US Army Corps
of Engineers ®
Portland District

Tillamook North and South Jetties

Garibaldi, Oregon

Major Maintenance Report

December 2003

TILLAMOOK JETTIES REPAIR

EXECUTIVE SUMMARY

The north and south jetties at the entrance to Tillamook Bay have experienced damage to both jetty heads, trunks, and north jetty root. A recent apparent increase in the Pacific Ocean wave climate has exposed both jetties to more extreme storm waves, especially the south jetty which is more exposed to southwesterly storm events. In addition to the increased concern regarding jetty stability, there is concern that further recession of the jetty heads will contribute to already hazardous navigation conditions over the ebb tidal shoal or bar.

Erosion of the shoreline along the north jetty is a major concern in terms of a potential breach at the jetty root. The jetty root has a smaller cross-section and the proximity of the deep channel (40 ft in depth) to this section of jetty is of increasing concern. The increasingly severe shore erosion at the north jetty root appears to be related to the north jetty head recession.

The north jetty has lost 384 ft of jetty from the seaward end of its 5700 ft authorized length. The south jetty has lost 666 ft from the seaward end of its 8025 ft authorized length. By 2006, at historical jetty head recession rates, the north jetty will be 480 ft shorter than the authorized length. The south jetty will be 890 ft shorter than the authorized length. The south jetty has never been repaired since its construction in 1969 to 1979 (25 to 35 years). The north jetty damage reach includes 1050 ft that has not been repaired since construction in 1918 (86 years).

This report focused on providing the design for the minimum and necessary repairs for the north and south jetties in order to achieve a stable project. The elements of those repairs included capping alternatives for both jetties, trunk repairs, and stabilizing the erosion occurring at the north jetty root. A preliminary analysis was also conducted to initiate discussion of the appropriate jetty length for the project performance.

The base condition or “without project” alternative assumes that the existing O&M practices will continue in the absence of major repairs. History has shown that Portland District’s normal O&M practices for our coastal jetties involves, at the minimum, stabilizing the jetty head, or capping.

Both 50 ft and 100 ft capping designs were developed for the north and south jetties. While the 50 ft cap is better than doing nothing, it does not provide a reliable long-term fix for this project. Technical analysis has shown the current jetty design section to be inadequate on both jetties within the increasing Pacific Ocean wave climate. A 50 ft head is more vulnerable to either flanking of the head or complications at the transition to the original structure. At an estimated 30% added cost, above that of a 50 ft cap, providing 100 ft of an updated and more robust design cross section is considered essential to a long term and reliable repair of the jetty heads. Mobilization alone on large jetty jobs makes

significant repairs problematic and infrequent. Ensuring a reliable repair up front is important to preventing future unexpected expenditures.

The south jetty head has never been repaired, which indicates that the relic stone base that serves as a first line of defense to protect the structure will be more limited, making the 100 ft cap all the more critical for this structure. The north jetty head position has been linked to the increased erosion at the north jetty root. So in addition to providing a more reliable longterm fix for the north jetty head, a slightly longer head fix on the north jetty will add stability to the root of the jetty.

In addition to head repairs, trunk repairs were identified as critical or routine. Critical repairs were estimated separately and are located on the north jetty from STA 29+50 to 37+00 (750 ft) and along the south jetty from STA 70+00 to 76+50 (650 ft). Routine trunk repairs are located along the north jetty from STA 22+00 to 29+00 (700 ft) and along the south jetty from STA 44+00 to 58+00 (1400 ft).

Based on this report, it is recommended that:

- The north and south jetties be repaired with 100 ft caps and a north jetty revetment be constructed with fronting sandfill added. ($16.7M)

- Trunk repairs be undertaken as soon as practicable to restore both jetties to current design standards in the following order of priority:
  - Critical:
    - South jetty: Station 70+00 to 76+50 ($12.9M)
    - North jetty: Station 29+50 to 37+00 ($4.9M)
  - Routine:
    - South jetty: Station 44+00 to 58+00 ($5.1M)
    - North jetty: Station 22+00 to 29+50. ($1.7M)

- Further analysis and project performance review be conducted to establish the acceptable final lengths for both jetties that will provide an acceptable level of navigation conditions at the Tillamook Navigation Project.

TILLAMOOK DESIGN REPORT – JETTY CAPPING DESIGN

TABLE OF CONTENTS

FIGURES

TABLES

SECTION 1

INTRODUCTION

1.1 GENERAL

The Tillamook Design Report describes the work effort and procedures that have been used to develop the design template for the minimum repair of the North and South jetties at Tillamook Bay. The north jetty head was last repaired in 1991, and the south jetty's final extension was completed in 1979.

1.2 PROJECT DESCRIPTION

Tillamook Bay is located on the Oregon Coast about 47 miles south of the mouth of the Columbia River. It is a tidal estuary about 6 miles long, north to south, and a maximum of 3 miles wide. The total area of the bay is about 12 square miles at high water and has a tidal prism of approximately 48,000 acre-feet. Five rivers, Kilchis, Wilson, Trask, Tillamook, and Miami, all flow into the bay. The ocean entrance to the bay is located at the northern end and is protected by two jetties. A location map can be seen in Figure 1-1.

The existing project for Tillamook Bay, Oregon is based on the authorizations in Table 1-1 and displayed in Figure 1-1.

Table 1-1 History of Congressional Actions

Date	Work Authorized	Document
Aug. 11, 1888	Improvements of Dry Stocking Bar and Hoquarton Slough	House Ex. Doc. 185, 50th Congress, 1st Session
July 13, 1892	Dredging channel 200 ft wide and 6 ft deep between north and middle channels above Bay City and construction of various control dikes	House Ex. Doc. 35, 52nd Congress, 1st Session
July 26, 1912 Mar. 4, 1913	Construction of north jetty 5,700 ft long and dredging channel 16 ft deep, 200 ft wide, to Bay City	House Doc. 349, 62nd Congress, 2nd Session
Mar. 2, 1919	Abandonment of that portion of the project above Bay City	House. Doc. 730, 65th Congress, 2nd Session
Mar. 3, 1925	Dredging 18-foot channel over bar; channel 18' by 200' in Tillamook Bay; turning basin in Miami Cove; abandonment of Bay City channel.	House Doc. 562, 68th Congress, 2nd Session
Jun. 30, 1948	Dredging small-boat basin and approach at Garibaldi, OR to a depth of 12 ft	House Doc. 650, 80th Congress, 1st Session
Sep. 3, 1954	Closure of breach in Bayocean Peninsula	Senate Doc. 128, 83rd Congress, 2nd Session
Oct. 27, 1965	Construction of the south jetty, 8,000 ft long	Senate Doc. 43, 89th Congress, 1st Session

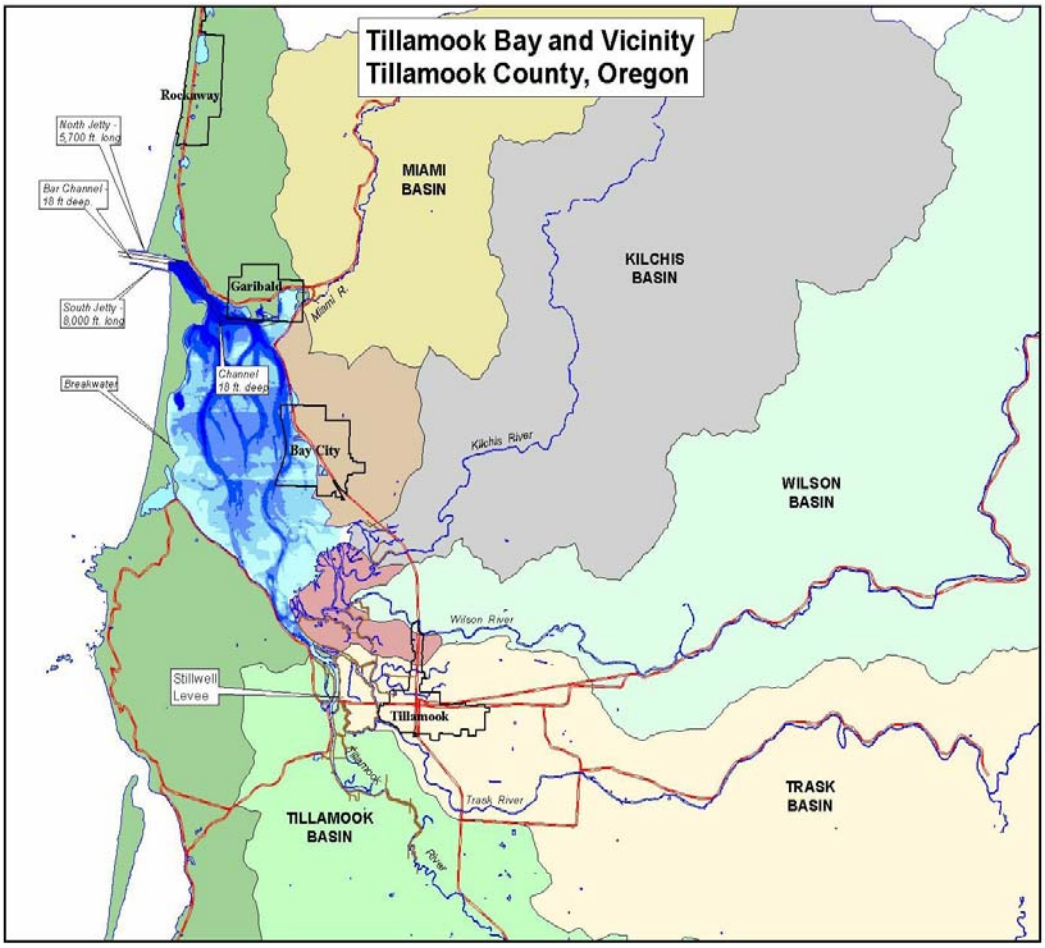

Figure 1-1 Project Area

1.3 TILLAMOOK JETTIES CONSTRUCTION

The north jetty was originally completed in 1917 to a length of 5400 ft, with the longest extension in 1965 to 5700 ft. The latest repair occurred to the head in 1991, leaving the end at Station 54+45, 255 ft shorter than the authorized length. A history of jetty construction and repairs for the north jetty is detailed in Table 1-2. The south jetty was built in three stages starting in 1969 and completed in 1979 to a length of 8025 ft, with no repairs since that time. The south jetty history of construction and extensions is in Table 1-3.

1.4 OBJECTIVES

This report will lay out the minimum repair plan that maintains the federal investment and protects the jetties from further deterioration. Numerical model studies to more accurately define the hydrodynamic, wave and current, environment at the design site were conducted. The numerical models provided information on project alternative performance with respect to structure stability and navigability at the entrance. The least cost plan addressed the issue of structure stability while the alternative length alternative begins to address the issue of navigation conditions.

Table 1-2 North Jetty History

DESIGN PARAMETER	1914-18	1921	1931-33	1946	1955	1955	1965	1991
Stone Density(pcf)	162		184				165-170	179.6
Structure Side slope (V:H)	1:1.5 & 1:2		1:2	1:1.5	natural	<1:1.25	1:2 & 1:1.5	1:2 & 1:1.5
Crest Elevation (ft MLLW)	16		18	18	15	18	18 to 24	18
Crest Width (ft)	15			16	12	15	30	30
Armor Stone Size (tons)		500 tons	320,350 tons		5,535 tons		234,000 tons	
Class A			7			6	18(sel), 15	21
Class B			1-6 tons			100lbs-4ton	8	--
Class C			< 1 ton					--
Stone Source	Miami River	Miami River	Watseco		Garibaldi	Garibaldi	Cook Creek & Fisher	A-21 & Liscom Hill
Stone Type	Basalt	Basalt	Basalt		Basalt	Basalt	Gabbro & Andesitic Basalt	Greenstone
Beginning Station	0+00	Shore-end	54+00	Shore-end	0+00	38+00	32+60	53+00
Ending Station	54+00	+500’	57+00	+193’	1+05	41+00	57+00	54+45

Table 1-3 South Jetty History

DESIGN PARAMETER	1969-1971	1974	1978-1979
Stone Density (pcf)	167	167	167
Structure Side slope (V:H)	1:1.5	1:2 (above MLLW) 1:1.5 (below MLLW)	1:2 (above MLLW) 1:1.5 (below MLLW)
Crest Elevation (ft MLLW)	16 to 18	18	18
Crest Width (ft)	30	30	30
Armor Stone	655,049 tons	783,944 tons	473,000 tons
Select A Size (tons)	-	-	23
Class A Size (tons)	8.9	11.3 (min)	20
Class B Size (tons)	6	6	9
Class C Size (tons)	2.5	2.5	-
Stone Source	Fisher	Fisher	Fisher
Stone Type	Andesitic Basalt	Andesitic Basalt	Andesitic Basalt
Beginning Station	4+75	41+70	70+30
Ending Station	55+00	70+30	85+00

SECTION 2

COASTAL ENGINEERING DESIGN

2.1. INTRODUCTION

a. General. This section describes the technical aspects of the Tillamook Jetties Major Maintenance Study. It provides the background for determining the design of the repair and major construction features including armor stone size, placement, and layout.

b. Study Purpose. Deterioration of the north and south jetty heads, as well as other locations along the structures, has caused concern for navigability of the channel and for overall stability of the jetties. Various factors contributed to the scope and definition of the project repair alternatives, including structure stability, constructability, and potential impact on navigation.

c. Scope. The scope of the coastal engineering analysis included looking at the best design for structure stability and initiating addressing navigation conditions within the channel. Numerical modeling using two models was performed to give a more accurate account of wave and current interaction in and around the navigation channel and structures. Updated wave design conditions were used to design the new heads for both jetties.

Due to projected limited funding to repair the entire project, 2 different capping lengths were estimated, 50 ft and 100 ft. A 100 ft head repair has been standard repair practice in this district and provides for a more reliable long-term fix in the presently increasing Pacific Ocean environment. In addition, trunk repairs were identified as critical or routine. Critical repairs were estimated separately and are located on the north jetty from STA 29+50 to 37+00 and along the south jetty from STA 70+00 to 76+50. Routine trunk repairs are located along the north jetty from STA 22+00 to 29+00 and along the south jetty from STA 44+00 to 58+00. The base condition or "without project" alternative assumes that the existing O&M practices will continue in the absence of major repairs. History has shown that Portland District's normal O&M practices for our coastal jetties involves, at the minimum, stabilizing the jetty head, or capping. The five alternatives are as follows:

1. Alternative 1 – Jetty Caps and Revetment. This is the he minimum maintenance option that would protect the Federal interest. This alternative addresses the areas of greatest concern in terms of structural stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The estimated cost of the plan is $16.7M. ($12.7 M for 50 ft cap)

2. Alternative 2 – Jetty Caps, Revetment, and Critical Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north

jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, a 650 ft trunk repair to the south jetty from STA 70+00 to 76+50, a 750 ft trunk repair to the north jetty from STA 29+50 to 37+00, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The estimated cost of the plan is $34.5M. ($30.5M for 50 ft cap.)

3. Alternative 3 – Jetty Caps, Revetment, and Critical and Routine Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, trunk repairs to the south jetty from STA 70+00 to 76+50 (650 ft in length) and STA 44+00 to 58+00 (1400 ft in length), trunk repairs to the north jetty from STA 29+50 to 37+00 (750 ft in length) and STA 22+00 to 29+50 (750 ft in length), and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The estimated cost of the plan is $41.3M. ($37.4M for 50 ft cap.)

4. Alternative 4 – Alternative Jetty Lengths, Revetment, and Critical and Routine Trunk Repairs. Plan considers both structural repairs to the jetties and further expands upon navigability of the channel. The preliminary plan calls for a 200-foot extension to the year 2003 end station of the north jetty (55+20) and a 360-foot extension to the year 2003 end station of the south jetty (82+00); repairs to damage areas along both jetties; and a revetment at the root of the north jetty. This plan leaves the north and south jetties 180 ft and 300 ft shorter than the authorized lengths, respectively. The objective of this plan is to increase the stability of the jetties and decrease wave amplification within the navigation channel. This alternative is not fully developed and would require more study to determine a constructible design and appropriate jetty length repair. The initial cost estimate is $53M.

5. Alternative 5 – "No Action". The "no action" alternative was reviewed for this study and was determined to be unacceptable due to the danger and risk of jeopardizing the integrity of both jetties. To allow the jetties to continue to deteriorate will eventually lead to an increase in shoaling at the channel entrance. As more of the jetties deteriorate, waves will move further into the navigation channel increasing boating hazards and further de-stabilizing the inner portion of the jetties.

2.2. CLIMATOLOGY, METEOROLOGY, HYDROLOGY, GEOMORPHOLOGY

a. Climatology. The Tillamook Bay entrance is located on the central coast of Oregon at latitude 45°34' N. and longitude 123°57' W. and is approximately 2.4 miles northwest of the town of Garibaldi and 9.5 miles northwest of Tillamook, as illustrated in figure 1-1. Garibaldi has a maritime climate primarily influenced by strong low-pressure centers generated in the Gulf of Alaska. Cool summers, mild winters, and year-round rainfall characterize the climate. Snow falls occasionally between November and March but it is rare, with most of the winter precipitation occurring as rainfall. Rains may occur any time of year, totaling an average of 90 inches a year. The wettest month is December, with an average of 14.3 inches of precipitation. Fog is common along the Oregon coast during the summer months from June through September. Normal winter temperatures range from 50 to 55°F, while summer temperatures range from 61 to 69°F. Temperatures can reach record lows of 0°F and record highs of 100°F. Freezing temperatures during the winter months are rare and of relatively short duration when they do occur. Freeze/thaw cycles are generally not of significant concern with regard to the durability and operations of the existing structures.

b. Winds. Predominant storm winds at Tillamook are generally caused by low-pressure storms with southerly or southwesterly wind directions. The Tillamook area is known for intense storms that arrive off the Pacific Ocean associated with the low-pressure systems originating in the Gulf of Alaska. The project site is directly exposed to storms with winds from the northwest, west, and southwest directions.

   Wind data from Oregon State University Marine Science Center is available for a site located near the South Jetty at the entrance to Yaquina Bay, which is located approximately 60 miles south of the project area. Average maximum wind speeds range from 23 knots in August to 39 knots in December. For the winter months of November through March, the average maximum wind speed is 36 knots. The highest and lowest monthly maximums were 47 knots in January 1974 and 15 knots in March 1982.

c. Tides. Tide levels at the project site, referenced to mean lower low water (MLLW), are shown in table 2-1. Extreme high water levels result from the combination of astronomic tides and rises in local water levels due to atmospheric and wave conditions.

   Tidal datums and ranges are based on 6 years (1971-1976) of simultaneous comparisons with Crescent City, California, referred to the 1960-1978 tidal epoch. The tidal benchmark at the Garibaldi station was established by National Ocean Service (NOS).

d. Currents. Current characteristics at the project site are the result of a very complex combination of factors. The predominant regional current along the Oregon coast during the winter months is a wind-driven southerly current offshore. Currents are also generated by wave action striking the coastline at oblique angles. The interaction of the offshore bathymetry and the existing jetties with wind and wave-driven currents adds to the variation in current directions and velocities adjacent to the Tillamook jetties.

Table 2-1. Tide Elevations, Garibaldi, Tillamook Bay, Oregon

Level	Elevation (ft MLLW)
Highest Tide (predicted)	+11.76
Mean Higher High Water (MHHW)	+7.98
Mean Sea Level	+4.28
Mean Lower Low Water (MLLW)	0.00
Lowest Tide (predicted)	-2.93
NAVD 88	+0.3
NGVD 29	+3.41

Source: NOAA National Ocean Service.

e. Storm Surge. Storm surges are increases in water elevation caused by a combination of relatively low atmospheric pressure and wind-driven transport of seawater over relatively shallow and large unobstructed waters. Storm surges can produce short-term increases in water level to an elevation considerably higher than mean high water levels. Storm surge at Yaquina Bay was analyzed by the Portland District Corps of Engineers (NWP 1994) and by ERDC (WES 1996). Due to the proximity of Tillamook Bay to Yaquina Bay, the storm surge analysis that was completed for Yaquina Bay was used for design work at Tillamook Bay. Water surface elevation data for the years 1978 to 1994 was taken at the project from the Hatfield Marine Science Center (HMSC) site. Residual sea level values were calculated by subtracting the predicted tide elevations from the recorded water surface elevations. A frequency curve was developed to give return period estimates for storm surge. Results indicated that the project area experiences storm surges up to 4.6 feet for 50-year return period events. During an average year at the project site, storm surges are on the order of 1 to 3 feet.

   The Yaquina study obtained water surface elevation data for the Southbeach station for the years 1995 through 2000. The previous frequency analysis was then extended to include the entire period of record in order to verify and (or) update the 50-year storm surge estimate. Results are summarized in Section 2.3.

f. River and Creeks in Project Vicinity. Tillamook Bay is a tidal estuary about 6 miles long, north to south, and a maximum of 3 miles wide. The total area of the bay is about 12 square miles at high water and has a tidal prism of approximately 48,000 acre-feet. Five rivers, Kilchis, Wilson, Trask, Tillamook, and Miami, all flow into the bay.

g. Littoral Drift. The rivers and creeks along the Oregon coast supply sediments to the beaches along with onshore/offshore movement of sand. Bluff erosion due to wind, precipitation, and wave action along the coastline is also a component of the sediment source.

h. Shoreline Change at North Jetty Root. The primary (sand) dune at the root of the Tillamook north jetty has been progressively eroding since 1995. The primary dune serves as a barrier protecting more than 1000 ft of weakened (and reduced crest elevation) jetty, landward of the dune, from direct wave attack and overtopping associated with the present surf zone. The area of concern is located at approximately STA 34+00. If the weakened shoreward area of the jetty were subjected to an active surf zone, the north jetty would be destabilized. Aerial photograph analysis has shown accelerated erosion rates of the beach just north of the jetty since 1997. The erosion rates have increased from 7 to 10 feet/year to 20 to 40 feet/year (80 feet eroded from the vegetation line adjacent to the jetty from 2001 to 2003). The width of the present dune in vicinity of the north jetty has been reduced to less than 90 ft and is overtopped by wave action during the winter. Photos from 1981 to 2003 reveal that the shoreline is eroding at least 680 ft north of the jetty, the extent of the aerial photographs. Figure 2-1 shows the recession of the vegetation at intervals of 400 ft, 500 ft and 680 ft north of the north jetty. With erosion rates already increasing and increased winter wave action, the remaining sand barrier will not last long. If the remaining sand barrier is breached, the jetty landward of the present dune line will be overtopped and destabilized, likely resulting in a jetty breach similar to that at the Coos Bay North Jetty (November 2002).

Although a limited quantity of small rip-rap was placed along the north side of the north jetty (near the root) during summer 2001, the long-term stability of the north jetty root and the stability of the primary dune were not addressed. During winter 2001, the primary dune in vicinity of the north jetty was eroded by 20-30 ft and was overtopped by wave action. Figure 2-2 shows the shoreline erosion and the rip-rap that was placed in the summer of 2001. Local efforts placed 1-ton sandbags along the north jetty and shoreline in the early spring of 2002, as seen in figure 2-3. Protecting only the jetty in the vicinity of the present root will not prevent a breaching scenario. The dune at this location needs to be fortified to slow down the erosion of that feature and to prevent further exposure of the north jetty root.

2.3. WAVE, WATER LEVEL ENVIRONMENT

a. Project Site Wave Climate. The wave climate at the project site is most extreme during the winter months, and is characterized by long-period, storm-generated waves. The project area is exposed to waves from a 62-degree western sector ranging from southwest to northwest. No islands or bathymetric features provide protection for the shoreline from open-ocean swells approaching from the northwest, west, and southwest. Waves are subject to refraction as they approach the coast at angles to the project site.

Strong southwesterly winds associated with low pressure systems generate large waves, which make for hazardous navigation conditions at the bar. Wave heights up to 46 feet have been recorded at the National Data Buoy Center (NDBC) buoys offshore (130 m water depth).

Wave periods during significant storm events generally vary from 13 to 18 seconds at the project site. Some longer period waves are associated with storm events as represented in

the available data. NDBC buoy data indicate that wave periods of 18.3 seconds and longer are possible and do occur.

b. Deep Water Wave Analysis. An extremal analysis of the two nearby NDBC buoys (46050 and 46029) was used to determine the 50 year wave height from that data. The 50-yr wave height derived from the analysis of the Columbia River buoy data (46029) was used due to proximity and expected additional focusing occurring at Newport (buoy 46050) from local features. The predicted 50-year offshore wave height, 44 ft, from the above results was then used as input to the ADCIRC and STWAVE numerical models. The models were run to evaluate the hydrodynamics in the vicinity of the jetties, and to determine the design wave at the structure. Several variables were accounted for in the numerical models including bathymetry, tides, storm surges, currents, offshore bathymetry, and jetty configurations.

c. Water Level Analysis. Water levels along the Oregon Coast are primarily a function of astronomical tide influences. The tidal cycle is semi-diurnal with two lows and two highs occurring per 24-hour period. Other factors that influence water levels are atmospheric pressure, wind set-up (storm surge), and wave set-up. Water levels associated with storm events have been analyzed in previous studies (NWP 1994, WES 1996, and NWP 1999). A study completed for Yaquina (NWP 2001) used additional measured water level data from the same tide gage to update the 50-year return period estimate by including maximum water levels from 1995 to 1999 in the data set. The predicted tide elevation for the maximum water level event data was subtracted from the water surface elevation to determine storm surge residual for each data point. This data set was then used to verify and (or) update the 50-year storm surge to be used as a base condition in the numerical models for determining the design wave at the structure.

The Corps of Engineers' Automated Coastal Engineering System (ACES) was used to perform the frequency analysis. Correlation coefficients from the results were evaluated and the Fisher Tippett Type I probability distribution results were selected based on best fit for the data. The resultant 50-year storm surge was determined to be 4.3 feet. A 95 percent confidence interval of 2.2 feet to 6.3 feet was calculated. Table 2-2 lists storm surge for the given return intervals of the events based on the 24 years of data applicable to the project area.

TABLE 2-2. Return Interval vs. Storm Surge

Recurrence Interval (Yrs.)	Storm Surge (ft.)
2	0.9
5	1.9
10	2.6
25	3.6
50	4.3
100	5.0
Source: ACES	

The predicted 50-year storm surge elevation from the above results was used as input to the ADCIRC and STWAVE numerical models. Storm surge was added to the predicted maximum tide elevation from the ADCIRC model to simulate the maximum water surface elevation during design conditions.

d. Numerical Modeling. Two numerical models were applied at the entrance to Tillamook Bay, Oregon as part of the Major Maintenance Study. This modeling effort had two primary goals: (1) to estimate design wave heights at the jetty heads for various storm conditions as well as various possible jetty lengths, in order to determine structural design parameters for multiple jetty maintenance scenarios, and (2) to evaluate the change in current patterns and velocities, wave heights, and locations of wave breaking as a result of continual jetty head recession, and thereby draw conclusions concerning the navigability of the entrance under various structural states. The combination of a two-dimensional hydrodynamic model (ACDIRC) with a two-dimensional, steady-state wave transformation model (STWAVE) enabled the completion of these objectives.

Four cases, representing the upper-limit of storm conditions along the Pacific Northwest Coast, were run using STWAVE. The wave spectra that were generated to simulate these storm conditions were based on data collected at NOAA buoy #46029 located offshore from the mouth of the Columbia River. Wave directions selected for input as offshore boundary conditions into the STWAVE model were southwest (222^{o}), west-southwest (245^{o}), west (262^{o}), and northwest (297^{o}). The predominant wave direction, deep water wave height, and dominant period of each of these storm cases is shown in Table 2-3. Each of the 4 storm cases was applied to the same 3 jetty head configurations used in the ADCIRC model: the 2002 jetty length, fully restored jetty length, and projected 2006 jetty length. Historical wave observations during storm events indicate that the largest waves occur from the southwest direction.

The offshore wave periods were chosen based on actual storm periods for the selected storms. The northwest and west storms had a period of 14.3 seconds, the west-southwest storm had a period of 20 seconds, and the southwest storm had a period of 16.7 seconds. Typically, wave periods during storm events range from 12 to 17 seconds. Periods up to 20 seconds and slightly larger have been measured along the Oregon coast, however these events are normally associated with much smaller significant wave heights during the summer swell conditions. Such longer period events are believed to be associated with large storms in the Southern Hemisphere.

The first stage in the numerical simulations of the Tillamook Bay entrance was the application of ADCIRC, a Corps-developed finite element hydrodynamic model. With user-specified tidal elevation signals at the ocean boundary, winds over the model domain, and riverine flow inputs, the model is able to simulate tidal circulation and storm surge over a very large area. The velocity and direction of currents, as well as water elevation, over the entire specified domain are provided as output.

For this case, the wind and tidal conditions chosen to drive the model needed to represent a typical Pacific Northwest storm condition. A previous application of the ADCIRC model at Tillamook Bay simulated a storm that peaked on November 14, 2001, and

included a spring tide, considerable river flows, and coastal storm surge. Since the model had already been calibrated for this storm case, and had performed in a stable manner, it was determined that another use of these previously developed and verified conditions would be an efficient and effective way to gather current and tidal information for the Tillamook Bay entrance. More information on the generation of the ADCIRC mesh and the storm conditions can be found in Moritz, et al., 2002. The ADCIRC model was run three times with wind, tide and riverine conditions for 1) 2002 jetty head positions, 2) Fully restored jetty head positions, and 3) Projected 2006 jetty head positions based on existing rates of jetty recession. The currents generated by these model runs at several tide stages were then used as input to the STWAVE model.

The second stage of numerical modeling was the application of STWAVE, a steady-state, spectral wave transformation model that simulates depth-induced wave refraction and shoaling, current-induced refraction and shoaling, depth- and steepness-induced wave breaking, wind-wave growth, and wave-wave interaction [Smith et al 2001]. With user-specified bathymetric and structural features, wave and water level conditions, and wind conditions, the model transforms waves from deep to shallow water, and provides information on wave height, period and directional transformation, as well as the location of wave breaking. By using the current information generated for a storm condition by ADCIRC as input for STWAVE, the model was able to more accurately predict wave transformation and breaking due to wave-current interaction, a phenomena that can be highly influential at jettied tidal entrances. One of the limitations of modeling waves using STWAVE is that waves can only propagate in one direction. Meaning, waves that reflect or refract off of steep surfaces caused by a sudden change in bathymetry or waves reflected off of structures are ignored. Taking this limitation into account, the wave heights selected for design purposes, discussed in the next section, were located one wavelength away from the structure.

Table 2-3 STWAVE Model results

Tide Level NGVD, ft	Storm Direction	Spectral Mean Wave Ht. (ft)	T (s)	Wave Height (ft)	
				North Jetty	South Jetty
6.3	NW	39	14.29	20.3	23.0
6.3	SW	44	16.67	21.0	25.0
6.3	WSW	39	20.00	21.6	26.2
6.3	W	36	14.29	20.6	25.3

e. Design Wave Determination. Spectral mean wave heights that exist at the various jetty head locations were determined from the model results by creating a search radius around the end of each jetty, equal to approximately one wavelength. The wavelength was calculated to be approximately 400 ft, based on a wave in a shallow water depth of 36 ft (approximate depth adjacent to jetty heads) with a 12 second wave period. The area within the search radius boundary was examined to determine the largest wave height predicted by the model for each storm condition. The resultant spectral mean wave height for each case, also listed in table 2-3, was used to determine design wave heights for the purpose of establishing design parameters. Design wave heights determined from the

modeling results can be seen in table 2-4. Previous studies of the wave climate at the Yaquina Bay entrance indicate that breaking waves do not impact the toe of the structure as severely as the portion above MLLW (USACE, 1994). As a result of this finding, the design wave height for the below MLLW portion of the structure was reduced by 2 ft.

Table 2-4 Design Wave Height Parameters

	Wave Height Above MLLW (ft)	Wave Height Below MLLW (ft)
North Jetty	29	27
South Jetty	32	30

f. Hydrodynamics at Jetty Entrance. Examining the changes in the ebb tidal shoal as the jetty configurations have changed due to both construction and recession show some interesting findings. Prior to south jetty construction and completion, according to a 1957 survey, the ebb tidal shoal (30 ft contour) was evenly distributed both north and south in a typical ebb shoal configuration. Even after the first phase of the south jetty was completed to STA 55+00 (3000 ft short of the final length), the 1973 survey shows only a slightly broader configuration that is located slightly further offshore. However, the 1984 survey, (the first survey analyzed since south jetty completion in 1979) shows the beginning of the change in the ebb tidal shoal. The ebb tidal shoal begins to hook around, away from the south side of the entrance, as evidenced by a recent survey shown in figure 2-4. By 2002, the 30 ft contour still is centered offshore of the north jetty, in the "hook" configuration, but it also extends into the navigation channel.

The movement of the ebb tidal shoal with respect to the end of the north jetty is shown in figure 2-5. The distance of the ebb tidal shoal from the end of the north jetty increased following the completion of the first part of the south jetty (to STA 55+00), however, it is unknown whether this is a result of the construction because surveys between 1957 and 1971 have not been evaluated. The offshore distance of the shoal did not change between 1973 and 1984, which is after the 1979 completion of the south jetty. After the north jetty was repaired in 1991, the shoal moved over 500 ft seaward of the north jetty in 1996, however, the shoal moved towards the jetty in 1999 and away again in 2002.

The ebb tidal shoal, prior to construction of the south jetty, was centered between the north jetty and the future location of the south jetty. It is speculated that the ebb tidal shoal was already choked by shoals present in the channel. These shoals can be seen in aerial photography prior to the south jetty construction, figure 2-6. Once the south jetty was constructed, the channel was protected from waves coming from the southwest, causing more shoaling along the south side of the channel. This shoaling caused the channel to deepen along the northern side. The increased depths would then send a concentration of the ebb current, which would be carrying sediment, along the north side of the channel.

2.4. EXISTING PROJECT CONDITIONS

Deterioration of the north and south jetty heads, as well as other locations along the structures, has caused concern for navigability through the channel and for overall stability of the jetties. Figure 2-7 shows an aerial view of the areas of concern. The severity of the jetty deterioration was analyzed along the entire length of both jetties. Damage areas were evaluated to determine the type and severity of damage evident at the various sections. Several severe damage areas were identified along the trunks of both jetties. Figures 2-8 and 2-9 show the damage areas along both jetties. Based on FY 2000 structure surveys, the north jetty exhibits 2,884 ft of damage along the structure, 2,500 ft damage along the trunk, and currently has 384 ft of submerged jetty head. An additional 2000 feet of the north jetty is also damaged based on visual inspection and aerial photography. Survey data for this portion of the jetty between stations 0+00 and 20+00 is not yet available; therefore, the exact amount of damage is unclear. Except for the head damage areas, damage areas are found on the channelside, oceanside toe, and crest primarily. Of the damage areas noted along the north jetty, severe/moderate/minor damages were assessed at (20/76/4) %, respectively. The south jetty exhibits 3,866 ft of damage along the structure, 3,200 ft damage along the trunk, and currently has 666 ft of submerged jetty head. The south jetty has not been repaired since its original construction. Damage areas were characterized by comparing the current jetty cross-sections to the constructed cross-sections, including the existing foundation. Of the damage areas noted along the south jetty, severe/moderate/minor damages were assessed at (51.5/47/1.5)%, respectively.

Severe damage areas occur at the seaward ends, where there is substantial deterioration evidenced by the submerged jetty heads. If repairs to the jetty heads are not conducted, figure 2-10 shows the projected recession of the ends of the jetties, based on historical recession rates through 2003. At historical jetty head recession rates, by 2005, the north jetty will be 201 ft shorter than the 1991 head location, 440 ft shorter than the authorized length. The south jetty will be 810 ft shorter than the authorized length. The 2005 jetty end station was chosen because that is the earliest possible construction year that work on the jetty heads could be started.

a. Assessment of North Jetty Condition in 2003. The head of the jetty has suffered extensive damage. The end of the jetty continues to erode, with the current end station at 53+16, 384 ft shorter than the authorized station of 57+00. The head that was constructed in 1991 has been destroyed. There appears to be wrapping of stone around the end of the jetty into the channel side. This is creating a notch at the end of the jetty, about 100 ft seaward of a pre-existing notch near the end of the jetty that has been apparent since about 1987.

   A large portion of the outer, channel side lower slopes were displaced prior to the previous repair and are present at low tide as a flattened slope that extends toward the channel. Small scallops have been observed at several locations along the channel side. The seaward side appears to be in good condition with stones still retaining good interlocking and placement.

   The area adjacent to the shoreline and extending landward, STA 22+00 to 37+00, is in need of repair. The jetty between STA 22+00 and 29+50 exhibits damage on the north sideslope above MLLW, and damage along the crest, mainly on the seaside. The worst

damage area extends from STA 29+50 to 37+00 with severe damage along the crest and damage to the south sideslope above and below MLLW.

b. Assessment of South Jetty Condition in 2003. The end of the south jetty eroded 145 ft since 2002, with the current end station at 78+34, 666 ft landward of the original end station, 85+00, constructed in 1979. Most damage on the seaside slope appears to be near the waterline causing stones near the crest to settle down the side.

There is a large scallop on the seaside that extends from 76+53 to the current end. The seaside scallop has changed very little since 1998. Damage extends all the way across the crest with the channel side crest stones subsiding about half a stone height. The remainder of the crest has subsided a full stone height or greater. The scallop forms a slope toward the seaside below low tide line. Stones on the surface are not well keyed in to resist wave forces and core stone is exposed. There is evidence of stones from the end of the jetty beginning to wrap around the seaside of the jetty along this reach.

The area adjacent to the shoreline and extending seaward, STA 44+00 to 58+00, is in need of repair. The jetty exhibits damage along the north sideslope above and below MLLW and also along the north side of the crest.

c. Assessment of Shoreline at North Jetty Root in 2003. The shoreline at the north jetty continues to recede. A notch that was created in the winter of 2001 is currently being held in place by 1-ton sandbags that were place there in March 2002. Despite the presence of the sandbags, waves still overtop the dune and wash into the adjacent parking lot and the base of the Coast Guard tower.

d. Navigation. Conditions through the south approach channel and the inner channel between the jetty heads are the major concerns to navigability. Wave conditions over the ebb tidal shoal, especially during the ebb tide, have become very treacherous over the past 6 years, possibly caused by receding jetty lengths, mainly the south jetty. The wave conditions over the ebb tidal shoal are very dangerous. There is a channel located just west of the end of the south jetty that boaters use to navigate through the entrance. This situation is complicated by the presence of remnant jetty stone that lies adjacent to this natural channel. This channel also forces boaters to put their vessels in a precarious position, broadside to the waves. Non-local boats that must use the entrance as a port of refuge are unaware of the particular dangers of the ebb tidal shoal and the use of the natural channel used by local boaters. According to the Coast Guard, non-locals do not navigate the entrance very well.

2.5. MINIMUM JETTY REPAIR DESIGN

a. General. The cross section design for the jetty head focused on three general design areas: design of a stable armor unit, design of cross section dimensions (i.e. crest width, crest elevation, toe berm dimensions), and design of and interaction of cross section elements (i.e. toe and main body design). Based on past experience, both design forcing parameters as well as cross section robustness characteristics are expected to vary

between the above and below water portions of the structure. Therefore, these areas were analyzed separately.

Using the design waves determined in Section 2, table 2-4, the Hudson rubblemound stability equation, given below, was applied to estimate armor stone size for the jetty head. The stability analysis was conducted for two separate areas, above and below MLLW. This reflects the controlling design wave as well as changes in construction quality below water. A sensitivity analysis (tables 2-5 and 2-6) was performed using stone density, side slope, and the stability coefficient (K_D) as variables. Also taken into consideration were the availability and density of armor stone within the size range of 35 to 50 tons from the various candidate quarries on the west coast. Stone densities from candidate quarries can range from 165 to 200 per cubic feet.

Hudson Rubblemound Stability Equation: (SPM, 1984)

$$W = \frac{\gamma_R * H^3}{K_D * (S_R - 1)^3 * \cot \theta}$$

W = weight of an individual armor unit (lbs)
γ_R = unit weight of armor unit (lb/ft^3)
H = design wave height (ft)
K_D = stability coefficient
S_R = specific gravity of armor unit, relative to the water at the structure ($S_R = \gamma_R/\gamma_W$)
θ = angle of structure slope measured from horizontal in degrees.

Realistic specification of the stability coefficient is essential to a robust rubblemound design. Research conducted for the 1994 Yaquina Major Maintenance report and communication with Portland District construction representatives revealed that the stability coefficient that is specified and the stability coefficient that is actually achieved in the field can be significantly different. This is particularly true for placement at the toe of a structure underwater. Other factors which can influence the actual stability coefficient achieved include: size of stone, shape of stone, placement technique, placement slope, equipment used, experience of the equipment operator, and placement on pre-existing relic stone base.

Due to wave overtopping and jetty head stability concerns, it was determined that a larger design cross-section than previous designs would be necessary. The crest width was increased from 30 ft to 40 ft to add stability during overtopping conditions. The 1991 repair of the north jetty utilized a stability coefficient of 7, however, that has been found very difficult to achieve during construction under water. Furthermore, it is very difficult to achieve the same level of stone interlocking below MLLW that can be achieved above MLLW. The sensitivity analyses used for design of the armor stone at the jetty heads are shown in Tables 2-5 and 2-6. Stability coefficients of 6 above MLLW and 4 below MLLW were chosen for the capping designs based on knowledge of previous jetty construction activities, and physical model studies of the Pacific Northwest jetties. Limitations of stone size and construction equipment factor into sideslope selection.

Sideslopes of 1:2.5 above MLLW and 1:3 below MLLW were chosen. The more shallow sideslope designed for below MLLW is intended to provide a more stable toe. An additional toe berm was also designed that is 2 armor stones wide and high. Plan views of the 50 ft and 100 ft capping designs can be seen in figures 2-11 and 2-12, respectively.

Table 2-5 North Jetty Sensitivity Analysis

Above MLLW

Design Wave Height (ft)	Wr	Ww	cot Slope	Kd	Weight of Stone (lbs)	Weight of Stone (tons)
29	167	64	2.5	4	97709.9	48.9
29	170	64	2.5	4	91256.8	45.6
29	175	64	2.5	4	81809.4	40.9
29	180	64	2.5	4	73728.0	36.9
29	185	64	2.5	4	66765.1	33.4
29	200	64	2.5	4	50833.2	25.4
29	167	64	3	4	81424.9	40.7
29	170	64	3	4	76047.3	38.0
29	175	64	3	4	68174.5	34.1
29	180	64	3	4	61440.0	30.7
29	185	64	3	4	55637.6	27.8
29	200	64	3	4	42361.0	21.2
29	167	64	3.5	4	69792.8	34.9
29	170	64	3.5	4	65183.4	32.6
29	175	64	3.5	4	58435.3	29.2
29	180	64	3.5	4	52662.9	26.3
29	185	64	3.5	4	47689.4	23.8
29	200	64	3.5	4	36309.4	18.2
29	167	64	2.5	6	65140.0	32.6
29	170	64	2.5	6	60837.9	30.4
29	175	64	2.5	6	54539.6	27.3
29	180	64	2.5	6	49152.0	24.6
29	185	64	2.5	6	44510.1	22.3
29	200	64	2.5	6	33888.8	16.9
29	167	64	3	6	54283.3	27.1
29	170	64	3	6	50698.2	25.3
29	175	64	3	6	45449.6	22.7
29	180	64	3	6	40960.0	20.5
29	185	64	3	6	37091.7	18.5
29	200	64	3	6	28240.6	14.1
29	167	64	3.5	6	46528.5	23.3
29	170	64	3.5	6	43455.6	21.7
29	175	64	3.5	6	38956.8	19.5
29	180	64	3.5	6	35108.6	17.6
29	185	64	3.5	6	31792.9	15.9
29	200	64	3.5	6	24206.3	12.1

Table 2-5 (cont'd) North Jetty Sensitivity Analysis

Below MLLW

Design Wave Height (ft)	Wr	Ww	cot Slope	Kd	Weight of Stone (lbs)	Weight of Stone (tons)
27	167	64	2.5	4	78856.2	39.4
27	170	64	2.5	4	73648.3	36.8
27	175	64	2.5	4	66023.8	33.0
27	180	64	2.5	4	59501.8	29.8
27	185	64	2.5	4	53882.4	26.9
27	200	64	2.5	4	41024.6	20.5
27	167	64	3	4	65713.5	32.9
27	170	64	3	4	61373.6	30.7
27	175	64	3	4	55019.8	27.5
27	180	64	3	4	49584.8	24.8
27	185	64	3	4	44902.0	22.5
27	200	64	3	4	34187.2	17.1
27	167	64	3.5	4	56325.9	28.2
27	170	64	3.5	4	52605.9	26.3
27	175	64	3.5	4	47159.8	23.6
27	180	64	3.5	4	42501.3	21.3
27	185	64	3.5	4	38487.4	19.2
27	200	64	3.5	4	29303.3	14.7
27	167	64	2.5	6	52570.8	26.3
27	170	64	2.5	6	49098.8	24.5
27	175	64	2.5	6	44015.8	22.0
27	180	64	2.5	6	39667.8	19.8
27	185	64	2.5	6	35921.6	18.0
27	200	64	2.5	6	27349.7	13.7
27	167	64	3	6	43809.0	21.9
27	170	64	3	6	40915.7	20.5
27	175	64	3	6	36679.9	18.3
27	180	64	3	6	33056.5	16.5
27	185	64	3	6	29934.7	15.0
27	200	64	3	6	22791.5	11.4
27	167	64	3.5	6	37550.6	18.8
27	170	64	3.5	6	35070.6	17.5
27	175	64	3.5	6	31439.9	15.7
27	180	64	3.5	6	28334.2	14.2
27	185	64	3.5	6	25658.3	12.8
27	200	64	3.5	6	19535.5	9.8

Table 2-6 South Jetty Sensitivity Analysis

Above MLLW

Design Wave Height (ft)	Wr	Ww	cot Slope	Kd	Weight of Stone (lbs)	Weight of Stone (tons)
32	167	64	2.5	4	131278.8	65.6
32	170	64	2.5	4	122608.7	61.3
32	175	64	2.5	4	109915.5	55.0
32	180	64	2.5	4	99057.7	49.5
32	185	64	2.5	4	89702.7	44.9
32	200	64	2.5	4	68297.2	34.1
32	167	64	3	4	109399.0	54.7
32	170	64	3	4	102173.9	51.1
32	175	64	3	4	91596.3	45.8
32	180	64	3	4	82548.1	41.3
32	185	64	3	4	74752.2	37.4
32	200	64	3	4	56914.4	28.5
32	167	64	3.5	4	93770.6	46.9
32	170	64	3.5	4	87577.6	43.8
32	175	64	3.5	4	78511.1	39.3
32	180	64	3.5	4	70755.5	35.4
32	185	64	3.5	4	64073.4	32.0
32	200	64	3.5	4	48783.7	24.4
32	167	64	2.5	6	87519.2	43.8
32	170	64	2.5	6	81739.1	40.9
32	175	64	2.5	6	73277.0	36.6
32	180	64	2.5	6	66038.5	33.0
32	185	64	2.5	6	59801.8	29.9
32	200	64	2.5	6	45531.5	22.8
32	167	64	3	6	72932.7	36.5
32	170	64	3	6	68115.9	34.1
32	175	64	3	6	61064.2	30.5
32	180	64	3	6	55032.1	27.5
32	185	64	3	6	49834.8	24.9
32	200	64	3	6	37942.9	19.0
32	167	64	3.5	6	62513.7	31.3
32	170	64	3.5	6	58385.1	29.2
32	175	64	3.5	6	52340.7	26.2
32	180	64	3.5	6	47170.4	23.6
32	185	64	3.5	6	42715.6	21.4
32	200	64	3.5	6	32522.5	16.3

Table 2-6 (cont'd) South Jetty Sensitivity Analysis

Below MLLW

Design Wave Height (ft)	Wr	Ww	cot Slope	Kd	Weight of Stone (lbs)	Weight of Stone (tons)
30	167	64	2.5	4	108170.4	54.1
30	170	64	2.5	4	101026.4	50.5
30	175	64	2.5	4	90567.6	45.3
30	180	64	2.5	4	81621.1	40.8
30	185	64	2.5	4	73912.7	37.0
30	200	64	2.5	4	56275.2	28.1
30	167	64	3	4	90142.0	45.1
30	170	64	3	4	84188.7	42.1
30	175	64	3	4	75473.0	37.7
30	180	64	3	4	68017.5	34.0
30	185	64	3	4	61594.0	30.8
30	200	64	3	4	46896.0	23.4
30	167	64	3.5	4	77264.6	38.6
30	170	64	3.5	4	72161.7	36.1
30	175	64	3.5	4	64691.1	32.3
30	180	64	3.5	4	58300.8	29.2
30	185	64	3.5	4	52794.8	26.4
30	200	64	3.5	4	40196.6	20.1
30	167	64	2.5	6	72113.6	36.1
30	170	64	2.5	6	67351.0	33.7
30	175	64	2.5	6	60378.4	30.2
30	180	64	2.5	6	54414.0	27.2
30	185	64	2.5	6	49275.2	24.6
30	200	64	2.5	6	37516.8	18.8
30	167	64	3	6	60094.7	30.0
30	170	64	3	6	56125.8	28.1
30	175	64	3	6	50315.3	25.2
30	180	64	3	6	45345.0	22.7
30	185	64	3	6	41062.6	20.5
30	200	64	3	6	31264.0	15.6
30	167	64	3.5	6	51509.7	25.8
30	170	64	3.5	6	48107.8	24.1
30	175	64	3.5	6	43127.4	21.6
30	180	64	3.5	6	38867.2	19.4
30	185	64	3.5	6	35196.5	17.6
30	200	64	3.5	6	26797.7	13.4

b. North Jetty Head Cross-Section Design. Design wave heights of 29 ft above MLLW and 27 ft below MLLW were chosen for the capping design. These wave heights represent a 50-year storm event. Table 2-7 shows the range of armor stone sizes. The cross-section at the projected 2005 end station (52+60) was readjusted to account for additional recession between 2000 and 2005. 50 ft and 100 ft capping designs were then placed at stations 52+50, 53+00 (50 ft cap), and 53+50 (100 ft cap). These designs can be seen in figures 2-13 and 2-14 and the design variables are:

- Design Wave Height = 29 ft above MLLW, 27 ft below MLLW
- Design stone density = 175 pcf
- Armor stone size = 28 ton.
- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 18 ft MLLW
- Crest width = 40 ft
- Above water sidelope = 1V:2.5H
- Below water sideslope= 1V:3H
- Toe berm: 2 armor stones wide and high (14 ft for 175 pcf stone)

Table 2-7 North Jetty Stone Sizes

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	25.8	**34.4**	43.0
167	24.6	**32.9**	41.1
170	23.0	**30.7**	38.4
175	20.6	**27.5**	34.4
180	18.6	**24.8**	31.0
185	16.8	**22.5**	28.1
200	12.8	**17.1**	21.4

c. South Jetty Head Cross-Section Design. Design wave heights of 32 ft above MLLW and 30 ft below MLLW were chosen for the capping design. These wave heights represent a 50-year storm event. Table 2-8 shows the range of armor stone sizes. The cross-section at the projected 2005 end station (76+90) was readjusted to account for additional recession between 2000 and 2005. 50 ft and 100 ft capping designs were then placed at stations 77+00, 77+50 (50 ft cap), and 78+00 (100 ft cap). These designs can be seen in figures 2-15 and 2-16 and the design variables are:

- Design Wave Height = 32 ft above MLLW, 30 ft below MLLW
- Design stone density = 175 pcf
- Armor stone size = 38 ton.

- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 18 ft MLLW
- Crest width = 40 ft
- Above water sideslope = 1V:2.5H
- Below water sideslope= 1V:3H
- Toe berm: 2 armor stones wide and high (15 ft for 175 pcf stone)

Table 2-8 South Jetty Stone Sizes

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	35.4	**47.2**	59.0
167	33.8	**45.1**	56.3
170	31.6	**42.1**	52.6
175	28.3	**37.7**	47.2
180	25.5	**34.0**	42.5
185	23.1	**30.8**	38.5
200	17.6	**23.4**	29.3

d. North Jetty Trunk Repair Design. There are areas along the north jetty that have lost stone and need to be repaired. The original design for the jetty was for a 16 ft MLLW high structure with a 15 ft wide crest and sideslopes of 1:2 above and below MLLW. Subsequent repairs changed the design seaward of STA 32+60, raising the crest elevation to 18 ft MLLW, increasing the crest width to 30 ft, and changing the sideslopes to 1:2 above MLLW and 1:1.5 below MLLW. The area landward of STA 32+60 has not been repaired since completion in 1918, with the exception of two minor repairs. This study has determined that the jetty between stations 22+00 and 37+00 is in need of repair. This section was divided into 2 sections, see figure 2-17, for design analysis based on the severity and type of structure damage.

The first section extends from STA 22+00 to 29+50, with the majority of damage on the north side and on the crest, see figure 2-18. As stated above, this section has not been repaired since original construction. Wave overtopping is not a large concern in this area; however, stability of the jetty could be compromised by a breach in this section. The original design for this section of a crest elevation of 16 ft MLLW, a crest width of 15 ft, and sideslopes of 1:2 was determined to be acceptable for this portion, see figure 2-18. The original stone size is uncertain for this reach. A design wave height of 13 ft was determined by using the wave and current modeling discussed earlier. Table 9 shows the range of stone sizes for this reach of trunk repair with the new design wave height.

- Design Wave Height = 13 ft
- Design stone density = 175 pcf

- Armor stone size = 5 tons
- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 16 ft MLLW
- Crest width = 15 ft
- Above water sidelope = 1V:2H
- Below water sideslope= 1V:2H

The second section extends from STA 29+50 to 37+00, with the majority of damage on the south side and along the crest, see figure 2-19. This section is adjacent to the receding shoreline mentioned above. Wave overtopping is a large concern in this area. STA 32+60 to 37+00 was repaired in 1965, with that repair increasing the crest elevation to 18 ft MLLW, and crest width to 30 ft. The stone used in this section during the last repair came from two quarries and averaged 4.6 tons (182 pcf) and 6.3 tons (167 pcf). A design wave height of 15 ft was determined by using the wave and current modeling discussed earlier. Figure 2-19 shows the design cross-section for this section. Due to the high potential for overtopping adjacent to the shoreline and proposed revetment, the crest elevation was raised to 23 ft MLLW, which coincides with the revetment design. The crest width was shortened to 20 ft and the sideslopes were designed to be 1:2 for above and below MLLW. The centerline of the repair was shifted 5 ft to the north to reflect the modification in crest elevation and crest width and to minimize the large quantities of stone that would have been required along the south side of the jetty. Table 10 shows the range of stone sizes for this reach of trunk repair with the new design wave height.

- Design Wave Height = 15 ft
- Design stone density = 175 pcf
- Armor stone size = 7 tons
- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 23 ft MLLW
- Crest width = 20 ft
- Above water sidelope = 1V:2H
- Below water sideslope= 1V:2H

Table 2-9 Stone Sizes for North Jetty Stations 22+00 to 29+50

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	4.5	**6.0**	7.5
167	4.5	**6.0**	7.5
170	3.8	**5.0**	6.3
175	3.8	**5.0**	6.3
180	3.0	**4.0**	5.0
185	3.0	**4.0**	5.0
200	2.3	**3.0**	3.8

Table 2-10 Stone Sizes for North Jetty Stations 29+50 to 37+00

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	6.8	**9.0**	11.3
167	6.0	**8.0**	10.0
170	6.0	**8.0**	10.0
175	5.3	**7.0**	8.8
180	4.5	**6.0**	7.5
185	4.5	**6.0**	7.5
200	3.0	**4.0**	5.0

e. South Jetty Trunk Repair Design. There are areas along the south jetty that have lost stone and need to be repaired. In general, the original design for the jetty was for an 18 ft MLLW high structure with a 30 ft wide crest and sideslopes of 1:2 above MLLW and 1:1.5 below MLLW. Two damaged areas were identified that are in need of repair, see figure 2-20.

The first reach is located between STA 44+00 and 58+00, with the majority of damage along the north side with some damage to the crest, see figure 2-21. Wave overtopping is not a large concern in this area; however, stability of the entire jetty could be compromised by a breach in this section. The original design for this section consisted of a crest elevation of 18 ft MLLW, a crest width of 30 ft, and sideslopes of 1:2 above MLLW and 1:1.5 below MLLW. The original stone size for this reach averaged 16.5 tons of 167 pcf stone for the armor layer. A design wave height of 17 ft was determined by using the wave and current modeling discussed earlier and also taking into account the depth along the structure in this reach. Figure 2-21 shows the design cross-section for this section. The crest width and elevation remain the same as the original design.

The below MLLW sideslope has been flattened to 1:2 in order to provide further jetty stability. Table 11 shows the range of stone sizes for this reach of trunk repair with the new design wave height and the design parameters are:

- Design Wave Height = 17 ft
- Design stone density = 175 pcf
- Armor stone size = 10 tons
- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 18 ft MLLW
- Crest width = 30 ft
- Above water sidelope = 1V:2H
- Below water sideslope= 1V:2H

The second reach is located between STA 70+00 and 76+50, with the majority of damage along the south side with severe damage to the crest. Wave overtopping on both sides of the jetty is a large concern in this area because this section is located at the seaward end of the jetty. The original design for this section consisted of a crest elevation of 18 ft MLLW, a crest width of 30 ft, and sideslopes of 1:2 above MLLW and 1:1.5 below MLLW. The original stone size for this reach averaged 19.5 tons of 167 pcf stone for the armor layer. The same design wave height used for the capping, 32 ft above MLLW and 30 ft below MLLW, was used for this reach because of the close proximity to the end of the jetty. Table 12 shows the range of stone sizes for this reach of trunk repair with the new design wave height. The crest width and elevation remain the same as the original design. The below MLLW sideslope has been flattened to 1:2.5 for STA 70+00 to 73+50, see figure 2-22. The design elements are shown below:

- Design Wave Height = 32 ft above MLLW, 30 ft below MLLW
- Design stone density = 175 pcf
- Armor stone size = 37.7 tons
- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 18 ft MLLW
- Crest width = 30 ft
- Above water sidelope = 1V:2H
- Below water sideslope= 1V:2.5H

The design for STA 74+00 to 76+50 differs due to need for a larger cross-section to withstand the impact of breaking waves. The crest elevation and width remain the same, however, the above MLLW slope was flattened to 1:2.5 and the below MLLW slope was flattened to 1:3. A toe berm was also added that is 2 armor stones tall and wide. The design is shown in figure 2-23 and the parameters are below:

- Design Wave Height = 32 ft above MLLW, 30 ft below MLLW
- Design stone density = 175 pcf

- Armor stone size = 37.7 tons
- Stability Coefficient = 6 above MLLW, 4 below MLLW
- Crest elevation = 18 ft MLLW
- Crest width = 30 ft
- Above water sidelope = 1V:2.5H
- Below water sideslope= 1V:3H
- Toe berm: 2 armor stones wide and high (15 ft for 175 pcf stone)

Table 2-11 Stone Sizes for South Jetty Stations 44+00 to 58+00

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	9.8	**13.0**	16.3
167	9.0	**12.0**	15.0
170	8.3	**11.0**	13.8
175	7.5	**10.0**	12.5
180	6.8	**9.0**	11.3
185	6.0	**8.0**	10.0
200	4.5	**6.0**	7.5

Table 2-12 Stone Sizes for South Jetty Stations 70+00 to 76+50

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	35.4	**47.2**	59.0
167	33.8	**45.1**	56.3
170	31.6	**42.1**	52.6
175	28.3	**37.7**	47.2
180	25.5	**34.0**	42.5
185	23.1	**30.8**	38.5
200	17.6	**23.4**	29.3

f. North Jetty Root Revetment Design. A 50-yr storm surge of 12.3 ft MLLW, was used in the design of the revetment structure. The total design water level of 12.3 ft MLLW also included a tide level at MHHW, 7.5 ft MLLW, and 0.5 ft sea level rise. Topography data for this area was limited to bathymetry created from an orthophoto in August 2000. The 2000 data was used to estimate the backshore and beach elevations. A considerable amount of erosion occurred between 2000 and 2003 as evidenced by aerial and on the ground photography. A winter profile

of the beach needed to be created in order to determine the typical conditions that would be present during a typical winter storm. Photos of the erosion scarp indicate that the bottom of the backshore is located between about 12 ft and 14 ft MLLW. Figure 2-24 compares a typical August 2000 profile to the predicted post-winter profile. Besides steepening and lowering the bottom elevation of the backshore, the beachslope was also increased to a more typical winter slope of 1H:15V. The depth of the structure was determined to be 4.4 ft, with a depth-limited breaking wave height of 7.5 ft. The crest elevation was designed for a wave-overtopping quantity of 0.5 cfs/ft. This criteria resulted in a structure height of 23 ft MLLW and should withstand run-up from a 50-yr storm event. A cross-section of the revetment can be seen in figure 2-25 and a plan layout in figure 2-26. The design calls for 4 armor stones along the crest and the remaining armor layer, 2 armor stones wide. The underlayer is also designed with 2 layers. The bedding layer is designed to be at least 2 ft thick. A geotextile filter will be placed under the bedding layer to prevent sand from eroding beneath and washing through the revetment due to water intrusion through the structure. The revetment is designed to tie into the existing structure and curve around the existing dune line, as seen in figure 2-26, with a total length of 300 ft. Typical design stone sizes can be seen in table 2-13 for the armor and underlayer. A bedding layer sized of 1-50 lbs and a geotextile filter sized for the existing sand have been designed. In order to help alleviate scour in front of the revetment, it is recommended that approximately 10 to 20 kcy of sand or a sand/gravel mixture be placed in front of the revetment.

- Design Water Level = 12.3 ft MLLW
- Design stone density = 175 pcf
- Armor stone size = 1.8 tons
- Underlayer stone size = 351 lbs
- Bedding stone size = 25 lbs
- Appropriately sized geotextile filter
- Crest elevation = 23 ft MLLW
- Crest width = 11 ft
- Structure Slope = 1V:2H
- Structure Length = 300 ft

Table 2-13 Revetment Stone Sizes

North Jetty Revetment

	Specific Wt. of Stone (lb/ft^3)	.75W (lbs)	**Wt. of Avg. Stone (lbs)**	1.25W (lbs)
Armor Layer	165	3294	**4392**	5491
	167	3144	**4192**	5240
	170	2936	**3915**	4894
	175	2632	**3510**	4387
	180	2372	**3163**	3954
	185	2148	**2864**	3580
	200	1636	**2181**	2726
Underlayer	165	329	**439**	549
	167	314	**419**	524
	170	294	**391**	489
	175	263	**351**	439
	180	237	**316**	395
	185	215	**286**	358
	200	164	**218**	273

2.6. QUANTITIES ESTIMATED FOR MINIMUM REPAIRS

a. General. Quantities for the various repair sections were estimated based on the plan view and cross-sections figures. The 2000 survey of the jetty provided by Portland District was used as a basis for creating the existing jetty and ground surface. Cross-sections of the proposed jetty repair were overlaid on existing ground sections. Additional deterioration of the jetties has occurred since the 2000 survey and more will likely occur prior to construction. To account for the additional erosion, estimated cross-sections of the jetties ends were drawn on the 2000 cross-sections for the calculation of the stone quantities. The quantities are based on a construction year of 2005. The projected end station for the north jetty is 52+50 and the south jetty projected station is 77+00. The stone volumes were measured in cubic yards and the mass is in tons with the voids accounted.

b. Jetty Head Quantities. Repair of the head is considered to be from the projected 2005 end station to the end of the cap. Two capping lengths, 50 ft and 100 ft, were calculated for each jetty. The volumes are presented in table 2-14.

Table 2-14. Estimated Jetty Head Repair Quantities

	Select A Armor Stone (cy)
North Jetty 50 ft Cap	10,390
South Jetty 50 ft Cap	23,980
North Jetty 100 ft Cap	19,655
South Jetty 100 ft Cap	32,919

c. Jetty Trunk Quantities. Repair quantities to construct the trunks of both jetties to a section with a 30 ft crest width and sideslopes of 1:2 were calculated for both jetties and can be found in table 2-15.

Table 2-15. Estimated Jetty Trunk Repair Quantities

	Stone (cy)
North Jetty STA 22+00 to 29+50 5-ton (175 pcf) stone	4,849
North Jetty STA 29+50 to 37+00 7-ton (175 pcf) stone	22,028
South Jetty STA 44+00 to 58+00 10-ton (175 pcf) stone	17,875
South Jetty STA 70+00 to 76+50 37.7-ton (175 pcf) stone	47,200

d. North Jetty Root Revetment Quantities. Repair quantities to construct a 300 ft long revetment was calculated can be found in table 2-16.

Table 2-16. Estimated North Jetty Root Revetment Quantities

	Volume of Stone (cy)
Armor Layer	2,989
Underlayer	1,278
Bedding	1,200

2.7. ALTERNATIVE JETTY LENGTH ASSESSMENT

a. Authorized Lengths and Alternative Jetty Lengths. The south jetty and the north jetty at Tillamook have both lost significant length of the seaward end of each jetty (jetty head). Figures 2-7 and 2-27 illustrate the jetties and the head loss as of 2003. The south jetty has an authorized length of 8,000 ft long. In 2003, the length of the south jetty was estimated at 7,830 ft long, 670 ft shorter than the authorized length. It has been projected that by 2006, the south jetty will have lost 890 ft from its authorized length. The north jetty has an authorized length of 5700 ft long. In 2003, the length of the north jetty was estimated at 5,320 ft,

380 ft shorter than the authorized length. It has been projected that by 2006, the north jetty will have lost 480 ft from its authorized length. This preliminary analysis, described in Section 2.7, looks at what might be considered the proposed jetty length for functional purposes at the entrance. A more comprehensive analysis should follow this report, which identifies navigation criteria and construction tradeoffs.

b. General Impacts of Variable Jetty Lengths. The south jetty exhibits about twice the head loss as the north jetty as measured in 2003. The south jetty has not been repaired since construction and appears to be more exposed to increasing southwesterly waves than the north jetty. The north jetty head was repaired in 1991. In assessing the variable impacts of different jetty lengths, the north and the south jetties have slightly different impacts. The increasingly severe shore erosion at the north jetty root appears to be related to the north jetty head recession. This is a persistent problem, which can impact the stability of the entrance as a whole. In addition, the navigation channel is located closer to the north jetty head, making breaking waves over submerged rocks (remnant from jetty head damage) more problematic in this location. The south jetty has a greater submerged rock length which is located in the vicinity of the "south hole", a deep tidal channel on the south side of the jettied entrance that is frequently used by the vessels to depart/enter Tillamook Bay. Loss of either of the jetty heads allows increased waves to not only impact the navigation channel but also to impact the opposite jetty.

c. Analysis of Variable Jetty Lengths. A preliminary analysis has been conducted of variable jetty lengths using the spectral wave transformation model, STWAVE [Smith et al 2001]. Wave conditions indicative of a typical navigation condition (waves of 6.6 ft (2 m) height and period of 7 seconds) were spectrally analyzed at the entrance from 3 different directions (southwest, west, and northwest) for full-authorized length and the projected 2006 jetty head location. From those data sets, wave amplification values were calculated for 5 different locations around the navigation entrance as shown in figure 2-28. The wave amplification factor was calculated by dividing the wave heights produced for the projected 2006 jetty head location by the full-authorized length jetty positions. The amplification factor is expressed as a percent increase or decrease in wave height when comparing the two jetty configurations mentioned above. Those entrance locations are:
    - Outside north jetty
    - Inside north jetty
    - Outside south jetty
    - Inside south jetty
    - Inner channel.

Figures 2-29 through 2-31 illustrate STWAVE model results for one of the wave cases. Figure 2-29 gives results for the full jetty length condition and figure 2-30 gives results for the projected 2006 jetty length condition. Figure 2-31 illustrates

wave amplification at the navigation entrance, comparing full authorized jetty length to 2006 reduced length results. Further analysis should include a wider range of wave conditions prior to drawing final conclusions.

Figure 2-32 compares the effect of wave direction on wave amplification at the different entrance locations for the 6.6 ft (2 m) wave events. Some results to note from this comparison are summarized below:

- Highest amplification magnitude is noted outside the south jetty for northwest storms.
- Inside the south jetty is consistently impacted with high amplification magnitudes.
- Northwest storms result in highest magnitude of amplification.

Finally, figures 2-33 through 2-35 summarize results for each principal wave direction at the entrance locations. The vertical scale provides percent increase in wave height as compared to the full authorized length. The bold lines (blue and red) indicate results for the areas inside the north and south jetties, which could be considered most critical. The shaded portion of each graph indicates a proposed "target zone" of 30% - 50% increase in wave height, which was used as a guide to choose the new jetty length. Further guidance on the target zone should be explored in the next phase of study. Utilizing all storm directions a selected maximum extension required to accomplish an amplification factor of no more than 30% was identified. Those results indicate proposed jetty head locations as follows and as shown in figure 2-36:

North Jetty: Authorized length – 180 ft = 55+20 (200 ft extension from 2003 position)
South Jetty: Authorized length – 300 ft = 82+00 (370 ft extension from 2003 position).

Some other conclusions noted from modeling results (comparing full authorized jetty length to the 2006 projected position) indicate that:

- Wave amplification at **high** tide due to jetty recession varies between 40 to 80% for area between jetties with 6.6 ft (2m) waves
- Wave amplification at **low** tide due to jetty recession varies between 30 to 90% for area between jetties with 6.6 ft (2m) waves (more variability/ unpredictability at low tide?)
- Northwest storms cause some of the largest wave amplification (83 and 86%) on both tide levels, particularly in the area inside of the north jetty where the navigation channel (or representative channel anyway) is present
- Wave amplification inside the south jetty is consistently high (>70%) for storms from all directions and both high and low tides (this would likely be the area that vessels would cross to take the shortest route to sea – just around the end of the south jetty) for 2m "navigable" conditions

- NW case shows amplification over largest area in navigation channel for high tide, SW case shows amplification over largest area in navigation channel for low tide.

d. Approximate Stone Volumes for Variable Jetty Lengths. Conceptual design stone volumes were calculated for the north and south jetty extended lengths. For the purposes of volume estimation, 100-ft caps, described in section 2.5, were placed at the ends of the lengths recommended in section 2.6.c. The caps are located from STA 54+20 to 55+20 for the north jetty and from STA 81+00 to 82+00 for the south jetty. Additional design work will need to be performed to have a final design for this repair option. The jetty landward of the cap on the north jetty, STA 52+00 to 54+20, was designed to have a crest elevation of 18 ft MLLW, crest width of 30 ft, and sideslopes of 1V:2H above MLLW and 1V:2.5H below MLLW. The conceptual design for the jetty landward of the cap on the south jetty, STA 76+00 to 81+00, had to take into consideration the increased wave environment that affects this jetty. The trunk repair design presented in section 2.5.e for STA 74+00 to 76+50 was used for this section. The approximate stone volumes are presented in table 2-17.

Table 2-17 Estimated Alternative Jetty Length Quantities

	Volume of Stone (cy)
North Jetty STA 52+00 to 55+20	27,041
South Jetty STA 76+00 to 82+00	82,245

e. Approximate Costs for Repair for Variable Jetty Lengths Based on the approximate volumes of the alternative jetty length quantities, cost estimates were calculated. The approximate cost for performing repairs to the ends of both jetties is $7M for the north jetty and $21M for the south jetty, with approximate unit costs for the jetty ends of $24,000/ft for the north jetty and $35,000/ft for the south jetty.

2.8. CONSTRUCTION CONSIDERATIONS

a. General. In order to determine the construction equipment to be used, assumptions must be made for the method of construction which may be employed during any repair or rebuild operation. Two methods are developed herein for consideration, a water-based operation, and a land-based operation.

b. Safety. Wind and weather conditions could play significant roles during construction. Wind conditions greater than 30 miles per hour will effectively stop

placement operations. Weather conditions such as heavy surf and higher tides could also hinder placement operations.

c. Qualified Operators. The project specifications will emphasize that the equipment operators should have experience in doing jetty construction type work. The crane operator's experience is key to a successful project. The technical specifications should include requirements for operator experience either in the Equipment section or in the Stone Placement section.

d. Quality Control – Quality Assurance. The contracting officer's representative (COR) should closely monitor (stone quality, placement of stone) to ensure quality requirements are being met. Handling of the stone by the contractor's equipment must be done such that the chipping and breaking of stone is minimized. This ensures integrity of the maximum stone size. The COR should report any non-compliance with the quality requirements specified in the contract to the Contracting Officer. The Contracting Officer will notify the Contractor of any detected noncompliance. The Contractor shall take immediate corrective action after receipt of such notice. The supply of materials to the off-loading facility and load out onto the barge could be subcontracted to the placement contractor. However, the prime contractor should be the placement contractor for appropriate project control.

e. Water-based operations. A waterborne operation would require quarry stone to be mined, transported overland to a barge offloading facility, then transported by tug to the placement site. Materials would need to be weighed prior to loading onto the transport barge for quality control since a waterborne placement operation would be placing materials directly from the transport barge onto the jetty section.

Placement reach required for the crane will be determined from slope distances, water depth, crane barge draft, and sea conditions. It appears feasible to place up to 40 ton toe stones from a barge mounted crane during favorable tidal conditions, within a 80 foot radius of the center pin, with cable line anchorage systems. The limiting factor is safe operating conditions given the depth of draft of the barge and sea swell conditions. A query of marine contractors has found two local candidates indicating that a water-based operation is feasible for these conditions.

Quality control of lines and grades during a water-based operation would appear to be more difficult due to wave motions, but since most placement below the water surface will be random placement with less control than above surface work, it would be relative.

When given the reach requirements based on jetty profile sections and plan view elevations, a water-based operation alone will not provide the reach necessary to accomplish the entire jetty repair at Tillamook north or south jetties. A supplemental placement requirement is needed for the inside core and cap stone area due to the anticipated 40 foot crest width and flat side slopes. This effort would require minor land-based operation to complete the section. Consequently,

accessibility onto the jetty by crane and truck transport for this segment of the work requires building a road surface.

f. Land-based Operations. A land-based operation would require quarry stone to be mined, transported overland to a barge loading facility, then transported by tug to the off-loading platform at the work site. The materials would be moved to a short-term storage area near the root area of the jetty during early stone production and placed within the vicinity of the off-loading crane or end dumped, without damage, for later transport to the placement area. As the placement activity starts stone would be loaded directly into off-road trucks, sent across the scales, and routed to the placement crane for final disposition.

g. Construction Equipment. The equipment to be used for construction of the jetty repairs will be determined by the contractor who performs the work. Selection of the appropriate crane based on the weight of stone and required reach is the contractor's responsibility. Given the size of armor stone required for the repair, and the long reach necessary for placement operations, a crawler crane would be the obvious choice. Generally, based on load charts and reach capabilities, a Manitowoc 2250 with a supplemental counterweight system or comparable equipment type would be the minimum size for this work. Typical support equipment may be loaders, off-road trucks, and dozers. Placement equipment should have operators positioned at a sufficient platform height for an adequate field of vision within the placement zone of operations. Manual release tag lines for rock tong release offer greater flexibility for placement than auto release lines.

h. Material Storage. For jetty repairs, early rock production, transport, and storage on-site will be necessary. This activity will require the mobilization phase of the project to be initiated well in advance of placement operations to create a location to off-load the materials. Adequate storage area will be needed for stockpiling a ready supply of jetty stone to maintain placement production operations. There appears to be adequate space available at both the north and south jetty root vicinities for material storage.

i. Off-loading Platforms. Due to the depth of water required for a materials barge draft within close proximity to the storage areas, offload platforms would be necessary for both moorage and a crane support structure. The contractor may elect to use an anchor line moorage or construct dolphins. The platform would be roughly 50 ft by 100 ft and constructed using a sheet pile perimeter wall with suitable backfill, in order to achieve the deep draft depth of a materials barge. Borrow materials for the backfill within the confines of the pile structure could be sand, dredge spoils, and/or quarry spalls. Stones will be required at the jetty/sheet pile interface to confine the backfill.

j. Weigh Scales. All scales for the project materials are to be furnished by the contractor and certified for accuracy. Platform scales will be required along with a weight house. Scales and weight house locations will be determined by the contractor. Tare weights of individual trucks used for hauling and weighing stone

should be certified by the contractor and clearly shown on each truck. Accuracy of the weighing mechanism will be examined by the Contracting Officers Representative (COR) periodically or as deemed necessary when scales are suspected of giving questionable weights. Scale examination will be at the discretion of the COR or the Contractor's Quality Control Representative (CQCR). Stone deliveries will immediately cease when weights are suspect, and will not be resumed until approved scales are deemed accurate and operational.

k. Placement Operations. Placement equipment will require a flat road surface for travel ahead as placement continues, and for retreat during inclement weather conditions. A minimum crest width of 30 feet is required for the anticipated crane size. The placement of stone will require the use of rock tongs, slings, or other specialized equipment to position the stone according to the special placement specification. Typically, rock tongs have been used on similar projects with large armor stone. Equipment must be capable of placing the stone individually and in such a manner as to not displace the underlying material. The capability to move, turn, adjust, or relocate the stone after placement will be necessary. The type of rock tongs or other stone handling equipment should be left for the contractor to select. However, past history indicates tong size and geometry may restrict placement effectiveness The selected equipment must be capable of placing the stone near its final position before release and be capable of moving the stone if necessary to achieve adequate interlock with adjacent stone.

   Draglines and skip buckets should be specifically limited to access road construction and/or revetment work. The revetment on the north jetty root area could be constructed using a trackhoe excavator and highway dump trucks.

l. Jetty Traffic. During the transport of materials from the off-load crane to the placement crane, passing lanes for the off-road trucks should be constructed and maintained. A turn-around will be necessary near each end of the haul road which can be used as a turn-out for passing on the jetty.

m. Performance Period. The typical construction window on the Oregon coast for jetty work extends from approximately July through September. Award of contract must be timed to allow rock production and storage for placement operations during this timeframe. Due to the crane size, supplemental counterweights, and special rigging, relatively slow production rates are anticipated. The length of time for the boom swing increases with a greater horizontal boom angle. Placement rates for the jetty stone may be as low as 80 to 100 tons per hour.

2.9. REFERENCES

Corson, W., et al. 1987. "Pacific Coast Hindcast Phase II Wave Information."

Moritz, Hans R., et al, 2002. "Modeling 2-Dimensional Unsteady Flow at the Confluence of Riverine and Estuarine Regimes".

Smith, J.M., Sherlock, A.R., Resio, D.T., 2001. "STWAVE: Steady-State Spectral Wave Model User's Manual for STWAVE, Version 3.0", ERDC/CHL SR-01-1. US Army Corps of Engineers – Engineer Research and Development Center, Vicksburg, MS.

US Army Corps of Engineers, 1962. "Tillamook Bay and Bar, Oregon North Jetty Rehabilitation – General Design Memorandum", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 1968. "Tillamook Bay and Bar, Oregon South Jetty Construction – General Design Memorandum", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 1977. "Tillamook Bay and Bar, Oregon South Jetty Construction – Supplementary Report No. 2 to General Design Memorandum", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 1986. "Engineering and design, design of breakwaters and jetties," EM 1110-2-2904.

US Army Corps of Engineers, 1987. "Yaquina Bay and Harbor, Oregon North Jetty Repair", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 1989. "Water levels and wave heights for coastal engineering design," EM 1110-2-1414.

US Army Corps of Engineers, 1989. "Tillamook Bay and Bar, Oregon North Jetty Rehabilitation – Reconnaissance Report", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 1991. "Tillamook Bay North Jetty Rehabilitation, Tillamook Bay, OR – Final General Design Memorandum and Environmental Assessment", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 1994. "Yaquina Bay and Harbor, Oregon, North Jetty Repair Major Maintenance Report", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, 2001. "Yaquina North Jetty Repair, Design Documentation Report", US Army Engineer District, Portland, OR.

US Army Corps of Engineers, Coastal Engineering Research Center. 1984. *Shore Protection Manual*.

US Army Corps of Engineers, Coastal Engineering Research Center. 1992. "Automated Coastal Engineering System, User's Guide and Technical Reference."

US Army Corps of Engineers, Waterways Experiment Station. 1995. "CERC-95-9, Monitoring of the Yaquina Bay Entrance North Jetty at Newport, Oregon; Summary and Results."

US Army Corps of Engineers, Waterways Experiment Station, Coastal and Hydraulics Laboratory. 1996. "EC 1110-2-289, Coastal Engineering Manual, Part II, Chapter 9."

SECTION 3

GEOTECHNICAL STUDIES

3.1. BACKGROUND

The north and south jetties at Tillamook Bay are under study for a major maintenance action to repair the heads and trunk portions of the authorized structures. Both jetties have been experiencing damage from winter storms and have each lost significant amounts of material over the past several years. In addition to decreased lengths, relic stone primarily from the south jetty, and southward-migrating displaced stone from the north jetty may have created navigation hazards at the entrance. A separate issue that has been incorporated into this study involves shoreline erosion adjacent to the north jetty. This erosion, if left unchecked, has the potential to ultimately breach the jetty at a weak point behind the current parking lot, which protects a portion of the jetty that has not been repaired since original construction.

3.2. PROJECT DESCRIPTION

The Tillamook jetties are located at the mouth of Tillamook Bay on the north Oregon coast. Both jetties were built on sand foundations. The north jetty was constructed between 1914 and 1917 to a length of 5,400 feet utilizing basalt from local sources. The jetty was extended by 300 feet between 1931 and 1933, and has been repaired on four occasions since the extension, with the last repair to the head section being in 1991 utilizing greenstone from Eureka, California quarries. The south jetty was built between 1969 and 1971 to a length of 3,695 feet, and extended an additional 2,830 feet in 1974, and an additional 1,470 feet between 1978 and 1979. Stone for this jetty has been obtained exclusively from the Fisher Quarry near Camas, Washington. The jetties are approximately 1,200 feet apart and provide an 18-foot deep channel depth with no specified width. The entrance channel maintains a depth of over 18 feet along the northern portion of the entrance and does not require maintenance dredging.

3.3. GEOLOGY AND SOILS

The City of Tillamook lies in the center of a broad, gentle downfold (syncline) that plunges westward at an approximate angle of five to ten degrees. Tillamook Bay is a drowned estuary carved into the north limb of the syncline. Rock formations exposed in the bay area are of Eocene to Miocene age and consist primarily of marine micaceous and tuffaceous sandstones, siltstones, and shales to the north; a series of submarine lava flows, breccias, and tuffs to the northeast and east; and marine micaceous sandstones, clays, and tuffaceous sandy shales, which are locally conglomeratic, to the south. The sedimentary beds, which comprise the majority of the rocks in the area, are of Oligocene to middle Miocene age (Schlicker and others, 1972; Lund, 1972) and are estimated to be approximately 5000 feet thick. Exposures at the northern mouth of Tillamook Bay show that these rocks strike to the northwest and dip southwesterly from 35^{o} to 77^{o} beneath the study area. Some local igneous dikes and sills are also found in the area. Although little is known about bedrock structures in this region, three discontinuous subparallel faults

with northwesterly trends have been mapped along the northeastern margin of Tillamook Bay (Schlicker, et. al., 1972).

Overburden near the mouth of the bay consists primarily of sand and of sand together with scattered boulders and gravels in areas along the north bay shore. The gravel has reportedly been derived from the basaltic Cape Meares headland and associated landslides, and moved by northward flowing currents and by storm waves during the winter when winds are strongest. Overburden in the interior and southern bay is mostly sand and mud derived from the five rivers emptying into the bay. Bayocean Peninsula at the bay mouth is the eroded remnant of a northeastward trending dune. It is undergoing continual and complex modification with the earlier bay entrance south of the Bayocean townsite having been filled, breached in the early 1950's, and again partly filled after construction of the Bayocean breakwater.

3.4. FOUNDATION CONDITIONS

No known subsurface explorations have been conducted by the Corps of Engineers in conjunction with jetty construction. The foundations for original construction of both the north and south jetties consisted of recently deposited fine sand. Bedrock is anticipated to occur at depth and is not believed to have been encountered during original construction. Conditions within the current footprint have been interpreted from analyzing multibeam fathometer surveys completed in 2000. The conditions surrounding each jetty foundation are discussed below.

a. North Jetty. The north jetty appears to have been anchored on a ledge of bedrock adjacent to the bluffs at Barview. The jetty, as constructed from this point, crossed sand foothills at the edge of the shoreline and continued out across the beach and through the breaker zone into water a little over El. –20 feet MLLW. Scour holes forming at the end of the jetty prevented completion of the outermost 300 feet during original construction. The jetty has been repaired numerous times since it was completed in 1917 and was extended 300 feet to the authorized length between 1931 and 1933. Later repairs were built on remnant jetty stone. Wave action, primarily from winter storms, dispersed the stone off the initial footprint, in effect widening the base of the jetty for future repairs to be founded on. The last repair, in 1991, repaired the damaged outer trunk section and established an approximate 100-foot long head section to Sta. 54+45, well short of the authorized length.

   (1) Present Condition. Repeated failures of the north jetty have distributed a large quantity of stones along the channel side of the jetty. Stones are located approximately 646 feet seaward of the current end of the jetty (approximate Station 53+16 based on field inspection in 2003) to Station 60+00 at a depth of –26 feet MLLW. The top of the submerged portion of the jetty is irregular, wide, and fairly flat in cross section, and displays a gradual profile with most of the stone surface occurring between El. –10 and –20 ft MLLW. Stones on the channel side of the jetty are present at a distance exceeding 200 feet from

jetty centerline between Stationing 56+50 and 46+00. Stones between Sta. 46+00 to Sta. 42+00 are found to be around 150 feet out from centerline, and stones between Sta. 42+00 and the start of recent repairs (approx. Sta. 33+00) are present to a distance of approximately 125 feet from centerline. Stones along most of the channel side of the jetty are present to El. –40 MLLW. Stones have been distributed a significantly less distance from centerline on the sea side of the jetty with stones being present to 100 feet from the jetty between Sta. 57+00 and Sta. 54+00, tapering back to around 75 feet between Sta. 53+00 and 48+50. Stones are present to El. –20 MLLW along most of this area.

(2) Stones deposited on the channel side of the jetty, as the latest jetty head repair unraveled exists at a significant elevation above MLLW. Stones exist above MLLW to a distance of 150 feet from centerline, achieving an elevation greater than +10 MLLW almost 100 feet from centerline. Deposition above MLLW on the sea side has been limited to only a handful of stones. The margins of the relic stone form a slope of approximately 1V on 2H to 2V on 3H. Slopes as steep as 1V on 1H occur in very small localized areas near the margins on the channel side.

b. South Jetty. The south jetty was built on the outer end of Bayocean Peninsula, which is a large sand spit forming the western edge of the bay. The jetty was constructed on top of a 3-foot thick bedding layer placed on fine-grained sand. The original ground profile was gradual, sloping from approximately El. 0 feet MLLW at the start of the jetty to approximately El. –20 feet MLLW. This jetty has not been repaired since it was completed in 1979. Numerous problems with scouring were encountered during construction. Scour holes up to 67 feet below MLLW formed off the end of the jetty between each construction season.

(1) Present Condition. Failure of the south jetty has scattered stone away from the original footprint, but to a much lesser degree than at the north jetty. Stones are present approximately 800 feet beyond the current end of the jetty (approximate Station 78+34 based on field measurements taken in 2003) to Station 86+35 at a depth of –50 feet MLLW. This submerged stone surface is fairly uniform, averaging 150 feet wide, fairly flat in cross section, and displays a gradual profile seaward with most stones being found between El. –10 and –20 MLLW. Stones are fairly evenly distributed on each side of the centerline, with no prominent protrusions present to either side of the jetty section. Stones on the side slopes are present almost equally on each side, averaging 120 feet from jetty centerline between Sta. 86+00 back to Sta. 79+00. Stones lost from the jetty side slopes are all present below the low water line. The margins of the relic stone form a slope of approximately 1V on 2H to 2V on 3H. Slopes as steep as 1V on 1H occur between STA 44+00 and 58+00 and 70+00 and 76+50.

c. Existing Stone Stability. Stone present below MLLW throughout the original footprint of the jetties should be fairly well stabilized. Various sizes of rock material within the original footprint, along with sand infilling, have probably created a hard, sound base for future construction. This is based on tough digging conditions encountered during rock removal at the Yaquina north jetty at Newport in 1999. Low tide inspection of displaced stones seaward of the current north jetty end has shown a large number of stones contain rounded edges, which tends to reduce the ability of the material to interlock and resist moving. A lesser degree of rounding is noted on the south jetty. Most stones comprising the base, however, are fairly well keyed in and will provide a sound and stable base, and would see very minor to no additional settlement upon reconstruction.

d. North Jetty Revetment. The shoreline area just north of the north jetty is the site for placing a revetment to prevent further erosion of the shoreline that protects the portion of the jetty that lies landward of the parking lot. This area was originally used as the Contractor's work area and part of the haul road for the 1991 repair of the north jetty and is currently used as a public parking lot at the end of the county park. The material originally placed for the Contractor's work area was the standard pit run material also utilized for haul road construction. The material has a wide range of sizes including fines, and provides a good, consolidated foundation for vehicular traffic. It was never intended to be a permanent structure, and for the past several years has suffered significant erosion during winter storm events. Local authorities have provided a temporary means of shoreline protection through placement of both riprap and sand-filled bags in a limited area where the shoreline meets the north jetty. The plan involved in this study will replace this temporary system with a more substantial repair.

3.5. STONE REQUIREMENTS

Stones to be utilized for the repair will need to meet the District's minimum requirements for jettystone. Laboratory test data, or service records from previous contracts will be necessary for approval. The largest hurdles for quarries to pass for providing stones for this job will be the size of the stones. Few quarries are available to produce the stone size necessary for this job. On the other hand, it is very likely that several quarries located a shorter distance from the site will be able to produce stone for the north jetty revetment. Some examples of these quarries will be discussed in a separate section below.

a. Stone Size. The anticipated stone size required for repair of both the north and south jetties, and the north jetty revetment are noted below:

North Jetty Head

Specific Wt. of Stone (lb/ft^3)	.75W (tons)	**Wt. of Avg. Stone (tons)**	1.25W (tons)
165	25.8	**34.4**	43.0
167	24.6	**32.9**	41.1
170	23.0	**30.7**	38.4
175	20.6	**27.5**	34.4
180	18.6	**24.8**	31.0
185	16.8	**22.5**	28.1
200	12.8	**17.1**	21.4

North Jetty Trunk, Sta. 22+00 to 29+50

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	4.5	**6.0**	7.5
167	4.5	**6.0**	7.5
170	3.8	**5.0**	6.3
175	3.8	**5.0**	6.3
180	3.0	**4.0**	5.0
185	3.0	**4.0**	5.0
200	2.3	**3.0**	3.8

North Jetty Trunk, Sta. 30+00 to 37+00

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	6.8	**9.0**	11.3
167	6.0	**8.0**	10.0
170	6.0	**8.0**	10.0
175	5.3	**7.0**	8.8
180	4.5	**6.0**	7.5
185	4.5	**6.0**	7.5
200	3.0	**4.0**	5.0

South Jetty Head

Specific Wt. of Stone (lb/ft^3)	.75W (tons)	**Wt. of Avg. Stone (tons)**	1.25W (tons)
165	35.4	**47.2**	59.0
167	33.8	**45.1**	56.3
170	31.6	**42.1**	52.6
175	28.3	**37.7**	47.2
180	25.5	**34.0**	42.5
185	23.1	**30.8**	38.5
200	17.6	**23.4**	29.3

South Jetty Trunk Sta. 44+00 to Sta. 58+00

Specific Wt. of Stone (lb/ft^3)	Minimum Wt. (tons)	**Wt. of Avg. Stone (tons)**	Maximum Wt. (tons)
165	9.8	**13.0**	16.3
167	9.0	**12.0**	15.0
170	8.3	**11.0**	13.8
175	7.5	**10.0**	12.5
180	6.8	**9.0**	11.3
185	6.0	**8.0**	10.0
200	4.5	**6.0**	7.5

South Jetty Cap and Trunk Sta. 70+00 to Sta. 76+50

Specific Wt. of Stone (lb/ft^3)	.75W (tons)	**Wt. of Avg. Stone (tons)**	1.25W (tons)
165	35.4	**47.2**	59.0
167	33.8	**45.1**	56.3
170	31.6	**42.1**	52.6
175	28.3	**37.7**	47.2
180	25.5	**34.0**	42.5
185	23.1	**30.8**	38.5
200	17.6	**23.4**	29.3

North Jetty Revetment

Specific Wt. of Stone (lb/ft^3)	Minimum Stone Weight (lbs)	**Wt. of Avg. Stone (lbs)**	Maximum Stone Weight (lbs)
165	3294	**4392**	5491
167	3144	**4192**	5240
170	2936	**3915**	4894
175	2632	**3510**	4387
180	2372	**3163**	3954
185	2148	**2864**	3580
200	1636	**2181**	2726

b. Stone Volume, North Jetty. Anticipated stone volumes required to repair the north jetty for three different repair lengths are listed below.

50' Cap Stone Volumes

Volume (cy)	Stone Density	**Fill Quantity (tons)**
10,390	165	**16,200**
10,390	167	**16,396**
10,390	170	**16,691**
10,390	175	**17,182**
10,390	180	**17,673**
10,390	185	**18,163**
10,390	200	**19,636**

100' Cap Stone Volumes

Volume (cy)	Stone Density	**Fill Quantity (tons)**
19,655	165	**30,647**
19,655	167	**31,018**
19,655	170	**31,575**
19,655	175	**32,504**
19,655	180	**33,433**
19,655	185	**34,362**
19,655	200	**37,148**

Alternative Length Stone Volume for 52+00 to 55+20

Volume (cy)	Stone Density	**Fill Quantity (tons)**
27,041	165	**42,163**
27,041	167	**42,674**
27,041	170	**43,441**
27,041	175	**44,718**
27,041	180	**45,996**
27,041	185	**47,274**
27,041	200	**51,107**

North Jetty Trunk Stone Volume for 22+00 to 29+50

Volume (cy)	Specific Wt. of Stone (lb/ft^3)	**Fill Quantity (tons)**
4,849	165	**7,560**
4,849	167	**7,652**
4,849	170	**7,789**
4,849	175	**8,018**
4,849	180	**8,248**
4,849	185	**8,477**
4,849	200	**9,164**

North Jetty Trunk Stone Volumes for 29+50 to 37+00

Volume (cy)	Specific Wt. of Stone (lb/ft^3)	**Fill Quantity (tons)**
22,028	165	**34,346**
22,028	167	**34,763**
22,028	170	**35,387**
22,028	175	**36,428**
22,028	180	**37,469**
22,028	185	**38,510**
22,028	200	**41,632**

c. Stone Volume, South Jetty. Anticipated volumes required to repair the south jetty for three repair lengths are listed below:

50' Cap Stone Volumes

Volume (cy)	Stone Density	**Fill Quantity (tons)**
23,980	165	**37,391**
23,980	167	**37,844**
23,980	170	**38,524**
23,980	175	**39,657**
23,980	180	**40,790**
23,980	185	**41,923**
23,980	200	**45,322**

100' Cap Stone Volumes

Volume (cy)	Stone Density	**Fill Quantity (tons)**
32,919	165	**51,328**
32,919	167	**51,950**
32,919	170	**52,884**
32,919	175	**54,439**
32,919	180	**55,995**
32,919	185	**57,550**
32,919	200	**62,216**

Alternative Length Stone Volume for 76+00 to 82+00

Volume (cy)	Stone Density	**Fill Quantity (tons)**
82,245	165	**128,240**
82,245	167	**129,794**
82,245	170	**132,126**
82,245	175	**136,012**
82,245	180	**139,898**
82,245	185	**143,784**
82,245	200	**155,442**

South Jetty Trunk Stone Volumes for 44+00 to 58+00

Volume (cy)	Specific Wt. of Stone (lb/ft^3)	**Fill Quantity (tons)**
17,875	165	**27,872**
17,875	167	**28,209**
17,875	170	**28,716**
17,875	175	**29,561**
17,875	180	**30,405**
17,875	185	**31,250**
17,875	200	**33,784**

South Jetty Trunk Stone Volumes for 70+00 to 76+50

Volume (cy)	Specific Wt. of Stone (lb/ft^3)	**Fill Quantity (tons)**
47,200	165	**73,597**
47,200	167	**74,489**
47,200	170	**75,827**
47,200	175	**78,057**
47,200	180	**80,288**
47,200	185	**82,518**
47,200	200	**89,208**

d. Stone Volume, North Jetty Revetment. Anticipated volume of stone required to construct a 300-foot long revetment adjacent to the north jetty.

North Jetty Revetment Armor Unit

Volume (cy)	Stone Density	**Fill Quantity (tons)**
2,989	165	**4,661**
2,989	167	**4,717**
2,989	170	**4,802**
2,989	175	**4,943**
2,989	180	**5,084**
2,989	185	**5,226**
2,989	200	**5,649**

e. Stone Sources for Jetty Repairs. Limited quarries are available to produce stones of the size required to meet the design for jetty repair. Quarries identified during this study are present in Oregon, Washington, and Canada. The Oregon quarries are located between Lincoln City and Newport, and southeast of Coos Bay. Three are in Washington, one near Castle Rock, one near Mt. Vernon, and the third near Centralia. All of these quarries have a fairly long haul distance to a barge loading facility on the coast. At least one quarry in British Columbia, Canada also has the capability to produce stones of the size required. All quarries have the capability to produce jettystones of the sizes required. No quarry has a stockpile of stones sufficient to accommodate repairs without additional quarrying. Also, many of the quarries require substantial advance notice to be able to produce sufficient quantities. The following discussion briefly describes each quarry investigated and incorporates information necessary for producing and delivering the proper sized stones to the Project.

(1) Cedar Creek Quarry. The Cedar Creek Quarry, owned by Road and Driveway Company of Newport, is located approximately 30 miles northeast of Newport, Oregon adjacent to Cedar Creek, a tributary to the Siletz River. This quarry is located in a diabase sill, and has been in production since the 1960's when it was opened up for use on the Yaquina North Jetty extension. The rock weighs 173 pcf, is of good quality, and meets Portland District

jettystone standards. Jointing within the quarry varies quite a bit, and only a portion of the existing quarry face has the capability to produce 40 ton and greater stones. It is not known what quantity of large stones can be produced out of this area at this time. Stones from this quarry would be hauled by truck to the Project site.

(2) Baker Creek Quarry. The Baker Creek Quarry is located just west of the town of Powers, OR, about 70 miles southwest of Coos Bay. The quarry is owned and operated by the BLM, Coos Bay District. This quarry contains very dense, and very hard metamorphic rock on the order of 200 lbs/ft^3. This quarry was utilized for the repair of the Coos Bay South Jetty in 1963-64. The quarry is currently permitted for utilizing stone for road base, but environmental assessments and a quarry development plan need to be completed and filed prior to any major mining. This quarry has the capability of providing large size stone. Jointing characteristics present in this quarry will produce stones of a more tabular shape. The stone is also very hard, which is hard on quarrying and handling equipment. Stone from this quarry would have to be hauled by truck to a barge loading facility in Coos Bay for further transport to Newport.

(3) Phipps Quarry. The Phipps Quarry is owned by Northwest Rock, Inc. of Aberdeen, WA, and is located on Weyerhaeuser land in the Hollywood Gorge area near Castle Rock, in Cowlitz County, WA. The quarry appears to be founded in a diabase sill on a logged off hillside. The sill appears to have intruded sedimentary rocks, some of which contain coal seams. Very little to no overburden is present on the surface, and the overall thickness is placed at over 100 feet. The area encompasses several acres, and includes reserve areas estimated at 11 million tons. The stone is blocky and angular. Stones tend to break large, with stones greater than 20 tons being quite common. Some iron stained joints are present, but don't affect the quality of the stone. Platey jointing is present on the upper margin of the rock body. The top contact of the rock body is exposed in some places. The stone appears to be of good quality. Lab test results presented to Portland District indicate that the stone weighs on the order of 170 lbs/ft^3 and meets our riprap specifications. Several of the abrasion tests from earlier reports came in higher than our normal limit of 15% loss, which could potentially be a problem. This stone has been used by Seattle District for jetty work along the coast. Stones exceeding 40 tons have been produced for their projects, and a high yield exists for stones in the 20-ton range. Stones would probably be hauled to a potential barge loading facility on the Columbia River, or would be hauled by truck directly to the Project.

(4) Beaver Lake Quarry. The Beaver Lake Quarry is located in Skagit County, Washington, near Mt. Vernon. The quarry is operated by Meridian Aggregate, which primarily supplies crushed aggregate for Forest Service access roads. The quarry is a rock monolith located in an outwash plain left

from the last Ice Age about 10,000 years ago. The rock was originally volcanic in origin that has been metamorphosed into greenstone, or metabasalt. The monolith is 600 feet long, 200 feet wide, and is somewhat less than 200 feet high. The rock is quite dense, weighing approximately 180 lbs/ft^3, is very hard, and massively jointed. Stones tend to break large from this quarry, and achieving the required sizes will be no problem at all. Stone from this quarry was the primary source for the repairs to the Yaquina North Jetty in 2001. For that job, stones from this quarry were hauled to a barge loading facility located in Anacortes, WA.

(5) Columbia Granite (formerly Skookumchuck) Quarry. The Columbia Granite Quarry is located approximately 10 air miles southeast of Tenino, Washington, east of the Centralia/Chehalis area. Weyerhaeuser originally owned the quarry when it was in operation in the late 1940's. The quarry had been inactive since that time until a few years ago, when it was purchased by private sources. Stones from this quarry have been used on the Columbia River North Jetty and Jetty A in the 1940's, by Seattle District for rehabilitating the jetties at Westport, WA., and most recently for repairs to the Yaquina North Jetty in 2001. This quarry has the potential to produce large stone sizes with a shape conducive to facilitate good interlocking. The stone tends to break in tabular shapes, due to the jointing characteristics present. When specialized blasting techniques are applied, a very high yield can be achieved. This stone also has the characteristic of being able to resist abrasion, which creates a higher coefficient of friction on the surfaces, and also tends to hold the shape better. This quarry has been developed in a diorite intrusive sill and contains rock tested at approximately 165 to 168 lbs/ft^3. Current production rates possible are on the order of 10,000 tons per month. The stockpile area within the quarry is quite small and would necessitate transport of the stones to a different storage area. Stones would more than likely be trucked by the Contractor to a barge loading facility in Aberdeen, WA for transport to the jetty. The quarry owner, however, did a comparison of haul costs for repairs done for the last repair to the Yaquina North Jetty in 2001, and found that it would have been cheaper to haul their stones rather than barge them.

(6) Granite Island Quarry. This quarry is in British Columbia, Canada, located on Texada Island, adjacent to the mainland, in the Straits of Georgia. Rock from this quarry is granite, and according to the owner, has a unit weight exceeding 165 lbs/ft^3. The owner indicated that rock from this quarry has been tested to and passed Portland District jettystone standards. Results of these tests are unconfirmed and unavailable at this time. The rock has massive jointing and has the capability to produce large stones. Stones can be produced in a variety of shapes, as quarrying procedures can be tailored to the shape required. A barge loading facility is present on the island immediately adjacent to the quarry.

f. Stone Sources for North Jetty Revetment. The need for smaller stones than that required for jetty repairs increases the number of quarries that will be able to provide stone for this structure. Most quarries will be in northwest Oregon and can provide stones in a shorter time period, also due to the smaller quantities required. Some quarries anticipated to be able to produce stone for this structure are indicated below.

(1) Cedar Creek Quarry. This quarry, located northeast of Newport, Oregon, and discussed in earlier paragraphs should have no problem producing stone sizes and quantities required for the revetment. Stone would be delivered by truck to the Project.

(2) Lighthouse Quarry. This quarry is located just south of the Cape Meares Lighthouse area, southwest of Tillamook. The quarry is leased by S-C Paving out of Tillamook. Rock produced from this quarry is a basalt and weighs approximately 177 lbs/ft^3. A report from 1970 indicates that the material passed all Corps lab test standards. Maximum size that could be produced at that time was estimated to be between 2 and 4 tons.

(3) 190 Pit. This quarry is located about 5 miles SW of Tillamook and is currently leased by Fallon Logging Co. located in Tillamook. This quarry provided stone for the Nehalem jetties rehabilitation in 1982. This is a basalt that weighs approximately 174 lbs/ft^3 and in the past has met Corps testing requirements. There is variability of rock in this quarry, but it can still produce riprap and smaller jettystone sizes. Stone from this quarry was used recently by the county at the Tillamook north jetty revetment site as a means of providing temporary shoreline protection.

3.6. Quarry Development and Production Time

No stockpiles of any appreciable size for stone of the sizes required for repairing the jetties are available at any of the quarries listed above. The larger stone sizes required translate to lower yields at the quarries than for previous jetty contracts. This means that more material needs to be quarried to supply the stone quantities required. The percent yield for these size stones varies by quarry based on jointing characteristics and quarrying techniques. A survey of several quarries able to produce the size stone required indicated that a minimum 6-month lead-time was necessary to produce the quantities for the longest alternative. The Granite Island Quarry and Columbia Granite Quarry indicated that it might take from one to three calendar years to produce the material required, due to large sizes and quantities. The Granite Island Quarry and Beaver Lake Quarry each have restrictions for quarrying; Granite Island having limited working time due to bad weather during the winter months, and the remote location of the quarry, and Beaver Lake Quarry having blasting restrictions from November through March due to environmental concerns. Utilizing more than one quarry will result in the faster production of the required stones, but that is entirely the Contractor's option. A supply contract for production and delivery of jettystones could be awarded prior to the jetty

construction contract. This would allow the time necessary for producing stones, with the potential for a better price. The ideal situation for construction in any case would be to award the contract early, allowing sufficient time for stone production prior to the jetty construction season..

3.7. CONCLUSIONS

The following items highlight the key elements necessary to consider for repair of the Tillamook jetties with jettystone.

a. Jettystone of the sizes and quantities identified as necessary for repairs to the Tillamook jetties are available within the combined known sources in Oregon, Washington, and Canada. Not all of the quarries or prospects are capable of producing the quantity of stones necessary for repairs; however, some sites or a combination of sites would be able to produce sufficient quantities.

b. Stockpiles of existing stones in the necessary large sizes are limited. The combined stockpiles of all quarries investigated do not have the quantities necessary for repairs at this time.

c. A greater lead-time for jettystone production than normal is evident based on these investigations. The lead-time after Contract award and notice to proceed to actual delivery of the stones at the Project should be a minimum of 6 months. The primary reasons for this are insufficient existing stockpiles, the need for quarry development, and the difficulty of producing the anticipated quantities of large stones.

d. Repairs will be accomplished on relic stone. This will provide a sound base for repairing the jetty, with no settlement or foundation disturbance taking place.

3.8. REFERENCES

Lund, E. H., 1972, Coastal landforms between Tillamook Bay and the Columbia River, Oregon: Oregon Dept. Geol. and Min. Ind., Ore Bin, v. 34, no. 11, p. 173-194.

Schlicker, H. G., Deacon, R. J., Beaulieu, J. D., and Olcott, G. W., 1972, Environmental geology of the coastal region of Tillamook and Clatsop Counties, Oregon: Oregon Dept. Geol. and Min. Ind. Bull. 74, 164 p.

SECTION 4

ECONOMIC CHARACTERISTICS

4.1 GENERAL

Information in this section describes the usage and socio-economic factors of the Tillamook Bay entrance and Port of Garibaldi marine facilities and is based upon two reports: Information from an Institute of Water Resources report titled *Economic Benefits of Recreation Activities at Oregon Coastal and River Ports, USACE, 2003;* and a publication by Oregon Coastal Zone Management Association, *Groundfish Fishery Trends, Implications and Transitioning Plans, OCZMA, June 2002.*

4.2 ENTRANCE AND PORT USAGE

The Tillamook entrance is one of the most heavily used on the Oregon coast and recent surveys indicate that the Port of Garibaldi is the third busiest recreational port in Oregon, behind the Port of Brookings and the Port of Umpqua. Total visitation to the Port of Garibaldi was 64,350 (Party Days) in 2002. Visitors in the area spent $6,747,000 on trip related expenditures to the port. 69% of this spending was captured by local economy yielding $4,666,000 in direct sales to tourism related firms. These sales generated $1,847,000 in direct personal income and supported 118 direct jobs. With multiplier effects, visitor spending resulted in $6,446,000 total sales, $2,453,000 in total personal income, and supported 143 jobs.

4.3 PORT FLEET CONSIDERATIONS

Total number of boats associated with the Port of Garibaldi was 619 in 2002. Boat owners in this area spent $1,127,000 on boat related annual and fixed expenditures in the region. 39% of this spending was captured by local economy yielding $434,000 in direct sales to related industries. These sales generated $168,000 in direct personal income and supported 08 direct jobs. With multiplier effects, visitor spending resulted in $589,000 total sales, $223,000 in total personal income, and supported 11 jobs. The Port of Garibaldi is also an active commercial fishing port. Garibaldi's total landing volume and value in the year 2000 was 1.7 million pounds and $2.0 million. The share of landing volume for groundfish was 16 percent. There were a total of 1,548 fishing trips made by 92 different vessels in the year 2000. There were nine different processors, buyers, restaurants, etc. issuing more than $10,000 in fish tickets.

4.4 MARINE FACILITIES

The Port of Garibaldi has over 300 slips available, with 60 slips available for vessels over 40 feet in length. The port also has 300 feet of dock available for transient vessels. The Coast Guard Tillamook Bay Station reports search and rescue cases annually. From 1995 to 2001, the station reported an average of 215 cases each year, with a high of 282 cases in 1999 and a low of 152 cases in 2000.

SECTION 5

COST ESTIMATES

5.1. GENERAL. Estimates have been provided for:

a. 50’ caps, 100’ caps, and longer repairs, for both jetties,
b. Trunk repairs for both jetties, and
c. Repair of the revetment at the north jetty.

5.2 BASIS OF THE ESTIMATE

The basis for the estimates are given in this Major Maintenance Report.

5.3 ESTIMATE REFERENCES

a. ER 1110-2-1302 (Civil Works Cost Engineering)

b. EP 1110-1-8 (Construction Equipment Ownership and Operating Expense Schedule)

5.4 CONSTRUCTION SCHEDULE

The construction schedule is dependent on when funding is provided for P&S preparation and for construction. The presumed schedule is for construction of all features to occur in summer of 2006. Since the long fixes include substantial quantities of stone, they might be difficult to accomplish in one season.

5.5 OVERTIME

No overtime is anticipated.

5.6 CONSTRUCTION WINDOWS

The construction window is June to October.

5.7 ACQUISITION PLAN

The number of construction contracts to be used to implement the jetty repair work is dependent on when, and how much, funding is received. For the purposes of this estimate, it is assumed that the north jetty caps/long fix, south jetty caps/long fix, north jetty trunk repair, south jetty trunk repair (44+00 to 58+00), south jetty trunk repair (70+00 to 76+50) and the north jetty revetment repair will all be accomplished using separate construction contracts. Some of these features may end up being combined into single contracts. It would probably be beneficial to produce required stone under supply contract(s), then place stone under separate construction contract(s). This would assure

stone was produced and available in a timely manner. It is recognized that funding the project for this sequence of acquisitions may be difficult.

5.8 SUBCONTRACTING PLAN

No subcontracting is anticipated in the contract.

5.9 GENERAL ESTIMATING INFORMATION

a. Sources of Historical Data. The 1991 Tillamook jetty repair job and the 1999 Yaquina jetty road repair job were among the sources of historical data used in the preparation of this estimate.

b. Hazardous, Toxic and Radioactive Waste (HTRW) Remediation. No HTRW remediation will be necessary for this job.

c. Site Access. Access to the construction areas will be via jetty haul roads, and adjacent access roads. See Appendix B for more information.

d. Computation of Quantities. Quantities were computed by Hydraulics Section.

e. Equipment/Labor Availability. Equipment of the appropriate size would likely be available from the Portland, OR area, though the Manitowoc 2250 cranes may need to be obtained from Seattle, WA.

f. Effective Dates for Labor, Equipment, Material Pricing. The effective date for all pricing is September 2003.

g. Equipment Rates. Equipment rates were from the MCACES equipment database, which is derived from the equipment methodology in EP 1110-1-8.

h. Labor Rates. Labor rates were updated using recent Davis-Bacon information. A payroll tax and insurance rate of 30% was used, based on recent experience. No overtime was considered necessary. No subsistence cost was added because labor will probably be available in the Tillamook area.

i. Overhead, Profit and Bond. Rule-of-thumb percentages were used for field office overhead and home office overhead. Profit was computed using weighted guidelines. Bond was determined using recent experience.

j. Functional Costs. Functional costs (i.e. Lands and Damages, Planning, Engineering and Design, and Construction Management) were obtained from the Project Manager.

k. Contingencies. Contingencies of 20% have been applied to all features. The design has a significant amount of uncertainty associated with it. Quantities are

likely to increase due to further degradation of the jetty. Pricing of stone could vary significantly as the quarries refine their quotes.

l. Escalation. Escalation to the midpoint of each activity has been applied. The current schedule was used to determine activity midpoints. The Civil Works Construction Cost Index System was used to determine escalation factors.

5.10 Cost Estimate Appendix

See Appendix A for specific estimating details and the MCACES printout for all the alternatives.

5.11 Total Project Cost Summary

The cost estimates for the caps, long fixes, trunk repairs and revetment are shown in Tables 5-1 to 5-11. It should be noted that the designs, including the estimated volumes and cost estimate, for the longer repairs is conceptual.

SECTION 6

ENVIRONMENTAL DOCUMENTS

The purpose of the proposed action is to repair the north and south jetties and the north jetty root. This action is necessary to prevent further deterioration and subsequent loss of the jetty heads, north jetty root and the United States Coast Guard (USGS) watchtower. Continued deterioration of both jetty heads and the north jetty root may jeopardize the structural integrity of each jetty; may breach the north jetty at the root; and may increase the navigational risks from waves involved in crossing the tidal ebb shoal at the entrance to the bay.

The following documents have been prepared for the proposed Tillamook Jetties maintenance alternative and will be submitted FY05 to appropriate agencies for consultation and compliance by FY06:

1. Environmental Assessment: required by the National Environmental Protection Act (NEPA), the EA is submitted to appropriate federal state and local agencies and any interested public persons. The review period usually is 30 days.

2. Finding of No Significant Impact: required by the National Environmental Policy Act (NEPA), and signed by the U.S. Army Corps of Engineers District Engineer, the FONSI determines that the project does not have any significant effects on the environment.

3. Coastal Zone Management Act: required by the Oregon Department of Land Conservation and Development (ODLCD) for projects within the coastal zone of the state. The review period is 60 days.

4. Biological Assessment: required by the Endangered Species Act (ESA) submitted to the United States Fish and Wildlife Service (USFWS) and NOAA-Fisheries, previously known as the National Marine Fisheries Service (NMFS). The review period is 130 days. A Biological Opinion (BO) is prepared by NOAA-Fisheries and/or USFWS during the review period which will concur and/or request any additional measures to implement in order to protect ESA species and their designated critical habitat.

5. Section 401: State water quality certification program, required by the Clean Water Act (CWA) which provides states the authority to review any federal permit of license that may result in a discharge to wetlands and other waters under state jurisdiction, and ensure that the actions would be consistent with the state's water quality requirements. The permit is submitted to Oregon Department of Environmental Quality (ODEQ) for compliance. The review period usually is 30 days – 1 year.

6. Cultural Resources Act: required by the National Historic Preservation Act, submitted to the Oregon State Historic Preservation Office (OSHPO) to determine no effect on cultural resources occur within the project area. The review period usually is 30-120 days.

SECTION 7

REAL ESTATE

7.1 General Information

This section covers general requirements applicable to real estate requirements for this project.

7.2 Local Sponsor

a. Tillamook North Jetty Maintenance. The authorizing legislation for this project does not require a Local Cooperation Agreement. Accordingly, the Government (Corps) will be required to obtain the necessary rights-of-way for the project.

b. Tillamook South Jetty Maintenance. The local sponsors for this project include the Tillamook County Court, Port Tillamook Bay, and Port of Bay City as set forth in a "Resolution of Formal Assurances for Local Cooperation" executed on 6 December 1967 for initial construction of the Tillamook South Jetty. As the local sponsors, these entities are required to provide all lands, easements and rights-of-way required for the project. The local sponsors will be required to provide an executed "Authorization for Entry for Construction" and "Attorneys Certificate of Authority" prior to a bid opening evidencing fulfillment of their obligation for this project.

7.3 Rights of Way

a. Work Areas.

(1) Tillamook North Jetty Maintenance. The United States (Government) owns the jetty structure. The work area required for construction storage and staging is located north of the existing jetty and is comprised of lands owned by Tillamook County (County Parks Division, Barview Jetty County Park) and lands owned by the State of Oregon (Parks and Recreation Department). The Government will obtain temporary right-of-way permits from those entities for use of the area.

(2) Tillamook South Jetty Maintenance. The United States owns the jetty structure. The primary work area required for construction storage and staging and for a barge off-loading site is comprised of adjoining United States and Tillamook County owned lands. The local sponsors will be required to obtain the necessary lands, easements, and rights-of-way from the County for storage, staging and access to the project site on and over County lands under the terms of the existing local cooperation agreement. A small portion of the work area required south of the existing jetty is under the jurisdiction of the Oregon State Parks and Recreation Department. This area

is needed to repair a short section of the access and haul road to the jetty crest. The local sponsors will be required to obtain the necessary special use permit(s) from the State of Oregon for use of the area under the terms of the existing local cooperation agreement.

b. Access/Haul Roads.

(1) Tillamook North Jetty Maintenance. Access to the work area is across County lands through the Barview Jetty County Park to the beach area which is under the jurisdiction of the State of Oregon (Parks and Recreation Department). A portion of the access road will be temporarily closed (gated) for public access during construction at the site. It may be necessary to construct a temporary "alternative" access road to the beach area for public use during the construction period. The Government will obtain a temporary right-of-way permit from the County to allow vehicular access through the park and any improvements required for the project. The Government will obtain the necessary permit(s) from the State of Oregon, Parks and Recreation Department for use of the roadway on lands under their jurisdiction.

(2) Tillamook South Jetty Maintenance. The Government (Corps) has permanent easement rights over a portion of the access road to the south jetty. The remaining portion of the existing access road is across lands owned by Tillamook County. Some portions of the access road in this area will need to be repaired and/or widened and vegetation removed to allow access for project purposes. The local sponsors will be responsible for obtaining the necessary right-of-way from the County for this section of the access road under the terms of the existing local cooperation agreement.

c. Coordination.

(1) Tillamook North Jetty Maintenance. The Corps shall coordinate with the State Department of Land Conservation and Development and Tillamook County Planning Department to obtain any special use permits which may be required for the project. The Corps and its contractor shall coordinate the scheduled use of the work area and access/haul road with the State of Oregon, Parks and Recreation Department, Barview Jetty County Park Manager, U. S. Coast Guard, and the Garibaldi Volunteer Fire Department. The Corps and its contractor will also coordinate with these entities regarding safety, security and emergency access requirements during project construction.

(2) Tillamook South Jetty Maintenance. The Corps shall coordinate with the State Department of Land Conservation and Development and Tillamook County Planning Department to determine if any special use permits will be required for the project. The Corps and its contractor shall coordinate the scheduled use of the access road with the Tillamook County Sheriff's Office and the State of Oregon, Parks and Recreation Department. The Corps and its

contractor will also coordinate with these entities regarding safety, security and emergency access requirements during project construction.

7.4 UTILITIES

a. Tillamook North Jetty Maintenance. Electricity and water are available in the work site area within the Barview Jetty County Park. The U.S. Coast Guard tower located near the work site has electrical service. The contractor shall coordinate the use of any utilities with the Barview Jetty County Park Manager and the U.S. Coast Guard.

b. Tillamook South Jetty Maintenance. No utilities are available at the work site. The contractor shall be responsible for providing any necessary utilities for the construction operations.

SECTION 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Deterioration of the north and south jetty heads, as well as other locations along the structures, has caused concern for navigability through the channel and for overall stability of the jetties. Severe damage areas occur at the seaward ends, where there is substantial deterioration evidenced by the submerged jetty heads, 384 ft at the north jetty and 666 ft at the south jetty. At historical jetty head recession rates, by 2006, the north jetty will be 475 ft shorter than the authorized length, and the south jetty will be 890 ft shorter than the authorized length. The south jetty has not been repaired since its original construction (1969 to 1979) and portions of the north jetty trunk have not been repaired since 1918. A recent apparent increase in the Pacific Ocean wave climate has exposed both jetties to more extreme storm waves, especially the south jetty which is more exposed to southwesterly storm events.

Minimum repair designs to protect the ends of both jetties from further degradation have been completed. An alternative that addresses navigation concerns is outlined in a conceptual format. Designs for the least cost alternatives that involve adding either a 50 ft or 100 ft cap to the end of the jetty at time of construction have been completed and have incorporated elements to address the range of damage processes believed to be contributing to the instability at the heads including: significant overtopping forces on the crest and backslope, large breaking waves, unstable underwater stone placement, and three-dimensional wave and current effects. Design cross-section elements include a wide, 2-layer toe berm, an increased crest width, flatter sideslopes, and larger armor stone. Repairing the jetties with either a 50 ft or 100 ft cap will only serve the purpose of protecting the federal investment. These alternatives will not improve navigation conditions within the Tillamook entrance over current conditions. Construction of a 50 ft cap on the north jetty is estimated to cost $3.5M; a 50 ft cap on the south jetty is estimated at $8.5M. A 100 ft cap on the north jetty is estimated to cost $5.4M and a 100 ft cap on the south jetty would cost $10.5M.

Numerical modeling of various wave conditions was performed to evaluate the conditions in and around the entrance. Based on these results, it is recommended that future study be conducted to look at jetty lengths that would improve navigation conditions. Although the minimum options would prevent worsening conditions within the entrance, there would be no improvement from existing navigation conditions. Conceptual design of alternative lengths for both jetties was performed using the modeling results. A wave amplification percentage range of 30-50% was set to determine the recommended jetty lengths that would improve navigation conditions within the entrance. A 200 ft extension (STA 55+20) to the current end of the north jetty and a 370 ft extension (STA 82+00) to the current end of the south jetty would be the recommended repair lengths for the jetties based preliminary modeling results.

Conceptual design cost estimates for the north jetty is $7M and the south jetty estimate is $20.6M. These designs and cost estimates would need to be updated and finalized.

Designs were also completed for repairs to 4 separate reaches along the trunks of the jetties, 2 critical and 2 routine. There are two reaches along the north jetty trunk that are in need of repair. The design for the first section, STA 22+00 to 29+50, is considered routine and does not deviate from the original design due to a low risk for wave overtopping. This section is in need of repairs, however, due to the risk of jetty breach that could compromise the stability of the entire jetty. The second reach joins the first reach and extends from STA 29+50 to 37+00 and is considered critical. Wave overtopping is a large concern in this area, and continued shoreline erosion that is adjacent to this section of jetty is a major factor in the need for repair. The crest width and elevation were both increased to compensate for wave overtopping. The cost estimate for repairs to both reaches is $5.8M.

The first repair reach on the south jetty is considered routine and is located between STA 44+00 and 58+00, just seaward of the shoreline. The potential for a jetty breach is of concern in this area. The design calls for flatter sideslopes and larger armor stone than the original design. The cost estimate for this repair is $5.1M. The second reach is considered critical and is located between STA 70+00 and 76+50, just landward of the existing jetty end. This area has severe damage to the crest and sideslopes. Wave overtopping on both sides of the jetty is a large concern because of the proximity to the end of the jetty. Flatter sideslopes and larger armor stone are used in the design along this reach, and a toe berm was added to the seaward portion. The estimated cost for this repair is $12.9M.

A revetment to attempt to stabilize the dune adjacent to the root of the north jetty was also designed. Severe erosion in this area has allowed waves to attack landward portions of the jetty that were not originally designed to withstand the waves. Continued erosion of the shoreline could also lead to a jetty breach that would threaten the stability of the entire jetty. The estimated cost of the revetment is $750,000, with yearly maintenance costs estimated at $22,500.

There are multiple repair areas identified through this study. Table 8-1 outlines the various repair components and presents the costs of each component and pros and cons of each. If it is not possible to repair all areas at once, the following repair priority is recommended based on impacts to navigation, structure stability if the area breached, and severity of damage:

1. North Jetty Revetment
2. Repair the South Jetty Head
3. Repair the North Jetty Head
4. Repair the South Jetty Trunk, STA 70+00 to 76+50
5. Repair the North Jetty Trunk, STA 29+50 to 37+00
6. Repair the South Jetty Trunk, STA 44+00 to 58+00
7. Repair the North Jetty Trunk, STA 22+00 to 29+50

8.2 RECOMMENDATIONS

It is recommended that:

- Alternative 1 be implemented, at an estimated cost of $16.7M that includes:
  - A revetment at the root of the north jetty
  - A 100 ft cap placed on the end of the north jetty at time of construction, leaving the jetty 375 ft shorter than the authorized length for a 2006 construction period.
  - A 100 ft cap placed on the end of the south jetty at time of construction, leaving the jetty 790 ft shorter than the authorized length for a 2006 construction period.

- Trunk repairs be undertaken as soon as practicable to restore both jetties to current design standards in the following order of priority:
  - Critical:
    - South jetty: Station 70+00 to 76+50 ($12.9M)
    - North jetty: Station 29+50 to 37+00 ($4.9M)
  - Routine:
    - South jetty: Station 44+00 to 58+00 ($5.1M)
    - North jetty: Station 22+00 to 29+50. ($1.7M)

- Further study be conducted to determine the appropriate jetty lengths that will provide an acceptable level of navigation conditions within the entrance channel.

Construction is expected in the summer of 2004 for the revetment and 2006 for the jetty heads.

Table 8-1 Jetty Repair Options

	Cost	Critical?	Consequences of not Repairing	Benefits of Repairing	Necessary to build for Head Repair?
50 ft NJ Cap	$3,461,200	Yes, for structure integrity	Jetty will continue to deteriorate. As the jetty length shortens, more waves will be present in the entrance channel. There will also be less flushing of sediment from the channel, perhaps allowing the buildup of shoals within the channel that would require dredging.	Building a cap will stabilize the jetty at the 2006 location and will keep the jetty performing to the same level as the time of construction.	N/A
100 ft NJ Cap	$5,436,600	Yes, for structure integrity	Same as the 50 ft NJ Cap	All of the benefits of the 50 ft cap plus additional longterm stability, which equates to longer project life.	N/A
Alt. NJ Length – 300 ft in 2006	$7,028,100	Yes, for improvements to navigation	Same as the 50 ft NJ Cap	Will decrease wave amplification in the navigation channel. Less submerged jetty head.	N/A
North Jetty Revetment – 300 ft	$750,300	Yes	Breach of the North Jetty at the shoreline which would lead to jetty damage both landward and seaward of the breach, large volume of adjacent shoreline entering the navigation channel, and shoreline recession.	The landward portion of the jetty would be protected from wave attack from the oceanside that is threatening to breach the jetty.	No
North Jetty Trunk Repair STA 22+00 to 29+50 (750 ft, routine)	$1,710,800	No	Potential for a jetty breach in this reach that could lead to structural stability issues.	Jetty cross section restored to section appropriate to withstand existing wave attack.	No
North Jetty Trunk Repair STA 29+50 to 37+00 (750 ft critical)	$4,921,600	No	Potential for a jetty breach in this reach that could lead to structural stability issues.	Would have a full jetty cross-section that could withstand a certain level of wave attack and overtopping..	

	Cost	Critical?	Consequences of not Repairing	Benefits of Repairing	Necessary to build for Head Repair?
50 ft SJ Cap	$8,518,400	Yes, for structure integrity	Same as the 50 ft NJ Cap	Same as the 50 ft NJ Cap	N/A
100 ft SJ Cap	$10,473,000	Should be same as for 50 ft cap.	Same as the 50 ft NJ Cap	All of the benefits of the 50 ft cap plus additional longterm stability, which equates to longer project life.	N/A
Alt. SJ Length – 600 ft in 2006	$20,580,700	Yes, for improvements to navigation	Same as the 50 ft NJ Cap	Will decrease wave amplification in the navigation channel. Less submerged jetty head.	N/A
South Jetty 1400 ft Trunk Repair STA 44+00 to 58+00 (1400 ft, routine)	$5,131,100	No	Potential for a jetty breach in this reach that could lead to structural stability issues.	Jetty cross section restored to section appropriate to withstand existing wave attack.	No
South Jetty 650 ft Trunk Repair STA 70+00 to 76+50 (650 ft, critical)	$12,896,600	Yes, for structure integrity	Large waves attack this jetty section on both sides. Core stone is exposed which leads to a high potential for a jetty breach that would increase the recession of the jetty end.	Would restore cross section to that appropriate to withstand a 50-yr storm.	No
Do Nothing	$0	N/A	The jetties would continue to deteriorate if not repaired. There is high potential for breaching along the root of the north jetty and near the end of the south jetty. As the jetties deteriorate, navigation conditions within the channel and over the ebb tidal shoal will worsen. Dredging would be required to maintain the authorized channel depth of 18 ft MLLW.	The only benefit to the Do Nothing approach is that there are no construction costs.	N/A

Tillamook Jetty CWE
Includes caps and trunk repairs
for both jetties and the North
Jetty Revetment. Two cap
lengths are considered for each.

Designed By: Heather Sumerell
Estimated By: Pat Jones

Prepared By: CENWP-EC-DX

Preparation Date: 11/07/03
Effective Date of Pricing: 11/07/03

Sales Tax: 0.00%

** CONTRACTOR SETTINGS **

		AMOUNT	PCT	PCT S	RISK	DIFF	SIZE	PERIOD	INVEST	ASSIST	SUBCON
AA Prime Ktr											
Prime Contractor's Field Overhead	P		5.00								
Prime's Home Office Expense			3.00								
Prime Contractor's Profit	C		8.85		0.090	0.090	0.060	0.050	0.090	0.120	0.120
Prime Contractor's Bond			2.00								
BB Prime Ktr - Revetment											
Prime Contractor's Field Overhead	P		15.00								
Prime's Home Office Expense			5.00								
Prime Contractor's Profit	C		8.85		0.000	0.000	0.000	0.000	0.000	0.000	0.000
Prime Contractor's Bond			2.00								

1. North Jetty 50' Cap

1_ 5. Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00

1. North Jetty 50' Cap

1_ 5. Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction					0.05	2.20	1.35	0.00	0.00	3.55	
	11130	CY	ZD11	100.00	557	24,493	15,058	0	0	39,550	3.55
USR AA < > Quarry Waste Material					0.00	0.00	0.00	20.00	0.00	20.00	
	11130	CY		0.00	0	0	0	222,600	0	222,600	20.00
TOTAL Haul road					557	24,493	15,058	222,600	0	262,150	
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	16691	TON	ZD10	150.00	668	29,443	38,044	0	0	67,487	4.04
USR AA < > Construct off load facility (rockfill)	4111.00	TON	ZD09	150.00	0.09 356	3.75 15,419	5.72 23,496	0.00 0	0.00 0	9.47 38,915	9.47
USR AA < > Road rock for off-load facility					0.05	2.20	1.35	20.00	0.00	23.55	
	1040.00	CY	ZD11	100.00	52	2,289	1,407	20,800	0	24,496	23.55
USR AA < > Remove offloading facility, place in jetty	5000.00	TON	ZD09	250.00	0.05 260	2.25 11,252	3.43 17,147	0.00 0	0.00 0	5.68 28,398	5.68

1. North Jetty 50' Cap

1_12. Off-loading facility,off-loading	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
TOTAL Off-loading facility,off-loading					1,336	58,402	80,094	20,800	0	159,295	
USR AA < > Construct turnout (jettystone)					0.13	5.63	8.57	0.00	0.00	14.20	
	1100.00	TON	ZD09	100.00	143	6,188	9,431	0	0	15,619	14.20
USR AA < > Road rock for turnout					0.05	2.20	1.35	20.00	0.00	23.55	
	450.00	CY	ZD11	100.00	23	990	609	9,000	0	10,599	23.55
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 30.7 ton Avg Wt Stone @ 170 pcf					0.13	5.63	8.57	59.50	0.00	73.70	
	16691	TON	ZD09	100.00	2,170	93,902	143,097	993,115	0	1,230,113	73.70
TOTAL Cap					2,170	93,902	143,097	993,115	0	1,230,113	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07

1. North Jetty 50' Cap

1_7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL North Jetty 50' Cap					5,400	235,082	293,540	1,251,844	178,400	1,958,866	

2. South Jetty 50' Cap

2_ 5. Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00

2. South Jetty 50' Cap

2_ 5. Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05	2.32	0.00	19.59	0.00	21.91	
					14	696	0	5,877	0	6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20	127.31	38.33	452.45	0.00	618.09	
					3	127	38	452	0	618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05	2.18	0.23	0.00	0.00	2.41	
					0	2	0	0	0	2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction					0.05	2.20	1.35	0.00	0.00	3.55	
	23400	CY	ZD11	100.00	1,170	51,494	31,658	0	0	83,152	3.55
USR AA < > Quarry Waste Material					0.00	0.00	0.00	20.00	0.00	20.00	
	23400	CY		0.00	0	0	0	468,000	0	468,000	20.00
TOTAL Haul road					1,170	51,494	31,658	468,000	0	551,152	
L AF AA <02112 0700 > Felling trees & piling, chipping, heavy brush	0.60	ACR	CODFB7	0.05	120.00	4703.80	1837.47	0.00	0.00	6541.27	
					72	2,822	1,102	0	0	3,925	6541.27
MIL AA <02239 0200 > Spread & compact, slope up to 1 in 4, shape enbankment, w/ machine	5600.00	SY	COFGB32A	150.00	0.02	0.85	0.47	0.00	0.00	1.32	
					112	4,742	2,630	0	0	7,372	1.32
B MIL AA <02239 0012 > Spread & compact, 8" lift, roadway embankment, 300 HP tractor	1850.00	CY	CODTB10C	75.00	0.02	0.85	0.90	12.00	0.00	13.75	
					37	1,566	1,662	22,200	0	25,428	13.75
B MIL AA <02215 1215 > Backfill, trench, dozer, no compaction, 200 HP	740.00	CY	CODTB10B	75.00	0.02	0.85	0.72	10.00	0.00	11.57	
					15	627	536	7,400	0	8,563	11.57

2. South Jetty 50' Cap

2_11. Access road	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
L MIL AA <02220 8900 > Compaction, structural/trench,					0.13	4.77	0.21	0.00	0.00	4.98	
by hand w/air tamp, 6" lift	740.00	CY	ULABB9	40.00	93	3,527	158	0	0	3,685	4.98
TOTAL Access road					328	13,284	6,089	29,600	0	48,972	
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	43458	TON	ZD10	150.00	1,738	76,660	99,054	0	0	175,714	4.04
USR AA < > Small quarry rock					0.05	2.20	1.35	20.00	0.00	23.55	
	400.00	CY	ZD11	100.00	20	880	541	8,000	0	9,421	23.55
USR AA < > Remove offloading facility					0.05	2.25	3.43	0.00	0.00	5.68	
matls.	5400.00	CY	ZD09	250.00	281	12,152	18,518	0	0	30,670	5.68
L MIL AA <02161 2550 > Sheet piling, stl, connections &					60.00	2859.00	791.80	186.83	0.00	3837.63	
struts, 2/3 salvage, wales	130.00	TON	ACARF4	0.10	7,800	371,670	102,933	24,288	0	498,891	3837.63
USR AA < > Place sand from nearby mounds					0.05	2.25	3.43	0.00	0.00	5.68	
	5000.00	CY	ZD09	250.00	260	11,252	17,147	0	0	28,398	5.68
TOTAL Off-loading facility,off-loading					10,099	472,613	238,193	32,288	0	743,094	
USR AA < > Construct turnout (jettystone)					0.13	5.63	8.57	0.00	0.00	14.20	
	1100.00	TON	ZD09	100.00	143	6,188	9,431	0	0	15,619	14.20
USR AA < > Road rock for turnout					0.05	2.20	1.35	20.00	0.00	23.55	
	450.00	CY	ZD11	100.00	23	990	609	9,000	0	10,599	23.55
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 42.1 ton Avg Wt Stone @ 170 pcf					0.13	5.63	8.57	61.50	0.00	75.70	
	43458	TON	ZD09	100.00	5,650	244,490	372,578	2,672,667	0	3,289,736	75.70
TOTAL Cap					5,650	244,490	372,578	2,672,667	0	3,289,736	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48

2. South Jetty 50' Cap

2_7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE	96.00	HR	T50IT005	1.00	0.00 0	0.00 0	36.98 3,550	0.00 0	0.00 0	36.98 3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F	8.00	HR	L40CA006	1.00	0.00 0	0.00 0	59.79 478	0.00 0	0.00 0	59.79 478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	24.00	HR	T55CA001	1.00	0.00 0	0.00 0	55.30 1,327	0.00 0	0.00 0	55.30 1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)	96.00	HR	T45XX017	1.00	0.00 0	0.00 0	8.38 804	0.00 0	0.00 0	8.38 804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)	10.00	HR	T15CA016	1.00	0.00 0	0.00 0	59.43 594	0.00 0	0.00 0	59.43 594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)	10.00	HR	T10CA017	1.00	0.00 0	0.00 0	8.49 85	0.00 0	0.00 0	8.49 85	8.49
MIL AA < > Outside Truck Drivers, Heavy	120.00	HR	X-TRKDVRHV	1.00	1.00 120	40.07 4,808	0.00 0	0.00 0	0.00 0	40.07 4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)	80.00	HR	X-LABORER	1.00	1.00 80	37.32 2,986	0.00 0	0.00 0	0.00 0	37.32 2,986	37.32
USR AA < > Foreman	40.00	HR	X-FOREHEAV	1.00	1.00 40	49.50 1,980	0.00 0	0.00 0	0.00 0	49.50 1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy	164.00	HR	X-EQOPRHVY	1.00	1.00 164	47.96 7,865	0.00 0	0.00 0	0.00 0	47.96 7,865	47.96
USR AA < > Scales, with scale house	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	2000.00 2,000	2000.00 2,000	2000.00
USR AA < > Office trailer	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 1,500	1500.00 1,500	1500.00
USR AA < > Generator	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1000.00 1,000	1000.00 1,000	1000.00
USR AA < > Storage trailer	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1000.00 1,000	1000.00 1,000	1000.00
USR AA < > Counter weights & misc equip	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3000.00 3,000	3000.00 3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL South Jetty 50' Cap					18,585	840,167	703,809	3,217,884	178,400	4,940,261	

4. North Jetty Revetment

4_25. Revetment	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR BB < > Underlayer, 350-600 lb					0.02	0.85	0.75	28.75	0.00	30.35	
	2200.00	TON	ZD01	100.00	44	1,876	1,645	63,250	0	66,771	30.35
USR BB < > Filter Layer, 1-25 lb					0.02	0.85	0.75	28.75	0.00	30.35	
	2000.00	TON	ZD01	100.00	40	1,706	1,495	57,500	0	60,701	30.35
USR BB < > Mob/demob for revetment					0.00	0.00	0.00	0.00	10000.00	10000.00	
	1.00	LS		0.00	0	0	0	0	10,000	10,000	10000
USR BB < > Armor Unit, 1.6T - 2.7T					0.02	0.85	0.75	38.75	0.00	40.35	
	5000.00	TON	ZD01	100.00	100	4,264	3,739	193,750	0	201,753	40.35
USR BB < > Gravel Layer, 1mm-4mm					0.03	1.14	1.00	20.00	0.00	22.13	
	720.00	CY	ZD01	75.00	19	819	718	14,400	0	15,937	22.13
USR BB < > Prep work for revetment					0.00	0.00	0.00	0.00	5000.00	5000.00	
	1.00	LS		0.00	0	0	0	0	5,000	5,000	5000.00
TOTAL Revetment					203	8,664	7,597	328,900	15,000	360,161	
TOTAL North Jetty Revetment					203	8,664	7,597	328,900	15,000	360,161	

20. North Jetty 100' Cap

20_ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction	11446	CY	ZD11	100.00	0.05 572	2.20 25,188	1.35 15,485	0.00 0	0.00 0	3.55 40,673	3.55
USR AA < > Quarry Waste Material	11446	CY		0.00	0.00 0	0.00 0	0.00 0	20.00 228,920	0.00 0	20.00 228,920	20.00
TOTAL Haul road					572	25,188	15,485	228,920	0	269,593	
USR AA < > Off load all jettystone	31575	TON	ZD10	150.00	0.04 1,263	1.76 55,698	2.28 71,969	0.00 0	0.00 0	4.04 127,667	4.04
USR AA < > Construct off load facility (rockfill)	4111.00	TON	ZD09	150.00	0.09 356	3.75 15,419	5.72 23,496	0.00 0	0.00 0	9.47 38,915	9.47
USR AA < > Road rock for off-load facility	1040.00	CY	ZD11	100.00	0.05 52	2.20 2,289	1.35 1,407	20.00 20,800	0.00 0	23.55 24,496	23.55
USR AA < > Remove offloading facility, place in jetty	5000.00	TON	ZD09	250.00	0.05 260	2.25 11,252	3.43 17,147	0.00 0	0.00 0	5.68 28,398	5.68
TOTAL Off-loading facility,off-loading					1,931	84,657	114,019	20,800	0	219,476	
USR AA < > Construct turnout (jettystone)	1100.00	TON	ZD09	100.00	0.13 143	5.63 6,188	8.57 9,431	0.00 0	0.00 0	14.20 15,619	14.20
USR AA < > Road rock for turnout	450.00	CY	ZD11	100.00	0.05 23	2.20 990	1.35 609	20.00 9,000	0.00 0	23.55 10,599	23.55

20. North Jetty 100' Cap

20_13. Turnout	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 30.7 ton Avg Wt Stone @ 170 pcf					0.13	5.63	8.57	59.50	0.00	73.70	
	31575	TON	ZD09	100.00	4,105	177,638	270,702	1,878,713	0	2,327,052	73.70
TOTAL Cap					4,105	177,638	270,702	1,878,713	0	2,327,052	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96

20. North Jetty 100' Cap

20_5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32

20. North Jetty 100' Cap

20_7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL North Jetty 100' Cap					7,946	345,769	455,497	2,143,762	178,400	3,123,428	

21. South Jetty 100' Cap

21_ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction					0.05	2.20	1.35	0.00	0.00	3.55	
	23673	CY	ZD11	100.00	1,184	52,095	32,027	0	0	84,122	3.55
USR AA < > Quarry Waste Material					0.00	0.00	0.00	20.00	0.00	20.00	
	23673	CY		0.00	0	0	0	473,460	0	473,460	20.00
TOTAL Haul road					1,184	52,095	32,027	473,460	0	557,582	
L AF AA <02112 0700 > Felling trees & piling, chipping, heavy brush	0.60	ACR	CODFB7	0.05	120.00 72	4703.80 2,822	1837.47 1,102	0.00 0	0.00 0	6541.27 3,925	6541.27
MIL AA <02239 0200 > Spread & compact, slope up to 1 in 4, shape enbankment, w/ machine	5600.00	SY	COFGB32A	150.00	0.02 112	0.85 4,742	0.47 2,630	0.00 0	0.00 0	1.32 7,372	1.32
B MIL AA <02239 0012 > Spread & compact, 8" lift, roadway embankment, 300 HP tractor	1850.00	CY	CODTB10C	75.00	0.02 37	0.85 1,566	0.90 1,662	12.00 22,200	0.00 0	13.75 25,428	13.75
B MIL AA <02215 1215 > Backfill, trench, dozer, no compaction, 200 HP	740.00	CY	CODTB10B	75.00	0.02 15	0.85 627	0.72 536	10.00 7,400	0.00 0	11.57 8,563	11.57
L MIL AA <02220 8900 > Compaction, structural/trench, by hand w/air tamp, 6" lift	740.00	CY	ULABB9	40.00	0.13 93	4.77 3,527	0.21 158	0.00 0	0.00 0	4.98 3,685	4.98
TOTAL Access road					328	13,284	6,089	29,600	0	48,972	

21. South Jetty 100' Cap

21_12. Off-loading facility,off-loading	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	57818	TON	ZD10	150.00	2,313	101,991	131,785	0	0	233,776	4.04
USR AA < > Small quarry rock					0.05	2.20	1.35	20.00	0.00	23.55	
	400.00	CY	ZD11	100.00	20	880	541	8,000	0	9,421	23.55
USR AA < > Remove offloading facility matls.					0.05	2.25	3.43	0.00	0.00	5.68	
	5400.00	CY	ZD09	250.00	281	12,152	18,518	0	0	30,670	5.68
L MIL AA <02161 2550 > Sheet piling, stl, connections & struts, 2/3 salvage, wales					60.00	2859.00	791.80	186.83	0.00	3837.63	
	130.00	TON	ACARF4	0.10	7,800	371,670	102,933	24,288	0	498,891	3837.63
USR AA < > Place sand from nearby mounds					0.05	2.25	3.43	0.00	0.00	5.68	
	5000.00	CY	ZD09	250.00	260	11,252	17,147	0	0	28,398	5.68
TOTAL Off-loading facility,off-loading					10,674	497,944	270,924	32,288	0	801,156	
USR AA < > Construct turnout (jettystone)					0.13	5.63	8.57	0.00	0.00	14.20	
	1100.00	TON	ZD09	100.00	143	6,188	9,431	0	0	15,619	14.20
USR AA < > Road rock for turnout					0.05	2.20	1.35	20.00	0.00	23.55	
	450.00	CY	ZD11	100.00	23	990	609	9,000	0	10,599	23.55
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 42.1 ton Avg Wt Stone @ 170 pcf					0.13	5.63	8.57	61.50	0.00	75.70	
	57818	TON	ZD09	100.00	7,516	325,278	495,691	3,555,807	0	4,376,776	75.70
TOTAL Cap					7,516	325,278	495,691	3,555,807	0	4,376,776	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79

21. South Jetty 100' Cap

21_5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48

21. South Jetty 100' Cap

21_7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE	96.00	HR	T50IT005	1.00	0.00 0	0.00 0	36.98 3,550	0.00 0	0.00 0	36.98 3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F	8.00	HR	L40CA006	1.00	0.00 0	0.00 0	59.79 478	0.00 0	0.00 0	59.79 478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	24.00	HR	T55CA001	1.00	0.00 0	0.00 0	55.30 1,327	0.00 0	0.00 0	55.30 1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)	96.00	HR	T45XX017	1.00	0.00 0	0.00 0	8.38 804	0.00 0	0.00 0	8.38 804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)	10.00	HR	T15CA016	1.00	0.00 0	0.00 0	59.43 594	0.00 0	0.00 0	59.43 594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)	10.00	HR	T10CA017	1.00	0.00 0	0.00 0	8.49 85	0.00 0	0.00 0	8.49 85	8.49
MIL AA < > Outside Truck Drivers, Heavy	120.00	HR	X-TRKDVRHV	1.00	1.00 120	40.07 4,808	0.00 0	0.00 0	0.00 0	40.07 4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)	80.00	HR	X-LABORER	1.00	1.00 80	37.32 2,986	0.00 0	0.00 0	0.00 0	37.32 2,986	37.32
USR AA < > Foreman	40.00	HR	X-FOREHEAV	1.00	1.00 40	49.50 1,980	0.00 0	0.00 0	0.00 0	49.50 1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy	164.00	HR	X-EQOPRHVY	1.00	1.00 164	47.96 7,865	0.00 0	0.00 0	0.00 0	47.96 7,865	47.96
USR AA < > Scales, with scale house	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	2000.00 2,000	2000.00 2,000	2000.00
USR AA < > Office trailer	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 1,500	1500.00 1,500	1500.00
USR AA < > Generator	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1000.00 1,000	1000.00 1,000	1000.00
USR AA < > Storage trailer	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1000.00 1,000	1000.00 1,000	1000.00
USR AA < > Counter weights & misc equip	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3000.00 3,000	3000.00 3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL South Jetty 100' Cap					21,040	946,887	860,022	4,106,484	178,400	6,091,793	

3 . NJ Alt (Long) Fix

3 _ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction					0.05	2.20	1.35	0.00	0.00	3.55	
	12116	CY	ZD11	100.00	606	26,662	16,392	0	0	43,054	3.55
USR AA < > Quarry Waste Material					0.00	0.00	0.00	20.00	0.00	20.00	
	12116	CY		0.00	0	0	0	242,320	0	242,320	20.00
TOTAL Haul road					606	26,662	16,392	242,320	0	285,374	
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	43441	TON	ZD10	150.00	1,738	76,630	99,015	0	0	175,645	4.04
USR AA < > Construct off load facility (rockfill)	4111.00	TON	ZD09	150.00	0.09 356	3.75 15,419	5.72 23,496	0.00 0	0.00 0	9.47 38,915	9.47
USR AA < > Road rock for off-load facility					0.05	2.20	1.35	20.00	0.00	23.55	
	1040.00	CY	ZD11	100.00	52	2,289	1,407	20,800	0	24,496	23.55
USR AA < > Remove offloading facility, place in jetty	5000.00	TON	ZD09	250.00	0.05 260	2.25 11,252	3.43 17,147	0.00 0	0.00 0	5.68 28,398	5.68
TOTAL Off-loading facility,off-loading					2,406	105,589	141,065	20,800	0	267,454	
USR AA < > Construct turnout (jettystone)					0.13	5.63	8.57	0.00	0.00	14.20	
	1100.00	TON	ZD09	100.00	143	6,188	9,431	0	0	15,619	14.20
USR AA < > Road rock for turnout					0.05	2.20	1.35	20.00	0.00	23.55	
	450.00	CY	ZD11	100.00	23	990	609	9,000	0	10,599	23.55

3 . NJ Alt (Long) Fix

3 _13. Turnout	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 30.7 ton Avg Wt Stone @ 170 pcf					0.13	5.63	8.57	59.50	0.00	73.70	
	43441	TON	ZD09	100.00	5,647	244,395	372,433	2,584,740	0	3,201,567	73.70
TOTAL Cap					5,647	244,395	372,433	2,584,740	0	3,201,567	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96

3 . NJ Alt (Long) Fix

3 _5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32

3 . NJ Alt (Long) Fix

3 _7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL NJ Alt (Long) Fix					9,997	434,932	585,181	2,863,189	178,400	4,061,701	

4 . SJ Alt (Long) Fix

4 _ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction	25092	CY	ZD11	100.00	0.05 1,255	2.20 55,217	1.35 33,947	0.00 0	0.00 0	3.55 89,164	3.55
USR AA < > Quarry Waste Material	25092	CY		0.00	0.00 0	0.00 0	0.00 0	20.00 501,840	0.00 0	20.00 501,840	20.00
TOTAL Haul road					1,255	55,217	33,947	501,840	0	591,004	
L AF AA <02112 0700 > Felling trees & piling, chipping, heavy brush	0.60	ACR	CODFB7	0.05	120.00 72	4703.80 2,822	1837.47 1,102	0.00 0	0.00 0	6541.27 3,925	6541.27
MIL AA <02239 0200 > Spread & compact, slope up to 1 in 4, shape enbankment, w/ machine	5600.00	SY	COFGB32A	150.00	0.02 112	0.85 4,742	0.47 2,630	0.00 0	0.00 0	1.32 7,372	1.32
B MIL AA <02239 0012 > Spread & compact, 8" lift, roadway embankment, 300 HP tractor	1850.00	CY	CODTB10C	75.00	0.02 37	0.85 1,566	0.90 1,662	12.00 22,200	0.00 0	13.75 25,428	13.75
B MIL AA <02215 1215 > Backfill, trench, dozer, no compaction, 200 HP	740.00	CY	CODTB10B	75.00	0.02 15	0.85 627	0.72 536	10.00 7,400	0.00 0	11.57 8,563	11.57
L MIL AA <02220 8900 > Compaction, structural/trench, by hand w/air tamp, 6" lift	740.00	CY	ULABB9	40.00	0.13 93	4.77 3,527	0.21 158	0.00 0	0.00 0	4.98 3,685	4.98
TOTAL Access road					328	13,284	6,089	29,600	0	48,972	

4 . SJ Alt (Long) Fix

4 _12. Off-loading facility,off-loading	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	132126	TON	ZD10	150.00	5,285	233,070	301,155	0	0	534,225	4.04
USR AA < > Small quarry rock					0.05	2.20	1.35	20.00	0.00	23.55	
	400.00	CY	ZD11	100.00	20	880	541	8,000	0	9,421	23.55
USR AA < > Remove offloading facility matls.					0.05	2.25	3.43	0.00	0.00	5.68	
	5400.00	CY	ZD09	250.00	281	12,152	18,518	0	0	30,670	5.68
L MIL AA <02161 2550 > Sheet piling, stl, connections & struts, 2/3 salvage, wales					60.00	2859.00	791.80	186.83	0.00	3837.63	
	130.00	TON	ACARF4	0.10	7,800	371,670	102,933	24,288	0	498,891	3837.63
USR AA < > Place sand from nearby mounds					0.05	2.25	3.43	0.00	0.00	5.68	
	5000.00	CY	ZD09	250.00	260	11,252	17,147	0	0	28,398	5.68
TOTAL Off-loading facility,off-loading					13,646	629,024	440,294	32,288	0	1,101,606	
USR AA < > Construct turnout (jettystone)					0.13	5.63	8.57	0.00	0.00	14.20	
	1100.00	TON	ZD09	100.00	143	6,188	9,431	0	0	15,619	14.20
USR AA < > Road rock for turnout					0.05	2.20	1.35	20.00	0.00	23.55	
	450.00	CY	ZD11	100.00	23	990	609	9,000	0	10,599	23.55
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 42.1 ton Avg Wt Stone @ 170 pcf					0.13	5.63	8.57	61.50	0.00	75.70	
	132126	TON	ZD09	100.00	17,176	743,328	1,132,756	8,125,749	0	10,001,832	75.70
TOTAL Cap					17,176	743,328	1,132,756	8,125,749	0	10,001,832	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79

4 . SJ Alt (Long) Fix

4 _5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48

4 . SJ Alt (Long) Fix

4 _7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW,					0.00	0.00	36.98	0.00	0.00	36.98	
6X4, 3 AXLE	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD					0.00	0.00	8.38	0.00	0.00	8.38	
TOWING TRUCK)	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE					0.00	0.00	59.43	0.00	0.00	59.43	
(ADD ATTACHMENTS)	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8					0.00	0.00	8.49	0.00	0.00	8.49	
(ADD D-8 TRACTOR)	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL SJ Alt (Long) Fix					33,743	1,499,138	1,668,377	8,704,806	178,400	12,050,721	

5 . North Jetty Trunk Repair 22-29.5

5 _ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction	1000.00	CY	ZD11	100.00	0.05 50	2.20 2,201	1.35 1,353	0.00 0	0.00 0	3.55 3,554	3.55
USR AA < > Quarry Waste Material	1000.00	CY		0.00	0.00 0	0.00 0	0.00 0	20.00 20,000	0.00 0	20.00 20,000	20.00
TOTAL Haul road					50	2,201	1,353	20,000	0	23,554	
USR AA < > Off load all jettystone	7789.00	TON	ZD10	150.00	0.04 312	1.76 13,740	2.28 17,753	0.00 0	0.00 0	4.04 31,493	4.04
USR AA < > Construct off load facility (rockfill)	4111.00	TON	ZD09	150.00	0.09 356	3.75 15,419	5.72 23,496	0.00 0	0.00 0	9.47 38,915	9.47
USR AA < > Road rock for off-load facility	1040.00	CY	ZD11	100.00	0.05 52	2.20 2,289	1.35 1,407	20.00 20,800	0.00 0	23.55 24,496	23.55
USR AA < > Remove offloading facility, place in jetty	5000.00	TON	ZD09	250.00	0.05 260	2.25 11,252	3.43 17,147	0.00 0	0.00 0	5.68 28,398	5.68
TOTAL Off-loading facility,off-loading					980	42,699	59,803	20,800	0	123,302	
USR AA < > Construct turnout (jettystone)	1100.00	TON	ZD09	100.00	0.13 143	5.63 6,188	8.57 9,431	0.00 0	0.00 0	14.20 15,619	14.20
USR AA < > Road rock for turnout	450.00	CY	ZD11	100.00	0.05 23	2.20 990	1.35 609	20.00 9,000	0.00 0	23.55 10,599	23.55

5 . North Jetty Trunk Repair 22-29.5

5 _13. Turnout	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 3.8-6.3 Ton Stone					0.13	5.63	8.57	46.50	0.00	60.70	
	7789.00	TON	ZD09	100.00	1,013	43,820	66,777	362,189	0	472,786	60.70
TOTAL Trunk repairs					1,013	43,820	66,777	362,189	0	472,786	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96

5 . North Jetty Trunk Repair 22-29.5

5 _5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32

5 . North Jetty Trunk Repair 22-29.5

5 _7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL North Jetty Trunk Repair 22-29.5					3,380	147,005	183,225	418,318	178,400	926,948	

6 . South Jetty Trunk Repair 44-58

6 _ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction	1000.00	CY	ZD11	100.00	0.05 50	2.20 2,201	1.35 1,353	0.00 0	0.00 0	3.55 3,554	3.55
USR AA < > Quarry Waste Material	1000.00	CY		0.00	0.00 0	0.00 0	0.00 0	20.00 20,000	0.00 0	20.00 20,000	20.00
TOTAL Haul road					50	2,201	1,353	20,000	0	23,554	
L AF AA <02112 0700 > Felling trees & piling, chipping, heavy brush	0.60	ACR	CODFB7	0.05	120.00 72	4703.80 2,822	1837.47 1,102	0.00 0	0.00 0	6541.27 3,925	6541.27
MIL AA <02239 0200 > Spread & compact, slope up to 1 in 4, shape enbankment, w/ machine	5600.00	SY	COFGB32A	150.00	0.02 112	0.85 4,742	0.47 2,630	0.00 0	0.00 0	1.32 7,372	1.32
B MIL AA <02239 0012 > Spread & compact, 8" lift, roadway embankment, 300 HP tractor	1850.00	CY	CODTB10C	75.00	0.02 37	0.85 1,566	0.90 1,662	12.00 22,200	0.00 0	13.75 25,428	13.75
B MIL AA <02215 1215 > Backfill, trench, dozer, no compaction, 200 HP	740.00	CY	CODTB10B	75.00	0.02 15	0.85 627	0.72 536	10.00 7,400	0.00 0	11.57 8,563	11.57
L MIL AA <02220 8900 > Compaction, structural/trench, by hand w/air tamp, 6" lift	740.00	CY	ULABB9	40.00	0.13 93	4.77 3,527	0.21 158	0.00 0	0.00 0	4.98 3,685	4.98
TOTAL Access road					328	13,284	6,089	29,600	0	48,972	

6 . South Jetty Trunk Repair 44-58

6 _12. Off-loading facility,off-loading	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	28716	TON	ZD10	150.00	1,149	50,655	65,452	0	0	116,107	4.04
USR AA < > Small quarry rock					0.05	2.20	1.35	20.00	0.00	23.55	
	400.00	CY	ZD11	100.00	20	880	541	8,000	0	9,421	23.55
USR AA < > Remove offloading facility matls.					0.05	2.25	3.43	0.00	0.00	5.68	
	5400.00	CY	ZD09	250.00	281	12,152	18,518	0	0	30,670	5.68
L MIL AA <02161 2550 > Sheet piling, stl, connections & struts, 2/3 salvage, wales					60.00	2859.00	791.80	186.83	0.00	3837.63	
	130.00	TON	ACARF4	0.10	7,800	371,670	102,933	24,288	0	498,891	3837.63
USR AA < > Place sand from nearby mounds					0.05	2.25	3.43	0.00	0.00	5.68	
	5000.00	CY	ZD09	250.00	260	11,252	17,147	0	0	28,398	5.68
TOTAL Off-loading facility,off-loading					9,509	446,608	204,592	32,288	0	683,488	
USR AA < > 8.3-13.8 Ton Stone					0.13	5.63	8.57	53.50	0.00	67.70	
	28716	TON	ZD09	100.00	3,733	161,553	246,191	1,536,306	0	1,944,050	67.70
TOTAL Trunk repairs					3,733	161,553	246,191	1,536,306	0	1,944,050	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49

6 . South Jetty Trunk Repair 44-58

6 _5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38

6 . South Jetty Trunk Repair 44-58

6 _7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE					0.00	0.00	59.43	0.00	0.00	59.43	
(ADD ATTACHMENTS)	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8					0.00	0.00	8.49	0.00	0.00	8.49	
(ADD D-8 TRACTOR)	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL South Jetty Trunk Repair 44-58					14,446	659,751	480,614	1,624,523	178,400	2,943,288	

8 . South Jetty Trunk Repair 70-76.5

8 _ 8. Weigh scales and scale house	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
MIL AA <02833 4620 > Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 > Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 > Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < > Haul road construction					0.05	2.20	1.35	0.00	0.00	3.55	
	23400	CY	ZD11	100.00	1,170	51,494	31,658	0	0	83,152	3.55
USR AA < > Quarry Waste Material					0.00	0.00	0.00	20.00	0.00	20.00	
	23400	CY		0.00	0	0	0	468,000	0	468,000	20.00
TOTAL Haul road					1,170	51,494	31,658	468,000	0	551,152	
L AF AA <02112 0700 > Felling trees & piling, chipping, heavy brush	0.60	ACR	CODFB7	0.05	120.00 72	4703.80 2,822	1837.47 1,102	0.00 0	0.00 0	6541.27 3,925	6541.27
MIL AA <02239 0200 > Spread & compact, slope up to 1 in 4, shape enbankment, w/ machine	5600.00	SY	COFGB32A	150.00	0.02 112	0.85 4,742	0.47 2,630	0.00 0	0.00 0	1.32 7,372	1.32
B MIL AA <02239 0012 > Spread & compact, 8" lift, roadway embankment, 300 HP tractor	1850.00	CY	CODTB10C	75.00	0.02 37	0.85 1,566	0.90 1,662	12.00 22,200	0.00 0	13.75 25,428	13.75
B MIL AA <02215 1215 > Backfill, trench, dozer, no compaction, 200 HP	740.00	CY	CODTB10B	75.00	0.02 15	0.85 627	0.72 536	10.00 7,400	0.00 0	11.57 8,563	11.57
L MIL AA <02220 8900 > Compaction, structural/trench, by hand w/air tamp, 6" lift	740.00	CY	ULABB9	40.00	0.13 93	4.77 3,527	0.21 158	0.00 0	0.00 0	4.98 3,685	4.98
TOTAL Access road					328	13,284	6,089	29,600	0	48,972	

8 . South Jetty Trunk Repair 70-76.5

8 _12. Off-loading facility,off-loading	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Off load all jettystone					0.04	1.76	2.28	0.00	0.00	4.04	
	75827	TON	ZD10	150.00	3,033	133,759	172,832	0	0	306,591	4.04
USR AA < > Small quarry rock					0.05	2.20	1.35	20.00	0.00	23.55	
	400.00	CY	ZD11	100.00	20	880	541	8,000	0	9,421	23.55
USR AA < > Remove offloading facility matls.					0.05	2.25	3.43	0.00	0.00	5.68	
	5400.00	CY	ZD09	250.00	281	12,152	18,518	0	0	30,670	5.68
L MIL AA <02161 2550 > Sheet piling, stl, connections & struts, 2/3 salvage, wales					60.00	2859.00	791.80	186.83	0.00	3837.63	
	130.00	TON	ACARF4	0.10	7,800	371,670	102,933	24,288	0	498,891	3837.63
USR AA < > Place sand from nearby mounds					0.05	2.25	3.43	0.00	0.00	5.68	
	5000.00	CY	ZD09	250.00	260	11,252	17,147	0	0	28,398	5.68
TOTAL Off-loading facility,off-loading					11,394	529,712	311,972	32,288	0	873,972	
USR AA < > Construct turnout (jettystone)					0.13	5.63	8.57	0.00	0.00	14.20	
	1100.00	TON	ZD09	100.00	143	6,188	9,431	0	0	15,619	14.20
USR AA < > Road rock for turnout					0.05	2.20	1.35	20.00	0.00	23.55	
	450.00	CY	ZD11	100.00	23	990	609	9,000	0	10,599	23.55
USR AA < > Remove turnout, place in jetty					0.17	7.50	11.43	0.00	0.00	18.93	
	2000.00	TON	ZD09	75.00	347	15,002	22,862	0	0	37,864	18.93
TOTAL Turnout					512	22,181	32,901	9,000	0	64,083	
USR AA < > 31.6-52.6 Ton Stone					0.13	5.63	8.57	61.50	0.00	75.70	
	75827	TON	ZD09	100.00	9,858	426,595	650,088	4,663,361	0	5,740,043	75.70
TOTAL Trunk repairs					9,858	426,595	650,088	4,663,361	0	5,740,043	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79

8 . South Jetty Trunk Repair 70-76.5

8 _5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48

8 . South Jetty Trunk Repair 70-76.5

8 _7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE	96.00	HR	T50IT005	1.00	0.00	0.00	36.98	0.00	0.00	36.98	
					0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F	8.00	HR	L40CA006	1.00	0.00	0.00	59.79	0.00	0.00	59.79	
					0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	24.00	HR	T55CA001	1.00	0.00	0.00	55.30	0.00	0.00	55.30	
					0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)	96.00	HR	T45XX017	1.00	0.00	0.00	8.38	0.00	0.00	8.38	
					0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)	10.00	HR	T15CA016	1.00	0.00	0.00	59.43	0.00	0.00	59.43	
					0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)	10.00	HR	T10CA017	1.00	0.00	0.00	8.49	0.00	0.00	8.49	
					0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy	120.00	HR	X-TRKDVRHV	1.00	1.00	40.07	0.00	0.00	0.00	40.07	
					120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)	80.00	HR	X-LABORER	1.00	1.00	37.32	0.00	0.00	0.00	37.32	
					80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman	40.00	HR	X-FOREHEAV	1.00	1.00	49.50	0.00	0.00	0.00	49.50	
					40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy	164.00	HR	X-EQOPRHVY	1.00	1.00	47.96	0.00	0.00	0.00	47.96	
					164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house	1.00	LS		0.00	0.00	0.00	0.00	0.00	2000.00	2000.00	
					0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer	1.00	LS		0.00	0.00	0.00	0.00	0.00	1500.00	1500.00	
					0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator	1.00	LS		0.00	0.00	0.00	0.00	0.00	1000.00	1000.00	
					0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer	1.00	LS		0.00	0.00	0.00	0.00	0.00	1000.00	1000.00	
					0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip	1.00	LS		0.00	0.00	0.00	0.00	0.00	3000.00	3000.00	
					0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
TOTAL South Jetty Trunk Repair 70-76.5					24,087	1,079,371	1,055,097	5,208,578	178,400	7,521,446	

9 . North Jetty Trunk Repair 29.5-37

9 _ 9. Fences and gates		QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
MIL AA <02833 4620 >	Fence, CL scty, std FE-6, 6' high, no gates/signs	300.00	LF	USKCSKWK3	62.50	0.05 14	2.32 696	0.00 0	19.59 5,877	0.00 0	21.91 6,573	21.91
MIL AA <02835 7280 >	Fence, CL, 6' high, dbl, 22'W, indl, gates, swing, galv, w/o barb wire	1.00	EA	CLABB80B	1.25	3.20 3	127.31 127	38.33 38	452.45 452	0.00 0	618.09 618	618.09
RSM AA <02046 0700 >	Site dml, chain link, remove only, 8' to 10' high	1.00	LF	CODLB6	55.63	0.05 0	2.18 2	0.23 0	0.00 0	0.00 0	2.41 2	2.41
TOTAL	Fences and gates					18	826	39	6,329	0	7,194	
L USR AA < >	Haul road construction	1000.00	CY	ZD11	100.00	0.05 50	2.20 2,201	1.35 1,353	0.00 0	0.00 0	3.55 3,554	3.55
USR AA < >	Quarry Waste Material	1000.00	CY		0.00	0.00 0	0.00 0	0.00 0	20.00 20,000	0.00 0	20.00 20,000	20.00
TOTAL	Haul road					50	2,201	1,353	20,000	0	23,554	
USR AA < >	Off load all jettystone	35387	TON	ZD10	150.00	0.04 1,415	1.76 62,423	2.28 80,658	0.00 0	0.00 0	4.04 143,080	4.04
USR AA < >	Construct off load facility (rockfill)	4111.00	TON	ZD09	150.00	0.09 356	3.75 15,419	5.72 23,496	0.00 0	0.00 0	9.47 38,915	9.47
USR AA < >	Road rock for off-load facility	1040.00	CY	ZD11	100.00	0.05 52	2.20 2,289	1.35 1,407	20.00 20,800	0.00 0	23.55 24,496	23.55
USR AA < >	Remove offloading facility, place in jetty	5000.00	TON	ZD09	250.00	0.05 260	2.25 11,252	3.43 17,147	0.00 0	0.00 0	5.68 28,398	5.68
TOTAL	Off-loading facility,off-loading					2,084	91,382	122,708	20,800	0	234,889	
USR AA < >	Construct turnout (jettystone)	1100.00	TON	ZD09	100.00	0.13 143	5.63 6,188	8.57 9,431	0.00 0	0.00 0	14.20 15,619	14.20
USR AA < >	Road rock for turnout	450.00	CY	ZD11	100.00	0.05 23	2.20 990	1.35 609	20.00 9,000	0.00 0	23.55 10,599	23.55
USR AA < >	Remove turnout, place in jetty	2000.00	TON	ZD09	75.00	0.17 347	7.50 15,002	11.43 22,862	0.00 0	0.00 0	18.93 37,864	18.93
TOTAL	Turnout					512	22,181	32,901	9,000	0	64,083	

9 . North Jetty Trunk Repair 29.5-37

9 _26. Trunk repairs	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > 6-10 Ton Stone					0.13	5.63	8.57	49.50	0.00	63.70	
	35387	TON	ZD09	100.00	4,600	199,084	303,383	1,751,657	0	2,254,124	63.70
TOTAL Trunk repairs					4,600	199,084	303,383	1,751,657	0	2,254,124	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00

9 . North Jetty Trunk Repair 29.5-37

9 _5 . Mob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Mob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Manitowoc 4600					0.00	0.00	0.00	0.00	27600.00	27600.00	
	2.00	EA		0.00	0	0	0	0	55,200	55,200	27600
EP AA < > TRK,HWY,10,000GVW,4X2, 1T-PICKUP					0.00	0.00	7.88	0.00	0.00	7.88	
	8.00	HR	T50FO005	1.00	0	0	63	0	0	63	7.88
MAP AA < > CRANE,HYD,S/P,RT,4WD,40T/110'BM					0.00	0.00	85.48	0.00	0.00	85.48	
	50.00	HR	C75GV019	1.00	0	0	4,274	0	0	4,274	85.48
EP AA < > TRK,HWY, 50,080 GVW, 60,000 GCW, 6X4, 3 AXLE					0.00	0.00	36.98	0.00	0.00	36.98	
	96.00	HR	T50IT005	1.00	0	0	3,550	0	0	3,550	36.98
MAP AA < > LDR,FE, WH, 4.50 CY, ARTIC, 966F					0.00	0.00	59.79	0.00	0.00	59.79	
	8.00	HR	L40CA006	1.00	0	0	478	0	0	478	59.79
EP AA < > TRK,OFF-HWY,R-DUMP, 22-30CY, 35T					0.00	0.00	55.30	0.00	0.00	55.30	
	24.00	HR	T55CA001	1.00	0	0	1,327	0	0	1,327	55.30
EP AA < > TRLR,LOWBOY, 60T, 3 AXLE (ADD TOWING TRUCK)					0.00	0.00	8.38	0.00	0.00	8.38	
	96.00	HR	T45XX017	1.00	0	0	804	0	0	804	8.38
MAP AA < > DOZER,CWLR, D-8R PS,W/BLADE (ADD ATTACHMENTS)					0.00	0.00	59.43	0.00	0.00	59.43	
	10.00	HR	T15CA016	1.00	0	0	594	0	0	594	59.43
MAP AA < > BLADE, UNIVERSAL, HYDR, D-8 (ADD D-8 TRACTOR)					0.00	0.00	8.49	0.00	0.00	8.49	
	10.00	HR	T10CA017	1.00	0	0	85	0	0	85	8.49
MIL AA < > Outside Truck Drivers, Heavy					1.00	40.07	0.00	0.00	0.00	40.07	
	120.00	HR	X-TRKDVRHV	1.00	120	4,808	0	0	0	4,808	40.07
MIL AA < > Outside Laborers, (Semi-Skilled)					1.00	37.32	0.00	0.00	0.00	37.32	
	80.00	HR	X-LABORER	1.00	80	2,986	0	0	0	2,986	37.32
USR AA < > Foreman					1.00	49.50	0.00	0.00	0.00	49.50	
	40.00	HR	X-FOREHEAV	1.00	40	1,980	0	0	0	1,980	49.50
MIL AA < > Outside Equip. Operators, Heavy					1.00	47.96	0.00	0.00	0.00	47.96	
	164.00	HR	X-EQOPRHVY	1.00	164	7,865	0	0	0	7,865	47.96

9 . North Jetty Trunk Repair 29.5-37

9 _7 . Demob	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
USR AA < > Scales, with scale house					0.00	0.00	0.00	0.00	2000.00	2000.00	
	1.00	LS		0.00	0	0	0	0	2,000	2,000	2000.00
USR AA < > Office trailer					0.00	0.00	0.00	0.00	1500.00	1500.00	
	1.00	LS		0.00	0	0	0	0	1,500	1,500	1500.00
USR AA < > Generator					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Storage trailer					0.00	0.00	0.00	0.00	1000.00	1000.00	
	1.00	LS		0.00	0	0	0	0	1,000	1,000	1000.00
USR AA < > Counter weights & misc equip					0.00	0.00	0.00	0.00	3000.00	3000.00	
	1.00	LS		0.00	0	0	0	0	3,000	3,000	3000.00
TOTAL Demob					404	17,639	11,176	0	63,700	92,515	
USR AA < > Scales/scale house					0.00	0.00	0.00	0.00	51000.00	51000.00	
	1.00	LS		0.00	0	0	0	0	51,000	51,000	51000
TOTAL Weigh scales and scale house					0	0	0	0	51,000	51,000	
TOTAL North Jetty Trunk Repair 29.5-37					8,072	350,951	482,735	1,807,786	178,400	2,819,873	
TOTAL Tillamook Jetty CWE	1.00	EA			146,900	6,547,716	6,775,695	31676075	1799000	46,798,48646798486	

** PROJECT INDIRECT SUMMARY - Contract **

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
1	North Jetty 50' Cap			1,958,866	97,943	61,704	187,488	46,120	2,352,122	
2	South Jetty 50' Cap			4,940,261	247,013	155,618	472,846	116,315	5,932,053	
4	North Jetty Revetment			360,161	54,024	20,709	0	8,698	443,592	
20	North Jetty 100' Cap			3,123,428	156,171	98,388	298,952	73,539	3,750,478	
21	South Jetty 100' Cap			6,091,793	304,590	191,891	583,062	143,427	7,314,764	
3	NJ Alt (Long) Fix			4,061,701	203,085	127,944	388,757	95,630	4,877,116	
4	SJ Alt (Long) Fix			12,050,721	602,536	379,598	1,153,408	283,725	14,469,988	
5	North Jetty Trunk Repair 22-29.5			926,948	46,347	29,199	88,721	21,824	1,113,039	
6	South Jetty Trunk Repair 44-58			2,943,288	147,164	92,714	281,710	69,298	3,534,174	
8	South Jetty Trunk Repair 70-76.5			7,521,446	376,072	236,926	719,898	177,087	9,031,429	
9	North Jetty Trunk Repair 29.5-37			2,819,873	140,994	88,826	269,898	66,392	3,385,982	
TOTAL	Tillamook Jetty CWE	1.00	EA	46,798,486	2,375,940	1,483,517	4,444,740	1,102,054	56,204,73756204737	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
1 North Jetty 50' Cap									
1_ 5 Mob			92,515	4,626	2,914	8,855	2,178	111,088	
1_ 8 Weigh scales and scale house			51,000	2,550	1,607	4,881	1,201	61,239	
1_ 9 Fences and gates			7,194	360	227	689	169	8,638	
1_10 Haul road			262,150	13,108	8,258	25,091	6,172	314,779	
1_12 Off-loading facility,off-loading			159,295	7,965	5,018	15,247	3,750	191,275	
1_13 Turnout			64,083	3,204	2,019	6,134	1,509	76,948	
1_20 Cap			1,230,113	61,506	38,749	117,738	28,962	1,477,067	
1_7 Demob			92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL North Jetty 50' Cap			1,958,866	97,943	61,704	187,488	46,120	2,352,122	
2 South Jetty 50' Cap									
2_ 5 Mob			92,515	4,626	2,914	8,855	2,178	111,088	
2_ 8 Weigh scales and scale house			51,000	2,550	1,607	4,881	1,201	61,239	
2_ 9 Fences and gates			7,194	360	227	689	169	8,638	
2_10 Haul road			551,152	27,558	17,361	52,752	12,976	661,800	
2_11 Access road			48,972	2,449	1,543	4,687	1,153	58,804	
2_12 Off-loading facility,off-loading			743,094	37,155	23,407	71,124	17,496	892,276	
2_13 Turnout			64,083	3,204	2,019	6,134	1,509	76,948	
2_20 Cap			3,289,736	164,487	103,627	314,870	77,454	3,950,173	
2_7 Demob			92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL South Jetty 50' Cap			4,940,261	247,013	155,618	472,846	116,315	5,932,053	
4 North Jetty Revetment									
4_25 Revetment			360,161	54,024	20,709	0	8,698	443,592	
TOTAL North Jetty Revetment			360,161	54,024	20,709	0	8,698	443,592	
20 North Jetty 100' Cap									
20_ 8 Weigh scales and scale house			51,000	2,550	1,607	4,881	1,201	61,239	
20_ 9 Fences and gates			7,194	360	227	689	169	8,638	
20_10 Haul road			269,593	13,480	8,492	25,804	6,347	323,716	
20_12 Off-loading facility,off-loading			219,476	10,974	6,913	21,007	5,167	263,537	
20_13 Turnout			64,083	3,204	2,019	6,134	1,509	76,948	
20_20 Cap			2,327,052	116,353	73,302	222,729	54,789	2,794,224	
20_5 Mob			92,515	4,626	2,914	8,855	2,178	111,088	
20_7 Demob			92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL North Jetty 100' Cap			3,123,428	156,171	98,388	298,952	73,539	3,750,478	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTY UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
21 South Jetty 100' Cap								
21_ 8 Weigh scales and scale house		51,000	2,550	1,607	4,881	1,201	61,239	
21_ 9 Fences and gates		7,194	360	227	689	169	8,638	
21_10 Haul road		557,582	27,879	17,564	53,368	13,128	669,520	
21_11 Access road		48,972	2,449	1,543	4,687	1,153	58,804	
21_12 Off-loading facility,off-loading		801,156	40,058	25,236	76,681	18,863	961,994	
21_13 Turnout		64,083	3,204	2,019	6,134	1,509	76,948	
21_20 Cap		4,376,776	218,839	137,868	418,913	103,048	5,255,445	
21_5 Mob		92,515	4,626	2,914	8,855	2,178	111,088	
21_7 Demob		92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL South Jetty 100' Cap		6,091,793	304,590	191,891	583,062	143,427	7,314,764	
3 NJ Alt (Long) Fix								
3 _ 8 Weigh scales and scale house		51,000	2,550	1,607	4,881	1,201	61,239	
3 _ 9 Fences and gates		7,194	360	227	689	169	8,638	
3 _10 Haul road		285,374	14,269	8,989	27,314	6,719	342,665	
3 _12 Off-loading facility,off-loading		267,454	13,373	8,425	25,599	6,297	321,147	
3 _13 Turnout		64,083	3,204	2,019	6,134	1,509	76,948	
3 _20 Cap		3,201,567	160,078	100,849	306,431	75,379	3,844,304	
3 _5 Mob		92,515	4,626	2,914	8,855	2,178	111,088	
3 _7 Demob		92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL NJ Alt (Long) Fix		4,061,701	203,085	127,944	388,757	95,630	4,877,116	
4 SJ Alt (Long) Fix								
4 _ 8 Weigh scales and scale house		51,000	2,550	1,607	4,881	1,201	61,239	
4 _ 9 Fences and gates		7,194	360	227	689	169	8,638	
4 _10 Haul road		591,004	29,550	18,617	56,567	13,915	709,653	
4 _11 Access road		48,972	2,449	1,543	4,687	1,153	58,804	
4 _12 Off-loading facility,off-loading		1,101,606	55,080	34,701	105,438	25,936	1,322,761	
4 _13 Turnout		64,083	3,204	2,019	6,134	1,509	76,948	
4 _20 Cap		10,001,832	500,092	315,058	957,303	235,486	12,009,770	
4 _5 Mob		92,515	4,626	2,914	8,855	2,178	111,088	
4 _7 Demob		92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL SJ Alt (Long) Fix		12,050,721	602,536	379,598	1,153,408	283,725	14,469,988	
5 North Jetty Trunk Repair 22-29.5								
5 _ 8 Weigh scales and scale house		51,000	2,550	1,607	4,881	1,201	61,239	
5 _ 9 Fences and gates		7,194	360	227	689	169	8,638	
5 _10 Haul road		23,554	1,178	742	2,254	555	28,282	
5 _12 Off-loading facility,off-loading		123,302	6,165	3,884	11,802	2,903	148,056	
5 _13 Turnout		64,083	3,204	2,019	6,134	1,509	76,948	

** PROJECT INDIRECT SUMMARY - Feature **

		QUANTY	UOM	DIRECT	FIELD OH	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT
5 _26	Trunk repairs			472,786	23,639	14,893	45,252	11,131	567,701	
5 _5	Mob			92,515	4,626	2,914	8,855	2,178	111,088	
5 _7	Demob			92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL	North Jetty Trunk Repair 22-29.5			926,948	46,347	29,199	88,721	21,824	1,113,039	
6	South Jetty Trunk Repair 44-58									
6 _ 8	Weigh scales and scale house			51,000	2,550	1,607	4,881	1,201	61,239	
6 _ 9	Fences and gates			7,194	360	227	689	169	8,638	
6 _10	Haul road			23,554	1,178	742	2,254	555	28,282	
6 _11	Access road			48,972	2,449	1,543	4,687	1,153	58,804	
6 _12	Off-loading facility,off-loading			683,488	34,174	21,530	65,419	16,092	820,703	
6 _25	Trunk repairs			1,944,050	97,203	61,238	186,070	45,771	2,334,332	
6 _5	Mob			92,515	4,626	2,914	8,855	2,178	111,088	
6 _7	Demob			92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL	South Jetty Trunk Repair 44-58			2,943,288	147,164	92,714	281,710	69,298	3,534,174	
8	South Jetty Trunk Repair 70-76.5									
8 _ 8	Weigh scales and scale house			51,000	2,550	1,607	4,881	1,201	61,239	
8 _ 9	Fences and gates			7,194	360	227	689	169	8,638	
8 _10	Haul road			551,152	27,558	17,361	52,752	12,976	661,800	
8 _11	Access road			48,972	2,449	1,543	4,687	1,153	58,804	
8 _12	Off-loading facility,off-loading			873,972	43,699	27,530	83,650	20,577	1,049,428	
8 _13	Turnout			64,083	3,204	2,019	6,134	1,509	76,948	
8 _25	Trunk repairs			5,740,043	287,002	180,811	549,395	135,145	6,892,397	
8 _5	Mob			92,515	4,626	2,914	8,855	2,178	111,088	
8 _7	Demob			92,515	4,626	2,914	8,855	2,178	111,088	
TOTAL	South Jetty Trunk Repair 70-76.5			7,521,446	376,072	236,926	719,898	177,087	9,031,429	
9	North Jetty Trunk Repair 29.5-37									
9 _ 9	Fences and gates			7,194	360	227	689	169	8,638	
9 _10	Haul road			23,554	1,178	742	2,254	555	28,282	
9 _12	Off-loading facility,off-loading			234,889	11,744	7,399	22,482	5,530	282,045	
9 _13	Turnout			64,083	3,204	2,019	6,134	1,509	76,948	
9 _26	Trunk repairs			2,254,124	112,706	71,005	215,748	53,072	2,706,655	
9 _5	Mob			92,515	4,626	2,914	8,855	2,178	111,088	
9 _7	Demob			92,515	4,626	2,914	8,855	2,178	111,088	
9 _8	Weigh scales and scale house			51,000	2,550	1,607	4,881	1,201	61,239	
TOTAL	North Jetty Trunk Repair 29.5-37			2,819,873	140,994	88,826	269,898	66,392	3,385,982	
TOTAL	Tillamook Jetty CWE	1.00	EA	46,798,486	2,375,940	1,483,517	4,444,740	1,102,054	56,204,73756204737	

** PROJECT DIRECT SUMMARY - Contract **

		QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
1	North Jetty 50' Cap			5,400	235,082	293,540	1,251,844	178,400	1,958,866	
2	South Jetty 50' Cap			18,585	840,167	703,809	3,217,884	178,400	4,940,261	
4	North Jetty Revetment			203	8,664	7,597	328,900	15,000	360,161	
20	North Jetty 100' Cap			7,946	345,769	455,497	2,143,762	178,400	3,123,428	
21	South Jetty 100' Cap			21,040	946,887	860,022	4,106,484	178,400	6,091,793	
3	NJ Alt (Long) Fix			9,997	434,932	585,181	2,863,189	178,400	4,061,701	
4	SJ Alt (Long) Fix			33,743	1,499,138	1,668,377	8,704,806	178,400	12,050,721	
5	North Jetty Trunk Repair 22-29.5			3,380	147,005	183,225	418,318	178,400	926,948	
6	South Jetty Trunk Repair 44-58			14,446	659,751	480,614	1,624,523	178,400	2,943,288	
8	South Jetty Trunk Repair 70-76.5			24,087	1,079,371	1,055,097	5,208,578	178,400	7,521,446	
9	North Jetty Trunk Repair 29.5-37			8,072	350,951	482,735	1,807,786	178,400	2,819,873	
TOTAL	Tillamook Jetty CWE	1.00	EA	146,900	6,547,716	6,775,695	31676075	1799000	46,798,48646798486	
	Prime Contractor's Field Overhead	5.08	%						2,375,940	
	SUBTOTAL								49,174,427	
	Prime's Home Office Expense	3.02	%						1,483,517	
	SUBTOTAL								50,657,943	
	Prime Contractor's Profit	8.77	%						4,444,740	
	SUBTOTAL								55,102,683	
	Prime Contractor's Bond	2.00	%						1,102,054	
	TOTAL INCL INDIRECTS								56,204,737	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
1 North Jetty 50' Cap									
1_ 5 Mob	404		17,639	11,176	0	63,700		92,515	
1_ 8 Weigh scales and scale house	0		0	0	0	51,000		51,000	
1_ 9 Fences and gates	18		826	39	6,329	0		7,194	
1_10 Haul road	557		24,493	15,058	222,600	0		262,150	
1_12 Off-loading facility,off-loading	1,336		58,402	80,094	20,800	0		159,295	
1_13 Turnout	512		22,181	32,901	9,000	0		64,083	
1_20 Cap	2,170		93,902	143,097	993,115	0		1,230,113	
1_7 Demob	404		17,639	11,176	0	63,700		92,515	
TOTAL North Jetty 50' Cap	5,400		235,082	293,540	1,251,844	178,400		1,958,866	
2 South Jetty 50' Cap									
2_ 5 Mob	404		17,639	11,176	0	63,700		92,515	
2_ 8 Weigh scales and scale house	0		0	0	0	51,000		51,000	
2_ 9 Fences and gates	18		826	39	6,329	0		7,194	
2_10 Haul road	1,170		51,494	31,658	468,000	0		551,152	
2_11 Access road	328		13,284	6,089	29,600	0		48,972	
2_12 Off-loading facility,off-loading	10,099		472,613	238,193	32,288	0		743,094	
2_13 Turnout	512		22,181	32,901	9,000	0		64,083	
2_20 Cap	5,650		244,490	372,578	2,672,667	0		3,289,736	
2_7 Demob	404		17,639	11,176	0	63,700		92,515	
TOTAL South Jetty 50' Cap	18,585		840,167	703,809	3,217,884	178,400		4,940,261	
4 North Jetty Revetment									
4_25 Revetment	203		8,664	7,597	328,900	15,000		360,161	
TOTAL North Jetty Revetment	203		8,664	7,597	328,900	15,000		360,161	
20 North Jetty 100' Cap									
20_ 8 Weigh scales and scale house	0		0	0	0	51,000		51,000	
20_ 9 Fences and gates	18		826	39	6,329	0		7,194	
20_10 Haul road	572		25,188	15,485	228,920	0		269,593	
20_12 Off-loading facility,off-loading	1,931		84,657	114,019	20,800	0		219,476	
20_13 Turnout	512		22,181	32,901	9,000	0		64,083	
20_20 Cap	4,105		177,638	270,702	1,878,713	0		2,327,052	
20_5 Mob	404		17,639	11,176	0	63,700		92,515	
20_7 Demob	404		17,639	11,176	0	63,700		92,515	
TOTAL North Jetty 100' Cap	7,946		345,769	455,497	2,143,762	178,400		3,123,428	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
21 South Jetty 100' Cap									
21_ 8 Weigh scales and scale house	0		0	0	0	0	51,000	51,000	
21_ 9 Fences and gates	18		826	39	6,329	0		7,194	
21_10 Haul road	1,184		52,095	32,027	473,460	0		557,582	
21_11 Access road	328		13,284	6,089	29,600	0		48,972	
21_12 Off-loading facility,off-loading	10,674		497,944	270,924	32,288	0		801,156	
21_13 Turnout	512		22,181	32,901	9,000	0		64,083	
21_20 Cap	7,516		325,278	495,691	3,555,807	0		4,376,776	
21_5 Mob	404		17,639	11,176	0	63,700		92,515	
21_7 Demob	404		17,639	11,176	0	63,700		92,515	
TOTAL South Jetty 100' Cap	21,040		946,887	860,022	4,106,484	178,400		6,091,793	
3 NJ Alt (Long) Fix									
3 _ 8 Weigh scales and scale house	0		0	0	0	0	51,000	51,000	
3 _ 9 Fences and gates	18		826	39	6,329	0		7,194	
3 _10 Haul road	606		26,662	16,392	242,320	0		285,374	
3 _12 Off-loading facility,off-loading	2,406		105,589	141,065	20,800	0		267,454	
3 _13 Turnout	512		22,181	32,901	9,000	0		64,083	
3 _20 Cap	5,647		244,395	372,433	2,584,740	0		3,201,567	
3 _5 Mob	404		17,639	11,176	0	63,700		92,515	
3 _7 Demob	404		17,639	11,176	0	63,700		92,515	
TOTAL NJ Alt (Long) Fix	9,997		434,932	585,181	2,863,189	178,400		4,061,701	
4 SJ Alt (Long) Fix									
4 _ 8 Weigh scales and scale house	0		0	0	0	0	51,000	51,000	
4 _ 9 Fences and gates	18		826	39	6,329	0		7,194	
4 _10 Haul road	1,255		55,217	33,947	501,840	0		591,004	
4 _11 Access road	328		13,284	6,089	29,600	0		48,972	
4 _12 Off-loading facility,off-loading	13,646		629,024	440,294	32,288	0		1,101,606	
4 _13 Turnout	512		22,181	32,901	9,000	0		64,083	
4 _20 Cap	17,176		743,328	1,132,756	8,125,749	0		10,001,832	
4 _5 Mob	404		17,639	11,176	0	63,700		92,515	
4 _7 Demob	404		17,639	11,176	0	63,700		92,515	
TOTAL SJ Alt (Long) Fix	33,743		1,499,138	1,668,377	8,704,806	178,400		12,050,721	
5 North Jetty Trunk Repair 22-29.5									
5 _ 8 Weigh scales and scale house	0		0	0	0	0	51,000	51,000	
5 _ 9 Fences and gates	18		826	39	6,329	0		7,194	
5 _10 Haul road	50		2,201	1,353	20,000	0		23,554	
5 _12 Off-loading facility,off-loading	980		42,699	59,803	20,800	0		123,302	
5 _13 Turnout	512		22,181	32,901	9,000	0		64,083	

** PROJECT DIRECT SUMMARY - Feature **

		QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
5 _26	Trunk repairs			1,013	43,820	66,777	362,189	0	472,786	
5 _5	Mob			404	17,639	11,176	0	63,700	92,515	
5 _7	Demob			404	17,639	11,176	0	63,700	92,515	
TOTAL	North Jetty Trunk Repair 22-29.5			3,380	147,005	183,225	418,318	178,400	926,948	
6	South Jetty Trunk Repair 44-58									
6 _ 8	Weigh scales and scale house			0	0	0	0	51,000	51,000	
6 _ 9	Fences and gates			18	826	39	6,329	0	7,194	
6 _10	Haul road			50	2,201	1,353	20,000	0	23,554	
6 _11	Access road			328	13,284	6,089	29,600	0	48,972	
6 _12	Off-loading facility,off-loading			9,509	446,608	204,592	32,288	0	683,488	
6 _25	Trunk repairs			3,733	161,553	246,191	1,536,306	0	1,944,050	
6 _5	Mob			404	17,639	11,176	0	63,700	92,515	
6 _7	Demob			404	17,639	11,176	0	63,700	92,515	
TOTAL	South Jetty Trunk Repair 44-58			14,446	659,751	480,614	1,624,523	178,400	2,943,288	
8	South Jetty Trunk Repair 70-76.5									
8 _ 8	Weigh scales and scale house			0	0	0	0	51,000	51,000	
8 _ 9	Fences and gates			18	826	39	6,329	0	7,194	
8 _10	Haul road			1,170	51,494	31,658	468,000	0	551,152	
8 _11	Access road			328	13,284	6,089	29,600	0	48,972	
8 _12	Off-loading facility,off-loading			11,394	529,712	311,972	32,288	0	873,972	
8 _13	Turnout			512	22,181	32,901	9,000	0	64,083	
8 _25	Trunk repairs			9,858	426,595	650,088	4,663,361	0	5,740,043	
8 _5	Mob			404	17,639	11,176	0	63,700	92,515	
8 _7	Demob			404	17,639	11,176	0	63,700	92,515	
TOTAL	South Jetty Trunk Repair 70-76.5			24,087	1,079,371	1,055,097	5,208,578	178,400	7,521,446	
9	North Jetty Trunk Repair 29.5-37									
9 _ 9	Fences and gates			18	826	39	6,329	0	7,194	
9 _10	Haul road			50	2,201	1,353	20,000	0	23,554	
9 _12	Off-loading facility,off-loading			2,084	91,382	122,708	20,800	0	234,889	
9 _13	Turnout			512	22,181	32,901	9,000	0	64,083	
9 _26	Trunk repairs			4,600	199,084	303,383	1,751,657	0	2,254,124	
9 _5	Mob			404	17,639	11,176	0	63,700	92,515	
9 _7	Demob			404	17,639	11,176	0	63,700	92,515	
9 _8	Weigh scales and scale house			0	0	0	0	51,000	51,000	
TOTAL	North Jetty Trunk Repair 29.5-37			8,072	350,951	482,735	1,807,786	178,400	2,819,873	
TOTAL	Tillamook Jetty CWE	1.00	EA	146,900	6,547,716	6,775,695	31676075	1799000	46,798,48646798486	

** PROJECT DIRECT SUMMARY - Feature **

	QUANTY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT
Prime Contractor's Field Overhead	5.08	%						2,375,940	
SUBTOTAL								49,174,427	
Prime's Home Office Expense	3.02	%						1,483,517	
SUBTOTAL								50,657,943	
Prime Contractor's Profit	8.77	%						4,444,740	
SUBTOTAL								55,102,683	
Prime Contractor's Bond	2.00	%						1,102,054	
TOTAL INCL INDIRECTS								56,204,737	

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	**** LABOR **** COST	**** EQUIP **** HOURS	**** EQUIP **** COST	TOTAL COST
	ACARF4	4 carpnters + 1 crane, hydr, trk mtd, 60 ton	PROD = 100%						CREW HOURS = 6500	
MIL	B-CARPNTERL	Carpenters	4.00	HR	48.35	4.00	193.40			193.40
MIL	B-EQOPRCRNL	Equip. Operators, Crane/Shovel	1.00	HR	47.96	1.00	47.96			47.96
MIL	B-EQOPROILL	Equip. Operators, Oilers	1.00	HR	44.54	1.00	44.54			44.54
GEN	C80Z2280	E CRANE, HYD, TRUCK MTD, 65T	1.00	HR	79.18			1.00	79.18	79.18
	TOTAL					6.00	285.90	1.00	79.18	365.08
	CLABB80B	3 laborers + 1 crane, hydr, trk mtd, 14 ton	PROD = 100%						CREW HOURS = 8	
MIL	B-LABORER	L Laborers, (Semi-Skilled)	3.00	HR	37.93	3.00	113.79			113.79
MIL	B-EQOPRLT	L Equip. Operators, Light	1.00	HR	45.35	1.00	45.35			45.35
GEN	C80Z2240	E CRANE, HYD, TRUCK MTD, 14T	1.00	HR	47.91			1.00	47.91	47.91
	TOTAL					4.00	159.14	1.00	47.91	207.05
	CODFB7	2 eqoprmed + 1 laoder, F/E, crawler, 2.60 CY	PROD = 100%						CREW HOURS = 60	
MIL	B-LABORER	F Laborers, (Semi-Skilled)	1.00	HR	38.93	1.00	38.93			38.93
MIL	B-LABORER	L Laborers, (Semi-Skilled)	4.00	HR	37.93	4.00	151.72			151.72
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	44.54	1.00	44.54			44.54
GEN	B20Z0890	E BRUSH CHIPPER, 12"(305MM)DIA LO	1.00	HR	18.63			1.00	18.63	18.63
GEN	L35Z4260	E LOADER, F/E, CRWLR, 2.60CY	1.00	HR	70.57			1.00	70.57	70.57
GEN	C05Z1210	E CHAINSAW, 24" - 42" LONG BAR	2.00	HR	1.34			2.00	2.68	2.68
	TOTAL					6.00	235.19	4.00	91.87	327.06
	CODLB6	1 eqoprlt + 1 loader, BH, wheel,0.80 CY F/E bkt	PROD = 100%						CREW HOURS = 0	
MIL	B-LABORER	L Laborers, (Semi-Skilled)	2.00	HR	37.93	2.00	75.86			75.86
MIL	B-EQOPRLT	L Equip. Operators, Light	1.00	HR	45.35	1.00	45.35			45.35
GEN	L50Z4640	E LOADER/BCK-HOE,WH, 0.80CY(0.6M3	1.00	HR	12.72			1.00	12.72	12.72
	TOTAL					3.00	121.21	1.00	12.72	133.93
	CODTB10B	1 eqoprmed + 1 dozer, crawler, 181-250 HP	PROD = 100%						CREW HOURS = 49	
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	44.54	1.00	44.54			44.54
MIL	B-LABORER	L Laborers, (Semi-Skilled)	0.50	HR	37.93	0.50	18.97			18.97
GEN	T15Z6520	E DOZER, CRAWLER, 181-250HP	1.00	HR	54.33			1.00	54.33	54.33
	TOTAL					1.50	63.51	1.00	54.33	117.83
	CODTB10C	1 eqoprmed + 1 dozer, crawler, 181-250 HP, PS	PROD = 100%						CREW HOURS = 123	
MIL	B-EQOPRMEDL	Equip. Operators, Medium	1.00	HR	44.54	1.00	44.54			44.54
MIL	B-LABORER	L Laborers, (Semi-Skilled)	0.50	HR	37.93	0.50	18.97			18.97
GEN	T15Z6520	E DOZER, CRAWLER, 181-250HP	1.00	HR	54.33			1.00	54.33	54.33
GEN	R50Z5760	E ROLLER, VIB, SD, SP 3.0T	1.00	HR	13.05			1.00	13.05	13.05
	TOTAL					1.50	63.51	2.00	67.37	130.88

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	**** LABOR **** COST	**** EQUIP **** HOURS	**** EQUIP **** COST	TOTAL COST
	COFGB32A	2 eqoprmed + 1 roller,vib,sd,S/P,12 ton,84"x60"	PROD = 100%						CREW HOURS = 187	
MIL	B-LABORER L	Laborers, (Semi-Skilled)	1.00	HR	37.93	1.00	37.93			37.93
MIL	B-EQOPRMEDL	Equip. Operators, Medium	2.00	HR	44.54	2.00	89.08			89.08
GEN	G15Z3080 E	GRADER, MOTOR, 135 HP (101KW)	1.00	HR	29.54			1.00	29.54	29.54
GEN	R50Z5810 E	ROLLER, VIB, SD, SP 12.0T	1.00	HR	40.91			1.00	40.91	40.91
	TOTAL					3.00	127.01	2.00	70.45	197.46
	ULABB9	5 laborers + 1 air compressor, 100 CFM	PROD = 100%						CREW HOURS = 93	
MIL	B-LABORER F	Laborers, (Semi-Skilled)	1.00	HR	38.93	1.00	38.93			38.93
MIL	B-LABORER L	Laborers, (Semi-Skilled)	4.00	HR	37.93	4.00	151.72			151.72
GEN	A15Z0120 E	AIR COMPRESSOR, 100CFM, 100PSI	1.00	HR	8.04			1.00	8.04	8.04
GEN	A20Z0480 E	AIR HOSE,1.5"X 100'L (38MMX 31M	1.00	HR	0.50			1.00	0.50	0.50
	TOTAL					5.00	190.65	2.00	8.54	199.19
	USKCSKWK3	3 skillwkrs	PROD = 100%						CREW HOURS = 48	
MIL	B-SKILLWKRL	Skilled Workers	3.00	HR	48.35	3.00	145.05			145.05
	TOTAL					3.00	145.05	0.00	0.00	145.05
	ZD01	Hyd Exc, oprtr, labr	PROD = 0.00%						CREW HOURS = 102	
MAP	H25CA029 E	HYD EXCAV, CRWLR,110,880 LBS,	1.00	HR	74.77			1.00	74.77	74.77
MIL	X-EQOPRHVYL	Outside Equip. Operators, Heavy	1.00	HR	47.96	1.00	47.96			47.96
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	1.00	HR	37.32	1.00	37.32			37.32
	TOTAL					2.00	85.28	1.00	74.77	160.05
	ZD09	Jettystone Placement Crew	PROD = 0.00%						CREW HOURS = 5512	
MAP	C85MA007 E	CR,ME,CWLR,LIFTING,240T/260'BOO	2.00	HR	251.54			2.00	503.09	503.09
MAP	L40CA006 E	LDR,FE, WH, 4.50 CY, ARTIC, 966	1.00	HR	59.79			1.00	59.79	59.79
MAP	T15CA016 E	DOZER,CWLR, D-8R PS,W/BLADE (AD	1.00	HR	59.43			1.00	59.43	59.43
MAP	T10CA017 E	BLADE, UNIVERSAL, HYDR, D-8	1.00	HR	8.49			1.00	8.49	8.49
EP	T55CA001 E	TRK,OFF-HWY,R-DUMP, 22-30CY, 35	3.00	HR	55.30			3.00	165.89	165.89
EP	T50FO005 E	TRK,HWY,10,000GVW,4X2, 1T-PICKU	2.00	HR	7.88			2.00	15.76	15.76
MIL	X-EQOPRHVYL	Outside Equip. Operators, Heavy	4.00	HR	47.96	4.00	191.84			191.84
USR	X-FOREHEAVL	Foreman	1.00	HR	49.50	1.00	49.50			49.50
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	3.00	HR	37.32	3.00	111.96			111.96
MIL	X-EQOPROILL	Outside Equip. Oilers	2.00	HR	44.54	2.00	89.08			89.08
MIL	X-TRKDVRHVL	Outside Truck Drivers, Heavy	3.00	HR	40.07	3.00	120.21			120.21
EP	B25GE006 E	BKT,CLAM, 15.0 CY, MEDIUM DUTY	2.00	HR	22.44			2.00	44.87	44.87
	TOTAL					13.00	562.59	12.00	857.33	1419.91
	ZD10	Off loading facility	PROD = 0.00%						CREW HOURS = 3152	
MAP	T15CA016 E	DOZER,CWLR, D-8R PS,W/BLADE	1.00	HR	59.43			1.00	59.43	59.43
MAP	T10CA017 E	BLADE, UNIVERSAL, HYDR, D-8	1.00	HR	8.49			1.00	8.49	8.49
MIL	X-EQOPROILL	Outside Equip. Oilers	1.00	HR	44.54	1.00	44.54			44.54
MIL	X-EQOPRHVYL	Outside Equip. Operators, Heavy	2.00	HR	47.96	2.00	95.92			95.92
USR	X-FOREHEAVL	Foreman	1.00	HR	49.50	1.00	49.50			49.50
MIL	X-LABORER L	Outside Laborers, (Semi-Skilled	2.00	HR	37.32	2.00	74.64			74.64

** CREW BACKUP **

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	**** LABOR **** COST	**** EQUIP **** HOURS	**** EQUIP **** COST	TOTAL COST
EP	B25GE006	E BKT,CLAM, 15.0 CY, MEDIUM DUTY	1.00	HR	22.44			1.00	22.44	22.44
MAP	C85MA007	E CR,ME,CWLR,LIFTING,240T/260'BOO	1.00	HR	251.54			1.00	251.54	251.54
	TOTAL					6.00	264.60	4.00	341.90	606.50
	ZD11	Jetty haul road crew			PROD = 0.00%				CREW HOURS = 1445	
MAP	T15CA016	E DOZER,CWLR, D-8R PS,W/BLADE	1.00	HR	59.43			1.00	59.43	59.43
MAP	T10CA017	E BLADE, UNIVERSAL, HYDR, D-8	1.00	HR	8.49			1.00	8.49	8.49
MAP	L40CA007	E LDR,FE, WH, 5.50 CY, ARTIC, 980	1.00	HR	67.37			1.00	67.37	67.37
USR	X-FOREHEAVL	Foreman	1.00	HR	49.50	1.00	49.50			49.50
MIL	X-LABORER	L Outside Laborers, (Semi-Skilled	2.00	HR	37.32	2.00	74.64			74.64
MIL	X-EQOPRHVYL	Outside Equip. Operators, Heavy	2.00	HR	47.96	2.00	95.92			95.92
	TOTAL					5.00	220.06	3.00	135.29	355.35

** LABOR BACKUP **

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-CARPNTER	Carpenters	28.23	0.0%	44.7%	7.49	0.00	48.35	HR	11/28/01	33.22	26000
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	31.21	0.0%	27.4%	8.20	0.00	47.96	HR	11/28/01	34.98	6500
MIL	B-EQOPRLT	Equip. Operators, Light	29.31	0.0%	26.7%	8.20	0.00	45.35	HR	11/28/01	30.98	8
MIL	B-EQOPRMED	Equip. Operators, Medium	28.25	0.0%	28.6%	8.20	0.00	44.54	HR	11/28/01	32.72	606
MIL	B-EQOPROIL	Equip. Operators, Oilers	28.25	0.0%	28.6%	8.20	0.00	44.54	HR	11/28/01	27.66	6500
MIL	B-LABORER	Laborers, (Semi-Skilled)	22.63	0.0%	32.7%	7.90	0.00	37.93	HR	09/20/01	25.28	1060
MIL	B-SKILLWKR	Skilled Workers	28.23	0.0%	44.7%	7.49	0.00	48.35	HR	11/28/01	29.39	144
MIL	X-EQOPRHVY	Outside Equip. Operators, Heavy	31.21	0.0%	27.4%	8.20	0.00	47.96	HR	09/05/01	31.61	34625
MIL	X-EQOPROIL	Outside Equip. Oilers	28.25	0.0%	28.6%	8.20	0.00	44.54	HR	07/30/02	24.58	14177
USR	X-FOREHEAV	Foreman	32.00	0.0%	30.0%	7.90	0.00	49.50	HR	07/30/02	24.17	10910
MIL	X-LABORER	Outside Laborers, (Semi-Skilled)	22.63	0.0%	30.0%	7.90	0.00	37.32	HR	09/05/01	24.17	27433
MIL	X-TRKDVRHV	Outside Truck Drivers, Heavy	25.08	0.0%	28.7%	7.80	0.00	40.07	HR	09/05/01	24.55	18937

** EQUIPMENT BACKUP **

SRC	ID.NO.	EQUIPMENT DESCRIPTION	DEPR	FCCM	FUEL	FOG	TR WR	TR REP	EQ REP	TOTAL RATE	** TOTAL ** HOURS
GEN	A15Z0120	AIR COMPRESSOR, 100CFM, 100PSI	0.96	0.23	4.16	1.57	0.03	0.00	1.08	8.04 HR	93
GEN	A20Z0480	AIR HOSE,1.5"X 100'L (38MMX 31M)	0.17	0.01					0.32	0.50 HR	93
GEN	B20Z0890	BRUSH CHIPPER, 12"(305MM)DIA LOG	2.05	0.37	9.74	3.68	0.06	0.01	2.72	18.63 HR	60
EP	B25GE006	BKT,CLAM, 15.0 CY, MEDIUM DUTY	10.46	2.05					9.93	22.44 HR	14177
GEN	C05Z1210	CHAINSAW, 24" - 42" LONG BAR	0.12	0.01	0.57	0.21			0.42	1.34 HR	120
MAP	C75GV019	CRANE,HYD,S/P,RT,4WD,40T/110'BM	30.68	8.41	6.35	2.26	2.98	0.50	34.32	85.48 HR	1000
GEN	C80Z2240	CRANE, HYD, TRUCK MTD, 14T	18.22	4.92	6.07	2.56	0.76	0.13	15.25	47.91 HR	8
GEN	C80Z2280	CRANE, HYD, TRUCK MTD, 65T	28.15	8.57	10.63	3.30	0.92	0.15	27.47	79.18 HR	6500
MAP	C85MA007	CR,ME,CWLR,LIFTING,240T/260'BOOM	89.43	33.22	8.33	2.31			118.26	251.54 HR	14177
GEN	G15Z3080	GRADER, MOTOR, 135 HP (101KW)	9.66	3.17	3.85	1.54	0.47	0.08	10.78	29.54 HR	187
MAP	H25CA029	HYD EXCAV, CRWLR,110,880 LBS,	22.28	7.49	8.68	2.22			34.11	74.77 HR	102
GEN	L35Z4260	LOADER, F/E, CRWLR, 2.60CY	19.95	3.51	5.30	2.35			39.45	70.57 HR	60
MAP	L40CA006	LDR,FE, WH, 4.50 CY, ARTIC, 966F	19.33	4.80	6.68	3.34	3.76	0.63	21.26	59.79 HR	5672
MAP	L40CA007	LDR,FE, WH, 5.50 CY, ARTIC, 980G	22.18	5.75	9.11	3.24	4.88	0.81	21.40	67.37 HR	1445
GEN	L50Z4640	LOADER/BCK-HOE,WH, 0.80CY(0.6M3)	3.73	0.94	1.82	0.69	0.72	0.12	4.70	12.72 HR	0
GEN	R50Z5760	ROLLER, VIB, SD, SP 3.0T	4.40	0.78	1.02	0.38	0.07	0.01	6.38	13.05 HR	123
GEN	R50Z5810	ROLLER, VIB, SD, SP 12.0T	12.12	2.17	6.14	2.32	0.48	0.08	17.61	40.91 HR	187
MAP	T10CA017	BLADE, UNIVERSAL, HYDR, D-8	3.50	0.75		0.13			4.10	8.49 HR	10310
MAP	T15CA016	DOZER,CWLR, D-8R PS,W/BLADE	16.21	6.01	10.10	3.36			23.75	59.43 HR	10310
GEN	T15Z6520	DOZER, CRAWLER, 181-250HP	15.42	5.72	7.95	2.65			22.59	54.33 HR	173
EP	T45XX017	TRLR,LOWBOY, 60T, 3 AXLE	3.08	0.91		0.50	1.02	0.17	2.69	8.38 HR	1920
EP	T50FO005	TRK,HWY,10,000GVW,4X2, 1T-PICKUP	1.96	0.36	2.28	0.76	0.46	0.08	2.00	7.88 HR	11185
EP	T50IT005	TRK,HWY, 50,080 GVW, 60,000 GCW,	12.03	2.17	8.37	2.79	0.91	0.15	10.57	36.98 HR	1920
EP	T55CA001	TRK,OFF-HWY,R-DUMP, 22-30CY, 35T	15.12	7.27	8.69	3.47	6.87	1.14	12.73	55.30 HR	17017

No errors detected...

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SUMMARY REPORTS SUMMARY PAGE

DETAILED ESTIMATE DETAIL PAGE

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ENVIRONMENTAL ASSESSMENT
TILLAMOOK MAJOR MAINTENANCE STUDY
TILLAMOOK COUNTY, OREGON

1. Introduction.

Tillamook Bay is located on the Oregon Coast about 47 miles south of the confluence of the Columbia River with the Pacific Ocean (Figure 1). It is a tidal estuary approximately 6 miles long, north to south, and a maximum of 3 miles wide. The total area of the bay is approximately 12 square miles at high water and has a tidal prism of 48,000 acre-feet. Five major rivers, the Kilchis, Wilson, Trask, Tillamook, and Miami, all flow into Tillamook Bay. The ocean entrance to the bay is located at the northern end and is protected by two jetties (Figure 2).

The north jetty was authorized in 1912 and completed in 1917, with the latest repair occurring at the head in 1991. The structure has experienced deterioration at both the jetty heads, with a loss of 384 ft according to field measurements. The south jetty was authorized in 1965 and built in three stages starting in 1969 and completed in 1979, with no repairs since that time. The structure has lost almost 666 feet from the end of the jetty.

The purpose of the jetties that were constructed at the entrance to Tillamook Bay was, and remains, to confine tidal currents to obtain scouring velocities in the bar and entrance channels. The north and south jetties at the entrance to Tillamook Bay have experienced damage to both jetty heads. The erosion of the south jetty head has been more pronounced in the last 6 or 7 years. There is concern that the receding jetty heads may contribute to already hazardous navigation conditions over the ebb tidal shoal or bar. The wave conditions on the ebb tidal shoal force boaters using the entrance to use a channel called the “south hole.” This route forces the boats to leave and enter the channel with the waves hitting broadside to the boat, placing the vessel in a dangerous position. This becomes even more dangerous because of remnant jetty stone that lies under water just seaward of the exposed end of the south jetty.

Also, erosion of the north shoreline of the north jetty is a major concern in terms of a potential breach at the jetty root or base. This area has a narrow but deep channel cross section (40 ft) and is an increasing concern. The erosion of the jetty root from winter storms has produced significant concern from local governments and U.S. Coast Guard (USCG) about the continued deterioration and possible breach of the north jetty root. A USCG watchtower located adjacent to the north jetty could be lost to waves attacking the tower base as well as a possible jetty root breach. The north jetty at Tillamook Bay was constructed between 1913-1917 to a length of 5,400 feet, and extended in 1933 to a total length of 5,700 feet. Since its construction, the north jetty has been repaired in 1946, 1955, 1963 and 1991. The footprint (1917) for the north jetty extends 5,700 feet, 1,800 feet seaward of shoreline, yet stands currently with approximately 384-foot loss at a length of 5,316 feet.

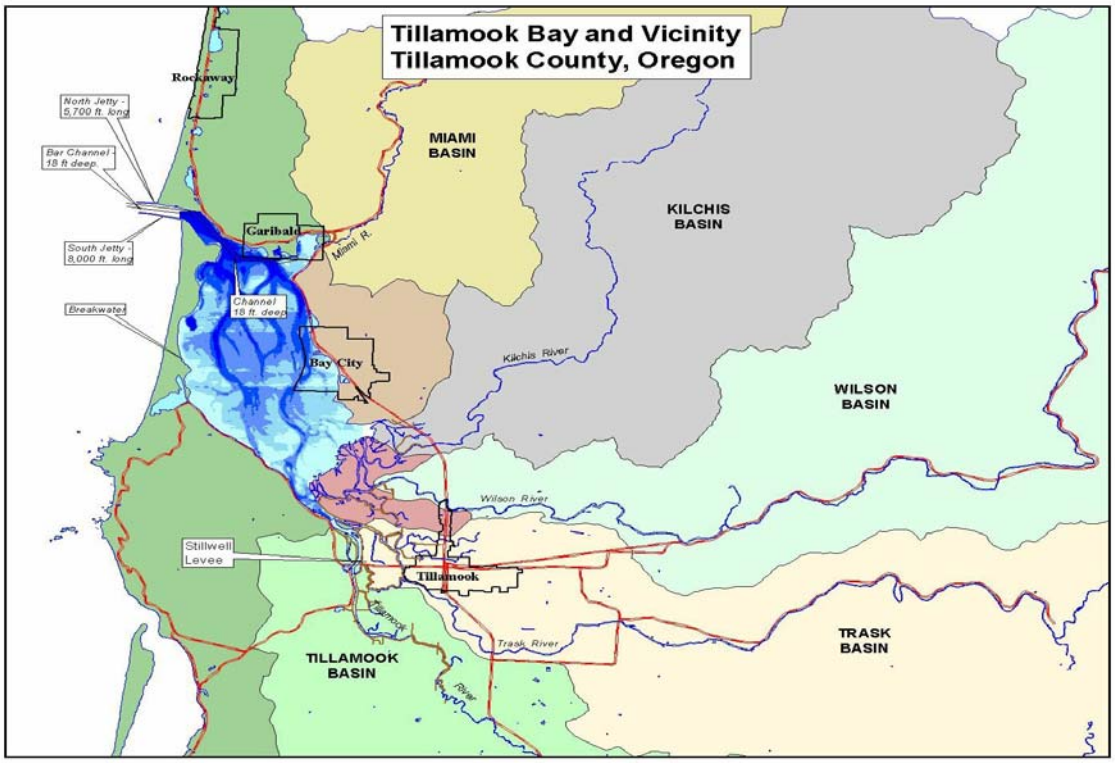

Figure 1. Location of Tillamook Bay Jetties, Bayview, Oregon.

Figure 2. North and south jetties at mouth of Tillamook Bay.

The south jetty at Tillamook Bay was constructed between 1969-1971 to a length of 3695 feet. While authorization of the south jetty in 1965 approved a length of 8,000 feet, continued construction in 1974 only added 2,830 feet until materials ran out. Finally, in 1974, the south jetty was extended to its authorized length of 8,000 feet, 3,200 feet seaward of shoreline. Since then, erosion has decreased the length of the south jetty to 7,334 feet.

The primary sand dune at the base or root of the Tillamook north jetty has been progressively eroding since 1995 (USACE 2002). This dune protects more than 1000 feet of weakened (and reduced crest) jetty, landward of the dune, from direct wave attack and overtopping associated with the present surf zone. If the weakened shoreward area of the jetty were subjected to an active surf zone, the north jetty would be destabilized.

A discussion of the Tillamook jetties and the surrounding environment can be found in the following U.S. Army Corps of Engineers documents:

a. Operation and Maintenance of jetties and Dredging Projects in Tillamook Estuary, Oregon, Final EIS, December 1975.
b. Extension of Tillamook south jetty, Tillamook Bay, Oregon, Final EIS, January 1978.
c. Environmental Assessment: Repair of north jetty at Tillamook Bay, Tillamook County, Oregon, December 1990.
d. Quality Plan for Draft Tillamook Major Maintenance Study. June 2002.

A summary of the information contained in these documents is included in this assessment.

1. Purpose and Need.

The purpose of the action is to repair the north and south jetties and the north jetty root. This action is necessary to prevent further deterioration and subsequent loss of the jetty heads, north jetty root and the United States Coast Guard (USGS) watchtower. Field measurements in 2003 determined a 384-foot loss to the north jetty and a 666-foot loss to the south jetty. Further analysis based on historical recession rates predict by 2006, the north jetty will be 475-feet shorter than its authorized length and the south jetty will be 890-feet shorter than its authorized length. Continued deterioration of both jetty heads and the north jetty root may jeopardize the structural integrity of each jetty; may breach the north jetty at the root; and may increase the navigational risks from waves involved in crossing the tidal ebb shoal at the entrance to the bay.

2. Proposed Alternatives.

Due to projected limited funding to repair the entire project, 2 different capping lengths were estimated, 50 ft and 100 ft. A 100 ft head repair has been standard repair practice in this district and provides for a more reliable long-term fix in the presently increasing Pacific Ocean environment. In addition, trunk repairs were identified as critical or

routine. Critical repairs were estimated separately and are located on the north jetty from STA 29+50 to 37+00 and along the south jetty from STA 70+00 to 76+50. Routine trunk repairs are located along the north jetty from STA 22+00 to 29+00 and along the south jetty from STA 44+00 to 58+00. The base condition or "without project" alternative assumes that the existing O&M practices will continue in the absence of major repairs. History has shown that Portland District's normal O&M practices for our coastal jetties involves, at the minimum, stabilizing the jetty head, or capping. The five alternatives are as follows:

1. Alternative 1 – Jetty Caps and Revetment. This is the he minimum maintenance option that would protect the Federal interest. This alternative addresses the areas of greatest concern in terms of structural stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $16.7M. ($12.7 M for 50 ft cap) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

2. Alternative 2 – Jetty Caps, Revetment, and Critical Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, a 650 ft trunk repair to the south jetty from STA 70+00 to 76+50, a 750 ft trunk repair to the north jetty from STA 29+50 to 37+00, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment

along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $34.5M. ($30.5M for 50 ft cap.) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

3. Alternative 3 – Jetty Caps, Revetment, and Critical and Routine Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, trunk repairs to the south jetty from STA 70+00 to 76+50 (650 ft in length) and STA 44+00 to 58+00 (1400 ft in length), trunk repairs to the north jetty from STA 29+50 to 37+00 (750 ft in length) and STA 22+00 to 29+50 (750 ft in length), and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $41.3M. ($37.4M for 50 ft cap.) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

4. Alternative 4 – Alternative Jetty Lengths, Revetment, and Critical and Routine Trunk Repairs. Plan considers both structural repairs to the jetties and further expands upon navigability of the channel. The preliminary plan calls for a 200-foot extension to the year 2003 end station of the north jetty (55+20) and a 360-foot extension to the year 2003 end station of the south jetty (82+00); repairs to damage areas along both jetties; and a revetment at the root of the north jetty. This plan leaves the north and south jetties 180 ft and 300 ft shorter than the authorized lengths, respectively. The objective of this plan is to increase the stability of the jetties and decrease wave amplification within the navigation channel. This alternative is not fully developed and would require more study to determine a constructible design and appropriate jetty length repair. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic

yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The initial cost estimate is $53M. This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

5. Alternative 5 – "No Action". The "no action" alternative was reviewed for this study and was determined to be unacceptable due to the danger and risk of jeopardizing the integrity of both jetties. To allow the jetties to continue to deteriorate will eventually lead to an increase in shoaling at the channel entrance. As more of the jetties deteriorate, waves will move further into the navigation channel increasing boating hazards and further de-stabilizing the inner portion of the jetties.

3. Existing Environment.

Tillamook Bay is 6 miles long (north to south), and a maximum of 3 miles wide. It is located about 50 miles south of the Columbia River and covers an area of 12 square miles. The bay is surrounded by uplands to the northeast and southwest, and to the southeast by a broad floodplain formed by the Kilchis, Trask, Wilson, and Tillamook Rivers. The Miami River, located to the north, also flows into the bay near the town of Garibaldi. The bar channel has been maintained naturally since the extension of the south jetty in 1971.

Agricultural lands are dominant east of Tillamook Bay. Natural upland consists of conifer and deciduous forest stands and meadow, marsh, and sandy beach and dune plant communities. The most commercially important and widely distributed tree species in Tillamook Bay is Douglas-fir. Older stands include Western-red cedar, Sitka spruce, and Western hemlock. Upland beach and dune communities may be classified as bare sand, grass-forb, or shrub communities. Beachgrass occurs behind most of the bare sandy areas with Scotch broom as the dominant species elsewhere. These plants are most extensive in accreted lands behind the north and south jetty sites.

Wildlife resources are abundant. Freshwater species using the estuary include mink, otter, beaver, raccoon and muskrat. Marine mammals using the estuary include the harbor seal, northern fur seal, California sea lion, northern sea lion, and occasionally killer whales (personal communication with David Nuzem, Biologist, Oregon Department of Fish and Wildlife, Tillamook Field Office, August 2002). Seals and sea lions haul out of the water onto the rocky beaches and offshore rocks to rest. Harbor

seals commonly use sandflats in lower Tillamook Bay as haul out areas. Other mammals that use habitats near the bay include black-tailed deer, black bear, and brush rabbits. Upland game birds, such as the blue grouse, mountain quail, and ruffed grouse occur on adjacent lands.

Fishery resources within Tillamook Bay include both migratory and resident species. Among the most common estuarine inhabitants are white sturgeon, northern anchovy, surf smelt, shiner surfperch, Pacific herring, English sole, starry flounder, and rockfish. Salmonids found in the estuary are chinook, chum and coho (ESA threatened) salmon, steelhead and cutthroat trout.

Pacific herring, starry flounder, and English sole prefer the sandy shoreline habitat. Cobble beaches are inhabited by rockfish, chinook salmon, and surf smelt. Shiner perch and white sturgeon are found in deeper water habitat, and English sole prefer the sandy silt areas.

As mentioned in the 1990 Environmental Assessment for the repair of the north jetty at Tillamook Bay, principal shellfish species include oysters , several species of shrimp and clam, and Dungeness crab. Clam digging is very popular on the intertidal flats. Cockles, gapers, butter, and littleneck clams predominate in the northern portion of the bay; softshell clams are more numerous in the southern portion.

Threatened and endangered species which may occur in the project area include the following: marbeled murrelet; bald eagle; brown pelican; western snowy plover; gray, humpback, blue, fin, sei, right, and sperm whales; leatherback sea turtles; Oregon Coast ESU coho salmon; and northern (Steller) sea lion. Steelhead, a candidate species, may also occur in the area.

Based on the Essential Fish Habitat (EFH) requirements of the Pacific Coast Salmon fishery and Pacific Coast Groundfish fishery, the potential direct, indirect, and cumulative effects of the proposed jetty maintenance project are not likely to adversely affect any identified EFH for the action area evaluated.

A charterboat and private boat sport fishery for salmon, sturgeon and bottom fish occurs in offshore waters. Within Tillamook Bay, fish and shellfish are harvested from open waters, jetties, shoreline areas, and tideflats. Most of the jetty angling in Tillamook Bay occurs from the north jetty because from Barview county parking lot located at the north jetty base and from boats. Access to the south jetty is very limited. The county park will be used during construction for hauling and storing vehicles and no access to the north jetty will be allowed until after the project is completed. This issue will be resolved with Tillamook County when construction begins.

4. <u>Environmental Effects</u>.

The environmental impacts associated with the proposed action would be minor because the maintenance work is to an existing structure within a limited area within the original

footprint and will not impact any benthic habitat. Some short-term loss of microhabitat will occur during the construction period but will be replaced by the completion of the proposed action. Approximately 2,500 ft^2 will be required to place a 50-foot cap at the end of each jetty. The north jetty will require 11,000 cubic yards (CY) of stone placed over the existing rock to complete this task. The south jetty, which has experienced a significant loss from wave action and erosion, will require 24,000 CY of stone for a 50-foot cap. The proposed activities are expected to have minimal effects on fish and wildlife species of the area. An increase in suspended sediments in the water column is expected during the construction period, however, this impact is expected to stay within acceptable levels for fish and wildlife species of concern. Avoidance of the area may occur throughout the construction period as a result of the increased activities and noise, but all species would be expected to return following project completion. No adverse affects on any listed/candidate threatened or endangered species are anticipated. All work will be coordinated with the local Oregon Department of Fish and Game (ODFW) district fisheries biologist and will occur during appropriate in-water work periods determined by ODFW to minimize impacts to fish, wildlife and habitat. Based on the analysis of the effects and consideration of conservation measures that would be implemented to avoid and reduce effects, we determined that the proposed project actions "may affect, but is not likely to adversely" effect with regard to listed species:

Public access to the north jetty and adjacent beach (jetty root) will be closed during the construction period. Placement of the staging area near the base of the north jetty will also deter foot traffic in the vicinity of the jetty during the construction period. It is not expected that construction equipment will impact commercial and fishing boat operations using the county park east of the north jetty. Designating another public area within the park for parking and beach access may offset these short-term impacts. Placement of the north jetty root revetment along the high water mark and dune face may impact some wildlife over the short-term. However, no wildlife use has been documented in this area and the revetment may provide some nesting habitat in the long-term. The project may require some vegetation planting due to access, site preparation, and construction in the area. The entire site will be planted with native vegetation

Because the contractor will determine the method of transporting material and equipment to the site, the route taken for road travel will not be known until the contract is awarded. The contractor will, however, be required to comply with all state and local regulations pertaining to the use of those roads.

The rock source will be determined when the contract is awarded, and as a result all the impacts resulting from the quarry activities cannot be predicted. It is expected that quarry activities would result in increased noise, dust, and traffic congestion in the vicinity of the quarry. Also, given the size of the jetty stone, repeated trips along the haul route could damage local roads.

Impacts to the construction staging area should be minimal. The area is nearly devoid of vegetation and as a result would not require much preparation. The site will be restored following project completion.

5. Coordination.

This Environmental Assessment (EA) is being issued for a 30-day public review. Comments are requested from the following:

U.S. Fish and Wildlife Service
NOAA Fisheries
Environmental Protection Agency
Confederated Tribes of the Grand Ronde Community of Oregon
Siletz Tribal Council
Oregon State Historic Preservation Office
Oregon Department of Land Conservation and Development
Oregon Division of State Lands
Oregon Department of Fish and Wildlife
City of Tillamook
Tillamook County

6. Consultation Requirements.

a. **Clean Water Act of 1977 (33 U.S.C.)**: Part of the proposed action is the repair and maintenance of a currently serviceable structure within the footprint of its authorized length [Section 404(f)(l)(B)] and, therefore, is exempt from the requirements of Section 404 of this act. The proposed dredging and filling required for the barge off loading sites will require a 404(b)(1) evaluation and Section 401 state water quality certification is required. The construction of the north jetty revetment is within the high water level, a Section 404 evaluation also will be required for this action. Section 402 is not required because less than 1-acre will be disturbed as a result of the proposed action.

b. **Coastal Zone Management Act of 1972, as amended**: The proposed project is located within Oregon's coastal zone. Applicable portions of the local land use plans were obtained from the Tillamook County Planning Department for use in preparing the required consistency determination. This determination concluded that the proposed action is consistent with Oregon's Coastal Management Program to the extent practicable. The determination will be provided to the DLCD for concurrence.

c. **Endangered Species Act of 1973, as amended**: In a letter dated June 5, 2002, the U.S. Fish and Wildlife Service (USFWS) listed the marbled murrelet, bald eagle, western snowy plover, and brown pelican as threatened and endangered species which may occur in the project area. The Oregon silverspot butterfly was also listed. Under jurisdiction of the National Marine Fisheries Service, now

referred to as National Oceanographic Atmospheric Administration Fisheries (NOAA Fisheries), are included gray, humpback, blue, fin, sei, right, and sperm whales; leatherback sea turtles; Oregon Coastal coho salmon; and northern (Steller) sea lion. Biological Assessments (BA) have been prepared and determination made that the proposed action may affect, but is not likely to adversely affect any listed or candidate species. BA's have been submitted for concurrence with this determination.

d. **Fish and Wildlife Coordination Act**: In compliance with this act, the proposed action has been coordinated with the USFWS, NOAA, the Oregon Department of Fish and Wildlife. A Fish and Wildlife Coordination Act Report is not required for operations and maintenance work.

e. **Marine Protection, Research, and Sanctuaries Act of 1972, as amended**: The proposed action does not involve the transportation of dredged material for the purpose of ocean disposal; therefore, this act does not apply.

f. **Cultural Resources Act**: The proposed project involves rehabilitation of the north and south jetties at entrance to Tillamook Bay, Tillamook, Oregon. The project involves adding rock at the contact point of the north jetty and the beach, filling in an eroded pocket near the landward end of the south jetty, and adding large rock at the seaward ends of both jetties. Access to the seaward ends of both jetties for rock placement will be accomplished by restoring the rubble road surface on the top of the jetties. Both of these structures are older than 30 years. No known prehistoric sites have been documented within the rehabilitation areas (these areas are most likely accreted ground) although records indicate prehistoric sites on both sides of the pre-jetty entrance to Tillamook Bay. Coordination with Oregon State Historic Preservation Office (OSHPO), per Section 106 and 110 of the National Historic Preservation Act will be undertaken. Coordination will involve providing the OSHPO with appropriate background information to indicate that the project will have no effect on significant cultural resources. We will propose that repairing the jetties is a necessary public safety measure and that all work will be restoration in kind.

g. **Executive Order 11988, Flood Plain Management, 24 May 1977**: The proposed project would not encourage development in or alter any flood plain areas.

h. **Executive Order 11990, Protection of Wetlands, 24 May 1977**: No wetlands would be affected by this project.

i. **Analysis of Impacts on Prime and Unique Farmlands, CEQ Memorandum 1976**: No prime or unique farmlands exist within the project area.

j. **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA).** No

hazardous, toxic and radioactive waste (HTRW) is known to occur in the proposed project vicinity. Presence of HTRW will be responded to within the requirements of the law and USACE regulations and guidance.

COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION
REPAIR OF THE NORTH AND SOUTH JETTIES AT TILLAMOOK BAY
TILLAMOOK COUNTY, OREGON

INTRODUCTION. The Federal action addressed in this consistency determination is the repair of the north and south jetties at Tillamook Bay, Oregon, as well as the protection of the north jetty root or base from coastal erosion. The Tillamook north jetty has an authorized length of 5,700 feet; however, with rehabilitation actions in 1921, 1933, 1946, 1955, 1963 and 1991, the jetty currently exists with a 384-foot loss. The Tillamook south jetty has an authorized length of 8,000 feet; however, with extensions in 1974 and 1978, the jetty currently exists with a 666-foot loss. Repair will consist of capping the tips of the north and south jetties, with 30-40 ton select stone within the jetty footprint. The jetties will remain authorized to 5,700 and 8,000 feet; the submerged portions of each jetty will be marked with the aids to navigation.

To ensure the stability of the north jetty landward and to prevent further erosion, the proposed action includes the construction of a revetment along the north side of the north jetty from the present dune line extending westward (offshore) 60 feet and northward along the coastline for a distance of 300 feet north of the north jetty.

Potential methods of transporting the stone to the project sites include barge and truck; access to the site for materials and equipment is at the discretion of the contractor, but subject to Corps approval. The barge alternative would require the placement of the temporary tie-off structures adjacent to the jetty consisting of either large jetty stone (preferable) or piling. These structures would be removed at the completion of the project.

Transportation by truck would involve the use of roads atop both the north and south jetties, to be constructed for temporary use by hauling trucks with coarse gravel prior to project implementation. These roads are expected to erode within two years of placement unless maintained by a non-Corps entity.

This determination of project consistency with Oregon's Coastal Zone Management Plan is based upon review of applicable policies and standards of the Oregon Statewide Planning Goals, the Oregon Ocean Plan, the Oregon Sea Plan and the Tillamook County Comprehensive Plan.

Goal 18. Beaches and Dunes. This goal includes conservation, protection and, where appropriate, restoration of the resources. Repair of the north and south jetty would not affect goal 18, however, the revetment of the north jetty base will require a permit from the Oregon Department of Parks and Recreation for the stabilization of this area. A new permit for this work will be obtained from the Oregon Department of Parks and Recreation and Tillamook County.

Goal 19. Ocean Resources. This goal includes conservation of the long-term values, benefits and natural resources of the nearshore ocean and continental shelf. State and Federal agencies shall develop inventory information necessary to understand impacts of their actions as they carry out activities related to ocean resources. The proposed action is consistent with this goal.

Oregon Ocean Resources Management Plan. This is a program to implement Goal 19. This plan, the Ocean Plan, and the Territorial Sea Plan, were established to protect the ocean resources. The proposed action is consistent with this goal.. Environmental effects are described in the attached Environmental Assessment. Biological Assessments being prepared by the Corps indicate no adverse effect on these species.

Oregon Territorial Sea Plan. An outgrowth of the Ocean Plan, this initiates a detailed planning effort for managing ocean resources in Oregon's territorial sea (3-mile band from land). Part 2 of the Territorial Sea Plan contains requirements for resource inventory information, evaluating environmental effects and conducting small-scale environmental disturbances to seek new information. For the proposed action, repair of the end of the jetties and the north jetty root would be consistent with Goal 19. Environmental effects are described in the attached Environmental Assessment. Biological Assessments being prepared by the Corps indicate no adverse effect on these species.

Estuary Policies. The jetties at Tillamook Bay are located within the Estuary Conservation-2 Zone (EC2). According to Section 3.108(1) of the Comprehensive Plan, one of the purposes of the EC2 Zone is to "provide for long-term use of renewable resources that do not require major alterations of the estuary except for purposes of restoration." Uses permitted within the EC2 Zone, as specified in Section 3.108(2), include a) "maintenance and repair of existing structures of facilities involving a regulated activity", and b) "navigational aids." These uses, as well as piling/dolphin installation, are subject to the procedure of Section 3.120 and the standards in Section 3.140, which are discussed below.

Section 3.120 – Review of Regulated Activities. This section provides an assessment process and criteria for review of State and Federal projects that could potentially alter the integrity of the estuarine ecosystem. Part of this review includes development of an impact assessment. A Federal Environmental Assessment (EA) may be substituted for this impact assessment. Because the impacts of the proposed project are discussed in the EA for the repair of the north jetty (which will be provided to state and local land use agencies), only a summary will be presented in this consistency determination.

Section 3.140 – Estuary Development Standards. Project related activities to which these standards apply include a) fill in estuarine waters, b) navigational structures and navigational aids, and c) piling/dolphin installation.

a. Estuarine Fill. This would include the placement of stone for the capping of the north and south jetties, the temporary placement of stones at the base of

the jetties for tie-off structures, and the construction of a revetment at the north jetty root. The standards require that when fill is proposed for the purpose of onsite maintenance of an existing structure, evidence be provided that 1) there are no alternatives to fill to maintain proper operation of the facility, and 2) fill is confined to the existing facility and is the minimum necessary to fulfill the need.

The purpose of the north jetty (in conjunction with the south jetty) is to stabilize entrance channel location, facilitate maintenance of project depths, and protect traffic entering or leaving the bay from wave attack during periods of northwesterly winds. Sedimentation resulting from the continued loss or failure of the north jetty could jeopardize the structural integrity of the south jetty. To allow the jetties to continue to deteriorate will eventually lead to sediment transport into the estuary, increasing shoaling rates. As more of the jetty is lost, waves will move into the inner harbor adding to the difficulty of maintaining a reliable year round channel. Therefore, the alternative of "no action" is unacceptable.

The amount of fill will be the minimum required to fulfill existing needs. Since extending the south jetty to 8,000 feet in 1979, maintaining authorized channel depths has not been a problem. Sediment infill has not occurred even with the present condition of the north jetty. The current length appears to be adequate for maintaining a stable entrance. However, capping the jetties and the construction of a revetment are necessary to prevent further deterioration and possible unstable conditions.

Impacts associated with these fill activities should be minor. The jetty repair work is to existing structures within a limited area and does not involve covering sandy habitat. Avoidance of the area by fish and wildlife species may occur throughout the construction period, but all species would be expected to return following project completion. No listed/candidate threatened or endangered species should be adversely affected by the proposed work.

The primary sand dune at the root or base of the Tillamook north jetty has been progressively eroding since 1995. The primary dune serves as a barrier protecting more than 1000 feet of weakened (and reduced crest) jetty, landward of the dune, from direct wave attack and overtopping associated with the present surf zone. If the weakened shoreward area of the jetty were subjected to an active surf zone, the north jetty would be destabilized.

b. Navigational Structures and Navigational Aids. The outer 425 (north) and 840 (south) feet of the jetty will remain submerged and will be marked with appropriate aid to navigation by the U.S. Coast Guard through October. At that time, seas become too rough to maintain a marker. These aids to navigation will not occupy more estuarine area than is necessary to accomplish the proposed use, and will not interfere with the normal public use of fishery, recreation, or water resources. The Corps of Engineers will issue a notice to mariners informing them

of the submerged portions of the north and south jetties. The markings will be replaced in the spring.

c. Piling/Dolphin Installation. Pilings may by installed to provide a temporary tie-off structure should barging be the selected method for transporting jetty stone to the project site. The piling would not occupy more area than necessary to accomplish the proposed use, and would not unduly interfere with the normal public use of fishery, recreation or water resources. All piling placed for the tie-off structure would be removed upon completion of the jetty rehabilitation.

STATEMENT OF CONSISTENCY. Based on the above evaluation, we have determined that the repair of the north and south jetties and the north jetty root at Tillamook Bay and activities associated with this repair complies with the Tillamook County Comprehensive Plan. The action is, therefore, consistent with the State of Oregon's Coastal Zone Management Program to the maximum extent possible.

BIOLOGICAL ASSESSMENT

FOR

BALD EAGLES, WESTERN SNOWY PLOVERS, BROWN PELICANS, MARBELED MURRELETS AND OREGON SILVERSPOT BUTTERFLY

FOR THE

TILLAMOOK MAJOR MAINTENANCE STUDY

TILLAMOOK BAY, OREGON

PROJECT DESCRIPTION

The proposed project involves the rehabilitation of the jetties at the mouth of Tillamook Bay, as well as the protection of Tillamook North Jetty root from coastal erosion. The project would involve constructing new heads to both jetties in order to prevent further deterioration of the structures. Additionally, to ensure the stability of the North Jetty landward and to prevent erosion, the construction of a revetment along the north side of the North Jetty from the present dune line extending westward (offshore) 50 feet, and northward along the shore face of the dune for a distance of 300 feet north of the North Jetty will be included in the rehabilitation project.

An Environmental Assessment (EA) was prepared for the Tillamook North Jetty Rehabilitation in 1990. Both jetties have experienced progressive loss in length since then, most notably from the winter storms of 1996. The first to be built, the North Jetty was constructed between 1913-1917, and has been repaired/extended six times since then. The South Jetty, constructed between 1969-1971, has undergone two repairs/extensions since that time. As they currently stand, the damage to the North Jetty head has resulted in a 384-foot loss and a 666-foot loss to the South Jetty. During the summer of 2001, rip-rap was placed along the north side of the North Jetty (near the root), yet stability of the primary dune was not addressed.

Material to be used for the capping is 30-40 ton stone, and would most likely be barged to the jetty sites, although access to the site for additional materials and equipment will be through the use of access roads on both the North and South Jetties.

Minimum protection of the root of the North Jetty and the adjacent beach would be achieved using a revetment made up of appropriately sized stone and graded filter. The staging areas for each work action would be located in the small parking areas adjacent to the root of each jetty, including the revetment construction.

Two access roads from the contractor's set up areas on top of the existing jetties will be utilized. These roadways will have to be constructed using gravel, and removal of the access roadways after construction is no longer requested. These roadways will erode by natural causes, or be maintained by non-Corps entities. Previous cultural resource inventories have indicated no cultural sites in the vicinity, thus no cultural resources should be affected.

A Section 404 Clean Water Act evaluation will be required for the protection of the north jetty root/base and staging areas for both jetties.. This proposed action also requires state water quality certification under Section 401 of this act. The repairs to the jetty heads involve no significant change to the original footprint and are exempt under Section 404 (f) repair and maintenance of a serviceable structure.

THREATENED AND ENDANGERED SPECIES

Written response from the United States Fish and Wildlife Service identified the possible occurrence of five listed species in the project area: bald eagle (*Haliaeetus leucocephalus*), Western snowy plover (*Charadrius alexandrinus nivosus*), brown pelican (*Pelicanus occidentalis*), marbled murrelet (*Brachyramphus marmoratus*) and Oregon silverspot butterfly (*Speyeria zerene hippolyta*).

BALD EAGLE

Four bald eagle territories occur within 5 miles of the project area on Tillamook Bay, the Pacific Ocean and Bayocean Spit (Isaacs and Anthony 1999). The Hobsonville Point territory is the pair nearest the project site. There is no information on key foraging areas for this pair in the project vicinity. Probable foraging areas for this pair include the estuarine intertidal flats and marshes in Tillamook Bay (west) and Miami Cove (north) of the nest location.

The Tillamook Bay pair's nest fronts on the western edge of Tillamook Bay. Probable foraging areas for this pair include intertidal marshes and mudflats of Tillamook Bay, particularly the delta formed by the Wilson, Trask and Tillamook Rivers.

The Cape Meares pair's nest territory fronts the Pacific Ocean. The foraging territory for this pair would be expected to occur along the coastline and extend to offshore rocks, which support very substantial breeding colonies of seabirds.

The Kilchis Point/Hall Slough bald eagle territory occurs at the mouth of the Kilchis River. The intertidal marshes and mudflats, plus open water areas of Tillamook Bay adjacent to the mouth of the Kilchis River represent the probable foraging area for this pair.

DISCUSSION

It is unlikely that these bald eagle pairs forage in the immediate vicinity of the proposed maintenance area and waters of the Pacific Ocean and Tillamook Bay. A high level of human use and development occurs in and around Tillamook Bay. Recreational use of beaches and waters of Tillamook Bay and the adjacent Pacific Ocean are substantial. Fortunately, the best available foraging habitat for these pairs, typically intertidal marshes and mudflats, plus offshore rocks, receives the least human use because of difficulty of access.

Members of the bald eagle pairs present at Tillamook Bay are not expected to forage significantly on or near the North and South Jetties. Occasionally, scavenging by bald eagles would be expected to occur along the ocean beach or in the adjacent bay marshes and mudflats.

CONCLUSION

The proposed project is distant enough from eagle nest locations and probable foraging areas that no disturbance to these pairs should result. Therefore, we conclude that the project may affect, but is not likely to adversely affect bald eagles.

LITERATURE CITED

Isaacs, F. B. and R. G. Anthony. 1999. Bald eagle nest locations and history of use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971 through 1999. Oregon Cooperative Wildlife Research Unit, Oregon State University, Corvallis. 20pp, 6 tables, 2 figures, 1 appendix.

WESTERN SNOWY PLOVER

Background information on population status and habitat requirements for western snowy plover are summarized in the Final Rule, Designation of Critical Habitat for the Pacific Coast Population of the Western Snowy Plover (Federal Register 64(234): 68508-68544). The United States Fish and Wildlife Service identified Bayocean Spit as Critical Habitat in the Final Rule. The Critical Habitat designation runs south along the beach for approximately 4 miles from the South Jetty and includes dune habitat interior to the foredune at the South Jetty and at the southern end of the designated Critical Habitat area. A map and description of Bayocean Spit delineating the specific boundaries of the Critical Habitat is included in the Final Rule on page 68523.

DISCUSSION

Wintering and nesting populations of snowy plovers occur on Bayocean Spit, beginning at the South Jetty and extending south for almost half a mile. The spit supplies a high sand foredune area that is ideal habitat for plover nesting and breeding, although bird counts have been zero for the last six breeding seasons (see Table 1).

Table 1. Western Snowy Plover Breeding Season Census Results for Bayocean Spit, Oregon, 1978-1998.

Breeding Season	Number	Notes
1978	21	
1979	7	
1980	8	
1981	11	Additional birds may have been present
1982	10	
1983	2	
1984	7	
1985	6	
1986	1	
1987	6	
1988	8	

1989	12	Observed early spring and assumed to be resident.
1990	10	
1991	0	
1992	0	
1993	2	
1994	0	
1995	6	
1996	0	
1997	0	
1998	0	
1999	0	
2000	0	
2001	0	

The proposed project is both across the navigation channel and directly north of the area frequented by snowy plovers. Construction activities will not modify their habitat on Bayocean Spit nor should they result in any disturbance of the species.

CONCLUSION

Therefore, the project may affect but is not likely to adversely affect this listed species.

BROWN PELICAN

The brown pelican is typically found along the Oregon coast between June and November. Concentrations usually occur first at the estuaries along the southern Oregon coast and then spread northward. The majority of birds (75%-85%) are immatures. The movement into Oregon waters occurs post-breeding and is an annual event. Brown pelicans apparently feed on northern anchovies which are common in the lower estuaries in summer. Large concentrations of pelicans occur at Tillamook Bay in September.

They are frequently observed foraging in the navigation channel between RM 2 and 3. Foraging also occurs within the bay and in the nearshore environment. Loafing occurs on spits, sandbars, offshore rocks, headlands, beaches, jetties and pilings. Brown pelicans are known to loaf on both jetties, interior bay sandbars, offshore and bay rocks and at port facilities at Tillamook Bay.

DISCUSSION

This species is commonly observed in and around human activities, particularly recreational boating, fishing, crabbing, claming and general sightseeing activities along the Oregon Coast and Oregon bays. These human activities are prevalent at Tillamook Bay, as is brown pelican use of the estuary and nearshore waters and rocks. Brown pelicans appear habituated to human activity. Recreational fishing and sightseeing by the non-boating public occurs on both the North and South Jetties at Tillamook Bay and on

Bayocean Spit beaches. Secure perching and roosting habitat for brown pelicans occurs at offshore rocks off Cape Meares that are included in the National Wildlife Refuge system.

Construction activities may result in some localized disturbance to loafing and/or foraging brown pelicans. Alternative sites for these activities are abundant in the project vicinity and temporary displacement of these birds would not be detrimental to their survival, either individually or as a population.

CONCLUSION

The proposed rehabilitation of Tillamook North and South Jetties may affect, but is not likely to adversely affect the brown pelican population or the survival of individuals.

MARBLED MURRELETS

The marbled murrelet is a near-shore marine bird that is most frequently observed within 1.5 miles of shore (Marshall 1988). Marbled murrelets reportedly forage just beyond the breaker-line and along the sides of river mouths where greater upwelling and less turbulence occurs. Sealy (1975a in Marshall 1988) reported that murrelets foraged within 500 meters of shore. Murrelets forage within the water column; prey items include invertebrates and small fish such as anchovy, herring and Pacific sandlance (Marshall 1988).

Currently, the largest concentrations of marbled murrelets in Oregon are thought to occur off the central coast (Marshall 1988) between Depoe Bay and Coos Bay. Lincoln and Lane Counties, which comprise a large block of the central Oregon coast, were historic centers of abundance for marbled murrelets in Oregon (Fed. Reg. 1991). Initial results from Strong (1992) indicate that abundance of murrelets is relatively higher on the central Oregon coast than the northern Oregon coast. Strong (1992) also reported that murrelet occurrence was patchy and that use of specific concentration locations was not consistent. Briggs et al. (1992) reported sightings of marbled murrelets off the central-northern Oregon coast (Cape Arago to Tillamook Head) during June 1989. These sightings occurred in waters less that 10 meters in depth and with temperatures of 12.5 to 13.6 degrees Celsius and were comparable in depth and temperatures to areas where murrelets were observed off the Washington coast. They observed 71 murrelets at 25 locations from the California-Oregon border to Cascade Head, Oregon during their September 1990 survey; and they found murrelets were in shallow waters with an average temperature of 11 degrees Celsius. It should be noted that surveys by Briggs et al. (1992) were not designed for murrelets and that the nearshore ocean zone frequented by this species was covered rapidly during their surveys. Nevertheless, their information does provide some information on murrelet occurrence.

Strong et al. (1993) reported that marbled murrelets were relatively scarce north of the Siletz River mouth. They did locate concentrations of marbled murrelets off Cape Falcon

and Cape Lookout State Parks. Cape Falcon is near Cannon Beach well north of Tillamook Bay. Cape Lookout it approximately 15 miles south of Tillamook Bay.

Marbled murrelets nest in old growth/mature coniferous forests (Fed. Reg. 1991). The low incidence of marbled murrelets at coastal locations is probably related to the loss of old growth coniferous forest from harvest and/or fire on near-coastal lands (Fed. Reg. 1991). Marbled murrelets populations now typically occur offshore of forested locations, which provide suitable nesting habitat. Detection of marbled murrelets was greater in old growth stands (California) greater than 500 acres in size than for stands of 100 acres; few detections were recorded for stands less than 60 acres in size (Paton and Ralph 1988 and Ralph et al. 1990 in Fed. Reg. 1991). Thus, size of remnant stands may influence presence of marbled murrelets on adjacent coastal waters.

DISCUSSION

Our literature review indicates the species occurs in the nearshore environment more so than in bays. The 1991 Federal Register, Volume 56, No. 119, page 28363, stated that: "Concentrations of murrelets offshore were almost always adjacent to old-growth forests on-shore." Forested land inland from Tillamook Bay has been subject to intensive logging activities. Additionally, hundreds of thousands of acres of forest lands inland from Tillamook Bay were consumed by wildfire in the various Tillamook burns in the 1920's and 1930's. Consequently, old growth inland from Tillamook Bay is very limited in extent.

The nearest concentration of marbled murrelets noted by Strong et al. (1993) was off Cape Lookout State Park, which is approximately 15 miles south of Bayocean Spit. Heavy recreational boating use of Tillamook Bay would probably preclude murrelet use of bay waters. Nearshore and bay waters would appear to receive minimal use by marbled murrelets due to the absence of old growth forest inland from Tillamook Bay.

CONCLUSION

The proposed rehabilitation of the Tillamook North and South Jetties may affect, but is not likely to adversely affect the marbled murrelet population or the survival of individuals.

LITERATURE CITED

Briggs, K. T., D. H. Varoujean, W. W. Williams, R. G. Ford, M. L. Bonnell, and J. L. Casey. 1992. Seabirds of the Oregon and Washington OCS, 1989-1990. Chapter Three in Brueggeman, J. J., editor. 1992. Oregon and Washington Marine Mammal and Seabird Surveys. Final Report for Pacific OCS Region, Minerals Management Service, USDI, Los Angeles, CA; Contract #14-12-0001-30426.

Emmett, R. L., S. L. Stone, S. A. Hinton, and M. E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries, Volume II: species

life history summaries. ELMR Rep.No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Federal Register. 1991. Endangered and threatened wildlife and plants; Proposed threatened status for the marbled murrelet in Washington, Oregon and California. Vol. 56(119):28362-28367.

Marshall, David B. 1988. Status of the Marbled Murrelet in North America With Special Emphasis on Populations in Washington, Oregon and California. Audubon Society of Portland 41 pp.

Moehl, C. and L. Barton. 1989. Dredge material sampling. Coos Bay, Oregon 1989 fish and invertebrate distribution. USACE, Portland District, Unpub. Report. 22 pp.

Paton, P. W. and C. J. Ralph. 1988. Geographic distribution of the marbled murrelet in California at inland sites during the 1988 breeding season. Calif. Dept. Fish Game, Sacramento, CA. 35pp.

Ralph, C. J., S. L. Miller, N. L. Naslund, B. O'Donnell, P. W. C. Paton, and J. Seay. 1990. Marbled murrelet research during 1989 in northern and central California - An interim report. Tech. Report 1990-8, Nongame Bird and Mammal Section Report, Calif. Dept. Fish Game, Sacramento. 39pp.

Sealey, S. G. 1975a. Feeding ecology of the ancient and marbled murrelets near Langara Island, British Columbia. Can. J. Zool. 53:418-433.

Strong, C. S. 1992. Marine surveys of marbled murrelets in Oregon: Research on distribution and population size. Progress Report for OR Dept. Fish and Wildlife Conditional Grant Agreement 92-06-01.

Strong, C. S., J. R. Gilardi, I. Gaffney, and J. M. Cruz. 1993. Distribution and abundance of marbled murrelets at sea on the Oregon in 1992. Final Report to Oregon Department of Fish and Wildlife; Conditional Grant Agreement No. 92-06-01.

Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture; 402 pp.

Trumble, R. J. 1973. Distribution, relative abundance, and general biology of selected underutilized fishery resources of the eastern north Pacific Ocean. M.S. Thesis, Univ. Wash., Seattle, WA. 178pp.

U.S. Army Corps of Engineers. 1991. Federal Navigation Projects: The Oregon Coast Maintenance Program. Nav. Br., Oper. Div., Portland, District. 145 pp.

Varoujean II, D. H. And W. A. Williams. 1995. Abundance and distribution of marbled murrelets in Oregon and Washington based on aerial surveys. Chapter 31 in Ralph, C. J., G. L. Hunt, Jr., M. G. Raphael and J. F. Piatt. 1995. Ecology and conservation of the marbled murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture; 402 pp.

OREGON SILVERSPOT BUTTERFLY

The documented historical occurrence (USFWS 1982) of this species at Cape Meares and Oceanside, Oregon is greater than four miles south of the project area. The Oregon silverspot butterfly is a terrestrial species that inhabits meadow habitats on coastal headlands or Oregon Coast Range peaks that provide specific habitat features, primarily the presence of *Viola adunca*, the obligate plant species of this butterfly.

DISCUSSION

Tillamook North and South Jetties do not historically, nor do they presently, provide suitable salt-spray meadow habitat conditions for Oregon silverspot butterflies.

CONCLUSION

The proposed action may affect, but is not likely to adversely affect the Oregon silverspot butterfly.

LITERATURE CITED

U.S. Fish and Wildlife Service. 1982. The Oregon Silverspot Butterfly Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon. 33pp.

BIOLOGICAL ASSESSMENT

FOR THE

TILLAMOOK MAJOR MAINTENANCE STUDY
TILLAMOOK COUNTY, OREGON

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT

October 2003

EXECUTIVE SUMMARY

Tillamook Bay, designated as a Safe Harbor, is located along the Oregon coast approximately 50 miles south of the Columbia River, in Garibaldi, Oregon. The north and south jetties, at the entrance to the bay, have experienced progressive loss in stability and length due to the Pacific Northwest's severe winter storms and harsh weather, most recently during the winter storm season of 2002/2003, resulting in hazardous navigation conditions over the bar into the channel. The wave conditions on the ebb tidal shoal force boaters using the entrance to use a channel called the "South Hole." This route forces the boats to leave and enter the channel with the waves hitting broadside to the boat, placing the vessel in a dangerous position. This becomes more dangerous because of remnant jetty stone that lies under water just seaward of the exposed end of the south jetty (Figure 1).

An Environmental Assessment (EA) was prepared for the Tillamook North Jetty Rehabilitation in 1990. Both jetties have experienced progressive loss in length since then, most notably from the winter storms of 1996 and 2002/2003. The north jetty was constructed between 1913-1917, and has been repaired/extended six times since then. The south jetty, constructed between 1969-1971, has undergone two extensions since that time. Currently, the damage to the north jetty head has resulted in a 384-foot loss and a 666-foot loss to the south jetty.

Another cause of concern is erosion of the shoreline along the north jetty in terms of a potential breach at the jetty root. The area has a smaller cross-section and the proximity of the deep channel (40 ft) to this section of jetty is of increasing concern. During the summer of 2001, rip-rap was placed along the north side of the north jetty (near the root), yet stability of the primary dune was not addressed. The recent winter storm period (2002/2003) has caused concern from both local government as well as the U.S. Coast Guard regarding the continued deterioration of the north jetty root. There is a Coast Guard watchtower located adjacent to the north jetty that the Coast Guard fears will be lost to waves attacking the tower base.

This Biological Assessment (BA) was prepared in accordance with Section 7 of the Endangered Species Act (ESA) to evaluate the effects of the proposed maintenance project on federally listed species. Conservation measures are also identified in the BA to avoid and minimize adverse effects of the proposed actions. Also, included in this document is an assessment of project effects on Essential Fish Habitat (EFH) as required under the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act.

In assessing the effects of the proposed project on listed and candidate species, the environmental baseline for the project area and a document evaluating how the proposed action would affect the environmental baseline was done. To ensure a thorough review of all the habitat pathways and indicators that could impact fish, we followed the methods outlines in *"Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale"* (NOAA Fisheries 1996). Emphasis of the effects analysis was placed on effect of suspended sediments/turbidity associated with the physical disturbance of the waterway

since this was considered the most likely impact. Direct, interrelated, interdependent and cumulative effects of the various project components were also considered.

Based on the analysis of the effects and consideration of conservation measures that would be implemented to avoid and reduce effects, we determined that the proposed project actions "may affect, but is not likely to adversely" effect with regard to the following listed species:

Humpback whale (*Megaptera noraeangliae*), Endangered
Blue whale (*Balaenoptera musculus*), Endangered
Finback whale (*Balaenoptera physalus*), Endangered
Sei whale (*Balaenoptera borealis*), Endangered
Sperm whale (*Physeter macrocephalus*), Endangered
Leatherback turtle (*Dermochelys coriacea*), Endangered
Loggerhead turtle (*Caretta caretta*), Threatened
Stellar sea lion *(Eumetopias jubatus*), Threatened

1. INTRODUCTION

The purpose of this BA is to address the potential impacts on listed marine species resulting from the proposed jetty maintenance project. The U.S. Army Corps of Engineers (USACE) prepared this BA in compliance with requirements of Section 7(c) of the Endangered Species Act (ESA) as amended. Section 7 assures that, through consultation (or conferencing for proposed species) with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic Atmospheric Administration (NOAA) Fisheries, federal actions do not jeopardize the continued existence of any threatened or endangered species.

Consultation is accomplished, in part, through this BA, which evaluates the potential effects the proposed maintenance project will have on species that are federally listed under the ESA. Conservation measures are identified in this BA to avoid or minimize any adverse effects of the proposed project on listed species.

The following listed marine species may occur in the vicinity of the project action areas. Those species under the jurisdiction of the NOAA Fisheries only are addressed in this BA:

1.1 LISTED MARINE SPECIES

Humpback whale (*Megaptera noraeangliae*), Endangered
Blue whale (*Balaenoptera musculus*), Endangered
Finback whale (*Balaenoptera physalus*), Endangered
Sei whale (*Balaenoptera borealis*), Endangered
Sperm whale (*Physeter macrocephalus*), Endangered
Leatherback turtle (*Dermochelys coriacea*), Endangered
Loggerhead turtle (*Caretta caretta*), Threatened
Stellar sea lion *(Eumetopias jubatus*)Threatened

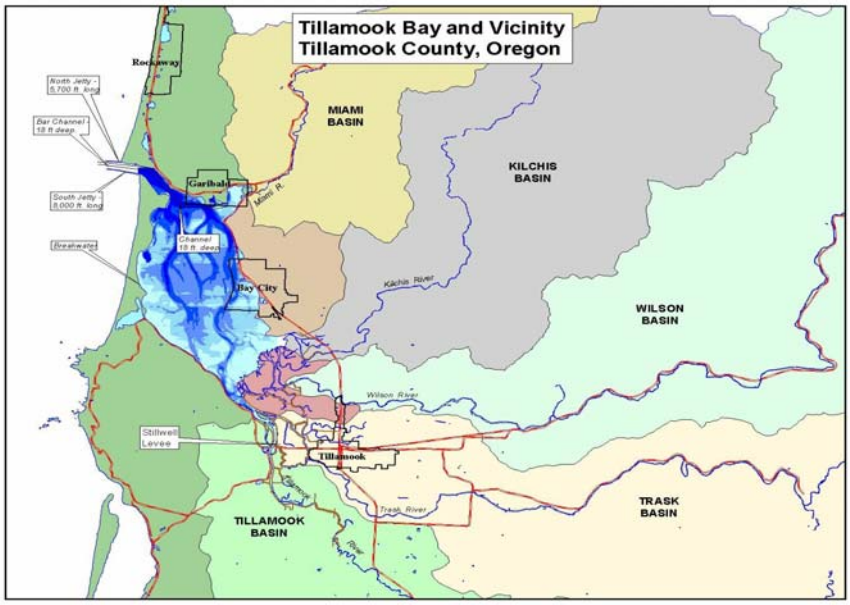

Figure 1. Location of Tillamook Bay and proposed rehabilitation projects to the jetties.

2. PROJECT ALTERNATIVES

Due to projected limited funding to repair the entire project, 2 different capping lengths were estimated, 50 ft and 100 ft. A 100 ft head repair has been standard repair practice in this district and provides for a more reliable long-term fix in the presently increasing Pacific Ocean environment. In addition, trunk repairs were identified as critical or routine. Critical repairs were estimated separately and are located on the north jetty from STA 29+50 to 37+00 and along the south jetty from STA 70+00 to 76+50. Routine trunk repairs are located along the north jetty from STA 22+00 to 29+00 and along the south jetty from STA 44+00 to 58+00. The base condition or "without project" alternative assumes that the existing O&M practices will continue in the absence of major repairs. History has shown that Portland District's normal O&M practices for our coastal jetties involves, at the minimum, stabilizing the jetty head, or capping. The five alternatives are as follows:

1. Alternative 1 – Jetty Caps and Revetment. This is the he minimum maintenance option that would protect the Federal interest. This alternative addresses the areas of greatest concern in terms of structural stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $16.7M. ($12.7 M for 50 ft cap) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

2. Alternative 2 – Jetty Caps, Revetment, and Critical Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, a 650 ft trunk repair to the south jetty from STA 70+00 to 76+50, a 750 ft trunk repair to the north jetty from STA 29+50 to 37+00, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The

south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $34.5M. ($30.5M for 50 ft cap.) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

3. Alternative 3 – Jetty Caps, Revetment, and Critical and Routine Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, trunk repairs to the south jetty from STA 70+00 to 76+50 (650 ft in length) and STA 44+00 to 58+00 (1400 ft in length), trunk repairs to the north jetty from STA 29+50 to 37+00 (750 ft in length) and STA 22+00 to 29+50 (750 ft in length), and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $41.3M. ($37.4M for 50 ft cap.) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

4. Alternative 4 – Alternative Jetty Lengths, Revetment, and Critical and Routine Trunk Repairs. Plan considers both structural repairs to the jetties and further expands upon navigability of the channel. The preliminary plan calls for a 200-foot extension to the year 2003 end station of the north jetty (55+20) and a 360-foot extension to the year 2003 end station of the south jetty (82+00); repairs to damage areas along both jetties;

and a revetment at the root of the north jetty. This plan leaves the north and south jetties 180 ft and 300 ft shorter than the authorized lengths, respectively. The objective of this plan is to increase the stability of the jetties and decrease wave amplification within the navigation channel. This alternative is not fully developed and would require more study to determine a constructible design and appropriate jetty length repair. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The initial cost estimate is $53M. This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

5. Alternative 5 – "No Action". The "no action" alternative was reviewed for this study and was determined to be unacceptable due to the danger and risk of jeopardizing the integrity of both jetties. To allow the jetties to continue to deteriorate will eventually lead to an increase in shoaling at the channel entrance. As more of the jetties deteriorate, waves will move further into the navigation channel increasing boating hazards and further de-stabilizing the inner portion of the jetties.

3. SPECIES INFORMATION

3.1 HUMPBACK, FINBACK, BLUE, SEI, AND SPERM WHALES

These five whale species may occur in the project area but information on numbers, distribution, and feeding habits is lacking other than in a general sense. Occurrence of blue whales off the Oregon coast is primarily in May-June and August-October. Blue whales typically occur offshore as individuals or in small groups. Blue whales winter well south of Oregon as do finback whales (Maser et al. 1981).

Finback whales do occur off the Oregon Coast during summer. Whaling records indicate that finback whales were primarily harvested off Oregon from May-September (Maser et al. 1981). Green et al. (1989), based upon entries (1911-1925) in the logbooks of W. Lagen, U. of Washington Library, noted that finback whales were harvested in Oregon waters in the vicinity of Heceta Head and Yaquina Bay where oceanic banks occur and at the mouth of the Columbia River. Green et al. (1991) reported observing thirteen groups totaling 27 finback whales off the Oregon coast between June and January; all but 5 observations (Nov. 1989-2; January 1990-3) occurred in either June or July of 1989 and 1990. They observed finback whale groups in slope

waters 85-90 km west of Newport, Oregon on three separate occasions and considered this an indication of site-specific preference. This area is referred to as the Newport Valley and has high topographical relief. They noted that other authors had observed site fidelity by this species.

Sei whales also winter south of Oregon. Based upon information from central California, Sei whales probably occur in southward migration off the Oregon coast in late summer - early fall (Maser et al. 1981).

Based upon whaling records, humpback whales occur off the Oregon coast between April and October with peak numbers occurring during June, July, and August (Maser et al. 1981). Green et al. (1991) observed 36 groups comprising 68 humpback whales off the Oregon and Washington coasts between May and November.

Observations by Green et al. (1991) indicate that humpback whales occur off the Oregon coast in May and off Washington by July. Humpbacks were only observed in Washington during August shipboard surveys and were more common in Washington during September than Oregon. By late November, humpback whales were only observed off the Oregon Coast. The largest concentration of humpback whales observed was 35 animals near the southern edge of the Heceta Bank in June, on the continental shelf and slope.

Sperm whales are migratory and some are observed off the Oregon coast in the summer months (Maser et al. 1981). Strandings have occurred along the Oregon coast. Sperm whales are pelagic, occurring in water greater than 1000 meters in depth and observed a preference by sperm whales for continental shelf margins and sea mounts where upwelling occurs.

Humpback, Fin, Blue, Sei and Sperm whales are rarely observed in the vicinity of coastal jetties, entrance channels and bays. There are no indications that Tillamook north and south jetties and/or immediate surroundings are important foraging areas for any of these species.

3.2 STELLER SEA LION

Steller sea lions breed along the west coast of North America from San Miguel in the California Channel Islands, to the Seward Peninsula/Bering Strait in Alaska. Two separate stocks of Steller sea lions are now recognized within U.S. waters: an eastern (animals east of Cape Suckling, Alaska) and a western stock (animals at and west of Cape Suckling, Alaska) (Ferrero et al. 2000). Steller sea lions addressed in this biological assessment are part of the eastern stock that is a transboundary stock and includes Steller sea lions from British Columbia, Washington, Oregon and California.

Steller sea lions are year-round residents along the Oregon coast. The subpopulation off Oregon is second in size to the Alaskan subpopulation (Brown 1988). Aerial surveys and ground counts in 1996 determined there were 3,990 Steller sea lions in Oregon. Steller sea lions are known to haul-out at a minimum of ten sites off Oregon; two of these sites, Rogue and Orford Reefs, are rookeries. Other important haul-out sites include Ecola State Park, Sea Lion Caves, Columbia

River South Jetty, Three Arch Rock, Cape Arago, and Seal Rock. The south jetty of the Columbia River and Three Arch Rock appeared to be used primarily during the winter (Brown 1988).

Population trend counts for Oregon remained fairly stable in the 1980's with uncorrected counts in the range of 2000-3000 animals (Ferrero 2000). Juvenile and adult counts of Steller sea lions in Oregon have shown a steady increase from 1976 (1,486 animals) to 1998 (3,971 animals) (Ferrero 2000). NMFS (1995) indicated that the increase in the Oregon population might be an artifact of improved surveys in recent years.

Peak counts (2352) during 1984-1985 surveys were made on May 21 and 23, 1984 with haul-out counts the highest at Ecola State Park, Sea Lion Caves, Orford Reef and Rogue Reef (Brown 1988). Peak observations at the two Oregon rookeries occur during May, June and July. Sea lions begin to leave the rookeries in August. The number of sea lions using Orford Reef has declined since 1986. It is not certain, but the decline may be related to a rapidly growing sea urchin fishery in the area (ODFW 1990). Seasonal shifts in the use of haul-out sites are common among Steller sea lions. Steller sea lion numbers appear to be lower off Oregon in the winter than summer, though it is not known where these animals migrate to for winter.

Steller sea lions forage at river mouths and nearshore areas along the coast. Roffe and Mate (1984) studied the feeding habits of pinnipeds, including Steller sea lions in the Rogue River estuary, Oregon in 1984 and determined that the sea lions fed most heavily on Pacific lamprey and the factor that most affected feeding habits was proximity to the mouth of the river. Although sea lions have been accused of damaging the commercial salmon fishery in several locations along the West Coast, studies have shown that sea lions generally consume less of these fish than thought, and in fact, that salmon comprise a relatively small proportion of their diet. Roffe and Mate (1984), based on observations of feeding, determined that only 2% were on salmon. The main food items for Steller sea lions in the Rogue River estuary appeared to be lamprey (26.8%) and non-salmonid fishes (32.4%) (Roffe and Mate 1984). No observational data has been collected in the project area.

The nearest haul-out area to Tillamook north and south jetties for northern sea lions is Three Arch Rock, just south of Tillamook Bay. There are no indications that northern sea lions haul-out at either jetty. The north jetty is a high use area for tourists and fishermen that probably preclude any use of the site for hauling-out.

Foraging by this species would be expected to occur in the project vicinity although the extent of foraging activities at the immediate project site is unknown. Bottomfish associated with offshore rocks and reefs coupled with salmonids rearing nearshore and runs into the five streams emptying into Tillamook Bay provide for a substantial prey resource.

Construction activities on the both jetties would most likely be initiated in July through September, 2004. This work window is outside the high use timeframe (winter) for northern sea lions at Three Arch Rock. Northern sea lions present during construction may avoid the immediate project area in response to high levels of human activity and noise associated with construction. Work activities are not expected to hinder sea lion use of the channel area access

to Tillamook Bay. The project may result in some localized avoidance around the immediate construction site by northern sea lions.

3.3 LEATHERBACK AND LOGGERHEAD SEA TURTLES

Sea turtle occurrences off the Oregon Coast are associated with the appearance of albacore tuna. Albacore tuna occurrence, and very likely that of sea turtles, are strongly associated with the warm waters of the Japanese current which tends to approach the Oregon Coast in late summer. Typically, warm water associated with the Japanese Current does not closely approach the Oregon Coast (i.e. 1-5 miles), generally occurring within 30 to 60 miles offshore. During El Niño events, warm water may occur much closer to the Oregon coast than usual.

Leatherback and loggerhead sea turtles generally occur well offshore from the project location with only occasional individuals occurring in nearshore, colder waters. It is expected that these turtles would be very infrequent visitors to the project area.

4. ANALYSIS OF EFFECTS

4.1 DIRECT EFFECTS

The proposed project may cause temporary and short-term impacts to the listed species during project construction. The probability for direct mortality to juveniles or adults of listed salmonids during the proposed project is very low because of their low abundance in the area and the temporary nature of the actions. The potential direct impacts are listed below:

- Surface water runoff during construction may increase suspended sediment levels near the jetties. Elevated turbidity levels have the potential to disrupt feeding and growth patterns of juveniles (Bjornn and Reiser 1991). No spawning occurs in the project area of Tillamook Jetties, therefore no direct impacts to redds, eggs or alevins are anticipated. The potential impacts are expected to be small because of the erosion and sedimentation control measures that will be used during construction and the duration of the impact.

- Construction activities will cause noise and vibration that may be detected by fish and could alter fish behavior in the action area (EPA 1971). However, these construction activities will be intermittent and short term and are not expected to have a significant impact on listed fish.

4.2 INDIRECT EFFECTS

Indirect impacts of construction activities on listed species include the loss and degradation of rearing habitat. The actions described above are expected to have no indirect effects.

4.3 INTERRELATED AND INTERDEPENDENT EFFECTS

Interrelated actions include that are part of a larger action and depend on the larger action for justification. Interdependent actions are defined as actions with no independent utility apart from the proposed action. The actions described above do not represent a new level of service, or require new roads. The proposed project is expected to have long-term benefits to listed species by decreasing the risks associated with jetty erosion.

4.4 CUMULATIVE EFFECTS

Cumulative effects are defined as the effects of future state, local or private activities that are reasonably certain to occur. No projects are known in the foreseeable future in the vicinity of the proposed project area.

5. CONSERVATION MEASURES

A number of conservation measures have been incorporated into the project to minimize the impacts to the riparian and aquatic resources. These measures include:

- Spill control planning (SCP) and best management practices (BMP) will be used to manage spillage of construction toxicants.

- On-site contractors shall not "harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct" of any listed species that occur within the project vicinity.

- Material used during the construction will be stockpiled away from construction sites.

- Fueling of construction equipment will not occur in the construction area.

- Equipment will not be stored within the construction site overnight.

6. DETERMINATION OF EFFECT

The United States Army Corps of Engineers, Portland District, has made the following determination of effect for endangered and threatened species reviewed under this biological assessment.

6.1 LISTED SPECIES

Based on the review of existing conditions and analysis of likely effects of the proposed project, we believe that a determination of "may effect, but is not likely to adversely affect" is appropriate for the following listed species:

Humpback whale (*Megaptera noraeangliae*), Endangered

Blue whale (*Balaenoptera musculus*), Endangered
Finback whale (*Balaenoptera physalus*), Endangered
Sei whale (*Balaenoptera borealis*), Endangered
Sperm whale (*Physeter macrocephalus*), Endangered
Leatherback turtle (*Dermochelys coriacea*), Endangered
Loggerhead turtle (*Caretta caretta*), Threatened
Stellar sea lion *(Eumetopias jubatus*), Threatened

7. REFERENCES

Brown, R.F., 1988. Assessment of Pinniped Populations in Oregon. Oregon Department of Fish and Wildlife report to National Marine Fisheries Service, Seattle, WA.44 pp. NMFS. 1990. Listing of Steller Sea Lions as Threatened and Endangered Species With Protective Regulations. Federal Register 50 CFR Part 227. Pp 12645-12661.

Ferrero, R.C., D.P. Demaster, P.S. Hill, M.M. Muto, and A.L. Lopez. 2000. Memorandum NMFS-AFSC-119, 191p.

Green, G. A., M. L. Bonnell, K. C. Balcomb, D. E. Bowlby, R.A.Grotefendt, and D. G. Chapman. 1989. Synthesis of information on marine mammals of the eastern North Pacific, with emphasis on the Oregon and Washington OCS area. Section 4, pp. -116, In: Brueggeman, J. J. (ed.). Oregon and Washington marine mammal and seabird surveys: Information synthesis and hypothesis formulation. Final Report prepared by Envirosphere Co., Bellevue, WA and Ecol. Consulting, Inc., Portland, OR for Minerals Management Service, Pacific OCS Region. OCS Study MMS 89-0030. 374pp.

Green, G. A., J. J. Brueggeman, C. E. Bowlby, R. A. Grotefendt, M. L. Bonnell and K. T. Balcomb, III. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Final Report prepared by Ebasco Environmental, Bellevue, WA, and Ecological Consulting, Inc., Portland, OR for the Minerals Management Service, Pacific OCS Region, OCS Study MMS 91-0093. 100pp.

Knutsen, Chris. 1999. Personal Communication. Habitat Protection Biologist, Oregon Department of Fish and Wildlife, North Coast Fish and Wildlife District. Letter to Robin Leighty, U.S. Army Corps of Engineers. 17 June 1999.

Maser, C., B.R. Mate, J.F. Franklin, and C.T. Dyrness. 1981. Natural history of Oregon coast mammals. PNW Forest and Range Exper. Stat., USDA, USFS, Gen. Tech. Rep. PNW-133.

National Marine Fisheries Service. 1995. Status review of the United States Steller sea lion *(Eumetopias jubatus)* population. Prepared by the National Marine Mammal Laboratory, AFSC, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115 61 pp.

Oregon Department of Fish and Wildlife (ODFW), 1990. Northern (Steller) Sea Lion Garners Concern. Wild Flyer, vol. 1,no.2, June 1990.

Roffe, T.J. and B.R. Mate, 1984. Abundances and Feeding Habits of Pinnipeds in the Rogue River, Oregon. J. Wildl. Manage. 48(4):1262-1274.

BIOLOGICAL ASSESSMENT

FOR THE

TILLAMOOK MAJOR MAINTENANCE STUDY
TILLAMOOK COUNTY, OREGON

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT

November 2003

EXECUTIVE SUMMARY

Tillamook Bay, designated as a Safe Harbor, is located along the Oregon coast approximately 50 miles south of the Columbia River, in Garibaldi, Oregon. The north and south jetties, at the entrance to the bay, have experienced progressive loss in stability and length due to the Pacific Northwest's severe winter storms and harsh weather, most recently during the winter storm season of 2002/2003, resulting in hazardous navigation conditions over the bar into the channel. The wave conditions on the ebb tidal shoal force boaters using the entrance to use a channel called the "South Hole." This route forces the boats to leave and enter the channel with the waves hitting broadside to the boat, placing the vessel in a dangerous position. This becomes more dangerous because of remnant jetty stone that lies under water just seaward of the exposed end of the south jetty (Figure 1).

An Environmental Assessment (EA) was prepared for the Tillamook North Jetty Rehabilitation in 1990. Both jetties have experienced progressive loss in length since then, most notably from the winter storms of 1996 and 2002/2003. The north jetty was constructed between 1913-1917, and has been extended six times since then. The south jetty, constructed between 1969-1971, has undergone two extensions since that time. Currently, the damage to the north jetty head has resulted in a 384-foot loss and a 666-foot loss to the south jetty.

Another cause of concern is erosion of the shoreline along the north jetty in terms of a potential breach at the jetty root. The area has a smaller cross-section and the proximity of the deep channel (40 ft) to this section of jetty is of increasing concern. During the summer of 2001, riprap was placed along the north side of the north jetty (near the root), yet stability of the primary dune was not addressed. The recent winter storm period (2002/2003) has caused concern from both local government as well as the U.S. Coast Guard (USGS) regarding the continued deterioration of the north jetty root. There is a Coast Guard watchtower located adjacent to the north jetty that the Coast Guard fears will be lost to waves attacking the tower base if no action is taken.

This Biological Assessment (BA) was prepared in accordance with Section 7 of the Endangered Species Act (ESA) to evaluate the effects of the proposed maintenance project on federally listed species. Conservation measures are also identified in the BA to avoid and minimize adverse effects of the proposed actions. Also, included in this document is an assessment of project effects on Essential Fish Habitat (EFH) as required under the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act.

In assessing the effects of the proposed project on listed and candidate species, the environmental baseline for the project area and a document evaluating how the proposed action would affect the environmental baseline was done. To ensure a thorough review of all the habitat pathways and indicators that could impact fish, we followed the methods outlines in *"Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale"* (NOAA Fisheries 1996). Emphasis of the effects analysis was placed on effect of suspended sediments/turbidity associated with the physical disturbance of the waterway

since this was considered the most likely impact. Direct, interrelated, interdependent and cumulative effects of the various project components were also considered.

Based on the analysis of the effects and consideration of conservation measures that would be implemented to avoid and reduce effects, we determined that the proposed project actions "may affect, but is not likely to adversely" effect with regard to the following listed species:

Oregon coastal coho salmon (*Oncorhychus kisutch*), Threatened

1. INTRODUCTION

The purpose of this BA is to address the potential impacts on listed species and their critical habitat resulting from the proposed jetty maintenance project. The U.S. Army Corps of Engineers (USACE) prepared this BA in compliance with requirements of Section 7(c) of the Endangered Species Act (ESA) as amended. Section 7 assures that, through consultation (or conferencing for proposed species) with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic Atmospheric Administration (NOAA) Fisheries, federal actions do not jeopardize the continued existence of any threatened or endangered species.

Consultation is accomplished, in part, through this BA, which evaluates the potential effects the proposed maintenance project will have on species that are federally listed under the ESA. Conservation measures are identified in this BA to avoid or minimize any adverse effects of the proposed project on listed species.

The following listed species may occur in the vicinity of the project action areas. Those species under the jurisdiction of the NOAA Fisheries only are addressed in this BA:

1.1 LISTED SPECIES

Oregon coastal coho salmon (*Oncorhychus kisutch*), Threatened

1.2 ESSENTIAL FISH HABITAT

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1801 et seq.) require the identification of Essential Fish Habitat for federally managed fishery species and the implementation of measures to conserve and enhance this habitat. The MSA requires the federally agencies to consult with NOAA Fisheries on activities that may adversely affect EFH (MSA section 305(b)(2)).

The EFH consultation for the proposed project will be completed through the ESA Section 7 consultation in this BA.

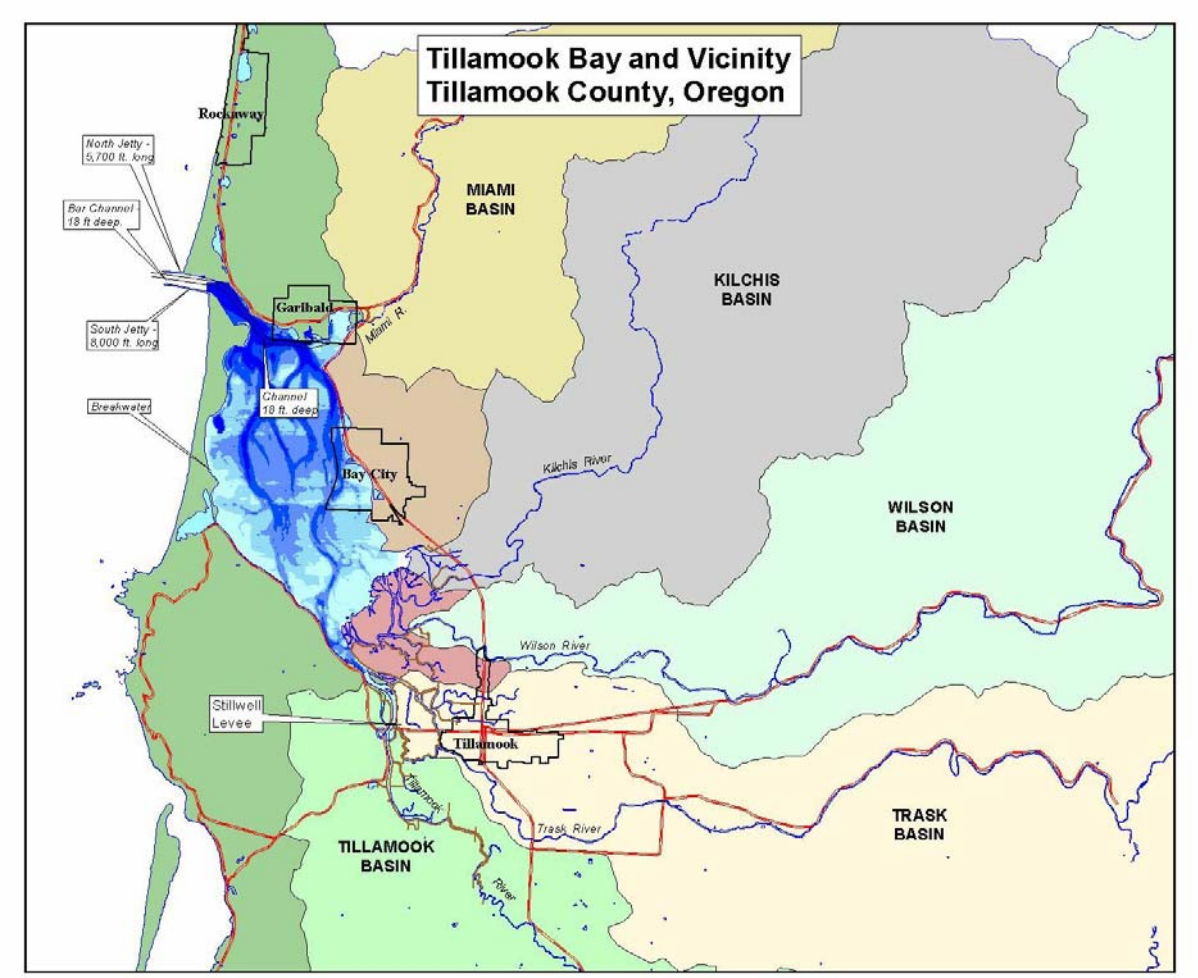

Figure 1. Location of Tillamook Bay and proposed rehabilitation projects to the jetties.

2. PROJECT ALTERNATIVES

Due to projected limited funding to repair the entire project, 2 different capping lengths were estimated, 50 ft and 100 ft. A 100 ft head repair has been standard repair practice in this district and provides for a more reliable long-term fix in the presently increasing Pacific Ocean environment. In addition, trunk repairs were identified as critical or routine. Critical repairs were estimated separately and are located on the north jetty from STA 29+50 to 37+00 and along the south jetty from STA 70+00 to 76+50. Routine trunk repairs are located along the north jetty from STA 22+00 to 29+00 and along the south jetty from STA 44+00 to 58+00. The base condition or "without project" alternative assumes that the existing O&M practices will continue in the absence of major repairs. History has shown that Portland District's normal O&M practices for our coastal jetties involves, at the minimum, stabilizing the jetty head, or capping. The five alternatives are as follows:

1. Alternative 1 – Jetty Caps and Revetment. This is the he minimum maintenance option that would protect the Federal interest. This alternative addresses the areas of greatest concern in terms of structural stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $16.7M. ($12.7 M for 50 ft cap) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

2. Alternative 2 – Jetty Caps, Revetment, and Critical Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, a 650 ft trunk repair to the south jetty from STA 70+00 to 76+50, a 750 ft trunk repair to the north jetty from STA 29+50 to 37+00, and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $34.5M. ($30.5M for 50 ft cap.) This alternative will require a 404(b)1

evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

3. Alternative 3 – Jetty Caps, Revetment, and Critical and Routine Trunk Repairs. This alternative addresses the areas of greatest concern, the jetty ends and the north jetty root, and also addresses trunk repairs that are important for structure stability, however, it does not address improving current navigation conditions in the entrance channel. The plan includes 100 ft caps at the ends of the north and south jetties, trunk repairs to the south jetty from STA 70+00 to 76+50 (650 ft in length) and STA 44+00 to 58+00 (1400 ft in length), trunk repairs to the north jetty from STA 29+50 to 37+00 (750 ft in length) and STA 22+00 to 29+50 (750 ft in length), and a revetment at the root of the north jetty. 100 ft caps on the ends of the north and south jetties would leave the jetties 375 ft and 790 ft shorter, respectively, than the authorized lengths for a 2006 construction year. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The estimated cost of the plan is $41.3M. ($37.4M for 50 ft cap.) This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

4. Alternative 4 – Alternative Jetty Lengths, Revetment, and Critical and Routine Trunk Repairs. Plan considers both structural repairs to the jetties and further expands upon navigability of the channel. The preliminary plan calls for a 200-foot extension to the year 2003 end station of the north jetty (55+20) and a 360-foot extension to the year 2003 end station of the south jetty (82+00); repairs to damage areas along both jetties; and a revetment at the root of the north jetty. This plan leaves the north and south jetties 180 ft and 300 ft shorter than the authorized lengths, respectively. The objective of this plan is to increase the stability of the jetties and decrease wave amplification within the navigation channel. This alternative is not fully developed and would require more study to determine a constructible design and appropriate jetty length repair. The south jetty will require a 50-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 5,000 cubic yard of material and a dolphin tie off eastward along the shore. The north side will require a 60-foot long by 50-foot wide pier-type structure made from sheet pile and back filled with approximately 3,500 cubic yard of fill. This north side pier platform is necessary

for a 165 ton land based crawler crane that can reach the off load pad. The revetment along the north jetty root will be 75-foot wide by 300-foot long and require approximately 5000 ton of stones. This work will be coordinated with Oregon Department of Fish and Wildlife (ODFW) district biologists and will not occur during appropriate in-water work period, but will be coordinated with state and federal agencies to minimize impacts to fish, wildlife and habitat. The initial cost estimate is $53M. This alternative will require a 404(b)1 evaluation and state water quality certification for the revetment work and the back filling of the dolphins for off-loading.

5. Alternative 5 – "No Action". The "no action" alternative was reviewed for this study and was determined to be unacceptable due to the danger and risk of jeopardizing the integrity of both jetties. To allow the jetties to continue to deteriorate will eventually lead to an increase in shoaling at the channel entrance. As more of the jetties deteriorate, waves will move further into the navigation channel increasing boating hazards and further de-stabilizing the inner portion of the jetties.

3. SPECIES INFORMATION

3.1 OREGON COAST COHO SALMON

The Oregon Coast Coho Salmon Evolutionary Significant Unit (ESU) includes all naturally spawning populations of coastal coho located between the Columbia River and Cape Blanco, Oregon (Sixes River).

Coho salmon are anadromous; they spend part of their life cycle in both fresh water and salt water. Coho commonly rear in freshwater from one to two years, and then migrate to salt water where they remain for about 18 months prior to returning to fresh water to spawn. Coho typically return to spawn at age three, though two year-old fish are not unusual (Groot and Margolis 1991).

Coho typically hatch after six to eight weeks and emerge from the gravel after a two to three week period (Bjornn and Reiser 1991). After emergence, coho feed on terrestrial and aquatic insects, often selecting prey that drifts on the surface or in the water column (Sandercock 1991). The most productive rearing areas for coho include small streams with sufficient pool and slack water habitats (Beechie et al 1994). Coho will commonly seek refuge in ponds and small tributaries where they avoid being flushed downstream during extreme high-flow events (Bustard and Narver 1975).

The Wilson, Trask, Kilchis, Miami and Tillamook Rivers feed into Tillamook Bay. These streams support populations of coho salmon, winter steelhead, summer steelhead (introduced/hatchery stock), spring and fall chinook salmon, and chum salmon (ODFW 1992, EPA 1998). These waterways are included among those proposed as critical habitat for the

threatened Oregon Coast ESU coho salmon (64 FR 24998). Outmigration of juvenile coho typically extends from September through January (Knutsen, pers.comm.) and adults begin to migrate into the bay in late August.

The proposed project will take place between July and September of 2004, finishing off at a time when migration into the bay is just beginning for adult coho and juvenile coho are migrating to sea. Increased levels of suspended sediments are anticipated during the construction period and may cause coho salmon to avoid these areas. This impact is considered to be minimal due to the dilution and tidal fluctuation during the project period. Therefore, the project may affect, but is not likely to adversely affect Oregon coastal coho salmon.

4. ANALYSIS OF EFFECTS

4.1 DIRECT EFFECTS

The proposed project may cause temporary and short-term impacts to the listed species during project construction. The probability for direct mortality to juveniles or adults of listed salmonids during the proposed project is very low because of their low abundance in the area and the temporary nature of the actions. The potential direct impacts are listed below:

- Surface water runoff during construction may increase suspended sediment levels near the jetties. Elevated turbidity levels have the potential to disrupt feeding and growth patterns of juveniles (Bjornn and Reiser 1991). This impact is considered to be minimal due to dilution and tidal influences. Also, no spawning occurs in the project area of Tillamook Jetties, therefore no direct impacts to redds, eggs or alevins are anticipated. The potential impacts are expected to be small because of the erosion and sedimentation control measures that will be used during construction and the duration of the impact.

- Construction activities will cause noise and vibration that may be detected by fish and could alter fish behavior in the action area (EPA 1971). However, these construction activities will be intermittent and short term and are not expected to have a significant impact on listed fish.

4.2 INDIRECT EFFECTS

Indirect impacts of construction activities on listed species include the loss and degradation of rearing habitat. The actions described above are expected to have no indirect effects.

4.3 INTERRELATED AND INTERDEPENDENT EFFECTS

Interrelated actions include that are part of a larger action and depend on the larger action for justification. Interdependent actions are defined as actions with no independent utility apart from the proposed action. The actions described above do not represent a new level of

service, or require new roads. The proposed project is expected to have long-term benefits to listed species by decreasing the risks associated with jetty erosion.

4.4 CUMULATIVE EFFECTS

Cumulative effects are defined as the effects of future state, local or private activities that are reasonably certain to occur. No projects are known in the foreseeable future in the vicinity of the proposed project area.

5. CONSERVATION MEASURES

A number of conservation measures have been incorporated into the project to minimize the impacts to the riparian and aquatic resources. These measures include:

- Spill control planning (SCP) and best management practices (BMP) will be used to manage spillage of construction toxicants.
- On-site contractors shall not "harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct" of any listed species that occur within the project vicinity.
- Material used during the construction will be stockpiled away from construction sites.
- Fueling of construction equipment will not occur in the construction area.
- Equipment will not be stored within the construction site overnight.

6. ESSENTIAL FISH HABITAT

The Sustainable Fisheries Act of 1996 amended the Magnuson-Stevens Act establishing requirements for EFH. Chinook and coho salmon have designated EFH (Pacific Fisheries Management Council 1999).

Freshwater EFH for chinook and coho salmon consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adults migration corridors and adult holding habitat. Important features of EFH for spawning, rearing and migration include adequate substrate composition, water quality (dissolved oxygen, nutrients, temperature, etc.), space, access and passage, and flood plain habitat connectivity. Based historic and current channel structure drawings, habitat types and

proximity to Tillamook Bay and those five rivers that flow into it, the area is prime migration corridor for juvenile and adult salmon.

The proposed project will reduce the risk of erosion of both the north and south jetties. Based on EFH requirements of chinook and coho salmon, the potential direct, indirect, and cumulative effects of the proposed maintenance project are not likely to adversely affect any identified EFH for the action are evaluated.

7. DETERMINATION OF EFFECT

The United States Army Corps of Engineers, Portland District, has made the following determination of effect for endangered and threatened species reviewed under this biological assessment.

7.1 LISTED SPECIES

Based on the review of existing conditions and analysis of likely effects of the proposed project, we believe that a determination of "may effect, but is not likely to adversely affect" is appropriate for the following listed species:

Oregon coastal coho salmon (*Oncorhychus kisutch*), Threatened
Steelhead trout (*Oncorhychus mykiss*), Candidate species

8. REFERENCES

Beechie, T., E. Beamer, and L. Wasserman. 1994. Estimating steelhead salmon rearing habitat and smolt production losses in a large river basin, and implications for habitat restorations. N. Am. J. Fish. Manage. 14:797-811.

Bjorrn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W.R. Meehan (ed.). Influences of forest and rangeland management on salmonid fishes and their habitats. Am. Fish. Soc. Spec. Publ. 19.

Bustard, D.R. and D.W. Narver. 1975. Aspects of the winter ecology of juvenile steelhead salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). J. Fish. Res. Board Can. 32:667-680.

Ferrero, R.C., D.P. Demaster, P.S. Hill, M.M. Muto, and A.L. Lopez. 2000. Memorandum NMFS-AFSC-119, 191p.

Groot, C. and L. Margolis (editors). 1991. Pacific Salmon Life Histories. UBC Press. Vancouver, British Columbia.

Knutsen, Chris. 1999. Personal Communication. Habitat Protection Biologist, Oregon Department of Fish and Wildlife, North Coast Fish and Wildlife District. Letter to Robin Leighty, U.S. Army Corps of Engineers. 17 June 1999.

Sandercock, F. K. 1998. "Life History of Steelhead Salmon (*Oncorhynchus kisutch*)." Pages 397 to 445 *in* C. Groot and L. Margolis eds. *Pacific Salmon Life Histories*. University of British Columbia Press. Vancouver, BC. 564 p.

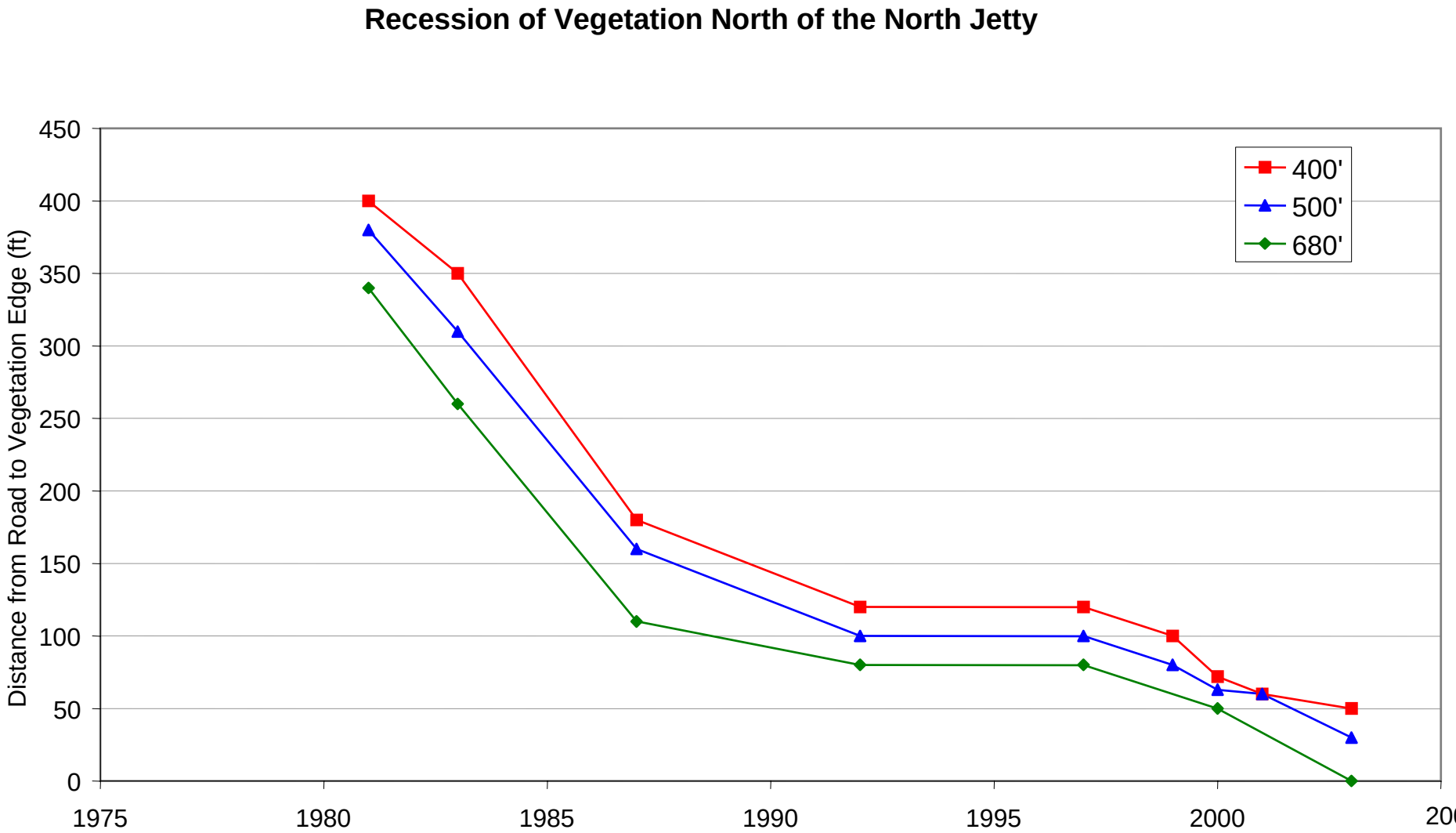

Figure 2-1 Recession of the Vegetation Line north of the North Jetty

Figure 2-2 North Jetty shoreline erosion and riprap placed winter 2001. Photo 1/18/2002

Figure 2-3 North Jetty shoreline erosion and sandbags placed in April 2002. Photo 9/23/2002

Tillamook Entrance

authorized depth
= 18 ft (5.5 m)

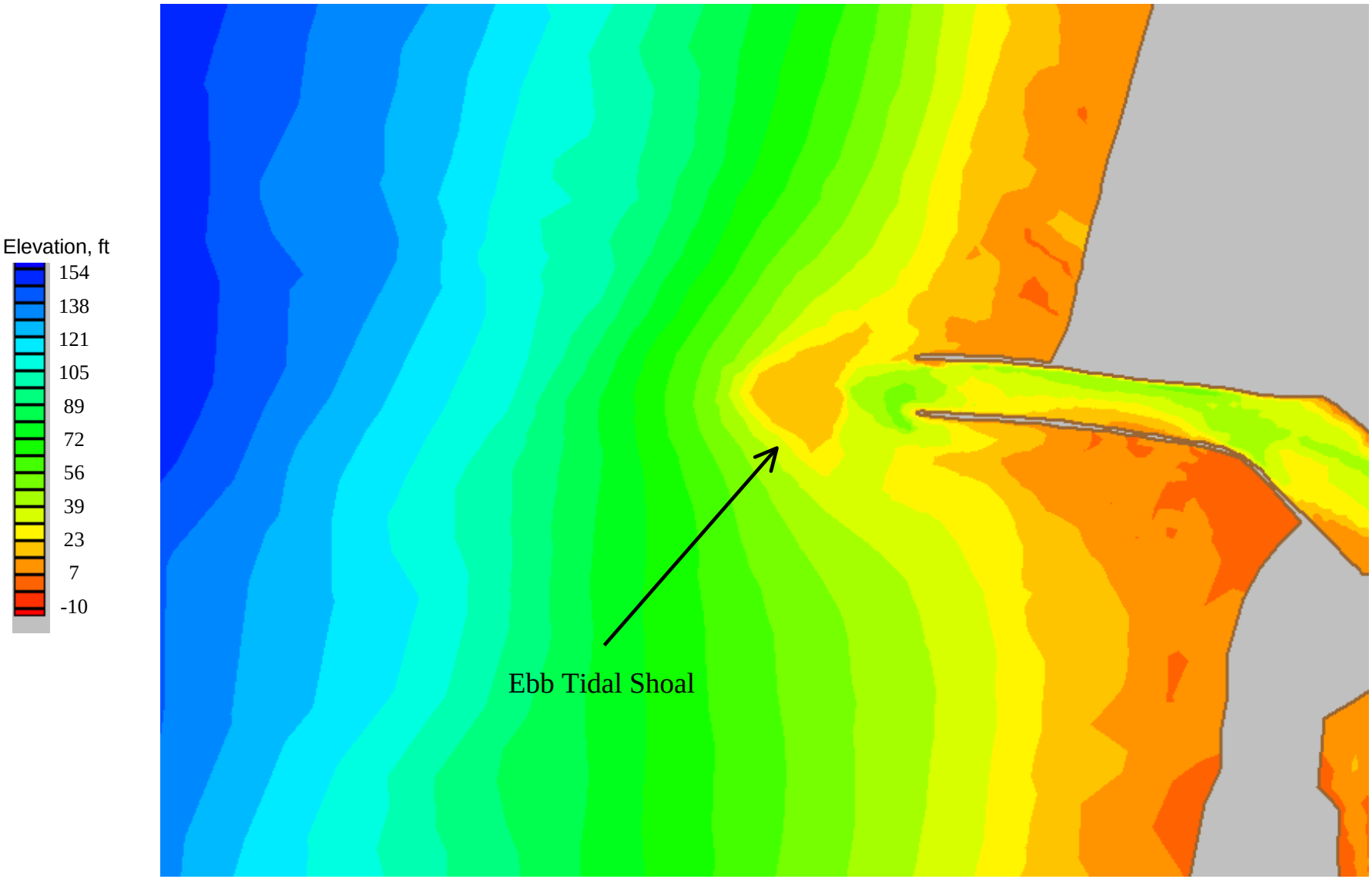

Figure 2-4 Contour map of the Tillamook Entrance

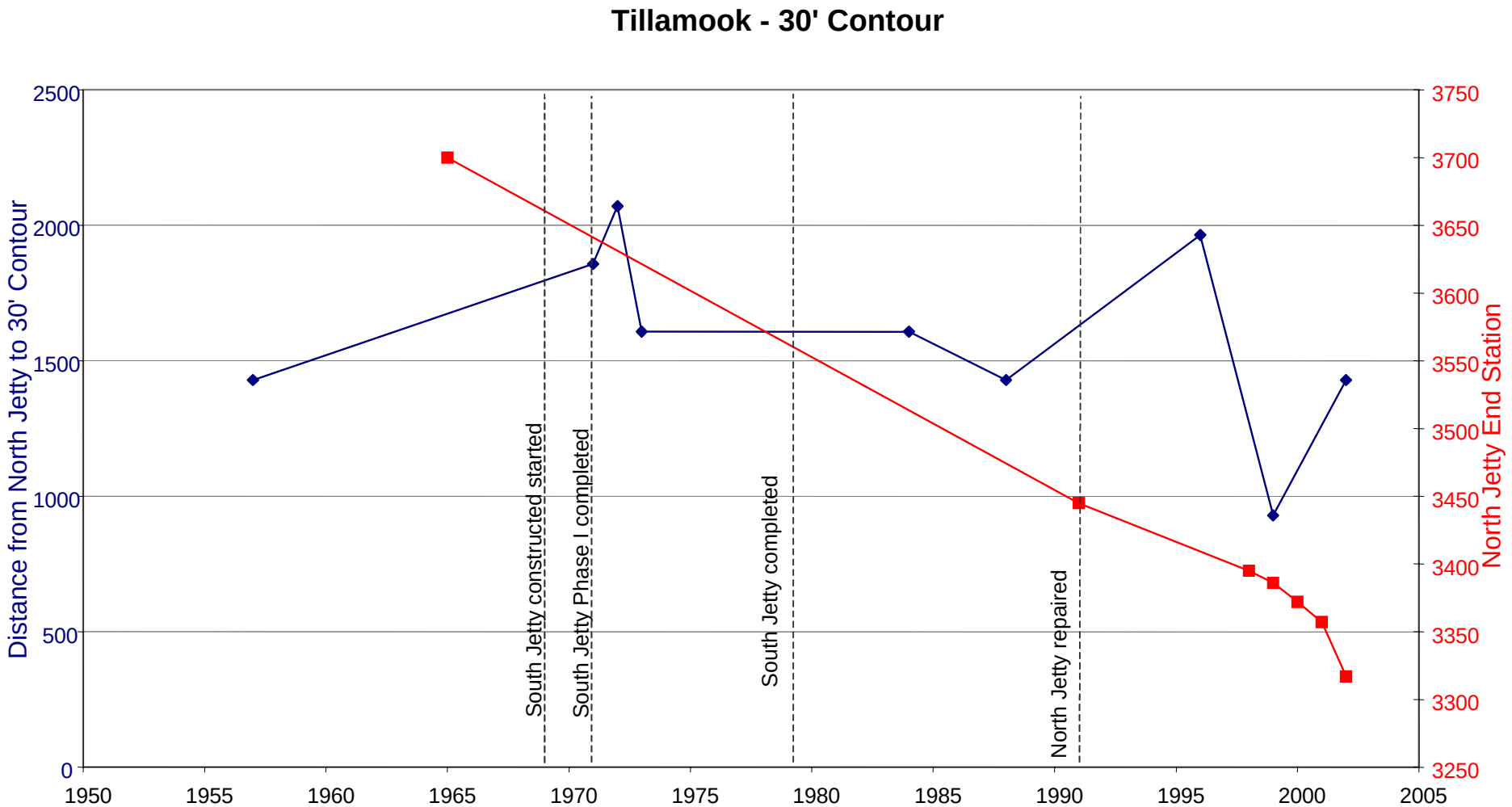

Figure 2-5 Analysis of 30' Depth Contour with change in North Jetty

Tillamook Bay Entrance in 1939 – one jetty system

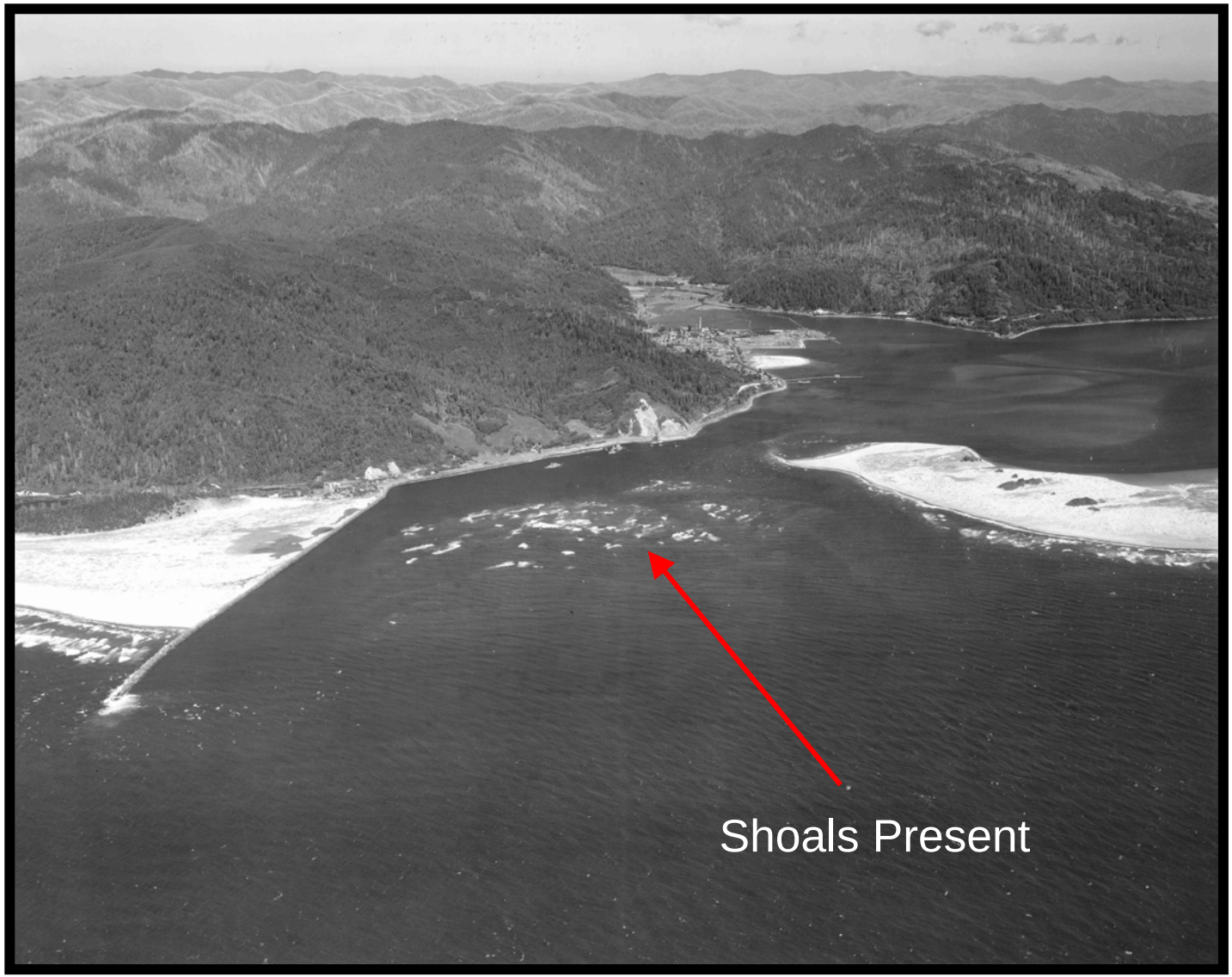

Figure 2-6 Tillamook Entrance in 1939

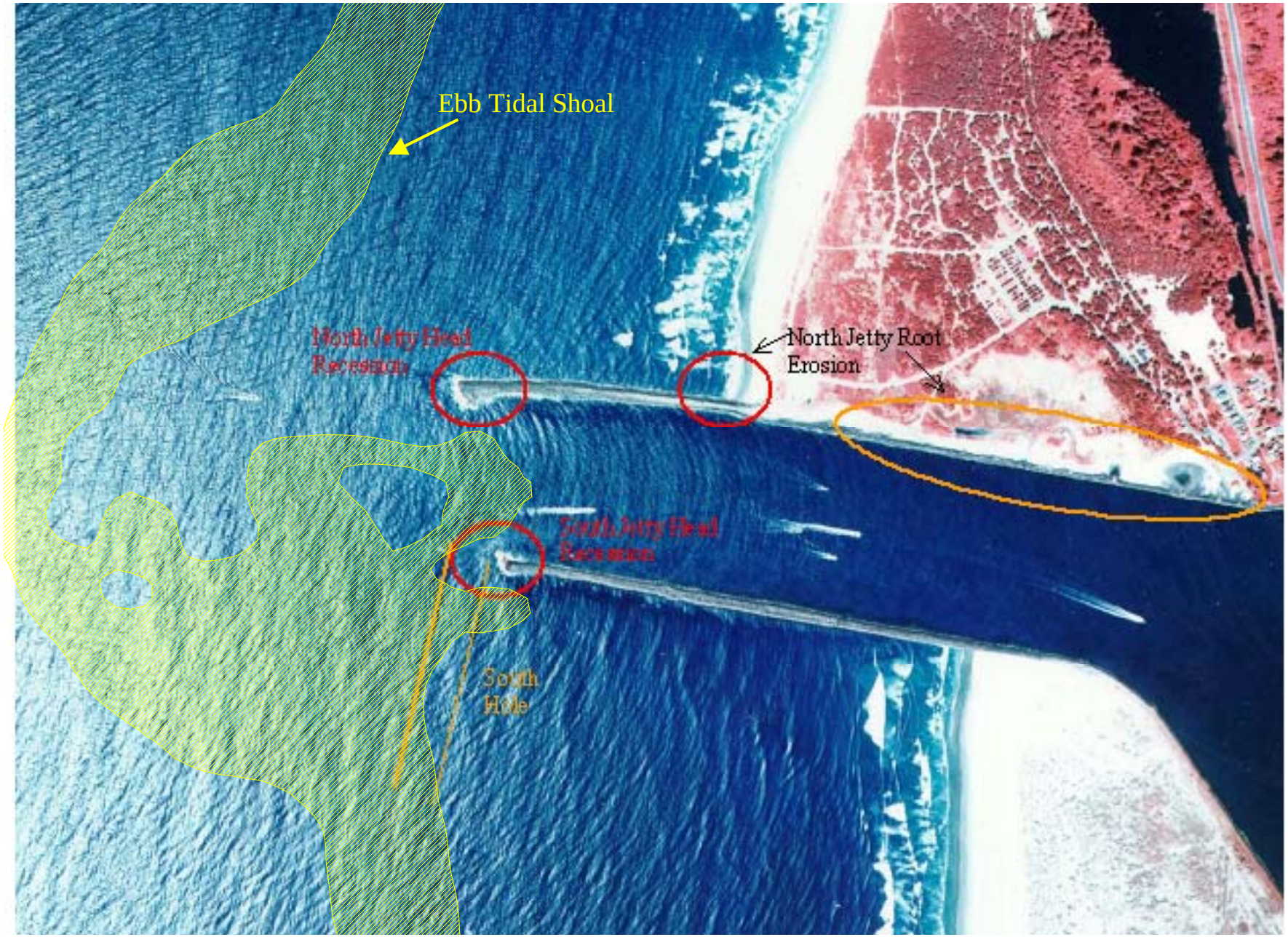

Figure 2-7 Problem Areas Map

Tillamook North Jetty

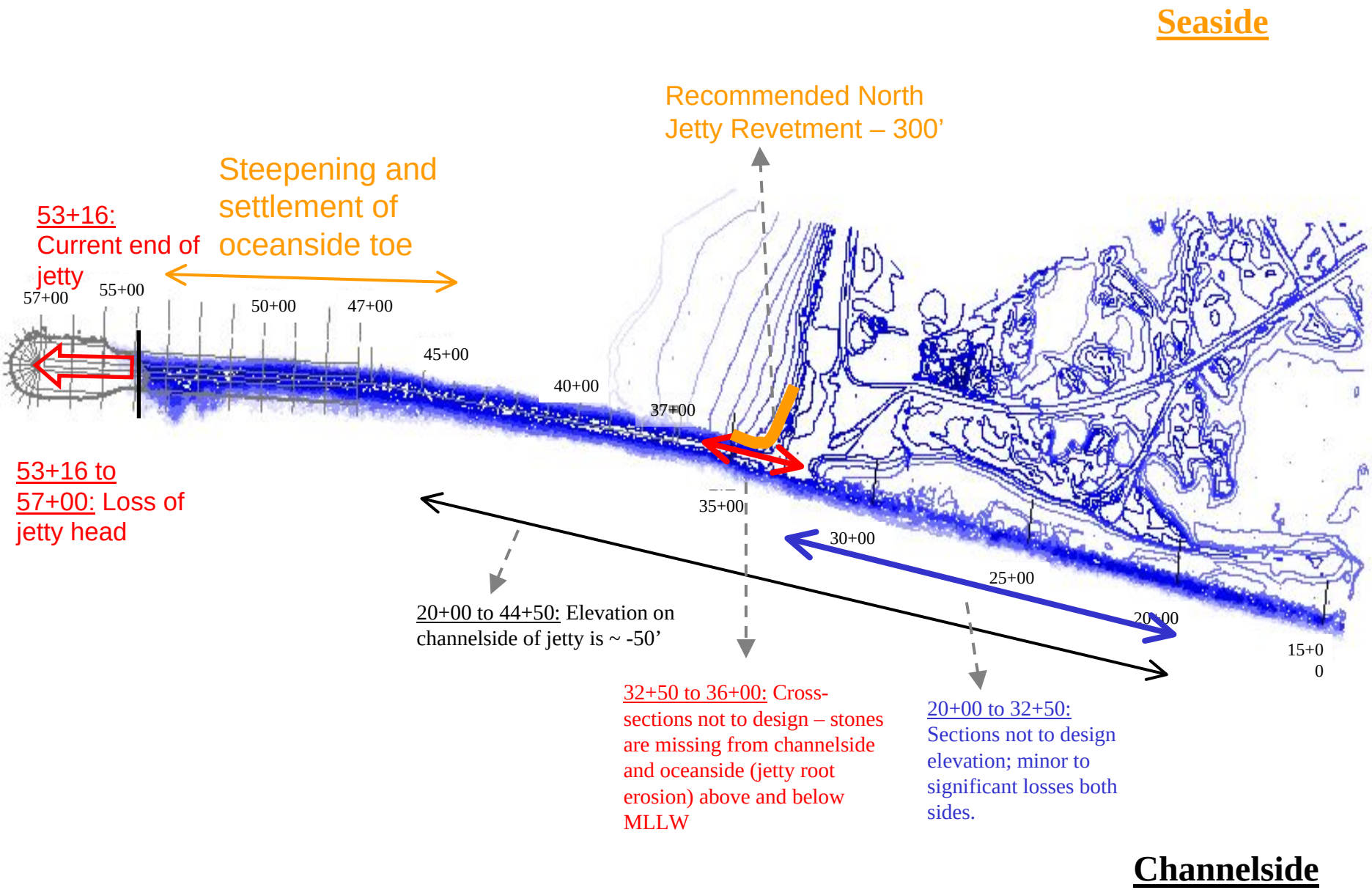

Figure 2-8 North Jetty Damage Areas

Tillamook South Jetty

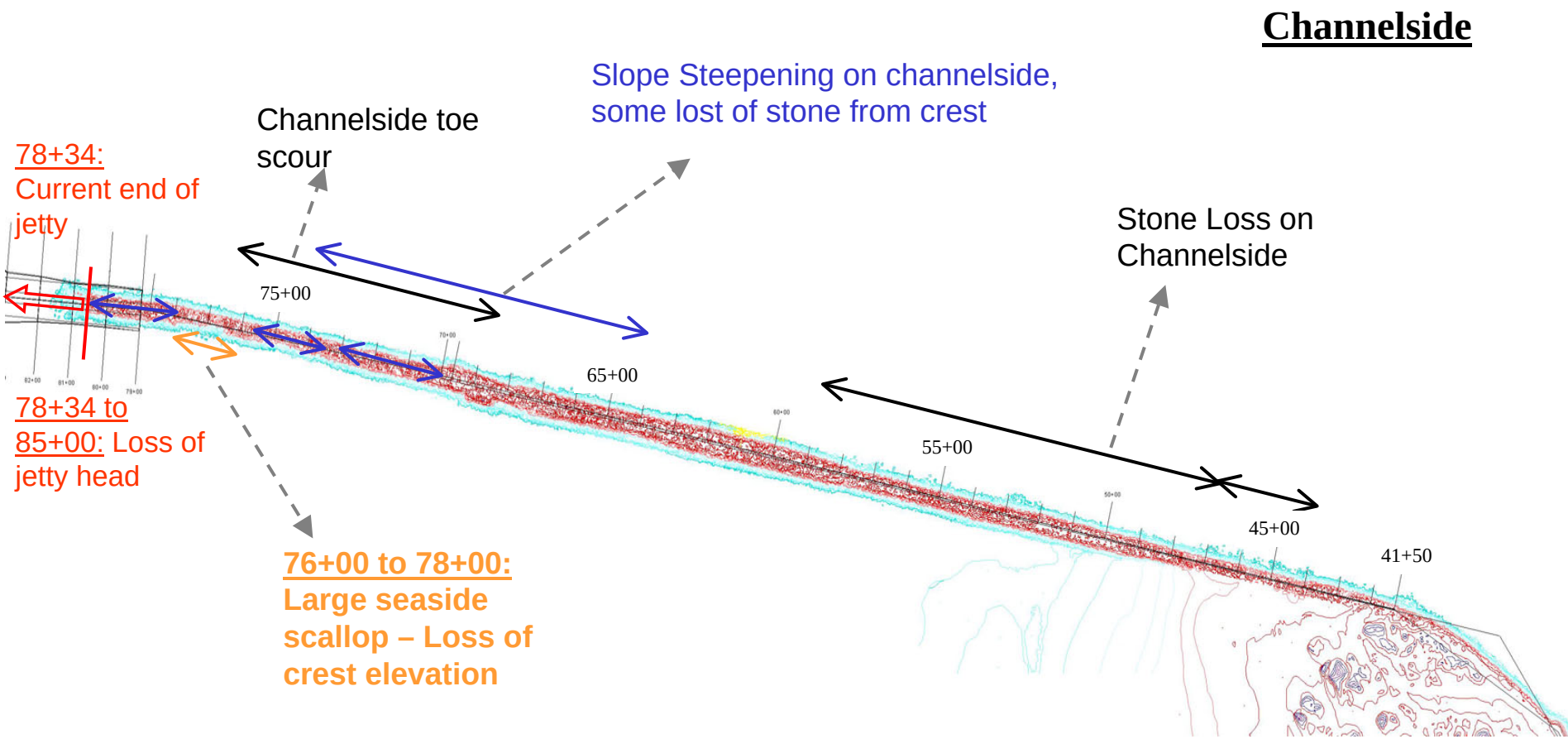

Figure 2-9 South Jetty Damage Areas

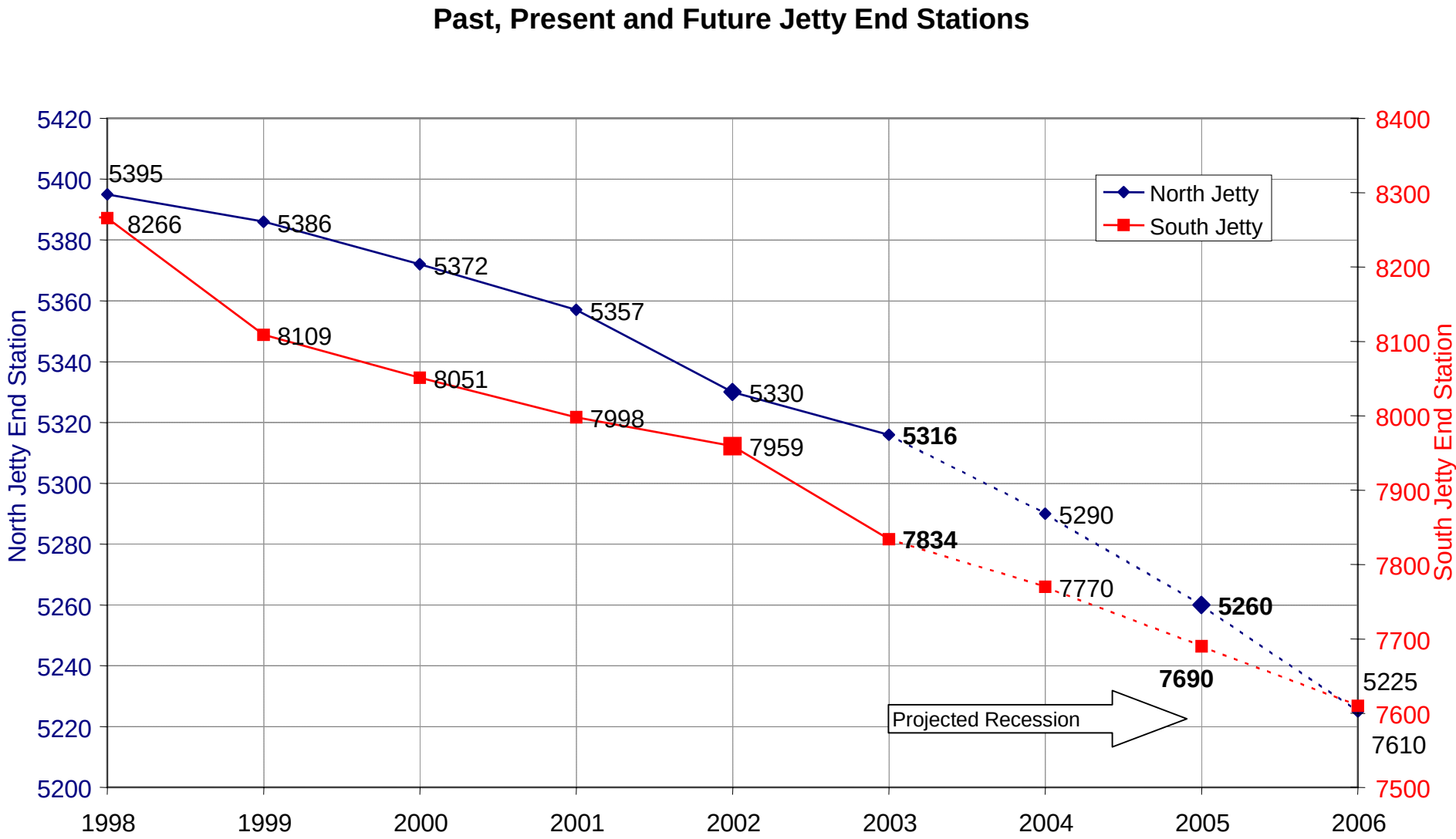

Figure 2-10 Projected Jetty End Stations

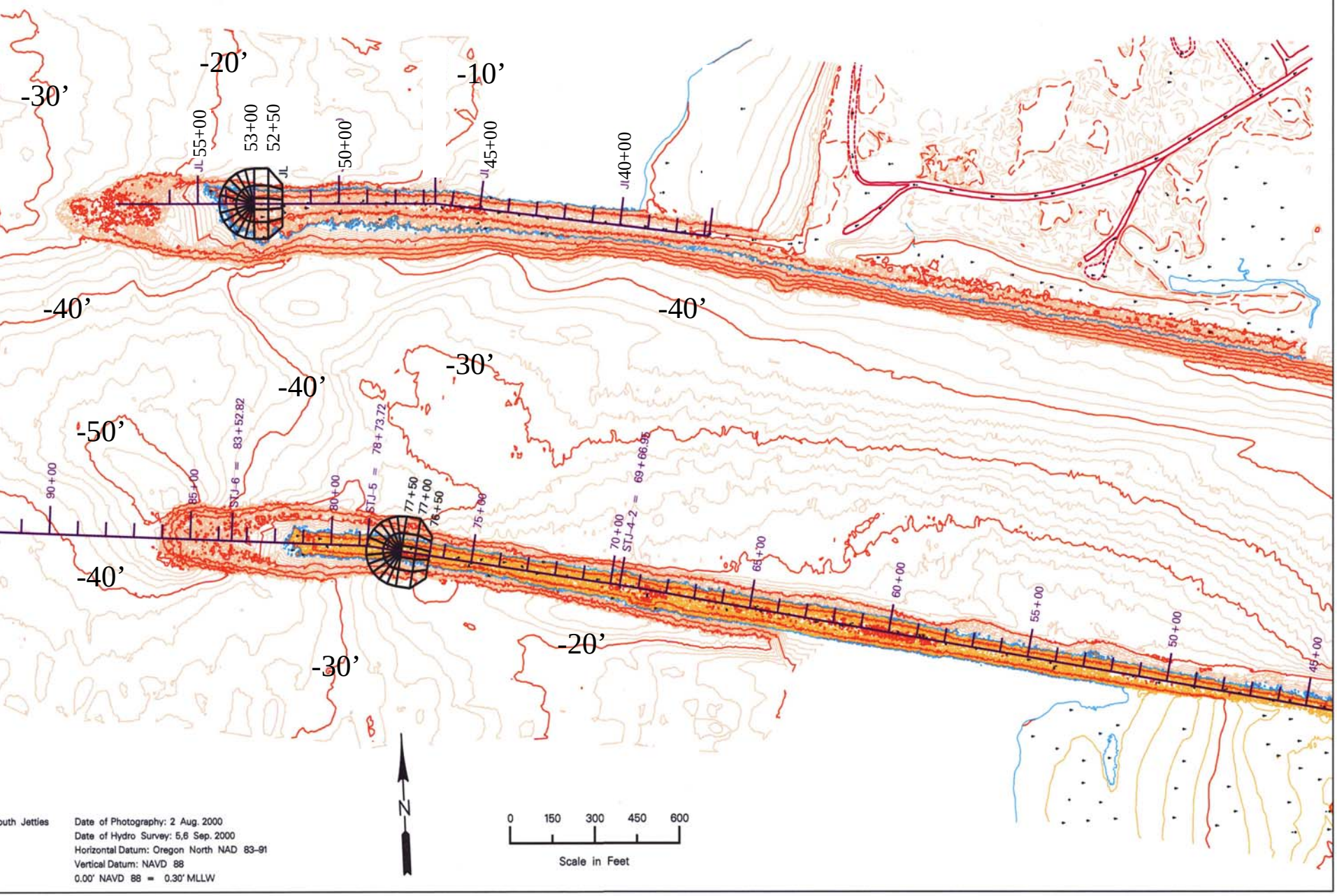

Figure 2-11 Plan layout of 50’ Caps

Survey vertical datum = ft, NAVD88

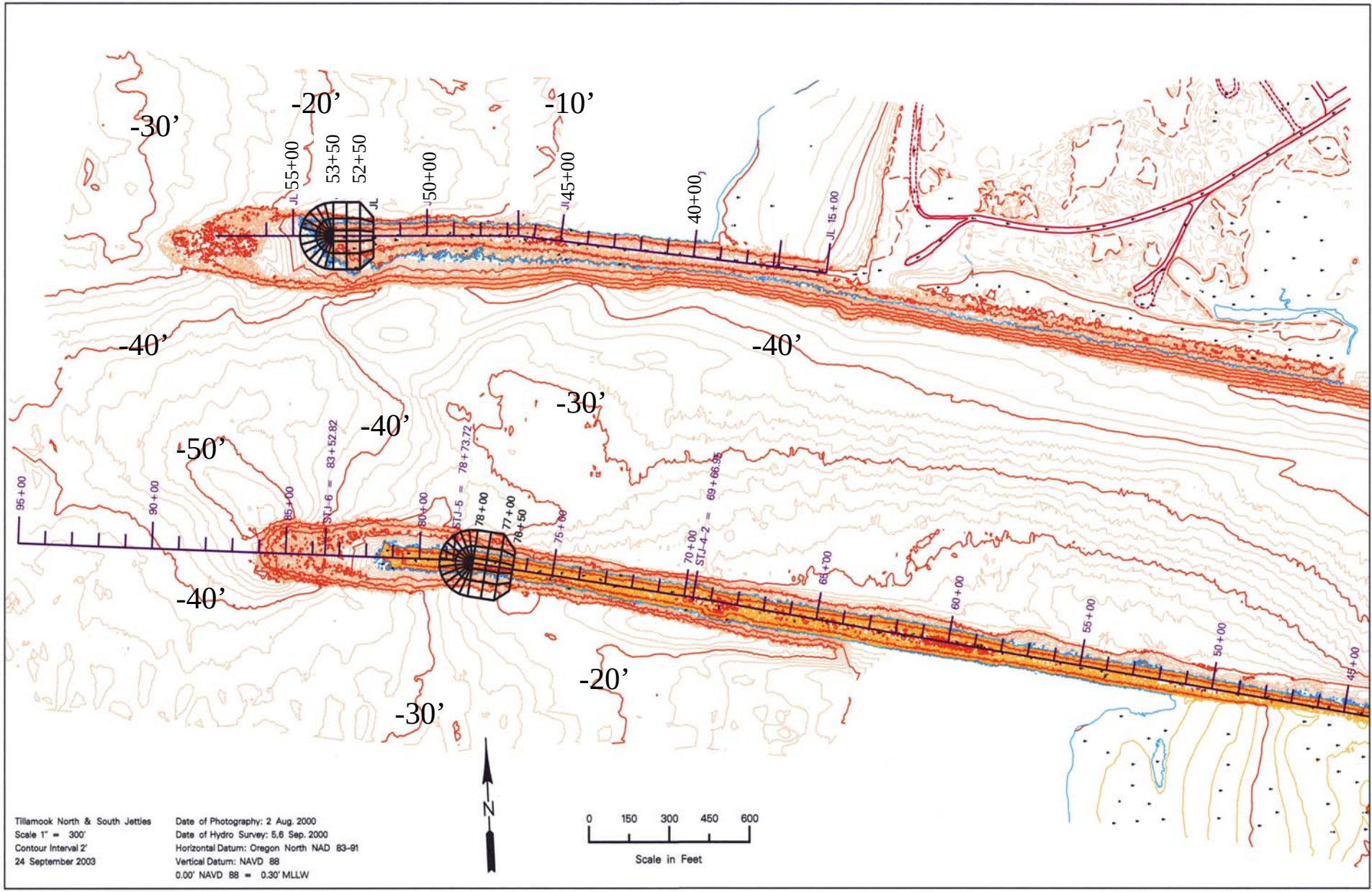

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Figure 2-12 Plan layout of 100’ Caps

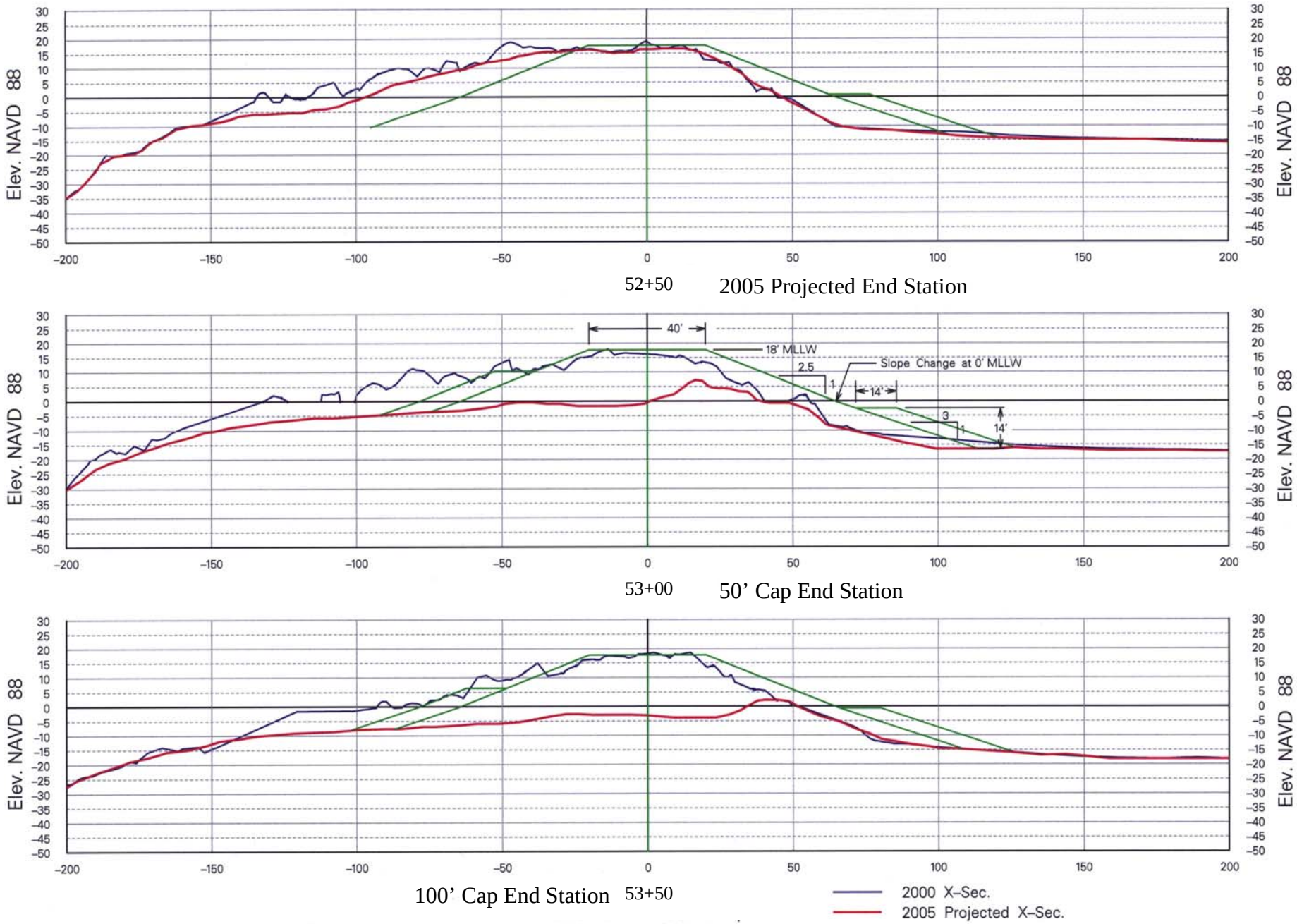
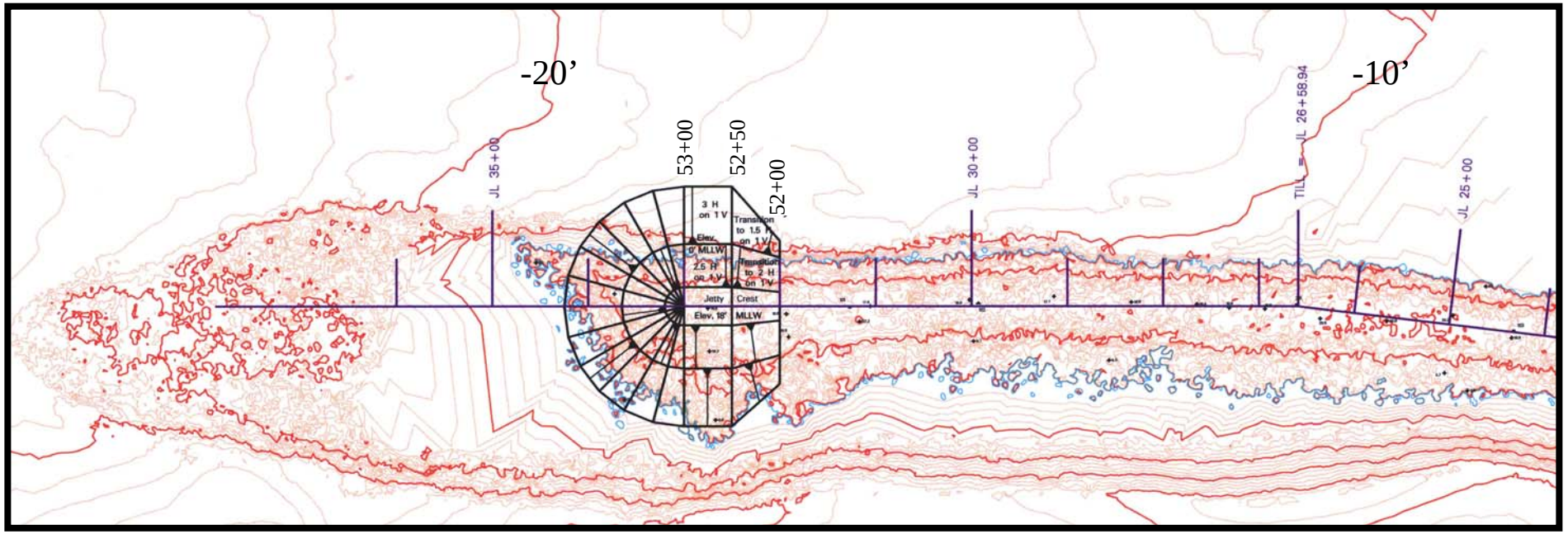
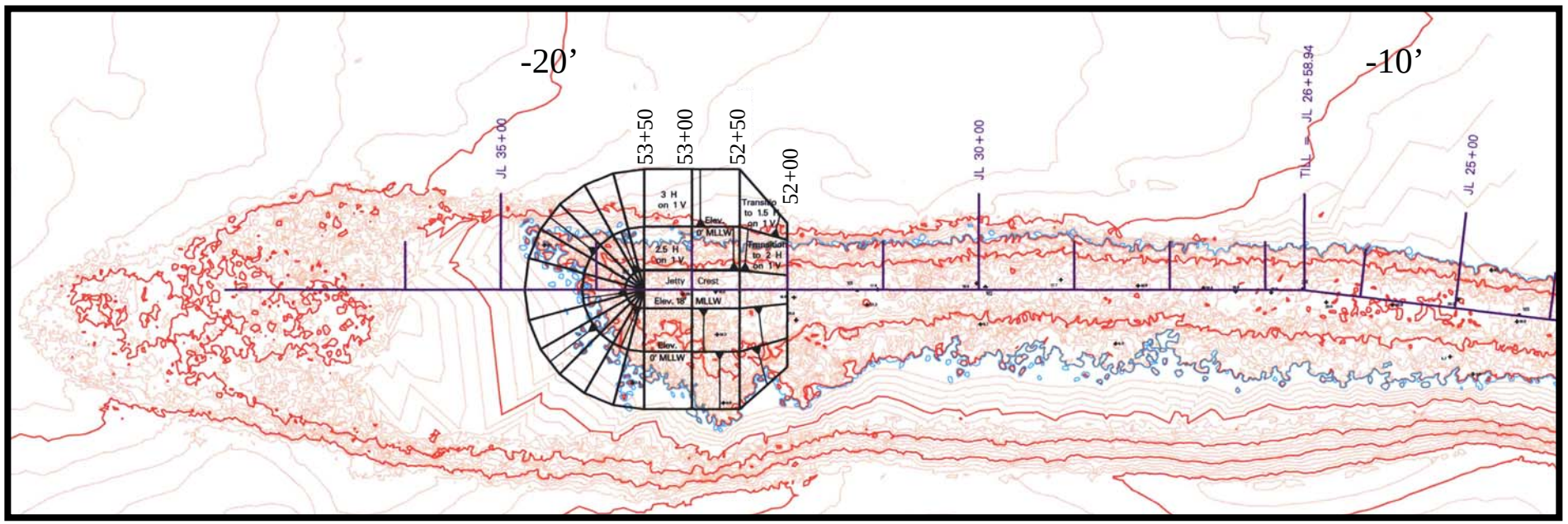


Figure 2-13 North Jetty Capping Designs



North Jetty 50’ Cap



North Jetty 100’ Cap

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Figure 2-14 North Jetty Capping Plan Views

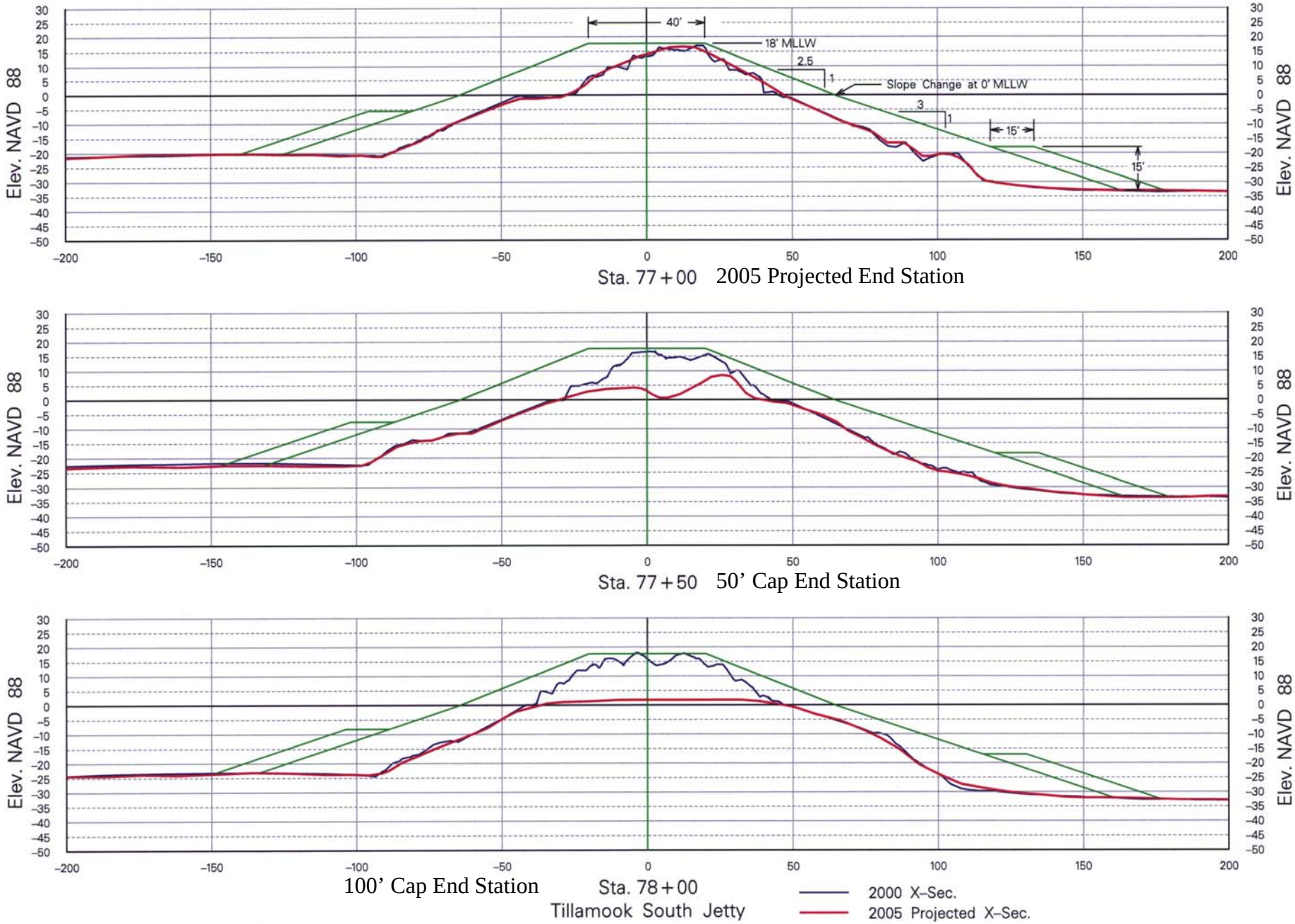
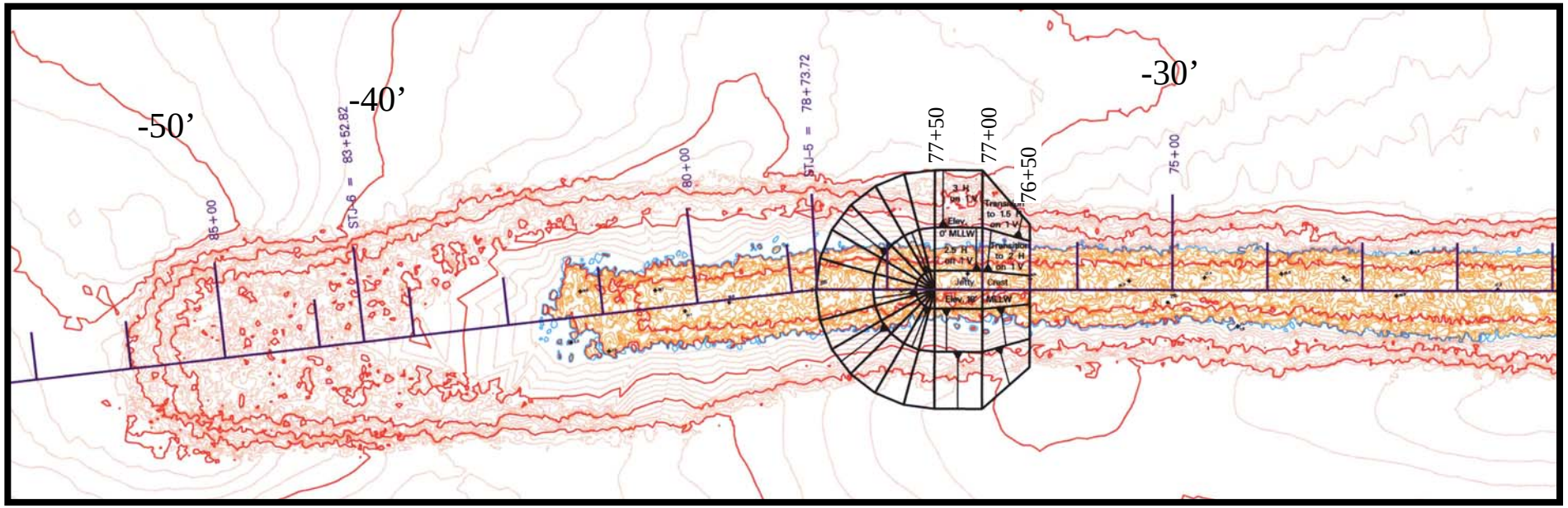
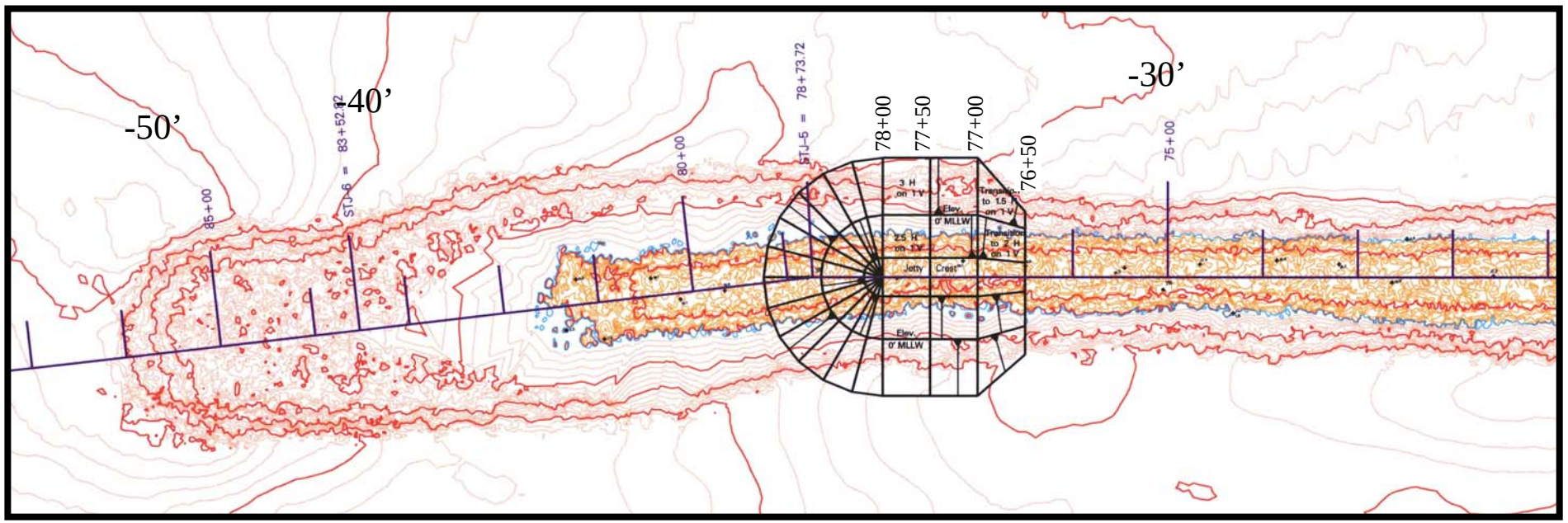


Figure 2-15 South Jetty Capping Designs



South Jetty 50’ Cap



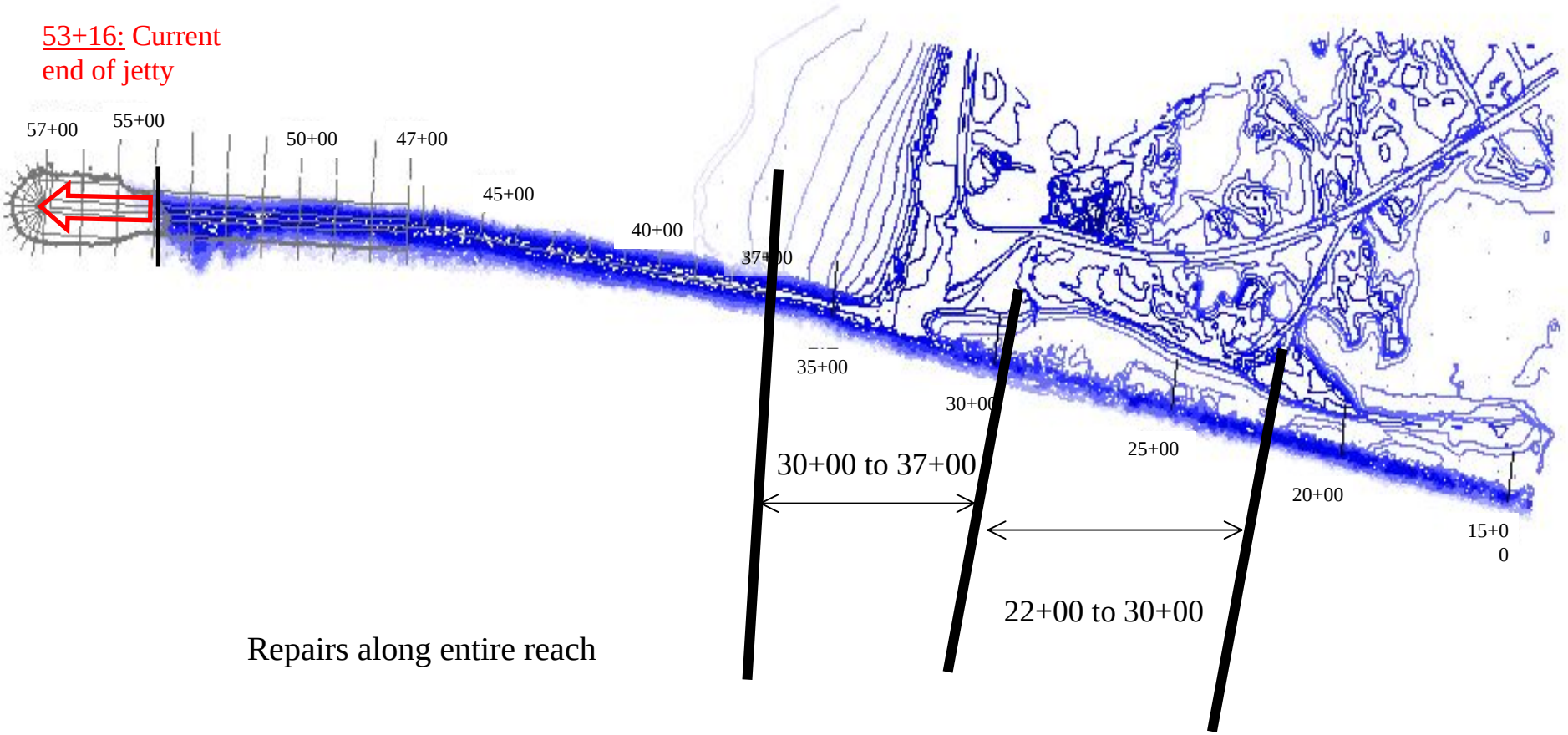
South Jetty 100’ Cap

Survey vertical datum = ft, NAVD88

Figure 2-16 South Jetty Capping Plan Views

Tillamook North Jetty

Seaside



Channelside

Figure 2-17 North Jetty Trunk Repair Reaches

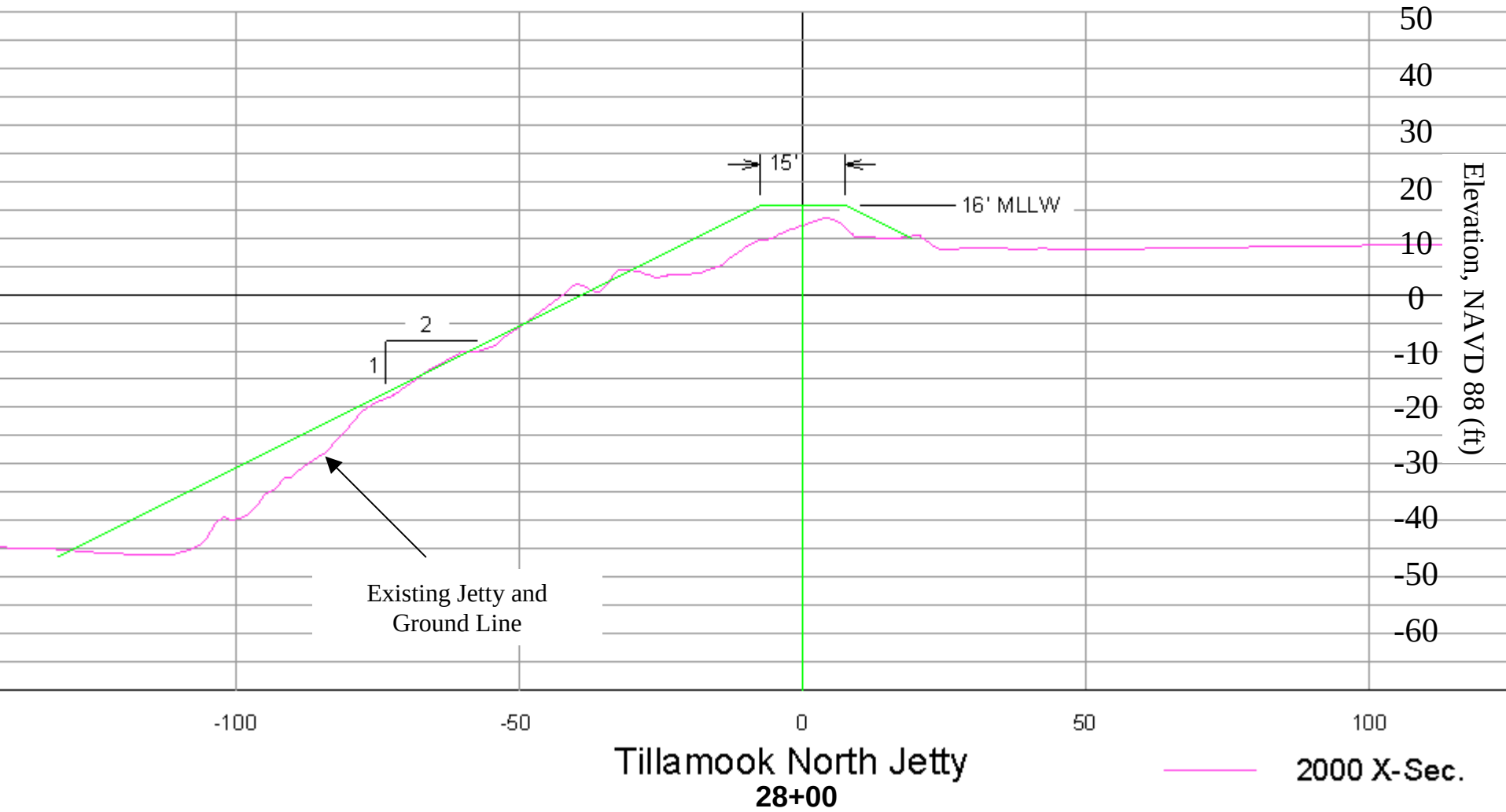


Figure 2-18 Typical Damage and Repair Design for North Jetty STA 22+00 to 29+50

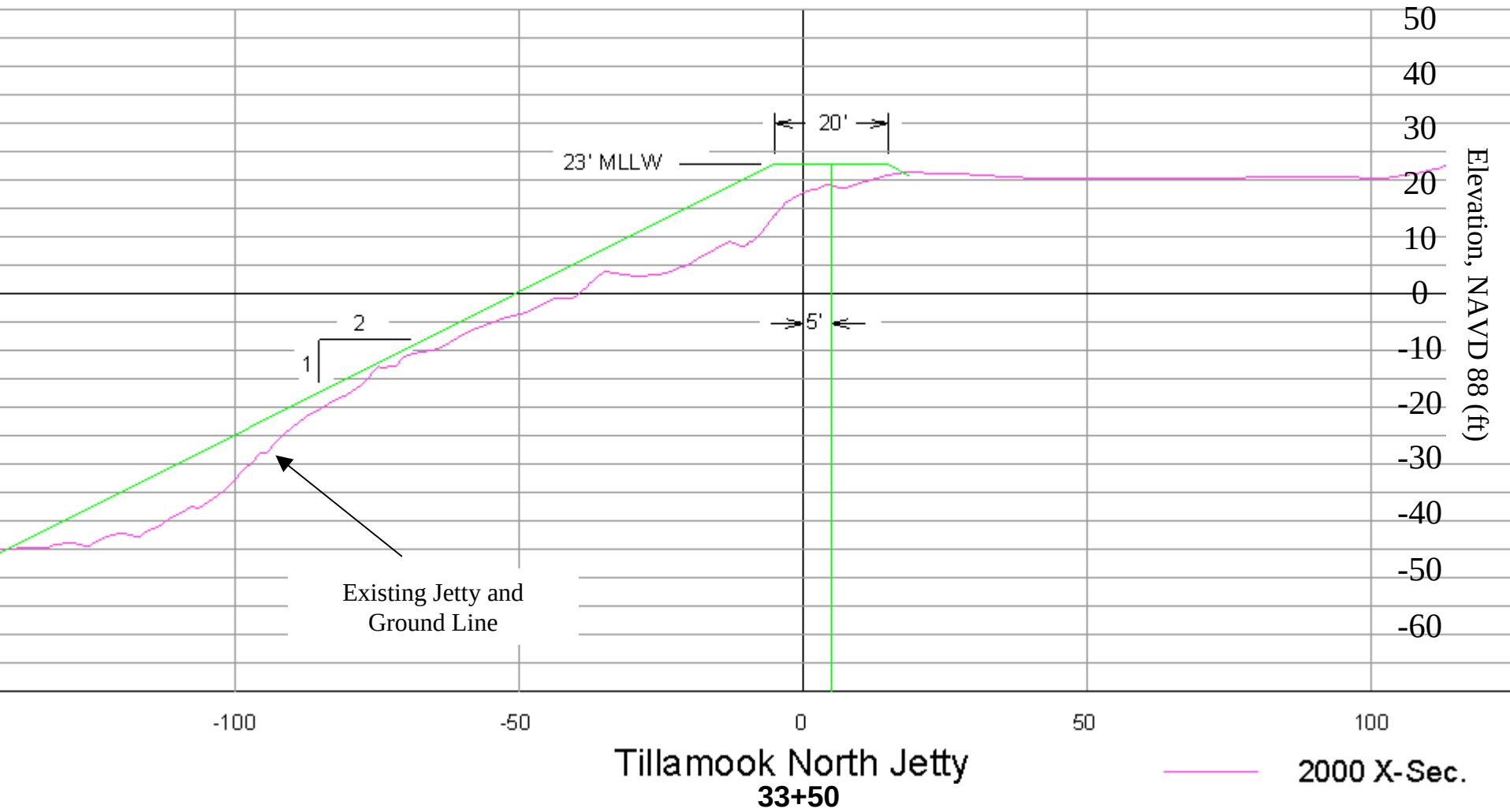
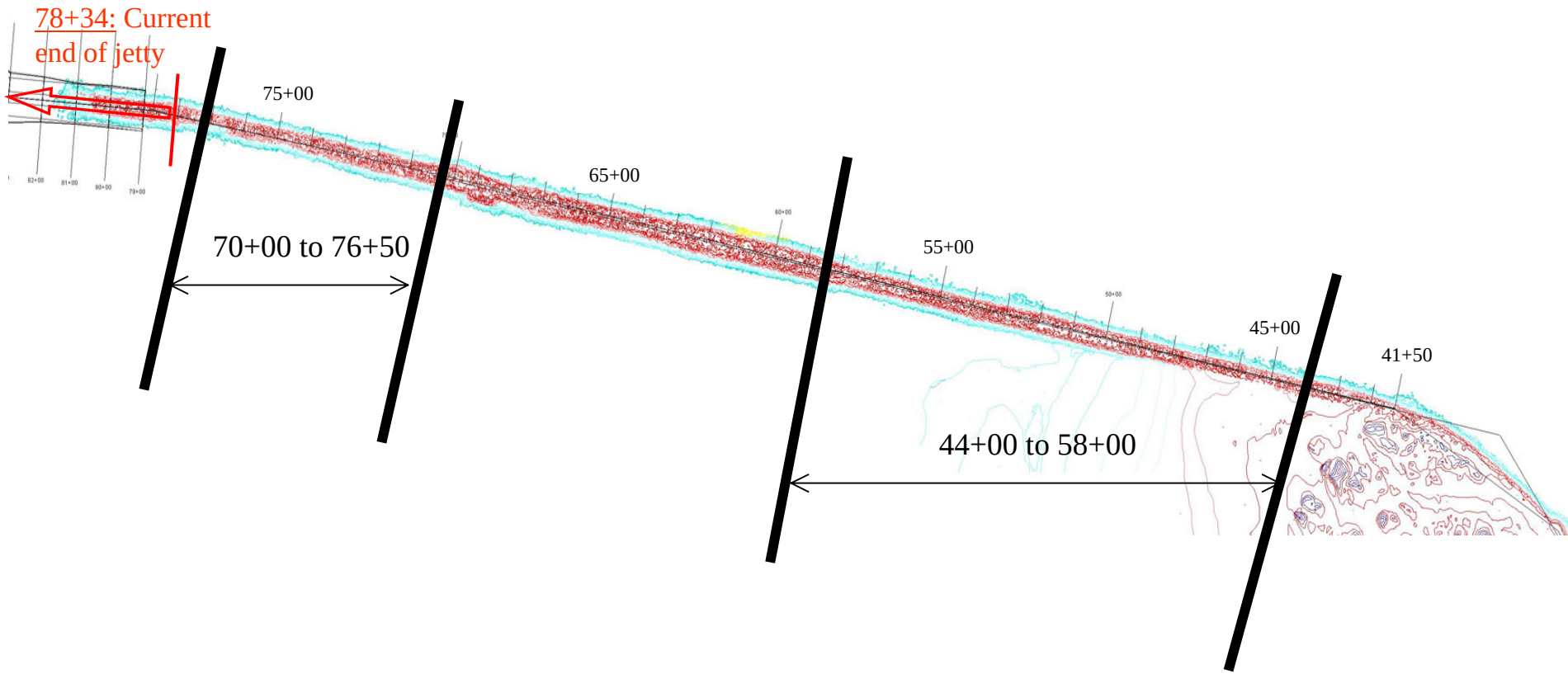


Figure 2-19 Typical Damage and Repair Design for North Jetty STA 30+00 to 37+00

Tillamook South Jetty

Channelside



Seaside

Figure 2-20 South Jetty Trunk Repair Reaches

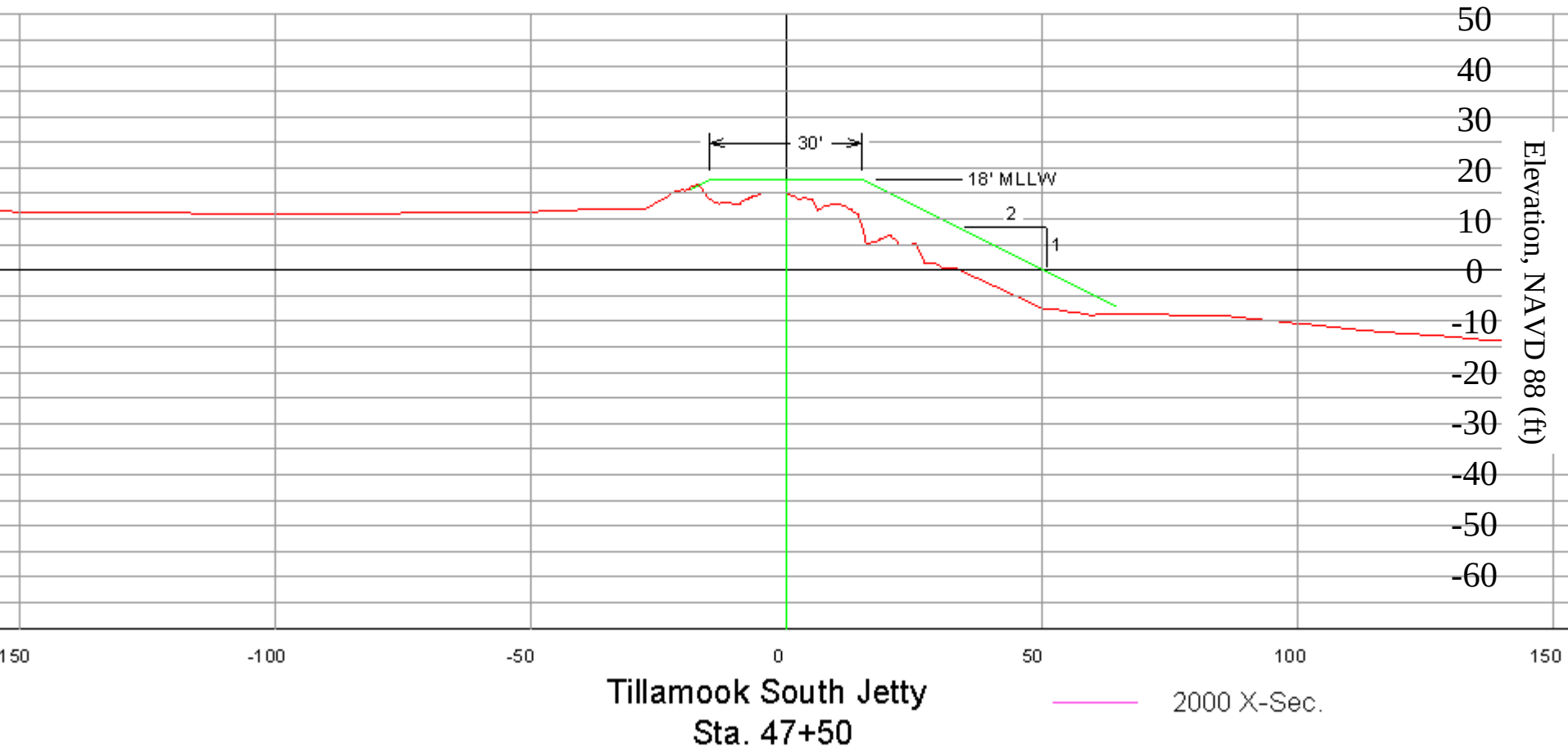


Figure 2-21 Typical Damage and Repair Design for South Jetty STA 44+00 to 58+00

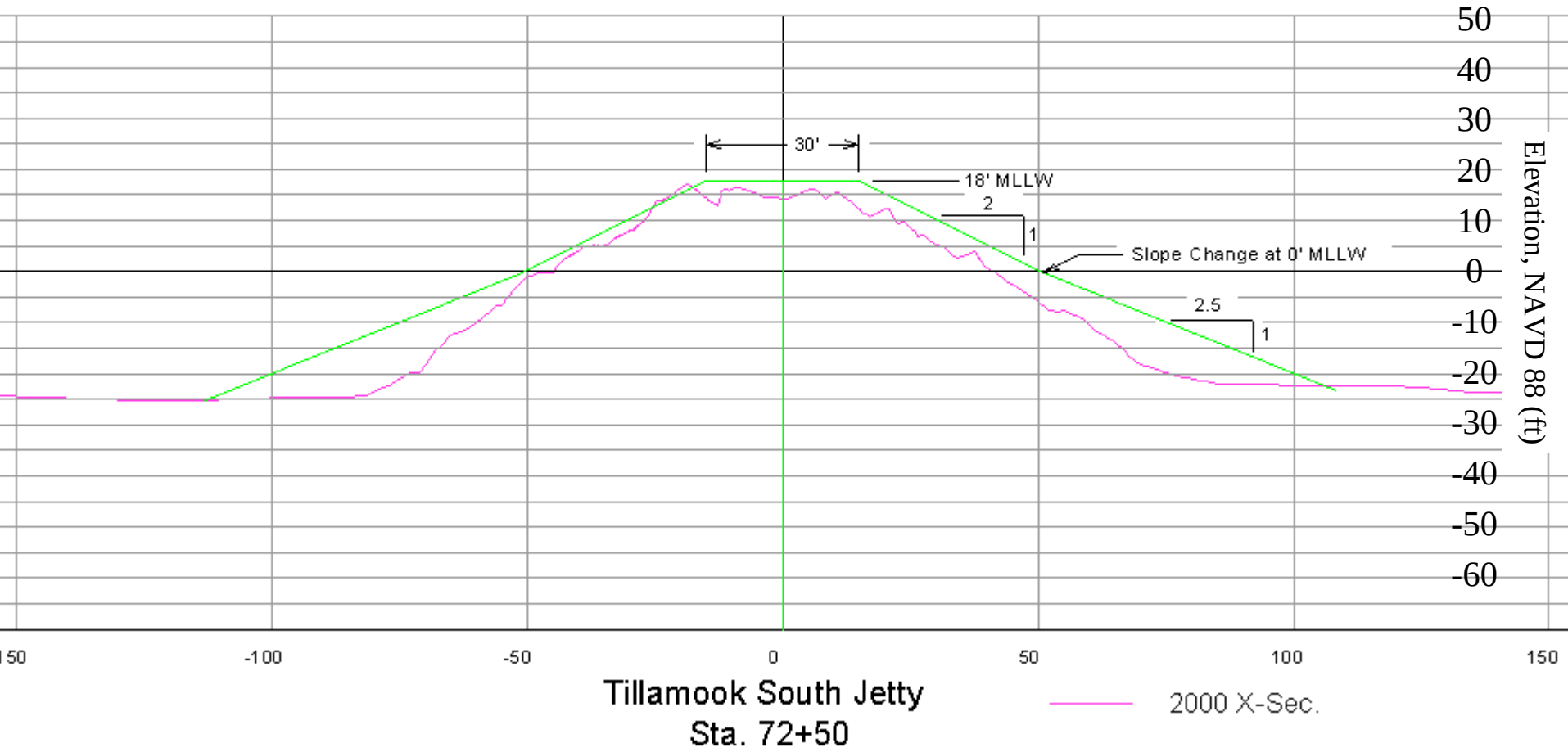


Figure 2-22 Typical Damage and Repair Design for South Jetty STA 70+00 to 74+00

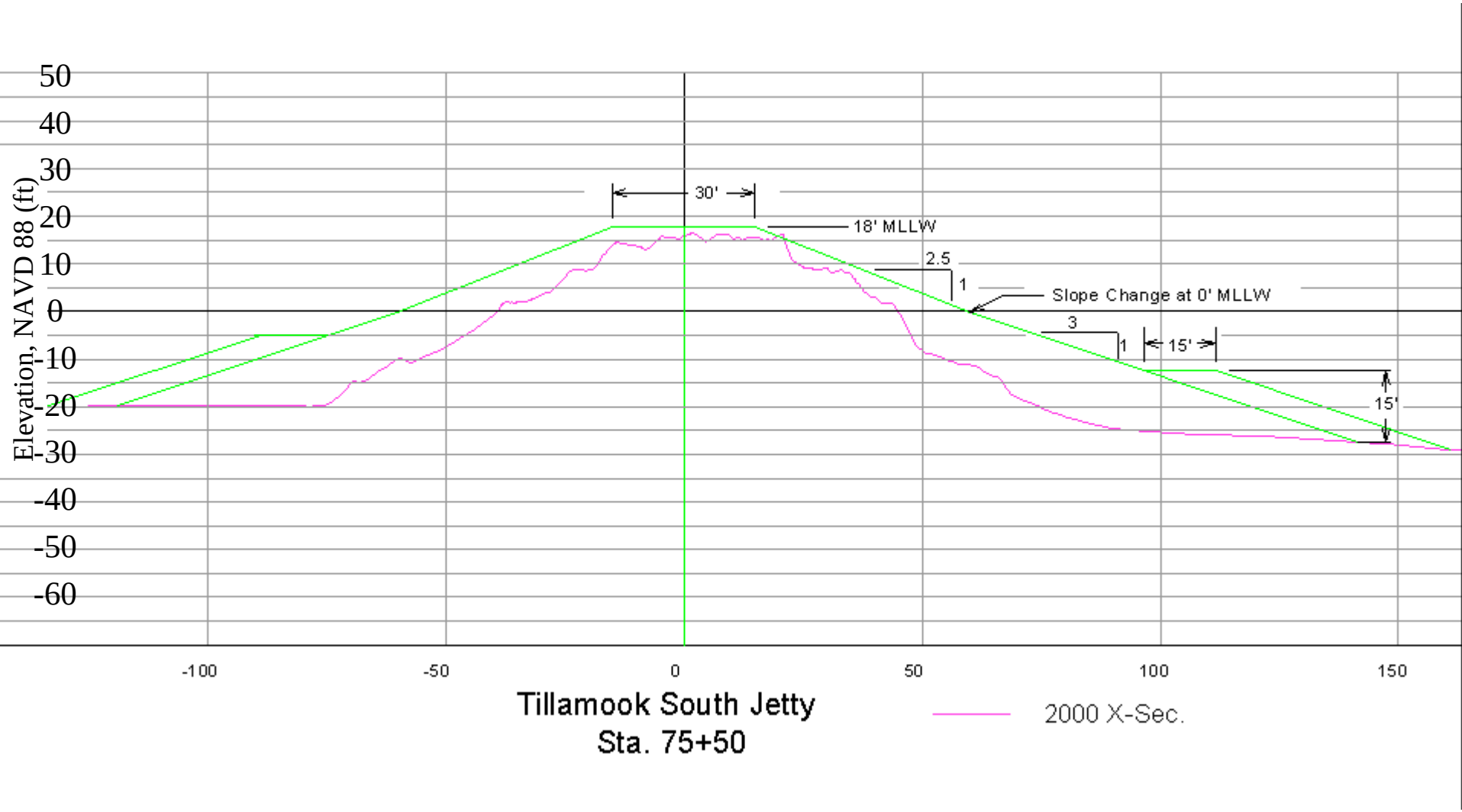


Figure 2-23 Typical Damage and Repair Design for South Jetty STA 74+00 to 77+00

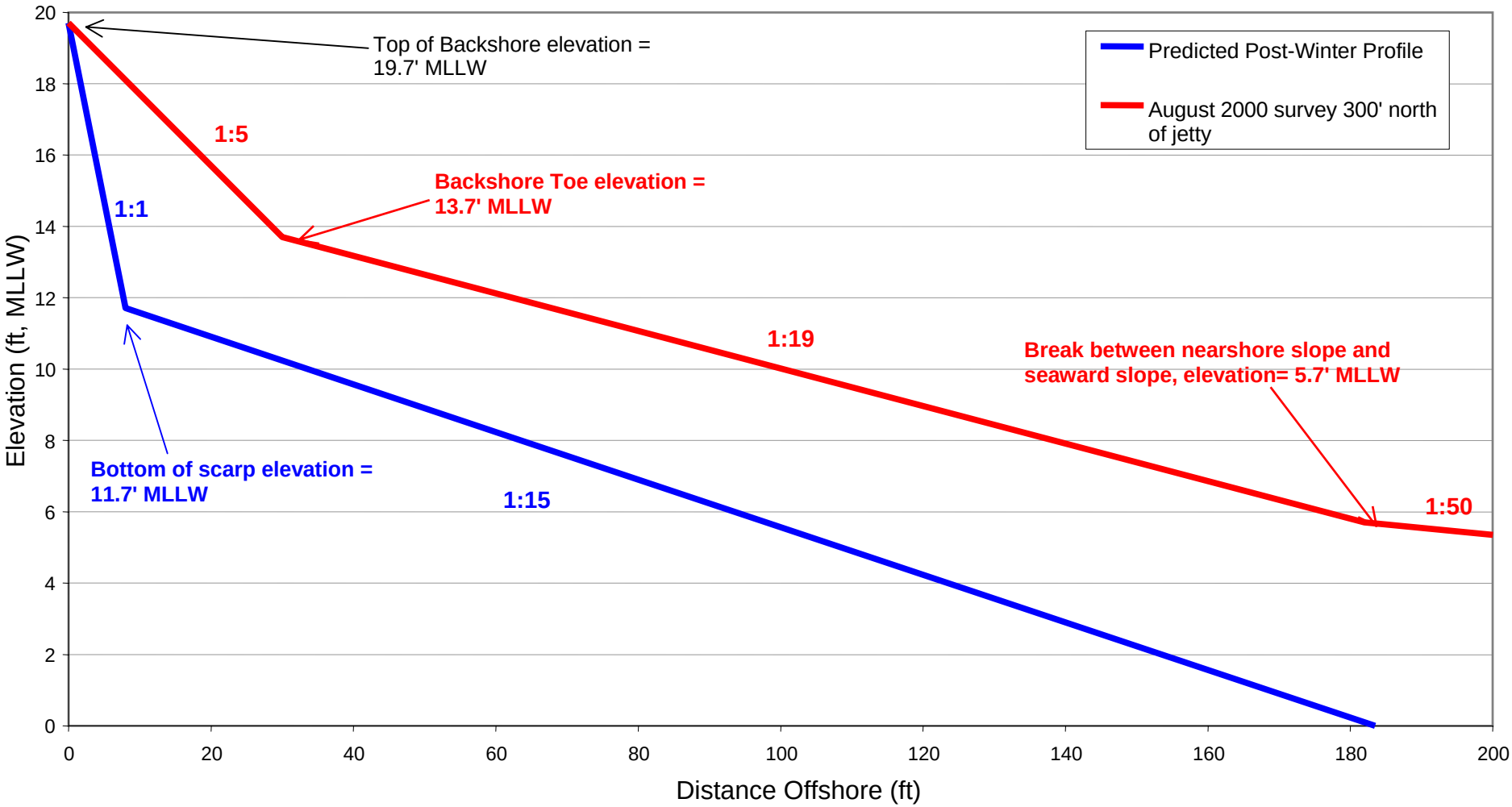


Figure 2-24 Shoreline north of the north jetty

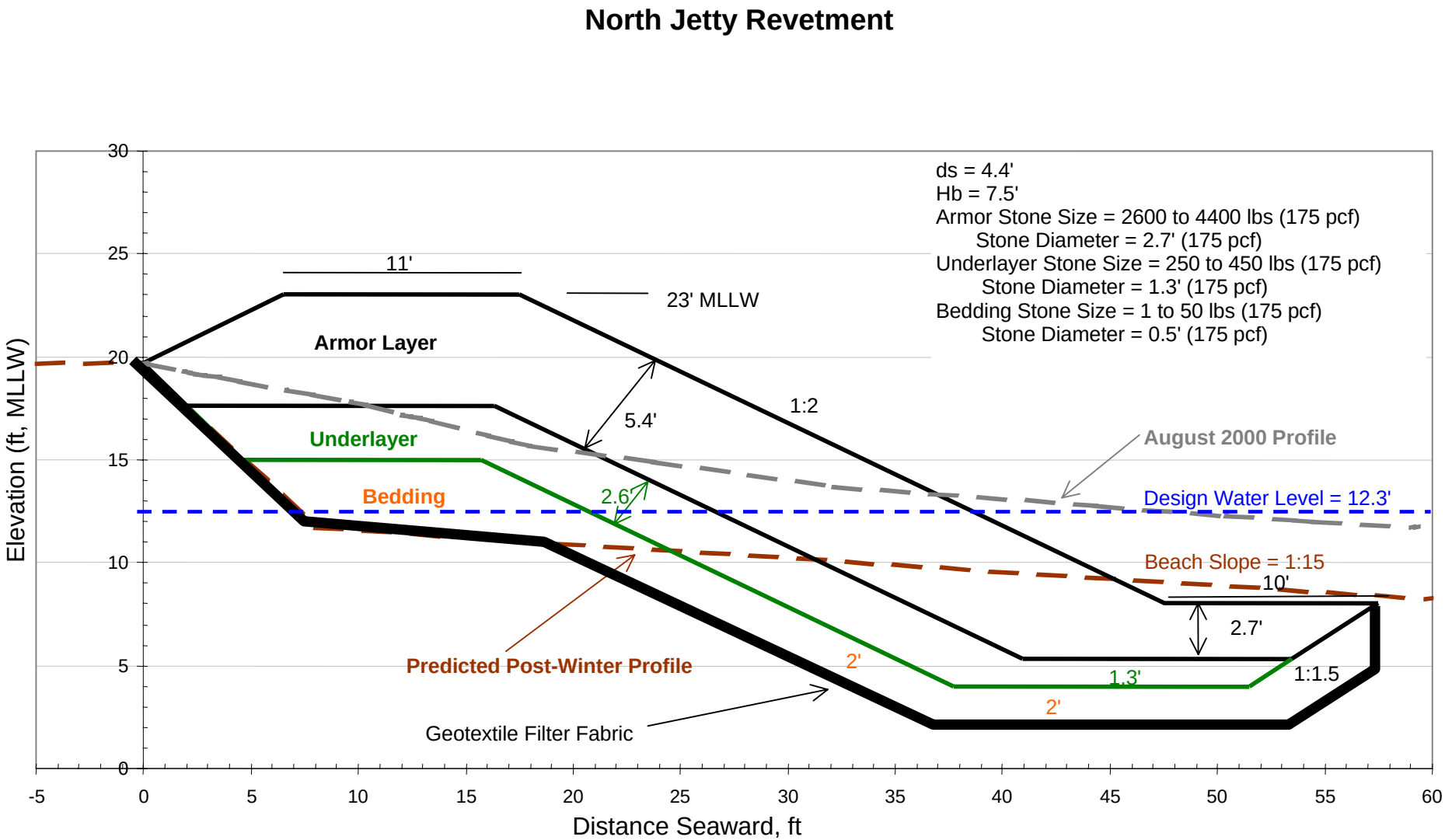


Figure 2-25 North Jetty Revetment Cross-Section

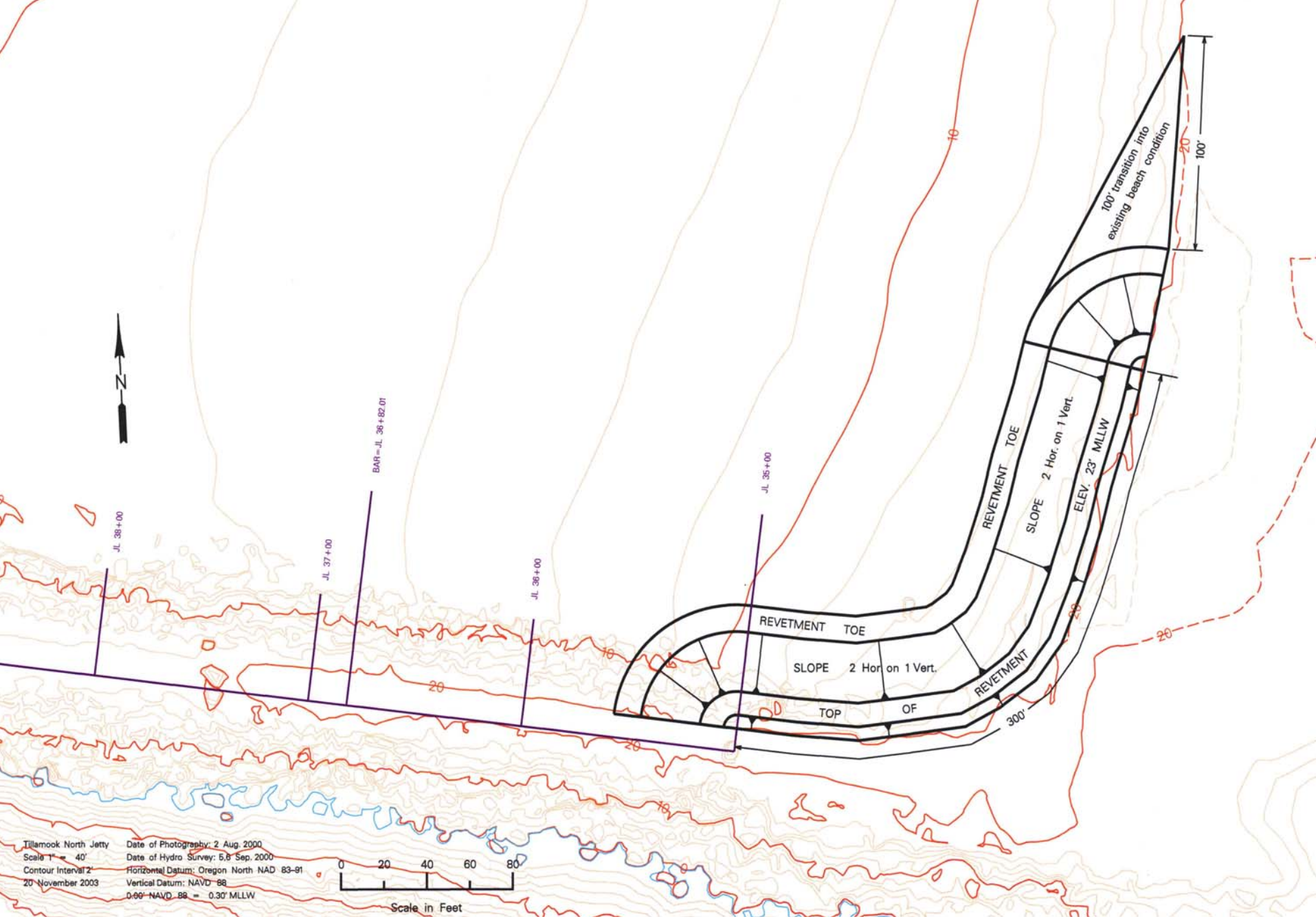


Figure 2-26 Plan layout of North Jetty Revetment

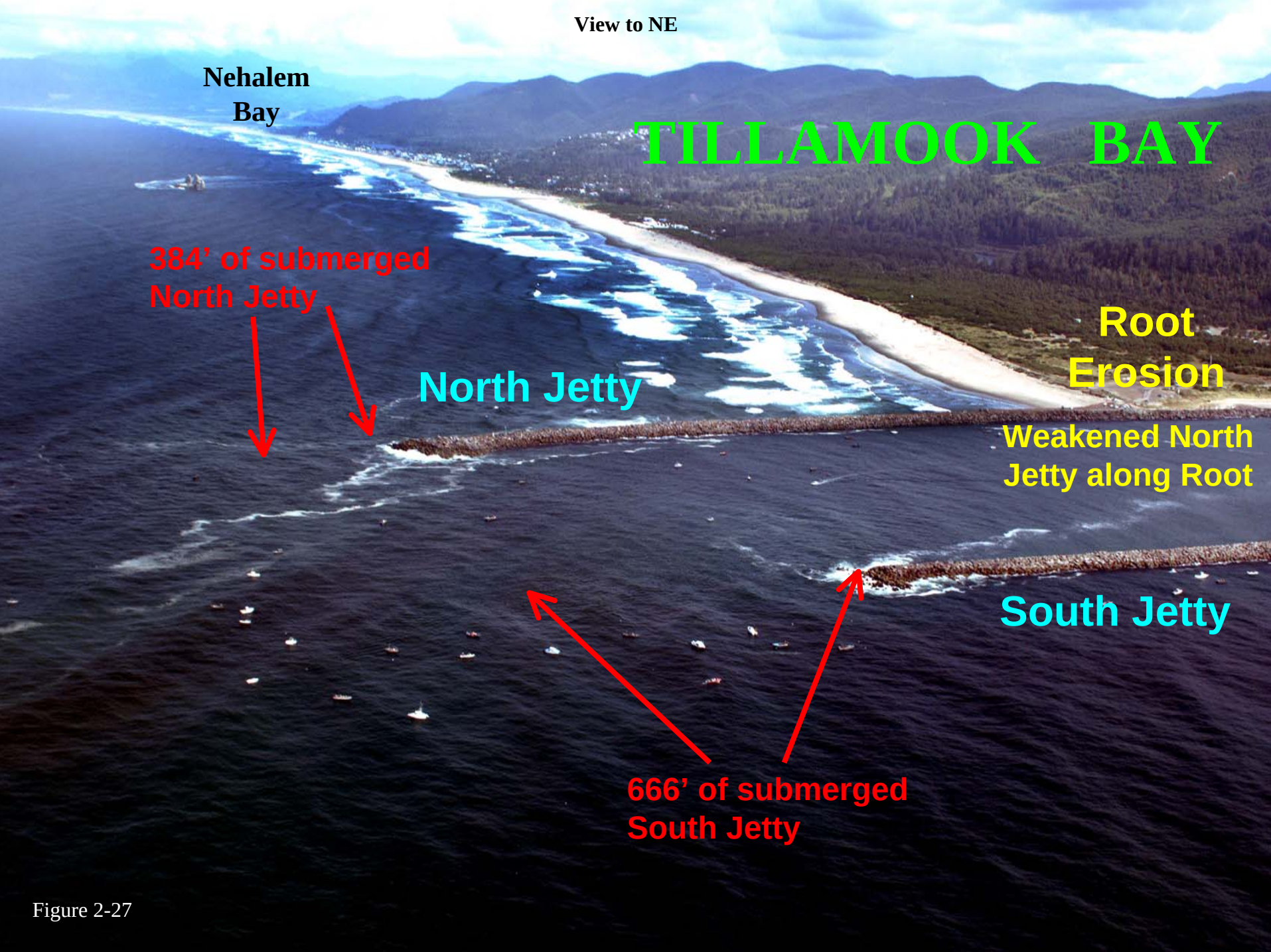
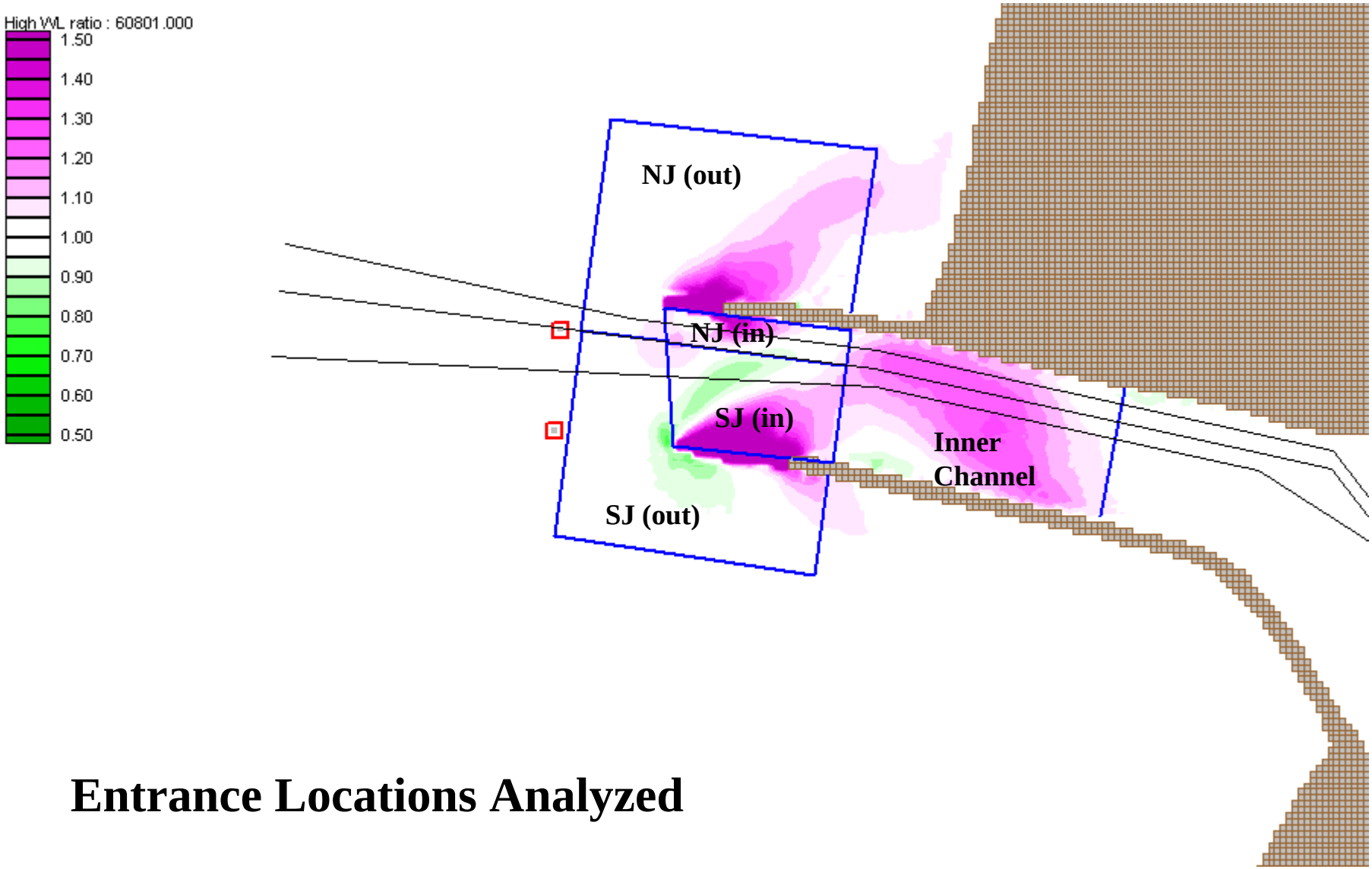

View to NE
Nehalem Bay
TILLAMOOK BAY
384' of submerged North Jetty
North Jetty
Root Erosion
Weakened North Jetty along Root
South Jetty
666' of submerged South Jetty

Figure 2-27



Entrance Locations Analyzed

Figure 2-28

SW 2m Storm: Wave Heights Based on Full Jetty Position

Low Tide Case

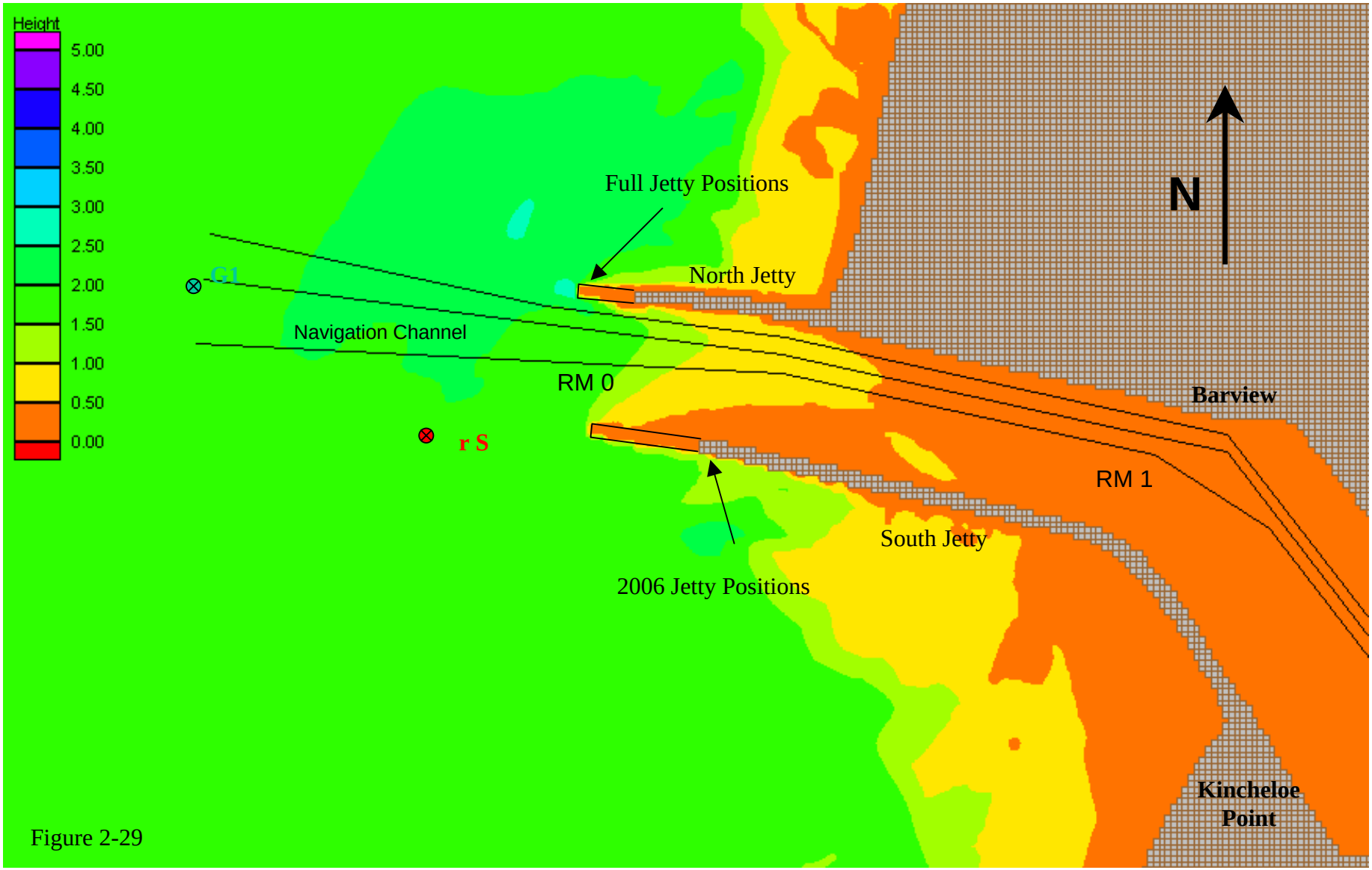


Figure 2-29

SW 2m Storm : Wave Heights Based on 2006 Jetty Position

Low Tide Case

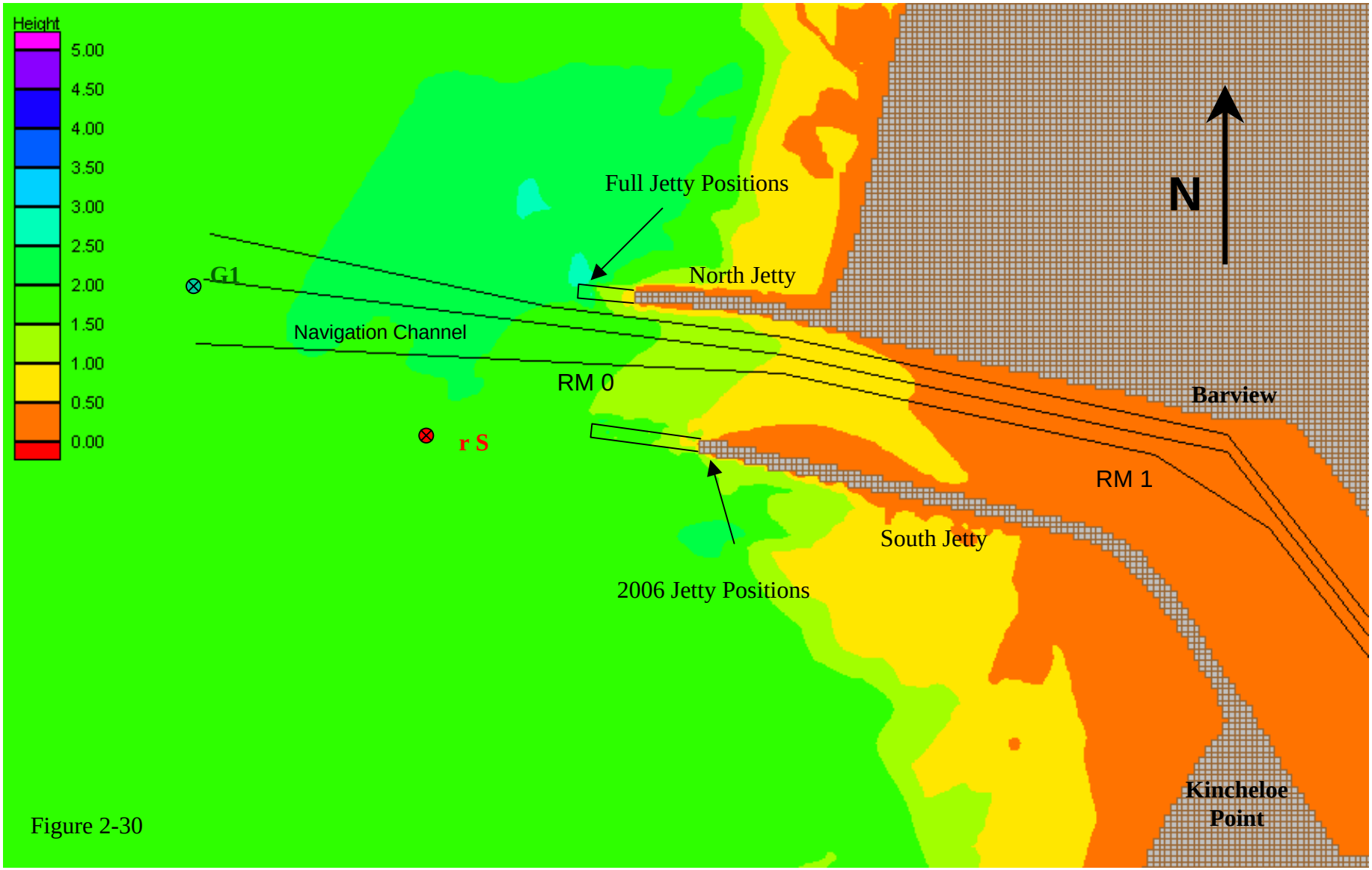


Figure 2-30

SW 2m Storm: Projected Wave Height Increase in 2006 Due to Jetty Recession

Low Tide Case

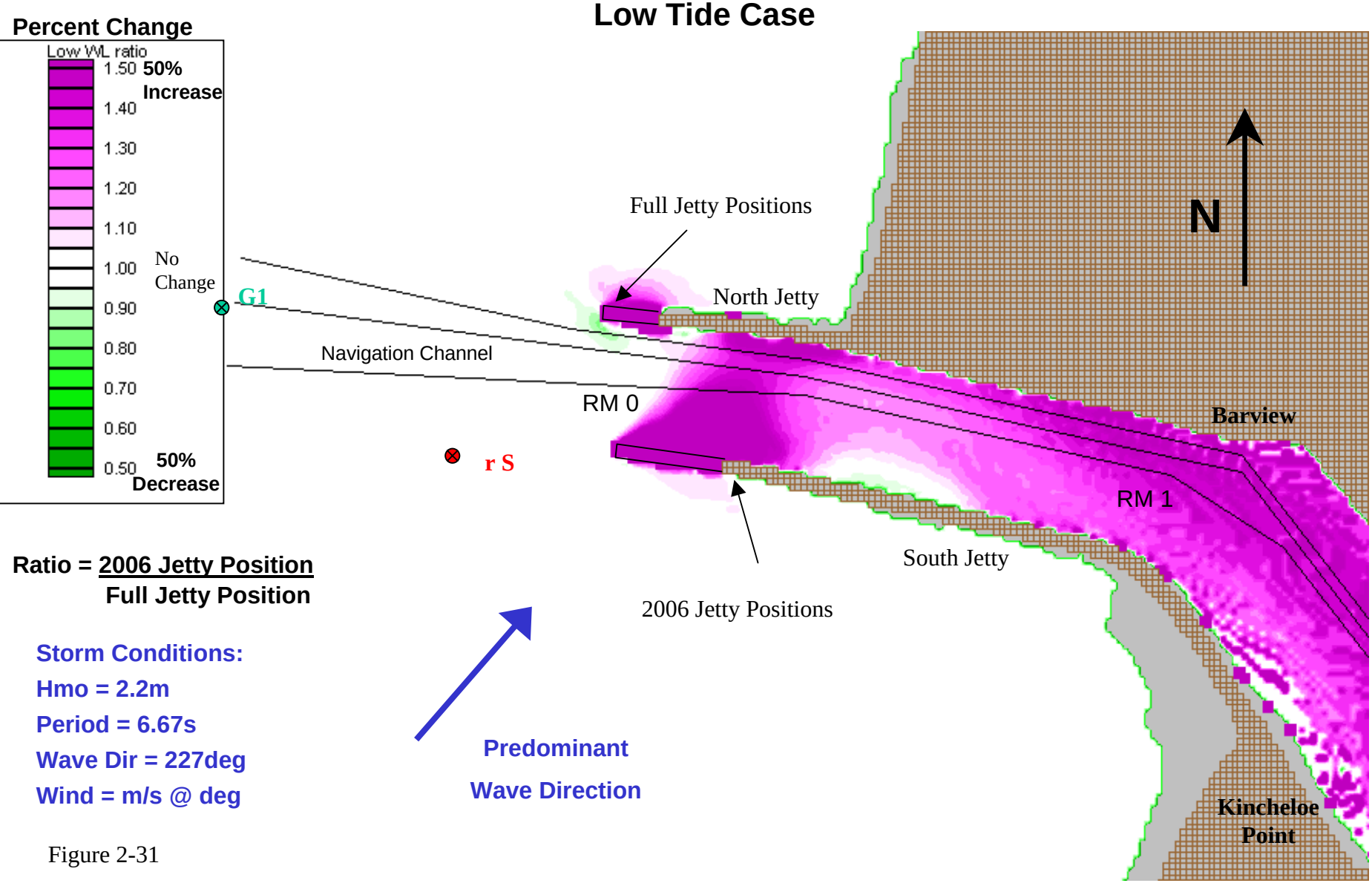


Figure 2-31

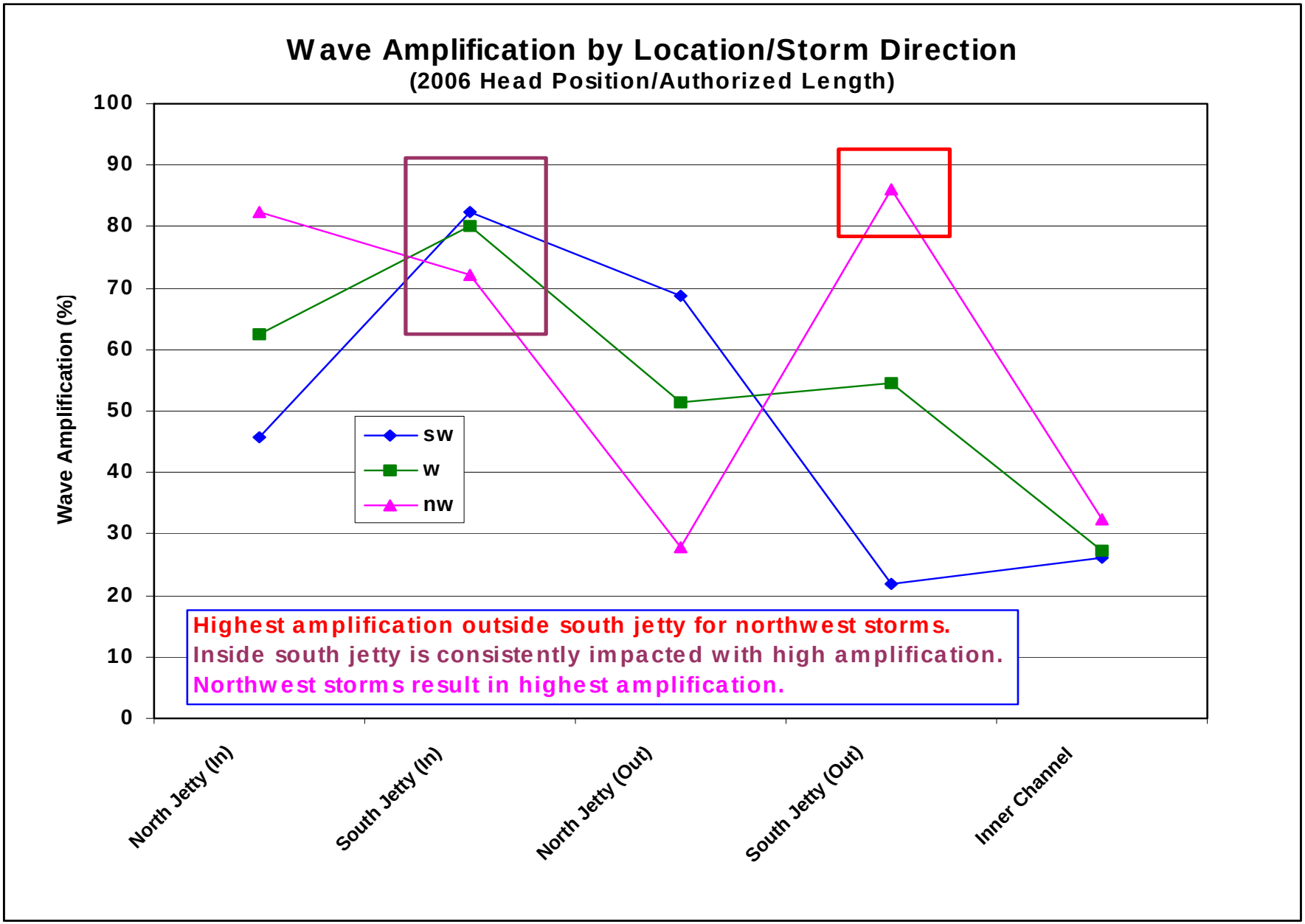

Wave Amplification by Location/Storm Direction
(2006 Head Position/Authorized Length)
Wave Amplification (%)
100
90
80
70
60
50
40
30
20
10
0
sw
w
nw
Highest amplification outside south jetty for northwest storms.
Inside south jetty is consistently impacted with high amplification.
Northwest storms result in highest amplification.
North Jetty (In)
South Jetty (In)
North Jetty (Out)
South Jetty (Out)
Inner Channel

Figure 2-32

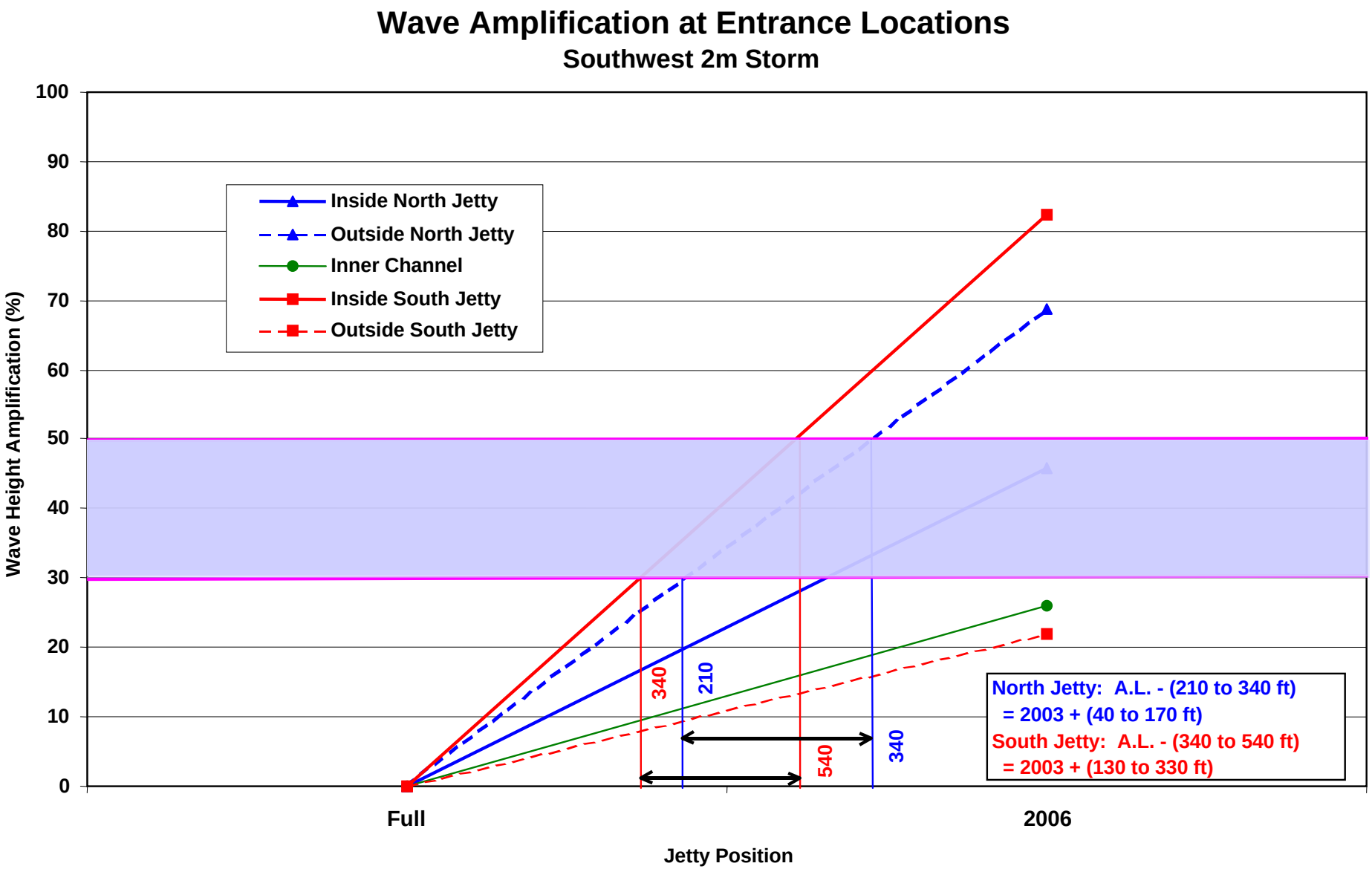

Wave Amplification at Entrance Locations
Southwest 2m Storm
Wave Height Amplification (%)
100
90
80
70
60
50
40
30
20
10
0
Inside North Jetty
Outside North Jetty
Inner Channel
Inside South Jetty
Outside South Jetty
340
210
540
340
North Jetty: A.L. - (210 to 340 ft)
= 2003 + (40 to 170 ft)
South Jetty: A.L. - (340 to 540 ft)
= 2003 + (130 to 330 ft)
Full
2006
Jetty Position

Figure 2-33

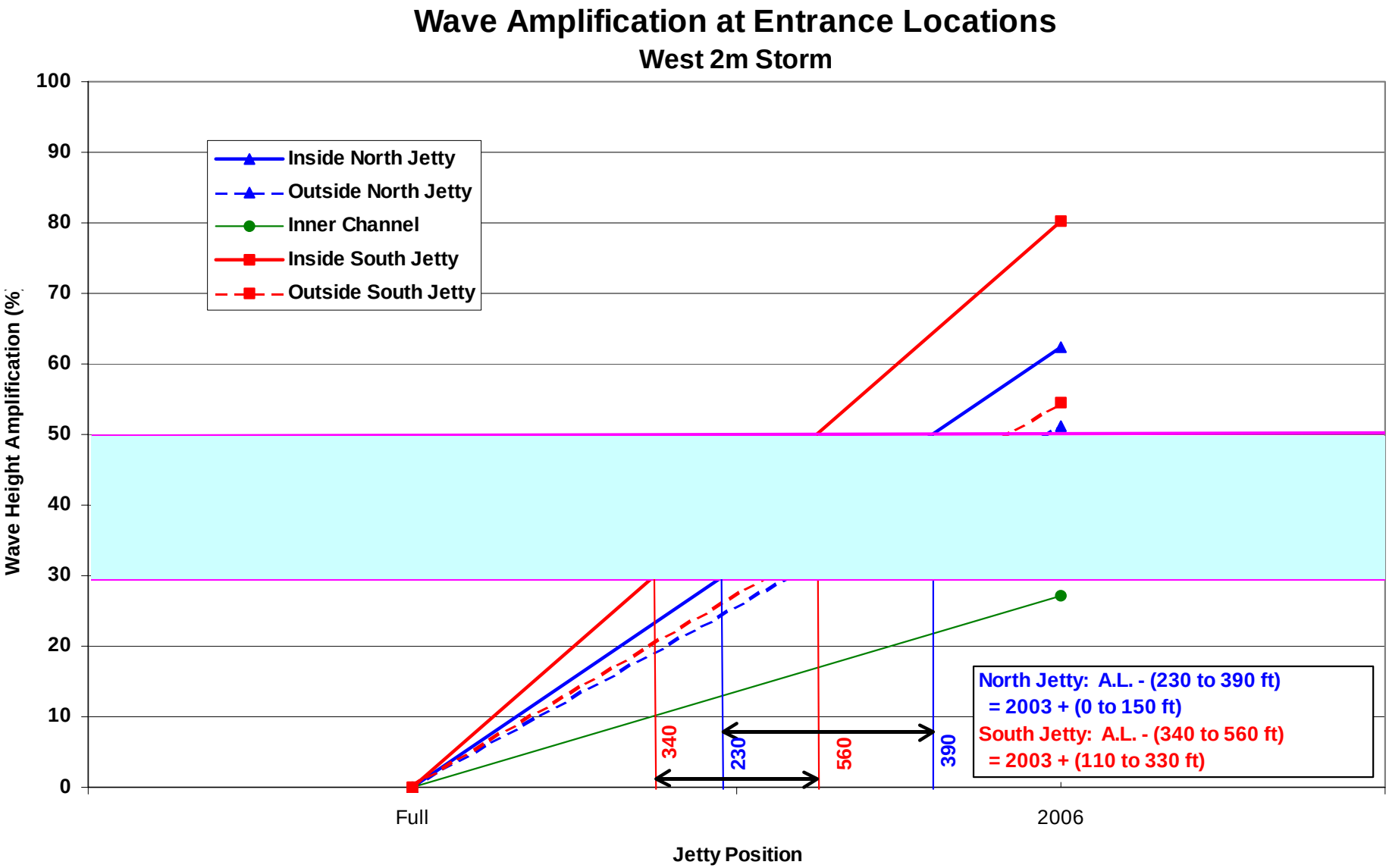

Wave Amplification at Entrance Locations
West 2m Storm
Wave Height Amplification (%)
100
90
80
70
60
50
40
30
20
10
0
Inside North Jetty
Outside North Jetty
Inner Channel
Inside South Jetty
Outside South Jetty
340
230
560
390
North Jetty: A.L. - (230 to 390 ft)
= 2003 + (0 to 150 ft)
South Jetty: A.L. - (340 to 560 ft)
= 2003 + (110 to 330 ft)
Full
2006
Jetty Position

Figure 2-34

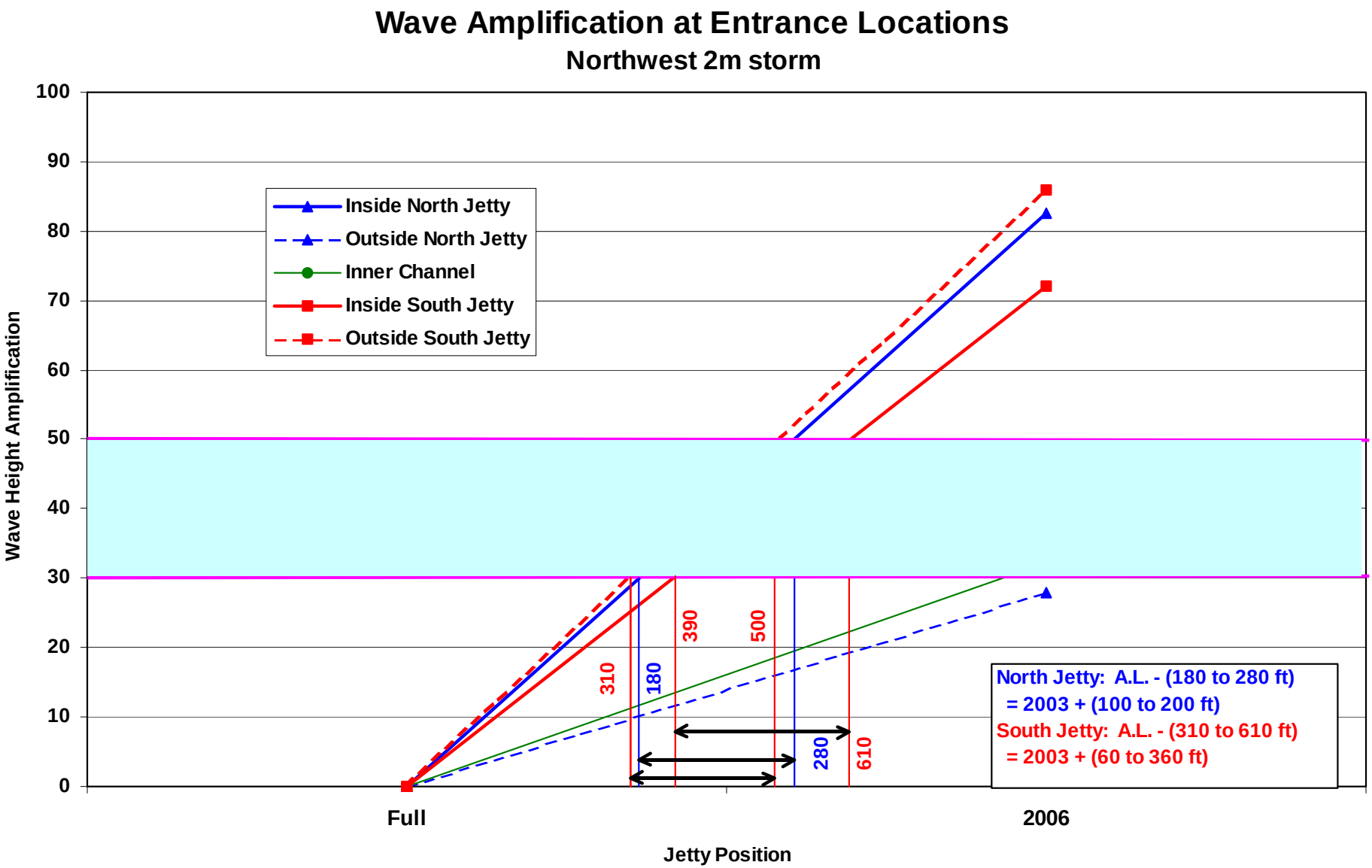

Wave Amplification at Entrance Locations
Northwest 2m storm
Wave Height Amplification
100
90
80
70
60
50
40
30
20
10
0
Inside North Jetty
Outside North Jetty
Inner Channel
Inside South Jetty
Outside South Jetty
310
180
390
500
280
610
North Jetty: A.L. - (180 to 280 ft)
= 2003 + (100 to 200 ft)
South Jetty: A.L. - (310 to 610 ft)
= 2003 + (60 to 360 ft)
Full
2006
Jetty Position

Figure 2-35

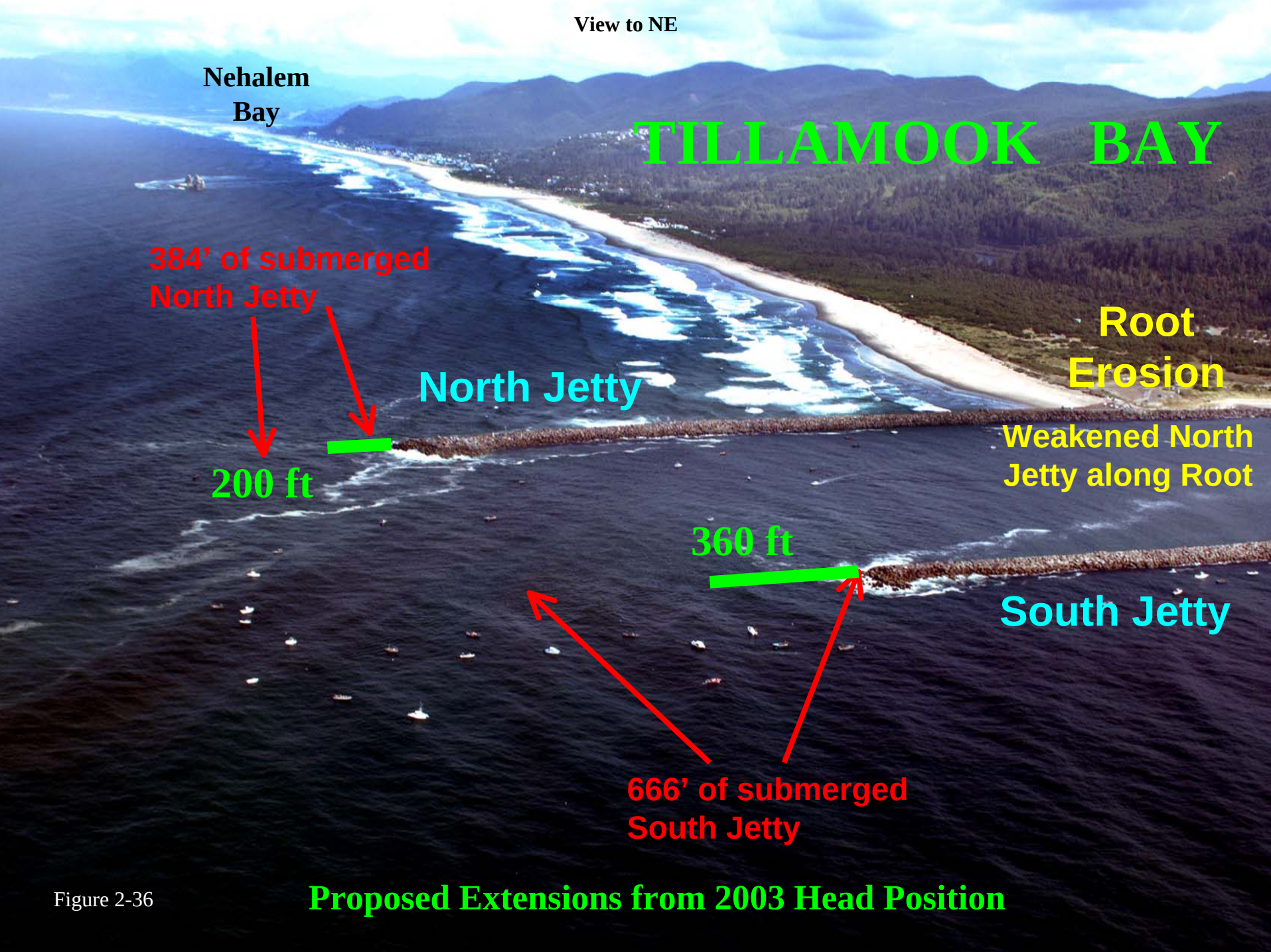


Figure 2-36

Proposed Extensions from 2003 Head Position

Cost Estimate for 50' North Jetty and South Jetty Caps, Trunk Repairs, and Revetment

******TOTAL PROJECT COST SUMMARY****** PAGE 1 OF 1

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North & South Jetty Caps (50 feet) and Trunks, plus Revetment DISTRICT: PORTLAND 12-Nov-03

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 EFFECT. PRICING LEVEL: SEP 03

ACCOUNT		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
10- - -	BREAKWATERS AND SEAWALLS	25,811.5	5,162.3	20%	30,973.8	0.0%	25,811.5	5,162.3	30,973.8		9.0%	28,134.5	5,626.9	33,761.4
	TOTAL CONSTRUCTION COSTS =====>	25,811.5	5,162.3	20%	30,973.8	0.0%	25,811.5	5,162.3	30,973.8		9.0%	28,134.5	5,626.9	33,761.4
01 - - -	LANDS AND DAMAGES	13.5	2.7	20%	16.2	0.0%	13.5	2.7	16.2		6.0%	14.3	2.9	17.2
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0			0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	715.8	143.2	20%	859.0	0.0%	715.8	143.2	859.0		6.0%	758.7	151.7	910.5
31 - - -	CONSTRUCTION MANAGEMENT	2,064.9	413.0	20%	2,477.9	0.0%	2,064.9	413.0	2,477.9		9.0%	2,250.8	450.2	2,700.9
	TOTAL COST =========>	28,605.7	5,721.1	20%	34,326.9	0.0%	28,605.7	5,721.1	34,326.9		8.9%	31,158.4	6,231.7	**37,390.0**

Table 5-1 Cost Estimate for 50' North Jetty Cap

******TOTAL PROJECT COST SUMMARY****** PAGE 1 OF 1

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North Jetty Cap (50 feet) DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

		CURRENT MCACES ESTIMATE PREPARED: Sep-03				AUTHORIZ./BUDGET YEAR: 2003				FULLY FUNDED ESTIMATE				
		EFFECTIVE PRICING LEVEL: Sep-03				EFFECT. PRICING LEVEL: SEP 03								
ACCOUNT	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)
10- - -	BREAKWATERS AND SEAWALLS	2,352.1	470.4	20%	2,822.5	0.0%	2,352.1	470.4	2,822.5	Aug-06	9.0%	2,563.8	512.8	3,076.5
	TOTAL CONSTRUCTION COSTS =====>	2,352.1	470.4	20%	2,822.5	0.0%	2,352.1	470.4	2,822.5		9.0%	2,563.8	512.8	3,076.5
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	188.2	37.6	20%	225.8	0.0%	188.2	37.6	225.8	Aug-06	9.0%	205.1	41.0	246.1
	TOTAL COST =========>	2,649.2	529.8	20%	3,179.0	0.0%	2,649.2	529.8	3,179.0		8.9%	2,884.3	576.9	**3,461.2**

Table 5-2 Cost Estimate for 50' South Jetty Cap

******TOTAL PROJECT COST SUMMARY****** PAGE 1 OF 1

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - South Jetty Cap (50 feet) DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 EFFECT. PRICING LEVEL: SEP 03

ACCOUNT	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)
10- - -	BREAKWATERS AND SEAWALLS	5,932.1	1,186.4	20%	7,118.5	0.0%	5,932.1	1,186.4	7,118.5	Aug-06	9.0%	6,466.0	1,293.2	7,759.2
	TOTAL CONSTRUCTION COSTS =====>	5,932.1	1,186.4	20%	7,118.5	0.0%	5,932.1	1,186.4	7,118.5		9.0%	6,466.0	1,293.2	7,759.2
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	474.6	94.9	20%	569.5	0.0%	474.6	94.9	569.5	Aug-06	9.0%	517.3	103.5	620.7
	TOTAL COST =========>	6,515.6	1,303.1	20%	7,818.7	0.0%	6,515.6	1,303.1	7,818.7		8.9%	7,098.7	1,419.7	**8,518.4**

Table 5-3 Cost Estimate for North Jetty Revetment

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North Jetty Revetment — DISTRICT: PORTLAND — 17-Sep-04

LOCATION: Tillamook, OR — P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED:		Sep-03				AUTHORIZ./BUDGET YEAR:			2003	FULLY FUNDED ESTIMATE					
EFFECTIVE PRICING LEVEL:		Sep-03				EFFECT. PRICING LEVEL: SEP 03									
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)	
10- - -	BREAKWATERS AND SEAWALLS	462.8	92.6	20%	555.4	0.0%	462.8	92.6	555.4	Aug-06	9.0%	504.5	100.9	605.3	
	TOTAL CONSTRUCTION COSTS =====>	462.8	92.6	20%	555.4	0.0%	462.8	92.6	555.4		9.0%	504.5	100.9	605.3	
01 - - -	LANDS AND DAMAGES	1.5	0.3	20%	1.8	0.0%	1.5	0.3	1.8	Jul-05	6.0%	1.6	0.3	1.9	
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0	
30 - - -	PLANNING, ENGINEERING AND DESIGN	74.4	14.9	20%	89.3	0.0%	74.4	14.9	89.3	Jul-05	6.0%	78.9	15.8	94.6	
31 - - -	CONSTRUCTION MANAGEMENT	37.0	7.4	20%	44.4	0.0%	37.0	7.4	44.4	Aug-06	9.0%	40.4	8.1	48.4	
	TOTAL COST =========>	575.7	115.1	20%	690.9	0.0%	575.7	115.1	690.9		8.6%	625.3	125.1	**750.3**	

Table 5-4 Cost Estimate for North Jetty Trunk Repairs - STA 22+00 to 29+50

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North Jetty Trunk Repair Sta 22+00 to 29+50 DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

		CURRENT MCACES ESTIMATE PREPARED: Sep-03				AUTHORIZ./BUDGET YEAR: 2003				FULLY FUNDED ESTIMATE				
		EFFECTIVE PRICING LEVEL: Sep-03				EFFECT. PRICING LEVEL: SEP 03								
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)
10- - -	BREAKWATERS AND SEAWALLS	1,113.0	222.6	20%	1,335.6	0.0%	1,113.0	222.6	1,335.6	Aug-06	9.0%	1,213.2	242.6	1,455.8
	TOTAL CONSTRUCTION COSTS =====>	1,113.0	222.6	20%	1,335.6	0.0%	1,113.0	222.6	1,335.6		9.0%	1,213.2	242.6	1,455.8
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	89.0	17.8	20%	106.8	0.0%	89.0	17.8	106.8	Aug-06	9.0%	97.1	19.4	116.5
	TOTAL COST =========>	1,310.9	262.2	20%	1,573.1	0.0%	1,310.9	262.2	1,573.1		8.8%	1,425.7	285.1	**1,710.8**

Table 5-5 Cost Estimate for North Jetty Trunk Repairs - STA 29+50 to 37+00

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North Jetty Trunk Repair Sta 29+50 to 37+00 DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03						AUTHORIZ./BUDGET YEAR: 2003				FULLY FUNDED ESTIMATE				
EFFECTIVE PRICING LEVEL: Sep-03						EFFECT. PRICING LEVEL: SEP 03								
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)
10- - -	BREAKWATERS AND SEAWALLS	3,385.9	677.2	20%	4,063.1	0.0%	3,385.9	677.2	4,063.1	Aug-06	9.0%	3,690.6	738.1	4,428.8
	TOTAL CONSTRUCTION COSTS =====>	3,385.9	677.2	20%	4,063.1	0.0%	3,385.9	677.2	4,063.1		9.0%	3,690.6	738.1	4,428.8
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	270.9	54.2	20%	325.0	0.0%	270.9	54.2	325.0	Aug-06	9.0%	295.3	59.1	354.3
	TOTAL COST =========>	3,765.7	753.1	20%	4,518.8	0.0%	3,765.7	753.1	4,518.8		8.9%	4,101.3	820.3	**4,921.6**

Table 5-6 Cost Estimate for South Jetty Trunk Repair - STA 44+00 to 58+00

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - South Jetty Trunk Repair - Sta 44+00 to 58+00 DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 EFFECT. PRICING LEVEL: SEP 03

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)
10- - -	BREAKWATERS AND SEAWALLS	3,534.2	706.8	20%	4,241.0	0.0%	3,534.2	706.8	4,241.0	Aug-06	9.0%	3,852.3	770.5	4,622.7
	TOTAL CONSTRUCTION COSTS =====>	3,534.2	706.8	20%	4,241.0	0.0%	3,534.2	706.8	4,241.0		9.0%	3,852.3	770.5	4,622.7
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	282.7	56.5	20%	339.3	0.0%	282.7	56.5	339.3	Aug-06	9.0%	308.2	61.6	369.8
	TOTAL COST =========>	3,925.8	785.2	20%	4,711.0	0.0%	3,925.8	785.2	4,711.0		8.9%	4,275.9	855.2	**5,131.1**

Table 5-7 Cost Estimate for South Jetty Trunk Repair - STA 70+00 to 76+50

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - South Jetty Trunk Repair - Sta 70+00 to 76+50 DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 EFFECT. PRICING LEVEL: SEP 03

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)
10- - -	BREAKWATERS AND SEAWALLS	9,031.4	1,806.3	20%	10,837.7	0.0%	9,031.4	1,806.3	10,837.7	Aug-06	9.0%	9,844.2	1,968.8	11,813.1
	TOTAL CONSTRUCTION COSTS =====>	9,031.4	1,806.3	20%	10,837.7	0.0%	9,031.4	1,806.3	10,837.7		9.0%	9,844.2	1,968.8	11,813.1
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	722.5	144.5	20%	867.0	0.0%	722.5	144.5	867.0	Aug-06	9.0%	787.5	157.5	945.0
	TOTAL COST =========>	9,862.8	1,972.6	20%	11,835.4	0.0%	9,862.8	1,972.6	11,835.4		9.0%	10,747.2	2,149.4	**12,896.6**

Cost Estimate for 100' North Jetty and South Jetty Caps, Trunk Repairs, and Revetment

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North & South Jetty Caps (100 feet) and Trunks, plus Revetment DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03						AUTHORIZ./BUDGET YEAR: 2003				FULLY FUNDED ESTIMATE				
EFFECTIVE PRICING LEVEL: Sep-03						EFFECT. PRICING LEVEL: SEP 03								
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)
10- - -	BREAKWATERS AND SEAWALLS	28,592.7	5,718.5	20%	34,311.2	0.0%	28,592.7	5,718.5	34,311.2		9.0%	31,166.0	6,233.2	37,399.3
	TOTAL CONSTRUCTION COSTS =====>	28,592.7	5,718.5	20%	34,311.2	0.0%	28,592.7	5,718.5	34,311.2		9.0%	31,166.0	6,233.2	37,399.3
01 - - -	LANDS AND DAMAGES	14.5	2.9	20%	17.4	0.0%	14.5	2.9	17.4		6.0%	15.4	3.1	18.4
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0			0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	715.8	143.2	20%	859.0	0.0%	715.8	143.2	859.0		6.0%	758.7	151.7	910.5
31 - - -	CONSTRUCTION MANAGEMENT	2,287.4	457.5	20%	2,744.9	0.0%	2,287.4	457.5	2,744.9		9.0%	2,493.3	498.7	2,991.9
	TOTAL COST =========>	31,610.4	6,322.1	20%	37,932.5	0.0%	31,610.4	6,322.1	37,932.5		8.9%	34,433.4	6,886.7	**41,320.1**

Table 5-8 Cost Estimate for 100' North Jetty Cap

******TOTAL PROJECT COST SUMMARY****** PAGE 1 OF 1

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North Jetty Cap (100 feet) DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

		CURRENT MCACES ESTIMATE PREPARED: Sep-03				AUTHORIZ./BUDGET YEAR: 2003				FULLY FUNDED ESTIMATE				
		EFFECTIVE PRICING LEVEL: Sep-03				EFFECT. PRICING LEVEL: SEP 03								
ACCOUNT	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)
10- - -	BREAKWATERS AND SEAWALLS	3,750.5	750.1	20%	4,500.6	0.0%	3,750.5	750.1	4,500.6	Aug-06	9.0%	4,088.0	817.6	4,905.7
	TOTAL CONSTRUCTION COSTS =====>	3,750.5	750.1	20%	4,500.6	0.0%	3,750.5	750.1	4,500.6		9.0%	4,088.0	817.6	4,905.7
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	300.0	60.0	20%	360.0	0.0%	300.0	60.0	360.0	Aug-06	9.0%	327.0	65.4	392.5
	TOTAL COST =========>	4,159.4	831.9	20%	4,991.3	0.0%	4,159.4	831.9	4,991.3		8.9%	4,530.5	906.1	**5,436.6**

Table 5-9 Cost Estimate for 100' South Jetty Cap

******TOTAL PROJECT COST SUMMARY****** PAGE 1 OF 1

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - South Jetty Cap (100 feet) DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 EFFECT. PRICING LEVEL: SEP 03

ACCOUNT	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)
10- - -	BREAKWATERS AND SEAWALLS	7,314.8	1,463.0	20%	8,777.8	0.0%	7,314.8	1,463.0	8,777.8	Aug-06	9.0%	7,973.1	1,594.6	9,567.8
	TOTAL CONSTRUCTION COSTS =====>	7,314.8	1,463.0	20%	8,777.8	0.0%	7,314.8	1,463.0	8,777.8		9.0%	7,973.1	1,594.6	9,567.8
01 - - -	LANDS AND DAMAGES	3.0	0.6	20%	3.6	0.0%	3.0	0.6	3.6	Jul-05	6.0%	3.2	0.6	3.8
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	585.2	117.0	20%	702.2	0.0%	585.2	117.0	702.2	Aug-06	9.0%	637.9	127.6	765.4
	TOTAL COST =========>	8,009.9	1,602.0	20%	9,611.9	0.0%	8,009.9	1,602.0	9,611.9		9.0%	8,727.5	1,745.5	**10,473.0**

Cost Estimate for North & South Jetty Long Fixes, Trunks, and Revetment[1]

******TOTAL PROJECT COST SUMMARY FOR RECOMMENDED ALTERNATIVE******

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North & South Jetty Long Fixes, Trunks, and Revetment DISTRICT: PORTLAND 17-Sep-04

LOCATION: Tillamook, OR P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 AUTHORIZ./BUDGET YEAR: 2003 FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 EFFECT. PRICING LEVEL: SEP 03

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)
10- - -	BREAKWATERS AND SEAWALLS	36,874.5	7,374.9	20%	44,249.4	0.0%	36,874.5	7,374.9	44,249.4		9.0%	40,193.2	8,038.6	48,231.8
	TOTAL CONSTRUCTION COSTS =====>	36,874.5	7,374.9	20%	44,249.4	0.0%	36,874.5	7,374.9	44,249.4		9.0%	40,193.2	8,038.6	48,231.8
		0.0	0.0		0.0		0.0	0.0	0.0			0.0	0.0	0.0
01 - - -	LANDS AND DAMAGES	14.5	2.9	20%	17.4	0.0%	14.5	2.9	17.4		6.0%	15.4	3.1	18.4
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0			0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	715.8	143.2	20%	859.0	0.0%	715.8	143.2	859.0		6.0%	758.7	151.7	910.5
31 - - -	CONSTRUCTION MANAGEMENT	2,950.0	590.0	20%	3,540.0	0.0%	2,950.0	590.0	3,540.0		9.0%	3,215.5	643.1	3,858.5
	TOTAL COST =========>	40,554.8	8,111.0	20%	48,665.7	0.0%	40,554.8	8,111.0	48,665.7		8.9%	44,182.8	8,836.6	**53,019.3**

1 Design, including estimated volumes and cost estimate, for the longer fixes is conceptual.

APPROVED:

_____ CHIEF, ENGINEERING AND CONSTRUCTION DIVISION

_____ CHIEF, PLANNING, PROGRAMS AND PROJECT MANAGEMENT DIVISION

_____ CHIEF, COST ENGINEERING SECTION

_____ APPROVAL DATE

Table 5-10 Cost Estimate for North Jetty Alternative (Long) Fix[1]

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - North Jetty Alternative (Long) Fix — DISTRICT: PORTLAND — 17-Sep-04

LOCATION: Tillamook, OR — P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 — AUTHORIZ./BUDGET YEAR: 2003 — FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 — EFFECT. PRICING LEVEL: SEP 03

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)
10- - -	BREAKWATERS AND SEAWALLS	4,877.1	975.4	20%	5,852.5	0.0%	4,877.1	975.4	5,852.5	Aug-06	9.0%	5,316.0	1,063.2	6,379.2
	TOTAL CONSTRUCTION COSTS =====>	4,877.1	975.4	20%	5,852.5	0.0%	4,877.1	975.4	5,852.5		9.0%	5,316.0	1,063.2	6,379.2
01 - - -	LANDS AND DAMAGES	2.0	0.4	20%	2.4	0.0%	2.0	0.4	2.4	Jul-05	6.0%	2.1	0.4	2.5
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	390.2	78.0	20%	468.2	0.0%	390.2	78.0	468.2	Aug-06	9.0%	425.3	85.1	510.3
	TOTAL COST =========>	5,376.2	1,075.2	20%	6,451.4	0.0%	5,376.2	1,075.2	6,451.4		8.9%	5,856.8	1,171.4	**7,028.1**

1 Design, including estimated volumes and cost estimate, for the longer fixes is conceptual.

Table 5-11 Cost Estimate for South Jetty Alternative (Long) Fix[1]

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

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TILLAMOOK JETTY MAJOR MAINTENANCE REPORT DATED NOVEMBER 2003

PROJECT: Tillamook Jetty Repair - South Jetty Alternative (Long) Fix — DISTRICT: PORTLAND — 17-Sep-04

LOCATION: Tillamook, OR — P.O.C.: PAT JONES, CHIEF, COST ENGINEERING SECTION

CURRENT MCACES ESTIMATE PREPARED: Sep-03 — AUTHORIZ./BUDGET YEAR: 2003 — FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Sep-03 — EFFECT. PRICING LEVEL: SEP 03

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)
10- - -	BREAKWATERS AND SEAWALLS	14,470.0	2,894.0	20%	17,364.0	0.0%	14,470.0	2,894.0	17,364.0	Aug-06	9.0%	15,772.3	3,154.5	18,926.8
	TOTAL CONSTRUCTION COSTS =====>	14,470.0	2,894.0	20%	17,364.0	0.0%	14,470.0	2,894.0	17,364.0		9.0%	15,772.3	3,154.5	18,926.8
01 - - -	LANDS AND DAMAGES	3.0	0.6	20%	3.6	0.0%	3.0	0.6	3.6	Jul-05	6.0%	3.2	0.6	3.8
22- - -	FEASIBILITY STUDIES	0.0	0.0	0%	0.0	0.0%	0.0	0.0	0.0		0.0%	0.0	0.0	0.0
30 - - -	PLANNING, ENGINEERING AND DESIGN	106.9	21.4	20%	128.3	0.0%	106.9	21.4	128.3	Jul-05	6.0%	113.3	22.7	136.0
31 - - -	CONSTRUCTION MANAGEMENT	1,157.6	231.5	20%	1,389.1	0.0%	1,157.6	231.5	1,389.1	Aug-06	9.0%	1,261.8	252.4	1,514.1
	TOTAL COST =========>	15,737.5	3,147.5	20%	18,885.0	0.0%	15,737.5	3,147.5	18,885.0		9.0%	17,150.6	3,430.1	**20,580.7**

1 Design, including estimated volumes and cost estimate, for the longer fixes is conceptual.