SACO RIVER AND CAMP ELLIS BEACH
SACO, MAINE

SECTION 111
SHORE DAMAGE MITIGATION PROJECT

APPENDIX F

ECONOMIC ASSESSMENT

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Introduction

The purpose of this analysis is to identify and evaluate alternatives for halting further beach erosion losses and associated damage caused by an existing Corps jetty in the Camp Ellis section of Saco, Maine. The report includes a description of the study area and a quantitative assessment of benefits and costs for each alternative. Benefits are derived from reduction of property losses due to future shoreline retreat in the without-project condition. The without-project condition for this study is defined as the condition as it currently exists with the original Corps jetty in place.

An In-Progress Review (IPR) Conference was convened in March 2010 to discuss the scope of work for the decision document and the process requirements for planning and review policies. The IPR Conference Planning Guidance Memorandum, dated 15 September 2010, clarified guidance for the study and stated that "Per the vertical team conference call on 29 March and IPR on 30 March 2010, it was determined that the project justification (recommended alternative) for this study will be based upon the least costly, technically feasible, and environmentally acceptable alternative.

This analysis is performed per the Camp Ellis Implementation Guidance issued 28 June 2010, the IPR Conference Planning Guidance Memorandum dated 15 September 2010, and US Army Corps of Engineers (Corps) guidance outlined in ER 1105-2-100 Appendix F, Section 111, River and Harbor Act of 1968, as amended - Shore Damage Prevention or Mitigation Caused by Federal Navigation Projects (22 April 2000). Future shoreline retreat is estimated under three Sea Level Rise (SLR) scenarios as defined in Corps Engineering Circular (EC) 1165-2-211 (01 July 2009). The without-project condition is evaluated for each of the three SLR scenarios. Benefits and costs are converted to average annual equivalent terms using the Fiscal Year 2013 Federal interest rate for water resources projects of 3 3/4 percent (3.75%) and a period of analysis of 50 years.

Economic Setting

The city of Saco is located in York County, Maine on the southwestern coastline. US Census data for 2000 (latest year available), show a population of 16,822 with approximately 8,200 housing units. Five-year estimates between 2005 and 2009 show a labor force of 10,250, of which 338 or 3.3% are unemployed. The largest employment sectors were in service industries for education, health care and social assistance which had 25.8 % of employment, followed by 12.6% in retail trade and 10.9% in manufacturing. Median household income for 2009 was $54,175.

Study Area

Camp Ellis Beach is located in Saco, Maine, about 16 miles south of Portland, Maine. The Saco River Federal Navigation Project consists of an 8-foot deep channel, 100 to 200 feet wide. The channel is protected to the south by a 4,800-foot long jetty and to the north by a 6,600-foot long jetty. The north jetty at the mouth of the Saco River separates the river from Camp Ellis Beach to the north. Camp Ellis Beach lies adjacent to the north jetty and extends 2,500 feet north to Ferry Beach.

The project was authorized and constructed by the Corps in several increments between 1828 and 1968. During the last modification in 1968, the shoreward end of the north jetty was adjusted to reduce the maintenance dredging frequency in the river channel. The beach north of the jetty has experienced severe erosion over the past several decades with losses of property, roadways, and public and private infrastructure.

The study area is defined as the stretch of shoreline in Camp Ellis extending 2500 feet from the northern jetty and extending inland from the shore for a distance delineated by the three SLR scenarios. The study area is divided into two reaches. Reach 1 has experienced the most severe and damaging erosion at current historic rates of 3 feet per year. The area stretches from the jetty to 1500 feet north of the jetty and includes the shoreline areas of Bay, Beach, Pearl, Eastern, North, Main and Riverside Avenues, Island View Street, Fore Street and Lower Beach Road. Reach 2 is the area from 1500 to 2500 feet north of the jetty and has experienced erosion at a slower historic rate of approximately 2 feet per year. Reach 2 includes the shoreline areas of Sunset, Sunrise, Beacon, Fairhaven and Eagle Avenues.

Without Project Condition

Sea Level Rise

The without project condition is an estimate of losses likely to happen in the study area if no federal mitigation project is constructed and erosion is allowed to continue unabated. Current Corps guidance outlined in EC 1165-2-211 (1 July 2009) further requires the without-project analysis to consider a range of future sea level rise (SLR) at the project area. The range consists of a “low” rate based on historic change at the project area, and an “intermediate” and “high” rate based on curves for local mean sea level change published by the National Resource Council. As SLR increases, the rate of erosion will increase causing the amount of property losses and damages to increase. The without-project condition will be evaluated for each of the three SLR scenarios.

The three rates of SLR and subsequent erosion rates determined by coastal engineering are presented below in Table 1. The historic rate of SLR exists as a component of the current erosion rates. The rise in water surface elevation of only 0.3 feet over the 50-year project life contributes erosion of 0.56 feet per year already included in the historic erosion rates. Over the 50-year life of the project, the historic erosion rate will cause a shoreline retreat

of approximately 150 feet (50 years x 3 feet/yr) in Area 1 and 100 feet (50 years x 2 feet/yr) in Area 2. Additional erosion of 2.24 feet per year is estimated to occur in the intermediate SLR scenario based on an addition of 1.5 feet of vertical rise in the water surface elevation over the 50 year project life. Shoreline in the intermediate SLR scenario will move inland an additional 112 feet beyond the historic shore retreat line. For the high SLR scenario, additional erosion of 3.54 feet per year is estimated to occur based on an addition of 2.2 feet of vertical rise in the water surface elevation over the 50 year project life. Shoreline retreat in the Intermediate SLR scenario will move inland an additional 177 feet from the historic shore retreat line.

A map indicating the shoreline retreat for each SLR scenario is available as Attachment 1 at the end of this appendix. For a more detailed analysis of sea level change and associated risk and uncertainty, please see Appendix C - Coastal Engineering.

Table 1 Rate of Sea Level Rise and Erosion at Camp Ellis Beach

	HISTORIC	INTERMED.	HIGH
SLR – Vertical feet per 50 yrs	0.3	1.5	2.2
Additional Erosion - feet/yr	0.56	2.24	3.54
Shoreline Retreat - feet per 50 yrs	28	112	177
Area 1			
Erosion Rate - feet/yr	3	5.24	6.54
Distance of Shoreline Retreat - feet	150	262	327
Area 2			
Erosion Rate - feet/yr	2	4.24	5.54
Distance of Shoreline Retreat - feet	100	212	277

Value of Property

Values for the land and structures in the study area were obtained from the most current tax assessments available from the City of Saco, dated July 31, 2010. The assessed values were used as the basis of valuing the land and properties projected to be lost to erosion. According to the city assessor, the assessed values represent 100 percent of current market value.

Current Corps guidance (ER 1105-2-100 §3-4) requires shorefront land to be valued as near shore land for economic evaluation purposes. An analysis was done comparing the average square foot value of land on shoreline lots to the average square foot value of land two and three lots back from the shoreline. On average it was found that the land of near shore lots was valued at approximately two-thirds of the land of the shore line lots. For this analysis, the market value of shore line lots was multiplied by 0.67 to reflect near shore, *not* shore line, land values.

Projected Property Losses – Historic Sea Level Rise

Based on historic erosion rates, future losses of land and structures in the without-project condition were predicted for the historic SLR scenario. Using Computer Aided Design (CAD) and Geographic Information Systems (GIS) technologies, the project area was overlaid on a current City of Saco Assessor's Map, the existing shoreline and the 50-year retreat line were drawn in. The shore retreat distance was sectioned into 10-year bands and properties to be lost to erosion were identified and grouped within 10 year intervals.

As displayed in Table 2 below, a total of 62 lots with 59 structures are projected to be lost over the next 50 years, with a current market value total of $20,774,500.

Table 2 Market Value of Projected Property Losses – Erosion Rates based on Historic SLR

TIME INTERVAL	NUMBER OF LOTS LOST	MARKET VALUE OF LAND	NUMBER OF STRUCTURES LOST	MARKET VALUE OF STRUCTURES	TOTAL LOSSES (ROUNDED)
YEARS 1-10	28	$ 7,003,000	25	$ 3,122,900	$ 10,125,900
YEARS 11-20	7	1,304,700	7	1,549,500	2,854,200
YEARS 21-30	13	2,220,600	13	1,404,300	3,624,900
YEARS 31-40	10	2,170,300	10	997,900	3,168,200
YEARS 41-50	4	695,500	4	305,800	1,001,300
TOTAL	62	$ 13,394,100	59	$ 7,380,400	$ 20,774,500

Projected Property Losses – Intermediate Sea Level Rise

For the intermediate SLR scenario, the inland distance of the shore retreat line was increased by 112 Ft beyond the historic retreat line on the CAD map. The new retreat line showed 24 additional lots and 22 additional structures affected by accelerated erosion rates over the 50-year project life. The accelerated erosion rates were used to place each structure in the correct 10-year interval of erosion. Total market value of all losses in the intermediate SLR scenario amounts to $28,862,300 as presented in table 3 below.

Table 3 Market Value of Projected Property Losses – Erosion Rates based on Intermediate SLR

TIME INTERVAL	NUMBER OF LOTS LOST	MARKET VALUE OF LAND	NUMBER OF STRUCTURES LOST	MARKET VALUE OF STRUCTURES	TOTAL LOSSES (ROUNDED)
YEARS 1-10	29	$ 7,298,100	27	$ 3,258,400	$10,556,500
YEARS 11-20	23	4,244,300	23	3,287,100	7,531,400
YEARS 21-30	10	1,851,600	9	834,900	2,686,500
YEARS 31-40	9	1,964,600	9	1,523,200	3,487,800
YEARS 41-50	15	2,625,500	13	1,974,600	4,600,100
TOTAL	86	$ 17,984,100	81	$ 10,878,200	$28,862,300

Projected Property Losses – High Sea Level Rise

For the high SLR scenario, the inland distance of the shore retreat line was increased by 177 Ft beyond the historic retreat line on the CAD map. In comparison to the intermediate SLR scenario, the new retreat line showed15 additional lots and 13 additional structures affected by accelerated erosion rates over the 50-year project life. Total market value of losses in the high SLR scenario amounts to $33,774,800 as presented in Table 4 below.

Table 4 Market Value of Projected Property Losses – Erosion Rates based on High SLR

TIME INTERVAL	NUMBER OF LOTS LOST	MARKET VALUE OF LAND	NUMBER OF STRUCTURES LOST	MARKET VALUE OF STRUCTURES	TOTAL LOSSES (ROUNDED)
YEARS 1-10	38	$ 9,031,900	36	$ 5,387,000	$14,418,900
YEARS 11-20	21	3,903,000	21	1,744,000	5,647,000
YEARS 21-30	3	459,100	2	249,400	708,500
YEARS 31-40	11	2,301,900	10	1,592,800	3,894,700
YEARS 41-50	28	5,460,300	25	3,645,400	9,105,700
TOTAL	101	$ 21,156,200	94	$ 12,618,600	$33,774,800

Calculation of Benefits

Prevention of Property Losses

In order to compare project costs and benefits on an equivalent annual basis, projected losses for each 10-year period are converted to present value equivalents using the midpoint of each 10-year interval. Annual equivalent values are calculated using the capital recovery factor for 50 years at 3.75% percent. Annualized property losses for each SLR scenario are presented in Tables 5 through 7 below.

Table 5 Annualized Value of Projected Property Losses – Historic SLR Scenario

TIME INTERVAL	MIDPOINT YEAR	MARKET VALUE OF PROPERTY	PRESENT VALUE FACTOR	CAPITAL RECOVERY FACTOR	ANNUALIZED VALUE (Rounded)
YEARS 1-10	5	$ 10,125,900	0.83188	0.04457	$ 375,500
YEARS 11-20	15	2,854,200	0.57568	0.04457	73,200
YEARS 21-30	25	3,624,900	0.39838	0.04457	64,400
YEARS 31-40	35	3,168,200	0.27569	0.04457	38,900
YEARS 41-50	45	1,001,300	0.19078	0.04457	8,500
TOTAL		$ 20,774,500			$ 560,500

Table 6 Annualized Value of Projected Property Losses – Intermediate SLR Scenario

TIME INTERVAL	MIDPOINT YEAR	MARKET VALUE OF PROPERTY	PRESENT VALUE FACTOR	CAPITAL RECOVERY FACTOR	ANNUALIZED VALUE (Rounded)
YEARS 1-10	5	$ 10,556,500	0.83188	0.04457	$ 391,400
YEARS 11-20	15	7,531,400	0.57568	0.04457	193,300
YEARS 21-30	25	2,686,500	0.39838	0.04457	47,700
YEARS 31-40	35	3,487,800	0.27569	0.04457	42,900
YEARS 41-50	45	4,600,100	0.19078	0.04457	39,100
TOTAL		$ 28,862,300			$ 714,400

Table 7 Annualized Value of Projected Property Losses – High SLR Scenario

TIME INTERVAL	MIDPOINT YEAR	MARKET VALUE OF PROPERTY	PRESENT VALUE FACTOR	CAPITAL RECOVERY FACTOR	ANNUALIZED VALUE (Rounded)
YEARS 1-10	5	$ 14,418,900	0.83188	0.04457	$ 534,700
YEARS 11-20	15	5,647,000	0.57568	0.04457	144,900
YEARS 21-30	25	708,500	0.39838	0.04457	12,600
YEARS 31-40	35	3,894,700	0.27569	0.04457	47,900
YEARS 41-50	45	9,105,700	0.19078	0.04457	77,400
TOTAL		$ 33,774,800			$ 817,500

Prevention of Maintenance and Emergency Services

The superintendent of Saco Public Works provided a detailed list of costs incurred between 1972 and 2010 for road repair, beach restoration, clean-up, and additional public works services for damages in the Camp Ellis area caused by the erosion problem. Costs were updated to 2011 values using the Construction Cost Index and Implicit Price Deflator. During this 38-year time period, there were 21 separate events costing more than $2.632 M (2011 dollars) for an average emergency repair cost of $125,300 per event. In some years there were several events and in other years there were no major storm events; yielding an average of 0.55 major storm events per year. On an annual basis, prevention of costs for beach restoration and infrastructure related emergency repairs were estimated at $69,300 under current conditions.

Average annual repair costs for the intermediate and high SLR scenarios were estimated by applying EPA suggested percentage increases. Historic costs were increased by 36 % to derive intermediate costs caused by a 1.5 foot increase in SLR. Costs for the high SLR scenario were derived from increasing historic costs by 46% corresponding to a 2.2 foot increase in SLR. Annualized costs for the three SLR scenarios are presented below in Table 8.

Table 8 Annualized Cost of Emergency Repairs

	HISTORIC	INTERMED.	HIGH
Major Road Repairs	$1,107,800	$1,506,600	$2,199,600
Seawall and Dune Repairs	$211,000	$287,000	$419,000
General Emergency Repairs	$1,313,000	$ 1,785,700	$2,607,100
Total Repairs	$2,631,800	$3,579,300	$5,225,700
Number of Events	21	21	21
Average Cost per Event	$125,324	$ 170,443	$48,843
Number of Events per Year	0.55	0.55	0.55
Average Annual Emergency Cost	$ 69,258	$ 94,192	$ 137,518

Calculation of Costs

Alternatives

The recommended alternative for Camp Ellis will be based upon the least costly, technically feasible, and environmentally acceptable plan. Economic justification through a positive cost-benefit ratio is not required. The alternatives being considered for the Camp Ellis project are as follows:

- Beach nourishment only
- 750 feet spur jetty attached to existing north jetty plus beach nourishment (Alternative 6)
- 500 feet spur jetty with two nearshore segmented breakwaters plus beach nourishment (Alternative 25a)
- Buy-out Plan

Calculations for cost development and details of each alternative are contained in the main report and engineering appendices. Annualized first costs for comparison of alternatives are presented below. Project first costs include engineering and design costs, costs for preparation of plans and specifications, supervision and administration costs, , and real estate costs. Costs are projected over the 50-year period of analysis for each alternative under each of the three SLR scenarios.

Beach Nourishment Only

The Beach Nourishment Only alternative consists of placing sand fill along Camp Ellis Beach. Beach nourishment reduces shoreline erosion by providing sacrificial fill that erodes during storm events. The initial nourishment for the design beach profile consists of approximately 712,000 cubic yards of material placed along approximately 3,250 feet of shoreline with the southern end of the project located at the northern jetty. The changes in

costs vary according to the volumes necessary for each subsequent fill required to maintain the design beach profile. The initial first cost for establishing the design beach profile is $14.437 M. Table 9 below presents the costs annualized for a 7-month construction period with re-nourishment every 10 years over the 50-year life of the project.

Table 9 Annualized Cost of Beach Nourishment for SLR Scenarios

Annualized Cost Calculation	Historic	Intermediate	High
Project First Cost	$14,437,000	$14,437,000	$14,437,000
Interest During Construction	$136,054	$136,054	$136,054
Total Investment Cost	$14,573,054	$14,573,054	$14,573,054
Capital Recovery Factor (CRF)	0.04457	0.04457	0.04457
Average Annual Cost	$649,600	$649,600	$649,600
Annual Re-nourishment Cost	$817,300	$948,800	$1,025,900
Annual O&M Costs	$15,000	$15,000	$15,000
Total Annual Cost of Beach Nourishment	$1,481,900	$1,613,400	$1,690,500

Alternative 6 – Spur Jetty and Beach Nourishment

Alternative 6 consists of a 750-feet spur jetty located approximately 1,500 feet from the shoreline and attached to the existing northern jetty. This alternative also includes the placement of 365,000 cubic yards of beach fill along Camp Ellis Beach to stabilize the shoreline. The initial first cost for constructing the jetty is $23.835 M. Table 10 below presents the costs annualized for a 19-month construction period. Due to wave energy reductions provided by the spur jetty, the beach re-nourishment interval was increased to every 11.6 years over the 50-year life of the project.

Table 10 Annualized Cost of Alt 6 Spur Jetty for SLR Scenarios

Annualized Cost Calculation	Historic	Intermediate	High
Project First Cost	$23,835,000	$23,835,000	$23,835,000
Interest During Construction	$682,380	$682,380	$682,380
Total Investment Cost	$24,517,380	$24,517,380	$24,517,380
Capital Recovery Factor (CRF)	0.04457	0.04457	0.04457
Average Annual Cost	$1,092,800	$1,092,800	$1,092,800
Annual Re-nourishment Cost	$202,800	$313,400	$377,500
Annual O&M Costs	$30,000	$30,000	$30,000
Total Annual Cost of Alternatives	$1,325,600	$1,436,200	$1,500,300

Alternative 25A – Spur Jetty with Two Breakwaters and Beach Nourishment

This alternative consists of a 500-ft. spur jetty located approximately 875 feet from shore, with two detached breakwater segments. This alternative also includes the placement of 328,000 cubic yards of beach fill along Camp Ellis Beach to stabilize the shoreline. The initial first cost for construction is $29.685 M. Table 11 below presents the costs

annualized for a 19-month construction period. As the spur jetty and breakwaters reduce wave energy reaching the beach, re-nourishment intervals are extended to every 19 years over the 50-year life of the project.

Table 11 Annualized Cost of Alt 25-A Spur Jetty with Breakwaters for SLR Scenarios

Annualized Cost Calculation	Historic	Intermediate	High
Project First Cost	$29,685,000	$29,685,000	$29,685,000
Interest During Construction	$849,862	$849,862	$849,862
Total Investment Cost	$30,534,862	$30,534,862	$30,534,862
Capital Recovery Factor (CRF)	0.04457	0.04457	0.04457
Average Annual Cost	$1,361,100	$1,361,100	$1,361,100
Annual Re-nourishment Cost	$103,100	$175,500	$218,300
Annual O&M Costs	$45,000	$45,000	$45,000
Total Annual Cost of Alternatives	$1,509,200	$1,581,600	$1,624,400

Real Estate Buy-Out Alternative

This plan consists of the purchase of all property that will be subject to erosion over the next 50 years. Under this option, all improvements will be removed and the land returned to a natural state after the purchase. The total cost of the buy-out option and the total number of properties purchased under each SLR scenario are listed in Table 12 below.

Table 12 Annualized Cost of Buy-Out Alternative

Annualized Cost Calculation	Historic	Intermediate	High
Real Estate Acquisition Cost	$38,220,000	$51,485,000	$59,480,000
Ownerships Acquired	62	86	101
Capital Recovery Factor (CRF)	0.04457	0.04457	0.04457
Average Annual Cost	$1,703,600	$2,294,900	$2,651,300

Summary

Table 13 below provides a comparison of all annualized costs for each alternative over the three SLR scenarios.

Table 13 Comparison of all Annualized Costs

	Historic	Intermediate	High
Beach Nourishment Only	$1,481,900	$1,613,400	$1,690,500
Spur Jetty	$1,325,600	$1,436,200	$1,500,300
Spur Jetty with Breakwaters	$1,509,200	$1,581,600	$1,624,400
Real Estate Acquisition	$1,703,600	$2,294,900	$2,651,300

Attachment 1
Camp Ellis Beach Projected Shoreline Retreat for Historic, Intermediate and High SLR over the 50-year project life