer
Dennis Blackwell (Dennis), COE, Cost Engineer

{James}: I have about 1:30. ##. I'll have Mike Stotts of the NSB do the introductions.

{Mike}: Good afternoon, everybody. My name is Michael Stotts with the NSB Department of CIPM We have the Army Corps of Engineers with us today in Barrow with regards to the storm damage reduction project that has been underway for some years. Let's go around the table and get some quick introductions.

{Forest}: I am Forest Brooks, the Plan Formulator on the Corps study team.

{Dennis}: I am Dennis Blackwell, the Cost estimator on the team.

{Dee}: I am Dee Ginter, from the Hydrology and Hydraulics Section.

{Mark}: I am Mark Rosenberry from ASCG, a contractor for the NSB.

{James}: I am James Patkopak. ##.

{Mike}: Let me start off with Forest. Mr. Brooks, can you explain exactly what the Barrow storm reduction study is?
{Forest}: The study began 2003. It's a cooperative effort between the NSB and the COE to evaluate the storm damage reduction problems of Barrow and potential solutions. The impetus goes back to at least 1963 when there was an event, which flooded the area. In the 70's and 80's the NSB undertook studies, sometimes with the Corps, sometimes with others. In the 90's, the NSB began a beach nourishment project to put material on the beach. In 2000, a storm drove the

dredge onto beach [*damaging it and ending the nourishment project*]. The NSB used funds remaining from that project to support this study. ##.

{Mike}: Mark, Let me ask you What's your role in this project?
{Mark}: Three years ago we started in with the NSB and COE to collect economic data to see what the economic impact of storm damage in the area. We started with an economic study of Barrow, identifying the value of Barrow's commercial property, government property, and private property. A second project took into account economic damages to utilities and costs for restoration of electric power, shipping in water, restoring power and gas, etc. A third project took account of Barrow's social-economic impact, particularly the value of Barrow as infrastructure for shipping, governmental functions, education to local villages. ##.

{Mike}: Forest, let me ask you in the year 2006 your reason for visiting today? Does the project focus on beach erosion or possible flooding in the Barrow area?
{Forest}: The study focuses on erosion of bluffs and flooding from storms. The beach is relatively stable based on preliminary technical study results. So, this is not a beach problem. You have more like an erosion problem and a flooding problem during storms. ##.

{Mike}: Forest, some of the questions in my mind are: What are some of the scenarios the project entails? What is the potential flooding?
{Forest}: Assuming that the elevation of normal sea level is elevation zero feet, a 50 year storm would result in an ocean wave elevation 8 ft above normal. The storm would hit the beach and run up, with water reaching as much as 13 ft elevation. For a 100 year storm, sea levels would be10 feet above normal sea level and have 5 foot runup, resulting in water up to 15 foot elevation. Actual flooding would be somewhere between 10 and 15 ft above normal sea levels. A 50 year flood would be similar to the 1963 flood. ##.

{Mike}: For clarification, can you define what you mean by a 50yr/100yr flood?
{Forest}: A 100 year flood is a flood that has a recurrence interval of 100 years, or a 1% chance of happening in a particular year. Similarly a 50 year flood has a 2% chance of happening each year. A 25-year flood has a 4% chance of happening in a year. So, the chance of a storm event happing is inversely proportional to the recurrence interval. ##.

{Mike} Can you describe some of the plans the project might entail to protect Barrow? Are you planning on building a seawall?
{Forest}: The current proposal has two segments. First, the western part where the bluff is eroding. Second, the eastern part of town [*Browerville*], where flooding is a problem due to high water. We have similar designs for both parts to provide erosion protection. Near the water on the beach the design includes a composite section of rock and HASCO Concertainers. Landward from Concertainers, we will have fill material w/super sacks to protect from spray. The eastern part is much the same, except that the backside wouldn't have fill behind it. It would still have rock outboard and Concertainers forming a core. ##.

{James}: Would you use gravel to fill the western part?

{Forest}: Gravel type material will be used between the Concertainers and the bluff. Concertainers may not necessarily contain gravel because it has a liner that would hold smaller material. ##.

{Mike}: Let me clarify, So you would put a barrier from the eastern part of the beach to the northern part of the beach? How does it go?
{Forest}: The western part would begin near the airport and extend to the Top of the World hotel near where the bluff ends. The eastern portion picks up there and stops after the last road before you get to the sewage lagoons. ##.

{Mike}: What is a Concertainer?
{Forest}: There are two examples near the waterfront now. One is a wall by the sewage lagoons. There is also one beyond the supersacks by the Top of the World. The Concertainer is a wire basket 3'x 3'x 3', tied together to make walls with a volume of 1 cy each. These cubes have a geotextile membrane forming a basket that small stuff like sand won't go thru. You can put any type of sand material in it and it holds it in place. ##.

{Mike}: Let me pick on Mark now. You said you have worked for some time on the project and had done some studies on storms and damages in Barrow. Can you elaborate on studies done by ASCG for the NSB?
{Mark}: The NSB wanted information 3 or 4 years ago. We performed surveys of 50 private homes to determine values of cars, homes, furniture, property, and contents. The sample was used to estimate a total for all of Barrow. All businesses within a 20 foot surge event boundary were also surveyed. The value of buildings, contents, and services (ie down for a month value of business lost) was determined. We put the data into a GIS mapping program. We also performed a land survey to determine what roads affected. This was also entered into GIS so we can model what would happen. ##.
The second project we looked at the value of utility services, sewage, water, power, gas, what would be damaged and what would it cost to replace utilities, ie ship in water, and what alternatives to replace lost services exist. Different levels of damage were evaluated. ##.
Third, because of large population and infrastructure, Barrow is the social center of many local villages, providing services including health, education. We determined what loss of Barrow would have on villages. What social and cultural impacts result and put a value on the impacts. The COE is taking that information and putting it in a report to justify remediation to stop the erosion. ##.
Those are the three projects the Corps is taking the information from and putting into the report to justify remediations for the problems.

{James}: Is this a call in show?
{Mike}: Yes. We are going to ask if there are any questions out in radio land. Do you have any? For any Corps [*person*] or any general questions regarding this project? It's a study looking at major damage along the beach that may happen every 50-years or 100-years.The study has looked at possible storm damage and flooding of Barrow and ways to protect lives and property.

{James}: Are there problems down in the Wainwright area? in outlying coastal villages?

{Mike}: There is a project at Wainright currently ongoing. The NSB funded a seawall, called the Wainwright erosion project. Today, they are putting Concentainer units there along the beach coast. ##.

{James}: How about Point Hope?
{Mike}: I don't have any information. ##.

{Caller}: I am hoping you are not going to use sand bags again. Every fall every year they are putting sand bags or gravel. How about using rock or cement and making a hard surface. Has anybody thought of doing that?
{Forest}: The current design uses rock as the primary erosion protection measure for the bluff and ocean-side of the potential dike. Using other materials to provide bluff/dike protection farther west in town. Above flood zone, on open slopes, we want to use super sacks for spray and minor rainfall erosion control. ##.

{Mike}: Where are you going to get the rock?
{Dee}: Rock will be imported from Nome. We will minimize rock use by making the core material out of HESCO Concertainers to use the least amount of rock possible. ##.

{Mike}: Forest, a point of clarification. I would encourage listeners to attend the meeting tonight in Barrow, where they can see the drawings. They are difficult to understand over the radio. The inftrastructure we are talking about is a slanted looking wall toward the ocean about 20 to 25 feet high, is that correct? With a 10-foot-high pyramid of Concertainers with the rest of the height being made up of super sacks? ##.
{Forest}: We will be using Concertainers as the core, then rock in front. It may be 10 to 15 feet high, up to the top of the bluff, up to the level you protect against the waves. Supersacks will be placed above, with wall height depending on how high the bluff is.

{Mike}: I am trying to help our listeners get a picture in their minds of the infrastructure that we are talking about. Down toward the gravel pit it would be definitely higher. Down toward the northeast side of our beach it would shrink down to a lesser level. We are talking about a large and long wall along the seashore, that is of considerable size along our waterfront. ##.

{Mike}: Will there be spots where people can launch their boats and stuff? Will that kind of wall be consistent?
{Forest}: Four locations will probably have openings to provide vehicle access. One, west of the Top of World, one near it, and two near the gas station. Again, height will depend on the bluff height. Some places, ie near the lagoon, there will probably be no supersacks. The ground is lower on the backside than the ground [on the dike crest] would be. ##.

{James}: How high will the pyramid be?
{Mike}: About 10 to 15 feet. ##.

{Mike}: The project has been underway for some time. There have been several meetings over the couple of years.

{Mark}: ASCG was a participant in some of them. We have helped meet with smaller groups, whalers, residents, businesses and the public. The COE and NSB have coordinated w/ASCG. The COE is only involved in the seawall. Other concerns are being addressed by ASCG, like how do we launch boats? How do we design boat ramps? ASCG is working with the COE to match designs by others for boat access to accommodate the community. ##.

{Forest}: I just want to note that 10 to 15 ft means above sea level, not above the ground surface. Near Brower's Café the wall would be 3 to 5 feet above existing ground surface. Heights so far should be about the same as what the NSB has been piling near the beach. The difference is that these measures are permanent, not temporary. ##.

{Mike}: Forest, again, tonight's meeting, 7-o'clock at the Heritage Center. Why are you meeting with the public? What are you looking for from the public?
{Forest}: Two reasons. First, to tell public what we've been doing and how we've progressed. Second, to get community input on defining the problem and finding solutions. We want to know: Are we doing the right thing? Is there something that they think will work better? The costs of any project are very high. The costs of the project we've described is about 30 to 60 million dollars, depending on how high you build it. We're looking for community input both on the problems and the proposed solutions. Are we looking at things right? Do we need to incorporate other things into the project to make it right? ##.

{Mike}: Forest, you have a couple of staff members who have been making a little bit of noise. I know they wanted to stay quiet today and didn't want to say much. I want to put them on the spot and ask a couple of questions. What is a hydrologist?
{Dee}: [*I am*] a hydraulic engineer. I work on harbor design and construction issues, coastal protection design and construction issues, anything dealing with harbors, coastal issues, sometimes rivers.

{Mike}: It's engineering level rather than cosmetic level?
{Dee}: Yes. It's providing protection. ##.

{Mike}: This gentleman as well a fellow staff member that has come up with Forest. It's my intention to introduce the public and our listeners to the radio right now to the people involved with this now. The army Corps has been involved in this project for quite some time as well as many people throughout the arctic and other entities. It's always interesting to get to know the people that have been involved over many years on similar projects over time. Some of the questions that a lot of people may have are those that I have been asking. I understand you are an economist?
{Dennis}: I am a cost engineer, with a background as a structural/design engineer. We look at a whole group of different solutions and estimate their costs by looking at how we will construct it and where we'll get our materials. We look at a whole bunch of solutions. We put a cost number on each early on. ##.

{Mike}: Your job is to find the most economical way to solve the problem?

{Dennis}: Yes, we work with the design team to find the most economical way to build the designs. We find where the most economical materials will come from. What they are going to cost. We talk with suppliers at material sites to develop costs.

{Mike}: How much is this going to cost? What id the base estimate?
{Dennis}: There are 2 phases: one, the bluffs which will cost between 20 and 31 million. Two, flood protection will cost between 27 and 35 million. Projects together will cost 45 and 60 million. It depends on how much can be built in a season. How many seasons it takes. More seasons equals more cost. We need to minimize the number of times the contractor has to leave and come back. ##.

{Forest}: In addition to the project we've outlined for the meeting, we are also looking at non-structural measures. There may be more economical ways to get the same benefits, ie relocating structures. We look at those as a cost check.

{Mike}: That's why you need public involvement?
{Forest}: Yes. ##.

{Mike}: Thank you, James. We've taken just about an hour. We've given opportunity for call-in with questions. I invite you to the meeting tonight. Refreshments will be served. Dorr prizes will be given. Again, a meeting regarding a sea barrier wall along the coast of Barrow. We need your input. They are here to listen to the public in Barrow. They are here to listen to you tonight, to hear your suggestions. 7-o'clock at the Heritage Center. ##.

{James}: KBRW 680 on radio dial. Thank you folks.

NOTE: *During the Fall of 2006, seawalls built out of Concertainers during the summer of 2006 at Kivalina and Wainwright were severely damaged. Wave action directed against the Concertainer was able to wash the interior material out, causing partial to complete failure of the Concertainer seawall. The use of Concertainer units as an integral part of the Barrow revetment design is being reconsidered by the COE during a design review taking place during the winter 2006-2007.*

U.S. Army Corps
of Engineers
Alaska District

Barrow, Alaska

Coastal Storm Damage Reduction
Technical Report

Appendix I – Background & Reference

July 2010

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Appendix I – Study Background and References

1.0 APPENDIX PURPOSE

The Background and Reference Appendix was added to the Barrow Technical Report (TR) to provide background information for better understanding of the Barrow, Alaska, area, the coastal storm damage problem, potential solutions, or reference materials that could be useful to local governments and others in evaluating future projects and proposals for Barrow and the North Slope Borough (NSB).

1.1 Prior Reports and Authorizations

1.1.1 Prior Corps Reports

The Corps of Engineers has conducted a number of studies considering water resources needs of northern Alaska, including Barrow. A major statewide, watershed-by-watershed study was conducted from 1947 to 1962 and produced 10 interim reports. Other studies covering Barrow include studies of beach erosion in 1969 and 1991 (under authority of Section 103 of the 1962 River and Harbor Act) and in 1999 (under Section 14 of the 1946 Flood Control Act); and studies of small boat harbors in 1979 and 1993 (under Section 107 of the 1960 River and Harbor Act).

Harbors and Rivers in Alaska, Survey Report, Interim Report No. 6, Northwestern Alaska, June 1957. The 1957 study considered water resources needs in Northwestern Alaska, defined as the mainland north and northwest of the Yukon River Drainage and St. Lawrence, Sledge, King, and Little Diomede Islands (an area of about 150,500 square miles). The study identified that climate extremes and lack of access roads hampered all economic development. The Corps was unable to identify any feasible navigation, flood control, hydroelectric power, or other water related project under then current conditions.

Point Barrow Beach Erosion Reconnaissance Report, Section 103 of River and Harbor Act of 1962, Point Barrow, Alaska, December 1969. The 1969 beach erosion study determined that, due to high alternative costs, insufficient economic benefits, and small relative percentage of public owned shores, Federal participation in structural measures was not justified. The Corps recommended that Barrow adopt a number of non-structural measures to reduce damage from erosion (i.e., relocate houses, businesses, and utilities and develop/enforce erosion zone ordinances).

Reconnaissance Report, Barrow Small Boat Harbor, March 1979. The 1979 Section 107 small boat harbor study looked at five lagoon sites to create a small boat harbor along the coast near Barrow. Sites between Barrow and Browerville, Tasigarok Lagoon, (estimated cost $963,000) and at Elson Lagoon ($638,000) appeared to be economically justified. The report recommended that a Detailed Project Investigation be initiated to determine design feasibility for a small boat harbor. The lagoon was used for sewage disposal prior to the study. Relocation of sewage disposal facilities was proposed as part of the harbor plan. Feasibility studies were terminated when it became apparent that the economic benefits did not offset project costs and that there were significant concerns about potential environmental impacts related to prior sewage discharges in Tasigarok Lagoon.

Barrow and Wainwright Shore Protection Studies, Alaska, 1991. The 1991 Section 103 beach erosion study looked at dredging material from an offshore site and transporting the material to the beach. The study determined that such a system (estimated cost $8.6 million) did not appear to be economically justified and thus lacked Federal interest. No Corps report was produced. Subsequently, the North Slope Borough implemented a similar dredging and beach nourishment plan. There is a detailed discussion of their project in Section 3.1.1.

Environmental Assessment and Finding of No Significant Impact, Department of Defense Environmental Restoration Program, Elson Lagoon, Alaska, May 1992. The 1992 DERP project removed about 1,200 tons of unsafe terrestrial debris from the Point Barrow Spit and about 300 tons of submerged unsafe debris up to 300 yards out from shore in Elson Lagoon. The debris consisted of landing craft, steel matting and tracks, storage tanks, and empty 55-gallon drums. The debris was from past Navy use of the area for storage and staging for exploration of Naval Petroleum Reserve No. 4 (1944-53), Air Force construction of the Distant Early Warning Line (1954-57), and Naval operation of the Naval Arctic Research Laboratory (NARL, 1947-66).

Preliminary Reconnaissance Report for Navigation Improvements, Barrow, Alaska, February 1993. The 1993 Section 107 small boat harbor study looked at three basic plans: a boat harbor at the Barrow gravel pit (estimated cost over $10 million), a shallow draft channel in Elson Lagoon ($2.8 million), and a small craft landing and channel from Elson Lagoon into North Salt Lagoon ($1.3 million). The reconnaissance study recommended that no further work was warranted since alternatives did not appear to be economically feasible.

Section 14 Emergency Bank Stabilization Study, Barrow, Alaska, 1999. The 1999 Section 14 erosion investigation agreed that there was an erosion problem occurring in front of Barrow and that the landfill and sewage lagoon were vulnerable to overtopping during a severe storm event. However, the cost of potential complete solutions ($20-$40 million) greatly exceeded the Federal participation limits ($1 million) of the Section 14 program. The draft Section 14 report recommended that the Section 14 studies be terminated and a General Investigation Study be started. No formal report was produced.

Barrow, Alaska, Section 905(b) (WRDA 86) Analysis, Storm Damage Reduction, Flood Reduction, and Navigation, June 2001. This 2001 analysis reviewed existing information and laid the basis for development of a Project Management Plan identifying the studies needed for a full feasibility study of Barrow's water resources problems. The report concentrated on beach nourishment/road-way raise options ($80 million for 25,000 linear feet) with navigation improvement measures, if incidental to beach nourishment ($13 million). The analysis recommended a feasibility study of possible water resources measures for Barrow.

Alaska Village Erosion Technical Assistance Program, Examination of Erosion Issues in the Communities of Bethel, Dillingham, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet, April 2006. This report responded to legislation (2003 Appropriations Act for Corps) directing the Corps to examine erosion problems at the seven named Alaska Native villages. In addition, the 2006 Appropriations Act for the Corps provided funds under authority of Section 117 of the 2005 Appropriations Act (authorized projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska) to consider nine villages (Kivalina, Newtok, Shishmaref, Kaktovik, Unalakleet, and Bethel—mentioned in the 2003 Act and also three new villages—Koyukuk, Barrow, and Point Hope). The 2006 report looked at the problems in the first seven villages and made recommendations for further consideration of each villages' problems individually (e.g., Shishmaref moving quickly to design and construction of preventative measures, followed by Unalakleet, Kivalina, and others as funds allowed). The three new 2006 Act villages would have had individual reports prepared for each, assessing implementation of a project under Section 117, if it had not been repealed.

1.1.2 Prior Congressional Authorizations

In recent years, Congress has passed several laws with sections relevant to coastal storm damages at Barrow. These are summarized in the following paragraphs.

Tribal Partnership Program, Consolidated Appropriations Act of 2005, Public Law 108-447, Division C – Energy and Water Development Appropriations Act, 2005. This legislation was implemented to provide additional funding through the Tribal Partnership program for technical activities for seven named communities: Kaktovik, Kivalina, Newtok, Shishmaref, Bethel, Dillingham and Unalakleet. Work using this appropriation considered the first four listed communities. Work for the last three was funded through other appropriations. The Alaska Baseline Erosion Assessment was initiated to identify, plan, and prioritize appropriate responses to ongoing erosion issues in almost 200 Alaska communities.

Section 117, Consolidated Appropriations Act of 2005, Public Law 108-447, Division C – Energy and Water Development Appropriations Act, 2005. This legislation (repealed by Congress in 2009) states as follows:

SEC.117. Notwithstanding any other provision of law, the Secretary of Army is authorized to carry out, at full Federal expense, structural and non-structural projects for storm damage prevention and reduction, coastal

erosion, and ice and glacier damage in Alaska, including relocation of affected communities and construction of replacement facilities.

Alaska Coastal Erosion, Energy and Water Appropriations Bill, 2006, Senate Report 109-84, Page 41. This report states:

"The Committee has provided $2,400,000 for Alaska Coastal Erosion. The following communities are eligible recipients of these funds: Kivalina, Newtok, Shishmaref, Koyukuk, Barrow, Kaktovik, Point Hope, Unalakleet, and Bethel. Section 117 of Public Law 108-447 will apply to this project."

With the limited amount of funds identified for construction activities, the money was primarily used for constructing shoreline protection for Shishmaref, Kivalina, and Unalakleet. The repeal of Section 117 in 2009 bars any future use of Alaska Coastal Erosion funds to perform work at full Federal expense.

Water Resources Development Act of 2007, Public Law 110-114, Title V – Miscellaneous. Section 5031 of this law provides construction authorization for a non-structural project at Barrow. The section states:

> *"SEC. 5031. BARROW, ALASKA.*
>
> *The Secretary shall carry out, under section 117 of the Energy and Water Development Appropriations Act, 2005 (118 Stat. 2944), a nonstructural project for coastal erosion and storm damage prevention and reduction at Barrow, Alaska, including relocation of infrastructure."*

The repeal of Section 117 in 2009 bars implementation of any structural or non-structural measures at full Federal expense. Such measures can still be implemented under normal Corps planning procedures, including showing economic justification and using appropriate cost sharing as specified by the 1986 Water Resources Development Act. Projects can also be pursued under Section 116 authority, as described below.

Section 117, Consolidated Appropriations Act of 2009, Public Law 111-8. Section 117 of this law repeals Section 117 of the 2005 Appropriations Act, as follows:

"SEC. 117. Section 117 of the Energy and Water Development and Related Agencies Appropriations Act, 2005, as contained in division C of Public Law 108-447, is hereby repealed."

Section 116, Energy and Water Development and Related Agencies Appropriations Act of 2010, Public Law 111-85. Title 1 of this law provides authority for the Secretary of Army to carry out structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska, including relocation of affected communities and construction of replacement facilities. The section states:

> **"**The Secretary of the Army is authorized to carry out structural and non-structural projects for storm damage prevention and reduction, coastal

> erosion, and ice and glacial damage in Alaska, including relocation of affected communities and construction of replacement facilities: Provided, That the non-Federal share of any project carried out pursuant to this section shall be no more than 35 percent of the total cost of the project and shall be subject to the ability of the non-Federal interest to pay, as determined in accordance with 33 U.S.C. 2213(m)."

This authority allows the Corps to evaluate and select a recommended project based in part or wholly on non-monetary units (Environmental Quality or Other Social Effects) supported by a cost effectiveness/incremental cost analysis consistent with established evaluation procedures. Non-monetary benefits that may be considered include such things as public health and safety; local and regional economic opportunities; and, social and cultural values to the community.

1.1.3 Prior Related Reports by Others

Bluff and Shoreline Protection Study for Barrow, Alaska, August 1987 by Tekmarine, Inc., Pasadena, Ca. This study for the NSB developed a feasible shoreline protection methodology for Barrow. The study recommended providing the reach with the eroding bluff face a gravel fill covered with a linked concrete block mattress on a 1:3 slope. The lagoon reach would receive a road raised to +12 MLLW combined with an approximately 4-foot-high barrier on the shore side of the road. The estimated total initial project cost was about $36 million. No construction resulted from this study.

Mitigation Alternatives for Coastal Erosion at Wainwright and Barrow, Alaska, April 1989 by BTS/LCMF Limited, Barrow/Anchorage, AK. This study for the NSB reviewed and analyzed alternative actions that could be taken to mitigate coastal erosion. It recommended that beach nourishment by dredging be pursued. The project was estimated to cost $14.3 million over 8 years by placing 800,000 yd^3 of material on the beach at an average cost of $15.27/$yd^3$. No construction resulted directly from this study.

Wainwright and Barrow Beach Nourishment Project and Plan Review, Final Report, September 1992, by Ogden Beeman & Associates, Inc., Portland, OR. This report for the NSB reviewed the plans for the beach nourishment by dredging project and made recommendations regarding changes to the dredging methodology and the specific tug and dredge design. This report combined with the July 1994, August 1994, and January 1995 reports, provided the basis for the NSB's beach nourishment project described in Section 2.1.2(1).

Barrow Beach Nourishment Project, A Synthesis of Pertinent Information, July 1994, by Coastline Engineering. This report for the NSB was intended to provide a summary of past information and the current NSB project to provide beach nourishment through dredging an offshore bar for third-party review by the Science Advisory Committee of the University of Alaska's Institute of Marine Science.

Review of the Barrow Beach Nourishment Project, August 1994, by NSB Science Advisory Committee, Fairbanks, AK. This review responded to citizen concerns regarding the proposed NSB dredging project and answered three specific questions posed by the NSB mayor. They determined that the material to be removed for beach nourishment would provide more benefits on the beach than offshore underwater, beaches down current would likely benefit, and suggested modifications to the dredging methodology to improve the project.

The Effect of Dredging Directly Offshore of Barrow on the Erosion of the Culturally Sensitive Bluffs, January 1995, by Coastline Engineering. This report for the NSB reviewed concerns raised by local residents about offshore dredging affecting shoreline bluff erosion in Barrow. The report concluded that neither the average run up nor the average littoral transport along the beach would be increased due to increased dredging offshore. No negative impacts would be experienced at the fill flanks due to presence of the fill.

Project Analysis Report, Barrow Landfill Closure Plan & Environmental Site Assessment – Phase 1, August 1997, by Montgomery Watson. This report for the NSB laid out the scope of work, cost, and schedule to perform the work necessary to develop plans to close the existing Barrow landfill, which is discussed in Section 3.3.

New Barrow Landfill Site Selection, May 2000, by Montgomery Watson, Anchorage, AK. This report for the NSB investigated and discussed the alternative sites available for a relocated Barrow Landfill and recommended a preferred site. The preferred Site E was located inland about 8 miles southeast of the old landfill near an existing gravel pit. Site C is about a mile north of the BIA Prospect Borrow area investigated as a material source by the current Corps study. Site E was selected for the new landfill, which is further discussed in Section 1.12.1.

Barrow Climatic and Environmental Conditions and Variations – A Compendium, 2005, by U of Colorado, Boulder, CO. This report for the National Science Foundation compiled what was known by residents and scientists about trends and processes affecting the Barrow environment over the previous half century. Findings were presented and recommendations made regarding a networking strategy for Barrow to use in acquiring assistance in relieving chronic erosion and flooding problems.

1.2 Civil and Native Governmental Organizations in Alaska

The relationship between civil governmental organization and Native organizations in Alaska are summarized in table 1. Because of unique circumstances involved in the development of Alaska during the last century, the relationship between the civil government and Native organizations, with one exception, is different from in the other

49 states. Civil government in Alaska provided for two levels of government under the state: boroughs (similar to counties) and cities of various classes. These levels were established in the Alaska State Constitution, which became effective upon statehood on January 3, 1959. Boroughs have been established covering less than half the area of the state, with the remainder being unorganized (unboroughed) at the regional level.

Table 1. Native and Civil Governments and Organizations

State	Tribal	Alaska Native Claims Settlement Act	Level
State of Alaska	Statewide Tribal Organization providing advocacy for tribes. **Alaska Inter-Tribal Council (177 tribes)**	Statewide Native Organization (non-tribal). **Alaska Federation of Natives (AFN)**	Statewide
Borough Assembly: State chartered regional municipal government. **North Slope Borough**	Regional Tribal Consortium/Non-Profit: Service delivery to tribal members/tribal advocacy. **Artic Slope Native Association**	ANCSA Regional Corporation: State chartered regional for profit; owns subsurface rights. **Artic Slope Regional Corporation**	Regional
City Council: State chartered municipal government. **City of Barrow**	Tribal Council: Federally recognized tribal government by Bureau of Indian Affairs. **Native Village of Barrow Inupiat Traditional Government** **Inupiat Community of the Arctic Slope**	ANCSA Village Corporation: For profit village corporation; owns surface rights. **Ukpeagvik Inupiat Corporation**	Local

Federally-recognized Tribes are defined as those Native entities within Alaska recognized and eligible to receive services from the Department of Interior, Bureau of Indian Affairs (BIA). The BIA has recognized 229 such entities in Alaska, most of which are relatively small. There is only one Indian Reservation in Alaska in which the tribal organization has control of the land, the Metlakatla Indian Community, on Annette Island south of Ketchikan at the southern end of the Alaska panhandle. Native land holdings come under provisions of the 1971 Alaska Native Claims Settlement Act (ANCSA) that extinguished aboriginal Native land claims in Alaska and vested the land rights for 44 million acres in Regional (subsurface rights) or Village (surface rights) Corporations. Both the Regional and Village Corporations are legal entities separate from the Federally recognized Tribe. Also, mainly for housing, health care, and social services, ANCSA Non-Profit Corporations were established. Subsequently, in 1980, the Alaska National Interest Lands Conservation Act (ANILCA) granted a subsistence preference for individual Alaska Natives on Native controlled land and for both Native and non-Native rural residents in the remainder of Alaska. In Barrow, the Federally-recognized entities are the Native Village of Barrow Inupiat Traditional Government (NVB) and the regional Inupiat Community of the Arctic Slope (ICAS). The ANCSA For-Profit Corporations are Ukpeagvik Inupiat Corporation (UIC) and the Arctic Slope Regional Corporation (ASRC). The ANCSA Not-For-Profit Corporation is the Arctic Slope Native Association (ASNA).

Barrow is in the North Slope Borough (NSB). Organized boroughs in Alaska are in some ways like counties in much of the rest of the United States, but with political structure and powers that may be substantially broader. The NSB includes almost all of Alaska north of the 68^{th} Parallel with a total population of about 9,600 people, or about 1 person for every 10 square miles. By comparison, Wyoming, the least populated of the 50 states has about five people per 1 square mile (about 50 times the population density of the

NSB). Alaskan Natives make up about 87 percent of the population of the NSB. The regional Native corporation for this area, the Arctic Slope Regional Corporation (ASRC), has the same geographic boundary as that of the NSB.

1.3 Stakeholders in Barrow

In Barrow, there are a large number of stakeholders, partly due to the unique relationships in Alaska between civil and Native governments and organizations. The entities and their primary responsibilities are listed in this section as follows:

- **North Slope Borough (NSB).** The NSB is the county-like, civil government. Established in 1972, it provides general government services for the entire 95,000-acre borough (mayor, assembly, elections, planning, wildlife management, health and social services), specialized services in each of the eight villages within the borough (K-12 schools, police, fire, search and rescue, public works (streets, sidewalks, refuse collection and disposal, health clinics, etc.) and Ilisagvik College (IC) in Barrow at the old NARL site.
- **Inupiat Community of the Arctic Slope (ICAS).** ICAS is the BIA-recognized entity representing the entire Arctic Slope. They oversee Tribal operations, natural resources, realty, roads, wildlife, parks, and vocational rehabilitation. They have agreements with oil and gas developers over their North Slope operations and with the military for demolition and restoration of former Distant Early Warning (DEW) Line sites.
- **Arctic Slope Regional Corporation (ASRC).** ASRC, incorporated in 1972, is the regional, private, for-profit, Alaska Native owned corporation covering the same territory as the NSB and representing the business interests of the Arctic Slope Inupiat. ASRC represents the eight villages on the North Slope of Alaska and has title to about 5 million acres of land. ASRC operates subsidiary companies in the professional fields of engineering, civil construction, financial management, oil and gas support services, petroleum refining, and distribution for aviation, marine, retail, and home heating, communications, hotel and tour business, military base and training range operation and management, military housing, solid state phased array radar system, and air-space surveillance, intercept control, and navigational assistance. Operations are primarily in Alaska but also in Washington, California, New Mexico, Colorado, Kansas, Maryland, Louisiana, Alabama, Massachusetts, Canada, Greenland, Great Britain, and Russia.
- **Arctic Slope Native Association, Limited (ASNA).** ASNA is the regional, private, not-for-profit, Alaska Native owned corporation that operates the Samuel Simmonds Memorial Hospital, a 14-bed acute care facility serving all the people of the North Slope. It is the oldest healthcare facility in Alaska and operates under a contracting agreement with the Indian Health Service. In addition, the ASNA operates a summer youth camp to teach the skills necessary to stalk, kill, and prepare animals (such as caribou and fish) from the region in accordance with traditional Inupiat values.

- **Tagiugmiullu Nunamiullu Housing Authority (TNHA).** Established in 1974, TNHA provides housing assistance services to eight communities, including Barrow. Annually, tribes sign a resolution authorizing TNHA to be their tribally designated housing entity. Funding is provided by the Alaska Housing Finance Corporation and the United States Department of Housing and Urban Development's Indian Housing Block Grant Program.
- **City of Barrow.** The civil city government, incorporated as a first-class city in 1959, primarily provides recreational opportunities (Piuraagvik-recreation center, Tupiqpak-ice rink, roller rink, community center, playgrounds), permitting services (alcohol, taxis, overburden removal, etc.), and the cemetery for residents. Every year it stages several regional festivals: *Puiraagiaqta* (Spring Festival), *Nalukataq* (Summer Blanket Toss), *July 4th Games* (Eskimo-Indian Olympics), *Qitik* (Christmas), and *Kivgiq* (tri-annual Arctic celebration).
- **Native Village of Barrow Inupiat Traditional Government (NVB).** NVB is the BIA recognized entity representing Barrow. It provides tribal government administration, tribal courts, wildlife, realty, social services and workforce development services.
- **Ukpeagvik Inupiat Corporation (UIC).** UIC, incorporated in 1973, is the private, for-profit Alaska Native Corporation for Barrow. UIC operates subsidiary companies that provide construction services, gravel borrow, vehicle repair and rental, barge services for Alaska, direct cargo service from the Lower 48 to Alaska, service on Puget Sound in Washington, logistics planning and execution, engineering and technical services, program management, information technology and computer systems operation, environmental cleanup, and building roofing. A UIC subsidiary, Bowhead Transportation Company, which began operation in 1982, is the managing partner for a joint venture that supports the Army National Guard to include the National Guard Bureau and the programs and interests of the Guard in 54 states and territories. Bowhead Support Services supports the V-22 and UAV at NAS Patuxent, MD, as well as the NAVAIR, NAWCAD, and NAS public affairs offices. In addition, UIC operates its own gravel pit 6 miles south of Barrow to support local road projects and building pad construction (Barrow Global Climate Change Research Facility).
- **Barrow Utilities & Electric Cooperative, Inc. (BUECI).** BUECI, the not-for-profit, member-owned, cooperative that provides the village of Barrow with electricity, natural gas, water, and sewer services, was formed in 1964. The water supply is provided from Isatkoak Reservoir and passed through a microfiltration/nanofiltration system prior to delivery to homes. The seven electric generators can produce 20.5 megawatts (double peak demand). Wastewater flows are pumped to South Salt Lagoon where "facultative treatment" occurs for a year. The lagoon contents are then pumped into Middle Salt Lagoon, where they sit for another year before they are discharged into the Arctic Ocean. Utilities are provided in Barrow either by direct bury or in a utilidor. The utilidor is a trapezoidal, buried, wood structure, 6 feet high by 6 feet wide at the base (5 feet wide at the top) carrying utility lines (potable water, sewage collection,

telephone, TV cable, fiber optic communications, and electric service lines. Gas delivery lines are direct-bury throughout Barrow.

- **Arctic Slope Telephone Association Cooperative (ASTAC)** ASRC is the not-for-profit, member-owned cooperative that provides the village of Barrow and the rest of the North Slope with telecommunications, including telephone, dial up and DSL Internet access, and facilities mapping.
- **Barrow Arctic Science Consortium (BASC)** BASC is a not-for-profit, community-based organization, established in 1995 and dedicated to the encouragement of research and educational activities pertaining to Alaska's North Slope and the adjacent portions of the Arctic Ocean. The NSB, UIC, and IC contributed to the creation and support of BASC. The BASC manages the Barrow Environmental Observatory (BEO), which is the facility previously operated by the U.S. Navy as the Naval Arctic Research Laboratory (NARL), and promotes transfer of information between scientists and community members. A cooperative agreement with the Office of Polar Programs of the National Science Foundation provides funding for BASC's activities. BASC will operate the Barrow Global Climate Change Research Facility, which is currently under construction.
- **GCI.** GCI is a private Alaskan corporation providing cable TV, internet, and long distance telephone service in Barrow since 2005, when they acquired Barrow Cable TV.
- **Alaska Eskimo Whaling Commission (AEWC).** AEWC was formed in 1977 to represent whaling communities and to coordinate with agencies responsible for the management of subsistence whaling. It promotes the protection and enhancement of the Eskimo culture, traditions, and activities associated with bowhead whales and subsistence whale hunting. The AEWC works cooperatively with the International Whaling Commission (IWC). Each whaling community also has a local organization of captains. The Barrow Whaling Captains represent local whalers at the AEWC and IWC meetings.
- **Inupiat Heritage Center (IHC).** IHC, dedicated in February 1999, houses exhibits, artifact collections, library, gift shop, and traditional crafts. The NSB owns and manages the IHC, which was designated as an affiliated area of New Bedford Whaling Historical Park in New Bedford, Massachusetts to ensure the contributions of Alaska Natives to the history of whaling are recognized.
- **Alaska Department of Transportation and Public Facilities (ADOT&PF).** ADOT&PF owns and operates most of the airports in the State of Alaska, including the Wiley Post-Will Rogers Memorial Airport in Barrow. The Department in recent years has been lengthening, widening, and adjusting the centerline of the main runway and upgrading the runway safety area, taxiways, aprons, navigational aids, lighting, and adjacent streets. They moved more than a million cubic yards of material from the borrow area, 50 acres in the southwest corner of the airport property, to form the higher/wider embankments. The borrow pit floor could be mined no deeper than 5 feet above mean high tide elevation to prevent erosion of the access road and shoreline during storm events. This borrow area is immediately adjacent to the NSB borrow area, which has been

used for decades to provide fill materials for the development of Barrow's infrastructure and building pads, but is now largely depleted. The end of the embankment for the west end of the new runway safety zone will be about 600 feet from the existing eroding shoreline.

- **United States Air Force (USAF).** A subsidiary of ASRC has the contract from the USAF to operate the network of 19 geographically separate radar stations forming the Alaska Radar System (ARS). Its mission is to provide air space surveillance, intercept control, and navigational assistance to military and civilian aircraft. The ARS covers over 590,000 square miles of Alaska (about twice the combined size of Texas and Louisiana). Ten sites are north of the Arctic Circle, including the Barrow radar site. It is about a half mile south of the old NARL aircraft hangers. The Barrow radar was originally constructed in 1953 as part of the Distant Early Warning System, which was designed to detect Soviet long-range bombers. The radars onsite have undergone several upgrades over the years. The continued operation of the Barrow site is an essential element of National Security.
- **National Oceanic and Atmospheric Administration (NOAA).** In 1973, NOAA established the Point Barrow Observatory (PBO) for their Earth System Research Laboratory about a quarter mile south of the USAF radar site. The Barrow Observatory is host to numerous cooperative global atmospheric research projects from around the world. Other similar NOAA observatories are on Mauna Loa, HI, American Samoa, the South Pole, and Trinidad Head.
- **United States Department of Energy (USDOE).** The Scandia National Laboratories of the USDOE, located in Albuquerque, New Mexico, established their Atmospheric Radiation Measurement (ARM) facility at the NOAA PBO. The ARM program involves data collection in Barrow and Atqasuk, Alaska, Darwin, Australia, and Manus and Nauru Islands in the Pacific. The ARM observatory has become an integral part of international collaborations and U.S. government research programs involving polar environment, ground-based, remote sensing for climate modeling and weather forecasting sponsored by NASA and NOAA. It also provides accommodations to scientific researchers on a space available basis.

1.4 Current and Future Projects of Other Agencies

In recent years, a number of Barrow stakeholders have been actively involved in planning, designing, and/or constructing major new facilities. One characteristic common to the facilities being replaced or upgraded is that they are relatively close to the shoreline and would or could suffer significant damages during extreme storm events. Local entities have taken seriously the erosion and flooding threat and generally employed the non-structural choice of retreat and relocation farther from danger for their vulnerable facilities. An exception is the airport, where the State extended the runway and safety zone toward the eroding coastline. These new projects will reduce future erosion and flood damages. Even though these projects reduced possible NED benefits for a new Corps project, the local community chose wisely to move out of harm's way what they can, when they can. The following paragraphs briefly discuss each of these major capital improvement projects. Their planned sites are shown on figure 3. In any event, although millions are being spent on these projects, large portions of commercial, residential, and public land and structures remain susceptible to erosion and flooding from extreme storm events. The current study provides an opportunity to address these smaller buildings and facilities that are critical to the long-term economic and social well-being of Barrow and the entire NSB.

1.4.1 Barrow Landfill

The existing Barrow landfill, owned and operated by the NSB, is along Stevenson Street in the northeast half of South Salt Lagoon. The existing landfill is unpermitted and operates under a Compliance Order by Consent Agreement (COBCA) with the Alaska Department of Environmental Conservation (ADEC). The COBCA mandates closing the existing landfill and developing a new Class II landfill (less than 20 tons/day) for the community. The old landfill will be encapsulated to freeze waste as a permanent landfill. The NSB conducted site selection studies in the 1990's and chose a 55-acre site inland, about 8 miles southeast of the old landfill near the existing UIC gravel pit. Design considerations included airport safety, floodplains, wetlands, seismic zones and unstable areas, subsistence resources, discharges, cover, etc. A permafrost landfill design was selected that first encapsulates the waste material and then encourages its freezeback. All sites considered were at least a mile or two from the shoreline, beyond any reasonable prediction of shoreline erosion or ocean flooding. The state issued the permit for the new landfill in 2004. Construction on the site creating the initial gravel pad and access road began in the winter of 2005 using an ice road from the UIC borrow pit to the site. Construction on the new landfill site is completed and the landfill operational.

The current Barrow landfill, located in the northeast half of the South Salt Lagoon, is being closed because of a 1997 state order. The U.S. Navy, U.S. Air Force, the NSB, the Native Village of Barrow, and the Department of Justice in 2002 negotiated a financial plan for the closure of that landfill. That plan provided for the Department of Defense to supply a majority of the funding for the closure, with the provision that no additional Federal funds would be given to support the landfill. The landfill closure plan included some minimal measures (such as jersey barriers along the road seaward of the landfill) to reduce flood damages that might be experienced in the future by the landfill. However, these measures are limited and assume that the beach and the road will remain in place and will not be eroded and/or damaged in the future. Because of lack of Congressional funding, the 2002 agreement was never implemented. In July 2005, the earlier agreement was replaced by a subsequent one, which implemented a $16 million settlement for landfill closure. The feasibility study will consider the coastal erosion and storm damage problems and measures to resolve them in the Barrow-Browerville area, which could include resolving erosion/storm problems, if there are any, on the beach at the landfill.

1.4.2 Barrow Wastewater Treatment Facility

The existing wastewater treatment for Barrow involves reduction of organic wastes solely by "facultative" treatment in the southwest half of South Salt Lagoon for a year followed by a second year in Middle Salt Lagoon, with ultimate discharge to the Arctic Ocean, generally during June of every year. The BASC sewage treatment plant also discharges its effluent into Middle Salt Lagoon. BUECI has selected a site for a new treatment facility to be located along Laura Madison Street, directly south of the landfill portion of the South Salt Lagoon. The first floor of the facility will be set on a gravel pad at elevation +22.5 feet MSL, well above any reasonably foreseen flooding. Instead of the existing wastewater collection system ending at the pump facility along the ocean edge of South Salt Lagoon, the pipe will be routed from Stevenson Street down Ahmaogak, Karluk, Uula, and Laura Madison Streets to the new plant. Construction began in the summer of 2006.

1.4.3 Barrow Hospital Replacement

The existing Samuel Simmonds Memorial Hospital, built in 1963, is a critical access facility serving as the only hospital available to residents of an area larger than Washington State. The hospital offers emergency, clinic, and urgent care facilities. However, the Indian Health Service (HIS) will fund a $104 million project creating a hospital four times larger than the current hospital (109,000 square feet) with an increase of about 140 jobs. The site selection process for the new hospital lasted 8 years, considering eight different sites. Location criteria included land parcel size, floodplains, environmental, utilities, community impact, and user/employee considerations. A 20-acre site in the Browerville subdivision of Barrow was selected in 2004. The old hospital was on the shore of Lower Isatkoak Lagoon, about 600 feet from the Arctic Ocean shoreline, potentially susceptible to damage from extreme storm events. The new hospital will sit on high ground at the intersection of Yugit and Uula Streets, just northeast of Upper Isatkoak Lagoon, the water supply for Barrow. Hospital work is currently underway. Building design was completed in 2007, and building construction is scheduled for completion in 2009.

1.4.4 Barrow Global Climate Change Research Facility (BGCCRF)

BASC has been coordinating the nation-wide planning of the approximately 89,000 square-foot facility that will provide modern research, housing, and maintenance and storage areas for future Arctic research. The facility will service the global scientific community and local and regional Inupiat Eskimo population and replace many of the old NARL facilities originally built during and shortly after World War II. In 2005 Congress authorized $61 million for a five-phase project in the FY 2005 Energy Bill. The site selected for the buildings is on the west shore of Imikpuk Lake, approximately 1,000 feet southeast of the existing NARL site. The 13-acre parcel was an undeveloped area with a tundra mantle underlain by permafrost with a surface elevation of about +8 feet MSL. Access roads will initially be extended from the NARL site, with a possible future connection to Cake Eater Road. The potential for flooding from coastal storms was a significant consideration in the facility design. A gravel pad was placed on the site founded on a geotextile membrane over the tundra, raising the surface to an average of +12 feet MSL, above expected storm surges. The bottom soffit of the pile supported research building was set at +15 MSL, with a finish floor at approximately +18 MSL. The detached maintenance/storage building is a slab-on-grade with a floor elevation of +14.5 MSL. The grand opening of the $20 million Phase 1 of the facility was held on June 1, 2007, just in time for the March 2007 beginning of the International Polar Year (2007-2008).

1.4.5 New BASC Access Road (Uivaqsaagiaq Road)

Associated with construction of the new BGCCRF, planning has been undertaken to provide a new access road to both the new facility and the remainder of the old NARL site. This road would start at Cake Eater Road, just south of its crossing over the creek that drains into the Middle Salt Lagoon, and run north along relatively high ground. This route would not be in as much danger of imminent attack by storms as is Stevenson Street every summer and fall. If the 2.5-mile-long-road were raised at low spots about 4 to 5 feet above the surrounding tundra, it would be able to maintain access between Browerville and NARL/BASC/IC during expected flood events. The new road would also serve as an evacuation route during storms. The NSB has indicated that after the BGCCRF, the new sewage treatment plant, and this new road are completed in a few years, the NSB will not continue to try to keep Stevenson Street operational during storm events east of Ahmaogak Road, but will let it flood. Also, the new road to the sewage treatment plant (Laura Madison Street) may be connected to the new “backdoor” road to BASC.

1.4.6 Itasigrook Dam Renovation

The fresh water supply for Barrow is collected in what originally was the natural Isatkoak Lagoon, between the Barrow and the Browerville parts of the city. In the 1960’s, the Bureau of Indian Affairs constructed an earth, concrete, and oil barrel dam. This divided the lagoon into a lower and an upper section, just northeast of the existing hospital site. The Tasigarook Lagoon served as receiving waters for the secondary sewage treatment plant of the local hospital in 1959. That effluent was scheduled to be rerouted to another lagoon.

The dam has an approximately 80-foot-wide concrete spillway set at about +4.5 MSL. The upper part of Isatkoak Lagoon was subsequently divided into a middle and an upper reservoir when Ahkovak Street was built across the lagoon just north of the new grade school. A series of corrugated metal pipe (CMP) culverts under the roadbed hydraulically join the waters on both sides. The water surface elevation is generally only a little higher in the upper reservoir as in the middle portion. Barrow’s water supply intake is on the eastern (upstream) side of the road. The pipe runs along the road to water treatment facilities at the BUECI plant where the water is treated to remove minerals, solids, and potentially pathogenic bacteria using a state-of-the-art Microfiltration-Nanofiltration System.

Over the years, the dam that separates the middle reservoir and lower lagoon (now Itasigrook Lagoon) has deteriorated to the point that the core has washed out and the concrete spillway apron has failed. The dam fix consists of adding a steel sheet-pile weir with buried steel sheet-pile wingwalls to form a sharp crested weir set at the same elevation as the current spillway. Additional gravel fill will be added to the seaward face of the dam to cover existing slope and toe protection consisting of exposed steel drums filled with concrete. The NSB renovated the dam during the summer of 2006. The renovated dam will still be subject to wave attack during storms if the shoreline berm and the Eben Hopson Street embankment are overtopped and/or breached. However, the dam and spillway should be better able to resist damages than in their present condition.

1.5 Local Government Past Damage Reduction Measures

The NSB and others have attempted to curb the erosion and flooding that impact the coast in front of Barrow and its associated facilities. Following is a list of the coastal erosion and flooding mitigation measures, discussed in following paragraphs, for avoiding damages from storm events:

- Pushing beach material into berms during storm events
- Placing sacrificial berms along the shoreline road
- Offshore dredging for beach nourishment
- Geotextile sack revetment
- Filled utilidor seawall
- Laid back tar barrels
- Longard geotextile tubes
- HESCO Concertainers

1.5.1 Placing Beach Material into Berms During Storm Events

The NSB actively moves beach material at critical locations during storm conditions, operating D7/D8 dozers on the beach in the surf zone (figures 1 and 2). The NSB has stated that although the berms provide limited protection during larger storms, they will continue doing what they can to keep the berms in place, even if that means continued operation of the dozers in salt water. When the dozers are operated this way, additional maintenance is required to keep this equipment in order. Due to the corrosive nature of the salt, the electrical systems are the hardest to keep in working order. The dozers must routinely be steam cleaned to keep salt off, while the electrical connections are shrink-wrapped to prevent salt from entering the connections.

Figure 1. Bulldozer working on the beach building berms at Itasigrook Lagoon

Figure 2. Bulldozer pushing beach material during heavy surf.

1.5.2 Placing Sacrificial Berms Along the Shoreline Road

Over the past decade sacrificial berm building has been the first protection against storms for the community. These sacrificial berms are sand and gravel mounds generally anywhere from 6 to 8 feet above the ground surface (crest would be at about elevation +13 to +15 feet). They are placed at the crest of the beach as a protection measure against rising water from storm surge and wave attack. The NSB normally uses lower grade material since they have a limited supply of gravel. Higher quality material is saved for maintaining the community's roads. Although the material is of a lower grade, the material still costs about the same per cubic yard as the higher quality ($37/cubic yard). This is due to the cost to extract the material from the borrow pit. Approximately 15,000 cubic yards of material is placed annually to form the berms (material cost, $548,000). Labor and fuel accounted for another $19,000, for a total placement cost of $567,000 annually in 2007 values. Storms that hit the community generally range in length from 3 to 5 days. When storms are larger, the berms do not last very long, often gone after 8 to 10 large waves.

During a 2000 storm, floodwater overtopped Stevenson St. (figure 3) and flowed into the Lower Salt Water Lagoon. Four sections of the shoreline road BASC were lost (up to 200 yards in length). Approximately $330,000 was spent to repair these sections of road out to the boat launch at Nixeruk (figure 4). It is estimated that this road needs to be repaired about every 3 years, or approximately $110,000 annually. Stevenson St, adjacent to the shoreline and susceptible to direct storm attack, provides an important transportation connection to Pt. Barrow, where fish camps used for subsistence harvesting are located on Elson Lagoon. The subsistence harvesting season for salmon, whitefish, and other types of fish all occur during open water periods, which is when most storm events occur. Many residents spend days or weeks at their camps. If the road was washed out, some residents would not be able to travel easily to or from their camps and Barrow. Some spend only weekends at their camp, but many return to Barrow regularly to buy food, fuel, and other supplies. Rebuilding these roads in Barrow has become difficult due to the number of projects that have reduced the availability of gravel (there is no stockpile readily available). The estimated annual damage to roads and berms under existing conditions is approximately $628,000. In the current without project condition, this cost will continue until a project is built that controls wave activity and protects the roads during storm events or the roads are relocated.

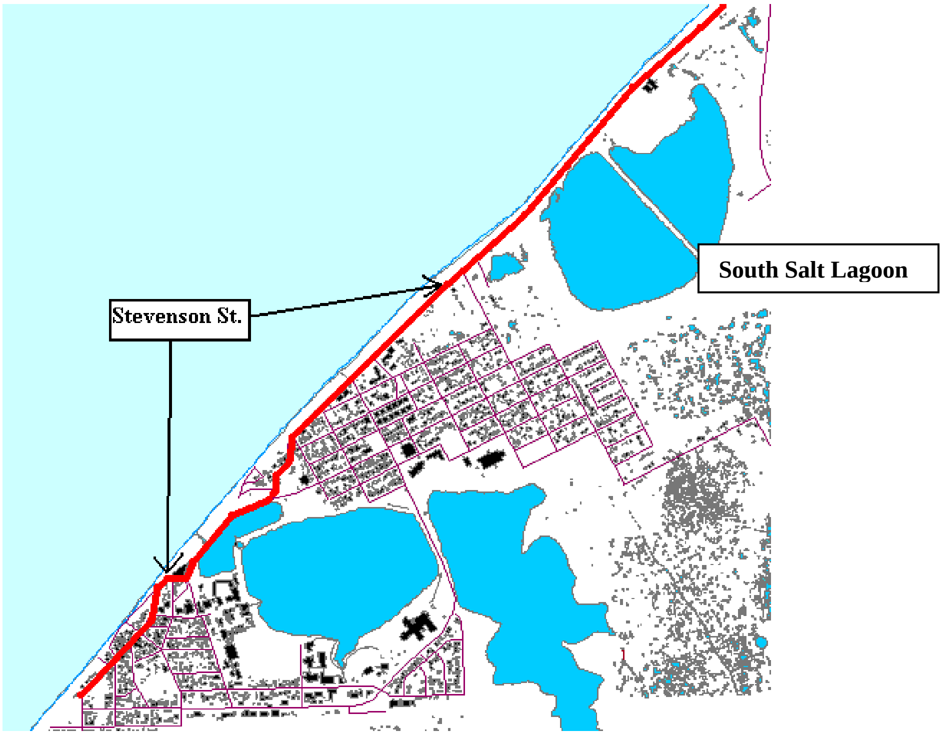

Figure 3. Location of Stevenson Street

Figure 4. Sacrificial berms placed along road.

1.5.3 Offshore Dredging with Beach Nourishment.

From 1989 through 2000 the NSB first studied and then implemented a major program to dredge offshore at Wainwright (a smaller community about 90 miles southwest of Barrow) and Barrow to provide materials for beach nourishment. The program, authorized by the NSB Assembly in August 1991, envisioned using a specially-built, barge-mounted dredge over a period of 8 years to remove about 800,000 cubic yards

TIM MacDONALD / Arctic Sounder

The North Slope Borough's multimillion-dollar off-shore dredge was pounded by waves after it broke loose and grounded itself on the Barrow beach Thursday when a rare summer storm with winds up to 65 mph hit the area.

Figure 5. Dredge beached during 2000 storm.

(yd^3) of material at Barrow and place it on the eroding beach for nourishment at a unit cost of about $15 per yd^3. After a number of construction delays, the NSB took delivery in Wainwright during July 1995 of the dredge, shore barge, and dredge tender. The 1995 season was spent dredging and providing beach nourishment for Wainwright. The 1996 season was spent completing dredge modifications to improve the working rate and conducting a 29-day dredging season (17.5 operating days) at Barrow. Material encountered offshore required additional dredge modifications to obtain efficient production. Dredging operations were suspended during 1997 and 1998. In 1999 additional dredge modifications were made and a full dredging season (July18 to September 3) was completed. About 64,000 yd^3 of material were placed along 1,800 feet of shoreline at a unit cost of about $78/yd^3 in place. Dredging resumed in the summer of 2000, continuing until August 10, when the dredge was severely damaged during a storm (figure 5). In July 2001, the NSB authorized selling the dredge and all specialized equipment and expressed support for further study of erosion processes, including both NSB work underway for the landfill closure and future Corps of Engineers studies. The NSB has stated that unless a suitable gravel source (sufficient sized gravel and economical) is found, a beach dredging nourishment program will not be considered in the future. About $28 million was spent over a decade on the NSB's Beach Nourishment Program to place about 100,000 yd^3 of material onto Barrow beach. After the program was initiated, NSB determined that the actual material dredged was not of a sufficient size/quality to significantly protect the beach. Excess program funds of $11 million were transferred to an area wide erosion control account, which has supplied the local cost share for this feasibility study. Figure 6 shows the results of a storm eroding the beach nourishment materials.

Figure 6. Remains of beach nourishment after storm.

1.5.4 Other Measures.

Over the years, the community has tried a number of erosion prevention measures along portions of the shoreline with varying degrees of success. These include the following: large rubber or geotextile “supersacks” laid on the bank slope along Egasak Street (figure 7); surplus, earth-filled, wooden utilidor sections serving as a seawall near sewage lagoons (figure 8); old tar barrels laid on the upper beach slope near Brower’s Café (figure 9), and Longard geotextile tubes laid along the base of the bank or berm near sewage lagoons (figure 10).

Figure 7. Supersack revetment.

Figure 8. Wooden utilidors backfilled with local material.

Figure 9. Tar barrels lay on beach at an angle.

Figure 10. Longard tube type protection.

1.5.5 HESCO Concertainers.

The most recent storm damage reduction measure tried was the installation of a seawall type structure using geotextile fabric (on vertical surfaces) encased in a wire basket. Two segments were installed in Barrow during the summer of 2004. One segment was placed just southwest of the filled utilidor revetment at the sewage lagoon and the other is just northeast of Egasak Street (figure 11). To date, it has held up well in Barrow through four winters without a major failure, but has failed at three other coastal applications in Alaska. In June 2006, minor damage to the lowest basket tier was noted at the Egasak gabions. The cause of the damage is uncertain, but appears to be either ice override or heavy equipment impact. The cause of the gabion system failure at the other locations in the State is not certain. Factors that would increase the system's survivability at Barrow include the fact that the system was not exposed to a storm event during or immediately after construction, which gave it time to saturate with water and freeze during the winter. Once frozen, the system acts more as a solid block rather than loose granular material that could be washed out by wave action. The system at Barrow was also put in place to stem road and bluff erosion, so it is set back from the shoreline typically out of the zone of wave impact unlike other applications in Alaska.

Figure 11. HESCO Concertainers near Okoksik Street.

1.5.6 Utqiagvik Village Archeological Site

The Utqiagvik Village Site is an historic/archeological site in northwestern Barrow adjacent to the shoreline bluffs. The Utqiagvik Village Site has been occupied for more than 2,500 years and at one time covered a large portion of what is now Barrow. The remaining archeological site has been set aside by the city and is the last portion of the former Utqiagvik Village Site along the coast that has not been redeveloped. The site is eligible for the National Register of Historic Places. The site suffers occasional damage/loss from coastal erosion of the Barrow bluff.

1.5.7 Barrow's Historic Importance for the Nation

Barrow has been important to the United States for both scientific and military advancements. During the First International Polar Year (1882-1883) a U.S. Naval expedition established one of two American research stations, studying magnetism, tides, meteorology, natural history, and ethnography of Inupiat Eskimos. The Weather Service began Barrow observations in the 1920's. During World War II in 1943, the Navy Seabees established a base at Barrow (with satellite bases at Cooper Island and inland at Umiat on the Colville River) to explore the National Petroleum Reserve for gas and oil badly needed for the war effort. The base was realigned to become the Naval Arctic Research Laboratory (NARL) in 1947 to provide facilities and support for scientists conducting research in oceanography, atmospheric science, and terrestrial and marine biology. During the Cold War, the Air Force established Early Warning Radar sites throughout the north and west coasts of Alaska. An Aircraft Control & Warning Center was established at Barrow with the other north Alaska radar sites feeding their target data to Barrow for analysis. Defense radars continue to be located at Barrow today. The NARL operations were decommissioned in 1980 and the facilities turned over to the UIC in 1989. In 1995 the Barrow Arctic Science Consortium (BASC) was formed to perform research and educational activities in cooperation with Ilisagvik College on the NARL

2.0 PUBLIC INVOLVEMENT AND NATIVE TRIBE CONSULTATION

2.1 Introduction

Public Involvement for this project was important because this was a long study with many technical components that required updates with the sponsor and the community. The public involvement activities summarized here includes coordination with the U.S. Fish and Wildlife Service, public meetings, meetings with whaling captains, and Native tribe consultations.

2.2 Notice of Intent

A Notice of Intent to Prepare an Environmental Impact Statement (EIS) was printed in the Federal Register on April 17, 2003. The Environmental Protection Agency responded to the notice with a letter outlining their review responsibilities under Section 309 and National Environmental Policy Act (NEPA) and the significant issues that need to be addressed in the EIS, such as: provide a clear purpose and need, analyze reasonable alternatives, consult with Tribal governments, analyze environmental justice issues, and seek traditional knowledge for alternative formulation.

2.3 U.S. Fish and Wildlife Service Coordination

Coordination with the U.S. Fish and Wildlife Service (USFWS) was initiated in 2003. The USFWS participated in the first public meeting, some team meetings, and in planning for geotechnical drilling and field investigations. A Planning Aid Letter was received in February 11, 2004. The USFWS believes that the project's gravel source location and methods of gravel extraction will be the most significant issues affecting fish and wildlife resource. The beach at Barrow is heavily disturbed so does not provide a lot of habitat. Cooper Island was the most sensitive area. Winter gravel mining was recommended. The BIA site is near nesting habitat for the threatened Spectacled and Steller's eider sea ducks. Winter gravel extraction is recommended here also. Complete mining and reclamation plans will be required. A draft Coordination Act Report (CAR) was received in August 2006. The current design and use of the existing gravel pit would not have significant environmental affects to fish and wildlife resources. If in the future gravel quantities are not available for the revetment project, the BIA site may have to be used and the USFWS would require further consultation under the Endangered Species Act.

2.4 Public Meetings

2.4.1 June 12, 2003

The first scoping meeting was held June 12, 2003 in Barrow. The Corps presented an overview of the planning process including the EIS process and the importance of public participation. Project purpose, objectives, and preliminary alternatives were discussed, which generated comments such as would the elevated road/dike cause drainage patterns or impoundment behind the road? Graves and cultural resources were cited as a concern along the beach. Residents encouraged the Corps to consider elder knowledge of conditions, consider climatic events beyond the 50- or 100-year events and to guard against seeking only institutional remedies for problems. An independent review of alternatives was recommended. Comments on a possible gravel borrow area on Cooper Island indicated concerns with cultural resources, traditional use areas, and bird habitat. The process of economic justification was discussed. People wanted to know how a cost/benefit analyses was done. Residents have become accustomed to modern services in Barrow, such as the utilidor, which contains water, sewer, and power. They are similar to services expected and depended upon most U.S. towns. Moving the utilidor would be very costly. There are fears that quality of life issues may not be captured as benefits. In order to get information and receive comments from the public, a project Web site was set up. The Corps also promised to hold meetings and provide written project updates. A written update was sent to every box holder in November 2004.

2.4.2 April 6, 2005

On April 6, 2005 a study progress meeting was held in Barrow, but public attendance was sparse due to conflicts with local whaling activities that night. The Corps presented and explained the study progress information provided in the November 2004 mailout. Measures to address the erosion and flooding problems were discussed as well as the planned summer field activities. Local residents identified possible impacts caused by various measures and suggested other measures for consideration. Major concerns were expressed about environmental and cultural impacts associated with opening new borrow areas and potential dike alignments.

2.4.3 August 23, 2006

On August 23, 2006 a study progress meeting was held in Barrow and attended by more than 60 residents. The meeting was held in both English and Inupiaq. The Corps presented the major results of studies to date: the beach appears currently stable and beach erosion is not a problem, but bluff erosion still is a problem along with flooding; beach nourishment is no longer being considered due to economic, environmental, and cultural concerns; the prime measures under consideration are revetment protecting the bluffs and a coastal dike preventing flooding. In addition, the Corps was going to look at non-structural measures, such as building raising and/or relocation. The public was informed that as part of any Corps project, the community would have to participate in the National Flood Insurance Program. Meeting participants identified impacts associated with measures being proposed and were concerned that any project would perform as designed, particularly in resisting the severe ice forces any project along the Barrow shoreline would encounter. As a result of public comments, the study team added physical model tests of the proposed dike/revetment section to the study plan. Earlier in the day, Corps study team members participated in a bi-lingual radio call-in show discussing the study and possible project alternatives on KBRW, the local AM radio station.

2.5 Meetings with the Whaling Captains

An informal meeting was set up to discuss the project plan alternatives with the whaling captains and the North Slope Borough in June 2006. The Corps wanted to get some insight into what the social implications might be with a high revetment along the beach front. Three members of the public, one of whom was a whaling captain, and a Borough official attended the lunch meeting. The Corps brought the worst case flood map to show the areas of potential wetting and revetment alignment figures. The Corps indicated that the maximum protection from the rock revetment would extend to the 16-foot elevation. If the beach is at 0 elevation, this would mean a rock wall 16 feet high causing a permanent visual block to the sea for some residences. This would also mean limited access to the beach, and in some cases, it would take up the entire beach. Comments on this concept were that a secure flood and erosion block was a desirable outcome. The beach berms now constructed are already a visual block. Access, if combined with boat launches, would be a good thing and the more the better. Questions on the alternatives were asked such as what about dikes at the end of the runway. Could this structure catch gravel and therefore nourish the beach? Can something like dolos (large concrete forms that fit together) be used instead of armor rock? The thought was that possibly they could be made in Barrow reducing costs. What about concrete mattresses used for erosion? Many of these ideas have been explored by the Corps and discounted because of lack of feasibility and were too costly. The subject of local gravel sources was brought up.The feasibility of using the available gravel at Point Barrow was decidedly rejected because of the impacts to a culturally important archeological village and burial site. Development of the BIA gravel site was socially acceptable because it would be economically beneficial. However, there is an existing gravel site that could supply the same quality of gravel/sand as the BIA site and this would be the favored site.

2.6 Native Tribe Consultation (Government to Government)

Coordination and consultation have been maintained with the Native organizations in Barrow throughout the study, including the IRA elements (the Native Village of Barrow and the Inupiat Community of the Arctic Slope). Government to Government notification of the project was initiated in May 8, 2003. A meeting in 2003 with both groups occurred to describe the project and to ask their input and concerns. Both groups were supportive of the study and the outcome of the project. The Inupiat Community of the Arctic Slope indicated that officials with the Native Village of Barrow could represent them on this study. The NVB participated in the study by providing boat services for instrument deployment and providing transportation for the fish surveys as a contractor for the North Slope Borough.

3.0 FEDERAL EMERGENCY MANAGEMENT AGENCY POLICIES & PROCEDURES

3.1 Participation in National Flood Insurance Program and Preparation of Floodplain Management Plan

As discussed in the main report, participation by the local community in the NFIP is a requirement mandated by Congress in WRDA 1988. As part of the local sponsor responsibilities, the NSB or the City of Barrow, will be required to agree to join and participate in the NFIP prior to construction of a Corps project. Under current FEMA procedures, communities first enter what is called the Emergency Phase of the NFIP. This gets the community started in the process quickly and makes flood insurance available for sale. The community will need to pass an ordinance to enter the NFIP. The ordinance includes provisions for requiring development permits that ensure new development is reviewed to see that proposed construction will be reasonably safe from flooding, that buildings in flood prone areas will be anchored, and that new construction will use methods and practices to minimize flood damages. Flood Hazard Boundary Maps (FHBM) are prepared to show the general area flooded by a one percent chance event. Flood Insurance Rate Maps (FIRM) are prepared showing the water surface elevation of the one percent coastal/riverine flood event, which enables the community to join the Regular Phase of the NFIP. The FIRM provides the basis for actuarial rates for insurance based on the structures lowest floor elevation relative to the one percent flood. At that time the community must adopt more stringent development regulations. Structures and contents can be insured. Flood insurance covers direct losses due to a general condition of flooding, which includes flood related erosion loss. The average annual flood insurance policy premium in Alaska was $655 per year as of February 2007. Under Congressional mandate, the community is required to prepare a Floodplain Management Plan within 1 year of signing a Project Cooperation Agreement and implement the plan within 1 year after project completion. This plan documents how the community will address flood hazards in the future and can be prepared as part of a FEMA All-Hazards Analysis. The NSB has already prepared an All-Hazards Analysis (with the exception of the Flood Hazard Analysis).

FEMA mapping requirements and criteria are contained in the *Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States, January 2005*. That document requires that for any protective effects of coastal levees or levee systems to be recognized by the NFIP and incorporated into FIRM's, they must be constructed , operated, and maintained to resist erosion and prevent any flooding or wave overtopping landward of the levee crest during the one percent chance flood conditions. The levee must be certified as providing protection from flooding. FEMA's freeboard requirement specific to coastal levees is: (1) the crest elevation must be elevated at least 2 feet above the one percent chance still water elevation, and (2) either 1 foot above the one percent chance wave height or the maximum wave run up elevation, whichever is greater.

The Corps of Engineers, upon completion of construction, would certify to FEMA that the project had been adequately designed and constructed to provide protection against the base flood (one percent event). The Corps would verify that all FEMA criteria (44 C.F.R. 65.10) had been met. The major FEMA requirements include provisions for freeboard, closures, embankment protection, foundation stability analysis, settlement, and interior drainage. An operations manual needs to be developed covering flood warning, flood operations, closures, manual backups, and periodic inspections. The Corps works with each of its sponsors to prepare a project Operation and Maintenance Manual during late stages of design and construction. That Manual documents the formal procedure to maintain stability, height, and overall integrity of the structure and its associated systems.

3.2 Questions and Answers About FEMA and the NFIP

The following pages provide questions and answers taken from the Federal Emergency Management Agency official web site. These cover information pertaining to the legislative authority, requirements, rules, regulations, and procedures of the National Flood Insurance Program. Additional information is available on their website www.fema.gov.

3.2.1 Introduction to the NFIP

1. **What is the National Flood Insurance Program (NFIP)?**
   The NFIP is a Federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

   Participation in the NFIP is based on an agreement between local communities and the Federal Government that states if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas, the Federal Government will make flood insurance available within the community as a financial protection against flood losses.

2. **Why was the NFIP established by Congress?**
For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses, nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

   In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

3. **How was the NFIP established and who administers it?**
The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 (PDF 446KB) and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 (PDF 294KB) and the Flood Insurance Reform Act of 2004. The NFIP is administered by Federal Emergency Management Agency (FEMA) a component of the Department of Homeland Security (DHS).

4. **What is a Special Flood Hazard Area (SFHA)?**
In support of the NFIP, FEMA identifies flood hazard areas throughout the U.S. and its territories by producing Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary & Floodway Maps (FBFMs). Several areas of flood hazards are commonly identified on these maps. One of these areas is the Special Flood Hazard Area (SFHA) or high risk area defined as any land that would be inundated by a flood having a 1-percent chance of occurring in any given year (also referred to as the base flood).

   The high-risk area standard constitutes a reasonable compromise between the need for building restrictions to minimize potential loss of life and property and the economic benefits to be derived from floodplain development. Development may take place within the SFHA, provided that development complies with local floodplain management ordinances, which must meet the minimum Federal requirements. Flood insurance is required for insurable structures within high-risk areas to protect Federal financial investments and assistance used for acquisition and/or construction purposes within communities participating in the NFIP.

5. **What is a flood?**
"Flood" is defined in the Standard Flood Insurance Policy (SFIP), in part, as:

   A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from overflow of inland or tidal waters, from unusual and rapid accumulation or runoff of surface waters from any source, or from mudflow.

6. **What is the NFIP's Write Your Own (WYO) program?**
The Write Your Own (WYO) Program, begun in 1983, is a cooperative undertaking of the insurance industry and FEMA. The WYO Program allows participating property and casualty insurance companies to write and service the Standard Flood Insurance Policy in their own names. The companies receive an expense allowance for policies written and claims processed while the Federal Government retains responsibility for underwriting losses. The WYO Program operates within the context of the NFIP, and is subject to its rules and regulations.

   The goals of the WYO Program are:
   - Increase the NFIP policy base and the geographic distribution of policies;
   - Improve service to NFIP policyholders through the infusion of insurance industry knowledge; and
   - Provide the insurance industry with direct operating experience with flood insurance.

   Currently, about 100 insurance companies write flood insurance with FEMA.

7. **Do the state insurance regulators have any jurisdiction over the NFIP in their respective states?**
As established by the U.S. Congress, the sale of flood insurance under the NFIP is subject to the rules and regulations of FEMA. FEMA Division has elected to have State-licensed insurance companies' agents and brokers sell flood insurance to consumers. State regulators hold the insurance companies' agents and brokers accountable for providing NFIP customers with the same standards and level of service that the States require of them in selling their other lines of insurance.

   Private insurance companies participating in the Write Your Own (WYO) Program must be licensed and regulated by States to engage in the business of property insurance in those States in which they wish to sell flood insurance.

8. **How does the NFIP benefit property owners? Taxpayers? Communities?**
Through the NFIP, property owners in participating communities are able to insure against flood losses. By employing wise floodplain management, a participating community can protect its citizens against much of the devastating financial loss resulting from flood disasters. Careful local management of development in the floodplains results in construction practices that can reduce flood losses and the high costs associated with flood disasters to all levels of government.

9. **What is the definition of a community?**
A community, as defined for the NFIP's purposes, is any State, area, or political subdivision; any Indian tribe, authorized tribal organization, or Alaska native village, or authorized native organization that has the authority to adopt and

enforce floodplain management ordinances for the area under its jurisdiction. In most cases, a community is an incorporated city, town, township, borough, or village, or an unincorporated area of a county or parish. However, some States have statutory authorities that vary from this description.

10. **Why is participation in the NFIP on a community basis rather than on an individual basis?**
    The National Flood Insurance Act of 1968 (PDF 446KB) allows FEMA to make flood insurance available only in those areas where the appropriate public body has adopted adequate floodplain management regulations for its flood-prone areas. Individual citizens cannot regulate building or establish construction priorities for communities. Without community oversight of building activities in the floodplain, the best efforts of some to reduce future flood losses could be undermined or nullified by the careless building of others. Unless the community as a whole is practicing adequate flood hazard mitigation, the potential for loss will not be reduced sufficiently to affect disaster relief costs. Insurance rates also would reflect the probable higher losses that would result without local floodplain management enforcement activities.

11. **Is community participation mandatory?**
    Community participation in the NFIP is voluntary (although some States require NFIP participation as part of their floodplain management program). Each identified flood-prone community must assess its flood hazard and determine whether flood insurance and floodplain management would benefit the community's residents and economy. However, a community that chooses not to participate within 1 year after the flood hazard has been identified and an NFIP map has been provided is subject to the ramifications explained in the answer to Question 20.

    A community's participation status can significantly affect current and future owners of property located in Special Flood Hazard Areas (SFHAs). The decision should be made with full awareness of the consequence of each action.

12. **What is the NFIP's Emergency Program?**
    The Emergency Program is the initial phase of a community's participation in the NFIP and was designed to provide a limited amount of insurance at less than actuarial rates. A community participating in the Emergency Program either does not have an identified and mapped flood hazard or has been provided with a Flood Hazard Boundary Map (FHBM), and the community is required to adopt limited floodplain management standards to control future use of its floodplains. Less than 1 percent of the 20,000 communities participating in the NFIP remain in the Emergency Program; FEMA hopes to convert all communities to the Regular Program of the NFIP. For additional information on mapping, please refer to the "Flood Hazard Assessment and Mapping Requirements" section of this booklet.

13. **What is the NFIP's Regular Program?**
    A community participating in the Regular Program of the NFIP is usually

provided with a Flood Insurance Rate Map (FIRM) and a detailed engineering study, termed a Flood Insurance Study (FIS). (Additional information on FIRMs and FISs is provided in the "Flood Hazard Assessment and Mapping Requirements" section of this booklet.) Under the Regular Program, more comprehensive floodplain management requirements are imposed on the community in exchange for higher amounts of flood insurance coverage.

14. **What happens when a community does not enforce its floodplain management ordinance?**
    Communities are required to adopt and enforce a floodplain management ordinance that meets minimum NFIP requirements. Communities that do not enforce these ordinances can be placed on probation or suspended from the program. This is done only after FEMA has provided assistance to the community to help it become compliant.

15. **What is probation?**
    Probation is the formal notification by FEMA to a community that its floodplain management program does not meet NFIP criteria. It is an action authorized under Federal regulations.

16. **When can a community be placed on probation?**
    A community can be placed on probation 90 days after FEMA provides written notice to community officials of specific deficiencies. Probation generally is imposed only after FEMA has consulted with the community and has not been able to resolve deficiencies. The FEMA Regional Director has the authority to place communities on probation.

17. **How long will probation last?**
    Probation may be continued for up to 1 year after the community corrects all Program deficiencies and remedies all violations to the maximum extent possible.

18. **What penalties are imposed when a community is placed on probation?**
    An additional $50 charge is added to the premium for each policy sold or renewed in the community. The additional charge is effective for at least 1 year after the community's probation period begins. The surcharge is intended to focus the attention of policyholders on the community's non-compliance to help avoid suspension of the community, which has serious adverse impacts on those policyholders. Probation does not affect the availability of flood insurance.

19. **What is suspension?**
    Suspension of a participating community (usually after a period of probation) occurs when the community fails to solve its compliance problems or fails to adopt an adequate ordinance. The community is provided written notice of the impending suspension and granted 30 days in which to show cause why it should not be suspended. Suspension is imposed by FEMA. If suspended, the community becomes non-participating and flood insurance policies cannot be written or

renewed. Policies in force at the time of suspension continue in force for the policy term.

20. **What happens if a community does not participate in the NFIP?**
Flood insurance under the NFIP is not available within that community. Furthermore, Section 202(a) of Public Law 93-234, as amended, prohibits Federal officers or agencies from approving any form of financial assistance for acquisition or construction purposes in a Special Flood Hazard Area (SFHA). For example, this would prohibit loans guaranteed by the Department of Veterans Affairs, insured by the Federal Housing Administration, or secured by the Rural Housing Services. Under Section 202(b) of Public Law 93-234, if a Presidentially declared disaster occurs as a result of flooding in a non-participating community, no Federal financial assistance can be provided for the permanent repair or reconstruction of insurable buildings in SFHAs. Eligible applicants may receive those forms of disaster assistance that are not related to permanent repair and reconstruction of buildings.

If the community applies and is accepted into the NFIP within 6 months of a Presidential disaster declaration, these limitations on Federal disaster assistance are lifted.

21. **Explain the discounts on premiums that can be obtained in communities that qualify for the Community Rating System (CRS) because they have floodplain management programs that go beyond the minimum requirements to participate in the NFIP.**
The NFIP's Community Rating System (CRS) recognizes community efforts beyond the NFIP minimum standards by reducing flood insurance premiums for the community's property owners. The discounts may range from 5 to 45 percent. The discounts provide an incentive for new flood mitigation, planning, and preparedness activities that can help save lives and protect property in the event of a flood.

22. **What procedures must be followed for a community to participate in the Community Rating System?**
Participation in the CRS is voluntary. A community in compliance with the rules and regulations of the NFIP may apply. The community's Chief Executive Officer must appoint a CRS coordinator to handle the application work and serve as the liaison between the community and FEMA. The first step in the application process is for the community to obtain a copy of the CRS Coordinator's Manual, which describes the program and gives details on the eligible activities. The CRS coordinator should fill out and submit an application for participation in the CRS. The CRS will verify the information and arrange for flood insurance premium discounts.

23. **How can a community acquire the CRS Coordinator's Manual and other information describing the program?**
The CRS Coordinator's Manual, additional CRS publications, and software may

be ordered online or by writing, phoning, or faxing a request to the NFIP/CRS. Contact information is listed in the "Additional Reading" section at the end of the booklet. All publications are free, and the computer software for completing the application is also available at no charge.

3.2.2 Prospective Buyer Information

24. **Who may purchase a flood insurance policy?**
NFIP coverage is available to all owners of insurable property (a building and/or its contents) in a community participating in the NFIP. Owners and renters may insure their personal property against flood loss. Builders of buildings in the course of construction, condominium associations, and owners of residential condominium units in participating communities all may purchase flood insurance.
Condominium associations may purchase insurance coverage on a residential building, including all units, and its commonly owned contents under the Residential Condominium Building Association Policy Form (PDF 328KB, TXT 76KB). The unit owner may separately insure personal contents as well as obtain additional building coverage under the Dwelling Policy Form (PDF 332KB, TXT 81KB) as long as the unit owner's share of the RCBAP and his/her added coverage do not exceed the statutory limits for a single-family dwelling. The owner of a non-residential condominium unit may purchase only contents coverage for that unit.

25. **How can property owners or renters find out if they are eligible to purchase flood insurance?**
NFIP coverage is available only in participating communities. Almost all of the nation's communities with serious flooding potential have joined the NFIP. The NFIP provides a listing of participating communities in the Community Status Book. To learn if a community participates in the NFIP, refer to this listing online at http://www.fema.gov/fema/csb.shtm or contact a community official or insurance agent.

26. **How can a property owner determine if the property is in a Special Flood Hazard Area (SFHA)?**
FEMA publishes maps indicating a community's flood hazard areas and the degree of risk in those areas. Flood insurance maps usually are on file in a local repository in the community, such as the planning and zoning or engineering offices in the town hall or the county building. A property owner may consult these maps to find out if the property is in an SFHA.

    In addition, maps can be viewed and ordered online or by writing, phoning, or faxing a request to the FEMA Map Service Center. Contact information is listed in the "NFIP Program Information" section at the back of this booklet. Delivery is usually within 2 to 4 weeks. There is a minimal charge for maps for most users, so it is advisable to call for detailed information.

27. **What types of property may be insured against flood loss?**
Almost every type of walled and roofed building that is principally above ground and not entirely over water may be insured if it is in a participating community. In most cases, this includes manufactured (i.e., mobile) homes that are anchored to permanent foundations and travel trailers without wheels that are anchored to permanent foundations and are regulated under the community's floodplain management and building ordinances or laws. (However, this does not include converted buses or vans.) Contents of insurable walled and roofed buildings also may be insured under separate coverage.

28. **What kinds of property are not insurable under the NFIP?**
Buildings entirely over water or principally below ground, gas and liquid storage tanks, animals, birds, fish, aircraft, wharves, piers, bulkheads, growing crops, shrubbery, land, livestock, roads, machinery or equipment in the open, and most motor vehicles are not insurable. Most contents and finishing materials located in a basement or in enclosures below the lowest elevated floor of an elevated building constructed after the FIRM became effective are not covered. (See "Coverage" section for coverage limitations in basements and below lowest elevated floors.) Information on the insurability of any special property may be obtained by contacting a property insurance agent or a broker.

29. **Are there certain buildings that cannot be covered?**
Flood insurance is not available for buildings that FEMA determines have been declared by a State or local zoning authority or other appropriate authority to be in violation of State or local floodplain management regulations or ordinances. No new policies can be written to cover such buildings; nor can an existing policy be renewed.

New construction or substantially improved structures located within a designated Coastal Barrier Resources System (CBRS) area are not eligible for flood insurance, but existing structures that predate CBRS designation are eligible for flood insurance coverage. These areas are located in nearly 400 communities on the Atlantic and Gulf coasts and along the Great Lakes shores, and are delineated on the communities' flood maps. If, at the time of a loss, it is determined that a post-CBRS-designation building is located in a CBRS area, the claim will be denied, the policy canceled, and the premium refunded. (See the answers to Questions 44 and 45 for a description of CBRS.)

30. **How is flood insurance purchased?**
After a community joins the NFIP, a policy may be purchased from any licensed property insurance agent or broker who is in good standing in the State in which the agent is licensed or through any agent representing a Write Your Own (WYO) company, including an employee of the company authorized to issue the coverage.

The steps leading to the purchase of a flood insurance policy are:

- A property owner or renter perceives a risk of flooding to an insurable building or its contents and elects to purchase flood insurance, or a lender making, renewing, increasing, or extending a loan, or at any time during the term of the loan, informs the builder or potential buyer that the building is in a Special Flood Hazard Area (SFHA) and flood insurance must be purchased as required by the Flood Disaster Protection Act of 1973 (PDF 446KB) and the National Flood Insurance Reform Act of 1994 (PDF 294KB). The builder or borrower contacts an insurance agent or broker or a Write Your Own (WYO) company.
- The insurance agent completes the necessary forms for the builder or buyer. In the case of a building constructed in an SFHA after the issuance of a Flood Insurance Rate Map (FIRM), the builder or buyer must obtain an elevation certificate completed by a licensed engineer, architect, surveyor, or appropriate community official.
- The insurance agent submits the application, necessary elevation certification, and full premium to the NFIP or to a participating WYO company.

31. **How are flood insurance premiums calculated?**
A number of factors are considered in determining the premium for flood insurance coverage. They include the amount of coverage purchased; location; age of the building; building occupancy; design of the building; and, for buildings in SFHAs, elevation of the building in relation to the Base Flood Elevation (BFE). Buildings eligible for special low-cost coverage at a pre-determined, reduced premium rate are single-family, one- to four-family dwellings, and non-residential buildings located in moderate-risk Zones B, C, and X. For these exceptions, certain loss limitations exist. (See the "Flood Hazard Assessment and Mapping Requirements" section for definitions of flood zones.)

32. **Is the purchase of flood insurance mandatory?**
The Flood Disaster Protection Act of 1973 and the National Flood Insurance Reform Act of 1994 mandate the purchase of flood insurance as a condition of Federal or Federally related financial assistance for acquisition and/or construction of buildings in SFHAs of any community. The purchase of flood insurance on a voluntary basis is frequently prudent even outside of SFHAs. The Acts prohibit Federal agency lenders, such as the Small Business Administration (SBA) and United States Department of Agriculture's (USDA) Rural Housing Service, and Government-Sponsored Enterprises for Housing (Freddie Mac and Fannie Mae) from making, guaranteeing, or purchasing a loan secured by improved real estate or mobile home(s) in an SFHA, unless flood insurance has been purchased, and is maintained during the term of the loan.

The Acts apply to lenders under the jurisdiction of Federal entities for lending institutions. These Federal entities include the Board of Governors of the Federal

Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Office of Thrift Supervision, the National Credit Union Administration, and the Farm Credit Administration. The Acts also require Freddie Mac and Fannie Mae to implement procedures designed to ensure compliance with the mandatory purchase requirements of the Acts.

The purchase of flood insurance does not apply to conventional loans made by Federally regulated lenders when the community in which the building is located is not participating in the NFIP. Although Federal flood insurance is not available for new construction or substantially improved structures in CBRS areas, conventional loans may be made there by Federally regulated lenders. In these cases, the lending institution is required to notify the borrower that, in the event of a flood-related Presidentially declared disaster, Federal disaster assistance will not be available for the permanent repair or restoration of the building. Federally regulated or insured lending institutions are required in all cases to notify the borrower when the building being used to secure a loan is in an SFHA.

33. **Why is there a requirement to purchase flood insurance in communities that have not suffered flooding in many years or ever?**
A major purpose of the NFIP is to alert communities to the danger of flooding and to assist them in reducing potential property losses from flooding. Therefore, FEMA determines flood risk through the use of all available information for each community. Historical flood data are only one element used in determining flood risk. More critical determinations can be made by evaluating the community's rainfall and river-flow data, topography, wind velocity, tidal surge, flood-control measures, development (existing and planned), community maps, and other data.

34. **Why is my lender requiring the purchase of flood insurance?**
For virtually every mortgage transaction involving a structure in the United States, the lender reviews the current NFIP maps for the community in which the property is located to determine its location relative to the published SFHA and completes the Standard Flood Hazard Determination Form (SFHDF). If the lender determines that the structure is indeed located within the SFHA and the community is participating in the NFIP, the borrower is then notified that flood insurance will be required as a condition of receiving the loan. A similar review and notification is completed whenever a loan is sold on the secondary loan market or perhaps when the lender completes a routine review of its mortgage portfolio. This fulfills the lender's obligation under the Flood Disaster Protection Act of 1973 and the National Flood Insurance Reform Act of 1994 that requires the purchase of flood insurance by property owners who are being assisted by Federal programs or by Federally regulated institutions in the acquisition or improvement of land, or facilities, or structures located or to be located within an SFHA.

35. **Are lenders required to escrow flood insurance payments?**
The statute requiring Federally regulated lenders, their services, and Federal

Agency lenders to escrow for flood insurance became effective on October 1, 1996. If escrow for taxes, insurance, and/or other reasons is already required, escrow for flood insurance on loans secured by improved residential real estate or mobile homes is also required. Lenders who escrow will comply 100 percent with the statutory requirement by maintaining flood insurance during the term or life of the loan.

36. **What if I disagree with my lender's determination that I am in the flood zone?**
Property owners may not contest the requirement if the lending institution has established the requirements as a part of its own standard lending practices. However, if a lending institution is requiring the insurance to meet mandatory flood insurance purchase requirements, the property owner and lender may jointly request that FEMA review the lending institution's determination. This request must be submitted within 45 days of the date the lending institution notified the property owner that a building or manufactured home is in the SFHA and flood insurance is required. In response, FEMA will issue a Letter of Determination Review (LODR). The LODR does not result in an amendment or revision to the NFIP map. It is only a finding as to whether the building or manufactured home is in the SFHA shown on the NFIP map. The LODR remains in effect until the NFIP map panel affecting the subject building or manufactured home is revised.

37. **What fees and data are required for LODRs?**
A fee of $80 must be submitted with all LODR requests. The fee payment may be in the form of a check or money order, in U.S. funds, made payable to the "National Flood Insurance Program." The fee must be accompanied by copies of the following: (1) the completed SFHDF; (2) the dated notification letter to the property owner; (3) a letter, signed by the property owner and lending institution, requesting FEMA's review; (4) an annotated copy of the effective NFIP map panel for the community showing the location of the structure or manufactured home; and (5) a copy of all material used by the lending institution or designated third party to make the determination.

38. **How many buildings or locations (and their contents) may be insured on each policy?**
Normally, only one building and its contents can be insured on each policy. The Dwelling Form of the Standard Flood Insurance Policy does provide coverage for up to 10 percent of policy amount for appurtenant detached garages but not for carports, tool and storage sheds, and the like. In addition, the Scheduled Building Policy is available to cover 2 to 10 buildings. The policy requires a specific amount of insurance to be designated for each building, and all buildings must have the same ownership and the same location.

39. **What is the flood insurance policy term?**
Flood insurance coverage is available for a 1-year term.

40. **Is there a minimum premium for a flood insurance policy?**
There is a minimum premium for all flood insurance policies. Because the minimum premium is subject to change, anyone interested in purchasing a flood insurance policy should contact a local property insurance agency or company that writes flood insurance coverage to obtain the current minimum premium amount.

41. **Is there a waiting period for flood insurance to become effective?**
There is normally a 30-day waiting period before flood insurance goes into effect. There are two exceptions:
    - If the initial purchase of flood insurance is in connection with the making, increasing, extending, or renewing of a loan, there is no waiting period. The coverage becomes effective at the time of the loan, provided the application and presentment of premium are made at or prior to loan closing.

    - If the initial purchase of flood insurance is made during the 13-month period following the revision or update of a Flood Insurance Rate Map for the community, there is a 1-day waiting period.

      In addition to the two basic exceptions, FEMA has issued a policy decision specifying the following four exceptions:

        - The 30-day waiting period will not apply when there is an existing insurance policy and an additional amount of flood insurance is required in connection with the making, increasing, extending, or renewing of a loan, such as a second mortgage, home equity loan, or refinancing. The increased amount of flood coverage will be effective as of the time of the loan closing, provided the increased amount of coverage is applied for and the presentment of additional premium is made at or prior to the loan closing.
        - The 30-day waiting period will not apply when an additional amount of insurance is required as a result of a map revision. The increased amount of coverage will be effective at 12:01 a.m. on the first calendar day after the date the increased amount of coverage is applied for and the presentment of additional premium is made.
        - The 30-day waiting period will not apply when flood insurance is required as a result of a lender's determining a loan that does not have flood insurance coverage should be protected by flood insurance. The coverage will be effective upon the completion of an application and the presentment of payment of premium.
        - The 30-day waiting period will not apply when an additional amount of insurance offered in the renewal bill is being obtained in connection with the renewal of a policy.

42. **What is "presentment of payment"?**
"Presentment of payment" is the receipt of premium and is considered to be the time payment is actually received by the NFIP or the WYO company. Delivery to an insurance agent or broker or mailing a premium by ordinary mail with placement of a postmark does not constitute presentment to the NFIP.

A premium mailed in a timely manner by certified mail and received by the NFIP is considered to have been delivered to and received by the NFIP as of the date of certification by the delivery service. (In this context, the term "certified mail" extends not only to the U.S. Postal Service but also to such third-party delivery services as Federal Express [FedEx], United Parcel Service [UPS], and courier services and the like that provide proof of mailing.) If time is short and coverage is needed, the certified mail transmittal of payment should be considered.

43. **Is there a special rating procedure applicable to coastal high hazard areas (V zones)?**
In calculating the applicable rates for buildings that were constructed or substantially improved in V zones after October 1, 1981, the actuarial formula takes into account the ability of the building to withstand the impact of wave action. The agent must follow the special instructions in the NFIP Flood Insurance Manual in preparing an application for coverage for buildings located in V zones. (See the "Flood Hazard Assessment and Mapping Requirements" section for a further explanation of V zones.)

44. **What is the Coastal Barrier Resources System?**
The U.S. Congress passed the Coastal Barrier Resources Act of 1982, and the Coastal Barrier Improvement Act of 1990, defining and establishing a system of protected coastal areas (including the Great Lakes) known as the Coastal Barrier Resources System (CBRS) and Otherwise Protected Areas (OPAs). The Acts define areas within the CBRS as depositional geologic features consisting of unconsolidated sedimentary materials; subject to wave, tidal and wind energies; and protecting landward aquatic habitats from direct wave attack. The Acts further define coastal barriers as "all associated aquatic habitats, including the adjacent wetlands, marshes, estuaries, inlets and near shore waters, but only if such features and associated habitats contain few manmade structures and these structures and man's activities on such features, and within such habitats do not significantly impede geomorphic and ecological processes." Otherwise Protected Areas (OPAs) means an undeveloped coastal barrier within the boundaries of an area established under Federal, State, or local law, or held by a qualified organization, primarily for wildlife refuge, sanctuary, recreational, or natural resource conservation purposes. The Acts provide protection to CBRS areas by prohibiting most expenditures of Federal funds within the CBRS. These prohibitions refer to "any form of loan, grant, guarantee, insurance, payment, rebate, subsidy or any other form of direct or indirect Federal assistance," with specific and limited exceptions.

45. **Is Federal flood insurance available in CBRS?**
Federal flood insurance is available in a CBRS area if the subject building was constructed (or permitted and under construction) before the CBRS area's effective date. For CBRS areas designated by the 1982 Act, the sale of Federal flood insurance is prohibited for structures built or substantially improved after October 1, 1983. For subsequent additions to the CBRS, the insurance prohibition date is shown on the Flood Insurance Rate Map (FIRM). For structures located in OPAs, insurance may be obtained if written documentation is provided certifying that the structure is used in a manner consistent with the purpose for which the area is protected. If an existing insured structure is substantially improved or damaged, any Federal flood insurance policy will not be renewed. If a Federal flood insurance policy is issued in error, it will be canceled and the premium refunded; no claim can be paid, even if the error is not found until a claim is made.

46. **Can flood insurance be cancelled at the request of the insured with a refund of premium?**
Flood insurance can be canceled, and a refund can be issued, only in certain circumstances, because all of the premium is fully earned on the first day of the policy term. Premium will be refunded on a pro-rata basis when the policyholder no longer owns or has an insurable interest in the insured property, provided no claim has been paid or is pending. There are other limited cancellation provisions for the refunding of premium. To discuss cancellation criteria and procedures, policyholders should contact the insurance agent who wrote the policy or call the NFIP toll-free at 1-800-427-4661.

47. **Is there a "grace period" for an insured under the NFIP policy conditions?**
All policies expire at 12:01 a.m. on the last day of the effective term. (For the ease and convenience of insurance agents and brokers, lenders, and policyholders, NFIP rules allow for "renewal" of expiring policies and no new application is required.) Coverage remains in force for 30 days after the expiration of the policy, and claims for losses that occur in the period will be honored providing the full renewal premium is received by the end of the 30-day period. Coverage also remains in force for any mortgagee named in the policy for 30 days after written notice to the mortgagee of the expiration of a policy.

48. **What is the requirement for purchasing flood insurance after receiving disaster assistance?**
The NFIRA requires individuals in SFHAs who receive disaster assistance after September 23, 1994, for flood disaster losses to real or personal property to purchase and maintain flood insurance coverage for as long as they live in the dwelling. If flood insurance is not purchased and maintained, future disaster assistance will be denied. If the structure is sold, the current owner is required to notify the buyer of the house of the need to purchase and maintain flood insurance. If the buyer is not notified, suffers uninsured flood losses, and receives Federal disaster assistance, the seller may be required to repay the Federal Government any Federal disaster assistance the buyer received.

3.2.3 Coverage

49. **How much flood insurance coverage is available?**
The following coverage limits are available under the Dwelling Form and the General Property Form of the Standard Flood Insurance Policy. Coverage limits under the Residential Condominium Building Association Policy are listed in the NFIP Flood Insurance Manual.

	Emergency Program	**Regular Program**
Building Coverage		
Single-family dwelling*	$ 35,000*	$250,000
Other residential*	$35,000*	$250,000
Other residential	$100,000*	$250,000
Non-residential	$100,000*	$500,000
Contents Coverage		
Residential	$ 10,000	$100,000
Non-residential including Small Business	$100,000	$500,000

50. **Under the Emergency Program, higher limits of building coverage are available in Alaska, Hawaii, the U.S. Virgin Islands, and Guam**.

52. **Are there limitations on the amount of insurance available for certain types of property?**
General coverage limitations are explained in the answers to Questions 28 and 29. In addition, items such as artwork, photographs, collectibles, memorabilia, rare books, autographed items, jewelry, watches, gems, articles of gold, silver, or platinum and furs are limited to $2,500 coverage in the aggregate. This limitation does not apply to other items that are personal property or household contents usual or incidental to the occupancy of the building as a residence. For other limitations under the Standard Flood Insurance Policy, see the current policy or contact a property insurance agent or broker.

53. **What flood losses are covered?**
The Standard Flood Insurance Policy (SFIP) Forms contain complete definitions of the coverages they provide. Direct physical losses by "flood" are covered. Also covered are losses resulting from flood-related erosion caused by waves or currents of water activity exceeding anticipated cyclical levels, or caused by a severe storm, flash flood, abnormal tidal surge, or the like, which result in flooding, as defined. Damage caused by mudflows, as specifically defined in the policy forms, is covered.

54. **What coverage is available in basements and in enclosed areas beneath the lowest elevated floor of a elevated building?**
Coverage is provided for foundation elements, including posts, pilings, piers, or other support systems for elevated buildings. Coverage also is available for basement and enclosure utility connections, certain mechanical equipment necessary for the habitability of the building, such as furnaces, hot water heaters, clothes washers and dryers, food freezers, air conditioners, heat pumps, electrical junctions, and circuit breaker boxes. Finished structural elements such as paneling and linoleum, and contents items such as rugs and furniture are not covered. The SFIP has a complete list of covered elements and equipment.

55. **What is a basement?**
The NFIP's definition of "basement" includes any part of a building where all sides of the floor are located below ground level. Even though a room may have windows and constitute living quarters, it is still considered to be a basement if the floor is below ground level on all sides.

56. **Are losses from land subsidence, sewer backup, or seepage of water covered?**
We will pay for losses from land subsidence under certain circumstances. Subsidence of land along a lake shore or similar body of water, which results from the erosion or undermining of the shoreline caused by waves or currents of water exceeding cyclical levels that result in a flood, is covered. All other land subsidence is excluded.

We do not insure for direct physical loss caused directly or indirectly by any of the following:

- Back ups through sewers or drains; or
- Discharges or overflows from a sump, sump pump, or related equipment;
- Seepage or leaks on or through the covered property; unless there is a general condition of flooding in the area and the flood is the proximate cause of the sewer or drain backup, sump pump discharge or overflow, or seepage of water.

57. **Does the NFIP apply a deductible to losses?**
A minimum deductible is applied separately to a building and its contents, although both may be damaged in the same flood. Higher deductibles are available, and an insurance agent can provide information on specific amounts of available deductibles. Optional high deductibles reduce policy premiums but will have to be approved by the mortgage lender.

58. **Are costs of preventive measures covered under the SFIP?**
Some are. When an insured building is in imminent danger of being flooded, the reasonable expenses incurred by the insured for removal of insured contents to a safe location and return will be reimbursed up to $1,000, and the purchase of sandbags and sand to fill them, plastic sheeting and lumber used in connection

with them, pumps, fill for temporary levees, and wood will be reimbursed up to $1,000. No deductible is applied to this coverage.

59. **Does insurance under the NFIP provide coverage at replacement cost?**
Only for single-family dwellings and residential condominium buildings, if several criteria are met. Replacement cost coverage is available for a single-family dwelling, including a residential condominium unit that is the policyholder's principal residence and is insured for at least 80 percent of the unit's replacement cost at the time of the loss, up to the maximum amount of insurance available at the inception of the policy term. Replacement cost coverage does not apply to manufactured (i.e., mobile) homes smaller than certain dimensions specified in the policy. Losses are adjusted on a replacement cost basis for residential condominium buildings insured under the Residential Condominium Building Association Policy (RCBAP). The principal residence and the 80 percent insurance to value requirements for single-family dwellings do not apply to the RCBAP. However, coverage amounts less than 80 percent of the building's full replacement cost value at the time of loss will be subject to a co-insurance penalty.

Contents losses are always adjusted on an actual cash value basis. If the replacement cost conditions are not met, the building loss is also adjusted on an actual cash value basis. Actual cash value means the replacement cost of an insured item of property at the time of loss, less the value of physical depreciation as to the item damaged.

60**. Does the flood insurance dwelling policy provide additional living expenses, if the insured dwelling is flood damaged and cannot be occupied while repairs are being made?**
No. The policy only covers direct physical flood damage to the dwelling and does not provide additional living expenses.

61. **What is Increased Cost of Compliance coverage**?
Increased Cost of Compliance (ICC) coverage under the Standard Flood Insurance Policy (SFIP) provides for the payment of a claim to help pay for the cost to comply with State or community floodplain management laws or ordinances from a flood event in which a building has been declared substantially damaged or repetitively damaged. When an insured building is damaged by a flood and the State or community declares the building to be substantially damaged or repetitively damaged, ICC coverage will help pay for the cost to elevate, floodproof, demolish, or relocate the building up to a maximum benefit of $30,000. This coverage is in addition to the building coverage for the repair of actual physical damages from flood under the SFIP.

62. **Is there a limit to the amount a policyholder can collect under ICC coverage?**
Yes. The maximum amount a policyholder may collect under ICC is $30,000. This amount is in addition to the amount the policyholder receives for physical

damages by flood. The total amount the policyholder receives for combined physical structural damage from flood and ICC is always capped by the maximum limit of coverage established by Congress. The maximum amount collectible for both ICC and physical damage from flood for a single-family dwelling is $250,000.

63. **Is ICC coverage included in all Standard Flood Insurance Policies?**
No. Insured under the Group Flood Insurance Policy and insured’s with condominium unit owner's coverage are ineligible for ICC coverage. Policies issued or renewed in Emergency Program communities are not eligible for ICC coverage. All other policies include the coverage.

3.2.4 Filing a Flood Insurance Claim

64. **How does a policyholder file a claim for flood loss?**
A flood insurance policyholder should immediately report any flood loss to the insurance company or agent who wrote the policy. A claims adjuster will be assigned the loss, and the policyholder must file a "proof of loss" within 60 days of the date of loss. A policyholder whose policy is with a WYO company must follow the company's claim procedures. The 60-day time limit for filling a proof of loss remains the same.

65. **What is a "proof of loss"?**
A proof of loss-the policyholder's valuation of claimed damages-is a sworn statement made by the policyholder that substantiates the insurance claim and is required to be submitted to the NFIP or WYO company within 60 days of the loss. A printed form usually is available from the adjuster assigned to the claim.

66. **What is a "loss in progress"?**
A loss in progress occurs when actual flood damage to a building or its contents started before the inception of the policy.

67. **Is a loss in progress covered?**
The NFIP does not cover damage caused by a loss in progress under any of the flood insurance policies.

68. **What is the maximum that can be collected for a loss under the NFIP policy?**
An insured will never be paid more than the value of the covered loss, less deductible, up to the amounts of insurance purchased. Therefore, purchasing insurance to value is an important consideration. The amount of insurance a property owner needs should be discussed with an insurance agent or broker.

3.2.5 Floodplain Management Requirements

69. **What is the role of the community in floodplain management?**
When the community chooses to join the NFIP, it must adopt and enforce minimum floodplain management standards for participation. FEMA works

closely with State and local officials to identify flood hazard areas and flood risks. The floodplain management requirements within the SFHA are designed to prevent new development from increasing the flood threat and to protect new and existing buildings from anticipated flood events.

When a community chooses to join the NFIP, it must require permits for all development in the SFHA and ensure that construction materials and methods used will minimize future flood damage. Permit files must contain documentation to substantiate how buildings were actually constructed. In return, the Federal Government makes flood insurance available for almost every building and its contents within the community.

Communities must ensure that their adopted floodplain management ordinance and enforcement procedures meet program requirements. Local regulations must be updated when additional data are provided by FEMA or when Federal or State standards are revised.

70. **Do State governments assist in implementing the NFIP?**
At the request of FEMA, each Governor has designated an agency of State or territorial government to coordinate that State's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures.

Some States require more stringent measures than those of the NFIP. For contact information, see the list of State Coordinating Agencies in the back of this booklet.

71. **Do Federal requirements take precedence over State requirements?**
The regulatory requirements set forth by FEMA are the minimum measures acceptable for NFIP participation. More stringent requirements adopted by the local community or State take precedence over the minimum regulatory requirements established for flood insurance availability.

72. **What is meant by "floodplain management measures"?**
"Floodplain management measures" refers to an overall community program of corrective and preventive measures for reducing future flood damage. These measures take a variety of forms and generally include zoning, subdivision, or building requirements, and special-purpose floodplain ordinances.

73. **Do the floodplain management measures required by the NFIP affect existing buildings?**
The minimum Federal requirements affect existing buildings only when an existing building is substantially damaged or improved. There may also be situations where a building has been constructed in accordance with a local floodplain management ordinance, and the owner subsequently alters it in violation of the local building code, without a permit. Such unapproved

modifications to an existing building may not meet the minimum Federal requirements.

74. **What constitutes "substantial improvement" or "substantial damage"?**
"Substantial improvement" means any rehabilitation, addition, or other improvement of a building when the cost of the improvement equals or exceeds 50 percent of the market value of the building before start of construction of the improvement. The term includes buildings that have incurred "substantial damage." "Substantial damage" means damage of any origin sustained by a building when the cost of restoring the building to its pre-damaged condition would equal or exceed 50 percent of the market value of the building before the damage occurred. Substantial damage is determined regardless of the actual repair work performed.

    Substantial improvement or damage does not, however, include any project for improvement of a building to correct existing violations of State or local health, sanitary, or safety code specifications identified by local code enforcement officials as the minimum specifications necessary to assure safe living conditions. Also excluded from the substantial improvement requirement are alterations to historic buildings as defined by the NFIP.

75. **Do the floodplain management requirements apply to construction taking place outside the SFHAs within the community?**
The local floodplain management regulations required by the NFIP apply only in SFHAs. However, communities may regulate development in areas of moderate flood hazard.

76. **Can modifications be made to the basic floodplain management requirements?**
In developing their floodplain management ordinances, participating communities must meet at least the minimum regulatory standards issued by FEMA. NFIP standards and policies are reviewed periodically and revised whenever appropriate.

77. **Does elevating a structure on posts or pilings remove a building from the Special Flood Hazard Area (SFHA)?**
Elevating a structure on posts or pilings does not remove a building from the SFHA. If the ground around the supporting posts or pilings is within the floodplain, the building is still at risk. The structure is considered to be within the floodplain, and flood insurance will be required as a condition of receipt of Federal or Federally related financing for the structure. The reason for this, even in cases where the flood velocity is minimal, is that the hydrostatic effects of flooding can lead to the failure of the structure's posts or pilings foundation. The effects of ground saturation can lead to decreased load bearing capacity of the soil supporting the posts or pilings, which can lead to partial or full collapse of the structure. Even small areas of ponding will be subject to the hydrodynamic effects

of flooding; no pond or lake is completely free of water movement or wave action. This movement of water can erode the ground around the posts or pilings and may eventually cause collapse of the structure.

3.2.6 Flood Hazard Assessments and Mapping Requirements

78. **What is the difference between an FHBM and a FIRM?**
A Flood Hazard Boundary Map (FHBM) is based on approximate data and identifies, in general, the SFHAs within a community. It is used in the NFIP's Emergency Program for floodplain management and insurance purposes. A Flood Insurance Rate Map (FIRM) usually is issued following a flood risk assessment conducted in connection with the community's conversion to the NFIP's Regular Program. If a detailed assessment, termed a Flood Insurance Study (FIS), has been performed, the FIRM will show Base Flood Elevations (BFEs) and insurance risk zones in addition to floodplain boundaries. The FIRM may also show a delineation of the regulatory floodway. (See the answer to Question 80 for a description of "regulatory floodway.") After the effective date of the FIRM, the community's floodplain management ordinance must be in compliance with appropriate Regular Program requirements. Actuarial rates, based on the risk zone designations shown on the FIRM, are then applied for newly constructed, substantially improved, and substantially damaged buildings.

79. **How are flood hazard areas and flood levels determined?**
Flood hazard areas are determined using statistical analyses of records of riverflow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. The FIS covers those areas subject to flooding from rivers and streams, along coastal areas and lake shores, or shallow flooding areas.

80. **What is the role of the local community in its flood hazard assessment?**
In conducting a FIS, FEMA considers all available information for use in the study. Public meetings are usually held with community officials and other interested parties in an effort to obtain all relevant information to help ensure accurate study results. FEMA also works closely with community officials before and during the study to describe technical and administrative procedures and to obtain community input before the FIRM and collateral FIS report are published. Before the FIS is initiated, FEMA representatives, the selected contractor, and community officials meet to discuss the areas to be studied and the level of study required. This meeting is called a "time and cost" meeting.

81. **What flood hazard zones are shown on the Flood Insurance Rate Map and what do they mean?**
Several areas of flood hazard are commonly identified on the FIRM. One of these areas is the SFHA, which is defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent-annual-chance flood is also referred to as the "base flood." SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone 99,

Zone AR, Zone AR/AE, Zone AR/AH, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30. Moderate flood hazard areas, labeled Zone B or Zone X (shaded), are also shown on the FIRM, and are the areas between the limits of the base flood and the 0.2-percent-annual-chance. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled Zone C or Zone X (unshaded). The definitions for the various flood hazard areas are presented below.

Zone V: Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Because detailed hydraulic analyses have not been performed, no BFEs or flood depths are shown. Mandatory flood insurance purchase requirements apply.

Zones VE and V1-V30: Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. BFEs derived from detailed hydraulic analyses are shown within these zones. Mandatory flood insurance purchase requirements apply. (Zone VE is used on new and revised maps in place of Zones V1-V30.)

Zone A: Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no BFEs or flood depths are shown. Mandatory flood insurance purchase requirements apply.

Zones AE and A1-A30: Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. BFEs are shown within these zones. Mandatory flood insurance purchase requirements apply. (Zone AE is used on new and revised maps in place of Zones A1-A30.)

Zone AH: Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements apply.

Zone AO: Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone A99: Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. Zone A99 may only be used when the flood protection system has reached specified statutory progress toward completion. No BFEs or flood depths are shown. Mandatory flood insurance purchase requirements apply.

Zone AR: Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection. Mandatory flood insurance purchase requirements apply.

Zones AR/AE, AR/AH, AR/AO, AR/A1-A30, AR/A: Dual flood zones that, because of the risk of flooding from other water sources that the flood protection system does not contain, will continue to be subject to flooding after the flood protection system is adequately restored. Mandatory flood insurance purchase requirements apply.

Zones B, C, and X: Areas identified in the community FIS as areas of moderate or minimal hazard from the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local stormwater drainage systems are not normally considered in the community's FIS. The failure of a local drainage system creates areas of high flood risk within these rate zones. Flood insurance is available in participating communities but is not required by regulation in these zones. (Zone X is used on new and revised maps in place of Zones B and C.)

Zone D: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

82. **What is a regulatory floodway and who designates it?**
The regulatory floodway, which is adopted into the community's floodplain management ordinance, is the stream channel plus that portion of the overbanks that must be kept free from encroachment in order to discharge the 1-percent-annual-chance flood without increasing flood levels by more than 1.0 foot (some states specify a smaller allowable increase). The intention of the floodway is not to preclude development. Rather, it is intended to assist communities in prudently and soundly managing floodplain development and prevent additional damages to other property owners. The community is responsible for prohibiting encroachments, including fill, new construction, and substantial improvements, within the floodway unless it has been demonstrated through hydrologic and hydraulic analyses that the proposed encroachment will not increase flood levels within the community. In areas that fall within the 1-percent-annual-chance floodplain, but are outside the floodway (termed the "floodway fringe"), development will, by definition, cause no more than a 1.0-foot increase in the 1-percent-annual-chance water-surface elevation. Floodplain management through the use of the floodway concept is effective because it allows communities to develop in flood prone areas if they so choose, but limits the future increases of flood hazards to no more than 1.0 foot.

83. **What procedures are available for changing or correcting a Flood Insurance Rate Map?**
FEMA has established administrative procedures for changing effective FIRMs and FIS reports based on new or revised scientific or technical data. A physical change to the affected FIRM panels and portions of the FIS report is referred to as a "Physical Map Revision," or "PMR." Changes can also be made by a Letter of Map Change (LOMC). The three LOMC categories are Letter of Map Amendment (LOMA), Letter of Map Revision based on Fill (LOMR-F), and Letter of Map Revision (LOMR). These LOMC categories are discussed in more detail later.

84. **What comprises technical or scientific data?**
In general, the scientific or technical data needed to effect a map amendment or revision include certified topographic data and/or hydrologic and hydraulic analyses to support the request for amendment or revision.

85. **What is a Physical Map Revision (PMR)?**
A PMR is an official republication of a community's NFIP map to effect changes to BFEs, floodplain boundary delineations, regulatory floodways, and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas, or correction to BFEs or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed, and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When BFEs are changed, a 90-day appeal period is provided. A 6-month period for formal approval of the revised map(s) is also provided.

86. **What is a Letter of Map Revision Based on Fill (LOMR-F)?**
A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the BFE and is, therefore, excluded from the SFHA.

87. **What is a Letter of Map Amendment (LOMA)?**
A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative procedure that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in an SFHA.

88. **What is a Letter of Map Revision (LOMR)?**
A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations, and

planimetric features. All requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

89. **What is a conditional map revision?**
NFIP maps must be based on existing, rather than proposed, conditions. Because flood insurance is a financial protection mechanism for real-property owners and lending institutions against existing hazards, flood insurance ratings must be made accordingly. However, communities, developers, and property owners often undertake projects that may alter or mitigate flood hazards and would like FEMA's comment before constructing them. A Conditional Letter of Map Revision (CLOMR) is FEMA's formal review and comment as to whether a proposed project complies with the minimum NFIP floodplain management criteria. If it is determined that it does, the CLOMR also describes any eventual revisions that will be made to the NFIP maps upon completion of the project.

While obtaining a CLOMR may be desired, obtaining conditional approval is not automatically required by NFIP regulations for all projects in the floodway or 1-percent annual chance floodplain. A CLOMR is required only for those projects that will result in a 1-percent annual chance water surface elevation increase of greater than 1.00 foot for streams with BFEs specified, but no floodway designated, or any 1-percent annual chance water surface elevation increase for proposed construction within a regulatory floodway. The technical data needed to support a CLOMR request generally involve detailed hydrologic and hydraulic analyses and are very similar to the data needed for a LOMR request.

In addition to the situations described above, property owners and developers who intend to place structures in the 1-percent annual chance floodplain may need to demonstrate to the lending institutions and local officials before construction that proposed structures will be above the base flood elevation. If the project involves only the elevation of structures on natural high ground, they can request a Conditional Letter of Map Amendment (CLOMA) from FEMA. If the elevation of structures on earthen fill is the sole component of the project (i.e., there is no associated channelization, culvert construction, etc., that would alter flood elevations) and there is no fill placed in the regulatory floodway, they can request from FEMA a CLOMR based on fill or a CLOMR-F. Requests for CLOMAs and CLOMRS should be made by the community and addressed to the Mitigation Division Director at the appropriate FEMA Regional Office. The addresses of all FEMA Regional Offices are provided in the back of this booklet. Until a LOMR is issued, this property remains in the floodplain and is subject to the community floodplain management ordinance and the mandatory flood insurance purchase requirements.

90. **Who should be contacted in FEMA to initiate a LOMA, LOMR, or Physical Map Revision?**
Requests for conditional and final map revisions should be sent to the FEMA LOMA Depot. Any questions regarding LOMA/LOMR should be directed to one of FEMA's Flood Map Specialists. Contact information is provided in the "FEMA LOMA Depot" section at the back of this booklet.

91. **How long does it take to obtain a LOMA, LOMR, or PMR?**
For single-building or single-lot determinations that do not involve changes to BFEs or floodways, a LOMA or LOMR-F generally can be issued within 4 weeks. LOMAs and LOMRs involving multiple lots or multiple buildings require up to 8 weeks to process. Times are specified from the date of receipt of all technical, scientific, or legal documentation. LOMRs involving decreases in BFEs or floodways take approximately 90 days for processing. If changes in flooding conditions are extensive or if BFEs increase, a PMR will be required, which will take 12 months or longer.

92. **If a LOMA, LOMR-F, or LOMR is issued by FEMA, will a lending institution automatically waive the flood insurance requirement?**
Although FEMA may issue a LOMA, it is the lending institution's prerogative to require flood insurance as a condition of its own beyond the provisions of the Flood Disaster Protection Act of 1973 and the National Flood Insurance Reform Act of 1994, before granting a loan or mortgage. Those seeking a LOMA should first confer with the affected lending institution to determine whether the institution will waive the requirement for flood insurance if a LOMA is issued. If it will, the policyholder may cancel flood insurance coverage and obtain a premium refund. If not, amending the NFIP map to remove the structure from the SFHA will generally lower the flood insurance premium.

93. **If a LOMA, LOMR-F, or LOMR is granted and the lender waives the requirement for flood insurance, how can a flood insurance policy be cancelled?**
To effect a cancellation of a flood insurance policy, the policyholder must supply a copy of the LOMA, LOMR-F, or LOMR and a waiver for the flood insurance purchase requirement from the lending institution to the insurance agent or broker who services the policy. A completed cancellation form with the LOMA, LOMR-F, or LOMR and the waiver must be submitted by the agent to the NFIP or the appropriate WYO company. When a LOMA, LOMR-F, or LOMR is issued and cancellation requested, the policyholder may be eligible for a refund of the premium paid for the current policy year only if no claim is pending and no claim has been paid during the current policy year.

94. **Why is the burden of proof on the person requesting a map change?**
FEMA and its Federal and private-sector contractors exercise great care to ensure that analytical methods employed in FISs are scientifically and technically correct, the engineering practices followed meet professional standards, and the

results of the FIS are accurate. In making amendments and revisions to NFIP maps and reports, FEMA must adhere to the same engineering standards applied in preparing the effective maps and reports. Therefore, when requesting changes to NFIP maps, community officials and property owners are required to submit adequate supporting data. FEMA would have no justification for changing a flood hazard determination without sufficient evidence that the change is appropriate.

95. **Are fees assessed for map change requests submitted by community officials, developers, and property owners?**
To minimize the financial burden on the policyholders while maintaining the NFIP as self-sustaining, FEMA implemented procedures to recover costs associated with reviewing and processing requests for conditional and final map amendments and map revisions. The fee schedule for these requests is published in the Federal Register and applies to all types of requests except those that are specifically exempted in Section 72.5(c) of the NFIP Regulations. Community officials and other individuals who have questions regarding the required review and processing fees should contact the appropriate FEMA Regional Office as listed at the back of this booklet.

96. **What is the purpose of the application/ certification forms that are required for map change requests?**
FEMA implemented the use of forms for requesting revisions or amendments to NFIP maps to provide a step-by-step process for requesters to follow. The forms are comprehensive; therefore, requesters are reasonably assured of preparing a complete request that includes all the necessary support data without having to go through an iterative process of providing additional information in a piecemeal fashion. Experience has shown piecemeal submissions to be time-consuming and expensive. Also, because use of the forms assures the requesters' submissions are complete and more logically structured, FEMA can complete its review in a shorter time frame. While completing the forms may appear to be burdensome, FEMA believes it is prudent to do so because of the advantages that result for the requester.

97. **How can someone obtain copies of the technical data used in preparing the published NFIP maps?**
Technical supporting data may be obtained by contacting a FEMA Flood Map Specialist listed in the "FEMA LOMA Depot" section at the back of this booklet. The letter should give the name of the community for which the data are sought, provide specific information as to the portion of the community and type of data needed, and give the requester's name and telephone number. Before the request is serviced, a representative will call to discuss the request. If a charge is necessary for the service, the extent of the service and the costs will be discussed during the call.

3.3 Contacts for the NFIP

The Alaska State Coordinator for Floodplain Management Programs is Tannie Boothby, who is located in the Division of Community Advocacy of the Alaska Department of Commerce Community and Economic Development. The office is in Anchorage, AK, at 550 West 7th Avenue, Suite 1770, telephone: (907) 269-4583. The web site is: http://www.commerce.state.ak.us/dca.

The FEMA office responsible for the state of Alaska is Region X in Bothell, Washington. The Region X NFIP contact's office is located at 19125 Northcreek Parkway, Suite 108, telephone: (425) 482-0316.
Information on FEMA Region X can be found at the Region's web site at: http://www.fema.gov/about/contact/regionx.shtm.
Additional information on the NFIP can be found on the Floodsmart web site at: http://www.floodsmart.gov/floodsmart/pages/about/nfip_about.jsp.

SECTION 4.0 GLOSSARY

Accretion: The buildup of land along the shore. Natural accretion occurs by the action of forces of nature. Artificial accretion occurs by the action of man (groin, breakwater, etc.).

Alignment: The course along which the centerline of a channel, levee, road, etc. is located.

Alluvium: Material (soil, sand, mud, etc.) deposited by moving water.

Alongshore: Parallel to or near the shoreline.

Armor Stone: Relatively large quarry stone or concrete shape selected for its geometric characteristics and density.

Ballasting: Filling of the ship's ballast tanks with sea water for stability and maneuverability.

Bank: Rising ground bordering a lake, river, or sea.

Bar: Submerged or emerged embayment of sand, gravel, or other unconsolidated material built on the sea floor in shallow water by waves and currents.

Barrier Beach: A bar essentially parallel to shore the crest of which is above normal high water level.

Barrier Island: A detached portion of a barrier beach between two inlets. (e.g., Cooper Island)

Barrier Lagoon: A bay roughly parallel to the coast and separated from the open ocean by barrier islands. (e.g., Elson Lagoon)

Barrier Spit: Similar to a barrier island, but connected to the mainland. (e.g., Point Barrow)

Base Flood Elevation: The flood with a one-percent chance of occurring in any year (also referred to as the 100-year flood).

Bathymetry: The measurement of depths of water in oceans, seas, and lakes.

Benthic: Relating to or occurring at the bottom of a body of water.

Bluff: A high, steep bank or cliff.

Bollard: A mooring device mounted on a dock that is used for securing a ship's mooring line.

Borrow Site: Site from which construction materials would be extracted.

Breakwater: A man-made structure protecting a shore area, harbor, or basin from waves.

Channel: The part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation.

Coastal High Hazard Area: That part of the coastal floodplain where wave heights during the base flood will be three feet or more.

Controlling Depth: The least depth in the navigable parts of a waterway, governing the maximum draft of vessels that can enter.

Current: The flowing of water or other liquid or gas.

Cost Apportionment: The process by which construction and operation & maintenance costs for a project are divided between the Federal government and the non-Federal local project sponsor.

Cross Section: surveyed information that describes a linear feature (road, dike, beach, etc.) at a particular point.

Day Mark: A visual navigational aid used by pilots for aligning a ship's path with a channel or fixing a position.

Design Capacity: The capacity on which basis design calculations are made. Usually, the design capacity equals the peak capacity or higher, depending on the degree of "safety factors" applied.

Dike: Earth structure along sea or river that protects low lands from flooding by high waters.

Draft: The vertical distance between a ship's waterline and its keel.

Dredging: Excavating the bottom or shoreline of a water body.

Eminent Domain: Governmental power to acquire a property without the owner's consent.

Executive Order 11988-Floodplain Management: A directive by the President that sets procedures that Federal Agencies must follow before they take or fund an action in the floodplain.

Executive Order 12898-Environmental Justice: A directive by the President that requires Federal Agencies to address disproportionately high and adverse human health and environmental effects on minority and low income populations.

Fetch: The area in which waves are generated by a wind having a constant direction and speed.

Flood-Coastal: High levels of coastal waters associated with severe storms, possibly combined with unusually high tides.

Floodplain: Any land area susceptible to being inundated by flood waters of any source.

Floodproofing: Protective measures added or incorporated in a building that is not elevated above the base flood elevation to prevent or minimize flood damage.

Floodproofing, Dry: Measures designed to keep water from entering a building.

Floodproofing, Wet: Measures that minimize damage to a structure and its contents from water that is allowed to enter a building.

Flood-Riverine: A periodic overbank flow of rivers and streams due to heavy and/or sustained rainfall.

Gabion: Steel wire-mesh basket that holds stones or crushed rock to protect a bank or bottom from erosion.

Gravel: Unconsolidated natural accumulation of rounded rock fragments coarser than sand but finer than pebbles (2-4mm diameter).

Gravity Structure: A structure that derives its lateral load resistance primarily by virtue of its weight. (e.g., caissons and sheetpile cells).

Groin: Narrow, roughly shore-normal structure built to reduce longshore currents and/or trap and retain littoral material.

Ice Scour: Ice forms in the open ocean and along the shore. As ice moves, it cracks, breaks, merges, often forming pressure ridges that have deep keels that impact and scour the near shore sea bottom and the beach.

Ivu: Floating ice is pushed by winds and/or currents onto the shore and inland, possibly damaging structures and facilities and endangering residents.

Jackup Barge: A floating barge equipped with retractable legs and jacks. After floating the barge into position, the legs are lowered to the sea bottom, and the jacks are used to elevate the barge hull on the legs to an elevation above the surface of the water.

Knot: A speed of one nautical mile per hour (one nautical mile = 1852 meters or 6,076.115 feet)

Lighter: A barge used for transporting goods between ships and shore in shallow water.

Littoral Drift: The sedimentary material moved in the littoral zone under the influence of waves and currents.

Littoral Zone: An indefinite zone extending seaward from the shoreline to just beyond the breaker zone.

Load (sediment load): The quantity of sediment transported by a current, including the suspended load of small particles, and the bedload of large particles that move along the bottom.

Longshore: Parallel to and near the shoreline.

Mean Lower Low Water: The average height of the lower low waters over a 19 year period. The lower low waters are the lowest of the two low waters in any tidal day.

Market Value: The price a willing buyer and a willing seller agree upon.

Mooring Buoy: A floating buoy equipped with a mooring hook that is used for mooring a ship at a berth.

National Economic Development Plan (NED Plan): The alternative plan that maximizes national economic development according to COE criteria.

Nautical Mile: The length of a minute of arc, 1/21,600 of an average great circle of the earth. Generally one minute of latitude is considered equal to one nautical mile. One nautical mile = 6,076.115 feet or 1.15 statute miles or 1,852 meters.

Navigable Waters: Waters that are either tidally-influenced, navigable in fact, or navigable in law.

Nearshore: An indefinite zone extending seaward from the shoreline well beyond the breaker zone (typically to water depths of 20 meters).

Non-structural Risk Reduction Measures: Measures that reduce risk by modifying the characteristics of buildings and structures subject to risk or modify the behavior of persons who live in the risk area. Typical non-structural measures would be administrative tools such as flood plain regulations and building codes, elevation of buildings, floodproofing of buildings, relocation of buildings and buyout & demolition of buildings.

Nourishment: The process of replenishing a beach either naturally by longshore transport or artificially by the addition of materials from another location.

Optimization: The application of a technique to identify parameters that maximize net economic benefit.

Permafrost: Perennially frozen ground,

Polynya: Semi-permanent open lead in sea ice.

Ponding: Runoff that collects in depressions and can not drain out.

Probability: A statistical term having to do with the size of a flood and the odds of that size of flood occurring in any year.

Profile: A graph that shows elevations of linear features.

Refraction: The process by which the direction of a wave moving in shallow water at an angle to the contours is changed. The part of the wave advancing in shallower water moves more slowly than the part still advancing in deeper water, causing the wave crest to bend toward alignment with the underwater contours.

Revetment: A facing of stone, concrete, etc. built to protect an embankment or shore structure against erosion by wave action or currents.

Riprap: A protective layer of quarrystone, usually well graded within wide size limits, randomly placed to prevent erosion, scour, or sloughing of an embankment or bluff.

Rock Anchor: In the context of a piled marine structure, a rock anchor is a method of anchoring piling to underlying bedrock, as a means of resisting uplift forces generated by lateral loads on the structure (generally caused by ice, waves, wind, or ship berthing).

Run up: The rush of water up a structure or beach on the breaking of a wave. The amount of run up is the vertical height above stillwater level that the rush of water reaches.

Sand: Sediment particles with a diameter between 0.062 mm and 2 mm, generally classified as fine, medium, coarse, or very coarse.

Scour: Removal of underwater material by waves and currents, especially at the base or toe of a shore structure.

Sediment: Loose, fragments of rocks, minerals, or organic material that are transported from their source for varying distances and deposited by air, wind, ice, and/or water.

Sheet flow: Floodwater that spreads out over a large area that does not have defined channels at a somewhat uniform depth.

Significant Wave Height: The average height of one-third of the highest waves of a given wave group.

Seismic: Related to or caused by earthquakes or man-made earth tremors.

Stationing: Determining the distance along a linear feature.

Storm Surge: A rise above normal water level on the open coast due to the action of wind stress on the water surface.

Structural Risk Reduction Measure: Measures that reduce risk by modifying the characteristics of the flood or erosion event. They do not modify the characteristics of buildings and structures at risk or modify the behavior of persons in the risk area. Typical structural measures would be revetments, groins, breakwaters, beach nourishment, etc.

Tombolo: A sand or gravel bar connecting an island with the mainland or another island.

Utilador: An insulated conduit that carries utilities (water, sewer, power, phone, etc) either above ground or underground.

Wave Height: The vertical distance between a crest and a preceding trough.

Wave Period: The time for a wave crest to traverse a distance equal to one wavelength. The time for two successive wave crests to pass a fixed point.

Wave Response: A hydrodynamic effect on a ship's hull caused by waves.

Wave Run up: Wave run up occurs when waves hit the shore and the water is moving with such a force that it keeps traveling inland.

Wind Set up: The difference in stillwater levels on the windward and leeward sides of a body of water caused by wind stresses on the surface of the water.

SECTION 5.0 UNITS, ABBREVIATIONS, AND ACRONYMS

Ac	acres
ACHP	Advisory Council of Historic Preservation
ACMP	Alaska Coastal Management Program
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADGC	Alaska Department of Governmental Coordination
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation & Public Facilities
AEWC	Alaska Eskimo Whaling Commission
ANCSA	Alaska Native Claims Settlement Act of 1971
ANILCA	Alaska National Interest Lands Conservation Act of 1980
ARM	Atmospheric Radiation Measurement
ASA (CW)	Assistant Secretary of Army for Civil Works
ASHPO	Alaska State Historic Preservation Office
ASNA	Arctic Slope Native Association, Limited
ASRC	Arctic Slope Regional Corporation
ASTAC	Arctic Slope Telephone Association Cooperative
BASC	Barrow Arctic Science Consortium
BCR	Benefit-to-Cost Ratio
BEO	Barrow Environmental Observatory
BFE	Base Flood Elevation
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BUECI	Barrow Utilities and Electric Cooperative, Inc.
C	Vertical Clearance
CAR	Coordination Act Report (US Fish & Wildlife Service)
CB	City of Barrow
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHL	Coastal & Hydraulics Laboratory of ERDC
CI	Cumulative Impacts
CMP	Corrugated Metal Pipe
COBCA	Compliance Order by Consent Agreement
COE	U.S. Army Corps of Engineers
CRREL	Cold Regions Research and Engineering Laboratory
CZMP	Coastal Zone Management Program
DA	Department of Army
DEW	Distant Early Warning (radar system)
DI	Department of Interior
DIIFR&EIS	Draft Integrated Interim Feasibility Report and Environmental Impact Statement
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency

ER	Engineering Regulation
ERDC	Engineering & Development Center, Vicksburg, MS
FAA	Federal Aviation Administration
FCSA	Feasibility Cost Sharing Agreement
FEL	Front End Loader
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIA	Federal Insurance Administration
FIS	Flood Insurance Study
FIRM	Flood Insurance Rate Map
fpm	feet per minute
ft	foot or feet
H	horizontal
h	hour
HQUSACE	Headquarters, US Army Corps of Engineers, Washington, D.C.
ICAS	Inupiat Community of the Arctic Slope
IDC	Interest During Construction
IFR	Interim Feasibility Report
IFS	Interim Feasibility Study
IHC	Inupiat Heritage Center
IHS	Indian Health Service
IRA	Indian Reorganization Act
IWR	Institute for Water Resources, Ft. Belvoir, VA
knots	nautical miles per hour
kW	kilowatt
LER	Lands, Easements, Rights-of-Way
LERR	Lands, Easements, Rights-of-Way, and Relocations
LPP	Locally Preferred Plan
m	meter
m^2	square mile
MHW	Mean High Water
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
m/s	meters per second
Mw	megawatt
NAAQS	National Ambient Air Quality Standards
NANA	Northwest Alaska Native Association
NARL	Naval Arctic Research Laboratory
NED	National Economic Development
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NOAA	National Oceanic & Atmospheric Administration
NOS	National Ocean Survey
NPS	National Park Service

NSB	North Slope Borough, Barrow, AK
NSF	National Science Foundation
NVB	Native Village of Barrow Inupiat Traditional Government
NWAB	Northwest Arctic Borough, Kotzebue, AK
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance, Repair, Replacement & Rehabilitation
OSE	Other Social Effects
PBO	Point Barrow Observatory
P&G	Principles and Guidelines
PDT	Project Delivery Team
PL	Public Law
PMP	Project Management Plan
POA	Pacific Ocean Division-Alaska District, Anchorage, AK
POD	Pacific Ocean Division-Headquarters, Ft. Shafter, HI
RED	Regional Economic Development
ROD	Record of Decision
RP	Recommended Plan
SPM	Shore Protection Manual (Corps of Engineers)
TIC	Total Investment Cost
tph	tons per hour
UAA	University of Alaska at Anchorage
UAF	University of Alaska at Fairbanks
UIC	Ukpeagvik Inupiat Corporation
USC	United States Code
USCG	United States Coast Guard
USFWS	U.S. Fish and Wildlife Service
v	vertical
w	Width
WEIO	World Eskimo Indian Olympics
WRDA	Water Resources Development Act
yd	yard
yd^3	cubic yard

6.0 CONVERSION TABLE FOR SI (METRIC) UNITS

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

Multiply	By	To obtain
cubic feet	0.0283	cubic meters
cubic yards	0.7646	cubic meters
acre	0.4049	hectare
Fahrenheit degrees	*	Celsius degrees
feet	0.3048	meters
feet per second	0.3048	meters per second
inches	0.396	centimeters
knots (international)	0.5144	meters per second
miles (U.S. statute)	1.6093	kilometers
miles (nautical)	1.8520	kilometers
square miles	2.590	square kilometers
miles per hour	1.6093	kilometers per hour
pounds (mass)	0.4536	kilograms
short ton (2,000 lb)	0.9072	megagram
U.S. gallon	3.7854	liter
part per million	1.0000	milligram per liter

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

7.0 LIST OF PREPARERS AND CONTRIBUTORS

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