U.S. Army Corps of Engineers
Waterways Experiment Station

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Proceedings of the 67th Meeting of the Coastal Engineering Research Board

13-14 May 1998 (Ft. Lauderdale, FL)

Hosted by: U.S. Army Engineer Division, South Atlantic
U.S. Army Engineer District, Jacksonville

Prepared for Headquarters, U.S. Army Corps of Engineers

Contents

Preface

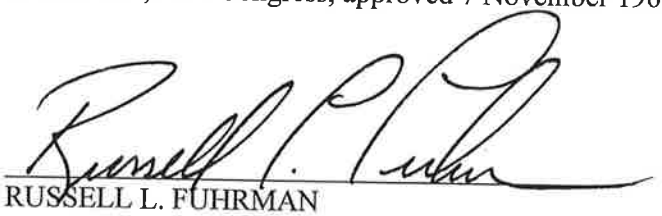
The Proceedings of the 67th Meeting of the Coastal Engineering Research Board (CERB) were prepared for the Office, Chief of Engineers, by the U.S. Army Engineer Waterways Experiment Station's (WES's) Coastal and Hydraulics Laboratory (CHL). These proceedings provide a record of the papers presented, the questions and comments in response to them, and the interaction among program participants and the CERB.

The meeting was hosted by the U.S. Army Engineer Division, South Atlantic, under the direction of BG Robert L. VanAntwerp, Commander, and the U.S. Army Engineer District, Jacksonville (SAJ), under the direction of COL Joe R. Miller, Commander.

Acknowledgements are extended to the following from SAJ: Mr. David V. Schmidt for overall coordination of the meeting and field trip; Ms. Cynthia B. Perez and Messrs. Daniel R. Haubner and Jason Bohrmann, for coordination and onsite support; Messrs. Charles F. Stevens, Michael Ornella, and Thomas D. Smith for field trip support; Messrs. Van R. Eason and John C. Carnes for audiovisual support; Messrs. James Boone, Mitchell A. Granat, Joseph E. Gurule, Thomas R. Martin, George R. Fryer, and Anthony Santana, and Mses. Deborah H. Peterson and Priscilla A. Trigg for exhibit support; MAJ Edward Pruett, Messrs. Michael Gray and Leo LaFrance for logistical and transportation support; and Mses. Loretta J. Downs and Rhonda L. Stubbs, who assisted with registration and onsite support. Thanks are also extended to all speakers; to Ms. Sharon L. Hanks of WES's CHL, for overall coordination and assistance in the setup of the meeting and the assembly of the information for this publication; Dr. Lyndell Z. Hales for his assistance in the preparation of the draft proceedings from the transcript; and Ms. Janean Shirley of WES's Information Technology Laboratory for editing these proceedings. Thanks are extended also to Ms. Susan C. Soderberg, Pro/Tech Reporting Services, for taking verbatim dictation of the meeting.

These proceedings were reviewed and edited for technical accuracy by Dr. James R. Houston, Director, WES's CHL, and Mr. Charles C. Calhoun, Jr., Assistant Director, WES's CHL. COL Robin R. Cababa, Executive Secretary of the Board, provided additional review.

The document is approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.



RUSSELL L. FUHRMAN
Major General, U.S. Army
President, Coastal Engineering Research Board

Agenda

THEME: REGIONAL SEDIMENT MANAGEMENT

TUESDAY, 12 MAY 1998

1830 - 1930 Reception (Doubles Lounge - Fort Lauderdale Airport Hilton)

WEDNESDAY, 13 MAY 1998

0730 - 0800 Registration

0800 - 0810 Opening Remarks
MG Russell L. Fuhrman

0810 - 0825 Welcome and Introduction
BG Robert L. VanAntwerp, South Atlantic Division
COL Joe R. Miller, Jacksonville District (SAJ)

0825 - 0855 Florida Keys Carrying Capacity Study
Mr. James F. Murley, Florida Department of Community Affairs

0855 - 0915 SandyDuck Media Update
Mr. Wayne A. Stroupe, Waterways Experiment Station (WES), Public Affairs Office

0915 - 0945 El Niño Update
BG J. Richard Capka, South Pacific Division

0945 - 1015 Integration of New Technologies into Corps Operational Practice
Mr. Barry W. Holliday, Headquarters, U.S. Army Corps of Engineers

1015 - 1030 Break

1030 - 1700 Regional Sediment Management (Panel Discussion)
Dr. James R. Houston, Moderator, WES/Coastal and Hydraulics Laboratory (CHL)

1030-1100 Sediment Management Overview
Dr. Houston

1100-1130 Sand Rights - The Fragile Coastal Balance
Mr. Orville T. Magoon, Coastal Zone Foundation

1130-1200 Fire Island to Montauk Point (FIMP), NY, Reformation Study and Results from FIMP
Ms. Lynn M. Bocamazo, New York District

1200 - 1300 Lunch (Guest Speaker)
Mr. Malcolm McLouth, Canaveral Port Authority

1300-1325 Ocean City/Assateague, MD, Studies
Mr. Gregory P. Bass, Baltimore District

1325-1350 East Pass Project Management
Mr. Howard M. Whittington, Mobile District

1350-1415 Beach Nourishment at Orange County, CA
Mr. Arthur T. Shak, Los Angeles District

1415-1440 Coast of Florida Erosion and Storm Effects Study
Mr. Charles F. Stevens, SAJ

1440-1500 Summary
Dr. Houston

1500 - 1515 Break

1515-1545 Current Research and Development (R&D) Related to Sediment Management
Mr. Thomas W. Richardson, WES/CHL

1545-1630 Coastal Inlets Research Program
Dr. Nicholas C. Kraus and Ms. Julie D. Rosati, WES/CHL

1630-1700 R&D Needs for Regional Sediment Management
Dr. Kraus

1700 Adjourn for the Day

1830 - 2200 Evening Social (Dinner Cruise on Inland Waterways)

THURSDAY, 14 MAY 1998

0900 - 0905 Opening Remarks
MG Fuhrman

0905 - 0930 Florida's Beach and Inlet Management Program
Mr. Kirby G. Green III, Florida Department of Environmental Protection

0930 - 1000	Long-Range Dredged-Material Management Program for the Atlantic Intracoastal and Okeechobee Waterways in Florida Mr. David K. Roach, Florida Inland Navigation District
1000 - 1030	Review of Long-Term Shoreline Changes in Florida Dr. Robert G. Dean, University of Florida
1030 - 1045	Break
1045 - 1115	Litigation Issues Mr. Lewis S. Wiener, Esq., U.S. Department of Justice
1115 - 1145	Sediment Management at Inlets - Federal Navigation Project Mitigation Mr. Erik Olsen, Olsen Associates, Inc.
1145 - 1215	Public Comment
1215 - 1230	Field Trip Overview
1230	Adjourn
1300 - 1700	Field Trip (Box lunch)

Attendees

Board Members
MG Russell L. Fuhrman
MG Jerry L. Sinn
BG J. Richard Capka
BG Robert L. VanAntwerp
Dr. Robert G. Dean
Dr. Billy L. Edge
Dr. Richard W. Sternberg

Headquarters, U.S. Army Corps of Engineers
Mr. John P. Bianco, CECW-EH
Mr. Charles B. Chesnutt, CECW-PF
Mr. Barry W. Holliday, CECW-OD
Mr. David B. Mathis, CERD-C
MAJ Michael Teague, CECW-ZA

Water Resources Support Center
Mr. Thomas M. Ballentine, CEWRC-IWR-P

Great Lakes and Ohio River Division
Mr. Charles N. Johnson, CELRD-GL-E-EQ-T
Mr. Ronald L. Erickson, CELRE-EP-DG

North Atlantic Division
Mr. Andrew Petallides, CENAD-ET-E
Mr. Gregory P. Bass, CENAB-EN-GH
Ms. Lynn M. Bocamazo, CENAN-EN

Pacific Ocean Division
Mr. Kenneth J. Eisses, CEPOA-EN-CW-HH

South Atlantic Division
Dr. Albert G. Holler, Jr., CESAD-ET-EH
Mr. John W. Meyer, CESAD-ET-PL
COL Joe R. Miller, CESAJ-DE
Mr. John F. Adams, CESAJ-CO-O
Mr. Girlamo DiChiara, CESAJ-CO
Mr. Daniel R. Haubner, CESAJ-PD-PC
Dr. Edward E. Middleton, CESAJ-EN
Mr. Michael A. Ornella, CESAJ-DP-I
Ms. Cynthia B. Perez, CESAJ-EN-HC
MAJ Edward G. Pruett, CESAJ-DP-I
Mr. David V. Schmidt, CESAJ-PD-PC
Mr. Thomas Smith, CESAJ-PD-PN
Mr. Charles F. Stevens, CESAJ-DP-I
Mr. George M. Strain, CESAJ-PD-P
Mr. J. Patrick Langan, CESAM-OP-P
Mr. W. Jeffrey Lillycrop, CESAM-OP-P
LTC Thomas E. Peck, CESAM-PM
Mr. Howard M. Whittington, CESAM-EN-H
Mr. Wade F. Seyle, CESAS-EN-HC

South Pacific Division
Mr. George W. Domurat, CESPD-ET-C
Mr. Arthur T. Shak, CESPL-ED-DC

Cold Regions Research and Engineering Laboratory
Mr. Andrew J. Bruzewicz, CECRL-RS

Waterways Experiment Station
COL Robin R. Cababa, CEWES-ZB
Mr. Charles C. Calhoun, Jr., CEWES-CV-A
Mr. C. E. Chatham, Jr., CEWES-CN
Dr. Lyndell Z. Hales, CEWES-CN-H
Ms. Sharon L. Hanks, CEWES-CV-Y
Ms. Carolyn M. Holmes, CEWES-CV-CC
Dr. James R. Houston, CEWES-CV-Z
Dr. Nicholas C. Kraus, CEWES-CC
Mr. William H. McAnally, CEWES-CE
Mr. E. Clark McNair, Jr., CEWES-CV-CD
Mr. Thomas W. Richardson, CEWES-CC
Ms. Julie D. Rosati, CEWES-CC-C
Mr. Wayne A. Stroupe, CEWES-LV-Z

Guest Participants
Mr. Orville T. Magoon, Coastal Zone Foundation, Middletown, CA
Mr. Malcolm McLouth, Canaveral Port Authority, Cape Canaveral, FL
Mr. James F. Murley, Florida Department of Community Affairs, Tallahassee, FL
Mr. Erik Olsen, Olsen Associates, Inc., Jacksonville, FL
Mr. David K. Roach, Florida Inland Navigation District, Jupiter, FL

Mr. Paden E. Woodruff, Florida Department of Environmental Protection, Tallahassee, FL

Guests

Mr. Santiago Alfageme, Coastal Systems International, Coral Gables, FL
Mr. Charles A. Adams II, City of Fort Lauderdale. Fort Lauderdale, FL
Mr. David Butler, Hillsboro Inlet District, Pampano Beach, FL
Mr. Irvin Baker, Point of Americas Bldg. II Condominium Association, Fort Lauderdale, FL
Mr. Thomas J. Campbell, Coastal Planning and Engineering, Boca Raton, FL
Mr. Michael L. Crane, NOAA, Miami, FL
Mr. Richard Czlapinski, Dames & Moore, Boca Raton, FL
Mr. Donald R. Deis, Post, Buckley, Schuh, and Jernigan, Inc., West Palm Beach, FL
Mr. Daan Dunsbergen, National Institute of Coastal and Marine Management, Rijkswaterstaat, The Netherlands
Mr. Peter J. Elkan, Coastal Technology Corporation, Vero Beach, FL
Mr. Carlos Espinosa, Dade County Department of Environmental Resource Management, Miami, FL
The Honorable Larry B. Fink, Mayor, Hillsboro Beach, FL
Mr. Brian Flynn, Dade County Department of Energy and Resource Management, Miami, FL
Mr. Richard Frost, Biscayne National Park, Homestead, FL
Dr. Gary Gelfenbaum, U.S. Geological Survey, St. Petersburg, FL
Ms. Judith Gray, NOAA, Miami, FL
Ms. Lorraine Guise, Gee and Jenson Engineers-Architects-Planners, Inc., West Palm Beach, FL
Mr. Lon E. Hachmeister, Foster Wheeler Environmental Corporation, Bellevue, WA
Mr. Jamie Hart, City of Fort Lauderdale, Fort Lauderdale, FL
Mr. Robert R. Heinen, TRS Consultants, Inc., San Ramon, CA
Mr. James M. Hemsley, National Data Buoy Center, Stennis Space Center, MS
Mr. Bruce D. Henderson, City of Miami Beach, Miami Beach, FL
Mr. Stephen Higgins, Broward County Department of Natural Resource Protection, Fort Lauderdale, FL
Mr. John G. Housley, Michael Baker, Jr., Alexandria, VA
Mr. Dan Hussin, Great Lakes Dredge and Dock, Oak Brook, IL
Mr. Jerry W. Ingram, Kimley-Horn and Associates, West Palm Beach, FL
Mr. George F. Isiminger, Gee and Jenson Engineers-Architects-Planners, Inc., West Palm Beach, FL
Mr. Wade Jumonville, John E. Chance and Associates, Lafayette, LA
Mr. Robert Kerry Kehoe, Coastal States Organization, Washington, D.C.
Dr. Edward J. Kent, Earth Tech, Concord, NH
Mr. Wayne D. Lasch, Post, Buckley, Schuh and Jernigan, Inc., Jacksonville, FL
Mr. Charles W. Listowski, West Coast Inland Navigation District, Venice, FL
Mr. John H. Lockhart, Jr., Fredericksburg, VA
COL Miller L. Love, Jr., Ret., U.S. Army, Collins Engineers, Inc., Mt. Pleasant, SC
Mr. Howard D. Marlowe, American Coastal Coalition, Washington, DC
Mr. Michael J. McCarthy, Frederic R. Harris, Inc., New York, NY
Mr. Thomas M. McCormick, CH2M Hill, Deerfield Beach, FL
Mr. Douglas H. Menefee, Jacksonville Port Authority, Jacksonville, FL
Mr. James D. Moore, Gee and Jenson Engineers-Architects-Planners, Inc., West Palm Beach, FL
Mr. Robert A. Nathan, Moffatt & Nichol Engineers, Tampa, FL
Mr. Michael J. Newbery, Harza Engineering Company, Chicago, IL
Mr. Roland Ottolini, Lee County Natural Resources, Ft. Myers, FL
CPT Alex Pfotenhauer, Point of Americas Bldg. II Condominium Association, Fort Lauderdale, FL
Mr. William F. Precht, Law Engineering and Environmental Services, Miami Lake, FL
Mr. Sebastian Puda, City of Boyton Beach, Boyton Beach, FL

Mr. Steven Richards, Point of Americas Bldg. II Condominium Association, Fort Lauderdale, FL
Mr. John C. Roberge, Ocean and Coastal Consultants, Inc., Trumbull, CT
Mr. John W. Rushing, HDR Engineering, Atlanta, GA
Mr. Frank Rysavy, Hillsboro Inlet District, Pompano Beach, FL
Mr. James M. Sigler, Brown & Root, Inc., Houston, TX
Dr. Jon Staiger, City of Naples, Naples, FL
Dr. Michael F. Stephen, Coastal Engineering Consultants, Inc., Naples, FL
Ms. E. Jeannie Stephenson, Canaveral Port Authority, Cape Canaveral, FL
Mr. Alexander Stone, Reefkeeper International, Miami, FL
Dr. William Stronge, Florida Atlantic University, Boca Raton, FL
Mr. Stanley L. Tait, Florida Shore and Beach Preservation Association, Tallahassee, FL
Mr. W. David Taylor, Consulting Engineers, North Palm Beach, FL
Dr. Jacobus van de Kreeke, RSMAS/University of Miami, Miami, FL
Mr. William A. Venezia, Naval Surface Warfare Center, Dania. FL
Mr. Paul A. Work, Clemson University, Clemson, SC

Court Reporter
Ms. Susan C. Soderberg, Pro/Tech

Proceedings of the 67th Meeting of the Coastal Engineering Research Board

Introduction

The 67th meeting of the Coastal Engineering Research Board (CERB) was held at the Ft. Lauderdale Airport Hilton in Dania, FL, on 13-14 May 1998. It was hosted by the U.S. Army Engineer Division, South Atlantic, under the direction of BG Robert L. VanAntwerp, Commander, and the U.S. Army Engineer District, Jacksonville, under the direction of COL Joe R. Miller, Commander.

The Beach Erosion Board (BEB), forerunner of the CERB, was formed by the Corps in 1930 to study beach erosion problems. In 1963, Public Law 88-172 dissolved the BEB by establishing the CERB as an advisory board to the Corps and designating a new organization, the Coastal Engineering Research Center, now the U.S. Army Engineer Waterways Experiment Station's (WES's) Coastal and Hydraulics Laboratory (CHL), as the research arm of the Corps. The CERB functions to review programs relating to coastal engineering research and development and to recommend areas for particular emphasis or suggest new topics for study. The Board meets twice a year to do the following:

a. Disseminate information of general interest to Corps coastal Districts or Divisions.

b. Obtain reports on coastal engineering projects in the host (local) District or Division; receive requests for research needs.

c. Provide an opportunity for state and private institutions and organizations to report on local coastal research needs, coastal studies, and new coastal engineering techniques.

d. Provide a general forum for public inquiry.

e. Provide recommendations for coastal engineering research and development.

Presentations during the 67th CERB meeting dealt with regional sediment management. Documented in these proceedings are summaries of presentations made at the meeting, discussions following these presentations, and recommendations by the Board. Documentation and verbatim transcripts of the 67th meeting are on file at WES's CHL.

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Opening Remarks and Welcome to the South Atlantic Division and Jacksonville District

MG Russell L. Fuhrman opened the 67th meeting of the Coastal Engineering Research Board (CERB) and welcomed attendees to the meeting. All members of the Board were present. *MG Fuhrman* introduced the new Board members, MG Jerry L. Sinn, Commander of the U.S. Army Engineer Division, North Atlantic, and Dr. Billy L. Edge of Texas A&M University. He also introduced the Honorable Larry B. Fink, Mayor of Hillsboro Beach. *MG Fuhrman* recognized Mr. John H. Lockhart, Jr., for his contributions to coastal engineering and to the CERB.

MG Fuhrman thanked BG Robert L. VanAntwerp, Commander of the U.S. Army Engineer Division, South Atlantic, for hosting, in his absence, the very successful Partnering Workshop prior to the CERB meeting. *BG VanAntwerp* and *COL Joe R. Miller*, Commander, U.S. Army Engineer District, Jacksonville, welcomed attendees.

Florida Keys Carrying Capacity Study

James F. Murley
Secretary
Florida Department of Community Affairs
Tallahassee, FL

The Florida Keys are home to hundreds of rare, exotic oceanic wonders. Known for their lush tropical hardwood hammocks, pine rocklands, and rocky shoreline, the Keys provide a breeding ground for the third largest coral reef system in the world, lush sea grass beds, and unique terrestrial natural communities.

But the Keys are dying, being choked off by too much human intrusion or other causes about which no one is absolutely certain. The genesis of this malady must be determined and mitigated; otherwise, one of the natural wonders of the world will cease to exist.

In concert with the U.S. Army Corps of Engineers, the Florida Department of Community Affairs (DCA) is taking steps to remedy this plight by conducting a Carrying Capacity Study.

The Keys, while they are not a sandy shoreline--they are basically limestone remnants of the receding sea--provide an unbelievably beautiful area for residents and tourists. Over 80,000 people reside on these small keys connected by U.S. Highway 1. Another 2 million visitors each year come to enjoy the many attractions of the area, and they create the kinds of coastal impacts that exist throughout the shorelines of the United States. They are particularly concentrated and have significant adverse impacts on the wonderful, valuable coral reef, which protects the Keys but also provides the tourist attraction to begin with.

With concerns about human impacts, the changing natural environment, and sustainability issues resulting from the South Florida Restudy, the DCA is examining some extraordinary new ways of approaching the long-term sustainability of the Florida Keys. This effort is referred to as the Carrying Capacity Study, one of the critical projects authorized by the Water Resources Development Act (the authority of the Corps of Engineers for conducting the South Florida Restudy and the water-management activities that are so critical to the Everglades (e.g., storing water for resupply and the estuaries)). Within that huge hydrologic study, there exists a place to study the very unique issues dealing with the Florida Keys.

The Florida state government is overseeing many decisions of the local officials. In partnership with them, the state is trying to provide extra resources to help them with their unique problems. Those

problems are substantial in the area of environmental quality, intershore pollution from cesspits, impacts on the coral reefs, threats to over 100 species, and endangered and threatened species including the Florida Key deer, which has its habitat on Big Pine Key and is significantly impacted by transportation and other residential impacts.

The Keys are one of the most difficult areas to plan for emergency evacuation. The DCA is responsible for emergency management in the state and, since Hurricane Andrew, has concentrated on its ability to evacuate citizens and visitors from the Keys. At least 24 hr are needed to evacuate the Keys. It is the worst type of forecast for any part of Florida, removing people within time of the predicted warning system from the National Oceanic and Atmospheric Administration weather service. Hence, hazard mitigation is an important part of the Carrying Capacity Study, along with environmental quality.

With cooperation from the Corps' Jacksonville District for the past several months, the DCA has been designing a scope of work for the Carrying Capacity Study. It is not an easy task to discuss real and perceived understanding of the facts as they relate to the issues with people who have been working in the Keys, to arrive at a consensus with which everyone will initially be comfortable about the strategy for advancing with this work over the next 3 years. This consensus is believed absolutely critical, but the DCA does not initially have the cooperation and input of some valuable players. When such studies take place, there can be people on the outside commenting from their perspective about what is not being done correctly. It is desired to have as many pertinent people working on the design of the scope of work as possible. The design is in its final phases.

The Carrying Capacity Study is intended to be a tool transferable to other similar areas in the United States, and perhaps island nations throughout the world, that allows decision makers at the local, state, and national levels to evaluate future decisions to determine whether they will reach certain sustainable thresholds or benchmarks that the DCA has developed for the Keys. If certain development patterns are allowed to proceed, the Carrying Capacity Study must determine if that will create demands on the system for treating the effluents and various other aspects of community development beyond the cost or capacity of that available in the Keys.

Besides the scientific, social, and economic information, the DCA is going to have to deal with the difficult task of understanding the values of the people, the citizens of the Florida Keys. The DCA must understand what the people want their communities to be like, because they may well set some thresholds from their perspective that may be different from what may be arrived at from scientific and engineering aspects.

The South Florida Restudy will set trends for one-third of the state of Florida, probably 7 to 10 million people, over the next 50 years. As the Carrying Capacity Study of the Keys progresses, it will provide us with the experience and benchmarks of how the rest of the two-thirds of the state could work. The DCA will learn a lot from the Carrying Capacity Study that can be used in the rest of the state, and hopefully the results may be applicable to other regions of the country and around the world.

Discussion

BG Robert L. VanAntwerp asked Mr. Murley if he could project the number of people expected in the Keys, beyond the 80,000 permanent residents there now, and if he felt that number to be fairly fixed over the next 5 to 10 years. *Mr. Murley* responded that the number will grow, but not rapidly because of an interim rate-of-growth ordinance unique to that area of Florida, which establishes a maximum number of 230 new units allowed each year.

BG VanAntwerp asked the timeline for the study. *Mr. Murley* said that his goal is for the study to be under way by 1 July. He said he hoped a year from now he would be able to report back on the final study design, the actual methodologies that consultants are using in the field.

COL Joe R. Miller stated that the District was looking to complete the study by August 2001, so it is going to be about a 3-year effort. *Mr. Murley* agreed that was correct.

SandyDuck Media Update

Wayne A. Stroupe
Public Affairs Office
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS

From 22 September to 31 October 1997, the U.S. Army Corps of Engineers Field Research Facility (FRF) at Duck, NC, was the site of SandyDuck, the largest coastal field experiment ever conducted. In conjunction with the research efforts, there was a concerted public affairs (PA) effort to promote the SandyDuck experiment, the collaboration of government and academia, and the coastal mission and capabilities of the U.S. Army Corps of Engineers (USACE).

Media Summary

SandyDuck was the perfect media opportunity to promote advances in coastal engineering and champion the need for additional research. Coastal programs and PA professionals from Corps Headquarters and the U.S. Army Engineer Waterways Experiment Station (WES) met months prior to the experiment and developed a detailed media plan that was coordinated with the other sponsoring agencies, U.S. Geological Survey and Office of Naval Research.

Media efforts included extensive use of the Internet as an information source; informative news releases sent to 108 coastal newspapers around the country with circulations of over 20,000; media fact sheets and information kits provided on request; and 16 national media outlets targeted for special emphasis with invitations to attend the experiment during "media days" set aside to minimize experiment interruptions.

Media coverage was very favorable for the Corps of Engineers and coastal engineering research. National television coverage (over 26 minutes) was provided by live broadcasts of The Weather Channel and features on CNN. National newspaper coverage included articles in the *New York Times*, *USA Today*, and Associated Press newspapers. A media highlight list is included at the end of the discussion.

Major media contacts made previously, including some from DUCK94 at the FRF, were reinforced through SandyDuck media efforts. Cory Dean, science editor for the *New York Times*, and Simon Ross, a producer for The Weather Channel, had both previously visited the FRF and were instrumental in coverage of SandyDuck. New national contacts were also established, most notably Ann Kellan and Rick Lockridge of CNN. Kellan has already called for more Corps coastal information.

Knowing that the activities of SandyDuck had a very limited life span but that media interest in such coastal activities would continue for years, a large volume (almost 7 hr) of broadcast quality videotape (Beta SP) was shot during the experiment. This footage was supplied to and used by both the CNN and North Carolina PBS broadcasts. A 30-minute compilation of some of the more exciting video scenes from SandyDuck has been edited and is available for future distribution. It has been recently distributed to ABC TV's documentary division for use in a Corps of Engineers documentary for The Learning Channel and to the BBC for use in a coastal storm documentary called "Savage Seas."

Advantages of SandyDuck and FRF

SandyDuck was a perfect vehicle for media interaction for several reasons. The research was of national scope and interest. There were many exciting, interesting, and visual activities going on in a very small, centralized location - perfect for television coverage. There was a very large and diverse group of coastal researchers in one location that provided excellent opportunities for both print and broadcast media. The actual experiment occurred in a very short (6-week) time span, which helped focus interest. Also, the FRF, by its very location, is on the "front line" of coastal research. It offers research on the beach - not in a government building or on a college campus.

Research efforts like SandyDuck appear to be more appealing to national media than typical coastal construction projects. In coastal dredging, breakwater, and related projects, the "story" as perceived and presented by the media is often the friction and skirmishes between the project proponents and opponents. The media story line is usually "developers versus environmentalists." For example, the CNN crew that visited and featured SandyDuck also did a related story on Oregon Inlet. While they tied the research application of SandyDuck to the problem at Oregon Inlet, a major emphasis of the feature was the long-term and ongoing struggle between the jetty supporters and opponents. In addition, most coastal projects have limited regional interest, while coastal research efforts can draw a national audience due to the widespread application of research results.

The FRF's geographic location and pier facility are important assets for media interaction, especially during storm events. Both The Weather Channel and National Public Radio, while aware of SandyDuck, were actually convinced to highlight the FRF because of storms and the research conducted during such conditions, especially with the Sensor Insertion System.

Lessons Learned

Several points are evident from the SandyDuck media interaction. Most coastal media attention

still revolves around storms (hurricanes, nor'easters, etc.) and beach erosion. These are exciting and visual topics. Due to its location, the FRF is perfect for storm-related media interest. WES will continue to use the FRF as the door for media to access all types of coastal engineering projects and research in the Corps of Engineers.

Also, until the Administration's policy on beach erosion changes, we are still in "limbo" as far as the Corps' mission and responsibilities in this area. But this has been, and will continue to be, one of the major areas of interest for the public and the media.

Conclusions and Future Plans

The SandyDuck media campaign was extremely successful for the amount of PA support that could be provided. We (the Corps) are still working with media contacts from SandyDuck and will continue to do so in the future. However, the majority of the normal media contacts (80-90 percent) are still reactive - responding to a call from the media. We do not aggressively market the Corps' coastal mission, responsibilities, research, or benefits to the Nation. This is mainly due to limitations on manpower and funding, and other job responsibilities.

Through the Public Affairs Office (PAO), Headquarters (HQ), USACE, the WES PAO is developing and will coordinate an effort in conjunction with Corps Districts and Divisions with coastal mission responsibilities in relation to El Niño responses. The WES PAO will compile a list of all regional and national El Niño media contacts for future use. We will also ask these Corps PA professionals for "lessons learned" from their El Niño experiences. To assist individual District PAOs during coastal storm events (when local public affairs resources may be overwhelmed), WES will compile a list of HQ, WES, and other coastal Corps professionals as possible media sources and contacts.

In this vein, the Corps needs to consider establishing a cadre of coastal professionals to interact with the media. While the Corps is fortunate to have coastal professionals at Districts, WES, and even the FRF, the Corps needs to consciously look at younger, diverse professionals, and nurture and train them as Corps coastal media contacts for the near and long term.

Discussion

MG Jerry L. Sinn commented that to him it seems like public affairs contact is frequently broken. He believed this is a great story about the FRF which included 26 minutes of coverage to the nation, but there will now be a 12-month discontinuity. And then there will be another story, etc. He

thought the Corps should find a better way to maintain contact with everyone. He lives in the most dense portion of the United States, but the Corps isn't visible except in a recent "Fleecing of America." He noted the bulk of the voting populace lives in the Northeast, and the Corps has probably missed an opportunity in that area for continuing coverage. *MG Sinn* added, "I am throwing stones at me more than anyone else. I can't help you make contacts very well. My Division and Districts don't have the resources to do that. Have you thought about how we might maintain contact?" *Mr. Stroupe* replied that the problem is resources and manpower everywhere. He thought PAOs should work together and do a better job of looking at the national implications.

SandyDuck and Related Coastal Media Highlights

The SandyDuck coastal experiment provided an excellent vehicle to promote the U.S. Army Corps of Engineers as the Nation's Coastal Engineer. The following is a synopsis of some of the larger media outlets that covered SandyDuck and subsequent media contacts related to the experiment.

The Weather Channel visited SandyDuck at the Field Research Facility (FRF) and broadcast live at the top of each hour throughout the morning and early afternoon on 18 October 1997. A variety of experiments and researchers were highlighted. Total broadcast time was 18:20 minutes (over 68 million subscribers - 325,000 viewers at any given moment.)

A **CNN** news crew visited the FRF 26-29 October 1997. A SandyDuck overview science feature ran nationwide on 6 December 1997 (4:05). They used quite a bit of video supplied by the Corps. A related feature on Oregon Inlet aired on 17 January 1998 (3:55). (Features ran on CNN, CNN-International, Headline News, and the Airport Channel.)

New York Times science feature article on SandyDuck by Science Editor Cory Dean was published on 21 October 1997 following a visit Dean made to SandyDuck (weekday circulation 1.2 millión).

USA Today ran a SandyDuck science brief article nationwide on 7 October 1997 (weekday circulation 1.9 million).

Associated Press national reporter Estes Thompson visited the FRF on 30 October 1997. A SandyDuck feature article ran on the nationwide AP wire 9 January 1998 and was picked up by numerous newspapers (1,551 AP newspapers nationwide).

Granada Television, a British documentary production company, was supplied SandyDuck video for their documentary, "Savage Seas." Their film crew visited the FRF on 31 March 1998 to film more footage.

North Carolina PBS film crew shot video at SandyDuck on 22 October 1997. They visited the FRF again in mid-November. Corps video was also supplied. NC PBS aired a SandyDuck segment the first week of December (5:50). A longer feature is scheduled to air in 1998.

Sea Technology magazine published a major feature article on SandyDuck in their January issue. They were invited to SandyDuck and received press pack, slides, and information.

International Dredging Review received press information on SandyDuck. Judith Powers conducted phone interview with SandyDuck staff.

The **National Public Radio** show **"All Things Considered "** interviewed Dr. Jane Smith working at the FRF concerning coastal research and an east coast storm. The interview aired nationwide on 6 February 1998 on NPR (4:20).

ABC Television Documentary Productions was supplied SandyDuck video for possible use in a one-hour documentary on the Corps of Engineers they are doing for The Learning Channel. Other Corps coastal subjects are also being promoted for use in the documentary.

Coastal Living magazine contacted the Waterways Experiment Station on 15 April 1998 about post-SandyDuck results. A media package is being assembled in reply that will highlight several major aspects of Corps coastal engineering efforts.

Virginia Pilot (Norfolk, VA) newspaper ran a large feature article on SandyDuck on 30 October 1997 following FRF visits by reporter and photographer (weekday circulation of 169,000).

El Niño Update

BG J. Richard Capka
Commander
U.S. Army Engineer Division, South Pacific
San Francisco, CA

From the Corps' perspective, in California, El Niño has taken on several contexts; certain flood, coastal damages, mud slides, etc. There are many different aspects this El Niño winter has caused in California. Things should be put into perspective. While one is mostly concerned with coastal phenomena, it is necessary to address other aspects of El Niño.

First, a year prior to El Niño, in January 1997, California had another pretty significant event, the intense, 4-day Pineapple Express. It brought a lot of rain and a lot of flooding when many levees broke. Repairs cost $120 million. That kind of repair ($120 million in unforeseen work) is not something the Corps normally does in one year. But that was the goal.

After that work was under way, about the June time frame, the National Oceanic and Atmospheric Administration (NOAA) discovered a warm mass of water that was moving across the Pacific, and hence, El Niño became the common term in our everyday lexicon. The anxieties caused by the previous January were still fresh in the minds of those in California, particularly in the Central Valley. Those who had experienced the El Niño of 1982-1983 still remembered that, also. When combined with discussions of El Niño droughts and severe weather, much anxiety was raised in California.

The 1998 El Niño effects in terms of storms, were serious and fast-moving. They really started moving into California in January 1998. About every 18 hr a new storm front would come through, broken by about 9-18 hr of calm weather. There was also a considerable amount of snowpack and, in terms of the flood-control aspect, all that snow sitting up in the Sierras was potential water into the drainage system, which certainly recalled January 1997, when the Pineapple Express came through. There was a lot of anxiety from the folks in California for flood control as well as other aspects of El Niño.

With all the attention that was being given to El Niño, a lot of other agencies in California, local, state, and Federal, were preparing for whatever might come. From the Corps' flood-control perspective, the work started in January 1997 was really the lead-in work. There were a number of prominent visitors in California for a summit in Los Angeles. General Fuhrman was there along with a number of

Washington-level people, including the Vice President, to talk about preparations for El Niño. Even the regulatory program, the Corps' 404 Program, was in high gear so that program could be set up to respond quickly to anything that might occur in the coastal area or in the wetlands and other waters of the United States. The National Weather Service said that on a scale of 1 to 5, this El Niño would be a 5+. Abnormal patterns of temperature throughout the globe would produce wetter than normal conditions in California. It was believed initially that southern California would probably get the brunt of El Niño, and things would taper off as one moved further up coast to the northwest.

El Niño probably impacted everywhere along the coast. Great white sharks were fighting killer whales, and marlin were off the coast of Oregon. Lots of unusual things were going on, setting the stage for a very wet winter. About $20 million of damages were experienced by flood-control projects in terms of Corps emergency funding which was available under Public Law 8499. These aren't the funds the Corps could use to repair or respond to coastal problems. Operations and maintenance money takes care of that. Nonetheless, $20 million as compared to $120 million the year before was what the Corps set aside and required to respond to emergency contracts.

Everyone saw on the news photographs the problems with supersaturated ground conditions, such as the photo from Pacifica near San Francisco, where the cliffs upon which homes were built (originally a good 150 to 200 ft back from the edge) gradually fell into the surf. It was a combination of undermining as a result of wave actions down below and a lot of supersaturated conditions and poor drainage on the top side of the cliffs. Those homes were eventually abandoned or torn down.

There was heavy surf. Twenty-foot waves were very common throughout the entire season, and there resulted a considerable amount of shoaling in the coastal harbors. The high tides, combined with high waves up north in the Pacifica/San Francisco area, as well as down south in the Malibu and the Los Angeles areas, certainly took their toll.

Regarding navigational impacts, there was a considerable amount of shoaling. That was the biggest problem in the South Pacific Division as a result of El Niño. There was not one beach the Corps was responsible for in terms of a Federal project, but it was really the shoaling of the harbors and channels that caused the Corps to respond along the coast. Ventura Harbor, Santa Barbara, Oceanside, Morro Bay, Humboldt Harbor, and Marina Del Rey all experienced significant shoaling. One vessel ran aground coming into Humboldt Harbor and had to be pulled off the shoal at high tide. There were very unusual shoaling patterns as a result of El Niño.

Regarding the wave climate that El Niño produced, the average for the western coast during this time of year is about 1 m. In January 1998, the average was up around 3 m, with some reaching as much

as 7 m around 20 January. The wave heights were consistently above 2 m. In February, the wave climate even increased, with an average of about 4 m throughout the entire period, and almost reaching 8 m. Things started to decline as February receded. Wet weather was experienced throughout this entire time.

When comparing this El Niño to others, the 1982-1983 El Niño is the one most people consider. The wave climate during that particular time frame was considerably higher than what was experienced in 1998. The 1998 El Niño had wave heights up to about 22-23 ft. The 1982-1983 events were significantly higher. Nevertheless, the 1998 events were consistent over the January/February time, and the California beaches, shores, and coastal structures took quite a beating, with a resulting requirement to clear shoaling from channels and harbors.

Regarding costs, the $20 million previously mentioned was the Corps' response for the 8499 authorities. In terms of dredging, the Corps attributed about $35 million worth of advanced maintenance dredging that is going to be required as a result of the El Niño storms. The Corps had to respond in emergency mode at two locations; at Humboldt Harbor where it was necessary to bring one of the Corps' dredges to do work, and at Marina Del Rey where the entrance channel shoaled almost completely closed. In order to get some of the emergency Coast Guard vessels in and out of Marina Del Rey, the Corps had to respond there also.

The navigation structure breakwater at Ventura received the most damage. A lot of the stones were displaced here. Other structures in very similar locations such as Ventura included Channel Islands, Port Hueneme, Port San Luis, and Redondo Beach, and these structures probably received the most damage. That damage ranged from just a little to a considerable amount of stone displacements, and the Corps will make the repairs. It will cost about $17 million to make these repairs.

From the Corps' perspective, the advanced concerns and the anxieties that the people of California felt as a result of the warning of an El Niño in the future, really allowed the local, state, and Federal agencies to respond very well. Not a lot can be done in the way of landslides. And folks are still living with those kinds of problems. The El Niño situation is about over.

About 200 percent of the snowpack still exists up in the Sierras. So that means that it is going to be a good year for high reservoirs. If there is not a flash melting of the snowpack, then the state of California should be in pretty good shape.

The Corps weathered this particular El Niño in pretty good fashion. George Domurat from the Division and Art Shak from Los Angeles are here, and can answer specific questions concerning any of the El Niño problems that may occur, the response of the beach, or other effects of El Niño.

Discussion

Dr. Billy L. Edge asked if there was any damage to the jetties at either Crescent City or Humboldt? *BG Capka* replied that although there was significant wave activity, there was no reported damage on either of the structures.

Mr. Steven Richards asked how the intensity of the storms was measured? *Mr. George W. Domurat* replied that it was the significant wave height in meters from the NOAA gauge off San Francisco. *Mr. J. Michael Hemsley* of the National Data Buoy Center gave more details.

Integration of New Technologies into Corps Operational Practice

Barry W. Holliday
Chief
Dredging and Navigation Branch
Construction and Operations Division
Headquarters, U.S. Army Corps of Engineers
Washington, DC

Our Research and Development (R&D) programs have been very successful in developing new tools and technologies that can improve the efficiency and effectiveness of Corps navigation and coastal projects. However, new tools are only effective if they are used. There are many cases where the tools have been fully incorporated in the Districts with no higher level guidance or policy needed. There are also cases where the tools have been developed, guidance manuals prepared, and little to no field usage has resulted.

One of the reasons for lack of use could be the organizational changes that have occurred in the Districts, including the many new faces responsible for projects - the Operations Managers (OM). Concurrently, many of the field people who guided the Dredging Research Program and the Dredged Material Research Program are retired, and the corporate memory has dwindled. New technology effects change that, quite often, may be threatening to some who function best in the comfort of constancy. We can create all the best new tools our R&D money can buy, but throwing them at our field staff without showing them how to grasp the handle will ensure they choose to duck, rather than embrace, the change.

We have to be sensitive to the changes that have occurred, and package and market our new technologies and new tools effectively. We can prepare guidance documents and support them with Headquarters policy statements that "expect" Districts to accept and use these new tools. But, as long as there are 40 Districts with 40 different viewpoints, full implementation will be a very tough nut to crack. Every opportunity must be identified to spread the word about new tools, even if the audiences overlap; redundancy may be required to overcome indifference and reluctance to change.

To ensure that our coastal and navigation R&D investments are fully implemented will require a change in the way we have sought to transfer the technology to applications in the field. First, we must focus on development of technologies and tools that the field needs and wants. This will require consistent field review group oversight through the research and development process. The end product must be a cost-effective tool or technology that will result in improvement. The product must be identified with a specific level of expertise. We cannot hand an OM a complex software package that

requires various input parameters that must be derived from years of coastal engineering experience and training, and expect the OM to immediately derive management decisions. THE TOOLS MUST FIT THE USERS! We must make sure there are qualified individuals identified to support the field implementation. To ensure someone is there creates a resource problem. We don't have the resources, both money and personnel, to support readily available tech support. With dwindling R&D budgets, comes substantially less flexibility to pull researchers off to help field implementation. The answer may be a line-item budgeted service, like the very successful Dredging Operations Technical Support (DOTS), that would be a central focal point for both promoting new technologies and a service for implementation questions and problems. Just being able to connect someone who is having a problem with someone who has experience using the technology may preclude involving a researcher's time to answer a question.

Discussion

Dr. Robert G. Dean believed that Mr. Holliday had addressed a very important and ongoing problem. He stated that if really good tools are developed and are on the forefront of technology, then they should be incorporated into university course content. He suggested the Corps could have a role in shaping the course content. *Mr. Holliday* agreed this would be a good forum. *Dr. Dean* also suggested the merits of new tools could be evaluated by applying these to a previous problem in which earlier tools had been used.

Dr. Nicholas C. Kraus made some observations and suggestions regarding technology transfer. One concerned getting the technology out to the field through a culture change in people doing R&D to reflect a "we-need-it-now" attitude. Some of the others concerned packaging programs within systems that minimizes systems that users have to learn. He noted we must better leverage mission support work to R&D. *Dr. Kraus* agreed with Dr. Dean's suggestion concerning getting tools to the universities. He noted the younger generation is very PC literate, and the U.S. Army Engineer Waterways Experiment Station can provide those tools to the universities that would use them.

Mr. Stanley L. Tait said an inexpensive mode of technology transfer is the shore protection conferences where pertinent people are in the audiences. He specifically referred to the American Shore and Beach Association annual conference, the Florida Shore and Beach annual conference, and the National Conference on Beach Preservation Technology.

Mr. Holliday said the Corps recognizes that it must embrace the industry, professional organizations, and alliances to partner with them and find ways to use the new tools. Conferences definitely should be used as tech transfer opportunities.

Mr. Charles N. Johnson made the point that technology adoption is a two-way street that requires action by the Districts, and that management must commit to their representatives attending Field Review Group meetings. *Mr. Johnson* strongly suggested formulation of a DOTS-type program.

Sediment Management Overview

Dr. James R. Houston
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U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS

The coast is where sea meets land. It includes the beach and the dunes behind it, offshore reefs, inlets, estuaries, bays, wetlands, and coastal engineering structures such as jetties and channels.

The coast is critical to the Nation's economic well-being. The Nation's water transportation infrastructure of ports and harbors is served by navigation channels passing through the coastal zone. This infrastructure is one of the world's most extensive and economically significant waterborne commercial operations handling 95 percent of the U.S. international trade. Beaches are critical to the U.S. economy since they are the number one U.S. tourist attraction, and tourism is the largest U.S. industry, employer, and earner of foreign revenues. Beaches provide a critical buffer to coastal infrastructure against storm attack thereby reducing losses due to storm flooding and saving costs of disaster relief. The coastal zone also has a very high ecological value since it serves as home for many species of animals and as spawning or nesting areas for others and supports a wide variety of aquatic vegetation.

The coast is dynamic, changing shape in a balance of the forces of waves and tides with sediment sources, natural barriers, and engineering actions. Waves, wind, and tide recognize no political boundaries, and the currents they produce move sand along the beach across local, state, and even international lines. Unimpeded, the typical current running along the beach would carry a grain of sand about 2 miles per month. This sand grain may have originated in distant mountains thousands of years before arriving at its current location. It may be deposited in the future on beaches and in dunes at other locations, depending on the balance of forces. Sand also is supplied by and lost from the beach in exchanges with the offshore, inlets, estuaries and bays, and the upland.

Ideally, the Nation's coast would be a balanced, continuous, natural system, but in actuality society's activities have affected virtually all coasts. Since the flow of sand is not unlike the flow of water in rivers and the flow of blood in our bodies, disruptions of the movement of sand can have serious regional, as well as local, consequences. Engineering actions on the coast may alter the movement of sand. Dams can prevent sand that would naturally flow to the ocean from doing so. Sand can be trapped in inlet navigation channels and by jetties, so that the beach on one side of an inlet may grow and the

beach on the other side may erode. Engineering practices that are not in accord with the trend of natural sand flow, such as disposal far from shore of material dredged from channels, will harm the beach where that sand would have moved. The natural transport process of sand recognizes no distinction between authorizations for navigation and for shore protection or beach preservation.

The Corps of Engineers actively interacts with the natural system, moving sand from location to location. The Corps maintains 925 coastal ports and harbors including 299 deep-draft and 626 shallow-draft ports and harbors. It spends about $500 million a year dredging 250 to 300 million cubic yards of sediments from coastal navigation channels and moving the dredged sediments to other locations. The Corps spent almost $100 million in FY97 on shore protection and restoration projects, taking tens of millions of cubic yards of sand from a wide variety of locations and placing it on the beach to protect against storm damage. Many Corps' navigation projects involving jetty construction and navigation-channel maintenance are now more than 50 or even 100 years old. These projects were constructed without knowledge of possible regional impacts. With advances in understanding of coastal sediment processes, and with experience gained through observing the impacts of earlier projects, we are learning of the regional impacts navigation projects may have. Large jetties, deep channels, and sand management practices that are in conflict with the natural movement of sand along the coast can be detrimental to beaches many miles from the project and across many political boundaries.

Although the Corps has traditionally had a project focus, there is an increasing interest in considering coastal problems on a regional basis so that we understand the complete effects projects will have before they are constructed. For example, Subsection 4 of Section 227, Water Resources Development Act of 1996, authorizes the Corps to " . . . cooperate with any State in the preparation of a comprehensive State or regional plan for the conservation of coastal resources located within the boundaries of the State." There also is increasing awareness that sediment is a valuable resource, and it should be carefully managed as such. For example, policy given by 33 CFR Part 337.9 directs that, "District engineers should identify and develop dredged material disposal management strategies that satisfy the long-term (greater than 10 years) needs for Corps projects. Full consideration should be given to all practicable alternatives including upland, open water, beach nourishment, within-banks disposal, ocean disposal, etc." In developing maintenance strategies, the Corps is directed to make all reasonable efforts to comply with state water-quality standards and with Federally approved coastal-zone programs. As part of these programs, several states recognize sand as a valuable resource, and they now require beach-quality sediment removed from navigation channels to be deposited on beaches or in the littoral zone. There also is increasing recognition that a project focus may not be the most economical way to

conduct business. In some cases sand dredged from navigation channels has been disposed offshore beyond the active littoral zone. Separate shore-protection projects restoring sand to beaches were then developed that had to search for sand sources to compensate for the sand lost to the littoral zone through ocean disposal.

What is necessary to manage sediment on a regional basis with the recognition that sediment is a valuable resource? First, the resource needs to be quantified by determining its amount, relevant characteristics, and its distribution. Most U.S. coastal regions process bits and pieces of a definition of the resource usually in the form of discrete geophysical investigations, dredging and fill records, river-discharge records, and site-specific sand budgets. There are few, if any, comprehensive sand inventories that have been performed on a regional basis. Second, it is important to quantify the movement of the resource (for example, how much sediment is moving along different reaches of the coast in a region, bypassing inlets and navigation structures, being trapped in ebb and flood deltas, being impounded by structures, and being relocated by dredging and beach nourishment). Few studies have attempted to determine the movement of sediment on a regional scale. Finally, to manage sediment on a regional scale, one must have engineering tools that allow one to predict on a project and regional basis the effects that enginering activities will have on the system. Currently, it is difficult to reliably model coastal processes on a regional scale and predict how engineering activities will affect the system.

The first presentation this afternoon will present a viewpoint on sand rights and responsibilities by the President of the Coastal Zone Foundation. It will be followed by presentations of current Corps' studies that look beyond just a project formulation to attempt to consider some aspects of the regional sediment system. Then we will discuss some tools being developed in the Corps' research and development programs that help understand sediment motion and impacts of engineering activities on this motion. Finally, there will be a presentation that will suggest additional research required to develop the tools needed to manage sediment on a regional basis.

Sand Rights - The Fragile Coastal Balance

Orville T. Magoon
President
Coastal Zone Foundation
Middletown, CA

and

Dr. Billy L. Edge
Professor, Ocean Engineering Program
Texas A&M University
College Station, TX

From the earliest time, civilizations have been dependent on coastlines. Fishermen built their huts, tended their nets, and gained access to the great food supply of the oceans at the coastlines. Kings and Lords recognized the values of the sea's products for food and the values of bays and river mouths for commerce and eventually as staging areas for their military. The coasts have always had an important recreation value. In modern times, we have come to realize that everyone benefits from the coast, thus, all must share in the responsibility for maintaining the coast.

As civilization demands more from the coast and interrupts natural processes, by constructing cities and harbors, cultivating lands and building structures at the coast, the works of humans often exacerbate the coastal changes induced by the vagaries of nature. Coastal structures that are wisely planned and implemented have stood the test of time. But some have not. But, until recently, the planners and designers did not understand that the works of civilization at some distance from the coast could cause a devastating effect on coastal beaches.

In the temperate regions, coastal plains that had once easily eroded during severe rain storms and supplied great quantities of sand to wash to the shore are covered with parking lots, streets, homes and buildings, and other structures. Some sands are mined from coastal streams and from beaches for fill and aggregate, for glass bottles, and for sandboxes. In tropic latitudes, increased turbidity and reduced water quality may have a negative impact on coral health and ultimate beach sand production. These cumulative actions all reduced the supply of sand to the coastal beaches, which in turn would have provided much needed recreational areas and an environmentally valuable habitat.

Although the impact of an individual action or development may be difficult to quantify, the combined cumulative effect is often catastrophic. Compounding this problem is that coastal remedial

works have usually focused on the immediate reach of coast affected and did not address the basic cause of the problem - the lack of supply of sand to the coast.

What is needed is a body of laws and regulations that will protect the right of sand to travel to and migrate along the coast so that long-term coastal shoreline solutions will be assured, a study of our national coasts to quantify sources and sinks of coastal beach material, the quantification of causes of beach erosion, and allocation for responsibility in equity of solutions where appropriate.

Discussion

Dr. Robert G. Dean recalled that about 10 years ago, California was still issuing or honoring permits to mine sand from riverbeds and asked if sand was still being mined from riverbeds. *Mr. Magoon* replied that they are still mining sand from riverbeds in some locations. He said the owners believe they have the right to mine sand, although it was stopped in numerous rivers such as San Juan Creek.

Dr. Edge said some years ago, South Carolina, in some permitting cases, required that the property owners, in order to build a seawall, place an amount of sand onto the beach each year or every other year equivalent to what would have been lost from the site based on the background erosion rates. He asked if that was happening anyplace else. *Mr. Magoon* replied yes. He was aware this policy has been implemented in many cases in California. He noted some of the difficulties in establishing quantities. In some states such as Massachusetts, land owners are not allowed to protect the coast. *Mr. Magoon* discussed some methods of providing protection.

Mr. Arthur T. Shak commented on removing and selling sand from the Santa Ana River flood channel improvement project in California. It was controversial because it cost more to remove the sand and designate a disposal site as opposed to letting the construction contractor have the material to sell and reduce the cost of the project. *Mr. Magoon* believed projects can be formulated to consider impacts of removing sand from the system.

Commenting on an earlier discussion, *Mr. Magoon* agreed conferences are a very effective tech transfer tool. He said the American Society of Civil Engineers and the Permanent International Association of Navigation Congresses are working together on a conference regarding how to monitor breakwaters. *Mr. Magoon* stated that potential clients come to these conferences, and they are the people who want to know about the CORE-LOCs and Scanning Hydrographic Operational Airborne Lidar Survey systems, etc.

Fire Island Inlet to Montauk Point (FIMP), NY Reformulation Study and Results from FIMP

Lynn Marie Bocamazo
Senior Coastal Engineer, Engineering Division
U.S. Army Engineer District, New York
New York, NY

and

Julie Dean Rosati
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U.S. Army Engineer Waterways Experiment Station
Coastal and Hydraulics Laboratory
Vicksburg, MS

The Fire Island Inlet to Montauk Point Reformulation Study (FIMP) is a comprehensive and systematic analysis to identify and evaluate long-term solutions for storm damage reduction along the south shore of Long Island, NY. The project area, located along the Atlantic Coast of Suffolk County, New York, is approximately 83 miles in length and comprises about 70 percent of the total ocean frontage of Long Island. The project area is characterized by barrier islands, transitional beaches and headlands, in addition to three Federal inlets, and over 200 miles of backbay shoreline. Sediment management, at a full range of spatial and temporal scales, is a primary concern of the reformulation effort.

The original project, authorized by the River and Harbor Act of 1960, proposed widening the beaches to a minimum of 100 ft at an elevation of 14 ft above mean sea level; raising the dunes to an elevation of 20 ft above mean sea level; installing sand fencing and planting grass on the dunes; constructing interior drainage structures at Mecox Bay, Sagaponack Lake, and Georgica Pond; Federal participation in the cost of beach nourishment for a period not to exceed 10 years from the year of completion of a useful nourishment unit; and construction, as needed, of not more than 50 groins. This project is being reformulated, since the original plan selection was conducted prior to the enactment of the National Environmental Policy Act (NEPA) in 1969, and the original formulation did not consider environmental impacts. Past engineering, formulation, and environmental efforts in the 1970's were deemed unacceptable by the Council on Environmental Quality in 1978, because the original study did not look at a wide range of alternatives, nor did it treat the 83-mile project area as a complete system.

The challenge of the Reformulation Study is to develop a suitable solution for storm damage reduction, which will protect and enhance the environmental resources of the study area. The adopted plan for the area must take a holistic approach to the individual engineering solutions, recognizing the interrelationship between the littoral transport patterns, the sediment budget, inlet dynamics, and the inland bays along the entire 83 miles of shoreline.

Current studies under way for the reformulation effort focussing on sediment management include:

a. A comprehensive shoreline change analysis and sediment budget.

b. A regional geomorphic analysis.

c. Computation of breaching and overwash locations and quantification of sediment volumes which enter the backbays.

d. A study of inlet bypassing at Shinnecock, Moriches, and Fire Island Inlets.

e. Cooperative efforts with the United State Geological Service to identify suitable sand sources, regionally map the seafloor and identify and correlate geological features to site-specific shoreline change.

f. An analysis of large-scale sand waves or undulations along the project area shorelines.

g. Coastal processes work efforts, such as numerical modeling of shoreline change and storm-induced erosion, which will predict without-project and with-project impacts to the longshore and cross-shore sediment movement for purposes of design and impact assessment.

Tasks in the Fire Island to Montauk Point project discussed above will evaluate coastal processes and geomorphology on a regional scale, for time periods of engineering significance. Results from these studies will be integrated into final project designs, thereby resulting in a comprehensive sediment management plan which will be formulated to enhance project purposes and avoid adverse impacts.

Discussion

Dr. Richard W. Sternberg asked Ms. Bocamazo to expand on the sand-wave issue.

Ms. Bocamazo replied that the District has identified the amplitudes, wave lengths, and propagation of the sand waves on Fire Island. They have started on the barrier between Shinnecock and Moriches, but there has not been much work east of there. Although only half of the work has been completed, the District has identified a large problem. The District will not be able to build the authorized project of a 100-ft berm without having impacts on the sand waves. This District must include extra volume, and consider how to incorporate the sand waves into the project design.

Dr. Robert G. Dean said that he noticed that the graph Ms. Rosati had shown (the one that Moffat and Nichol had prepared) indicated there was an offshore flow of sand in the vicinity of Shinnecock Inlet. He asked if the onshore flow of sand was still the most popular theory. *Ms. Bocamazo* stated that it was still being considered as a viable theory. By working with the U.S. Geological Survey (USGS), the District will try to determine if there is a large onshore movement. One of the large issues is: Is there a depth of closure? The District has been working with USGS on that issue. *Ms. Bocamazo* added that it is not sufficient to just identify an onshore movement of sand; it must also be quantified.

Mr. Orville T. Magoon asked at what depth the District considers the limit of sand movement offshore? *Ms. Bocamazo* replied that the standard depth of closure the District used was between 8 and 10 m. *Ms. Rosati* stated that there is some theoretical work under way by Mr. Mark Gravens at the U.S. Army Engineer Waterways Experiment Station's Coastal and Hydraulics Laboratory to determine the depth of closure. *Ms. Bocamazo* discussed other work ongoing on this topic.

Luncheon Address
Sediment Management at Port Inlets

Malcolm McLouth
Executive Director
Port Canaveral Commission
Port Canaveral, FL

The Corps, by statute and practice, has a long relationship in building and maintaining the waterways and ports of our Nation, a vital link in our transportation system. For the well-being of the Nation and to participate in a global economy, we must continue to deepen and extend our ports and serve the growing needs of international trade. We must also maintain our harbors with periodic dredging on a responsible and ecologically sound basis, including a comprehensive sediment management approach. The Corps must continue good environmental science; sound engineering practice; sound economic evaluation encompassing local, state, and national benefits; and comprehensive sediment management.

The Corps is one of the world's greatest engineering organizations, and has the in-house talent, experience, and research facilities and administrators to adhere to and foster the aforementioned goals. Concerning new construction, we have all heard that it takes too long to complete a project, the process is too political and smacks of pork-barreling at the Congressional level, and the Corps is too inflexible with regards to adopting innovative solutions. Finally, there is little communication between the various disciplines within the Corps and Civil Works Department, one area I think maybe we can do something about.

The Corps, having heard that, has made great strides in improving its performance in reducing the time required from a recon study to authorization for projects. We have done a whole lot better in the last 4 or 5 years. It's really great progress. Further improvement is needed, but the Corps is on the right track. Efforts are also needed to modify the planning process to allow projects to be approved in a more timely manner consistent with the needs of the port community. We play the chicken-and-egg game: You can't prove you need it until the demand is there, and then it takes 8 to 10 years to get it built.

In the maintenance area, the Supreme Court upheld a lower court ruling on the Harbor Maintenance Trust Fund relating to exports, saying it was not a true user fee, but a tax and thus violated the U.S. constitution. New formulae for user fees must be developed that will overcome the objections of the Court and will result in user fees that are fair, reasonable, and more fully represent the degree of

benefits received by ports and shippers. Excess collections should not be allowed to accumulate beyond a safe and reasonable amount. The amount of money collected by those fees should cover all the necessary maintenance as well as the cost of the sediment management criteria, which are designed to mitigate the effects of Federal inlets on adjacent beaches. I personally feel that a user tax is probably the way to go. It's not going to be easy to solve that problem.

Including funds for capital improvements has also been suggested. It's probably not doable the first time around when added to a similar complex problem relating to the various maintenance needs of the ports. The ports themselves are arguing whether or not we need funding for capital improvements, because some need it and some don't. It is not a level playing field.

Another concern of ports is advocacy. Current practice is that the Corps will only become an advocate when a project has been formulated and a favorable benefit-to-cost ratio has been established. What is missing, from the Port's perspective is the the need for the Corps to assume a leadership role in concert with the U.S. Department of Transportation's intermodal mandates to advocate, educate, and demonstrate the necessity of improving and maintaining the Nation's harbors and channels.

Clearly, ports are as vital to our Nation's infrastructure as interstate highways and roads if we are to compete in the global economy. The absence of investment for port infrastructure in the Administration's 1998 budget indicates a lack of understanding that our ports and waterways are essential to our well-being in this global economy. When you compare the Federal Aviation Administration and its relationship to the airports with the Corps' and MARAD's relationship to ports, it's clear that the latter is not as focused or as effective. The Department of Transportation and the Corps of Engineers need to work closer as advocates for ports and waterways. Perhaps combining port-related functions in these agencies should be considered by the Administration.

Regarding total sediment management practices at port inlets, in many cases the states are well ahead of the Federal government, and the states will require an inlet management plan to accomplish this task. This is certainly true in the state of Florida. Mr. Green and Dr. Dean will expand on Florida's progress in this regard. Mr. Olsen will include applications of a sediment budget in an inlet management plan at Port Canaveral.

Over the years, Canaveral has experienced a segmented approach to sediment management. The Operations and Maintenance managers, following the Corps' regulations, dredge the navigation channel at Canaveral in the most cost-effective manner, using a hopper dredge that over the years has moved in excess of 8 million cu yd of beach-quality sand to a remote offshore disposal site while the beach planners were telling us that shore protection projects were not economical because of the high cost and

unavailability of sand. Doesn't make sense. It took turtle-taking by the hopper dredges to stop this process so we could at least place the beach-quality sand in a nearshore berm off adjacent eroded beaches using a clamshell dredge and split barges. It's now accepted practice at Port Canaveral, and common practice at the Jacksonville District on a routine basis wherever possible.

Although this example demonstrates a lack of advocacy for restoring the Nation's beaches, it also demonstrates the Corps' willingness to adapt to new solutions if they can first be proven. As a first step to turning a negative into a positive advocacy, the Corps needs to look at modifying its rules within their legal ability with regards to dredging materials that can be accomplished in accord with existing legislation.

I suggest the following: (1) a comprehensive inlet management plan for each port needs to be included in the planning process for the Corps, (2) the Corps needs to accept responsibility for mitigating the damage caused to adjacent beaches by Federal inlets (as identified in an inlet management plan), (3) the least-cost mandate needs to be replaced with a policy encouraging the placement of dredged, beach-quality sand on beaches, and (4) bonus incentives need to be included in dredging contracts for clean sand placed directly on beaches, with alternatives to encourage contractors to apply innovative and creative solutions to get the job done.

Demonstration projects need to be utilized, adopting new research technology available from the coastal engineering laboratories, such as the use of hydrocycling of mixed materials or dredged materials to extract the clean sand elements and return them to the beaches. I know you are pushing that. Unfortunately, an overriding, pronounced, negative apathy for beach nourishment now exists in Washington, key to the Administration's policy to get the Federal government out of beach restoration. There is also a significant disagreement between Congress and the Administration on how to treat beach projects, whether or not erosion was caused by a navigation project.

It is clear from recent developments that the Administration is looking to get the Corps out of the beach project business, despite words to the contrary. This would not happen all at once, but there are indications, as we see it. The first indication is the budget process itself. Beach studies are given the lowest priority. It's only when Congress adds funds for studies that they are carried out. Furthermore, follow-on funds or studies in PEDs are frequently omitted in subsequent budgets. The second indication is in cost-sharing. The Administration's Water Resources Development Act (WRDA) '98 bill includes a provision that would change cost-sharing for periodic nourishment from 65-percent Federal and 35-percent non-Federal to the opposite, 35-percent Federal and 65-percent non-Federal. We are getting the message. The third indication is implementation of Congressional mandates. Despite a number of

recent legislative provisions included in the WRDA bill (e.g., Section 206 of WRDA '92, construction of shoreline protection projects by non-Federal interests, and Section 227 of WRDA '96, shore protection), the Administration has done virtually nothing to implement these provisions as intended by the enacted legislation.

Not a single Section 206 agreement has been signed. The Corps to date has not even produced a model 206 agreement, and the beach-related items contained in Section 227 have been ignored. These problems and others were recently summarized by Mr. Marlowe, President of the American Coastal Coalition, to Mr. Guthra, Associate Director of National Resources, Energy, and Science at the Office of Management and Budget. Mr. Marlowe points out that "If non-Federal sponsors are to be asked to take on a greater share of the financial responsibility, they must benefit from a streamlining of the time-consuming and costly process which currently applies to shore protection projects. The feasibility of study processes must be shortened and reduced in cost. In addition, policies should be adopted which encourage the planning, budgeting, and construction of reimbursable projects."

The ports know that it will take time to work out the legislation necessary to establish a replacement for the Harbor Maintenance Trust Fund and a comprehensive, enhanced national shoreline protection program that meets the fiscal requirements of a balanced Federal budget. But we also recognize that there are those who say that the cost of beach restoration is a waste of Federal tax dollars. Considering the hefty economic benefits our beaches have to the national economy, the Corps' own studies indicate they are way off base. However, to blunt this inaccurate perception, which is seemingly shared by the Administration, the Corps needs to do a better job of combining benefits to the project, such as maintaining navigation channels and beach restoration using a comprehensive sediment management approach.

Ocean City/Assateague Island, Maryland, Studies

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The Ocean City Water Resources Study (OCWRS) was a multi-faceted investigation into the historical evolution of Ocean City Inlet, its effects on the adjacent barrier islands and bays, and an evaluation of potential solutions for ongoing and anticipated project-induced impacts at the site. In particular, a range of alternatives to minimize storm damage of the barrier islands (and ultimately the mainland), decrease bay sedimentation, and mitigate for downdrift barrier erosion (Assateague Island) were defined. In this discussion, the history of Ocean City Inlet and its impacts on the adjacent barrier islands and the existing Atlantic Coast of Maryland (Ocean City) Shoreline Protection Project will be briefly reviewed. Additionally, the portion of the OCWRS that focused on developing a long-term restoration project for Assateague Island will be presented.

Ocean City Inlet was formed by a hurricane on 23 August 1933, which separated a continuous barrier island into Fenwick Island to the north and Assateague Island to the south. The inlet was stabilized with jetties from 1933 through 1935. Ocean shoreline change rates for the downdrift barrier, Assateague Island, more than doubled from a pre-inlet (1849/50-1929/33) erosion rate averaging -4.9 ± 5.2 ft/year to a post-inlet (1929/33-1996) erosion rate averaging -11.5 ± 11.5 ft/year (latter rate excludes shoreline advancement due to beach fill). These data represent calculations for the Assateague Island ocean shoreline extending 8.8 miles south of the inlet. For the post-inlet time period, overwash processes were significant along Assateague Island, with bay shoreline change indicating accretion for all consecutive time periods. For the updrift barrier, Fenwick Island, the shoreline erosion rate has been relatively constant through time (-1.8 ± 3.1 ft/year for the pre-inlet time period to -2.0 ± 3.6 ft/year in the post-inlet time period (latter rate excludes shoreline advancement due to beach fill)). These data represent calculations for the Fenwick Island ocean shoreline extending 9.4 miles north of the inlet. For the post-inlet time period, the bay portion of Fenwick Island was comparatively stable, experiencing only rare overwash events.

In accordance with the Water Resources Development Act of 1986, the Atlantic Coast of Maryland (Ocean City) Shoreline Protection Project was authorized for construction. The project was constructed in two separate phases. In 1988, the state of Maryland placed a recreational beach fill

between 3rd Street and the Maryland-Delaware state line. In 1990 and 1991, the U.S. Army Corps of Engineers (USACE) placed a storm-protection beach fill which included a dune, seawall, and wider beach and berm along the same stretch of shoreline. Furthermore, the project is to be renourished periodically over its 50-year economic life. In addition to the initial construction, the Federal project was rehabilitated in 1992 and 1994, to reestablish the project protection level after a series of major storms impacted the area. The projects were constructed of beach quality material taken from three offshore borrow areas. A total of approximately 9.4 million cu yd of material were placed during the initial three years of construction and the subsequent project rehabilitation. Total project costs through February 1998 are approximately $47,200,000, while it is estimated that the project has prevented approximately $230,000,000 in damages to upland development, resulting in a project benefit/cost ratio of 4.9.

In accordance with the Water Resources Development Act of 1996, the USACE is authorized to carry out the restoration of Assateague Island pursuant to Section 111 of the River and Harbor Act of 1968, as amended, if the Federal navigation project has contributed to degradation of the downdrift shoreline. Section 111 authorizes the USACE to mitigate for shore damage attributable to a navigation project. Analysis of the sediment transport processes which have existed in the vicinity of Ocean City Inlet indicated that the jetty and inlet system have indeed impacted northern Assateague Island.

During the feasibility study, numerous alternative solutions were evaluated and a plan was identified that will adequately mitigate for the impacts caused by the construction of the jetties. The plan involves two parts: (1) a short-term restoration, and (2) a long-term restoration. The short-term restoration plan includes placing approximately 1.8 million cu yd of sand on Assateague Island. The borrow area to be used for the project is Great Gull Bank, an offshore shoal. The area to be renourished is between 1.6 and 7.0 miles south of the inlet. The beach width will vary along the shoreline in accordance with the erosion rate that affects that reach of the shoreline. In addition, a low storm berm will be constructed to an elevation of 10.8 ft National Geodetic Vertical Datum in the portion of the beach between 1.6 and 6.2 miles south of the inlet. The placement will be configured such that the impacts to piping plovers, a threatened species, is minimal, and the integrity of the island is restored.

Because the jetties and inlet will continue to disrupt sediment transport processes along northern Assateague Island, a long-term sand placement plan for the island must also be implemented. The goal of the long-term plan is to restore a supply of sediment to Assateague Island which would have naturally occurred, if the Federal navigation project did not exist. The following discussion is focused on defining a littoral transport rate which would "restore natural processes" to Assateague Island.

Key parameters in the development of a long-term restoration plan for Assateague Island were the estimation of: the rate at which littoral material presently reaches Ocean City Inlet, Q1; a present-day bypassing rate, which is defined as the rate at which Ocean City Inlet and its shoal system provide littoral material to Assateague Island, Q2; and the rate at which Assateague Island backpasses material to Ocean City Inlet, Q3 . To estimate these quantities, a series of three historical sediment budgets, each representing a different evolutionary state of the inlet and adjacent beaches, were formulated. The historical perspective was essential in defining sediment flux magnitudes and directions for the present-day condition. In creating the sediment budgets, the historical evolution of the ebb and flood tidal shoals, adjacent ocean and bay shoreline change rates, morphological condition of the inlet and adjacent beaches, as well as the history of significant engineering events (e.g., dredging volumes, beach fills, structure rehabilitation and modification) were utilized. Only the present-day sediment budget will be discussed herein.

The present-day sediment budget, representing the time span 1980 to 1996, indicated the following quantities: Q1 , the littoral transport rate from Fenwick Island into Ocean City Inlet equal to approximately 150,000 cu yd/year; Q2 , the transport of littoral sediments from the ebb tidal shoal to Assateague Island equal to approximately 69,000 cu yd/year; and Q3 , the littoral transport rate from Assateague Island into Ocean City Inlet equal to approximately 108,000 cu yd/year. The quantity required to "restore natural processes" to Assateague Island could potentially be defined as: (a) Q1 $\sim$ 150,000 cu yd/year, representing the volume transport rate that would have reached Assateague Island if the inlet did not exist; (b) Q1 - Q2 $\sim$ 81,000 cu yd/year, which accounts for the fact that Assateague Island presently receives a quantity of material from the ebb tidal shoal; or (c) Q1 - Q2 + Q3 $\sim$ 192,000 cu yd/year, which takes into account the loss of material from Assateague Island into the inlet system. For initial planning purposes, definition (c) was used, setting the restoration rate to 192,000 cu yd/year. Definition (c) is considered to more fully compensate for inlet-induced impacts to northern Assateague Island, such as wave and current processes associated with the ebb shoal growth and its morphologic evolution, and reorientation of the Assateague Island shoreline. Plans are to monitor the long-term restoration project and modify this quantity as required.

Potential sources from which to mine the restoration volume include the updrift beach fillet, the ebb tidal shoal, and/or the flood tidal shoal, and navigation channels. A comprehensive monitoring plan is also planned for the borrow site(s) to evaluate the impacts of this engineering activity on the inlet system, and to modify future borrow and inlet maintenance activities.

Discussion

Dr. Richard W. Sternberg asked if the Baltimore District had developed a monitoring plan for the long-term restoration project and, if so, what does it consist of? *Mr. Bass* replied that the District has proposed a monitoring plan in the feasibility study which mainly consists of profile surveys of the islands, and both pre- and post-borrow surveys of the various borrow sources. There is also a hydrodynamic model used for another aspect of the projects that will be used to evaluate baseline conditions in case things change. He stated that additional current and tide studies and comparisons would be performed.

Dr. Billy L. Edge asked if the District had determined how far south the barrier islands on the coast of Virginia have been impacted. *Mr. Bass* said the impact area only goes down about 12 km, well within the Maryland portion.

Mr. Orville T. Magoon pointed out that from looking at the 81st Street viewgraph, it seemed to him that the seaward portion of that profile at about -25 ft between two surveys where the shoal drops off into deep water had migrated 50 to 100 ft. It appeared to him that there was a lot of activity out there at the end of the measured profile. *Mr. Bass* replied that there are some detached offshore shoals in the region, and that is probably what is shown there. He felt that for engineering purposes the majority of the materials are being retained within the depth of closure at -21 ft.

Mr. Barry W. Holliday asked if he had understood correctly that the District was planning to use the CURRITUK to place about 145,000 cu yd and, if so, why did the District choose the CURRITUK? *Mr. Bass* replied that the CURRITUK would be used, and the Baltimore District had coordinated with the Wilmington District on using that particular dredge. The CURRITUK was chosen as the most cost-effective means. Baltimore District also looked at contract dredging and mechanical bypass systems. The CURRITUK can get into the inlet channels and onto the ebb shoal in the inlet fillet where some of the contract dredges could not operate.

East Pass Project Management

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East Pass Inlet is located on the Florida panhandle in Destin, FL, approximately 40 miles east of Pensacola and about 60 miles west of Panama City. It connects the Gulf of Mexico with the Choctawhatchee Bay, and Choctawhatchee Bay is connected to the west through Santa Rosa Sound to Pensacola Bay and to the east through the Gulf Intracoastal Waterway to St. Andrews Bay in Panama City. The bay is approximately 122 square miles in size, over 30 miles long, and about 3-1/2 miles in width.

The Federal project at East Pass consists of a navigation channel through the pass, two jetties (east and west) and a spur groin that helps control the thalweg through the inlet and prevents erosion of the east jetty. The spit of sand in the inlet is called Norriego Point. Recently there have been condominiums built here. There are six separate condominiums here, and the Corps is continuously under pressure to try to give up some of this land to allow more construction of condominiums.

The old East Pass Inlet used to go from northwest to southeast through the old lagoon pass and exited into the Gulf approximately 2 miles east of where the existing inlet is. The 1928 storm cut Santa Rosa Island in this general vicinity, and for a period of time there were actually two entrances to the Gulf. A year later, in 1929, heavy rainfall fell over the basin, 16 in. in 48 hr. Choctawhatchee Bay increased in elevation by about 5 ft. To alleviate some of the flooding problems, the local inhabitants cut a pilot channel across in the vicinity where the 1928 breach was, and some of the newspaper accounts said the water rushed out like a millrace. The inlet expanded and widened. In 1930, a Federal navigation project was authorized, and in 1931, a 6-ft-deep by 100-ft-wide navigation channel was dredged through the bar. In 1967 to 1969, the Corps constructed some jetties to help stabilize the mouth of this inlet.

There are a number of challenges faced by the Corps at East Pass. One is transport along the beachfront and across the ebb shoal. There also is a controversy over which way the net drift is at this inlet. Regardless, there is a good deal of sand that moves across the mouth of the inlet. It appears to be somewhat of a nodal point. Net transport across the inlet is fairly small, although again there is some controversy about this.

The District is concerned about the dredging amounts that come from the inlet. We have to dredge about 100,000 cu yd per year. We are concerned about the movement of Norriego Point. If that point eroded away, the energy can affect the island harbor for the city of Destin. We would like to stabilize that, if possible. We also would like to stabilize the thalweg. It appears there is some tendency for the thalweg to move back to the east towards its old traditional position. We are concerned about shoreline movement. Are we getting erosion on the east or west beaches? And also we are worried about jetty stability. And the jetties were damaged somewhat in some recent hurricanes.

The Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS) system is an airborne laser surveying and mapping system that is capable of both hydrographic and topographic surveying. It is owned by the Corps and operated by John Chance & Associates, Lafayette, LA. The system uses a laser to measure the water depth and also the above-water elevation. SHOALS collects 200 elevation and position measurements each second. The survey products are accurate to within about 15 cm vertically and 3 m horizontally. The survey meets the Corps' criteria for Class I surveys and also standards for international nautical charts. SHOALS performs surveys at 60 knots, and the scanning laser covers an area about 110 m wide. A Federal navigation project may consist of navigation channels, jetties, adjacent shoreline and disposal areas, which would be upland or underwater. By flying parallel flight lines, entire projects are covered, including both the bathymetry and the topography.

Since SHOALS became available, East Pass has been flown and surveyed four times. Each time it has covered approximately 2 square miles. This is done very economically, and it is done very rapidly. The total cost for each survey that is so completed is almost exactly what we were paying for just the channel surveys by traditional methods. After the airborne survey is complete, the data are presented and processed into maps, engineering drawings, or nautical charts. Digital data are also produced that can be used for computer-aided design drawings and Geographic Information System programs. One map can be created with about 350,000 individual measurements. Before SHOALS surveyed East Pass, we never got a comprehensive synoptic survey of the whole inlet area. Now we can.

SHOALS first surveyed East Pass immediately following Hurricane Opal. Opal hit the Florida panhandle in 1995 with maximum winds of 150 mph, causing major damage along the coast and causing substantial shoaling in East Pass and the breaching of Norriego Point. The six condominiums were very close to the eroded area. There was evidence of some of the overwash of sand across the west jetty. SHOALS conducted a survey in 1 hr, and covered the entire inlet region with data for both bathymetry and topography. The survey was completed by 5:00 p.m. the day following the storm, and by 11:00 p.m.

the data had been mapped and navigation channel shoaling volumes had been calculated. This information was given to the Mobile District the following morning.

Channel shoaling is something we have traditionally gotten out of our normal surveying, and that is one of the most important things we look at. Each SHOALS survey has covered the same area, which included bathymetry and topography. The surveys determine changes in the inlet system as a whole. Standard engineering calculations were easily made, and are used for planning when and where to dredge the inlet.

We also receive data on the jetties. We think the cross section surveys that we get for the jetties are the very best thing that we can possibly get in the way of surveying, as opposed to the traditional methods. Scour near the jetty is shown following Hurricane Opal. It filled by 1996. Higher rubble is shown in 1997 after the jetty was rehabbed. We can survey a jetty in areas where boats can't get in close enough to do a proper underwater survey. With the SHOALS system, we can get 3-m coverage everywhere on the jetty, and we think we get very accurate volumes out of it.

It is particularly neat that we can evaluate the thalweg right up close to the jetty. With SHOALS surveys, we can see that we have had about 100 ft of erosion on both the east and the west shorelines. We can also evaluate thalweg changes. And we can evaluate what changes have taken place in the deep water. It doesn't appear that it has moved too much further to the east. Maybe that is because there are some sheet-pile walls over there that are protecting the condominiums. But the west side of the thalweg has moved maybe 100 ft again, also to the east.

We can evaluate scour hole changes that are occurring in the project. Scour holes form off the end of the groin and also at the end of the jetties. During the 1995 Hurricane Opal event, the scour holes were pretty much filled, but they appear to be working their way back towards equilibrium at this time. For 1995, 1996, and 1997, the volume of each of the scour holes has increased, and also the maximum depth has increased in the last 3 years. The Coastal Inlets Research Program of the U.S. Army Engineer Waterways Experiment Station's (WES) Coastal and Hydraulics Laboratory has looked at the scour part of East Pass. Of course, SHOALS data can be used to support many different types of research and development efforts.

Based on a new potential flow model being developed by Dr. Steven Hughes at WES, we believe we have a much better understanding of the scour at East Pass. His model substantiates our belief that the scour on the west jetty is caused by flood flows. A great deal of water comes down the west jetty and goes into the inlet during flood flows. If we construct a scour blanket at the tip of this west jetty,

Dr. Hughes believes we can move the scour further to the north and get it away from anything that would affect our navigation Federal project.

At first look at this portion of his model on the ebb flow, it appears that maybe the predominant transport is from the west to the east as the deeper water turns away. Dr. Hughes' model shows that this actually is a function of the asymmetry of the ebb flow, which causes this eastward bend in the scour pattern as opposed to sediment transport. Scour is not a problem and, in fact, it helps to maintain the authorized depth through the bar.

We have a lot of things to consider in managing East Pass. There are a lot of options for us to use. We think the SHOALS surveys done on a yearly basis and looking at the whole system gives a much better tool to use in trying to make proper decisions for operations and engineering. Here are questions to be answered: Can we place material in the scour holes? Is that a good thing to do? Can we place it in the thalweg? Can we place it on Norriego Point? Can we train the thalweg better with some more groins? Should we allow the jetty ends to erode? Or should we put some stone blankets out there? When we try some of these things, we will have a very accurate and a very quick method of looking at whether or not they were successful.

There is no doubt that East Pass and the inlets in general behave as systems. If part of a Federal project is altered, it will trigger changes elsewhere in that inlet system. Today, many Federal projects are being evaluated for modifications (channel deepening), as usage by more and larger boats and ships is encouraged.

SHOALS allows us to do a complete survey, a comprehensive survey, of the entire inlet system. Data are being used to better quantify changes from year to year. This is going to result in better management decisions for project operation and maintenance. But, like all technology, SHOALS is not perfect. It needs to work in relatively clear water. If you have a very turbid project, or if you have some back areas of your project, it may not give you complete coverage and you may have to supplement it at times with more traditional type surveys. But, all things considered, it is a great system. SHOALS is a system that will help us do coastal management better on our projects.

Discussion

BG Robert L. VanAntwerp asked how the District was using SHOALS in dredged material and disposal areas. *Mr. Whittington* replied that for the nearshore disposal areas, the District is able to evaluate the following year what happened to that material and where it moved. He said they were also

able to evaluate whether material placed on Norriego Point is staying there, to determine if it has helped to stabilize the point or is it eroding away.

Dr. Richard W. Sternberg inquired about when the condos were constructed on Norriego Point. *Mr. Whittington* thought they were erected in the early 1970's.

Dr. Sternberg commented that the condos seemed to be in a precarious place, and it appeared the District was protecting the condos. *Mr. Whittington* responded that the project does not protect these condos, the owners have constructed sheet-pile walls for protection.

MG Jerry L. Sinn asked if SHOALS could be used in a Boston Harbor or Baltimore Harbor area, given what is known about the water clarity. *Mr. Whittington* asked Jeff Lillycrop from the WES Coastal and Hydraulics Laboratory to respond. *Mr. Lillycrop* said the rule of thumb is SHOALS can work in water at two or three times Secchi depth. SHOALS cannot work in either Boston Harbor or Baltimore Harbor. SHOALS has surveyed about 40 to 50 projects in the New York, Philadelphia, and New England Districts in the past couple of years, and was being mobilized to go to New York within a week.

MG Sinn said there are readiness applications for SHOALS. There are 2,200 possible ports that the United States Army or Marine Corps could go into on various contingencies in the world, all of them requiring quick surveys. *MG Sinn* said perhaps the Army and the Marines could fit their helicopters so SHOALS could be attached. *Mr. Lillycrop* thought that was a very good idea. He added that WES has been working with the Army and the Navy on developing an unmanned system.

Mr. Erik J. Olsen asked if the $6,000/square mile operating cost for the SHOALS mentioned previously was the cost that the Corps would charge to survey for the private sector. *Mr. Lillycrop* replied that the cost of doing the work comes from a cost model which evaluates many things in determining the true cost of doing a survey. It is not subsidized, so each site must be individually evaluated.

Mr. Olson said that conventional surveys are performed essentially perpendicular to the contours. The SHOALS survey Mr. Lillycrop had shown ran basically parallel with the contours. *Mr. Olson* asked if that was a problem for the SHOALS system. *Mr. Lillycrop* replied that surveying parallel to the contours was no problem at all. The flight lines are set up to get the longest lengths to minimize turns.

Mr. Lon Hackmeister asked if the SHOALS system could be transported internationally and if it could be operated from a fixed-wing plane. *Mr. Lillycrop* stated that SHOALS could operate out of a fixed-wing aircraft. He said WES was in the process of upgrading SHOALS to 400 measurements per second, and it could be flown from aircraft such as a Twin Otter at 120 knots.

Beach Nourishment at Orange County, California

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The Pacific coast shoreline of Orange County, California, extends in a general southeastward direction for about 42 miles from the northern boundary of Orange County, at the mouth of the San Gabriel River, to the southern boundary near the mouth of San Mateo Creek. The shoreline of northern Orange County, which extends for about 17 miles, has been subjected to dramatic man-made influence over the past decade, resulting in induced erosion and coastal storm damages, a continuing program of beach nourishment and shore protection structures, and continuing study of coastal processes. The following presentation is about northern Orange County, California, and includes an overview of the natural coastal environment, the homogenic influences of the past century, the Federal beach erosion and shore protection project that ensued, and the findings of recent survey data and review of the past 30 years of beach nourishment.

The first USC&GS surveys taken in the late 1800's represent the natural coastal environment of southern California. Northern Orange County's shoreline, as a segment of the San Pedro Bay littoral cell, formed a classic crenulate shape planform anchored by the headlands at San Pedro/Palos Verdes at its northern boundary, bisected by a promontory of marine terraces at Huntington cliffs, and ending in a shoreline perturbation at the head of the Newport Submarine Canyon near the entrance to Newport Bay. There were three significant rivers feeding sediments to the coast, sometimes in episodic pulses: the San Gabriel, the New San Gabriel, and the Santa Ana Rivers. There were six tidal inlets and lagoons: the most westerly was the inlet into Wilmington Lagoon, which is now the Port of Los Angeles's Main Channel; the outlet of the old San Gabriel River, now the mouth of the Los Angeles River; the entrance to Alamitos Bay and outlet of the San Gabriel River, now Long Beach Marina; the inlet to Anaheim Bay/Lagoon, now the Naval Weapon Station (NWS) and Wildlife Preserve; the inlet to Bolsa Chica Lagoon, since closed off; and the inlet to Newport Bay, to which the Santa Ana River flowed in 1876, but not always. The shoreline was essentially a narrow strip of sand beach fronting marine terrace formations, or a sand barrier island or spit fronting coastal lagoons. It must have been very dynamic responding to an unsteady supply of sediments and varying wave conditions.

Development of the southern California basin in the 50 years beginning at the turn of the century included construction of the Los Angeles/Long Beach (LA/LB) breakwaters and harbor complex (14 miles of breakwater, jettied entrances, and harbors at Alamitos, Anaheim, and Newport Bays, closing off of the inlet to Bolsa Chica Lagoon); flood control works on all three rivers, groins at Long Beach, Seal Beach, Surfside and Newport Beach, piers at Long Beach, Seal Beach, and Huntington Beach; and mineral extraction. Along with the development came access for more development and public use of the shoreline. The only beach areas in the littoral cell without public access are the LA/LB port complex and the NWS at Seal Beach.

In 1962, the Corps of Engineers reported in a Beach Erosion Control Study findings of erosion along northern Orange County caused in part by natural events and in part by the construction of Federal structures. The report recommended a comprehensive plan which would provide protection to the shore. This plan was authorized and became the San Gabriel River to Newport Bay Erosion Control Project. Elements of the plan include a protective beach at Surfside and Sunset Beach, a detached breakwater just upcoast of the Newport fishing pier, and periodic beach nourishment. The initial protective beach at Surfside-Sunset was completed in 1964, and it has been renourished eight times since (five times by the project and three times with opportunistic dredging of the NWS), for a total beach fill volume at Surfside-Sunset of about 14.2 million cubic yards (mcy). The planned protective and renourishment beach volume would have been 3 mcy initially and six 1.75-mcy periodic nourishment events on 5-year cycles, for a total of 13.5 mcy. Execution of the project deferred construction of the single detached breakwater pending identification of need, and added eight groins and beachfill to create the groin field at west Newport Beach.

Regional studies of coastal processes have been attempted by the Coast of California Study for Orange County. Survey and wave data were collected and analyzed with previously collected data, and the results are presently under interpretation. Definitive conclusions of the prevailing coastal processes are not obvious; however, the trends in location of the mean high-water line, the beach volume, and profile volume shoreward of the -20-ft contour all indicate the effectiveness of the protective beach and periodic nourishment in creating wider beaches and a greater volume of sand in the surf zone. In 1995, about 7.6 mcy more sand was located in the profile volume than in 1963. In that same time interval, about 16.1 mcy of beachfill volume was placed and sediments were delivered to the shore from flows of the Santa Ana River. What is not evident is where the sediments that are lost from the beach and profile go. The nearshore seaward of the -20-ft contour shows a deepening trend, and large shoals or impoundments are not evident.

Future issues that should consider the regional effects are the same as the issues of the past:

a. Opportunistic utilization of a fine aggregate resource, i.e., dredged material if underwater and riverbed and debris basin excavation upstream. A California Coastal Zone Management Act decree is to use beach-compatible sediments to nourish beaches to the maximum practicable extent. Definition of "beach compatible" and "maximum practicable" differ with respect to sediment size, chemical content, and commercial value.

b. Considerations in reestablishing open tidal inlets to saltwater lagoon systems, specifically, the Bolsa Chica wetland Restoration Project.

c. Project modifications to reduce beach renourishment costs, such as reef structures and groins.

d. Consideration of how bad the next El Niño will be.

Discussion

Mr. Magoon asked what was the deepest depth where Mr. Shak had seen changes in the surveys offshore. *Mr. Shak* replied that much of his data stopped at around -30 ft, but some went out to -40 ft. Depth changes were seen even at -40 ft, so he felt sure sand was moving out there. But at locations that far out, the slopes are very flat, so depth changes of a foot uniformly over that much area represent a huge volume.

Coast of Florida Erosion and Storm Effects Study

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The Coast of Florida study is the most comprehensive shore protection study ever undertaken by the state of Florida and the Jacksonville District. The study, authorized in 1984, is a cooperative effort between the U.S. Army Corps of Engineers (USACE) and the Florida Department of Environmental Protection (DEP), the study sponsor. The study was initiated in June 1988 to investigate coastal processes along the state's coastline on a regional basis, and to make recommendations regarding modifications for existing shore protection and navigation projects.

Study Purpose

The authorization for the study states that two major topics will be addressed: (1) the previously published reports of the Chief of Engineers pertaining to shoreline erosion on the Florida coast will be reviewed to determine if any modifications to existing projects are necessary; and (2) a comprehensive body of knowledge, information, and data on coastal processes along Florida's coastline will be developed. The study area has been divided into five coastal regions to facilitate study funding and management. The 92 miles of shorefront in Palm Beach, Broward, and Dade Counties (Region III) was the first region studied due to the large financial commitment in State and Federal funds for shore protection projects in the area. Over $110 million in local, state, and Federal funds have been spent to restore beaches within Region III.

National Interest. There are over 90 Federal navigation projects and 21 Federal shore protection projects in Florida. The navigation projects include all of the state's 11 deepwater ports, 30 inlets and passes, and over 2,000 miles of navigation channels, with an annual maintenance cost of $32 million. Maintenance of Federal navigation projects in Florida results in the placement of an average of 1 million cu yd of sand on Florida's beaches each year. Of the 141 miles of authorized shore protection projects, 90.5 miles have been constructed to date.

State Interest. The state has a threefold program to mitigate or prevent damage to development due to erosion and storms: (1) funding up to 50 percent of the non-Federal share of beach nourishment,

(2) preventing unwise development by means of a coastal construction control line, and (3) purchasing available undeveloped shorefront for preservation of natural resources.

The state priorities for the study changed as the study for Region III progressed. Completion of the feasibility phase of the study for Region III required 8 years and about $6.5 million for preparation of the feasibility report, Environmental Impact Statement (EIS), and Geographic Information System (GIS) databases. The state currently desires regional scope strategic management planning of the use of resources. This is being incorporated into the strategic management plan under way for Region IV.

CURRENT STUDY ACTIVITIES

The feasibility report and EIS for Region III were completed in November 1996. A sand transfer plant at Lake Worth Inlet was authorized by Section 101 of the Water Resources Development Act of 1996, as a result of the feasibility report. The GIS coverages for Region III data are being made available by the state of Florida DEP via their Internet web site (http://www2.dep.state.fl.us/water/beaches). Region IV of the study was initiated in October 1991. The study includes the shorefront from Brevard County to Palm Beach, a distance of 132 miles. It is anticipated that completion of the feasibility report for Region IV would require $4.3 million and require 4 years to complete. However, the study is not funded for continuation. Carryover funds are being utilized to conclude current study efforts in fiscal year 1998. A strategic management plan is being prepared in response to the state's request to evaluate the best management practices on the use of sand resources along the Atlantic coast of Florida.

Discussion

Dr. Billy L. Edge asked if the work was performed by the District with support from the U.S. Army Engineer Waterways Experiment Station (WES), or was it done by a consortium or by contract? *Mr. Stevens* replied that the Jacksonville District had the lead, but worked very closely with the state of Florida (the cost-sharing partner), WES, and other sources such as academia, consultants, the dredging industry, and environmental agencies.

Dr. Edge said that upland disposal areas for disposing of dredged material did not appear to be a beneficial use of the material. He asked if the District planned for beneficial uses of dredged material. *Mr. Stevens* answered that the District was well focused on what the state had asked for, and that was for the District to look at all the material that is dredged in the coastal area including upland disposal areas

authorities are saying "We are reaching our capacity in this area. We would like to offer this material for the use of the beach." The District is looking for and desires to address all of the operations necessary to do wise management of moving sand. He believes the District will consider every possible disposal site option as it looks as far back as the mainland side of the Intracoastal Waterway.

Mr. Charles B. Chesnutt asked how many projects would come out of Region III if shore protection projects had an equal priority with flood control, navigation, and environmental restoration. *Mr. Stevens* replied that the 20 projects that the District had, plus the sand transfer plant, are all economically justified under current guidance.

Current Research and Development (R&D) Related to Sediment Management

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INTRODUCTION

Comprehensive management on a regional scale of a resource such as coastal sediment involves a number of activities, ranging in nature from technical to political. Research and Development (R&D) can facilitate the execution of at least four of these activities:

1. Quantifying the resource.
2. Assessing its movement into, out of, and within the region.
3. Predicting changes in amounts or movement patterns.
4. Monitoring the resource.

This presentation will summarize ongoing and recently completed efforts in the Direct Allotted programs or areas of programs managed by the U.S. Army Engineer Waterways Experiment Station's Coastal and Hydraulics Laboratory relevant to one or more of the above activities. Efforts under the Coastal Inlets Research Program (CIRP) will be addressed by another presentation.

COASTAL NAVIGATION AND STORM DAMAGE REDUCTION R&D PROGRAM

Work Unit Title: Frequency Analysis of Storm Processes
Principal Investigator: Dr. Norman Scheffner
Objective: Verify Empirical Simulation Technique (EST) technology and procedures and make available for use at District level.
Product/s: Detailed guidance in using EST to estimate frequency-of-occurrence relationships for storm responses such as beach erosion.
Activity Relevance: 2, 3

Work Unit Title: Field Research Facility (FRF) Measurements and FRF Analysis
Principal Investigator: William Birkemeier
Objective: Make and analyze comprehensive, long-term field measurements of coastal processes and responses; develop and evaluate field measurement sensors and procedures, and train personnel in field monitoring techniques.

Product/s: Field data and data products, new and improved measurement techniques, and enhanced analysis methods.
Activity Relevance: 1, 2, 3, 4

Work Unit Title: Directionality of Waves in Shallow Water
Principal Investigator: Dr. Charles Long
Objective: Develop fundamental knowledge and quantification of directionally distributed wave properties, esp. height and energy, in shallow water.
Product/s: Data for and input to other work units developing improved directional spectral wave models; high-resolution data sets for large-scale field experiments.
Activity Relevance: 2, 3

Work Unit Title: Modeling the Evolution of Wave Spectra in Shallow Water
Principal Investigator: Dr. Robert Jensen
Objective: Improve existing directional spectral wave models.
Product/s: Improved models and guidance for applying them.
Activity Relevance: 2, 3

Work Unit Title: Improving Wave Estimates in Coastal Areas
Principal Investigator: Dr. Linwood Vincent
Objective: Develop an improved capability to hindcast wave climatology along the U.S. coast using data assimilation and advances in wave modeling.
Product/s: New, automated hindcast system for the Wave Information Study.
Activity Relevance: 2, 3

Work Unit Title: Large-Scale Laboratory Investigation of Longshore Sediment Transport
Principal Investigator: Julie Rosati
Objective: Develop robust local and total longshore sediment transport relationships for use in all levels of project design.
Product/s: Improved longshore transport relationships.
Activity Relevance: 2, 3

Work Unit Title: Sediment Transport Processes
Principal Investigator: Dr. Donald Resio
Objective: Develop framework for a physics-based longshore sediment transport model using suite of direct sediment transport and process measurements made during storms.
Product/s: Comprehensive data sets on longshore sediment transport during storms; physics-based model framework.
Activity Relevance: 2, 3

Work Unit Title: Geological Analysis of Shelf/Beach Sediment Interchange
Principal Investigator: William Birkemeier
Objective: Estimate amounts, direction, and temporal scales of sediment movement at depths in the vicinity and just oceanward of the depth of closure.
Product/s: Guidance for estimating sediment interchange and geologic techniques for quantifying the profile envelope.
Activity Relevance: 1, 2, 4

Work Unit Title: Nearshore Berm and Long-Term Profile Evolution
Principal Investigator: Randall Wise
Objective: Develop quantitative methods for estimating profile evolution and cross-shore berm movement on time scales of months to years.
Product/s: Guidance for predicting profile evolution and berm movement and estimating the resulting benefits and their changes with time.
Activity Relevance: 2, 3

Work Unit Title: Diagnostic Modeling System to Reduce Estuarine Channel Shoaling
Principal Investigator: Dr. Nicholas Kraus
Objective: Develop a diagnostic modeling system (DMS) to help identify the leading causes of shoaling hot spots and formulate objective alternatives for reducing channel shoaling.
Product/s: DMS and guidance on its application.
Activity Relevance: 2, 3

DREDGING OPERATIONS AND ENVIRONMENTAL RESEARCH (DOER) R&D PROGRAM

Work Unit Title: Evaluation and Design of Nearshore Placement of Mixed Sediments
Principal Investigator: Cheryl Pollock/Jack Davis
Objective: Synthesize products from other work units into comprehensive guidance for planning and evaluating alternatives for placing mixtures of sand and fine-grained material in the nearshore.
Product/s: Guidance on siting, designing, and evaluating nearshore placement, supported by field data from prototype placements.
Activity Relevance: 2, 3, 4

Work Unit Title: Comprehensive Open Water Site Management Software
Principal Investigator: James Clausner
Objective: Develop an integrated suite of tools (archiving, analysis, simulation, and display) for use in managing open water dredged material placement sites.
Product/s: Dredged Material Spatial Management Analysis Record Tool (DMSMART).
Activity Relevance: 1, 2, 4

Work Unit Title: Near Field Modeling of Subaqueous Dredged Material Placements
Principal Investigator: Dr. Joseph Gailani/Dr. Norman Scheffner
Objective: Enhance existing model for predicting erosion rates of dredged material placed on the bottom to include more complex sediment characteristics and responses, and to incorporate processes important to nearshore placement.
Product/s: Improved Long-Term Fate (LTFATE) model
Activity Relevance: 2, 3

Work Unit Title: Silent Inspector for Pipeline Dredges
Principal Investigator: James Rosati
Objective: Develop commercially implementable standards and requirements for monitoring and reporting data from contract pipeline dredges for production verification and environmental compliance.

Product/s: Contract specifications and guidance on their implementation.
Activity Relevance: 2, 4

Work Unit Title: Dredge Contract Payment Using Tons Dry Solids (TDS) Method
Principal Investigator: Timothy Welp
Objective: Develop the technical basis for implementing TDS as a method of payment for contract dredging that uses hopper dredges and dump scows.
Product/s: TDS system specifications and guidance on their application and use.
Activity Relevance: 2, 4

COASTAL FIELD DATA COLLECTION PROGRAM

Work Unit Title: Wave Information Study
Principal Investigator: Dr. Martin Miller
Objective: Provide accurate, reliable hindcast data on the climatology of coastal waves, currents, and water levels for planning and designing coastal projects and other uses.
Product/s: Hindcast data and resulting statistics for all U.S. coasts.
Activity Relevance: 2, 3

Work Unit Title: Field Wave Gaging Program
Principal Investigator: David McGehee
Objective: Acquire measured data sets of wave energy and water levels to establish climatology and to provide input to and validation for models working in the hind-, now-, or forecast mode.
Product/s: Data and analysis products, standards for analysis, and evaluation of measurement methods.
Activity Relevance: 2, 3

MONITORING COMPLETED NAVIGATION PROJECTS (MCNP) PROGRAM

Work Unit Title: Morro Bay Harbor, CA
Principal Investigator: Ray Bottin
Objective: Evaluate performance of nonstructural navigation improvements on hydrodynamic conditions and impacts on existing structures, verify shoaling rates and sediment pathways, and validate the physical and numerical models used as design tools.
Product/s: Results of evaluations; recommendations for improvements in design methods.
Activity Relevance: 2, 3

Work Unit Title: St. Joseph, MI
Principal Investigator: Dr. Andrew Morang
Objective: Evaluate the performance of a coarse beach fill, the methods used for predicting its behavior, and its armoring effects on an underlying clay layer.
Product/s: Results of evaluations; recommendations for design approaches or modifications to existing design methods.
Activity Relevance: 1, 2, 3, 4

Work Unit Title: Mouth of the Columbia River
Principal Investigator: Dr. Nicholas Kraus
Objective: Evaluate the causes of sediment mounding in the Ocean Dredged Material Disposal Site offshore of the Columbia River and assess the suitability of new sediment fate models to predict dispersion in such an environment.
Product/s: Guidance on model use for disposal site designation; recommendations on standardized methods for data collection and management.
Activity Relevance: 2, 3, 4

DISCUSSION OF ABOVE LIST

Some general patterns are evident in reviewing the above work units from the perspective of regional sediment management. First, the largest single concentration of effort involves quantifying nearshore waves, covering a range of topics from shallow water spectral characteristics to basin-scale, 30-plus-year climatology. The next largest concentration involves predicting the response of sediment to forcing functions, primarily waves. This effort focuses mostly on improving existing parametric relationships, developing or enhancing project-scale predictive models, or assessing the performance of predictive methods on specific project applications. The remaining effort in the above work units is diffuse, with most of it relating to discrete aspects of measuring or monitoring sediment at a project scale. The largest single concentration in this category deals with monitoring sediment movement by dredging.

The above list comprises more than 80 percent of all work units presently active in the above programs (in the case of DOER, in the two relevant areas of the program). This indicates primarily that the topic of regional sediment management involves most of the major coastal processes and responses that also are important at a project level, which traditionally has been the principal R&D focus. Of course, regional sediment management also involves spatial and temporal scales well beyond those normally of interest in project design, such as the decades-scale behavior of ebb deltas and other large offshore sand bodies and the development of rational process climatologies and methods for predicting such behavior. Phenomena such as aeolian transport, overwash, and dune growth also may play significant roles in regional evaluations, whereas they usually are not considered important to project-level designs. Some of these scales and phenomena will be addressed by the CIRP; others will appear as unmet R&D needs.

Coastal Inlets Research Program

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Regional Sediment Management and Inlet Research

The Coastal Inlets Research Program (CIRP) is purposefully addressing coastal sediment processes across all temporal and spatial scales of concern to the U.S. Army Corps of Engineers. This unique systems approach to coastal research and development, and the way it relates to the Corps' designs and projects, is illustrated through several examples in this section.

Inlets store huge volumes of sediment in their shoals, which become unavailable to the rest of the system, including the shores adjacent to the inlet. Stabilization of inlets with jetties and maintenance of navigation channels further removes sediment from the nearshore unless provisions are made to bypass littoral material and address possible site-specific requirements for beach stability. Jetties translate ebb-tidal shoals seaward, placing this material further offshore and reducing or eliminating long-term cycles of shoal migration, which periodically rebuild the shore. These consequences of Federal engineering works at inlets have major impacts extending across state borders and along large reaches of the coast.

In the past, the Corps has focussed on ebb-tidal shoals as a potential borrow source for replenishing the adjacent shores. Recent observations in the CIRP have identified flood-tidal shoals as a major factor which can be responsible for scour near jetties, excessive dredging, and reduction in navigability. "Flood shoal engineering" is a concept introduced by the CIRP in discussion of these issues. Flood shoals are viewed as an environmental resource by regulatory agencies, yet the long-term (decades to century) deposition of sediments in flood shoals is having regional as well as local impacts on the physical processes and environment at inlets.

The deep-draft Matagorda Ship Channel (MSC) entrance to Matagorda Bay, Texas, is another example illustrating the need for a systems approach to regional sediment management. This entrance, dug in 1962, is capturing the tidal flow from the natural inlet, Pass Cavallo, located about 6 miles to the south. Pass Cavallo was about 3 miles wide when first discovered by LaSalle in 1686 (his supply ship

sunk in the treacherous entrance of Pass Cavallo). Because of the capture of flow by the MSC, Pass Cavallo is presently only 2,000 ft wide and continues to close. The closure of Pass Cavallo and resultant change in circulation and loss of a migration route for fish larvae is becoming a concern to citizens of the area and the state of Texas. What are the processes controlling the unintended consequences of opening of the MSC, and how do we deal with them in a systems approach? This problem will be addressed in the CIRP.

The following contains selected CIRP research and development related to regional scales of coastal sediment management.

Sediment Budget Analysis System

Under the CIRP research work unit "Inlet Channels and Adjacent Shorelines," a PC-based system to formulate sediment budgets for inlets and adjacent shores is being developed. Sediment budgets are regularly produced by the Corps to represent local and regional sediment transport magnitudes and pathways for an inlet and its adjacent beaches. The sediment budget may then be modified to reflect a perceived range of impacts for proposed engineering activities at the site. Presently, a consistent Corps-wide method for formulating sediment budgets for inlet and adjacent shores, particularly for reaches with multiple inlets, does not exist, nor do methods for estimating error or uncertainty associated with the parameters of interest.

The **S**ediment **B**udget **A**nalysis **S**ystem (**SBAS**) under development within the CIRP will provide a uniform, defensible procedure for designing sand management alternatives, and for identifying, quantifying, and mitigating inlet impacts. This PC-based system will provide methods and a uniform structure to estimate (1) alongshore distance of an inlet's impact, (2) sediment volume captured by an inlet system, (3) magnitudes and directions of sediment fluxes, and (4) uncertainties associated with each of (1) to (3). The Corps requires estimates of these quantities to mitigate for inlet impacts (Section 111 studies), to design sand-bypassing systems, to formulate sand-management strategies, and to optimize channel maintenance and sediment handling.

SBAS is ideally suited for sediment-management studies extending over long spatial extents because it allows for an unlimited number of alongshore cells and multiple inlets. Input data include the rate of volume change on the adjacent beaches, shoals, and inlet channel; mechanical bypassing history; engineering activities that would alter the budget; other sources and sinks; net and gross longshore sediment transport rates at the boundaries of the system; and uncertainties associated with each of these data sets or estimated quantities. Parameters which the user can vary include the effectiveness of inlet jetties in trapping sand and the degree to which the inlet naturally bypasses sand to the adjacent beaches.

Help screens and on-line guidance for incorporating engineering activities (e.g., beach fill and dredging history), geologic features (e.g., sink action of submarine canyons), coastal processes (e.g., wind-blown sand transport), and long-term trends (e.g., erosion or accretion due to relative sea level change) are planned. The output from an application may vary, depending on which quantities the user has entered as knowns and unknowns. Typical results for an inlet application might include the range of net and gross longshore sediment transport rates for the inlet and its adjacent beaches, with associated values of uncertainty. The user might compare these results to those from a modified regional sediment budget which incorporates a particular engineering activity at the inlet or along the adjacent shores, e.g., overdepth dredging, and mechanical bypassing.

As part of developmental testing on a regional scale, **SBAS** has been applied to the littoral system extending from Fire Island Inlet to Montauk Point, Long Island, New York, which extends for 134 km (83 miles) and includes three inlets. Two sediment budgets have been formulated representing the 1933 to 1979 and 1979 to 1995 time periods, and are intended to provide the guiding framework to ensure consistency between other ongoing studies along the project reach. The regional sediment budgets will be used by the New York District in arriving at a sediment-management plan for the south shore of Long Island.

Discussion

Dr. Robert G. Dean asked if the Sediment Budget Analysis System handles only steady-state, or will it also handle transients. He said that if you cut an inlet, then the ebb tidal shoal is going to grow over time, and the flood tidal shoal is going to grow as well. He was wondering if that could be handled. *Dr. Kraus* replied that as presently envisioned, one project could have many time intervals, for example, 10-year or 30-year increments, or whatever data you had. In that sense, the system could handle a transient. Presently, he said they had not considered the condition where the ebb shoal is capturing sediment analytically, but agreed it should be considered.

Mr. Steven Richards noticed that the cell width in the demonstration example defaulted to 1,000 ft, and asked if that meant that survey markers should routinely be set at 1,000 ft. *Ms. Rosati* said 1,000 ft was just a number being used in the example and knew of other work where the cell widths were around 25 m. *Ms. Rosati* added that probably the most realistic approach in the type of presentation of this system is to have cells representing morphologic regions. It could be 1,000 ft where a cell is

influenced by the inlet, but it could also be 5,000 ft where the cell has conditions that are the same along that whole length.

Mr. Richards was also concerned about how confident can one be with 1,000-ft or 3,000-ft spacings. *Ms. Rosati* thought that if you have essentially plane and parallel contours there probably is not much error associated with it. But when you get in the vicinity of an inlet where you have an impoundment or downdrift erosion, you probably do have some error, and survey profiles should be closer-spaced here, perhaps as close as 50 ft apart.

R&D Needs for Regional Sediment Management

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Acting on the recommendation of President Jefferson, in 1807 Congress adopted a resolution for a "Survey of the Coast." The President was authorized "...to cause a survey to be taken of the coasts of the United States, in which shall be designated islands and shoals, with the roads or places of anchorage, within 20 leagues (60 nautical miles) of any part of the shores of the United States...together with such other matters as he may deem proper for completing an accurate chart of every part of the coasts with the extent aforesaid." Jefferson and the Congress inaugurated the Survey of the Coast both to promote navigation and to solidify territorial claims of the United States against European powers still active in the Northern Hemisphere. The young nation had to know its boundaries as well as provide stable and navigable waterways for commerce and self defense.

The first coastal field survey work was begun in 1816 with reconnaissance for two geodetic base lines, one near Englewood, New Jersey, and the other on Long Island. A triangulation network extended over the bay and harbor of New York. Congress failed to provide further funds, and work was suspended until 1832, when Congress revived the original act. The first topographic and hydrographic surveys were completed in 1834 along Great South Bay, Long Island.

These pioneering Federal surveyors left a valuable legacy of accurate charts from the era of approximately 1840 to 1880 that now serve as the base reference for conducting coastal regional morphologic analysis and coastal engineering works nationwide. Without these early surveys, we would not now know how the coast has evolved and how to improve the performance of our coastal projects.

Many of our inlets were stabilized in the late 19th century. Through the Corps, therefore, the Federal government has caused major modifications along the coast for more than a century. These modifications are now becoming apparent on a regional scale that extends far beyond the authorized limits and political boundaries of the original projects. It is interesting to note that the Corps' project limits are usually defined narrowly in a spatial sense (inlet, harbor, channel, specific beach), but the temporal scale of such projects is indefinitely long (more than a century). In fact, we can assume that the

Corps will assure navigation as long as the so-called commerce clause of the Constitution is in effect "To regulate Commerce with foreign nations, and among the several States, and with the Indian Tribes."

With awareness that sand moving along the coast recognizes no political boundaries, the Corps conducts regional-scale studies, such as the Coast of California Study and the Coast of Florida Study. However, in the end, individual projects are initiated locally by the political process and not regionally with cognizance of the scale of the interactive physical system.

The prototype for regional studies lies in The Board on Sand Movement and Beach Erosion established by the Corps in January 1929. The first work was conducted in 1929 – 1930 on the beach adjacent to a jetty built at Far Rockaway, Long Island, and along parts of the New Jersey shore. The Beach Erosion Board (BEB) replaced the previous Board in 1930, and the BEB investigated coastal damage caused by the great hurricane of 21 September 1938, which devastated much of the coasts of Long Island and New Jersey (600 lives lost). Some researchers believe that these coasts still have not recovered from the 1938 hurricane. An early regional study was "The Atlantic Coast of New Jersey from Sandy Hook to Barnegat Inlet, Erosion Control Report on Cooperative Study" developed in 1954 by the New York District. After the 1962 Ash Wednesday northeaster that severely damaged the Atlantic Coast from Montauk Point on the eastern end of Long Island down to Florida, Corps Research and Development (R&D) made great progress in quantifying storm surge and frequency, and in beach-fill design.

In summary, it is recognized that the Corps is operationally involved with coastal processes on a regional scale because of (1) the impacts of Federal projects, and (2) the great scales of natural forces of longshore sand movement, inlets, hurricanes, and storms. Little explicit R&D has been conducted, however, to develop engineering tools for treating coastal and inlet processes on a regional scale or as a system that exchanges sediment by many and diverse mechanisms. In fact, a paradigm shift is needed to move the engineer and physical scientist from the traditional "micro-scale" perspective of the motion of water and sediment grains at a point to consider large-scale and often collective motions of coastal morphological bodies at "macro-scale" and greater. Such a systems approach for regional sediment management would treat major morphologic bodies of inlets and headlands, and sub-reaches and full reaches of the coast.

Great gains in cost savings in the Corps' coastal missions can be expected through implementation of R&D targeted specifically at regional sediment management. In the hydrodynamics area, a good example of the benefits of dedicated R&D for regional processes is the ADCIRC (Advanced CIRCulation) numerical model developed in the Dredging Research Program. The model has been

applied in calculating the tidal hydrodynamics of the entire Atlantic coast, the Gulf coast, and the Pacific coast, thereby supporting numerous local projects. The large but calculationally efficient ADCIRC model grids eliminate ambiguities in boundary conditions for local, sub-regional, and regional studies, and this robust model has supported military missions of the U.S. Army and Navy worldwide, as well as civil missions domestically.

Similar progress can be made in regional-scale coastal sediment transport and morphology change. Such research needs include:

a. Regional sediment budgets encompassing interstate impacts.

b. Regional sediment transport patterns from wave and tidal hindcasts.

c. Large-scale morphology change, including trends in shoreline change, longshore sand waves and oscillations, and other collective or organized sediment motion.

d. Barrier-island dynamics, including wind-blown sand processes, overwash, and barrier island migration and shape changes.

e. Inlet shoal dynamics and channel stability.

f. Impacts of navigation channels and jetties on the adjacent beaches.

g. Role of ebb-tidal shoals and flood-tidal shoals on channel stability, jetty stability, and navigation safety.

h. Sediment exchange mechanisms between inlets and the adjacent shores.

i. Tidal shoals as sources of beach sand and consequences for inlet and channel stability.

j. Prediction of long-term wetland and coastal land losses, and practical mitigation options.

k. Physics governing long-term evolution of coastal morphology (shoreline, inlets, offshore shoals, sand ridges, sandbars, etc.) expressed in terms of large temporal and spatial scales that include the consequences of hydro-meteorological phenomena such as El Niño events, changing weather patterns, and relative sea-level rise.

Finally, it is noted that there is potential for the Corps to become involved on great regional scales through environmental restoration and preservation projects. These "socio-environmental engineering" projects will consider issues such as preservation and maintenance of barrier islands, lagoons, wetlands, and estuaries.

Discussion

Dr. Robert G. Dean commented that bypassing should play a great role in the Coastal Inlets Research Program. He wondered if that is contemplated. *Dr. Kraus* replied that bypassing is playing a role in the first work unit, with developing models to take the shoreline model into inlets as a first step. Bypassing is part of the sediment budget and geomorphology work.

Dr. Dean asked if bypassing technology was part of the program. *Mr. E. Clark McNair, Jr.,* reviewed the history of the program and said that at this time, bypassing technology is not included in the Coastal Inlets Research Program. However, it is a potential subject for the Dredging Operations and Environmental Research Program. *Dr. Dean* said there is a real need to look at bypassing technologies.

Mr. Steven Richards said that when you take a look at a net system, you find that when you bypass you are just keeping sand within the system. If you can find where the sand sinks are, you can then continually use them to capture the sediments and then inject sand into the overall system.

Mr. Thomas M. Ballentine commented that he was the secretary of the U.S. section of the Permanent International Association of Navigation Congresses (PIANC), of which MG Fuhrman is the president. He said PIANC has a study under way entitled "Recommendations for Bypass Systems for Harbors on Sandy Coasts." Dr. Richard Wiegel from Drexel University is the United States' representative to the international study group looking into bypass systems that are in use in various countries describing existing systems and operations, and understanding the reliability and economic aspects of the systems. *Mr. Ballentine* said the draft report is finished and is being reviewed by people in different countries, and will provide further information.

Florida's Beach and Inlet Management Program

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presented by

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Background

Recognizing the importance of the state's beaches, the Florida Legislature in 1986 adopted a posture of protecting and restoring the state's beaches through a comprehensive beach management planning program. Under the program, the Department of Environmental Protection's Bureau of Beaches and Coastal Systems evaluates beach erosion problems throughout the state, seeking viable solutions. The primary vehicle for implementing the beach management planning recommendations is the Florida Beach Erosion Control Program, which was established for the purpose of working with local, state, and Federal governmental entities to protect, preserve, and restore the state's coastal sandy beaches. Under the program, funding is available to Florida's county and municipal governments, community development districts, or special taxing districts with the responsibility of erosion prevention or beach and shore preservation. Financial assistance in an amount up to 50 percent of the project costs may be available for shore protection and preservation activities located on the Gulf of Mexico, Atlantic Ocean, or Straits of Florida. Eligible activities include beach restoration and nourishment activities, project design and engineering studies, environmental studies and monitoring, inlet management planning, inlet sand transfer, dune restoration and protection activities, dune walkover construction, and other activities related to beach erosion prevention. The program is authorized by Section 161.101, Florida Statutes, and is administered by the Department of Environmental Protection's Bureau of Beaches and Coastal Systems.

Florida has almost 800 miles of shoreline fronting the Atlantic Ocean and Gulf of Mexico. Over 300 miles of Florida's beaches are experiencing "critical erosion."

A critical erosion area is defined as an area or segment of shoreline where natural processes or human activities have caused or contributed to erosion and recession of the coastal system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost.

Florida's Comprehensive Regional Approach to Sediment Management

The Department of Environmental Protection, Bureau of Beaches and Coastal Systems is revising the way it develops and implements erosion control projects, which historically have focused on local short-term needs and is instead working with local governments and the Corps to develop long-range beach management plans. Once developed, these plans, which are components of the strategic beach management plan, will emphasize a regional approach to look at sediment management as a key component of the Department's beach management strategy that will encourage coordination among local governments, lower costs, and provide long-term solutions to beach erosion. This systems approach takes advantage of the needs of major sediment dredgers such as the ports and intercoastal waterway to dispose of beach quality material, the role of altered inlets as causes of downdrift erosion, and their relationship to the coastal system to devise strategies to address not only the problem, but also the cause, in an efficient cost-effective manner.

Discussion

Dr. Richard W. Sternberg asked how often the beach profiles at the 4,000 monuments around the state are monitored. *Mr. Woodruff* replied that they are not monitored as often as he would like, but once the control lines have been established, they hope to survey on an annual basis. He noted the Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS) system; this will enhance the ability to resurvey more beach areas on a more frequent basis.

Dr. Robert G. Dean inquired about the $140,000 contract on the southwest coast of Florida. He asked how many miles of surveying that would comprise. *Mr. Woodruff* stated the John Chance SHOALS survey region extended from Pinellas County through Collier. He was not sure of the exact mileage, close to 200 miles.

Dr. Dean also asked as a follow-up to Dr. Sternberg's question if Mr. Woodruff saw the laser swath mapping as playing a greater role in updating the shoreline positions. *Mr. Woodruff* answered

absolutely. The system has already been used in the panhandle with great success.

Dr. Billy L. Edge asked why the state of Florida did not use eminent domain in Ocean Ridge to take that property mentioned in the presentation. *Mr. Woodruff* replied that state statutes do not allow the use of eminent domain for that purpose in this program. It can be used for roads, but there is no statutory authority to take property to fix the beach erosion.

Mr. Steven Richards asked how often would the SHOALS surveys be run, is it the intention to do away with the marker system, and would the data be fed into a computer simulation to track the sand flows? *Mr. Woodruff* answered that the SHOALS surveys are scheduled annually, if funds are available. The data will be made available on the Florida Department of Environmental Protection website. He did not believe SHOALS would make the marker system obsolete, because ground-truthing would still be needed.

Mr. Richards asked if there has been any technology developed to improve the dredging techniques around the inlets. *Mr. Woodruff* said he hopes to use the *Punaise* system along with density separators as an experiment or innovative project. Legislation recently passed allows the state to sponsor or cosponsor demonstration projects which before could not be done.

Long-Range Dredged Material Management Program for the Atlantic Intracoastal and Okeechobee Waterways in Florida

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and

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The identification and permitting of suitable dredged material management areas for the Atlantic Intracoastal and Okeechobee Waterways in Florida has become increasingly difficult. This has resulted from the nature of dredging, the requirements of handling and storing dredged material, and the environmentally sensitive and rapidly developing areas in which these operations are performed. In response to the situation, the Florida Inland Navigation District (District) initiated in 1986 a program of long-range dredged material management. When fully implemented, this program will provide a permanent infrastructure of management facilities for all maintenance material dredged from the 374 miles of Intracoastal Waterway channel connecting Fernandina Harbor in Nassau County with Miami Harbor in Dade County and for 15 miles of the Okeechobee Waterway from its confluence with the Intracoastal Waterway to the first navigation lock (collectively referred to as the waterway).

The District's program, executed in close cooperation with the Jacksonville District, Corps of Engineers, comprises three main elements: (1) a two-phased plan development and property acquisition element, (2) a facility permitting and construction element, and (3) a facility operation element. Program execution begins with the development of long-range material management plans for the waterway on a county-by-county basis (Phase I of the planning and property acquisition process). Upon finalization of each plan, Phase II of the planning and property acquisition process begins with site boundary surveys. The process continues with detailed environmental site characterizations, soils testing, topographic surveys, preliminary facilities design and site plans, site operation and management plans, and a summary of expected costs for site development and operation. All of this information is then used for property acquisition and facilities permitting.

To date, this planning effort has identified approximately 44.6 million cu yd of sediment to be maintenance dredged from 342 miles of waterway channel over the next 50 years. Of this dredging volume, 21.5 million cu yd of sand has been identified as potentially beach quality material and six permanent beach placement areas have been identified and designed for these materials. The other 23.1 million cu yd of sediment contains levels of silt that preclude this material from being placed on the beach. These sediments will be temporarily stored in 50 upland containment sites where the material will be selectively excavated and used beneficially. Additionally, at least 3 million cu yd of beach quality materials will be offloaded from existing sites in the vicinity of ocean inlets and transported to ocean beaches, thereby returning this sediment to the coastal system.

Once dredged material management needs have been addressed, resources can be directed to the control of sediment inflow into the waterways. Each long-range dredged material management plan includes a general identification of the source of the sediments entering into the waterway channel. This sediment inflow is being addressed by the District and other government agencies through cooperative projects involving inlet management, storm-water control and shoreline stabilization. If successful, sediment inflow reductions will save local and Federal maintenance dredging funds, increase the length of time to fill the upland sites to capacity, reduce the impact of suspended sediments on the environment of Florida's waterways and increase retainage of these sediments in our beach and upland system.

This program is being managed through a Geographic Information System (GIS) developed by the District. The District's GIS contains all historical dredging records of the waterway, current reconnaissance level surveys, channel telemetry, and dredged material management site data including capacities. The GIS is expected to be a very important tool in the effective and efficient long-term management of this program.

Discussion

Dr. Robert G. Dean asked how the grain size of the 23 million cu yd of sand judged to be of beach quality compares to the size of the sand on the beach. *Mr. Roach* replied that the grain size is a little bit smaller than the sand on the beach. As the sand flows through the inlet system, the heavier-grained sand falls out in the throat of the inlet and the impoundment basin of the inlet, if there is one. So, the intracoasal waterway receives the smallest grain size. But it has been found to be good beach quality material. *Mr. Roach* added that the Florida Department of Environmental Protection has supported the Florida Inland Navigation System in getting that sand returned to the coastal system.

Review of Long-Term Shoreline Changes in Florida

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Introduction and Database

This presentation describes results obtained through analysis of a large high-quality shoreline position database for the state of Florida. The Bureau of Beaches and Coastal Systems of the Florida Department of Environmental Protection has made a long-term commitment to the monitoring of Florida's sandy beaches and the incorporation of these data along with available historical data into a high-quality and readily available database.

These data encompass some 1,150 km (714 miles) and comprise Florida's 24 predominantly sandy beach counties with 12 each located on the east and west coasts. The 3,769 locations at which the data are available are spaced at approximately 300 m (1,000 ft) along the shoreline. Modern surveys are aided by physical (concrete) monuments imbedded in the dunes with accurate x,y,z positions available for the brass cap epoxied into the top of each monument. The time span represented in the database is from the mid 1800's to the mid 1990's, an average time period of 130 to 140 years depending on the particular county. At any specific location, 5 to 12 shoreline positions are available in the historical database.

Results

The common perception is that most of the Nation's shoreline is eroding and there is a sense of futility in stabilizing those areas that are out of equilibrium. This general erosion is attributed, in part, to the effects of sea level rise. Application of standard coastal engineering methods to predict the effects of sea level rise indicates that Florida's shoreline should be retreating on the average at 0.16 m/year (0.53 ft/year). The analysis described below addresses this and other issues. Several unexpected results were found.

Shoreline Change Rates. Along the 592 km (368 miles) of Florida's east coast, it was found that the average shoreline change was advancement of 22 cm/year (0.72 ft/year); however, there were large deviations of the individual trend rates about this average with maximum rates of advancement and

recession of 10 m/year (33 ft/year). Also, the effects of beach nourishment on Florida's east coast are quite evident in the data. Limiting the analysis to prior to the early 1970's, the average shoreline change is advancement at a rate of 16 cm/year (0.53 ft/year). Interpreting the difference between the entire period (+22 cm/year) and that for the pre-nourishment period (16 cm/year), the effects of beach nourishment over the full 592 km for the last approximately 20 years are inferred to be advancement of 0.56 m/year (1.84 ft/year). For purposes of analysis, the west coast was divided into the upper and lower regions, each comprising six counties. The average shoreline change for the upper region (six northwest counties, 285 km or 177 miles) was recession of 16 cm/year (0.53 ft/year) and the average for the lower west coast (six counties, 272 km or 169 miles) was recession of 2 cm/year (0.07 ft/year). The extreme shoreline changes at individual locations for these two shoreline segments are quite large, on the same order as those for the east coast.

Longshore Sediment Transport. It is well-known that the net longshore sediment transport along Florida's east coast is from north to south and best estimates are that the net transport at the north end of the state is approximately 420,000 m^3/year (600,000 yd^3/year) and that at Government Cut at the south end of Miami Beach net transport is 7,000 m^3/year (10,000 yd^3/year). It is possible through a fairly simple sediment budget analysis to interpret the shoreline changes described earlier to examine characteristics of both the longshore and cross-shore sediment transport components. Applying standard coastal engineering sediment budget analysis procedures demonstrates clearly and strongly that there must be an additional source of sediment supplying the combination of shoreline advancement and longshore sediment transport. This amount is 0.8 m^3/m/year (0.32 yd^3/ft/year). This additional source could be due to a slow shoreward movement of sediment from deeper waters into the nearshore zone or due to biogenetic production of beach material (by clams and corals), or a combination of the two. The latter is believed to be too small to account for the magnitudes noted of this additional source.

Shoreline Fluctuations. In order to examine the dynamics of shoreline changes, the standard deviations of the deviations of shoreline positions about the trend lines at the individual locations were calculated and plotted versus longshore position for each county. It was found that these standard deviations were quite uniform around the state, except in the vicinity of inlets. The deviations outside the influence of inlets ranged from 10 to 15 m (33 to 50 ft), which is of the same order as the seasonal shoreline fluctuations from summer to winter and vice versa. However, within the longshore influence of inlets, the standard deviations were an order of magnitude greater, ranging up to in excess of 150 m. These plots also provide a good basis to determine estimates of the longshore influence of inlets.

Summary

It is hoped that this presentation of the results obtained through an analysis of a long-term, high-quality shoreline position database has demonstrated the merits of monitoring the shoreline and incorporating the results into a readily available and usable form. Such a database is instrumental in both understanding the shoreline and in application to rational coastal zone management.

Discussion

Dr. Richard W. Sternberg asked what percent of the nourished material is remaining on the beach along the southern part of the east coast of Florida to show up as changes? *Dr. Dean* said he is not certain and that is one of the things he wishes to investigate. He also wants to look at the amount of material that flows into the inlets and deposits in the flood tidal shoals.

BG Robert L. VanAntwerp asked if it makes a difference when a beach is renourished with a smaller particle size material? *Dr. Dean* replied that it makes an enormous difference. The project at Longboat Key on the west coast has suffered from using sand that was too fine, and it has been unfairly judged because at the last minute the regulatory agencies required the engineer to actually use material from the outer edges of ebb tidal shoals where the fine material resided.

Dr. Billy L. Edge said this is really interesting work, and the state of Florida should be commended for the foresight that it had to implement this monitoring program back in the 1970's. He said if information as detailed and complete as that in Florida existed for Texas and California, better-founded coastal management decisions could be made. *Dr. Edge* recommended the data collection system be expanded to get more real-world data to assist in making long-term decisions.

Mr. Stephen Higgins asked Dr. Dean how the postulated additional source of sand that resulted from his studies correlated with the nourishment quantities, if there was a way to translate that into a shoreline movement result, and what did it mean in terms of shoreline movement. *Dr. Dean* replied that the postulated additional source of sand could indeed be translated into shoreline movement. It can demonstrate that the additional source of sand was there prior to the intensive beach nourishment.

Mr. William F. Precht asked Dr. Dean if he had any data on the biogenic content and the carbonate content from Jacksonville to the Dade/Monroe County line. He believes the possibility for biogenic contribution (specifically mollusks) is very high as a potential source for additional sand. *Dr. Dean* responded that he had only qualitative data in that regard, but he believed the data existed.

Litigation Issues

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Historically, coastal issues attracted the attention of a small group of scientists and some activist beachfront property owners. Today, those issues have been (literally) thrust onto the national spotlight as evidenced by the attached article that appeared on the front page of the *New York Times* on 20 April 1998. Issues that were once the sole province of Corps and administration policy makers (if and how a project should be constructed, cost-sharing, etc.) are now fodder for well-financed and increasingly visible litigation in Federal and state courts. With million-dollar homes hanging in the balance, and with communities and regions taking an eager and proactive interest in the issues, it is likely that the coming years will see a proliferation of "coastal" litigation.

Until recently, "coastal" litigation was generally limited to cases brought by a few beachfront property owners (Owens v. United States; Pittman v. United States). Today, coastal erosion issues have galvanized entire regions. In New York and in Florida, for example, large groups of beachfront property owners, joined or supported by their local communities (who believe that their economic interests are being adversely affected) have sued the Federal Government. DiVito et al. v. United States (New York) and Applegate et al. v. United States (Florida) are two examples. The foundations of these suits are Plaintiffs' allegations that their properties have been "taken" by the Government as a consequence of the Corps' construction, operation, and maintenance of harbors, ports, and other coastal structures. In these cases, traditional theories like the statute of limitations applicable to erosion cases and the navigational servitude are being poked, probed, and tested.

Courts have found that property owners take property subject to the regulations in place. In Lucas, the Supreme Court specifically noted that property owners take property subject to a regulatory scheme that is in place at the time the property owner takes title (Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1027 (1992)). In fact, the Court acknowledged that it would recognize the Federal navigational servitude as an example of a preexisting limit on a landowner's title. Id. at 2900

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[1]The structure and contents of this outline express the author's own views and are in no way expressive of, or binding upon, the U.S. Department of Justice.

(discussing Scranton v. Wheeler, 179 U.S. 141, 163 (1900) (holding that riparian interests in submerged lands were subject to Federal navigational servitude) and Kaiser Aetna v. United States, 444 U.S. 164, 178-80 (1979) (holding imposition of Federal Government's power under navigable servitude was a "taking"). In Preseault v. United States, the Court of Federal Claims remarked that claimants took their reversionary interest subject to the Federal and state law extant at the time of the purchase. 27 Fed. Cl. 69, 90, 94 (1992), affirmed, 66 F.3d 1167 (Fed. Cir. 1995), rehearing en banc granted, judgment vacated and opinion withdrawn, 66 F.3d 1190 (Fed. Cir. 1995); Lewis Blue Point Oyster Cultivation Co. v. Briggs, 229 U.S. 82, 87-88 (1913) (holding landowner's title to submerged lands under navigable waters is subject to Federal Government's paramount power pursuant to the navigable servitude); Connolly v. Pension Benefit Guaranty Corp., 475 U.S. 211 (1986) (holding Federal law requiring employers to pay proportionate share of a pension plan's unfunded vested benefits was not a taking because employers were on notice before their obligations to pay arose that pension plans were regulated by Congress and that certain obligations were imposed on employers).

Under the United States Constitution, the Federal Government has both a power and a duty to regulate waters in the public interest. Indeed, the authority of the United States over navigable waters is supreme. United States v. Rands, 389 U.S. 121, 123, 88 S.Ct. 265, 267 (1967); Marks v. United States, 34 Fed. Cl. 387, 403 (1995). Known as the navigational servitude, it authorizes the United States to prohibit interference with its navigable waters. The navigational servitude also excepts the United States from liability for burdens imposed on others, such as riparian owners, due to the prohibition. Thus, the compensable property interests of riparian and/or littoral owners in the flow of sands that lay below mean high water is clearly subject to the Federal Government's powers and duties under the navigational servitude. Marks, 34 Fed. Cl. at 403. Compensation is not due for destruction of property rights lying below mean high water.[2] Lucas, 505 U.S. at 1028-29 citing Scranton v. Wheeler, 179 U.S. 141 (1900)

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[2]Of course, Congress' exercise of its servitude does not create a "blanket exception" to the Fifth Amendment's taking clause. United States v. Cherokee Nation of Oklahoma, 480 U.S. 700, 704 (1987); Laney v. United States, 661 F.2d 145 (Ct.Cl. 1981) (the government may be liable under the Fifth Amendment where it prohibits any feasible access to island); Kaiser Aetna v. United States, 444 U.S. 164, 178-80 (1979). Some cases have held the United States liable, despite the existence of the servitude, where its actions in navigable waters result in the destruction of property rights outside the bounds of those waters. See e.g., United States v. Kansas City Life Ins. Co., 339 U.S. 799, 800-01 (1950) (Government liable "for the effects of [change in water level] upon private property beyond the bed of the stream); Owen v. United States, 851 F.2d 1404, 1412 (Fed. Cir. 1988) (en banc) (Government not immune from liability where improvements to navigation "result in erosion to land" located above the ordinary high-water mark).

(holding interests of riparian owner in submerged lands bordering on navigable water are subject to Federal navigable servitude); United States v. Cherokee Nation of Oklahoma, 480 U.S. 700, 704 (1987) (Commerce Clause confers upon the United States a dominant servitude, whose proper exercise "is not an invasion of any private property rights" in areas lying below navigable waters); Kaiser Aetna, 444 U.S. at 175 ("this Court has held in many cases that compensation may not be required as a result of the navigational servitude"); Owen v. United States, 851 F.2d 1404, 1409 (Fed. Cir. 1988) (en banc) ("holdings of the Supreme Court and the other Federal courts make clear that no compensation is owed by the government for injury or destruction of a riparian owner's property" in land beneath navigable waters); Marks, 34 Fed. Cl. at 403 (holding that the navigational servitude defines the appropriate boundaries within which the United States can assert its power to supersede private ownership without creating an obligation to pay just compensation).

The Supreme Court first examined the scope of Federal power over navigation in the landmark case of Gibbons v. Odgen, 22 U.S. (9 Wheat.) 1 (1824). The Court, through an opinion by Chief Justice Marshall, encountered little difficulty in concluding that the Commerce Clause reached navigation, stating:

> All America understands, and has uniformly understood, the word "commerce," to comprehend navigation. . . . The power over commerce, including navigation, was one of the primary objects for which the people of America adopted their government, and must have been contemplated in forming it.

Id. at 5. The Court noted that this power transcends state borders, extending as "far as that navigation may be, in any manner, connected with 'commerce with foreign nations, or among the several States, or with the Indian tribes.'" Id. at 9 (emphasis added). The Supreme Court has repeatedly held that the navigational servitude applies without exception to all holders of riparian and riverbed interests. United States v. Grand River Dam Authority, 363 U.S. 229, 233, reh'g denied, 364 U.S. 855 (1960) (Grand River); United States v. Chandler-Dunbar Water Power Co., 229 U.S. 53, 62-63 (1913); Gibson v. United States, 166 U.S. 269, 271-72 (1897). In United States v. Grand River Dam Authority 363 U.S. 229 (1960), the Court states, in terms that could hardly be more explicit, that when Congress applies "its superior power under the Commerce Clause, it is exercising established prerogatives and is beholden to no one." Id. at 233.

In fact, it is well-established that the proper Congressional exercise of the navigational servitude pursuant to the Commerce Clause

> is not an invasion of any private property rights in the stream or the lands underlying it, for the damage sustained does not result from taking property from riparian owners within the meaning of the Fifth Amendment but from the lawful exercise of a power to which the interests of riparian owners have always been subject." Cherokee Nation, 480 U.S. at 704, (quoting United States v. Rands, 389 U.S. 121, 123 (1967)).

See also, Grand River Dam Authority, 363 U.S. 229, 233 (1960 (noting that when Congress exercises its power under the Commerce Clause, it is exercising "established prerogatives and is beholden to no one."); United States v. Twin City Power Co., 350 U.S. 222, 224-25 (1956) (noting Congress' power pursuant to the Commerce Clause "is a dominant one [power] which can be asserted to the exclusion of any competing or conflicting one [power]."); Chandler-Dunbar, 229 U.S. 53, 64 (1913) (noting that all structures in the water of a navigable river are subordinate to Congress' right of navigation and must be removed if Congress requires, regardless of whether such removal causes a loss to the owner).

How the Courts that have coastal cases pending before them will apply the navigational servitude is unclear. Likewise, there are no clear-cut answers to the other myriad legal problems presented in "coastal" litigation. Whether and to what degree, if any, the Federal Government is liable for the "taking" of beachfront property owners' properties due to erosion caused or exacerbated by a Federal project is still an open question. At a minimum, close coordination of efforts and recognition of the interrelationship between and among programmatic, policy, and litigation issues is essential to defend the existing litigation and possibly avoid anticipated litigation.

(Mr. Wiener was unable to attend the meeting; therefore, there was no discussion.)

Sediment Management at Inlets
Federal Navigation Project Mitigation

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Abstract

This presentation pertains to the culture of mitigation or the culture of the laws and policies that have to do with mitigation, much of which relates to ongoing litigation, and the use of existing sediment budget technology at navigation projects for purposes of addressing long-term and annualized impacts to adjacent shorelines. In addition, the presentation (a) reflects upon the history and principles of Section 111 which theoretically holds the Federal government responsible for damages associated with Federally sponsored projects, (b) comments on the findings of a recent (December 1997) Policy Study prepared by the Water Resources Support Center entitled "Shoreline Protection--Mitigation for Federal Harbor Projects," and (c) discusses the magnitude of Federal navigation project impacts at two inlets in Florida which have resulted from recent Inlet Management Plans at these locations.

The state of Florida has embarked on what probably could be defined as a very proactive program of inlet management plan formulation for most of the interrelated navigation projects in the state, whether Federal or non-Federal. A number of the inlet management studies have begun to well quantify at many of the larger east coast navigation inlets the magnitude and spatial extent of shoreline damages which heretofore have neither been addressed nor publicly recognized by the Federal government. Much of this technical documentation has come about in the last 8 years. These particular studies have been done on the basis of in-depth sediment budget analysis formulated for each one of these specified inlet regimes. A number of these are beginning to be adopted as inlet management plans by the governor and his cabinet.

Section 111 has been extremely disappointing to those who have attempted to gain some level of satisfaction in having the Federal government accept fiscal responsibility for damages to adjacent shorelines as a result of navigation project construction and maintenance. Section 111 succinctly directed the Corps to mitigate damages associated with Federal navigation projects. Unfortunately, the law literally was too succinct. It never fiscally related shore damages, historical or ongoing, to

navigation project construction, operation, or maintenance. Policy guidelines promulgated by the office of the Chief of Engineers over the years circumvented the fundamental congressional intent and stifled Section 111 with restrictions which made it solely an incremental feature associated only with the construction of companion shore protection projects. The actual implementation has been unfairly tied to the requirements of justification of shore protection projects in accordance to the requisite principles and standards for those particular civil works projects. If you weren't qualified for a shore protection project, you couldn't qualify for mitigation of your problem associated with a navigation project.

Over the years, the unwritten policy of fending off mitigation at navigation projects, or the damages associated with navigation projects, permeated the ranks of the Corps obviously all the way from the implementation of the policy down through the ranks of the actual individuals in planning, engineering, and navigation who were charged with the actual implementation at the lower level. Even when site-specific Section 111 evaluations were reluctantly performed by Districts, particularly in the 1970's and early 1980's, the Corps was always in the unique position of sitting in judgment of themselves when it came time to determine the impacts and the eventual culpability for damages. The favored explanation was that the impacts associated with a navigation project can't be segregated from other impacts. The official policy in 1986 was that the major cause of erosion is sea level rise and not dredging at navigation projects.

The December 1997 draft policy study entitled "Shore Protection Mitigation for Federal Harbor Projects" was reviewed for a number of clients, including the Canaveral Port Authority. Unfortunately, this particular policy study was formulated in the context of existing policy and, to a large degree, even long-standing engineering myths regarding shore damages.

Within the very first paragraph of the executive summary of this particular document, it is stated that most erosion problems have multiple erosion causes, only one of which may be erosion from a Federal harbor project. Unfortunately, the study basically picks up from there to discuss mitigation on downdrift shorelines, again solely as an incremental cost of a shore protection project, which has always been the classic procedure. Hence, navigation project damages are never addressed as stand-alone features. The policy study is, therefore, an extension of the historical dialog in the context of several new directives that are associated with the Water Resources Development Act of 1996.

This study does bring up one new point. It acknowledges several pending landmark lawsuits filed by "local interests with mitigation problems." The Canaveral Harbor case is specifically addressed by that policy document. There is a mitigation problem. Existing Federal policy of mitigation

justification and conventional shore protection standards are neither reasonable nor prudent. This can be understood through the concept of inlet sediment budget formulation.

At Port Canaveral, it is the global sediment budget which provides the locals presently in litigation with the Federal government the proverbial smoking gun as to Federal culpability for downdrift impacts. The inlet management plan formulated for that navigation project 6 or 7 years ago determined that the navigation project acts as a complete littoral trap, that littoral impacts have occurred and continue to occur, except for those which are being successfully mitigated by the District through a very innovative bypassing program, and that the deficit is about 350,000 cu yd/ year. The spatial extent of downdrift impact is 19 to 26 miles. The net deficit to the downdrift shorelines is very easy to establish since this was a new project constructed through virgin land. The net deficit is now about 10 million cu yd. The downdrift impact is based on the easily substantiated accretion to the north, removal of sand for navigation, and computation of changes in the tidal shoals. The amount of impact is very simply those quantities which are easily documentable and should not be the subject of debate. The goal is to determine both the long-term and annualized volumes of sediment deficit to the adjacent downdrift shoreline. In Florida, the purpose of the entire inlet management planning program is to correct both of these known impacts in concert with the Federal government or inlet Districts to correct both historical and ongoing downdrift impacts.

The policy of the state of Florida regarding participation in the bypassing of sediment at inlets (not the reconstruction of shorelines or the construction of fill projects, but literally the bypassing of an annual, biannual, or some frequency of sediment at inlets) no longer requires the classic justification associated with shore protection projects.

At St. Mary's Entrance, it has been determined that over the 100-year life, the navigation project has caused over 81 million cu yd of sediment to deposit to the downdrift shoreline. The navigation project is responsible for an impact of somewhere between 500,000 and 800,000 cu yd/ year. The spatial extent of the impact to the south and on the downdrift shoreline extends throughout the entirety of the barrier island and probably goes even beyond that onto the next barrier island. Local interests are beginning to maintain that they shouldn't need to be even participating in a project that is computed on incremental benefits funded by Section 111 and justified under conventional shore protection projects and guidelines. It is beginning to be widely held that the cumulative responsibility of the Federal government is so large and so easily documented that the local cost-sharing of any solution, or even participation in the reinstatement of annual bypassing deficit, should theoretically be zero.

Without a change of Federal policy, beginning with the Administration through the Office of Management and Budget and on down to the Districts, it is highly probable that large-scale litigation, such as that which the Corps is now beginning to experience at Port Canaveral, New York, and potentially other locations, will soon begin to escalate. The local perspective is that the Federal government has and always has had responsibility for adequately mitigating navigation project damages, and that incremental mitigation dependent upon conventional shore protection project planning policies at such locations can no longer be tolerated. The concept of inlet management as being implemented in the state of Florida should be considered as some type of a potential model for future Federal policy actions and justifications regarding navigation project mitigation.

Discussion

Dr. Robert G. Dean asked Mr. Olsen if he would try to reinstate the sediment flows, or would he try to fix the past erosion that has occurred since construction of the inlets? *Mr. Olsen* believes the obvious and most prudent thing is to reinstate natural bypassing at each of the inlets. But, unfortunately, the difficulty of that is the Corps doesn't dredge enough to reinstate bypassing. There is a large deficit to be made up, even on an average annual basis, just to reinstate natural bypassing.

Dr. Dean asked if we need better means and technologies for bypassing sand around inlets, or did he think our existing knowledge is adequate? *Mr. Olsen* responded that there is always an argument for new technology. But, he also submitted that the existing technology is grossly underused. With existing laws and contractual requirements, it is very difficult to be innovative even with the projects that exist and the technologies that are available.

Dr. Albert G. Holler, Jr., asked about the situation where, although it is rare, the downdrift property owner such as Glynn County did not want additional sand. *Mr. Olsen* replied that was an interesting exercise. The Corps basically said, "We will pay for everything to get the sand from Brunswick Channel back on the beaches in that location." Political instabilities were there, and private interests did not want the public on their beaches. Glynn County made the choice of keeping their beaches armored as they are today, and to suffer the vulnerability.

Mr. Stephen Higgins asked Mr. Olsen if when he is theorizing about assigning responsibility for the impacts of these navigation projects and the magnitude of the Federal responsibility seems so high, had he figured in the local and regional benefits of the navigation projects which are considerable, and calculated those benefits into the equation? *Mr. Olsen* said that basically, the Districts can only look at

mitigation as it relates to shore protection projects, which just doesn't make sense. That is the very position the state has gotten out of. There are benefits that go beyond just the local area of impact. *Mr. Olsen* believes the first and foremost thing to do is get them to bypass the average annual net transport on an annual basis. There certainly are benefits that go beyond the area of mitigation.

Public Comment

Michael L. Crane
National Oceanic and Atmospheric Administration
Miami, FL

One of the additional assets talked about besides the valuable assets of sand was the information from your research and monitoring programs. We would like to do our part, in cooperation with the Navy, which has a test facility here. We have two underwater sound velocity or acoustic Doppler current meter profilers that measure the velocity of the ocean at the sea buoy and 3 miles offshore. That data is available to both the academic and the Corps' operational and research communities as a service.

In regards to the inquiry about the visibility of the water, the Oceanographic Data Center operates a World Data Center A for oceanography and has cooperating institutions worldwide. And I have the address for contacting them for getting information on secci depths globally, which was mentioned earlier.

In addition to us transmitting data, we would also like to discuss with the appropriate groups the receipt of beneficial data, because we have the mission of outreach and distributing data by legislative mandate. And we would offer that cooperative service to the research and academic communities.

Stephen Higgins
Broward County
Fort Lauderdale, FL

It's my privilege to have been present at three of these at this location since the 1990's began. And I was proud to be the local sponsor which hosts these events, and it's very useful for us as well as it is for everyone else here.

To summarize what I got from the conference, sediment management on the coast is a very critical thing. Shore protection and beach nourishment, irrespective of what is probably a temporary policy position by the Administration, is a worthwhile endeavor.

I think our growing body of economic studies has indicated that beaches are a very important economic engine, not only locally and regionally, but also nationally. Beach nourishment is a proven technology at this point. It works. It's really the only thing that does provide a beach where a beach is lacking.

But I think the most important point that came out of the conference here is that inlet

management is the key to sustainability of our beaches. Unless we can find a way to keep the train of sand moving down the coast, the costs of beach nourishment are going to become prohibitive. Sand, at least in this area of the country, is beginning to diminish.

There's not an unlimited amount of sand offshore. There are environmental considerations, particularly in this area of the country, with coral reefs and so forth, which increase costs of extraction. And we have to find a way to manage the sand which is already in the system.

And that means inlet management. And I am so happy to see that the focus of this conference seems to be on managing the sand at inlets.

Wayne D. Lasch
Post, Buckley, Schun, and Jernigan
Jacksonville, FL

While I am not sure that it is within your authority or purview, I would like to suggest that we set up some work groups to address some of these issues. I have been coming to these meetings off and on for years. The same issues are frequently discussed, and I am not sure of the mechanisms that are available to just keep them going or address them.

So we would like to help in any of those.

MG Fuhrman stated that work groups are within our purview to set up and work.

Frank Rysavy
Hillsboro Inlet District
Pompano Beach, FL

The observation that I have made is that there is a discontinuous and disjointed effort to move sand past inlets. I think Steve Higgins is absolutely correct in his understanding. Inlets are the biggest problem you have got. Unless there is further thought given to regional planning so that this is done on a programmed basis, we aren't going to make it.

Don't forget, the Bahamas has just refused to sell Dade County sand. They are even in worse shape than we are, and we are not in good shape. So unless you give some serious thought to regional sand bypassing, we are not going to make it. You can't do it in spots and expect that Mother Nature is going to take care of the rest.

Closing and Field Trip

MG Russell L. Fuhrman thanked the Jacksonville District and the U.S. Army Engineer Waterways Experiment Station staffs and the court reporter for their excellent support at the Board meeting.

COL Joe R. Miller briefly described the itinerary of the field trips. The helicopter tour would go to Lake Worth Inlet in Palm Beach County, proceed south along the coastline, where three deepwater ports, Palm Beach, Port Everglades, and Miami Harbor, would be viewed. Four shallow-draft harbors and

92 miles of coastline will be viewed. Approximately 40 miles of shore protection projects along the way will be discussed.

For the bus tour, the following projects will be visited and discussed: Lake Worth Sand Transfer Plant, Delray Beach, Pompano Beach, and Hallendale Beach.

MG Fuhrman then adjourned the 67th meeting of the CERB.