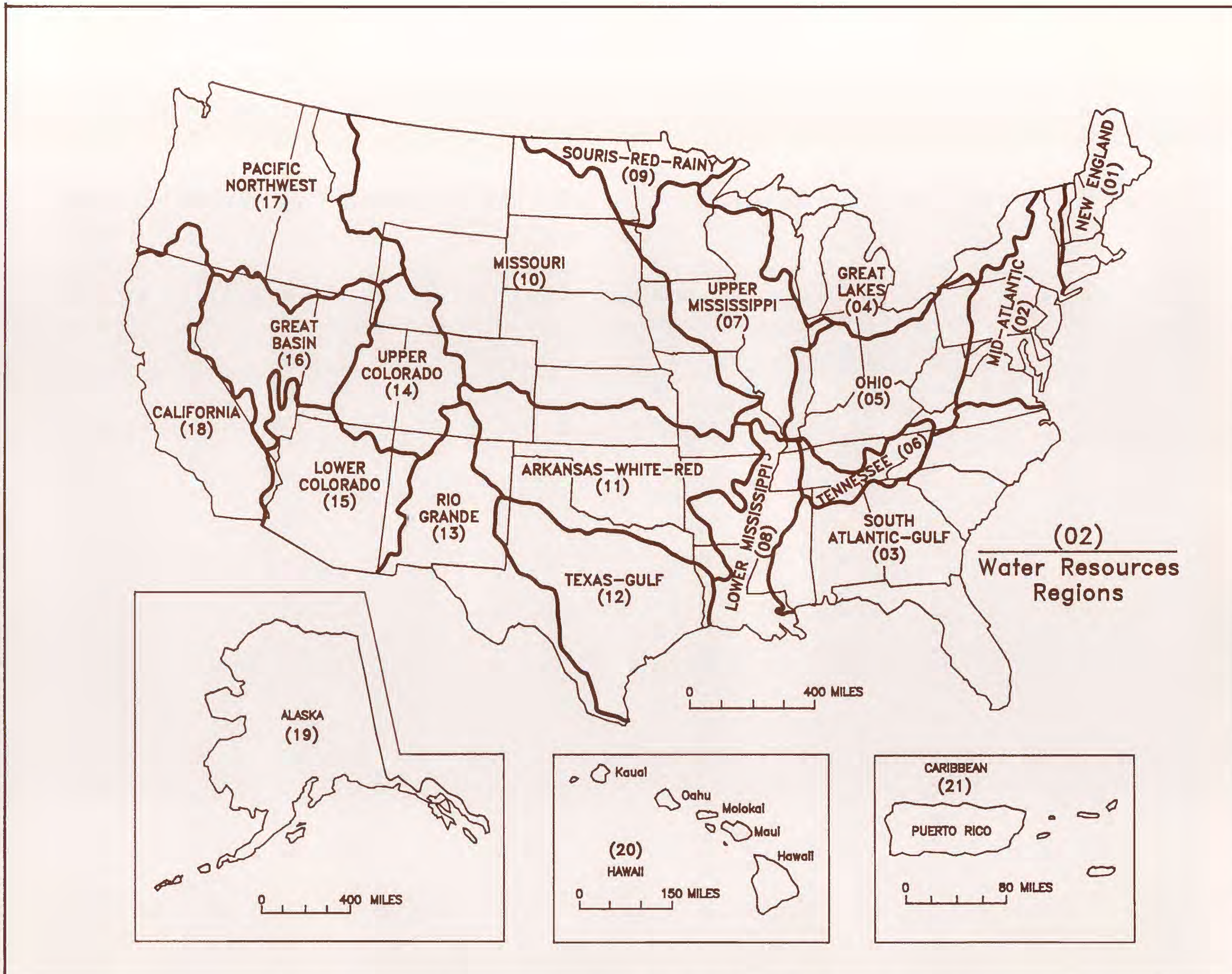
INTERAGENCY ADVISORY COMMITTEE ON WATER DATA

NOTES ON SEDIMENTATION ACTIVITIES CALENDAR YEAR 1991

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
Water Resources Division
Office of Water Data Coordination
417 National Center
Reston, Virginia 22092



Water Resources Regions of the United States

NOTES ON SEDIMENTATION ACTIVITIES
CALENDAR YEAR 1991

the
Subcommittee on Sedimentation
of the
INTERAGENCY ADVISORY COMMITTEE ON WATER DATA

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
Water Resources Division
Office of Water Data Coordination
417 National Center
Reston, Virginia 22092

August 1992

PREFACE

This report is a digest of information furnished by Federal agencies conducting sedimentation investigations. The decision to publish the report was made in 1946, from a proposal by the Chairman of the Federal Interagency River Basin Committee, Subcommittee on Sedimentation. The subcommittee approved the proposal and agreed to issue this report as a means of effecting better coordination of the work of various Federal agencies in the field of sedimentation. The report was issued on a quarterly basis in 1946 and 1947, from 1948 to 1953 reports were issued every 6 months, and from 1954 to the present, the report has been issued annually.

Descriptions of work in progress or planned are included in the report, as well as important findings, new methods, new publications, information relating to laboratory and research activities, and other pertinent information. The material is organized by major drainage regions in the conterminous United States, Alaska, Hawaii, and the Caribbean.

Until 1979, each issue of this publication contained a list of stations where sediment data are collected giving the station location, drainage area, and other related information. Because the station list did not change significantly from year to year, it was eventually deleted from the publication. Also, because most users of the station list were only interested in the stations in a certain geographic area, it was felt that their needs could be served more efficiently by acquiring the necessary information through the National Water Data Exchange (NAWDEX). Therefore, locations and addresses of NAWDEX assistance centers are included in this report.

Information for this report was contributed by the representatives of participating Federal agencies. Suggestions for improving the report are welcome.

CONTENTS

	Page
Preface	iii
Subcommittee on Sedimentation	ix
Locations of NAWDEX Assistance Centers	xiii
Annual Report	xxvii
New England Region (01)[1]	
Geological Survey	1
Soil Conservation Service	3
Mid-Atlantic Region (02)	
Corps of Engineers	5
Geological Survey	6
Soil Conservation Service	10
South Atlantic-Gulf Region (03)	
Corps of Engineers	11
Geological Survey	17
Soil Conservation Service	22
Great Lakes Region (04)	
Corps of Engineers	23
Geological Survey	28
Soil Conservation Service	31
Ohio Region (05)	
Corps of Engineers	33
Geological Survey	35
Soil Conservation Service	38
Tennessee Region (06)	
Geological Survey	39
Upper Mississippi Region (07)	
Corps of Engineers	41
Geological Survey	43
Soil Conservation Service	48
Lower Mississippi Region (08)	
Corps of Engineers	49
Geological Survey	55
Soil Conservation Service	58

[1]Numbers in parentheses refer to Water Resources Regions shown on the map on the inside of the front cover.

Page

Souris-Red-Rainy Region (09)
Geological Survey 59
Missouri Region (10)
Bureau of Reclamation 61
Corps of Engineers 62
Geological Survey 69
Soil Conservation Service 77
Arkansas-White-Red Region (11)
Bureau of Reclamation 79
Corps of Engineers 80
Geological Survey 82
Soil Conservation Service 87
Texas-Gulf Region (12)
Bureau of Reclamation 89
Corps of Engineers 90
Geological Survey 91
Soil Conservation Service 93
Rio Grande Region (13)
Bureau of Reclamation 95
Corps of Engineers 96
Geological Survey 97
Upper Colorado Region (14)
Bureau of Reclamation 101
Geological Survey 102
Soil Conservation Service 105
Lower Colorado Region (15)
Geological Survey 107
Soil Conservation Service 111
Great Basin Region (16)
Geological Survey 113
Soil Conservation Service 116
Pacific Northwest Region (17)
Bureau of Reclamation 117
Corps of Engineers 118
Geological Survey 120
Soil Conservation Service 127

Page

California Region (18)
Bureau of Reclamation 129
Corps of Engineers 130
Geological Survey 134
Soil Conservation Service 137
Alaska Region (19)
Geological Survey 139
Hawaii Region (20)
Geological Survey 141
Caribbean Region (21)
Corps of Engineers 143
Geological Survey 144
Laboratory and Other Research Activities 147
Agricultural Research Service 149
Corps of Engineers 173
Federal Highway Administration 179
Federal Interagency Sedimentation Project 185
U.S. Geological Survey 187

ILLUSTRATIONS:
Water Resources Regions of the United States . . . . . Inside front cover

SUBCOMMITTEE ON SEDIMENTATION

<u>**Chair FY 1991**</u>

David A. Farrell
Agricultural Research Service

<u>**Alternate Chair FY 1991**</u>

Richard B. Perry
National Oceanic and Atmospheric Administration

Representatives	**Alternates**

Department of Agriculture

Representatives	Alternates
David A. Farrell Agricultural Research Service	
Warren C. Harper Forest Service	
Jerry Bernard Soil Conservation Service	

Department of Commerce

Representatives	Alternates
Richard B. Perry National Oceanic and Atmospheric Administration	David B. Duane National Oceanic and Atmospheric Administration

Department of Defense

Representatives	Alternates
Yung H. Kuo Army Corps of Engineers	Lewis A. Smith Army Corps of Engineers

SUBCOMMITTEE ON SEDIMENTATION--Continued

Representatives	Alternates

Department of Housing and Urban Development

Truman Goins Office of Environment and Energy	

Department of the Interior

Charles R. Smith Bureau of Indian Affairs	
Ron Huntsinger Bureau of Land Management	
James Cook Bureau of Mines	Allen Perry Bureau of Mines
Robert Strand Bureau of Reclamation	Roy Rush Bureau of Reclamation
Charles W. Boning U.S. Geological Survey	
William L. Jackson National Park Service	
Ranvir Singh Office of Surface Mining	

Department of Transportation

D.C. Woo Federal Highway Administration	

SUBCOMMITTEE ON SEDIMENTATION--Continued

Representatives	Alternates
Independent Agencies	
Francis R. Skidmore Council on Environmental Quality	
Christopher F. Zabawa Environmental Protection Agency	
Shou-shan Fan Federal Energy Regulatory Commission	
Andrew Seiger International Boundary and Water Commission	Paul Storing International Boundary and Water Commission
Terry (Ted) L. Johnson Nuclear Regulatory Commission	Fred Ross Nuclear Regulatory Commission
Robert T. Joyce Tennessee Valley Authority	
OWDC Liaison: G. Douglas Glysson	

Working Group

Technical Committee on Sedimentation Working Groups
Chair: James Fagg, Bureau of Land Management

LOCATIONS OF NAWDEX ASSISTANCE CENTERS

ALABAMA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	520 19th Avenue, Tuscaloosa, AL 35401	
TELEPHONE:	(205) 752-8104	Central Time
NAWDEX CONTACT:	Will Mooty	

ALASKA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	4230 University Drive, Suite 201, Anchorage, AK 99508-4664	
TELEPHONE:	(907) 786-7100	Alaska Time (Pacific time minus 1 hour)
NAWDEX CONTACT:	Liska Snyder	

ARIZONA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	375 S. Euclid Avenue, Tucson, AZ 85719	
TELEPHONE:	(602) 620-6120	Mountain Time
NAWDEX CONTACT:	Christopher Smith	

ARKANSAS

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	700 West Capitol, 2301 Federal Office Building, Little Rock, AR 72201	
TELEPHONE:	(501) 378-6391	Central Time
NAWDEX CONTACT:	John E. Owen	

CALIFORNIA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	2234 Federal Building, 2800 Cottage Way, Sacramento, CA 95825	
TELEPHONE:	(916) 978-4643	Pacific Time
NAWDEX CONTACT:	John Bader	

CALIFORNIA--Continued

ORGANIZATION: Earth Science Information Center, U.S. Geological Survey
ADDRESS: Room 3128, Building 3 (MS 533), 345 Middlefield Road, Menlo Park, CA 94025
TELEPHONE: (415) 329-4390 Pacific Time
NAWDEX CONTACT: Jack Mottram

COLORADO

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Building 53, Denver Federal Center, Mail Stop 415, Box 25046, Lakewood, CO 80225
TELEPHONE: (303) 236-4882 Mountain Time
NAWDEX CONTACT: Vacant

CONNECTICUT

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Abraham A. Ribicoff Federal Building, 450 Main Street, Room 525, Hartford, CT 06103
TELEPHONE: (203) 240-3060 Eastern Time
NAWDEX CONTACT: Lawrence A. Weiss

DELAWARE

(See U.S. Geological Survey Office in Maryland)

DISTRICT OF COLUMBIA

ORGANIZATION: Earth Science Information Center, U.S. Geological Survey
ADDRESS: Room 2650, 1849 C Street, NW, Washington, DC 20240
TELEPHONE: (202) 208-4047 Eastern Time
NAWDEX CONTACT: Stephen P. Shivers

FLORIDA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 227 N. Bronough Street, Suite 3015, Tallahassee, FL 32301
TELEPHONE: (904) 681-7620 Eastern Time
NAWDEX CONTACT: Linda Geiger

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 9100 N.W. 36th Street, Miami, FL 33122
TELEPHONE: (305) 526-2895 Eastern Time
NAWDEX CONTACT: George A. Karavitis

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 224 West Center Street, Suite 1006, Altamonte Springs, FL 32714
TELEPHONE: (407) 648-6191 Eastern Time
NAWDEX CONTACT: Larry Fayard

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 4710 Eisenhower Boulevard, Suite B-5, Tampa, FL 33634
TELEPHONE: (813) 228-2124 Eastern Time
NAWDEX CONTACT: Jack Rega

GEORGIA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 3039 Amwiler Road, Suite 130, Peachtree Business Center, Doraville, GA 30360
TELEPHONE: (404) 986-6860 Eastern Time
NAWDEX CONTACT: Keith W. McFadden

HAWAII

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 677 Ala Moana Boulevard, #415 Honolulu, HI 96813-5412
TELEPHONE: (808) 541-2653 Alaska-Hawaii Time (Pacific Time minus 2 hours)
NAWDEX CONTACT: Iwao Matsuoka

NAWDEX ASSISTANCE CENTERS--Continued

IDAHO

ORGANIZATION: U.S. Department of the Interior, Bureau of Land Management
ADDRESS: 3948 Development Avenue, Boise, ID 83705
TELEPHONE: (208) 384-3001 Mountain Time
NAWDEX CONTACT: Mark Vinson

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 230 Collins Road, Boise, ID 83702
TELEPHONE: (208) 334-1750 Mountain Time
NAWDEX CONTACT: Luther C. Kjelstrom

ILLINOIS

ORGANIZATION: Illinois State Water Survey Division
ADDRESS: 2204 Griffith Drive, Champaign, IL 61820
TELEPHONE: (217) 333-4952 Central Time
NAWDEX CONTACT: Robert A. Sinclair

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Busey Bank County Plaza, Fourth Floor, 102 East Main Street, Urbana, IL 61801
TELEPHONE: (217) 398-5595 Central Time
NAWDEX CONTACT: Gary O. Balding

INDIANA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 5957 Lakeside Boulevard, Indianapolis, IN 46278-1996
TELEPHONE: (317) 290-3333 Eastern Time
NAWDEX CONTACT: Don Arvin

IOWA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Room 269, Federal Building, 400 South Clinton, Box 1230, Iowa City, IA 52244
TELEPHONE: (319) 337-4191 Central Time
NAWDEX CONTACT: Joe Gorman

NAWDEX ASSISTANCE CENTERS--Continued

KANSAS

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 4821 Quail Crest Place, Lawrence, KS 66049
TELEPHONE: (913) 842-9909 Central Time
NAWDEX CONTACT: Claude Geiger

KENTUCKY

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 2301 Bradley Avenue, Louisville, KY 40217
TELEPHONE: (502) 582-5241 Eastern Time
NAWDEX CONTACT: Sandy J. Couts or Harry C. Rollins

LOUISIANA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: P.O. Box 66492, 6554 Florida Boulevard, Baton Rouge, LA
70896
TELEPHONE: (504) 389-0281 Central Time
NAWDEX CONTACT: Wendy Lovelace

MAINE

(See U.S. Geological Survey Office in Massachusetts)

MARYLAND

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 208 Carroll Building, 8600 LaSalle Road, Towson, MD 21204
TELEPHONE: (410) 828-1535 Eastern Time
NAWDEX CONTACT: Robert W. James, Jr. or John F. Hornlein

MASSACHUSETTS

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 28 Lord Road, Suite 280, Marlborough, MA 01752
TELEPHONE: (508) 485-6360 Eastern Time
NAWDEX CONTACT: Thomas B. Shepard

MICHIGAN

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 6520 Mercantile Way, Suite 5, Lansing, MI 48911
TELEPHONE: (517) 377-1608 Eastern Time
NAWDEX CONTACT: Gary C. Huffman or Stephen P. Blumer

MINNESOTA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 2280 Woodale Drive, Mounds View, MN 55112
TELEPHONE: (612) 783-3100 Central Time
NAWDEX CONTACT: Allan D. Arntson

MISSISSIPPI

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Suite 710, Federal Office Building, 100 West Capitol Street, Jackson, MS 39269
TELEPHONE: (601) 965-4600 Central Time
NAWDEX CONTACT: Fred Morris, III

MISSOURI

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 1400 Independence Road, Mail Stop 200, Rolla, MO 65401
TELEPHONE: (314) 341-0824 Central Time
NAWDEX CONTACT: Loyd Waite

MONTANA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Federal Building, Drawer 10076, 301 South Park Avenue, Helena, MT 59626-0076
TELEPHONE: (406) 449-5263 Mountain Time
NAWDEX CONTACT: Melvin White

NEBRASKA

ORGANIZATION:	Nebraska Natural Resources Commission
ADDRESS:	301 Centennial Mall South, P.O. Box 94876, Lincoln, NE 68509
TELEPHONE:	(402) 471-2081 Central Time
NAWDEX CONTACT:	Mahendra K. Bansal, Head, Data Bank Section, Natural Resources Information System

ORGANIZATION:	U.S. Geological Survey, Water Resources Division
ADDRESS:	Room 406, Federal Building & U.S. Courthouse, 100 Centennial Mall North, Lincoln, NE 68508
TELEPHONE:	(402) 437-5082 Central Time
NAWDEX CONTACT:	Donald E. Schild

NEVADA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division
ADDRESS:	Room 203, 333 West Nye Lane, Carson City, NV 89706
TELEPHONE:	(702) 887-7600 Pacific Time
NAWDEX CONTACT:	M. Teresa Foglesong

NEW HAMPSHIRE

(See U.S. Geological Survey Office in Massachusetts)

NEW JERSEY

ORGANIZATION:	U.S. Geological Survey, Water Resources Division
ADDRESS:	Mountain View Office Park, 810 Bear Tavern Road, Suite 206, West Trenton, NJ 08628
TELEPHONE:	(609) 771-3900 Eastern Time
NAWDEX CONTACT:	Deloris W. Speight

NAWDEX ASSISTANCE CENTERS--Continued

NEW MEXICO

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	4501 Indian School Road, N.E., Suite 200, Albuquerque, NM 87110-3929	
TELEPHONE:	(505) 262-5330	Mountain Time
NAWDEX CONTACT:	Jim C. Schafer	

NEW YORK

ORGANIZATION:	New York State Geological Survey	
ADDRESS:	Room 3136 CEC, Albany, NY 12230	
TELEPHONE:	(518) 474-5816	Eastern Time
NAWDEX CONTACT:	Robert Fickies	

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	P.O. Box 1669, Albany, NY 12201	
TELEPHONE:	(518) 472-3109	Eastern Time
NAWDEX CONTACT:	Lloyd A. Wagner	

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	5 Aerial Way, Syosset, NY 11791	
TELEPHONE:	(516) 938-8830	Eastern Time
NAWDEX CONTACT:	George W. Hawkins	

NORTH CAROLINA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	3916 Sunset Ridge Road, Raleigh, NC 27607	
TELEPHONE:	(919) 571-4014	Eastern Time
NAWDEX CONTACT:	Pamilee Breton	

NORTH DAKOTA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	821 East Interstate Avenue, Bismarck, ND 58501	
TELEPHONE:	(701) 250-4604	Central Time
NAWDEX CONTACT:	Russell E. Harkness	

NAWDEX ASSISTANCE CENTERS--Continued

OHIO

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	975 West Third Avenue, Columbus, OH 43212	
TELEPHONE:	(614) 469-5553	Eastern Time
NAWDEX CONTACT:	Ann E. Arnett	

OKLAHOMA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	Broadway Executive Park, Building 7, 202 N.W. 66th, Oklahoma City, OK 73102	
TELEPHONE:	(405) 231-4256	Central Time
NAWDEX CONTACT:	John S. Havens	

OREGON

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	10615 S.E. Cherry Blossom Drive, Portland, OR 97216	
TELEPHONE:	(503) 231-2024	Pacific Time
NAWDEX CONTACT:	Suzanne J. Miller	

PENNSYLVANIA

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	840 Market Street, Lemoyne, PA 17043	
TELEPHONE:	(717) 782-3851	Eastern Time
NAWDEX CONTACT:	Robert Helm	

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	Great Valley Corporate Center, 111 Great Valley Parkway, Malvern, PA 19355	
TELEPHONE:	(215) 647-9008	Eastern Time
NAWDEX CONTACT:	Cynthia L. Gilliam	

ORGANIZATION:	U.S. Geological Survey, Water Resources Division	
ADDRESS:	Room 2204, Moorhead Federal Building, 1000 Liberty Avenue, Pittsburgh, PA 15222	
TELEPHONE:	(412) 644-2864	Eastern Time
NAWDEX CONTACT:	Greg Wehner	

RHODE ISLAND

(See U.S. Geological Survey Office in Massachusetts)

SOUTH CAROLINA

ORGANIZATION: South Carolina Water Resources Commission
ADDRESS: 1201 Main Street, Suite 1100 Capital Center, Columbia, SC 29202
TELEPHONE: (803) 737-0800 Eastern Time
NAWDEX CONTACT: Theresa Greaney

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Stephenson Center, Suite 129, 720 Gracern Road, Columbia, SC 29210-7651
TELEPHONE: (803) 750-6001 Eastern Time
NAWDEX CONTACT: David E. Bower

SOUTH DAKOTA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Room 408, Federal Building, 200 4th Street, S.W., Huron, SD 57350
TELEPHONE: (605) 353-7176 Central Time
NAWDEX CONTACT: Rick D. Benson

TENNESSEE

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 810 Broadway, Suite 500, Nashville, TN 37203
TELEPHONE: (615) 736-5424 Central Time
NAWDEX CONTACT: Lori R. Mercer

TEXAS

ORGANIZATION: Texas Natural Resources Information System
ADDRESS: P.O. Box 13231, Austin, TX 78711-3231
TELEPHONE: (512) 463-8402 Central Time
NAWDEX CONTACT: Dr. Charles Palmer

NAWDEX ASSISTANCE CENTERS--Continued

UTAH

ORGANIZATION: Utah Division of Water Rights
ADDRESS: Room 231, 1636 West North Temple, Salt Lake City, UT 84116
TELEPHONE: (801) 533-6071 Mountain Time
NAWDEX CONTACT: James Riley

ORGANIZATION: Center for Water Resources Research
ADDRESS: Utah State University, UMC-82, Logan, UT 84322
TELEPHONE: (801) 750-3155 or 3172 Mountain time
NAWDEX CONTACT: David G. Tarboton

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Room 1016, Administration Building, 1745 West 1700 South, Salt Lake City, UT 84104
TELEPHONE: (801) 524-5654 Mountain Time
NAWDEX CONTACT: Pat Fikstad

ORGANIZATION: Earth Science Information Center, U.S. Geological Survey
ADDRESS: 8105 Federal Building, 125 South State Street, Salt Lake City, UT 84138
TELEPHONE: (801) 524-5652 Mountain Time
NAWDEX CONTACT: Wendy R. Hassibe

VERMONT

(See U.S. Geological Survey Office in Massachusetts)

VIRGINIA

ORGANIZATION: Virginia Water Resources Research Center
ADDRESS: Virginia Polytechnic Institute and State University, 617 North Main Street, Blacksburg, VA 24060-3339
TELEPHONE: (703) 231-8033 Eastern Time
NAWDEX CONTACT: T.W. Johnson

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 3600 West Broad Street, Room 606, Richmond, VA 23230
TELEPHONE: (804) 771-2427 Eastern Time
NAWDEX CONTACT: Byron J. Prugh, Jr.

NAWDEX ASSISTANCE CENTERS--Continued

VIRGINIA--Continued

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: National Water Data Exchange, 421 National Center, Reston, VA 22092
TELEPHONE: (703) 648-5663 Eastern Time
NAWDEX CONTACT: Carol Lewis

ORGANIZATION: Earth Science Information Center, U.S. Geological Survey
ADDRESS: 507 National Center, Room 1C402, Reston, VA 22092
TELEPHONE: (703) 648-6045
NAWDEX CONTACT: Information Services

WASHINGTON

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: Suite 600, Pacific Northwest Area, Washington District, 1201 Pacific Avenue, Tacoma, WA 98402
TELEPHONE: (206) 593-6510 Pacific Time
NAWDEX CONTACT: L.A. Fuste

ORGANIZATION: Earth Science Information Center, U.S. Geological Survey
ADDRESS: 678 U.S. Courthouse, West 920 Riverside Avenue, Spokane, WA 99201
TELEPHONE: (509) 353-2524 Pacific Time
NAWDEX CONTACT: Thomas L. Servatius

WEST VIRGINIA

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 603 Morris Street, Charleston, WV 25301
TELEPHONE: (304) 347-5130, 5132 Eastern Time
NAWDEX CONTACT: Elizabeth Hanna

WISCONSIN

ORGANIZATION: U.S. Geological Survey, Water Resources Division
ADDRESS: 6417 Normandy Lane, Madison, WI 53719
TELEPHONE: (608) 274-3535 Central Time
NAWDEX CONTACT: Robert Bodoh

WYOMING

ORGANIZATION:	Wyoming Water Research Center
ADDRESS:	Wyoming University, P.O. Box 3067, University Station, Laramie, WY 82071
TELEPHONE:	(307) 766-2143 Mountain Time
NAWDEX CONTACT:	Barry Lawrence

ORGANIZATION:	U.S. Geological Survey, Water Resources Division
ADDRESS:	2617 East Lincolnway, Suite B, Cheyenne, WY 82001
TELEPHONE:	(307) 772-2713 Mountain Time
NAWDEX CONTACT:	Sharon L. Green

Interagency Advisory Committee on Water Data
Annual Subcommittee Report
Fiscal Year 1991

Subcommittee Name: Sedimentation

Chair FY 1991: David A. Farrell
Agency: Agricultural Research Service - USDA
Telephone: 301/344-4246

Chair FY 1992: Richard B. Perry
Agency: National Ocean Service - NOAA
Telephone: 301/443-8251

Accomplishments During the Year

The Subcommittee met six times during fiscal year 1991. All but one of these meetings was held at the Nassif Building, Department of Transportation, Washington, DC. The Washington, DC meetings were held on October 31, 1991; November 28, 1990; February 6, 1991; May 22, 1991; and August 6, 1991. During the weekend prior to the start of the Fifth Federal Interagency Sedimentation Conference, the Subcommittee met in Las Vegas, NV. The Technical Committee met twice during fiscal year 1991, in Las Vegas, NV in March, and at the Waterways Experiment Station in Vicksburg, MS in August.

The highlight of the subcommittee's activities for the year was the Fifth Federal Interagency Sedimentation Conference that was held in Las Vegas, NV from March 18-21, 1991. The conference was judged to be the most successful in the subcommittee's history. There were close to 400 participants with almost 200 papers presented at the conference. In keeping with previous conferences, the published proceedings were made available to all registered participants at the Las Vegas conference. Additional copies of the proceedings have been distributed to all federal agencies that are represented on the subcommittee. The subcommittee and conference organizers are most appreciative of the contributions made by members who served on the conference's operations, programs, and publications committees, and on the outstanding support provided by the Office of Water Data Coordination.

A report on the conference is being developed under the leadership of Mr. Robert Joyce of the Tennessee Valley Authority, who was the chairman for this conference. The subcommittee plans to benefit from the knowledge and experience gained at the Las Vegas conference, and use the recommendations from the conference chairman's report to improve the program quality and operational efficiency of the Sixth Federal Interagency Sedimentation Conference scheduled for 1996. Issues that the subcommittee plans to review include, the desirability of providing more sophisticated audio-visual aids, expand participation by international scientists, adequacy of the sedimentation topics included in the program, need for clearer guidelines on presentations by keynote and banquet speakers, and the appropriateness of strengthening peripheral conference activities, such as preconference and postconference tours and the spousal program. Of major interest from the standpoint of improving preconference and on-site resources and information management will be an evaluation of the need for more efficient storage and retrieval of registration, financial, program, and operational information through the use of improved hardware and software.

An issue that has been discussed by the membership of the subcommittee at some length during the year is the future of the Federal Interagency Sedimentation Project. This project has been located at the St. Anthony Falls laboratory of the University of Minnesota in Minneapolis, MN for many years. These discussions were precipitated by decisions made by the Corps of Engineers (COE) in 1990, that relate to the type and level of support that COE can continue to provide the project through its District Office in St. Paul, MN. After several months of deliberations by the two agencies that provide most of the financial resources and personnel for the project, namely the U.S. Geological Survey and Corps of Engineers, a decision to relocate the project from Minneapolis, MN to the Waterways Experiment Station at Vicksburg, MS has been reached. This decision was based on the recommendations of a working group set up by the Technical Committee to assess the merits of four alternative locations for the project. The four locations that were assessed are Minneapolis, MN; Denver, CO; Fort Collins, CO; and Vicksburg, MS. Implementation of the transfer is expected to take some time. Specific details related to future funding mechanisms and changes in program focus are still being negotiated.

The Notes on Sedimentation Activities for calendar year 1990 have been printed and distributed to participating agencies. Because of the heavy work load of the subcommittee associated with preparations for the Las Vegas conference, publication and distribution of the 1990 Notes was delayed by a few weeks. A return to the normal timetable for the development and publication of the report by the Sedimentation Subcommittee is planned for calendar year 1991.

Action Plans for Coming Year

The Subcommittee plans to meet six times in the coming year, including a joint meeting with the Technical Committee probably in Vicksburg, MS. The Technical Committee plans to hold two meetings during the coming year. The first meeting will be held in Minneapolis, MN on October 29-30, 1991.

The subcommittee anticipates significant action on the transfer on the Federal Interagency Sedimentation Project from Minneapolis, MN to Vicksburg, MS.

Notes on Sedimentation Activities for calendar year 1991 will be published and distributed to participating agencies.

Preliminary planning for the Sixth Interagency Sedimentation Conference will begin with the appointment of a site selection committee to solicit information from hotels in five to six cities that would be prepared to contract for the next conference.

Further action on the assessment of sediment transport models is planned. The Federal Energy Regulatory Commission (FERC), in cooperation with the Subcommittee, the National Academy of Sciences, a team of U.S. modelers, and a scientist group from Taiwan, will continue the evaluation of sedimentation models begun in 1987 by the Subcommittee's Ad Hoc Work Group. This project, which has broad support, will assist the Subcommittee in formulating and promoting improved guidelines for selecting and using sedimentation models.

The first two phases of this project, namely, and inventory of sedimentation models and a 550-page report on "Twelve Selected Computer Stream Sedimentation Models" were successfully completed. This final model testing phase was delayed through lack of funds.

A report on "Sediment Deposition in U.S. Reservoirs for the Period 1981-1985" will be published. A critical evaluation of the benefits of the available sedimentation data and the need for additional information on reservoir flows by the subcommittee or a working group made of key data collection agencies is planned. Further discussions on the processing of reservoir sedimentation data for the period 1985-1990, including improvements in software, are planned.

Recommendations

The Subcommittee is on record that the value of the reservoir sedimentation data that is collected by several federal agencies would be substantially improved by the collection and release of reservoir flow data. The Interagency Advisory Committee on Water Data should explore the options available for promoting support at the federal level to have this additional information made available.

NEW ENGLAND REGION

GEOLOGICAL SURVEY

St. John Subregion

1. Suspended-sediment data are being collected bimonthly at St. John River near Van Buren, ME, as a part of the National Stream Quality Accounting Network (NASQAN).

Penobscot Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Penobscot River at Eddington, ME, as a part of NASQAN.

Kennebec Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Kennebec River near North Sidney, ME, as a part of NASQAN.

Androscoggin Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Androscoggin River at Brunswick, ME, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Wild River at Gilead, ME, as a part of the National Hydrologic Benchmark Network.

Maine Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at St. Croix River at Milltown, ME.

Saco Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Saco River at Cornish, ME, and on a bimonthly basis at Presumpscot River near West Falmouth, ME, as a part of NASQAN.

Connecticut Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Connecticut River at North Walpole, NH, and at Connecticut River at Thompsonville, CT, as a part of NASQAN.

Massachusetts-Rhode Island Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Pawcatuck River at Westerly, RI, as a part of NASQAN.

Connecticut Coastal Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Housatonic River at Stevenson, CT, and quarterly at Shetucket River at South Windham, CT, as a part of NASQAN.

St. Francois Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Black River at Coventry, VT, as part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
10 Causeway, Room 926
Boston, MA 02222-1040

District Chief, WRD
U.S. Geological Survey
26 Ganneston Drive
Augusta, ME 04330

District Chief, WRD
U.S. Geological Survey
450 Main Street, Room 525
Hartford, CT 06103

District Chief, WRD
U.S. Geological Survey
New Hampshire/Vermont District
525 Clinton Street
Bow, NH 03304

NEW ENGLAND (01) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. River Basin Studies

Major Drainage	Watershed	Stream	County	State
Connecticut River	Ball Mountain Brook	Ball Mountain Brook		VT

MID ATLANTIC REGION

CORPS OF ENGINEERS

North Atlantic Division

Baltimore District

Sedimentation Survey. A sedimentation survey was conducted in 1991 at Jennings Rudolph Lake under a contract, with Vandemark & Lynch, Inc.. The purpose of this survey was to re-establish sediment ranges and to perform a hydrographic survey. The survey reset, replaced, or established horizontal or vertical control to existing monuments which have been lost, destroyed or vandalized, and established five new sediment ranges. The hydrographic survey in the reservoir was done in 1991. Analyzed survey result is expected by summer 1992.

Sedimentation Study. The district is conducting a study to determine sediment yield from the watershed of the North Branch Potomac River to Jennings Randolf Lake. Standard sediment engineering methods (based on Corps EM 1110-2-4000) will be used to determine the average annual sediment yield for the watershed, broken down by subbasin. The study will be completed in mid-summer 1992.

New York District

The District conducted sediment tests at the following locations.

Project Name	Grain Size	Bulk Sediment	Elutri-ate	Bioassay	Bioaccumu-lation	E.P. Toxi-city
Long Island Intracoastal Waterway, NY	X	X	-	-	-	X
Bayridge & Red Hook Channels, NY						
- Bay Ridge	X	X	X	X	X	-
- Red Hook	X	X	X	X	X	-
Newtown Creek, NY						
- Newtown Creek	X	X	X	X	X	-
- Dutch Kills	X	X	X	X	X	-
New York Harbor, NY						
- Main Ship Channel	X	X	X	X	X	-
NY & NJ Channels						
- Perth Amboy Anchorage	X	X	X	X	X	-
Shark River, NJ	X	X	X	X	X	-
Milton Harbor, NY	X	X	X	X	X	-

MID-ATLANTIC REGION

GEOLOGICAL SURVEY

Richelieu Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Richelieu River (Lake Champlain) at Rouses Point, NY, as a part of the National Stream Quality Accounting Network (NASQAN).

Upper Hudson Subregion

1. Suspended-sediment data are being collected on a daily basis at Hudson River at Stillwater, NY, and Hudson River at Waterford, NY, in cooperation with the New York State Department of Environmental Conservation. Suspended-sediment data are being collected on a periodic basis at Hudson River at Rogers Island at Fort Edward, NY, and Hudson River at Schuylerville, NY, and Hudson river near Fort Miller, NY.

2. Suspended-sediment data are being collected on a quarterly basis at Hudson River at Green Island, NY, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Esopus Creek at Shandaken, NY, as a part of the National Hydrologic Benchmark Network.

4. Suspended-sediment data are being collected five times a year at Wallkill River near Sussex, NJ, Papakating Creek at Sussex, NJ, Wallkill River near Unionville, NY, and Black Creek near Vernon, NJ.

Lower Hudson-Long Island Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Passaic River at Little Falls, NJ, and quarterly at Raritan River at Queens Bridge at Bound Brook, NJ, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Nissequoque River near Smithtown, NY, and Carmans River at Yaphank, NY, as part of NASQAN.

3. Suspended-sediment data are being collected five times a year at Hackensack River at Riverdale, NJ, Passaic River near Millington, NJ, Passaic River near Chatham, NJ, Rockaway River above reservoir at Boonton, NJ, Rockaway River at Pine Brook, NJ, Whippany River near Pine Brook, NJ, Passaic River at Two Bridges, NJ, Pequannock River at Macopin Intake Dam, NJ, Ramapo River near Mahwah, NJ, Pompton River at Packanack Lake, NJ, Passaic River at Route 46 at Elmwood Park, NJ, Saddle River at Lodi, NJ, Rahway River near Springfield, NJ, Rahway River at Rahway, NJ, South Branch Raritan River at Middle Valley, NJ, South Branch-Raritan River, Arch Street at High Bridge, NJ, Spruce Run near Glen Gardner, NJ, Mulhockaway Creek at Van Syckel, NJ, South Branch Raritan River at Stanton, NJ, South Branch Raritan River at Three Bridges, NJ, Neshanick River at Reaville, NJ, North Branch Raritan River near Chester, NJ, North Branch Raritan River at Burnt Mills, NJ, Lamington (Black) River near Pottersville, NJ, Rockaway Creek at Whitehouse, NJ, Lamington River at Burnt Mills, NJ, Raritan River at Manville, NJ, Millstone River near Manalapan, NJ, Millstone River at Grovers Mill, NJ, Stony Brook at Princeton, NJ, Beden Brook near Rocky Hill, NJ, Millstone River at Blackwells Mills, NJ, Matchaponix Brook at Mundy Ave., at Spotswood, NJ, Manalapan Brook at Federal

Road near Manalapan, NJ, in cooperation with the New Jersey Department of Environmental Protection and Energy.

Delaware Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Toms River near Toms River, NJ, Maurice River at Norma, NJ, and West Branch Wading River at Maxwell, NJ, and on a quarterly basis at Delaware River at Trenton, NJ, as a part of NASQAN.

2. Suspended-sediment data are being collected on a monthly basis at McDonalds Branch in Lebanon State Forest, NJ, as a part of the National Hydrologic Benchmark Network.

3. Bottom material data (carbon, metals, organochlorine pesticides) are being collected at about 16 subregion sites in New Jersey on a yearly schedule.

4. Suspended-sediment data are being collected five times a year at Manasquan River at Squankum, NJ, Mullica River near Atco, NJ, Mullica River at outlet of Atsion Lake at Atsion, NJ, Hayes Mill Creek at Atco, NJ, Hayes Mill Creek near Chesilhurst, NJ, Sleeper Branch near Atsion, NJ, Clark Branch near Atsion, NJ, Pump Branch near Waterford Works, NJ, Blue Anchor Brook at Elm, NJ, Albertson Branch near Elm, NJ, Batsto River at Batsto, NJ, West Branch Wading River at Maxwell, NJ, Oswego River at Harrisville, NJ, East Branch Bass River near New Gretna, NJ, Great Egg Harbor River near Sicklerville, NJ, Great Egg Harbor River at Folsom, NJ, Great Egg Harbor River at Weymouth, NJ, Maurice River near Millville, NJ, Delaware River at Montague, NJ, Delaware River at Portland, PA, Paulins Kill at Balesville, NJ, Paulins Kill at Blairstown, NJ, Pequest River at Pequest, NJ Delaware River at Northampton Street at Easton, PA, Pohatcong Creek at New Village, NJ, Musconetcong River at Lockwood, NJ, Musconetcong River near Bloomsbury, NJ, Musconetcong River near Riegelsville, NJ, Delaware River at Riegelsville, NJ, Delaware River at Lumberville, PA, Assunpink Creek near Clarksville, NJ, Assunpink Creek at Trenton, NJ, Crosswicks Creek at Extonville, NJ, Doctors Creek at Allentown, NJ, South Branch Rancocas Creek at Vincentown, NJ, North Branch Rancocas Creek at Pemberton, NJ, North Branch Pennsauken Creek near Moorestown, NJ, South Branch Pennsauken Creek at Cherry Hill, NJ, Cooper River at Haddonfield, NJ, South Branch Big Timber Creek at Blackwood Terrace, NJ, Raccoon Creek near Swedesboro, NJ, Oldmans Creek at Porches Mill, NJ, Salem River at Woodstown, NJ, in cooperation with the New Jersey Department of Environmental Protection and Energy.

Susquehanna Subregion

1. As a part of the NASQAN and Hydrologic Benchmark programs, suspended-sediment data are being collected on a bimonthly basis at Raystown Branch Juniata River at Saxton and Susquehanna River at Harrisburg, and on a quarterly basis at Susquehanna River at Danville, West Branch Susquehanna River at Lewisburg, and Young Womans Creek near Renovo. In addition, four samples were collected during high-flow events at the Susquehanna River at Harrisburg as part of the NASQAN program.

2. Daily suspended-sediment data are being collected at Juniata River at Newport, PA, as a Federal sediment index station.

3. Suspended-sediment data are being collected on a bimonthly basis at Susquehanna River at Conowingo, MD, as a part of NASQAN and on a daily basis, beginning July 1984, as part of the Chesapeake Bay River-Input Monitoring project.

Upper Chesapeake Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Choptank River near Greensboro, MD, as part of NASQAN, and on a daily basis as part of the Chesapeake Bay River-Input Monitoring project.

2. Suspended-sediment data are being collected on a bimonthly basis at Patuxent River near Bowie, MD, as a part of NASQAN and on a daily basis, beginning October 1984, as part of the Chesapeake Bay River-Input Monitoring project.

Potomac Subregion

1. Suspended-sediment data are being collected on a daily basis at Monocacy River at Reichs Ford Bridge near Frederick, MD, as part of the Federal CBR program.

2. Suspended-sediment data are being collected on a daily basis at Potomac River at Point of Rocks, MD, as a part of the Federal CBR program.

3. Suspended-sediment data are being collected on a bimonthly basis at Potomac River at Shepherdstown, WV, Potomac River at Chain Bridge, Washington, D.C., and Shenandoah River at Millville, WV, as a part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Monocacy River at Bridgeport, MD, in cooperation with the Interstate Commission on the Potomac River basin as part of a study looking at nutrient loadings.

Lower Chesapeake Subregion

1. Suspended-sediment data are being collected on a twice weekly basis and during storm events at Rappahanock River at Remington, VA, as a part of the Federal CBR program.

2. Suspended-sediment data are being collected bimonthly at Rappahanock River near Fredericksburg, VA, Mattaponi River near Beulahville, VA, Pamunkey River near Hanover, VA, Appomattox River at Matoaca, VA, and James River at Cartersville, VA, as part of NASQAN.

3. Suspended-sediment data are being collected quarterly at Holiday Creek near Andersonville, VA, as part of the National Hydrologic Benchmark Network.

4. Suspended-solids data are being collected daily at Rappahanock River near Fredricksburg, James River at Cartersville, VA, Pamunkey River near Hanover, VA, Mattaponi River near Beulahville, VA, and Appomattox River at Matoaca, VA, in cooperation with the Virginia Water Control Board.

Special Studies

1. A study of agricultural best management practices in the carbonate region of southeastern Pennsylvania was started in the Conestoga River basin in Lancaster County, PA, during 1982. Suspended-sediment and nutrient data were collected from the Little Conestoga Creek near Morgantown and near Churchtown using automatic samplers.

2. Suspended-sediment data are being collected using an automatic sampler from the Conestoga River at Conestoga, PA, as part of a study of nutrient discharges. Base-flow samples are collected monthly.

3. Samples of reservoir bottom materials and the "slurries" at the water-sediment interface were collected as part of a project to evaluate nutrient and other chemical loads associated with resuspendable sediment in reservoirs on the lower Susquehanna River.

4. Suspended-sediment data are being collected with automatic samplers from Brush Run, a 200-acre agricultural basin in the noncarbonate region of southeastern Pennsylvania. Base-flow samples are collected monthly using manual samplers and storm-event samples are collected using automatic samplers. The study is designed to evaluate the effects of best management practices on sediment and nutrient discharge.

5. Suspended-solids data are being collected daily at Rappahanock River near Fredricksburg, VA, Mattaponi River near Beulahville, VA, Pamunkey River near Hanover, VA, James River at Cartersville, VA, and Appomattox River at Matoaca, VA, in cooperation with the Virginia Water Control Board. These data are being used to improve the understanding of input of suspended solids into Chesapeake Bay.

6. Suspended-sediment data are being collected periodically at base flow and during storms at Upham Brook at Richmond, VA, Chickahominy River near Atlee, VA, Chickahominy River at Richmond, VA, and Chickahominy River near Providence Forge, VA, as part of a cooperative study with the City of Newport News to assess the sources and sinks of trace metals, nutrients, and selected contaminants in the Chickahominy River basin.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
208 Carroll Building
8600 LaSalle Road
Towson, MD 21204

District Chief, WRD
U.S. Geological Survey
P.O. Box 1669
Albany, NY 12201

District Chief, WRD
U.S. Geological Survey
810 Bears Tavern Road
Suite 206
West Trenton, NJ 08628

District Chief, WRD
U.S. Geological Survey
603 Morris Street
Charleston, WV 25301

District Chief, WRD
U.S. Geological Survey
840 Market Street
Lemoyne, PA 17043-1586

District Chief, WRD
U.S. Geological Survey
3600 West Broad Street, Room 606
Richmond, VA 23230

MID-ATLANTIC (02) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Schuylkill River	Tulpehocken Creek	Tulpehocken Creek	Berks & Lebanon	PA

   b. River Basin Investigations

Major Drainage	Watershed	Stream	County	State
Lake Champlain	Lake Champlain			VT

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Middle Creek, PA-636	Snyder	PA

3. Special Studies

Final reports have been issued on the comprehensive monitoring and evaluation projects LaPlatte Watershed, Chittenden County, Vermont and in the St. Albans Bay Watershed, Franklin County, Vermont. These are long term projects to evaluate the effects of installing Best Management conservation practices on sediment yield and nutrient yields.

SOUTH ATLANTIC-GULF REGION

CORPS OF ENGINEERS

South Atlantic Division

Charleston District

Coastal Shoreline Monitoring. Monitoring of coastal shoreline changes for dual jetty systems at Little River and Murrells Inlets, South Carolina continued through 1991. The third five-year monitoring period for Murrells Inlet, South Carolina, which was begun in October 1987, continued throughout 1991. Maintenance dredging at Murrells Inlet and placement of the dredged material along the beach front at North Litchfield Beach, Hunting Beach State Park, and south Garden City was completed in May 1988. This was the first and only maintenance dredging effort to take place at the inlet since the dual jetty system was completed. The third five-year monitoring plan for Little River Inlet was continued during 1991. The Coastal Engineering Research Center (CERC) has recently conducted an analysis of the monitoring data collected at Little River Inlet between 1980 and 1989. This analysis included beach profile analyses; computations of shoal and fillet volumes; a pre- and post-project refraction analysis using RCPWAVE; examination of aerial photography; and a brief review of historical shoreline change maps. Anticipated date for the CERC report covering the first 10-year monitoring phase is FY 92. The monitoring of the projects is being performed to determine the effects that a dual jetty system has on littoral transport processes and adjacent shorelines. Data being collected for monitoring these projects include:

a. Aerial photography
b. Beach profiles upcoast and downcoast of the jetties
c. Hydrographic surveys of the inlet area
d. Structural performance

The data, which is collected on a regular basis, is forwarded to CERC at US Army Engineers Waterways Experiment Station in Vicksburg, Mississippi, for analysis and report preparation. In FY 91, CERC and the District conducted current measurements at various locations within Little River Inlet during ebb and flood tidal conditions. These current measurements along with data obtained from model studies conducted prior to the project's construction and bathymetric surveys within the inlet will be used by CERC to analyze the thalweg which is located adjacent to the downcoast jetty. The date for CERC's preliminary report on the thalweg status at the Little River Inlet is March 1992. In addition to the above monitoring of the two dual jetty systems, monitoring of the storm surge protection projects for Folly Beach and Myrtle Beach, South Carolina, has been initiated. Beach survey profiles for Folly Beach were taken in FY 89, and beach survey profiles for Myrtle Beach were taken in FY 91. Also controlled orthographic maps were made for the Folly Beach project from aerial photographs which were taken in October 1990. These maps will be used as a basis for any mitigation which may be required at Bird Key which is a small island situated in close proximity to the proposed borrow area. The Myrtle Beach Storm Surge Protection Project's General Design Memorandum will use controlled orthographic maps which were made from aerial photographs which were taken in September 1991.

Cooper River Rediversion Project. The post-construction monitoring of the entrance, intake, and tailrace canals was begun following completion of the Cooper River Rediversion Project in 1985. The monitoring consists of the hydrographic and topographic surveys of 114 cross sections across the canal plus seven cross sections across the Santee River. The monitoring is to be done annually unless conditions warrant otherwise. Following the initial start-up of the powerhouse in 1985, a scour hole developed immediately off the end of the tailrace stilling basin. Emergency measures were taken to repair the scour hole by dewatering a portion of the tailrace canal, filling the scour hole with soil to elevation -5 NGVD, and then placing a five-foot layer of riprap across the channel bottom. Upon completion of this repair, another scour hole formed downstream of the initial hole. Plans and specifications were prepared during 1988 and work was completed in 1989 to armor the channel bottom around the secondary scour hole with riprap. Hydrographic surveys of this area were taken every three months to monitor the condition of the area. As a result of the 1990 monitoring surveys, it was determined to reduce the frequency of the monitoring to a semi-annual cycle.

Bank-to-bank cross sections are also being taken at approximate 1,000-foot intervals in the Charleston Harbor (Cooper River) from Fort Sumter to Snow Point. These sections are being used to monitor sediment movement in the harbor as a result of the reduced freshwater releases into the river from Lake Moultrie. These cross sections will reveal any sloughing of navigation channel banks and will aid in determining effects on sediment deposits outside of these channels. These surveys will also be used as a basis for predicting the volume of future maintenance dredging, because in addition to the Rediversion Project, the harbor is currently being deepened which may cause changes is shoaling patterns. These bank-to-bank cross sections are to be taken annually for a ten-year period. The seventh set of these cross sections was taken during 1991.

Mobile District

Sediment Load Measurements. The daily suspended sediment samples continued to be collected at Amory, Mississippi.

The ongoing program of collecting suspended samples includes periodic sampling at 40 stations. Thirty-two of these stations are operated by the U.S. Geological Survey at the following locations:

Alabama	Alabama River nr Montgomery, AL
	Alabama River at Claiborne, AL
	Alabama River at Catherine, AL
	Alabama River at Midway, AL
	Alabama River at Selma, AL
	Black Warrior River at Northport, AL
	Cahaba River at Suttle, AL
	Tombigbee River at Nanafalia, AL
	Tombigbee River at Pickensville, AL
	Tombigbee River at Cochrane, AL
	Tombigbee River at Gainesville, AL
	Tombigbee River at Jackson, AL

Florida	Apalachicola River at Chattahoochee, FL Apalachicola River at Sumatra, FL
Georgia	Chattahoochee River at Cornelia, GA Chattahoochee River at Whitesburg, GA Chestatee River at Dahlonega, GA Flint River at Newton, GA Oostanaula River at Resaca, GA
Mississippi	Buttahatchee River near Aberdeen, MS Luxapallila Creek at Columbus, MS Mantachie Creek at Dorsey, MS Noxubee River at Macon, MS Tombigbee River at Marietta, MS Tombigbee River at Fulton, MS Tombigbee River at Bigbee, MS Tombigbee River at Amory, MS Tombigbee River at Aberdeen, MS Tombigbee River at Columbus, MS Town Creek at Nettleton, MS Twentymile Creek at Guntown, MS Twentymile Creek at Mantachie, MS

Bed material samples were collected at numerous study sites and gaging stations within the Mobile District. Grain size analyses were utilized in bed load computations, stability analysis, and environmental studies for the various streams.

Equipment used to obtain suspended sediment or bed material samples was the DH-48, DH-59, D-74, P-61, BMH-53, BM-54, and BMH-60.

Other Investigations.

1. Tennessee-Tombigbee Waterway Bendway Management Study. The collection of suspended and bed load samples to define the sedimentological processes in the bendways continued periodically throughout the year.

2. Apalachicola, Chattahoochee, and Flint Rivers. River flows and suspended sediment loads continued to be monitored at seven locations in compliance with the "Apalachicola, Chattahoochee and Flint Rivers Navigation Maintenance Plan." Bed samples were taken at 27 Environmental Study ranges IAW the Navigational Maintenance Plan.

Savannah District

Dredging Survey. District performed examination and before and after dredging surveys in Savannah and Brunswick Harbors and in the Atlantic Intracoastal Waterway (AIWW) between Hilton Head, South Carolina and Fernandina Beach, Florida. The following is a summary of the number of project controlling depth surveys made during 1991:

Project	No. of Surveys
Savannah Harbor	9
Brunswick Harbor	8
Atlantic Intracoastal Waterway	1

The controlling depth surveys summarize the minimum depths in each channel quarter of a specified reach in Savannah and Brunswick Harbors. Controlling depth surveys of the AIWW summarize minimum depths in specified reaches along the channel centerline. Four condition surveys of Kings Bay Naval Submarine Base were published. Kings Bay is not a Corps project; however, Savannah District performs hydrographic surveys for the Base Public Works Office. Condition surveys are full channel width hydrographic survey lines run at 500- and 250-foot intervals.

Wilmington District

Inlet Sedimentation

1. Masonboro Inlet.

a. Purpose. To determine the rate and extent of shoaling between the jetties and in the sound areas behind the inlet and to determine sound bypassing requirements.

b. Type of Survey. Hydrographic.

c. Elements Measured. Depths in the inlet and beach profiles.

d. Survey Scope. Complete hydrographic surveys are made of the inlet between the jetties and Banks Channel, Shinn Creek, and Masonboro Channel. In addition, surveys are made of the adjacent beaches, Wrightsville Beach and Masonboro Island, to determine impacts of the jetties on the stability of the shorelines and regulate sand bypassing requirements.

e. Surveys of the inlet are made at 6-month intervals whereas beach surveys are made annually.

f. Based on the results of the surveys, sand bypassing from Masonboro Inlet was accomplished between April and July 1986 with 900,000 cubic yards being pumped northward to Wrightsville Beach and 1,128,000 cubic yards placed on Masonboro Island to the south. Surveys of the sediment trap in the inlet and in Banks Channel showed an accumulation of 562,000 cubic yards of material between 1986 and 1988. The sediment trap was redredged in the fall of 1991 with 912,000 cubic yards of material being removed from between the jetties and in Banks Channel and placed on Wrightville Beach. Approximately 8,000 feet of beach was covered by the material beginning at a point 7,000 feet north of the inlet.

2. Carolina Beach Inlet.

a. Purpose. To monitor the rate of shoaling in a deposition basin constructed in the inlet. The deposition basin is to be used as a source of future beach nourishment material for the Town of Carolina Beach.

b. Type of Survey. Hydrographic.

c. Elements Measured. Depths in the deposition basin and beach profiles.

d. Survey Scope. Hydrographic surveys are made of the deposition basin and the inlet ocean bar and interior channels. Beach profile surveys are made on Masonboro Island and Carolina Beach. The survey data is used to determine nourishment requirements for Carolina Beach and assess the ability of the deposition basin to trap sufficient quantities of material to satisfy the nourishment requirements.

e. Surveys of the deposition basin and beach profiles are made annually.

f. The deposition basin was dredged in the spring of 1985 with approximately 765,000 cubic yards of material being pumped southward to the north end of Carolina Beach. A survey of the deposition basin made in the summer of 1984 indicated that over 555,000 cubic yards of sand had accumulated in the trap. Renourishment of the Carolina Beach project using an expanded deposition basin began on 16 March 1988 and was completed on 27 April 1988. A total of 950,000 cubic yards was removed from the trap and placed on the northern 6,000 feet of Carolina Beach. Between April 1988 and April 1990, approximately 445,000 cubic yards of sand was deposited in the deposition basin. The accumulated material was removed during the spring of 1991 and placed on Carolina Beach. A total of 1,008,000 cubic yards was dredged from the trap and distributed along the entire 14,000 lineal feet of the Carolina Beach storm damage reduction project.

3. Oregon Inlet.

a. Purpose. To measure shoaling rates in a dredge maintained navigation channel across the inlet's ocean bar and monitor the response of the adjacent beaches, Bodie Island to the North and Pea Island to the south.

b. Type of Survey. Hydrographic.

c. Elements Measured. Depths in the inlet bar channel and beach profiles.

d. Survey Scope. Hydrographic surveys are made approximately every two weeks in the bar channel, extending from the Bonner Bridge seaward to the 25-foot depth contour. Beach profiles are made along 3 miles of beach both north and south of the inlet every two months.

e. The beach profile surveys were begun in 1983. Due to the relatively short period of record, no conclusions have been reached as to the impact of dredging on the stability of the beaches. However, rapid erosion of the north end of Pea Island has been occurring over the last 3 years with the erosion threatening the Bonner Bridge, U.S. Coast Guard Station, and N.C. Highway 12 on Pea Island. The bar channel surveys indicate rapid channel shoaling particularly following coastal storms. The erosion on the north end of Pea Island became so severe during a northeast storm of March 1989 that the State of North Carolina constructed a terminal groin on the north tip of the island in order to protect the southern abutment of the bridge and the NC Highway 12 approach to the bridge. The groin was completed in March 1991. In April 1991, 300,000 cubic yards of sand was excavated from the portion of the navigation channel that passes beneath the Bonner Bridge. This material was deposited on Pea Island between one and two miles south of the inlet. The channel under the bridge was redredged in September 1991 along with the ocean bar channel with the material also being placed on Pea Island. Approximately 96,500 cubic yards of sand was removed from under the bridge while 90,000 cubic yards was dredged from the bar channel.

Reservoir Sedimentation. B. Everett Jordan Project. The first sedimentation resurvey of B. Everett Jordan Lake was finished in the summer of 1990. Preliminary data indicates minor storage losses due to sedimentation coming into Jordan Lake since inception of the project in 1982. A report detailing the field data, and revised storage is nearing completion.

SOUTH ATLANTIC-GULF REGION

GEOLOGICAL SURVEY

Chowan-Roanoke Subregion

1. Suspended-sediment data are collected bimonthly at Dan River at Paces, VA, and quarterly at Nottoway River near Sebrell, VA, Meherrin River at Emporia, VA, and Blackwater River near Franklin, VA, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are collected quarterly at Roanoke River at Roanoke Rapids, NC, as part of NASQAN.

Neuse-Pamlico Subregion

1. Suspended-sediment data are collected bimonthly at Neuse River at Kinston, and Contentnea Creek at Hookerton, NC, and quarterly at Tar River at Tarboro, NC as a part of NASQAN.

Cape Fear Subregion

1. Suspended-sediment data are collected quarterly on the Cape Fear River at Lock 1 near Kelly, NC, as part of the NASQAN program.

Pee Dee Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Scape Ore Swamp near Bishopville, SC, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Lynches River at Effingham, SC, Black River at Kingstree, SC, Rocky River near Norwood, NC, and at Pee Dee River at Pee Dee, SC, as a part of NASQAN.

3. Suspended-sediment data are being collected daily and more frequently during flood events at the Yadkin River at Yadkin College, NC, as part of the Federal Collection of Basic Records (CBR) program. (bimonthly for NASQAN).

4. Suspended-sediment data are being collected on a bimonthly basis at Rocky River near Norwood, NC, as part of NASQAN.

Santee-Edisto Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Edisto River near Givhans, SC, as a part of NASQAN.

2. Suspended-sediment data are being collected on a monthly basis at Santee River below St. Stephens, SC. This is being done in cooperation with the COE.

Ogeechee-Savannah Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Upper Three Runs near New Ellenton, SC, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a quarterly basis at Savannah River near Clyo, GA, and bimonthly at Ogeechee River near Eden, GA, as a part of NASQAN.

Altamaha-St. Marys Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Falling Creek near Juliette, GA, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Altamaha River near Everett City, GA, and quarterly at Satilla River at Atkinson, GA, as a part of NASQAN.

St. Johns Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at four sites in Florida as a part of NASQAN.

Southern Florida Subregion

1. Suspended-sediment data are being collected on a bimonthly or quarterly basis at five sites in Florida as a part of NASQAN.

Peace-Tampa Bay Subregion

1. Suspended-sediment data are being collected on a quarterly basis at two sites in Florida as a part of NASQAN.

Suwannee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at two sites in Florida as a part of NASQAN.

Ochlockonee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at one site in Florida as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis at one site in Florida as a part of the National Hydrologic Benchmark Network.

Apalachicola Subregion

1. Suspended-sediment data are being collected on a quarterly basis at two sites in Florida as a part of NASQAN. Suspended-sediment data are being collected periodically at two sites in the Apalachicola River basin in cooperation with the COE.

2. Suspended-sediment data are being collected on a bimonthly basis at Flint River at Newton, GA, and Chattahoochee River near Columbia, AL, as part of NASQAN.

Choctawhatchee-Escambia Subregion

1. Suspended-sediment data are being collected on a quarterly basis at four sites in Florida as a part of NASQAN.

Alabama Subregion

1. Suspended-sediment data are being collected 10 times per year and quarterly at Alabama River near Montgomery, AL, in cooperation with the COE, as a part of NASQAN, respectively, and bimonthly at Alabama River at Claiborne, AL, as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis in cooperation with the COE at the following sites:

Alabama River at Selma
Cahaba River near Suttle
Alabama River above Millers Ferry
Alabama River below Millers Ferry

Mobile-Tombigbee Subregion

1. Suspended-sediment data are being collected 10 times per year at Tombigbee River at Gainesville, AL, and at Black Warrior River at Northport, AL, in cooperation with the COE, monthly at Tombigbee River at Gainesville, bimonthly at Black Warrior River below Warrior Dam near Eutaw, AL, and quarterly at Tombigbee River at Coffeeville lock and dam, AL, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Blackwater River near Bradley and Sipsey Fork near Grayson, AL, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a periodic basis in cooperation with the COE at the following sites:

Tombigbee River at Pickensville, AL
Tombigbee River near Cochrane, AL
Chickasaw Bogue near Linden, AL
Tombigbee River near Nanafalia, AL
Tombigbee River at Jackson Bridge, AL

4. Suspended-sediment data are being collected on a periodic basis in cooperation with the COE at the following sites:

Tombigbee River near Marrietta, MS
Twentymile Creek near Guntown, MS
Twentymile Creek near Mantachie, MS
Tombigbee River near Fulton, MS
Mantachie Creek below Dorsey, MS
Tombigbee River at Bigbee, MS
Tombigbee River near Amory, MS
Tombigbee River at Aberdeen, MS
Buttahatchie River near Aberdeen, MS
Tombigbee River near Columbus, MS
Luxapallila Creek near Columbus, MS
Town Creek at Nettleton, MS
Noxubee River at Macon, MS

Additional data are being collected on two storm events per year at the following sites:

Tombigbee River near Fulton, MS
Mantachie Creek below Dorsey, MS

Tombigbee River at Aberdeen, MS
Town Creek at Nettleton, MS
Noxubee River at Macon, MS

Pascagoula Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Pascagoula River near Benndale, MS, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Cypress Creek near Janice, MS, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a quarterly basis at Escatawpa River near Agricola, MS, as part of NASQAN.

Pearl Subregion

1. Suspended-sediment data are being collected on a daily basis at Pearl River near Bogulusa, LA, as a part of the Federal CBR program.

2. Suspended-sediment data are being collected on a bimonthly basis at Bogue Chitto River near Bush, LA, as a part of NASQAN.

Special Studies

1. Suspended-sediment and bed-material data are being collected periodically and during two storm events per year at five sites in order to gage sediment deposition in certain Georgia reservoirs as part of a cooperative program with the COE.

2. Suspended-sediment data are collected monthly at 14 sites as part of the surface-water quality assessment for the Triangle J COG Region located in the central Piedmont of North Carolina. The data are collected in cooperation with the Triangle Area Water-Supply Monitoring Project Steering Committee.

3. Suspended-sediment data are collected bimonthly and more frequently during runoff conditions at three sites in the Treyburn Project, a large-scale development in the upper Neuse River basin in cooperation with the city of Durham. This data is needed to assess impacts of various land-use development on surface-water quality.

4. The effect on downstream receiving waters of water-control structures located on artificial drainage canals in eastern North Carolina is largely unknown. To address this question in part, water-quality samples are being collected from three canals that drain agricultural land in Beaufort County and three similar canals in Hyde County.

Samples are collected biweekly; samples are also automatically collected during high-flow events at approximately hourly intervals. The samples are analyzed for nutrient concentrations as well as for sediment concentrations. This work is being done cooperatively with the North Carolina Department of Environment, Health, and Natural Resources (EHNR), with additional assistance from the Beaufort and Hyde County Soil and Water Conservation Districts.

5. A bathymetric study to determine the extent of sediment deposition in Lake Michie, a water supply for the city of Durham, was conducted in February 1990.

Lake Michie is located in northern Durham County, NC, and was built in 1926 and has been surveyed three times in the past (1926, 1935, 1970). A contour map of the lake depths along with corresponding area-capacity table is still being developed. Analysis of suspended-sediment inflow to Lake Michie will be completed in 1992

6. The South Carolina District continued sediment data collection associated with NASQAN and Benchmark stations.

8. Changes in channel bathymetry were measured over a tide cycle in February at Altamaha River at Interstate 95 as part of a bridge scour study being done in cooperation with the Federal Highway Administration.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
520 19th Avenue
Tuscaloosa, AL 35401

District Chief, WRD
U.S. Geological Survey
227 N. Bronough Street, Suite 3015
Tallahassee, FL 32301

District Chief, WRD
U.S. Geological Survey
6481 Peachtree Industrial Blvd.
Suite B
Doraville, GA 30360

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

District Chief, WRD
U.S. Geological Survey
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

District Chief, WRD
U.S. Geological Survey
3916 Sunset Ridge Road
Raleigh, NC 27607

District Chief, WRD
U.S. Geological Survey
Stephenson Center
720 Gracern Road
Suite 129
Columbia, SC 29210

Chief, Virginia Office, WRD
U.S. Geological Survey
3600 West Broad Street, Room 606
Richmond, VA 23230

SOUTH ATLANTIC--GULF (03) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Apalachicola	Little Kolomoki-Factory Creeks (continuation)	Tribs. to the Chatahoochee River	Early	GA
Ogeechee	Upper Lotts Creek (continuation)	Lotts Creek	Bullock	GA
	Ogeechee Area (continuation)	Ogeechee River	Screven	GA
Withlacoochee	Piscola Creek (continuation)	Piscola Creek	Thomas Brooks	GA
Oconee (continuation)	Upper Oconee Basin	North Oconee Middle Oconee River Apalachee River	Barrow Clarke Greene Gwinnett Hall Jackson Morgan Oconee Walton	GA
Pearl River	Dry Creek	Dry Creek	Marion	MS
Tar-Pamlico	Nahunta Swamp	Nahunta Swamp	Wayne Greene	NC

b. Public Law-639

Major Drainage	Watershed	Stream	County	State
Tangipahoa River	Tangipahoa	Tangipahoa	Pike	MS

c. Special Studies

Major Drainage	Watershed	Stream	County	State
Catawba	Long Creek	Long Creek	Gaston	NC

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	Survey Date	Drainage Area	County	State
Pittsboro Town Lake	11/91	8.3 mi^2	Chatham	NC

GREAT LAKES REGION

CORPS OF ENGINEERS

North Central Division

Buffalo District

Environmental Analyses of Harbor Sediments for O & M Program.

1. Harbor Testing. Sediment samples were obtained from the various locations within the District as listed below. Sediment sampling consisting of bulk chemical physical, and elutriate testing was completed at Rochester, NY; Dunkirk, NY; West Harbor, OH; Fairport, OH; Huron, OH.

Project	No. of Stations	Type of Test
Rochester Harbor, NY	12	Dioxin, Dibenzofurans, PCB's
Dunkirk Harbor, NY	13	Particle Size Analysis, Bulk Chemistry (Organic & Inorganic), Elutriate Testing
West Harbor, OH	19	Bulk Chemical Analysis (Organic and Inorganic), Elutriate, Particle Size Analysis
Fairport Harbor, OH	11	Particle Size Analysis, Bulk Chemical Analysis (Organic & Inorganic), Elutriate Testing
Huron Harbor, OH	16	Particle Size Analysis, Bulk Chemical Analysis (Organic and Inorganic), Elutriate Testing

2. Sediment and Water Testing. The purpose of testing was to evaluate the sediments for open-lake or confined disposal following maintenance dredging of the Federal Navigation channels. In addition, special water quality and sediment testing project is summarized below.

Project	Type of Test
Presque Isle, Pennsylvania	Beach Sand Testing included Bulk Chemical Analysis, Particle Size, and Fecal Coliform

3. Discussion of the Project.

a. Rochester Harbor, New York: State concerns of high dioxin levels in the sediment. Sampling and analysis for dioxin, dibenzofurans, and PCB's show concentrations well within background levels which supports the environmental acceptability of open-lake disposal.

b. Dunkirk Harbor, New York: Bulk chemical (organic & inorganic) and elutriate testing for suitability and support for open-lake disposal.

c. Fairport Harbor, Ohio: Bulk chemical (organic & inorganic) and elutriate testing to determine suitability for open-lake disposal.

d. Huron Harbor, Ohio: Testing for bulk chemical (organic & inorganic) and elutriate sediment parameters to determine suitability for open-lake disposal.

e. West Harbor, Ohio: Bulk chemical and elutriate sediment testing for open-lake disposal acceptability.

Sedimentation Analyses.

1. Shoaling Rates and Dredging Intervals and Quantities for the Lower Ashtabula River and Ashtabula Harbor.

a. Purpose - The Ashtabula River is located in northeast Ohio. The purpose of the study was to determine the shoaling rates and the required dredging intervals and quantities for the Ashtabula River Federal Navigation Channel from the mouth to Station 139 and for the entire outer harbor. In addition, an assessment was made of the migration of polluted sediments. Previous studies have identified the sediments in the Federal Navigation channel as highly polluted or toxic from the upper turning basin to the lower turning basin. There is a concern regarding the physical processes that control the fate of these sediments. The increased use of the river for recreational purposes has added pressure to dredge the upper part of the navigation channel which includes the upper and lower turning basins. One objective of this analysis was to determine if the polluted sediments were buried and what would be the impact of dredging.

b. Method of Analysis - The HEC-6 model, "Scour and Deposition in Rivers and Reservoirs", was run for the lower river to determine the dredging interval by assessing the change in channel elevation. For the outer harbor, the only available information was a limited amount of dredging records and the before and after soundings for each year dredged. Several methods were used to determine the dredging intervals for the outer harbor. An average depth versus time relation was developed based on the soundings. This resulted in shoaling rate curves. A shoaling rate versus depth relation was developed. From this curve, the shoaling rate was determined by using the starting averaged depth and the final desired average depth. The last two methods used a percent area above the project depth versus average depth relation and a percent area above project depth versus time relation. Dredged volumes were calculated using the depth-area method and the volume-area method.

The contaminated sediments were analyzed using data that were collected by an AE-firm for the United States Environmental Protection Agency. Sediment cores were plotted along the longitudinal axis of the channel. Results of the analysis show that there is a "pocket" of more highly polluted material in the upper turning basin. Concentrations of the tracer substance, Arochlor 1248, in the "pocket" area are greater by an order of magnitude than background concentrations.

Based on the results of the modeling, it was determined that 2 to 3 year dredging intervals would be required in the river and harbor to maintain authorized project depths and a total quantity of 233,500 cubic yards and 342,000 cubic yards respectively would be the estimated volume requiring removal.

The results of the contaminated sediment migration analysis indicate that at least for one tracer substance, Alochlor 1248, the highest concentrations are generally restricted in lateral extent as well as depth. The concentrations reach a maximum of 84,000 micrograms/kilogram compared to the background levels of 100-900 micrograms/kilogram.

2. Limestone Creek at Manlius, New York. The project ar Limestone Creek at Manlius, New York is a flood control project that includes grouted fabric along the banks and channel bottom at the upstream end of the project. A sedimentation analysis was performed to determine the sediment load and to design a sediment trap. The purpose of the sediment trap is to collect the sediment upstream of the grouted fabric to prevent scour to the fabric and to provide access for maintenance.

3. Canaseraga Creek, New York. An analysis of Canaseraga Creek, New York was performed to determine the total sediment load expected to deposit in the project area. In addition, an analysis was performed to design a sediment basin. The purpose of the basin is to provide an area for the sediment to deposit that is accessible for maintenance. It was not designed to be 100% efficient because removing all of the sediment from the system may increase the erosive capability downstream. The trap will collect primarily bedload and will allow most of the suspended load to pass downstream.

Detroit District

Sediment Sampling Activities.

1. Environmental Analysis. In 1991, sediment and water sampling were obtained at the following locations for environmental analysis:

Algoma, WI
Alpena, MI
Arcadia, MI
Au Sable, MI
Caseville, MI
Detroit River, MI
Hammmond Bay, MI
Harbor Beach, MI
Holland, MI
Lexington, MI
Ludington,MI
Manistee. MI
Manistique, MI
New Buffalo, MI
Pensaukee, WI
Port Sanilac, MI
Sebewaing River, MI
Sheboygan, WI
St. Clair River, MI
St. Joseph, MI
St. Marys River, MI

Sediments were analyzed for metals, PCB's, pesticides, nutrients, and physical parameters. Water samples were also collected concurrently to determine ambient water quality conditions.

2. Geotech Section of the District took samples of areas to be dredged in the upper Saginaw River. The samples are being used to size a Confined Disposal Facility. The samples were tested to determine the settling and consolidation characteristics of the sediments.

Sedimentation Surveys. Operations and Maintenance Surveys. In 1991, hydrographic surveys were completed at Great Lakes harbors, channels and rivers (see listing below). Condition surveys were made at 50 locations to record the bathymetry of navigable waters. The results of the surveys are compiled and disseminated to the public in "Notice to Mariners" bulletins if there were significant changes affecting navigation. Sixteen "Prior" and sixteen "After" surveys were made in support of O&M maintenance dredging operations. "Prior" surveys were conducted to determine the shoaling conditions before scheduled dredging. "After" surveys confirm that the required dredging depth was achieved.

Algoma, WI
Alpena, MI
Arcadia, MI
Au Sable, MI
Bayfield, WI
Belle River, MI
Big Suamico, WI
Black River, MI (Port Huron)
Black River, MI (Gogebic County)
Bolles, MI
Cheboygan, MI
Detroit River, MI
Duluth-Superior, MN-WI
Eagle, MI
Grand Haven, MI
Grand Traverse, MI
Grays Reef Passage, MI
Greilickville, MI
Hammond Bay, MI
Harrisville, MI
Holland, MI
Kenosha, WI
Kewaunee, WI
Knife River, MN
Lac La Belle, MI
Lake Huron, MI
Lake St. Clair, MI
Leland, MI
Little Bay De Noc, Gladstone Harbor and Kipling, MI
Ludington, MI
Manitowoc, WI
Menominee Harbor & River, MI & WI
Monroe, MI
Muskegon, MI
New Buffalo, MI
Ontonagon, MI
Pensaukee, WI
Pentwater, MI
Petoskey, MI
Pine River, MI
Port Washington, WI
Portage Lake, MI
Saxon, WI
Sheboygan, WI
South Haven, MI
St. Clair River, MI
St. Joseph, MI
St. James, MI
Sturgeon Bay Ship Canal, WI
Two Rivers, WI

Water Quality Monitoring. Water quality monitoring was conducted at four projects in 1991.

1. The Clinton River site is a confined disposal facility. Groundwater monitoring wells were sampled to determine background water quality. The Saginaw River upland site is a proposed upland disposal site. Groundwater well monitoring was conducted to determine background water quality at the site.

2. Water quality monitoring was conducted at Bolles Harbor, MI to monitor the discharge from the confined disposal facility and its' effect on Lake Erie. Samples were obtained in the dredge discharge into the facility, the overflow from the facility, a mixing zone where the overflow mixes in the lake water, and three background sites in the lake.

3. Monitoring was also conducted to evaluate the discharge of the dredge Columbus in Saginaw Bay. Samples were obtained in the discharge and in the river behind the dredge.

Special Studies.

1. St. Joseph Harbor. The District applied Toxic Contaminants Leachate Procedure (TGLP) to sediment samples to assess potential groundwater quality effects of upland disposal by MDNR regulatory protocol. Arsenic, lead and cadmium "failed" low ppb concentration standards for "inert" classification. The District then applied a customized TCLP extraction medium acidified (ph 4) distilled water to simulate realistic worst case, acid rain. Using the tailored extract medium, the samples achieved "inert" status. Formal coordination with MDNR remains.

2. Duluth-Superior Deepening. The proposed project would deepen portions of the inner harbor from the existing 23 foot depth to 27 feet, removing 1.8 million cubic yards of moderately polluted sediments. The dredged sediments would be taken through a washing process which would allow approximately 600,000 cubic yards of coarse-grained material to be placed outside Dredged Material Disposal Facility to be available for re-use. The District Engineer worked extensively with the City of Superior, Wisconsin to obtain approval of the Local Cooperation Agreement (LCA) by the City. The LCA was approved by the City Council during August 1991.

3. Green Bay Hydrodynamic Modeling. The concern over changes in distribution of water and sediments due to construction of the expanded Confined Disposal Facility (CDF) will be addressed to provide an insight into the impact of the proposed CDF on sediment redistribution. The 3D water quality model used by the U.S. Army Waterways Experiment Station in the Chesapeake Bay study will be applied to evaluate the conventional water quality problems such as Fox River biochemical oxygen demand (BOD) loading and redistribution and associated DO levels resulting from the modification of the hydrodynamics of lower Green Bay. The model will be operated in a 2D mode for calibration, verification, and scenario testing. To accurately address DO questions, the model will include the following nine state variables:

a. Temperature
b. DO
c. Carbonaceous BOD
d. Algae Biomass
e. Total Organic Phosphorus (TOP)
f. PO_4 - P
g. Total Organic Nitrogen (TON)
h. NH_4 - N
i. NO_2 + NO_3 - N

Sediment samples from the Rouge River, the Saginaw River and Manistique Harbor were provided to the Coleraine Laboratory in Duluth, Minnesota for evaluation of potential treatment technologies under the ARCS program. Sediment will be subjected to various separation techniques to determine their efficacy.

GREAT LAKES REGION

GEOLOGICAL SURVEY

Western Lake Superior Subregion

1. Suspended-sediment data are being collected on a periodic and storm-event basis at Bad River near Odanah, WI, on a quarterly basis at Baptism River near Beaver Bay, MN, and on a bimonthly basis at St. Louis River at Scanlon, MN, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended and bedload (Helley-Smith) sediment and bed-material data are being collected at three sites on North Fish Creek near Ashland, WI, in cooperation with Wisconsin Department of Natural Resources. Data collection ended September 30, 1991, at all three sites.

Southern Lake Superior-Lake Superior Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Washington Creek at Windigo (Isle Royale), MI, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a quarterly basis at Ontonagon River near Rockland, MI, and at Tahquamenon River near Paradise, MI, as a part of NASQAN.

Northwestern Lake Michigan Subregion

1. Suspended-sediment data are being collected on an intermittent basis at Popple River near Fence, WI, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Fox River at Wrightstown, WI, and Escanaba River at Cornell, MI, and on a quarterly basis at Ford River near Hyde, MI, as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic and storm-event basis at White Creek at Forest Glen Beach, Silver Creek and Green Lake Inlet near Green Lake, WI, in cooperation with the Green Lake Sanitary District.

Southwestern Lake Michigan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Milwaukee River at Milwaukee, WI, and at Manitowac River at Manitowac, WI, as a part of NASQAN.

2. Suspended-sediment data are being collected daily at Trail Creek at Michigan City, IN, at a fixed sampling location by an observer. USGS personnel samples sediment over the cross section of the creek every 3 to 4 weeks.

Southeastern Lake Michigan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Grand River at Eastmanville, MI, St. Joseph River at Niles, MI, and Kalamazoc River near Fennville, MI, as a part of NASQAN.

Northeastern Lake Michigan-Lake Michigan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Manistee River at Manistee, MI, as a part of NASQAN.

Northwestern Lake Huron Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Thunder Bay River at Alpena, MI, and Au Sable River near Au Sable, MI, as a part of NASQAN.

Southwestern Lake Huron-Lake Huron Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Pigeon River near Caseville, MI, Rifle River near Sterling, MI, and bimonthly at Tittabawassee River near Midland, MI, as a part of NASQAN. Suspended-sediment data are being collected on a quarterly basis at Saginaw River at Saginaw, MI, in cooperation with the Detroit District Corps of Engineers.

St. Clair-Detroit River Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Clinton River at Mount Clemens, MI, as a part of NASQAN.

Western Lake Erie Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Maumee River at Waterville, OH, and Sandusky River at Fremont, OH, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at Sandusky River near Fremont, OH, Maumee River at Waterville, OH, in cooperation with the Ohio Department of Natural Resources.

3. Suspended-sediment data were collected at the Huron River at Milan, OH, until September 30, 1991, in cooperation with the Ohio Department of Natural Resources.

4. Suspended-sediment data are being collected on a quarterly basis at River Raisin near Monroe, MI, as a part of NASQAN.

Southern Lake Erie Subregion

1. Suspended-sediment data are being collected on a daily basis at Cuyahoga River at Independence, OH, and at Grand River at Painesville, OH, in cooperation with the Ohio Department of Natural Resources, and on a quarterly basis as part of NASQAN.

Eastern Lake Erie-Lake Erie Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Cattaraugas Creek at Gowanda, NY, and Niagara River (Lake Ontario) at Fort Niagara, NY, as a part of NASQAN.

Southwestern Lake Ontario Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Genesee River at Charlotte Docks at Rochester, NY, as a part of NASQAN.

Southeastern Lake Ontario Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Oswego River at Lock 7 at Oswego, NY, and on a bimonthly basis at Sandy Creek at Adams, NY, as a part of NASQAN.

Northeastern Lake Ontario-Lake Ontario-St. Lawrence Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Black River at Watertown, NY, and on a quarterly basis at Raquette River at Raymondville, NY, St. Regis River at Brasher Center, NY, and St. Lawrence River at Cornwall, Ontario, near Massena, NY, as a part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Champaign County Bank Plaza
102 East Main St., 4th Floor
Urbana, IL 61801

District Chief, WRD
U.S. Geological Survey
702 Post Office Building
St. Paul, MN 55101

District Chief, WRD
U.S. Geological Survey
975 West Third Avenue
Columbus, OH 43212

District Chief, WRD
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46254

District Chief, WRD
U.S. Geological Survey
6520 Mercantile Way, Suite 5
Lansing, MI 48911

District Chief, WRD
U.S. Geological Survey
P.O. Box 1669
Albany, NY 12201

District Chief, WRD
U. S. Geological Survey
6417 Normandy Lane
Madison, WI 53719

GREAT LAKES (04) REGION

SOIL CONSERVATION SERVICE

1. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Chippewa Creek Watershed, Site III-A	Medina	OH

2. Special Studies

Erosion and sediment yield estimates were completed for the following Clean Water Act, Section 319, Non-Point Source Management Program implementation grant proposals:

Watershed	County	State
Big Creek	Arenac	MI
Paint Creek	Washtenaw	MI

A method for calculating and reporting accomplishments with respect to water quality has been developed in Michigan. This simple, easy to use method appears on electronic spreadsheet and calculates nutrient load reductions associated with reduced sediment yield to a given watershed outlet.

OHIO REGION

CORPS OF ENGINEERS

OHIO RIVER DIVISION

Huntington District

Sedimentation Studies. The Corps of Engineers Committee on Channel Stabilization held a bi-annual committee meeting in the Huntington District at Athens, Ohio on 11 July 1991. Prior to the meeting, the committee participated in a field reconnaissance of the Athens, Ohio Local Protection Project with representatives of the Huntington District and with representatives of the local sponsor of the project, the Hocking Conservancy District, on 9 July 1991.

On the following day, a meeting was held to discuss the sediment deposition problem, study approaches, data requirements, and potential alternative solutions. Subsequent to this meeting, the District is pursuing a sediment study under the Section 22 (Planning Assistance to States) cost sharing authority with the local sponsor.

Louisville District

Sedimentation Surveys.

1. Buckhorn Lake, Middle Fork, Kentucky River, Kentucky. The Buckhorn Lake sedimentation report was approved by the Ohio River Division in April 1991.

2. West Fork Lake, Mill Creek, Ohio. West Fork Lake sediment accumulations were recomputed in June 1991, using an improved version of the sedimentation computer program. The revised accumulation was 655 acre-feet, 20 percent less than originally been tabulated.

Nashville District

Sedimentation Surveys.

1. Laurel River Lake, Laurel River, Kentucky. The Laurel River Dam and Reservoir Sediment Resurvey Report, December 1988, was approved by the Ohio River Division in April 1991.

2. Old Hickory Lake, Cumberland River, Tennessee. The Old Hickory Dam and Reservoir Sediment Resurvey Report, November 1988, was approved by the Ohio River Division in June 1991.

3. Wolf Creek Lake, Cumberland River, Kentucky. The Wolf Creek Dam and Reservoir Sediment Resurvey Report, November 1988, was approved by the Ohio River Division in June 1991.

4. Middlesboro Diversion Channel, Yellow Creek, Kentucky. The Waterways Experiment Station (WES) is conducting model testing of sedimentation problems

in the diversion channel of Yellow Creek in Middlesboro, Kentucky. WES has identified an efficient composite cross section for the dredging template for the Yellow Creek diversion channel. Two dredging alternatives were evaluated and the final numerical testing program was outlined. It was concluded that the numerical model simulation will be expanded to include historical runoff between 1987 and 1991. This expansion will increase the historical simulation from 10 to 14 years.

5. Barbourville Diversion Channel, Cumberland River, Kentucky. Plots of the original sedimentation range survey and the November 1988 resurvey of ranges in the Barbourville Diversion Channel area were made. The original survey was made in June 1986. Twenty three ranges are located in the Cumberland River, three are located in the Diversion Channel, and six are located in Richland Creek. Very little, if any, change in geometry of the ranges occurred during this time interval.

Pittsburgh District

Sedimentation Surveys. Conemaugh River Lake, Conemaugh River, Pennsylvania - Results of the reservoir sedimentation studies indicate all projects except Conemaugh River Lake do not have excessive sediment deposition. The Conemaugh River Lake sedimentation study is currently being investigated by the WES.

A detailed sedimentation report for the 1982 Conemaugh River Lake survey was submitted in FY 1985 to Ohio River Division. Review comments by the Division and headquarter have been received. Resolution of these comments is being delayed until the results of WES' study are known. The district's removal activities will probably be based on the study's recommendations.

OHIO REGION

GEOLOGICAL SURVEY

Upper Ohio Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Allegheny River at New Kensington, PA, Monangahela River at Braddock, PA, Beaver River at Beaver Falls, PA, and on a bimonthly basis at Ohio River at Benwood, near Wheeling, WV, and at Little Kanawha River at Palestine, WV, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a daily basis at Wheeling Creek near Blaine, OH, in cooperation with the Ohio Department of Natural Resources (discontinued 9/30/91).

Muskingum Subregion

1. Suspended-sediment data are being collected on a daily basis at Muskingum River at McConnelsville, OH, in cooperation with the Ohio Department of Natural Resources (discontinued 9/30/91).

2. Suspended-sediment data are being collected on a bimonthly basis at the Muskingum River at McConnelsville, OH, as a part of NASQAN.

Hocking Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Hocking River below Athens, OH, as a part of NASQAN.

Kanawha Subregion

1. Suspended-sediment data are being collected on a bimonthly basis as part of NASQAN on the New River at Glen Lyn, VA.

2. Suspended-sediment data are being collected on a quarterly basis at Kanawha River at Winfield, WV, as a part of NASQAN.

Scioto Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Scioto River at Higby, OH, as a part of NASQAN.

Big Sandy-Guyandotte Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Guyandotte River at Branchland, WV, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Big Sandy River at Louisa, KY, as part of NASQAN.

Great Miami Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Whitewater River near Alpine, IN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Great Miami River at New Baltimore, OH, as a part of NASQAN.

Middle Ohio Subregion

1. Suspended-sediment data are being collected on a monthly basis at Upper Twin Creek at McGaw, OH, and on a quarterly basis at South Hogan Creek near Dillsboro, IN, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a daily basis at Little Miami River at Milford, OH, in cooperation with the Ohio Department of Natural Resources and on a bimonthly basis as a part of NASQAN.

Kentucky-Licking Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Licking River at Butler, KY, and on a bimonthly basis at Kentucky River at Lock 2 at Lockport, KY, as a part of NASQAN.

Green Subregion

1. Suspended-sediment data are being collected on a daily basis at Green River at Munfordville, KY, as a part of the Federal Sediment Index Network, and on a bimonthly basis as part of NASQAN.

Wabash Subregion

1. Suspended-sediment data are being collected on a monthly basis at White River near Centerton, IN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a monthly basis at Little Eagle Creek at 52nd Street at Indianapolis, IN, Little Eagle Creek at Speedway, IN, Little Buck Creek near Southport, IN, and Little Buck Creek near Indianapolis, IN.

2. Suspended-sediment data are being collected on a bimonthly basis at Little Wabash River at Main Street at Carmi, IL, and Embarras River at Sainte Marie, IL, as a part of NASQAN.

Cumberland Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at South Fork Cumberland River near Stearns, KY, and Cumberland River at Carthage, TN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily and storm-event basis in cooperation with the COE, Nashville District, at the following stations:

Clover Fork at Harlan, KY
Yellow Creek near Middlesboro, KY
Cumberland River at Barbourville, KY
Cumberland River at Williamsburg, KY

Lower Ohio Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Rolling Fork near Lebanon Junction, KY, and on a bimonthly basis at Ohio River at Lock and Dam 53 near Grand Chain, IL, Whitewater River near Alpine, IN, and Salt River at Shepherdsville, KY, as part of NASQAN.

2. Suspended-sediment data are being collected quarterly at South Hogan Creek near Dillsboro, IN, as part of the National Hydrologic Benchmark Network.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Busey County Bank Plaza
102 East Main Street, 4th Floor
Urbana, IL 61801

District Chief, WRD
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46278

District Chief, WRD
U. S. Geological Survey
208 Carroll Building
8600 La Salle Road
Towson, MD 21204

District Chief, WRD
U.S. Geological Survey
840 Market Street
Lemoyne, PA 17043-1586

District Chief, WRD
U.S. Geological Survey
810 Broadway, Suite 500
Nashville, TN 37203

Chief, Virginia Office, WRD
U.S. Geological Survey
3600 West Broad Street, Rm. 606
Richmond, VA 23230

District Chief, WRD
U.S. Geological Survey
2301 Bradley Avenue
Louisville, KY 40217

District Chief, WRD
U.S. Geological Survey
975 West Third Avenue
Columbus, OH 43212

District Chief, WRD
U.S. Geological Survey
603 Morris Street
Charleston, WV 25301

OHIO (05) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Sandy Lick Creek	Pitch Pine Run	Pitch Pine Run	Jefferson	PA

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Mather	Greene	PA
Lake Santee	Decatur Franklin	IN
Lake Roaming Rock	Ashtabula	OH
Rocky Fork Lake	Highland	OH
Upper Wabash Watershed, Site 1	Darke	OH

3. Special Studies

The SCS published the "Salt Fork Hydrologic Unit Proposal" February, 1991. Salt Fork Lake (2953 acres) is impacted by sedimentation derived from excessive erosion on pastured forestland. The proposal presents a conservation and related funding program to reduce sedimentation by 42 percent.

A water quality study was conducted on Sympson Lake Watershed, Nelson County, KY.

Reservoir	Date of Service	Drainage Area	County	State
Sympson Lake	August 1991	8.86 sq. mi.	Nelson	KY

TENNESSEE REGION

GEOLOGICAL SURVEY

Upper Tennessee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at French Broad River at Marshall, NC, and bimonthly at Clinch River at Melton Hill Dam, TN, and Holston River near Knoxville, TN, as part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are collected on a bimonthly basis at Little River above Townsend, TN, and quarterly at Cataloochee Creek near Cataloochee, NC, as a part of the National Hydrologic Benchmark program.

Lower Tennessee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tennessee River at Pickwick Landing Dam, TN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Buffalo River near Flat Woods, TN, as part of the National Hydrologic Benchmark Network.

Special Studies

1. Suspended-sediment data are being collected four times per year at three sites along Carters Creek, Maury County, TN, as part of a monitoring program designed to assess effects of large-scale construction activities.

2. Suspended-sediment data are being collected monthly and on a stormevent basis by the U.S.Geological Survey at one site on the Clinch River, TN, and one site on the Powell River, TN, as part of a study to define the variability in suspended sediment and nutrients in the two basins.

3. Suspended-sediment data are being collected on a stormevent basis at five sites in the Metropolitan Nashville, TN, area as part of the Urban Stormwater Quality Project.

4. Suspended-sediment data are being collected on a stormevent basis at five sites in the Metropolitan Knoxville, TN, area as part of the Urban Stormwater Quality Project.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
2301 Bradley Avenue
Louisville, KY 40202

District Chief, WRD
U.S. Geolologlical Survey
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

District Chief, WRD
U.S. Geological Survey
3916 Sunset Ridge Road
Raleigh, NC 27607

District Chief, WRD
U.S. Geological Survey
810 Broadway, Suite 500
Nashville, TN 37203

UPPER MISSISSIPPI REGION

CORPS OF ENGINEERS

North Central Division

Rock Island District

Suspended Sediment Sampling. Suspended load sampling is being conducted at 22 stations, 3 located on the Mississippi River, 17 located on tributaries to the Mississippi River, and 2 on tributaries to the Illinois River. Of these 22 stations, 4 stations which began in conjunction with the GREAT II program are now being operated and maintained under a cooperative program with the U.S. Geological Survey while the remaining are operated independently.

Sedimentation Surveys. Sedimentation survey reports for Farmdale and Fondulac Reservoirs in Illinois and Coralville Reservoir in Iowa will be completed this fiscal year.

St. Paul District

Sediment Load Measurements. Both suspended and bedload measurements were conducted daily at four stations by the U.S. Geological Survey under the sponsorship of the District and published in the USGS Water Resources Data. These stations are at Anoka, MN on the Mississippi River; at Mankato, MN on the Minnesota River; at Winona, MN on the Mississippi River and at McGregor, IA on the Mississippi River.

Sedimentation Surveys. The following survey was performed under the Environmental Management Program.

1. Polander Lake, Mississippi River Pool 5A, Minnesota. A sedimentation study was done on the Polander Lake Habitat Rehabilitation and Enhancement Project. Bathimetric data was obtained in Polander Lake and Burleigh Slough. This data was then compared to surveys taken before the inundation of Pool 5A on the Mississippi River. Results of the study are published in "Definite Project Report/Environmental Assessment, Polander Lake, Habitat Rehabilitation and Enhancement Project" 1992.

2. Marsh Lake, Minnesota River, Minnesota. Bathimetric data was obtained in the lake. The data was used to determine acreage for various drawdown conditions. The data is not available in a publication.

3. Bussey Lake, Mississippi River, Minnesota. Bathimetric data was obtained in the lake to provide baseline conditions for the Bussey Lake Habitat Rehabilitation and Enhancement Project. The data is not available in a publication.

4. Leach Lake, Sandy Lake, Lake Winnibigoshish, Mississippi River Headwaters area, Minnesota. Bathimetric data within wild rice beds was obtained to be used in a drought impact contingency plan. Data was collected by the Leach Lake Band. The data is not available in a publication.

5. Weaver Bottoms, Mississippi River Pool 5, Minnesota. Bathimetric data was collected to monitor the impact of the Weaver Bottoms Project. The data is unpublished.

UPPER MISSISSIPPI REGION

GEOLOGICAL SURVEY

Mississippi Headwaters Subregion

1. Suspended-sediment data are being collected on a daily basis during open water at Mississippi River near Anoka, MN, in cooperation with the U.S. Army Corps of Engineers (COE).

2. Suspended-sediment data are being collected on a bimonthly basis at Mississippi River near Royalton, MN, and on a quarterly basis at Mississippi River at Nininger, MN, as a part of the National Stream Quality Accounting Network (NASQAN).

Minnesota Subregion

1. Suspended-sediment data are being collected on a daily basis during open water at Minnesota River at Mankato, MN in cooperation with the COE.

2. Suspended-sediment data are being collected on a quarterly basis at Minnesota River near Jordon, MN, as a part of NASQAN.

Chippewa Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Chippewa River near Durand, WI, as a part of NASQAN.

Upper Mississippi-Black-Whitewater Subregion

1. Suspended-sediment data are being collected during high-flow events and on a bimonthly basis at North Fork Whitewater River near Elba, MN, in cooperation with the U.S. Fish and Wildlife Service and as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected during high-flow events at Middle Fork Whitewater River near St. Charles, MN, South Fork Whitewater River near Altura, MN, and at Whitewater River near Beaver, MN, in cooperation with the Whitewater Watershed Joint Powers Board.

3. Suspended and bedload (Helley-Smith) sediment and bed material are being collected on an intermittent basis at Joos Valley Creek, Eagle Creek at Schaffner Road, and Eagle Creek at CTH G near Fountain City, WI. These data are being collected in cooperation with the Wisconsin Department of Natural Resources.

4. Suspended-sediment data are being collected periodically at Mississippi River at Winona, MN, in cooperation with the COE.

5. Suspended-sediment data are being collected on a bimonthly basis at Black River at Galesville, WI, as a part of NASQAN.

Upper Mississippi-Maquoketa-Plum Subregion

1. Suspended-sediment data are being collected on a daily basis at Mississippi River at McGregor, IA, in cooperation with the COE, St. Paul District.

2. Suspended-sediment data are being collected on a periodic and storm-event basis to determine monthly suspended-sediment loads for the COE at the Grant River at Burton, WI.

Wisconsin Subregion

1. Suspended-sediment and bed-material data are being collected on a bimonthly basis at Ten Mile Creek near Nekoosa and Wisconsin River at Muscoda, WI, as part of NASQAN.

Upper Mississippi-Turkey Subregion

Suspended-sediment data are being collected weekly and on an event basis in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau at Roberts Creek above Saint Olaf, Iowa and at Big Spring near Elkader, Iowa.

Upper Mississippi-Iowa-Skunk-Wapsipinicon Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Cedar River at Cedar Falls, IA, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at the following in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau:

Iowa River at Marshalltown, IA
South Skunk River at Colfax, IA
Skunk River at Augusta, IA

3. Suspended-sediment data are also being collected on a bimonthly basis at Skunk River at Augusta, IA, as part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Iowa River at Wapello, IA, in cooperation with COE, Rock Island District. Suspended-sediment data are also being collected on a bimonthly basis as part of NASQAN.

Rock Subregion

1. Suspended-sediment data are being collected on a periodic and storm-event basis at:

Jackson Creek at County Hwy H near Elkhorn, WI
Jackson Creek tributary near Elkhorn, WI
Delavan Lake tributary at South Shore Drive at Delavan Lake, WI

These data are being collected in cooperation with the Delavan Lake Sanitary District.

1. Suspended-sediment data are being collected on a periodic and storm-event basis at Yahava River near Windsor, WI. These data are being collected in cooperation with the Dane County Regional Planning Commission.

2. Suspended-sediment data are being collected on a storm-event basis in cooperation with Dane County, WI, at:

Pheasant Branch Creek at Middleton, WI, at U.S. Highway 12
Spring Harbor Storm Sewer at Madison, WI

3. Suspended-sediment data are being collected on a quarterly basis at Rock River near Joslin, IL, as part of NASQAN.

Des Moines Subregion

1. Suspended-sediment data are being collected on a daily basis at Des Moines River near Saylorville, IA, in cooperation with the COE, Rock Island District.

2. Suspended-sediment data are being collected on a bimonthly basis at Raccoon River at Van Meter, IA, as a part of NASQAN.

3. Suspended-sediment data are being collected on a daily basis at Des Moines River at St. Francisville, MO, in cooperation with the COE, Rock Island District, and bimonthly as part of NASQAN.

Upper Mississippi-Salt-Subregion

1. Suspended-sediment data are being collected on a daily basis and particle-size data collected on a intermittent basis in cooperation with the COE, St. Louis District, at the following stations:

North Fork Salt River near Shelbina, MO
Middle Fork Salt River at Paris, MO

2. Suspended-sediment data are being collected on an event basis at the Salt River near New London, MO, in cooperation with the COE, St. Louis District.

3. Suspended-sediment data are being collected on a daily basis at Mississippi River at Grafton, IL, in cooperation with the COE, St. Louis District, and on a bimonthly basis at Alton, IL, as part of NASQAN.

4. Suspended-sediment data are being collected eight times a year at Cuivre River near Troy, MO, as part of NASQAN and in cooperation with the Missouri Department of Natural Resources.

Upper Illinois Subregion

1. Suspended-sediment data were collected monthly and more frequently during high flows as part of NAWQA at the following stations:

Illinois River at Marseilles, IL
Des Plaines River at Riverside, IL
Fox River at Dayton, IL
Chicago Sanitary and Ship Canal at Romeoville, IL

2. Suspended-sediment data are being collected on a monthly basis at Illinois River at Marseilles, IL, as a part of NASQAN and NAWQA.

Lower Illinois Subregion

1. Suspended-sediment data were being collected weekly and more frequently during high flows, at Illinois River at Valley City, IL, in cooperation with the COE, St. Louis District. Additional samples are collected on a bimonthly basis at Sangamon River near Oakford, IL, and Spoon River at Seville, IL, as part of the NASQAN program.

Upper Mississippi-Kaskaskia-Meramec Subregion

1. Suspended-sediment data are being collected weekly and more often during high flows, in cooperation with the COE, St. Louis District at the following sites:

Kaskaskia River at Cooks Mills, IL
Kaskaskia River at Venedy Station, IL
Big Muddy River at Murphysboro, IL

Suspended-sediment samples are also collected on a bimonthly basis at Big Muddy River at Murphysboro, IL, as part of the NASQAN program.

2. Suspended-sediment data are being collected on a daily basis at Mississippi River at St. Louis, MO, in cooperation with the COE, St. Louis District.

3. Suspended-sediment data are being collected on a bimonthly basis at Meramac River near Eureka, MO, as part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Mississippi River at Chester, IL, in cooperation with the COE, St. Louis District.

5. Suspended-sediment data are being collected on a daily basis at Mississippi River at Thebes, IL, in cooperation with the COE, St. Louis District. Suspended-sediment data also are being collected on a monthly basis in cooperation with the Missouri Department of Natural Resources.

Special Studies

1. Suspended-sediment data are being collected on a daily basis at Blue Earth River near Rapidan, MN, and on a periodic basis at 21 other sites on and tributary to the Minnesota River. Some bed material also is being collected. The study is a non-point source study within the Minnesota River basin that is being done in cooperation with the Minnesota Pollution Control Agency.

2. Suspended-sediment data were collected every other day, and more frequently during high flows at Big Creek near Bryant, IL, in cooperation with the Metropolitan Sanitary District of Greater Chicago (discontinued December 1986). The sediment data collected were used to monitor changes in sediment transport during the reclamation of a strip-mined area by irrigating with digested sludge from sewage treatment facilities.

Laboratory Activities

The Geological Survey laboratory in Iowa City, IA, analyzed suspended-sediment samples collected by the COE at:

Bay Creek at Nebo, IL
Turkey River at Garbor, IL
Crow Creek at Beltendort, IA
Green River at Geneseo, IL
Wapsipinicon River at DeWitt, IA
Iowa River at Marengo, IA
Iowa River at Coralville Dam, IA
Mississippi River at Burlington, IA

Mississippi River at Keokuk, IA
Des Moines River near Stratford, IA
Raccoon River at Van Meter, IA
North River near Norwalk, IA
Middle River near Indianola, IA
South River near Ackworth, IA
Des Moines River near Tracy, IA
Des Moines River at Keosauqua, IA
Mississippi River at East Dubuque, IL

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Busey County Bank Plaza
102 East Main Street, 4th floor
Urbana, IL 61801

District Chief, WRD
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46254

District Chief, WRD
U.S. Geological Survey
P.O. Box 1230
Iowa City, IA 52244

District Chief, WRD
U.S. Geological Survey
702 Post Office Building
St. Paul, MN 55101

District Chief, WRD
U.S. Geological Survey
1400 Independence Road
Mail Stop 200
Rolla, MO 65401

District Chief, WRD
U.S. Geological Survey
6417 Normandy Lane
Madison, WI 53719

UPPER MISSISSIPPI (07) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Mississippi River	Little Paint Creek	Little Paint Creek	Allamakee	IA
Des Moines River	White Breast Creek	White Breast Creek	Clarke, Lucas, Marion, Warren	IA

2. Special Studies

Dr. Stanley Trimble, Fluvial Geologist, Geography Department, University of California, Los Angeles, presented a 2-day slide lecture and field trip course entitled "Fluvial processes in the Upper Mississippi River Hill Country." the course examined past and present fluvial processes occurring in the Whitewater and Coon Creek Watersheds in Minnesota and Wisconsin.

LOWER MISSISSIPPI REGION

CORPS OF ENGINEERS

Lower Mississippi River Division

Memphis District

Monthly sediment sampling continued at the 15 stations (Established for the purpose of St. Francis River O&M. 7 stations were sampled November through June and 8 stations are sampled during the entire year. Five of these stations maintained daily observations.) previously established in the St. Francis Basin and the station (Established for the purpose of aid in flood control design.) previously established near Colt, Arkansas, in the L'Anguille River Basin. Suspended sediment samplers DH76TM, DH78, D74ALTM and bed sampler BMH60 were used. Records of discharge, observed suspended and bed sediment grain size distribution, observed suspended sediment concentrations, computed suspended sediment load and temperature are maintained.

New Orleans District

Sediment Load Measurements.

1. Suspended sediment and bed material sampling was continued at the following 12 ranges: Mississippi River at Tarbert Landing, MS, semimonthly; Old River Outflow Channel near Knox Landing, LA, semimonthly; Old River Low Sill Structure Outflow Channel, semimonthly; Atchafalaya River at Simmesport, LA, semimonthly; Old River Auxiliary Structure Outflow Channel, semimonthly; Wax Lake Outlet at Calumet, LA, monthly; Lower Atchafalaya River at Morgan City, LA, monthly; Red River above Old River Outflow Channel, semimonthly; Atchafalaya Basin, Bayou Chene below Bayou Crook Chene, monthly; Atchafalaya Basin, Lake Long below Bayou La Rompe, monthly; Atchafalaya Basin, Little Tensas below Blind Tensas Cut, monthly; Atchafalaya Basin, East Access Channel above Chicot Pass, monthly.

2. With the addition of the Vidalia Hydropower station to the Old River Complex, the "Mississippi River at Coochie, LA." range has been relocated 9 miles upstream to river mile 326.2 (Union Point Landing). For the sake of consistency this range will continue to be referred to as Coochie, LA. and will retain the station code 01020. Sampling at this range will continue at semimonthly interval. An additional range was established in the Old River Outflow Channel. "Old River Outflow Channel at Range D-76" (station code 02450) is located between the confluences of the Auxiliary outflow channel and Hydropower outflow channel. This range is sampled only when the Low Sill Structure is operated and then at a semimonthly interval.

2. Suspended sediment samples were taken with a U.S. P-46, or U.S. P-61 sampler. Bed material samples were taken with a BM-54 sampler or drag bucket-type sampler.

Sedimentation Surveys. Channel surveys, including hydrographic, topographic and bathymetric ranges were obtained on many streams within the district to measure channel depths and elevation of deposits.

SEDIMENTATION SURVEYS

Drainage Basin or Project	Survey Purpose	Type of Survey	Elements Measured	Equipment Used	Survey Scope	Available Results
Lower Mississippi River						
Bsr channel	Shoal study	Hydrographic and topographic ranges	Channel depths	Fathometer, lead line	Elevation of shoal in channel @ 500 ft intervals	Comparative cross-sections Head of Passes to Gulf
Navigation crossings	Shoal study	Hydrographic and topographic ranges	Channel depths	Fathometer, lead line	Elevation of shoal in channel	Detailed surveys of eight river crossings*
Main channel	Channel depths	Hydrographic ranges	Channel depths	Fathometer	Selected ranges District Boundary to Head of Passes	Comparative cross-sections computed widths, depths, areas
Atchafalaya River Basin						
Sedimentation ranges	Hydraulic elements	Topographic ranges	Elevation of deposits	Level, lead line	Sediment deposits at selected ranges	Comparative elevations, and profiles
Main channel	Channel depth	Hydrographic ranges	Channel depths	Fathometer	Selected ranges entire length	Comparative cross-sections Computed widths, depths,
Atchafalaya Bay	Hydraulic elements	Bathymetric and topographic ranges	Elevation of deposits	Fathometer, level	Selected ranges	Bathymetric/topographic map w/contours
Old River Control						
Auxiliary inflow channel	Channel depths	Hydrographic ranges	Channel depths, deposits	Fathometer	Selected ranges entire length	Comparative cross-sections contour plots
Outflow channel	Channel depths	Hydrographic ranges	Channel depths	Fathometer	Selected ranges entire length	Comparative cross-sections computed widths, depths, areas

NOTES: * Crossings: Red Eye, Medora, Granada, Bayou Goula, Alhambra, Philadelphia, Smoke Bend, Belmont, and Fairview

Office Investigations. The district continues studying the diversion of suspended and bed sediment at the latitude of Old River. These studies are being funded by the supporting interests in the Vidalia Hydropower Plant venture. The studies include data collection and modeling of Old River Control Outflow Channel using HEC-6.

The district continues to monitor sediment diversion at the Old River Complex as stipulated in the operation agreement between the Corps and the Vidalia Hydropower Plant partnership. The agreement's guidelines and requirements for the diversion and measurement of sediments by the Hydropower interests continues to be a point of discussion. To that end the district is attempting to establish a procedure for determining annual sediment deficit.

The district continued collecting bed and suspended sediment samples in conjunction with the Comite River Diversion Project. The samples will provide input data for an HEC-6 computer model. The model will be run to assess conditions on the Comite River and the diversion channel tributaries during the General Design Memorandum phase.

The district finished collecting bed and suspended sediment samples on the Amite River in the vicinity of the Darlington Reservoir site. These samples provided input data for an HEC-6 model of existing conditions currently being developed for the project feasibility study.

The district's investigations of methods for diverting sediments from the Lower Mississippi River were revisited under the Breaux Bill project selection studies. The estimates of sediment volume diverted and acres of marshlands created were used to rate the relative project benefit and selection potential.

A computer Data Base System is being used to store hydrographic data for the period of record in the district. This System for storing, retrieving, and analyzing sediment data has been converted to run on a micro-computer system.

St. Louis District

Sedimentation Investigations.

1. The data collected with the first resurvey of the sedimentation ranges at Mark Twain Lake has been finalized into report form. The completed report, including higher authority review comments should be completed in early 1992.

2. A total of 32 innovative underwater dikes, called Bendway Weirs, have been built in three bends of the Middle Mississippi River. These bends are Dogtooth Bend (mile 24.0 to 22.0), Prices Bend (mile 31.0 to 30.0), and Cape Bend (mile 52.0 to 53.0). The weirs have been designed to rearrange the sediment fallout within bendways. Prototype surveys have confirmed that they are producing a more efficient navigation channel around the bends. For detailed information contact the Potamology Section of the St. Louis District.

3. The district has set up a new program called Integrated River Management (IRM), whereby the latest technologies are applied to River and Dredge Engineering in order that channel maintenance measures such as Bendway

Weirs, dike construction, and actual dredging operations are optimized to their fullest potential. IRM relies strongly on a channel sweep type surveying system in conjunction with a Global position System technology to analyze sediment movement and bottom contours in District rivers. For detailed information contact the Geodesy Section of the St. Louis District.

Sediment Load Measurements. Bi-Monthly sampling (Mar thru Oct) of temperature, turbidity, total solids, suspended solids, dissolved solids were done at the following locations.

1. Cannon Damsite at Hwy A Bridge, Salt River, Missouri. (Station established for the purpose of Mark Twain Lake O&M General.)

2. Lake Shelbyville T.W., Kaskaskia River, Illinois. (Station established for the purpose of Lake Shelbyville O&M General.)

3. Carlyle Dam T.W., Lower Kaskaskia River, Illinois. (Station established for the purpose of Carlyle Lake O&M General.)

4. Below Rend Lake Dam, Big Muddy River, Illinois. (Station established for the purpose of Rend Lake O&M General.)

5. St. Louis Harbor, Mississippi River, Illinois. (Station established for the purpose of St. Louis Harbor Study.)

Vicksburg District

Sedimentation Surveys. Channel surveys, including cross sections and profiles, were obtained on many streams within the District during the year. These data, which are to be used in various hydrologic and hydraulic studies, were collected by surveying existing and new permanent ranges, temporary ranges, and fathometer spot surveys.

Sediment Load Measurements.

1. Both bed sample and suspended sample measurements are being made weekly at three locations on the Mississippi River. These locations are Natchez, MS; Vicksburg, MS; and Arkansas City, AR. Bed material samples are gathered using a BM-54 bed material sampler, and suspended material samples are collected using a P-61 suspended materials sampler.

2. An ongoing program in which the suspended sample, bed material sample, temperature, discharge, and stage data are collected and computerized for many stations within the District has been continued. Bed samples were collected using either BM-54, BMH-60, or drag bucket bed material samplers, while suspended samples were collected using either D-48, D-57, D-61, or D-74 suspended material samplers or by dip sampling.

3. A comprehensive data collection program was continued for Goodwin Creek. This data collection program was continued by the Agricultural Research Service at no cost to the District.

Office Investigations.

1. Red River Waterway.

a. During 1991, the expanded Red River sediment sampling program initiated during 1988 continued. This expanded program is required in order to obtain sufficient sediment data to insure the effective design of project features. Prior to 1988, suspended sediment samples were taken at random time intervals at Fulton, AR; Shreveport, LA; and Alexandria, LA. The expanded program includes weekly suspended sediment sampling and discharge measurements at Fulton, Shreveport, and Alexandria. Also, suspended sediment samples and discharge measurements are taken biweekly at Spring Bank, AR, and Grand Ecore, LA.

b. During 1991, hinge pool operation studies for Lock and Dam Nos. 4 and 5 continued. These studies are required to determine the most effective hinge pool operation for enhancement of sediment transport within these two pools.

c. During 1991, the TABS-2 numerical model study for the upstream approach to Lock and Dam No. 5 was completed. The results of this study indicated the need for additional TABS-2 and HEC-6 studies. These studies should be initiated in 1992.

2. Demonstration Erosion Control (DEC) Project . The DEC Project is a joint effort between the District and the Soil Conservation Service to reduce flooding, erosion, and sedimentation problems in 15 watersheds in the Yazoo River Basin. Sedimentation related activities ongoing as part of the DEC Project include:

a. Geomorphic and sediment transport studies were continued in 1991 for Pelucia Creek, Black Creek, and Coldwater River watersheds as part of the development of technical work plans for these watersheds. Geomorphic and sediment transport studies were completed for Abiaca Creek watershed. The Abiaca Creek studies addressed measures to reduce sediment delivery to Matthews Brake National Wildlife Refuge into which Abiaca Creek discharges.

b. Automatic suspended-sediment sample stations have been installed in 7 of the 15 DEC watersheds. Stations on Batupan Bogue, Otoucalofa Creek, Hickahala Creek, Senatobia Creek, and Hotophia Creek have been operational for approximately 7 years. Stations on Fannegusha Creek, Long Creek, and Harland Creek went into operation in early 1987. New stations on Abiaca Creek were installed during 1991. These are being maintained and operated by U.S. Geological Survey for the District.

3. Upper Steele Bayou Reformation Study. A sedimentation analysis report was completed as part of the Upper Steele Bayou Reformation Study.

4. Upper Yazoo Project Reformation Project. A sedimentation analysis report was initiated for the Upper Yazoo Project Reformulation Study. This study will be completed in conjunction with the Upper Yazoo Project Reformation Study in 1992.

Southwestern Division

Little Rock District

Sediment sampling continued at Dam No. 2, L&D No. 3, L&D No. 4, L&D No. 5 and David D. Terry L&D on the Arkansas River. Samples were taken intermittently with USD-49 and concentration in terms of the percent of weight were obtained.

LOWER MISSISSIPPI REGION

GEOLOGICAL SURVEY

Lower Mississippi-Hatchie Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Mississippi River at Memphis, TN, Obion River near Obion, TN, and at Hatchie River at Bolivar, TN, as a part of the National Stream Quality Accounting Network (NASQAN).

Lower Mississippi-St. Francis Subregion

1. Suspended-sediment data are being collected on a daily basis at St. Francis River, Saco, MO, in cooperation with COE, St. Louis District.

2. Suspended-sediment data are being collected on a bimonthly basis at St. Francis River at Parkin, AR, and at St. Francis Bay at Riverfront, AR, as a part of NASQAN.

3. Suspended-sediment data are being collected on a bimonthly basis at L'Anguille River near Colt, AR, as part of a State Coop Program.

Lower Mississippi-Yazoo Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Yazoo River at Redwood, MS, and on a quarterly basis at Mississippi River near Arkansas City, AR, as a part of NASQAN.

2. Suspended-sediment data are being collected by an automatic PS-69 pumping sampler at the following sites in cooperation with the Interagency Demonstration Erosion Control Task Force:

Hotopha Creek near Batesville, MS
Otoucalofa Creek near Water Valley, MS
Hickahala Creek near Senatobia, MS
Batupan Bogue at Grenada, MS
Peters (Long) Creek near Pope, MS
Harland Creek near Howard, MS

Lower Red-Ouachita Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Ouachita River at Columbia, LA, and on a quarterly basis at Ouachita River at Camden, AR, as a part of NASQAN. Sediment data are being collected on a quarterly basis at Big Creek at Pollock, LA, as a part of the National Hydrologic Benchmark Network.

Boeuf-Tensas Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tensas River at Tendal, LA, as a part of NASQAN.

Lower Mississippi-Big Black Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Big Black River at Bovina, MS, and quarterly at Homochitto Creek at Rosetta, MS, and Mississippi River at Vicksburg, MS, as part of NASQAN.

Lower Mississippi-Lake Maurepas Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Amite River at Port Vincent LA, Tangipahoa River at Robert, LA, and at Tchefuncta River near Covington, LA, as a part of NASQAN.

Louisiana Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bayou Teche at Keystone Lock and Dam below St. Martinville, LA, Mermentau River at Mermentau, LA, and at Calcasieu River near Kinder, LA, and bimonthly at Atchafalaya River at Melville, LA, as a part of NASQAN and in cooperation with the U.S. Army Corps of Engineers (COE).

2. Suspended-sediment data are being collected on a bimonthly basis at the following site as a part of NASQAN.

    Mississippi River at Belle Chasse, LA

3. Suspended-sediment data are being collected on a monthly basis at the following site:

    Mississippi River near St. Francisville, LA, in cooperation with the COE.

4. Suspended-sediment and bed-material data are collected at the following sites on a monthly basis in cooperation with the COE:

    Lower Atchafalaya River at Morgan City, LA
    Wax Lake Outlet at Calumet, LA, as part of NASQAN and in cooperation with the U.S. Army Corps of Engineers (COE).

5. Suspended-sediment and bed-material data are collected weekly by the COE in the Atchafalaya Basin at Bayou Chene above Bayou Crook Chene, East Access Channel above Lake Chicot, Lake Long below Bayou LaRompe, and Little Tensas Cut.

Special Studies

1. Suspended-sediment data are being collected at 15 stations on the St. Francis River and selected tributaries for the COE. Daily sediment stations are operated at four sites. Eight sites are collected on a monthly basis and the remaining seven sites are collected on a monthly basis from November through June. Monitoring is expected to continue from year to year as the need exists.

2. Suspended-sediment data are being collected on a stormevent basis at four sites in Shelby, Fayette, and Tipton Counties as part of the Beaver Creek pre- and post-best-management-practices comparison study.

3. Post-settlement flood-plain sedimentation rates and patterns are under study in the Tigrett Wildlife Management Area along the North Fork Forked Deer River, Dyer County, TN.

Laboratory Activities

The Geological Survey sediment laboratory located in Baton Rouge, LA, analyzed suspended-sediment and bed-material samples collected by the COE at the following locations:

Old River Outflow near Knox Landing
Red River above Old River Outflow
Mississippi River at Coochie
Mississippi River at Tarbert Landing
Atchafalaya River at Simmesport
Bayou Chene above Bayou Crook Chene
East Access Channel above Lake Chicot
Lake Long below Bayou LaRompe
Little Tensas below Blind Tensas Cut
Old River Low Sill Structure Outflow Channel
Old River Auxillary Structure Outflow Channel
Amite River at selected sites.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Office Building
Room 2301
700 West Capitol Avenue
Little Rock, AR 72201

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

District Chief, WRD
U.S. Geological Survey
Suite 710, Federal Building
100 West Capitol Street
Jackson, MS 39269

District Chief, WRD
U.S. Geological Survey
810 Broadway, Suite 500
Nashville, TN, 37203

LOWER MISSISSIPPI (08) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Mississippi River	Grady-Gould	Choctaw Bayou	Lincoln	AR
Pearl River	Dry Creek	Dry Creek	Marion	MS
Macoupin Creek	Carlinville Lake	Honey	Macoupin	IL

   b. Public Law-534

Major Drainage	Watershed	Stream	County	State
Tallahatchie River	Long Creek Johnson's Creek	Long Creek	Panola	MS

   c. Public Law-639

Major Drainage	Watershed	Stream	County	State
Mississippi River	Adams County Second Creek	St. Catherines	Adams	MS

SOURIS-RED-RAINY REGION

GEOLOGICAL SURVEY

Souris Subregion

1. Suspended-sediment data are being collected on a periodic basis at Souris River near Westhope, ND, as part of the National Stream Quality Accounting Network (NASQAN).

Red Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Sheyenne River at Kindred, ND, and Red River at the north at Halstad, MN, as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis at Beaver Creek near Finley, ND, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a bimonthly basis at the Red River of the North at Emerson, Manitoba, Canada, as part of NASQAN. The Water Survey of Canada provides daily sediment concentrations information at this site.

4. Suspended-sediment data are being collected on a bimonthly basis at the Red Lake River at Crookston, MN, and quarterly at Roseau River below State Ditch 51 near Caribou, MN, as a part of NASQAN.

Rainy Subregion

1. Suspended-sediment data were collected on a quarterly basis at Kawishiwi River near Ely, MN, as part of the National Hydrologic Benchmark Network, and on a bimonthly basis at Rainy River at Manitou Rapids, MN, as part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
702 Post Office Building
St. Paul, MN 55101

District Chief, WRD
U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58501

BUREAU OF RECLAMATION

MISSOURI

Kent Diversion Dam - A settling basin was sized to remove suspended sediment from diverted flows entering the Kent Canal from the North Loup River in Nebraska. The basin was sized for both maximum and average annual diverted sediment volume. For a basin having an 8-foot flow depth as a constraint the average annual sediment diverted volume could be removed in a basin 4100-feet in length, while the maximum annual sediment volume would require a basin 6300-feet in length. For a basin with flow area as the constraint the required basin length would be 2400 feet. The depth of sediment for the various settling basin options over one water year is as follows:

Condition	Length 2400 ft.	4100 ft.	6300 ft.
Average Year	5.9	4.0	2.9
Maximum Year	7.8	5.5	4.0

Tongue River Reservoir - A sediment distribution study for the years 1991 and 2041 was prepared for the Tongue River Reservoir. The yield rate from the 1948 reservoir survey was used for the projections. Excellent agreement was obtained between the predicted distribution for 1984 and the partial survey completed that season.

MISSOURI BASIN REGION

CORPS OF ENGINEERS

Missouri River Division

Kansas City District

Sediment Load Measurements. Three sampling stations were operated on the Missouri and two streams flowing into the Harry S. Truman Reservoir. The Missouri District of the United States Geological Survey (USGS) collected points, depth integrated, and bed samples on a monthly basis at St. Joseph, Kansas City, and Herman, Missouri on the Missouri River. Observers, hired by the USGS, collected daily depth integrated samples at Schell City, Missouri, on the Osage River and at Clinton, Missouri, on the South Grand River. These are two of the major stream flowing into the Harry S. Truman Reservoir. Gradation analysis for the sediment samples was performed at the USGS laboratory located in Rolla, Missouri.

Lake and Reservoir Sediment Activities.

1. Clinton Lake: In FY 1991, funds were obtained to complete the resurvey started in FY 1990. The flood pool aggradation ranges and the outlet channel degradation were surveyed with the end monuments tied to the Kansas State Plan Coordinate System. The completed information will be used to enter the data into the Geographic Information System (GIS). Updated area-capacity tables have been computed, but have not been checked or distributed.

2. Long Branch Lake: A sediment report for this project is nearing completion and will be ready for review in the near future. The report should be completed in FY 92 providing CADD support is available to finalize the record drawings. The report will present a detailed analysis of the lake and the data collected during the resurvey period.

Special Studies.

1. Missouri River Data Base: The Missouri District of the USGS is reformatting the historical Missouri River sediment data base into a structured personal computer program. The program will allow simultaneous interrogation of multiple parameters for making data analyses.

2. Lake and Reservoirs: Considerable effort was expended during the year to develop CADD formats for all lake and reservoir cross section data. Most of the frequently used analytical or computational programs have been converted and recompiled to accept the CADD format.

3. Lake of the Ozarks. The monitoring program below Harry S. Truman Dam was continued. The erosion sites were surveyed twice during calendar year 1991. In March when an extremely low stage existed in the Lake of the Ozarks a good definition of the beaching process was measured. In December the ranges were surveyed to the channel thalweg or just beyond. Water depths during this survey were obtained by connecting a pressure transducer to a digital data logger.

4. Kansas River: Starting 1 January 1992, the commercial dredging

industry operating in the Kansas River will be subject to the District's regulations. The regulations limit the annual volume of material that can be extracted from a specified reach as well as the depth of permissible channel degradation in the same reach. These regulations are the result of numerous studies over a period of several years to control or reduce further geomorphic degradation of the channel. A monitoring plan was developed for compliance and the industry's association will furnish the required data for the District's analysis and review. As part of the implementation of this monitoring program, District personnel collected 535 bed samples to establish a new baseline bed materials inventory.

5. Milford Outlet Channel: A reconnaissance of the outlet channel was performed to identify the source of a large quantity of rock scattered over the bed. Channel degradation has intercepted the bed rock lying below the Republican River alluvium. The intercepted materials are highly fractured and weathered. Apparently, these materials have been transported and distributed along the bed by the increased velocity that occurs during the initial period of release.

6. Lower Republican River: A thalweg and water surface survey was made to verify channel degradation near the town of Junction City, Kansas. An incised low flow channel has developed within the old river channel. Low inflows into Milford Lake over the past few years have limited the magnitude of the daily releases and allowed the channel bottom to become covered with vegetation. The degradation of the channel and the minimal releases from Milford Lake have severely limited the recharge of the aquifer from which Junction City, Kansas, draws its water supply.

7. Harlan County Lake: Because of low pool elevations and irrigation demands, cross sections of the aggradation ranges and the base maps were heavily used to identify locations of various projected drawdown pool elevations. A considerable amount of this data was used to make decisions regarding lowering the pool to meet irrigation demands. At the lowest pool elevation two sets of aerial photographs were taken. One set was taken to identify bed features at the low pool. The second flight photographed the banklines and surrounding perimeter. The bankline photographs will be used to measure bankline retreat and estimate the volume of eroded materials by comparing these photos to earlier aerial photographs.

8. Sac River below Stockton Lake: The Sac River banklines are being remapped from Stockton Dam to the mouth. Recent low altitude photographs are being used to make overlays to compare against the base maps used for establishing erosion easements. This study has shown the banklines have moved beyond the easement take lines in several places.

9. Lower Missouri River: Water samples were collected at 6 different locations in the Lower Missouri River. The samples were collected and analyzed to verify results of measurements taken in 1990. Some of the parameter values determined from the 1990 samples were considered to be abnormally high for the river conditions that existed in 1990. The data was used as input to a water quality model study conducted at the Waterway Experiment Station for the Missouri River Division.

10. Kanopolis Lake: The Planning Division requested assistance in performing two very short studies at this project.

a. Planning Division requested assistance in making an assessment for boating navigability and mobility because of a requested multipurpose pool lowering to meet downstream water demands. The work involved profiling 5 public boat ramps and grid sounding a cove adjacent to the intake where the concessioned marina is located. The data were analyzed and an assessment of the impacts were made regarding the draft needed for the more commonly used Class I and II size vessels and to provide minimal motor skag clearance. Alternatives were suggested to alleviate most of the pool lowering impacts on boating.

b. Another study made involved the evaluation of an impending lease with the State of Kansas. The area of concern involves the reach between the lake's headwaters and the upper portion of the delta. Prior to committing to a lease, it was concluded the District needs to review the development proposed by the State of Kansas and perform an encroachment sensitivity study for determining future maintenance needs in preserving the inflow channel.

11. <u>Big Blue River</u>: Hydrographic soundings and bed material sampling were conducted in the portion of the lower river adjacent to the East Bottom's Missouri River Levee tieback. The purpose was to locate any hard points or armored areas. Some channel fill rock was encountered, that had been placed by field changes during the current construction to bring the channel up to grade. However, the prime cause of channel controls was determined to be two low flow crossings where steel mill slag had been used as surfacing material.

Hydrographic soundings were made between the reach under construction and the mouth to locate and measure the depth of bed scour that occurred during a flood event in May 1990. Bed material samples were also collected. These samples contained a large quantity of steel slag and organic material. A gradation analyses of the material should give a good indication of spatial transport from the source.

The notched portion of the Missouri River right bank revetment at the outlet of the Big Blue River was surveyed to determine the loss of material during May 1990 flood. The original notched portion was found to be intact, but a sizable hole was eroded in the revetment just upstream.

Omaha District

<u>Special Studies</u>.

1. <u>Missouri River Water Control Master Manual Update</u>. Data collection support was again given the Missouri River Division in support of the environmental impact statement for the above manual. Work included:

a. Fort Peck Degradation Reach. Hydrographic surveys of index range lines, channel discharge measurements, velocity measurements, water surface profiles, bed material samples, and habitat identification were provided to the Environmental Resources office (Missouri River Division) at discharges of 3,000 and 8,000 cfs. The field work was a combined effort with the Montana United States Geological Survey.

b. Garrison Degradation Reach. Similar field work was completed for a discharge of 30,000 cfs. The field work was a combined effort with the North

Dakota United States Geological Survey.

c. Fort Randall Degradation Reach. Similar field work was completed for a discharge of 6,000 cfs. The field work was a combined effort with the Iowa United States Geological Survey.

d. Missouri River below Sioux City, Iowa. Similar field work, was completed near river miles 671.0, 563.0, 460.5, 298.5, 186.0, and 91.0. The field work was a combined effort with the Iowa United States Geological Survey.

e. Missouri River below Sioux City, Iowa. Low water season bed contour mapping was completed for nine tributary confluences in Iowa, Nebraska, and Missouri. These sites were the Big Sioux River, Big Nemaha River, Big Tarkio Creek, Fishing River, Fire Creek, Moniteau Creek, Perchee Creek, Cole Creek, and L'outre River. Topographic maps with two foot contours were prepared for these sites along with the confluences of the Little Sioux River, the Platte River, and Nishnabotna River. The latter three sites were contoured from previously collected data.

2. Fort Peck Marina. Possible impacts from sediment deposition and littoral drifting were analyzed for proposed changes to the Fort Peck Marina in Montana.

3. Rock Creek Marina. Possible impacts from sediment deposition, shoreline erosion, and littoral drifting were analyzed for the proposed relocation of the marina on the Rock Creek tributary arm of Fort Peck Lake.

4. Lake Sakakawea Headwaters Phase II Study. The purpose of this study was to determine future aggraded channel flow conditions of the Missouri River in the Lake Sakakawea headwaters reach, predict future groundwater trends, assess government boundary needs, and determine aggradation impacts on the Williston, North Dakota levee system and the Buford-Trenton Irrigation District.

5. Lake Sakakawea Area-Capacity Tables. The area-capacity tables for Lake Sakakawea were updated using 1988 hydrographic survey data.

6. Little Missouri River Aggradation Assessment. The purpose of this study was to document historical sedimentation of the Little Missouri River arm of Lake Sakakawea. The analysis is based on project statistical data, pool elevation records, aggradation range profiles, bed and suspended sediment data, and sediment density data.

7. Garrison Bank Erosion Study. The purpose of this study was to document the methodology and results obtained from a study of bank erosion along the Missouri River between Garrison Dam (RM 1389.0) and Lake Oahe (RM 1308.0). The period studied extends from 3 June 1981 to 25 October 1990 or a time span of 9.4 years.

8. Garrison Degradation Reach. Suspended sediment samples and discharge measurements were made at index cross sections located between Garrison Dam and Bismarck, North Dakota at 30,000 cfs discharge. The data will be used to update an ongoing study of suspended sediment sources for the reach by the

North Dakota United States Geological Survey.

9. Fort Rice and Sugarloaf Bottoms Marinas. Possible impacts from sediment deposition, littoral drift, and erosion were analyzed for a proposed marina at one of these two locations.

10. Cheyenne River Aggradation Assessment. A Sedimentation Problems Analysis (Phase I) Report was conducted to assess aggradation in the Cheyenne River arm of Lake Oahe. Work on Phase II, a future condition assessment was concluded and is awaiting final approval.

11. Bismarck, North Dakota Sediment Sampling Station. Suspended sediment samples were collected over a 24 hour period at the stream gaging station on the Missouri River. The data will supplement a North Dakota United States Geological Survey study on the adequacy of sampling procedures for the station.

12. Lake Oahe Area-Capacity Tables. The area-capacity tables for Lake Oahe were updated using 1989 hydrographic survey data.

13. Bad River Aggradation Assessment. The purpose of this report was to identify channel trends on the lower six miles of the Bad River at Fort Pierre, South Dakota. The report compiles historical channel geometry, groundwater elevations, and sediment transport data into one report, and includes a general discussion of sedimentation impacts on river stages and groundwater levels. These parameters will be used in any future aggradation study of the upper Lake Sharpe areas.

14. Niobrara River Sediment Impacts Study. The purpose of this study is to document the effect of the operation of Lewis and Clark Lake and Fort Randall Dam releases on the Niobrara River. Aggradation on this tributary has produced higher stages for a given discharge, resulting in increased open flow flooding of overbank areas and possible increase in the magnitude and frequency of ice-affected flooding.

15. Wiegand Marina Reconnaissance Survey. A reconnaissance survey was completed at the Wiegand marina, Lewis and Clark Lake, to determine the extent of sedimentation and shoaling.

16. Missouri River Special Point Sampling. A Missouri River Division sediment series report on the special point sediment sampling effort conducted by the U.S.G.S. on the Missouri River at Sioux City, Iowa; Omaha, Nebraska; and Nebraska City, Nebraska (see "Sediment Load Measurements") was compiled and published.

17. Chatfield Lake. The area-capacity tables for the lake were updated using 1991 hydrographic survey data.

18. Papio Creek Site #16. The area-capacity tables for Standing Bear Lake were updated using 1989 hydrographic survey data.

19. Big Sioux River. A feasibility level study was completed to determine the sediment depletion rates and groundwater impacts associated with the proposed reservoir near Watertown, South Dakota.

20. Little Sioux River. Cross section surveys were completed above Sill #4 on the Little Sioux River to determine sedimentation impacts at the project.

21. Platte River. Cross section surveys were completed for the Section 205 (Flood Control, Continuing Authority, Small Project Program) study near Cedar Creek, Nebraska.

Sediment Load Measurements. The Omaha District maintained five suspended sediment sampling stations during the year. One is a Missouri River station and four are major tributary stations. The U.S. Geological Survey monitors, computes, and publishes sediment load records at these stations under a cooperative stream gaging program. In addition, they collect suspended sediment samples, bed materials, and flow velocity data in the Missouri River at Nebraska City, Nebraska; Omaha, Nebraska; and Sioux City, Iowa. Data collected include point integrated samples, flow velocity, and bed samples at five vertical locations in the cross section. Samples are obtained from a boat at each station at about six week intervals during the open water season. Sediment data from this source is used to monitor the bed material load being transported by the Missouri River.

Aggradation/Degradation Reach Groundwater Measurements. As a result of complaints and legal claims against the government, stemming from aggradation or degradation effects on groundwater levels adjacent to privately owned lands, several observation wells have been placed along the Missouri River in the major aggradation and degradation reaches. These wells are being used to monitor the degree of impact over time. All records are obtained either by the U.S.G.S. or by contract observers, and the data entered into a HEC Data Storage System data base by District personnel.

1. Fort Peck Project. Four wells were read monthly immediately downstream of Fort Peck Dam. Data from these wells were used for the Fort Peck Additional Hydropower Study, and will be used in the future to assess relationships between river stages and groundwater levels.

2. Yellowstone Confluence. Sixteen wells are located in the vicinity of the confluence of the Missouri and Yellowstone Rivers. One well was relocated this year at the landowner's request. These wells are used to monitor the effect of Missouri and Yellowstone River stage increases on local groundwater levels. They were read on a monthly basis during the irrigation season and quarterly the remainder of the year.

3. Buford-Trenton Irrigation District. Fourteen wells were read monthly during the irrigation season and quarterly during the remainder of the year to monitor the effect of Missouri River stage increases on local groundwater levels. One well was destroyed by a state road crew and had to be replaced. Data from these wells is currently being used to assess aggradation impacts on the ground water levels in the area.

4. Garrison Project. Four wells are located immediately downstream of Garrison Dam. They were read monthly and will be used to assess relationships between river stages and groundwater levels.

5. Bismark, North Dakota. Nine groundwater wells in the Bismark vicinity

were read quarterly by the U.S. Geological Survey.

6. Pierre, South Dakota. Data from eleven observation wells are used to monitor groundwater levels in a residential area as well as to predict the ground water levels associated with aggradation. Readings are taken monthly.

7. Fort Randall Project. Four wells were read weekly upstream of the Niobrara township on the Missouri River. Data from these wells are used to monitor the ground water impacts of aggradation in the Missouri River.

8. Niobrara River. Four observation wells were read weekly to monitor groundwater changes associated with lake headwater aggradation effects in Lewis and Clark Lake and the effects of delta growth at the mouth of the Niobrara River.

Reservoir Sediment Activities.

1. Lake Sakakawea. A series of lake bed core samples were again taken upstream from Garrison Dam near Beulah Bay. The samples were collected under the supervision of Dr. John Reid, University of North Dakota, and are to be used to determine the destination of eroded shoreline material. The 1 to 2 meter cores were measured, photographed and analyzed. Analysis of the cores previous collected data will be published as MRD Sediment Series Number 38 to be completed in 1992.

2. Lake sharpe. Hydrographic surveys were completed for thirteen sediment rangelines at the lake. The new data will be combined with 1990 survey data to update the area-capacity curves, assess sediment depletion, and quantify shoreline erosion for Lake Sharpe.

2. Salt Creek Project - Pawnee Lake. Hydrographic surveys of the nineteen sediment rangelines were completed for Pawnee Lake located north of Lincoln, Nebraska. Data will be used to update area-capacity curves, assess sediment depletion, and quantify shoreline erosion.

3. Salt Creek Project - Branched Oak Lake. Hydrographic surveys of the twenty-eight sediment rangelines were completed at Branched Oak Lake located north of Lincoln, Nebraska. Data will be used to update area-capacity tables, assess sediment depletion, and quantify shoreline erosion.

4. Chatfield Lake. Hydrographic surveys of the twenty-two sediment rangelines for Chatfield Lake were completed. Data was used to update area-capacity tables and for future assessments concerning sediment depletion, shore erosion, and state and local water needs.

MISSOURI REGION

GEOLOGICAL SURVEY

Saskatchewan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at St. Mary's River at Montana, USA-Alberta, Canada, border, as a part of the National Stream Quality Accounting Network (NASQAN).

Missouri-Marias Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Missouri River at Toston, MT, and bimonthly at Sun River near Vaughn, MT, as a part of NASQAN.

Missouri-Musselshell Subregion

1. Suspended-sediment data are being collected on a daily basis at Missouri River near Landusky, MT, and at Musselshell River at Mosby, MT, in cooperation with the U.S. Army Corps of Engineers (COE).

2. Suspended-sediment data were collected on a bimonthly basis at Musselshell River at Harlowton and at Musselshell, MT, as part of the Federal Collection of Basic Records (CBR) program. Sediment sampling discontinued September, 1991.

Milk Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Milk River at Nashua, MT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Rock Creek below Horse Creek near the international boundary, as a part of the National Hydrologic Benchmark Network and quarterly at Lodge Pole Creek at Lodge Pole in cooperation with the Bureau of Indian Affairs.

Missouri-Poplar Subregion

1. Suspended-sediment data are being collected on a monthly basis in cooperation with Montana Department of Natural Resources at the following sites to define water-quality characteristics of the Poplar River basin:

   Poplar River at international boundary
   East Poplar River at international boundary
   East Fork Poplar River near Scobey, MT

2. Suspended-sediment data are being collected on a bimonthly basis at Poplar River near Poplar, MT, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Beaver Creek at international boundary as part of the Water Ways Treaty Program.

4. Bed-material data were collected at 14 sites between Fort Peck Dam and the confluence of the Yellowstone River in cooperation with the COE, Omaha District, to describe channel substrate characteristics for aquatic habitat assessment.

Upper Yellowstone Subregion

1. Suspended-sediment data are being collected on a daily basis April through September at the Yellowstone River at Corwin Springs, MT, and at the Lamar River near Tower Falls Ranger Station, Yellowstone National Park, in cooperation with the National Park Service

2. Suspended-sediment data are being collected on a bimonthly basis at Yellowstone River near Livingston, MT, and quarterly at Yellowstone River at Billings, MT, as part of NASQAN.

Big Horn Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Bighorn River at Bighorn, MT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a 6-week and storm-event basis at Bighorn River at Kane, WY, as a part of the Missouri River basin program.

3. Suspended-sediment data and bed-load are being collected on an event basis for the nonwinter season at Wind River above Bull Lake Creek near Crowheart, Wind River near Crowheart, and Wind River near Kinnear, WY, as part of the Missouri River basin program.

4. Suspended-sediment data are being collected on a daily basis at Wind River at Riverton, and Wind River above Boysen Reservoir near Shoshoni, WY, in cooperation with the Wyoming State Engineer and as part of NASQAN.

5. Suspended-sediment data are being collected on a quarterly and storm-event basis at Baldwin Creek below Dickinson Creek at Lander, WY, Beaver Creek near Arapahoe, WY, Little Wind River near Riverton, WY, Bighorn River at Lucerne, WY, Shoshone River near Lovell, WY, and on a 6-week and storm-event basis at Fifteen mile Creek near Lovell, WY, in cooperation with the Wyoming Department of Environmental Quality.

6. Suspended-sediment data are being collected on a daily basis for the non-winter season at Jones Creek at mouth, near Pahaska, WY, and Crow Creek at mouth, at Pahaska, WY, in cooperation with the U.S. Forest Service and the Wyoming Department of Environmental Quality, and as part of the Federal program.

Powder-Tongue Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tongue River at Miles City, MT, and a bimonthly basis at Powder River at Locate, MT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis March through September at Powder River at Moorhead, MT, and at Powder River at Broadus, MT, as part of the National Research Program.

3. Suspended-sediment data are being collected on a quarterly and storm-event basis at Big Goose Creek near Sheridan, WY, Little Goose Creek at Sheridan, WY, Goose Creek below Sheridan, WY and Crazy Woman Creek at upper station, near Arvada, WY, in cooperation with the Wyoming Department of Environmental Quality.

4. Suspended-sediment data are being collected on a monthly basis at Tongue River at Tongue River Dam and quarterly at Hanging Woman Creek near Birney, MT, and Otter Creek at Ashland, MT in cooperation with the U.S. Bureau of Land Management.

Lower Yellowstone Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Armells Creek near Forsyth, MT, and Rosebud Creek at mouth near Rosebud, MT, in cooperation with the U.S. Bureau of Land Management.

2. Suspended-sediment data are being collected daily during runoff and approximately weekly during non-runoff conditions at Cherry Creek at Terry, MT, in cooperation with the Bureau of Land Management.

3. Suspended-sediment data are being collected on a daily basis at Yellowstone River near Sidney, MT, in cooperation with the COE.

Missouri-Little Missouri Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Bear Den Creek near Mandaree, ND, as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a periodic basis at Little Missouri River near Watford City, ND, as part of NASQAN.

Missouri-Oahe Subregion

1. Suspended-sediment data are being collected on a periodic basis at Knife River at Hazen, ND, at Heart River near Mandan, ND, and at Cannonball River at Breien, ND, as a part of NASQAN.

2. Suspended-sediment data are being collected on a periodic basis at Grand River at Little Eagle, SD, and Moreau River near Whitehorse, SD, as a part of NASQAN.

3. The U.S. Geological Survey in cooperation with the COE, Omaha District, has begun a study to describe the characteristics of suspended-sediment movement and changes in concentration in the reach of the Missouri River between Garrison Dam and the headwaters of Oahe Reservoir. Suspended-sediment data are being collected at 20 sites on the Missouri River during a range of steady-state discharges.

4. The U.S. Geological Survey in cooperation with the COE, Omaha District, conducted a 48-hour diurnal sediment study on the Missouri River at Bismarck, ND, to determine whether suspended sediment concentrations vary significantly due to regular daily fluctuations in streamflow caused by regulation at Garrison Dam 75 miles upstream.

Missouri-Cheyenne Subregion

1. Suspended-sediment data are being collected on a periodic basis at Belle Fourche River near Elm Springs, SD, and at Cheyenne River at Cherry Creek, SD, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly and storm-event basis at Little Thunder Creek near Hampshire, WY, as part of the Missouri River basin program.

3. Suspended-sediment data are being collected on a 6-week and storm-event basis in cooperation with the city of Gillette, WY, at Stonepile Creek at Gillette, WY.

4. Suspended-sediment data are being collected on a quarterly basis at Castle Creek above Deerfield Dam, near Hill City, SD, as a part of the National Hydrologic Benchmark Network.

5. Suspended-sediment data are being collected on a bimonthly basis at Belle Fourche River below Moorcroft, WY, as part of NASQAN.

Missouri-White Subregion

1. Suspended-sediment data are being collected on a daily basis at South Fork, Bad River near Cottonwood, SD, Plum Creek below Hayes, SD, Willow Creek near Fort Pierre, SD, and White River near Oacoma, SD, in cooperation with North Central RC&D and the COE.

2. Suspended-sediment data are being collected on a daily basis at Little White River above Rosebud, Little White River near Vetal, SD, and Keya Paya River near Keya Paha, SD, in cooperation with the U.S. Bureau of Indian Affairs, Rosebud Sioux.

3. Bedload-sediment data are being collected on a periodic basis at South Fork Bad River near Cottonwood, SD, Plum Creek below Hayes, SD, Willow Creek near Fort Pierre, SD, and Bad River near Fort Pierre, SD, in cooperation with North Central RC&D.

Missouri-Andes Creek Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Andes Creek near Armour, SD, Lake Andes Tributary No. 1 near Lake Andes, SD, Lake Andes Tributary No. 2 near Lake Andes, SD, and Lake Andes Tributary No. 3 near Armour, SD, in cooperation with the USBR and as part of the Missouri River basin program.

Missouri-Choteau Creek Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Choteau Creek near Wagner, SD, and Choteau Creek near Dante, SD, in cooperation with the USBR.

Niobrara Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Niobrara River near Verdel, NE, as a part of NASQAN.

Missouri-James Subregion

1. Suspended-sediment data are being collected on a periodic basis at James River at LaMoure, ND, James River at Pingree, ND, and James River near Ludden, ND, as part of the Missouri River Basin program.

2. Suspended-sediment data are being collected on a periodic basis at James River near Manfred, ND, James River near Grace City, ND, James River above

Arrowhead Lake near Kensal, ND, James River at Jamestown, ND, and James River at Oakes, ND, as part of the Garrison Diversion Refuge Monitoring Program.

3. Suspended-sediment data are being collected on a bimonthly basis at James River near Columbia, SD, as a part of NASQAN, and the Missouri River basin program.

4. Suspended-sediment data are being collected on a quarterly basis at, James River near Scotland, SD, as part of NASQAN.

5. Suspended-sediment data are being collected on a periodic basis at James River at Columbia, SD, in cooperation with the U.S.Bureau of Reclamation.

Missouri-Big Sioux Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Big Sioux River at Akron, IA, as a part of NASQAN.

North Platte Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at North Platte River near Lisco, NE, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Encampment River above Hog Park Creek near Encampment, WY, Encampment River above East Fork Encampment River near Encampment, and East Fork Encampment River at mouth near Encampment, WY, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a 6-week and storm-event basis at Deer Creek in canyon near Glenrock, WY.

4. Suspended-sediment data are being collected on a bimonthly and storm-event basis at North Platte River above Seminoe Reservoir, near Sinclair, WY, as part of NASQAN.

5. Suspended-sediment data are being collected on a quarterly and storm-event basis at Laramie River near Bosler, WY, in cooperation with the Wyoming Department of Environmental Quality.

6. Suspended-sediment data are being collected on a flow-event basis at North Platte River at North Platte, NE, in cooperation with the U.S. Bureau of Reclamation (USBR).

South Platte Subregion

1. Suspended-sediment data are being collected on a quarterly basis at South Platte River at Julesburg, CO, and bimonthly at South Platte at Henderson, CO, as a part of NASQAN.

2. Suspended-sediment data are being collected monthly at North Fork Cache La Poudre River at Livermore, CO.

3. Suspended-sediment data are being collected on a storm-event basis at South Platte River at Roscoe, NE, in cooperation with the USBR.

Platte Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Platte River at Louisville, NE, as a part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Platte River near Duncan, NE, as part of NASQAN.

3. Suspended-sediment data are being collected on a flow-event basis at Platte River at Brady, NE, in cooperation with the USBR.

4. Suspended-sediment data are being collected on a flow-event basis at Platte River near Overton, NE, in cooperation with the USBR.

5. Suspended-sediment data are being collected on a flow-event basis at Platte River near Grand Island, NE, in cooperation with the USBR.

Loup Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Cedar River near Fullerton, NE, as part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Dismal River near Thedford, NE, as part of the National Hydrologic Benchmark Network.

Elkhorn Subregion

1. Suspended-sediment data are being collected at Elkhorn River at Waterloo, NE, on a bimonthly basis as a part of NASQAN.

Missouri-Little Sioux Subregion

1. Suspended-sediment data which includes bed material, suspended-sediment samples, and velocities at several points in a vertical are being collected at the following stations in cooperation with the COE, Omaha District:

    Missouri River at Sioux City, IA
    Missouri River at Omaha, NE
    Missouri River at Nebraska City, NE

Missouri-Nishnabotna Subregion

1. Suspended-sediment data are being collected on a daily basis at Nodaway River at Clarinda, IA, in cooperation with the Iowa Department of Natural Resources, Geological Survey Bureau.

2. Suspended-sediment data are being collected on a quarterly basis at Nishnabotna River above Hamburg, IA, as a part of NASQAN.

3. Suspended-sediment data are being collected on a quarterly basis at Platte River at Sharps Station, MO, as a part of NASQAN.

4. Suspended-sediment data are being collected on a monthly basis at Missouri River at St. Joseph, MO, in cooperation with the Missouri Department of Natural Resources. Sediment data, which includes bed material, suspended-sediment samples, and velocities at several points in a vertical, are being collected periodically at the Missouri River at Kansas City, MO, in cooperation with COE, Kansas City District.

Republican Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Republican River near Clay Center, KS, as part of NASQAN.

Smoky Hill Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at South Fork Solomon River at Osborne, KS, as part of NASQAN.

Kansas Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Big Blue River at Barneston, NE, as part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at West Fork Big Blue River near Dorchester, NE, as part of the Federal CBR program.

3. Suspended-sediment data are being collected on a quarterly basis at Kings Creek near Manhattan, KS, as part of the National Hydrologic Benchmark Network.

Chariton-Grand Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Elk Creek near Decatur City, IA, as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a monthly basis at Grand River near Summer, MO, as a part of NASQAN, and in cooperation with the Missouri Department of Natural Resources.

Gasconade-Osage Subregion

1. Suspended-sediment data are being collected on a daily basis in cooperation with the COE, Kansas City District at the following locations:

Osage River above Schell City, MO
South Grand River at Clinton, MO

2. Suspended-sediment data are being collected on a monthly basis at Osage River below St. Thomas, MO, and at Osage River above Schell City, MO, as a part of NASQAN.

3. Suspended-sediment data are being collected on a monthly basis at Gasconade River near Jerome, MO, as a part of NASQAN, and in cooperation with the Missouri Department of Natural Resources.

Lower Missouri Subregion

1. Suspended-sediment data are being collected on a monthly basis at Missouri River at Hermann, MO, as a part of NASQAN, and in cooperation with the Missouri Department of Natural Resources. Sediment data, which includes bed material, suspended-sediment samples, and velocities at several points in a vertical, are being collected periodically in cooperation with COE, Kansas City District.

Special Studies

1. PS-69 pumping sediment samplers are operating at Lower Hay Creek Tributary near Wilbaux, MT, discontinued September 30, 1981, and at West Branch Antelope Creek Tributary No. 4 near Zap, ND, as part of EMERIA studies. Sediment data are collected at these and several other sites in the study basins.

2. Historical sediment data collected from 1948 until the current year on three Missouri River sites (St. Joseph, MO, Kansas City, MO, and Hermann, MO) are being entered into a computerized data base. This project is being undertaken in cooperation with the Kansas City District Corps of Engineers.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

District Chief, WRD
U.S. Geological Survey
P.O. Box 1230
Iowa City, IA 52244

District Chief, WRD
U.S. Geological Survey
4821 Quail Crest Place
Lawrence, KS 66049

District Chief, WRD
U.S. Geological Survey
1400 Independence Road
Mail Stop 200
Rolla, MO 65401

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 428
301 South Park Ave., Drawer 10076
Helena, MT 59626

District Chief, WRD
U.S. Geological Survey
Room 406, Federal Building
100 Centennial Mall, North
Lincoln, NE 68508

District Chief, WRD
U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58501

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 408
200 4th Street, S.W.
Huron, SD 57350

District Chief, WRD
U.S. Geological Survey
2617 Lincolnway, Suite B
Cheyenne, WY 82001

MISSOURI BASIN (10) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Nemaha	Turkey Creek	Turkey Creek	Pawnee Johnson Nemaha Marshall	NE
Nemaha	Upper Big Nemaha	Big Nemaha River	Gage, Otoe Lancaster Johnson	NE
Platte	Wahoo Creek	Wahoo Creek	Saunders	NE
Missouri	Belfield	Heart River	Stark, Billings	ND
Missouri	James River	Snake Creek	Edmunds	SD
Missouri	Moniteau Creek	Moniteau Creek	Boone, Howard, Randolph	MO
Missouri	Town Branch	Town Branch	Gentry	MO
Missouri	E. Fk. Grand River	East Fork	Harrison, Worth, Ringgold, Union	MO IA

   b. River Basin Investigations

Major Basin	Watershed	State
Republican	Elm Creek (AGNPS)	NE
Platte	Wildwood (AGNPS)	NE
Elkhorn	Taylor Creek (AGNPS)	NE
Statewide Study	Nebraska Watershed Evaluation Cooperative River Basin Study	NE

   c. Floodplain Management Studies

   Data and products include floodplain damage assessments, classical and ephemeral gully erosion damages, stream instability interpretations, and sheet-and-rill erosion estimates.

Major Drainage	Watershed	Stream	County	State
Missouri River	Flat Creek	Flat Creek	Franklin	MO
Missouri River	Westons Bear Creek	Bear Creek	Platte	MO

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Lake Patterson	Stark	ND
Mina Lake	Edmunds	SD
Rothwell Lake	Randolph	MO

3. Special Studies

A review of the sediment storage requirements for Blackwood Creek Structure 11-A was conducted as part of a hydrology review of the site.

The Nebraska sedimentation geologist, who is a certified trainer for "Remote Sensing--Basic Photo Interpretation," conducted three sessions of that course. Course concepts in terrain analysis are applicable to erosion/sedimentation studies.

The West Missouri River Basin Study continued in 1991.

Estimates of erosion and sediment yield from sheet and rill, ephemeral gully, classical gully, streambank erosion, and flood plain scour by land use were reported by hydrologic units in eight northeast counties in Kansas.

The Missouri SCS Water Resources Staff prepared two reports entitled "Parsons Creek EARTH Project--A Summary of Problems and Possible Solutions" (Livingston, Linn, and Sullivan Counties, MO) and "Peruque Creek EARTH Project--A Summary of Problems and Possible Solutions" (Warren and St. Charles Counties, MO). Erosion and sedimentation problems were inventoried in order to calculate erosion rates and sediment yields. The AGNPS water quality model was run on each watershed to help quantify water quality problems. These reports were prepared for EARTH projects, which are land assistance programs of the Soil and Water Conservation Districts Commission with funding provided through the Missouri Department of Natural Resources (MDNR).

The Missouri SCS Water Resources Staff provided technical assistance to the Missouri Department of Conservation (MDC) to assess sediment yield to a group of lakes located in the Hames A. Reed Memorial Wildlife Area (Jackson County). Concern has been expressed by MDC that intensive cropping in the drainage areas above the lakes is causing accelerated sedimentation within the lakes. A brief report covering erosion, sedimentation, and sediment yields was prepared.

BUREAU OF RECLAMATION

ARKANSAS - WHITE - RED

Upper Arkansas River - A sediment sampling program was initiated on the Upper Arkansas River near Leadville, Colorado as part of an investigation related to mine water treatment and related problems. Suspended and bed-load samples were collected at three locations and on three occasions during the 1991 runoff season. Suspended samples were analyzed for size gradation and concentration. Bed material samples were analyzed for size gradation and heavy metal concentrations.

ARKANSAS-WHITE-RED REGION

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sediment Load Measurements. Suspended sediment load measurements were made at two stations (Arkansas River below John Martin Reservoir, CO., and Purgatorie River below Trinidad Lake near Trinidad, CO.) in the region. They are obtained for O&M purposes.

Other Investigations. Trinidad and John Martin Dams continued to be operated to control sediment in the Arkansas River Basin.

Little Rock District

Sedimentation Surveys. Sediment ranges were surveyed in Dardanelle, Ozark, and Winthrop Rockefeller (P-9) Lake.

Sediment Load Measurements. Sediment measurements were obtained at 34 stations on Arkansas River, Mulberry, Spadra Creek, Little Piney Creek, Piney Creek, Petit Jean, Fourche La Fave, White River, Taylor Bay, James River, Bryant Creek, North Fork, Current River, Black River, Piney Fork, Strawberry River, Little Red River. The concentration in percent of weight records were maintained.

Tulsa District

Sedimentation Surveys. A detailed sedimentation resurvey was completed on Waurika Lake, Oklahoma. The detailed resurvey of degradation ranges below Denison Dam on the Red River in Oklahoma and Texas was completed in April. Hydrographic surveys were conducted on Hulah and Sardis Lakes in Oklahoma, and on John Redmond Reservoir in Kansas. Other hydrographic resurveys were begun at Heyburn Lake in Oklahoma and Elk City Lake in Kansas, with completion scheduled by 1 April 1992. A hydrographic investigation was performed on the approach channel for the spillway at Great Salt Plains Lake, Oklahoma. Hydrographic surveys of Jemez Canyon Reservoir and Cochiti Lake in New Mexico were completed for Albuquerque District.

Sediment Load Measurements. The suspended sediment sampling program consisted of 40 operational stations with 36 stations in the Arkansas River Basin and 4 stations in the Red River Basin. Samplers DH-48 and DH-49 were used.

Arkansas River Basin	Arkansas Riv	at Arkansas City, KS
		Haskell,OK
		Kaw Dam
		Ralston, OK
		Tulsa, OK
	Beaver Riv	Guymon,OK
	Big Hill Cr	Cherryvale, KS

Arkansas River Basin	Birch Cr	Barnsdall, OK
	Bird Cr	Sperry, OK
	Black Bear Cr	Pawnee, OK
	Canadian Riv	Calvin, OK
	Caney Riv	Ramona, OK
	Cimarron Riv	Perkins, OK
	Cottonwood Riv	Marion, KS
		Plymouth, KS
	Deep Fork Riv	Arcadia, OK
		Beggs, OK
		Warwick, OK
	Elk Riv	Elk Falls, KS
	Grand (Neosho) Riv	Americus, KS
		Commerce, OK
	Hominy Cr	Skiatook, OK
	Illinois Riv	Tahlequah, OK
	Little Ark Riv	Valley Center, KS
	Little Caney Riv	Copan, OK
	N. Canadian Riv at	Oklahoma City, KS
	N. Canadian (beaver) Riv	Optima Dam, OK
		Selling, OK
	Otter Cr	Climax, KS
	Salt Fork, Ark Riv	Alva, OK
		Jet, OK
	Verdigris Riv	Claremore, OK
		Lenapah, OK
	Walnut Riv	Winfield, KS
	Whitewater Riv	Towanda, KS
Red River Basin	Beaver Cr at	Waurika, OK
	Red Riv	Dekalb, TX
	Washita Riv	Dickson, OK
	Middle Pease Riv	Paducah, TX

Other Investigations. The Reservoir Sediment Data Summaries (ENG Form 1787) for the detailed resurveys of the following lakes (dates of survey in parentheses) have been completed and forwarded to Southwestern Division: Keystone Lake, Oklahoma (1988), Birch Lake, Oklahoma (1989), Waurika Lake, Oklahoma (1991), and the revised data for Hugo Lake, Oklahoma (1985). A draft of the report for the 1985 resurvey of Pat Mayse Lake, Texas is also under review and is scheduled for completion in early 1992. Sediment estimates and projections are being performed as required. The review of data transferred from the Honeywell computer is complete, and software needed to replace that formerly used on the Honeywell system has been completed, with copies of the programs furnished to Albuquerque District.

ARKANSAS-WHITE-RED REGION

GEOLOGICAL SURVEY

Upper White Subregion

1. Suspended-sediment data are being collected bimonthly at White River at Calico Rock, AR, as part of the State Coop Program.

2. Suspended-sediment data are being collected on a bimonthly basis at North Sylamore Creek near Fifty Six, AR, as part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a bimonthly basis at White River at Newport, AR, as a part of the National Stream Quality Accounting Network (NASQAN).

4. Suspended-sediment data are being collected bimonthly at Black River at Black Rock, AR, as part of the State Coop Program.

Upper Arkansas Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Arkansas River at Portland, CO, as part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Halfmoon Creek near Malta, CO, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a daily basis at the following stations, in cooperation with the U.S. Army, Fort Carson, CO:

   Purgatoire River near Thatcher, CO
   Taylor Arroyo below Rock Crossing near Thatcher, CO
   Chacauco Creek at mouth near Timpas, CO
   Purgatoire River at Rock Crossing near Timpas, CO

4. Suspended-sediment data are being collected on a daily basis, approximately 6 months of the year, at Badger Creek upper station near Howard, CO, and Badger Creek lower station near Howard, CO, in cooperation with the U.S. Bureau of Land Management.

5. Suspended-sediment data are being collected on a periodic basis at the following stations, in cooperation with the city of Colorado Springs:

   Fountain Creek near Colorado Springs, CO
   Fountain Creek at Colorado Springs, CO
   Fountain Creek at Secrity, CO

6. Study is being performed to determine what metals are being transported on the sediments and in solution in the Leadville, CO, area.

7. Suspended-sediment data are being collected nine times per year at 12 gaging stations on the Arkansas River and Fountain Creek.

Middle Arkansas Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Arkansas River near Coolidge, KS, as part of NASQAN.

2. Suspended-sediment data are being collected on a 6-week or periodic basis at Little Arkansas River at Valley Center, KS, Arkansas River at Arkansas City, KS, Whitewater River at Towanda, KS, and Walnut River at Winfield, KS, in cooperation with the U.S. Army Corps of Engineers (COE).

Lower Cimarron Subregion

1. Suspended-sediment data are being collected at Cimarron River near Buffalo, OK, as a part of NASQAN.

2. Suspended-sediment data are being collected at Cimarron River at Perkins, OK, in cooperation with the COE and as a part of NASQAN.

Arkansas-Keystone Subregion

1. Suspended-sediment data are being collected at Arkansas River near Ponca City, OK, Salt Fork Arkansas River Near Jet, OK, Salt Fork Arkansas River at Alva, OK, Black Bear Creek at Pawnee, OK, and Arkansas River near Haskell, OK, in cooperation with the COE.

2. Suspended-sediment data are being collected at Arkansas River at Ralston, OK, as a part of NASQAN and in cooperation with the COE.

Neosho-Verdigris Subregion

1. Suspended-sediment data are being collected on a 6-week or periodic basis at the following sites in cooperation with the COE:

   Otter Creek at Climax, KS
   Elk River at Elk Falls, KS
   Big Hill Creek near Cherryvale, KS
   Neosho River at Council Grove, KS
   Neosho River near Americus, KS
   Cottonwood River below Marion Lake, KS
   Cottonwood River near Plymouth, KS

2. Suspended-sediment data are being collected at Neosho River below Fort Gibson Lake near Fort Gibson, OK, as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic basis at the following sites in cooperation with the COE:

   Verdigris River near Lenapah, OK
   Little Caney River near Copan Lake, OK
   Verdigris River near Claremore, OK
   Birch Creek below Birch Lake near Barnsdall, OK
   Bird Creek near Sperry, OK
   Neosho River near Commerce, OK

4. Suspended-sediment data are being collected at Caney River near Ramona, OK, as a part of NASQAN and in cooperation with the COE.

Upper Canadian Subregion

1. Suspended-sediment data are being collected at the following stations at this indicated frequency in cooperation with the New Mexico Interstate Stream Commission:

Cimarron River near Cimarron, NM (semiannual)
Ponil Creek near Cimarron, NM (bimonthly)
Rayado Creek near Cimarron, NM (bimonthly)
Mora River at La Cueva, NM (bimonthly)
Ute Reservoir near Logan, NM (annual)

2. Suspended-Sediment data are being collected on a bimonthly basis at the Canadian River near Sanchez, NM, in conjunction with the Water Quality Surveillance Program in cooperation with the New Mexico Interstate Stream Commission and as part of NASQAN.

Lower Canadian Subregion

1. Suspended-sediment data are being collected at Canadian River near Canadian, TX, as part of NASQAN.

2. Suspended-sediment are being collected at Canadian River at Calvin, OK, as a part of NASQAN and in cooperation with the COE.

North Canadian Subregion

1. Suspended-sediment data are being collected at North Canadian River at Woodward, OK, and at Beaver River at Beaver, OK, as a part of NASQAN.

2. Suspended-sediment data are being collected at North Canadian River near Wetumka, OK, as a part of NASQAN.

3. Suspended-sediment data are being collected at the following sites in cooperation with the COE:

Beaver River near Guymon, OK
North Canadian River near Seiling, OK
North Canadian River below Lake Overholser near Oklahoma City, OK
Deep Fork near Arcadia, OK
Deep Fork near Warwick, OK

4. Suspended-sediment data are being collected at Deep Fork near Beggs, OK, for NASQAN and in cooperation with the COE.

5. Suspended-sediment data are being collected at North Canadian River near Harrah, OK, in cooperation with the Oklahoma Water Resources Board.

Lower White Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Cache River at Patterson, AR, as part of a State Coop Program.

2. Suspended-sediment data are being collected bimonthly at Bayou DeView at Morton, AR, as part of the State Coop Program.

Lower Arkansas Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Arkansas River at James W. Trimble Lock and Dam near Van Buren, AR, and at Arkansas River at David D. Terry Lock and Dam below Little Rock, AR, as a part of NASQAN.

2. Suspended-sediment data are being collected at Illinois River near Tahlequah, OK, in cooperation with the COE.

3. Suspended-sediment data are being collected at Arkansas River at Tulsa, OK, in cooperation with the COE and as a part of NASQAN.

Red Headwaters Subregions

1. Suspended-sediment data are being collected periodically at North Fork Red River near Headrick, OK, at Salt Fork Red River near Elmer, OK, and at Prairie Dog Town Red River near Wayside, TX, as a part of NASQAN.

Red-Washita Subregion

1. Suspended-sediment data are being collected periodically at Red River near Burkburnett, TX, at Red River at Denison Dam near Denison, TX (discontinued September 1986), and at Red River near Gainesville, TX (discontinued September 1986), as a part of NASQAN.

2. Suspended-sediment data are being collected at Washita River near Dickson, OK, in cooperation with the COE and as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic basis at the following sites in cooperation with the COE:

    Red River near Quanah, TX (Discontinued 12/31/90)
    North Wichita River near Truscott, TX (Discontinued 12/31/90)
    Red River near DeKalb, TX
    Beaver Creek near Waurika, OK

4. Suspended-sediment data are being collected at Blue Beaver Creek near Cache, OK, as part of the National Hydrologic Benchmark Network.

Red-Sulphur Subregion

1. Suspended-sediment data are being collected at Kiamichi River near Big Cedar, OK, as a part of the National Hydrologic Benchmark Network and in cooperation with the COE.

2. Suspended-sediment data are being collected bimonthly at Red River at Index, AR, as a part of NASQAN.

3. Suspended-sediment data are being collected on a bimonthly basis at Cossatot River near Vandervoort, AR, as part of the National Hydrologic Benchmark Network.

4. Suspended-sediment data are being collected on a quarterly basis at Twelve-mile Bayou near Dixie, LA, and Red River at Alexandria, LA, as a part of NASQAN.

Special Studies

Suspended sediment, bed-material samples, and channel bathymetry data was collected on Red River at the highway crossings of U.S. 71, Interstate 30 and State Road 3032, as part of a bridge-scour investigation being conducted in cooperation with the Federal Highway Administration.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Federal Office Building
Room 2301
700 West Capitol Avenue
Little Rock, AR 72201

District Chief, WRD
U.S. Geological Survey
4821 Quail Crest Place
Lawrence, KS 66049

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
Broadway Executive Park
202 N.W. 66th, Room 102
Oklahoma City, OK 73116

District Chief, WRD
U.S. Geological Survey
8011 Cameron Road
Austin, TX 78753

District Chief, WRD
U.S. Geological Survey
Building 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

ARKANSAS-WHITE-RED (11) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Floodplain Management Studies

Major Drainage	Watershed	Stream	County	State
Arkansas River	Hickory Creek	Hickory Creek	Newton	MO

BUREAU OF RECLAMATION

TEXAS GULF

Lake Livingston Resurvey - A bathymetric resurvey of Lake Livingston on the Trinity River in Texas was completed in October, 1991 between elevations 60 and 131.9. The survey was at the request of the Trinity River Authority. Area and capacity tables will be developed from the survey data in 1992.

Lake Texana Resurvey - A bathymetric resurvey of Lake Texana on the Navidad River in Texas was completed in June 1991 between elevations -3.3 and 43.7, mean sea level. Area and capacity tables will be developed from this survey data in 1992.

Comanche Creek Reservoir - A sediment study was made covering two alternate sites for the proposed Comanche Creek Reservoir in the Nueces River Basin. The sediment accumulation estimates for the reservoir sites were as follows:

Reservoir site	Drainage area (mi2)	Sediment yield rate (a.f./mi2/yr.)	Trap efficiency (%)	Sediment Accumulation 25 yr. (a.f.)	Sediment Accumulation 50 yr. (a.f.)
Original	1584	0.031	85	1045	2090
Alternate	1497	0.031	80	930	1860

Sediment distributions were made to represent the completion of 25 and 50 years of reservoir operations.

TEXAS-GULF REGION

CORPS OF ENGINEERS

Southwestern Division

Fort Worth District

Sedimentation Survey Reports.

1. Stillhouse Hollow Lake, Lampasas River, Brazos River Basin, Texas. Resurvey of December 1987 which was initially submitted to the Division in October 1988, was modified as per Division comments and resubmitted for Division approval in June 1991. Approval was received in July 1991.

2. Bardwell Lake, Waxahachie Creek, Trinity River Basin, Texas. Resurvey of August 1981, which was initially submitted to the Division in August 1987 was modified as per Division comments and resubmitted for approval in August 1991.

Sedimentation Survey. Initial plot of sedimentation ranges at Cooper Lake has been accomplished.

Galveston District

A total of 310 in-place samples were obtained from navigation projects. These samples were analyzed to determine the quality of the sediment relative to chemical constituents which would be resuspended during dredging, disposal activities, and construction. The projects sampled and number of samples taken are as follows:

Navigation Project	Number of Samples
Matagorda Ship channel	36
Gulf Intracoastal Waterway	69
Sabine-Neches Waterway	24
Houston Ship Channel	149
Freeport Harbor	1
Corpus Christi Ship Channel	13
Brazos Island Harbor	7
Sims Bayou	7
Neches River Channel	4
Total	310

Surveyed cross-sections are established for the Horsepen and Langham diversion channel in Addicks Reservoir and for the Mason Creek diversion channel and Buffalo Bayou in Barker Reservoir. Staff gages were placed to monitor sediment deposition. A resurvey of all of the above cross sections is planned for FY 92 provided adequate funds are available for both reservoirs. Sediment surveys will be scheduled in FY 93 as needed.

TEXAS-GULF REGION

GEOLOGICAL SURVEY

Sabine Subregion

1. Suspended-sediment data are being collected at Sabine River near Ruliff, TX, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a daily basis at Big Sandy Creek near Big Sandy, TX, in cooperation with the U.S. Bureau of Reclamation (USBR) beginning October 1, 1984 (discontinued September 1986).

Neches Subregion

1. Suspended-sediment data are being collected on a periodic basis at Neches River at Evadale, TX, as a part of NASQAN.

Trinity Subregion

1. Suspended-sediment data are being collected on a periodic basis at Mountain Creek near Cedar Hill, TX, Duck Creek near Garland, TX, and at Kings Creek near Kaufman, TX, as a part of the Federal Collection of Basic Records (CBR) program (discontinued September 30, 1982).

2. Suspended-sediment data are being collected on a periodic basis at Trinity River at Trinidad, TX, as a part of NASQAN.

3. Suspended-sediment data are being collected on a periodic basis at Trinity River at Romayor, TX, and at Chocolate Bayou near Alvin, TX (discontinued September 1986), as a part of NASQAN.

4. Suspended-sediment data are being collected on a daily basis at Bedias Creek near Madisonville, TX, in cooperation with the USBR (discontinued September 1986).

Galveston Bay-San Jacinto Subregion

1. Suspended-sediment data are being collected on a periodic basis at West Fork San Jacinto River near Conroe, TX, and at Buffalo Bayou at West Belt Dr., Houston, TX (discontinued September 1986), as part of NASQAN.

2. Suspended-sediment data are being collected on a storm-event basis at Cypress Creek near Westfield, TX, in cooperation with the U.S. Army Corps of Engineers, Galveston, beginning October 1, 1986.

Middle Brazos Subregion

1. Suspended-sediment data are being collected on a periodic basis at Salt Fork Brazos River near Aspermont, TX, Double Mountain Fork Brazos River near Aspermont, TX, Brazos River near Highbank, TX, and at Brazos River near South Bend, TX, as a part of NASQAN.

Lower Brazos Subregion

1. Suspended-sediment data are being collected on a daily and periodic basis at Brazos River at Richmond, TX, as part of the Federal CBR program and also as part of NASQAN (daily sampling discontinued September 1986).

2. Suspended-sediment data are being collected four times a year at South Fork Rocky Creek near Briggs, TX, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a periodic basis at Little River near Cameron, TX, as a part of NASQAN.

Upper Colorado Subregion

1. Suspended-sediment data were being collected on a periodic basis at Colorado River above Silver, TX, as a part of NASQAN.

Lower Colorado-San Bernard Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Colorado River at Austin, TX, Colorado River at Wharton, TX, Colorado River near San Saba, TX, and at San Bernard River near Boling, TX (discontinued September 1986), as a part of NASQAN. The collection of suspended-sediment data at Llano River at Llano, TX (discontinued September 1986) began April 1, 1979, as part of NASQAN.

2. Suspended-sediment data for total-load determination is being collected on a periodic basis at Colorado River above Columbus, TX, in cooperation with the Lower Colorado River Authority beginning October 1, 1982 (discontinued September 1986).

Central Texas Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Guadalupe River at Victoria, TX, San Antonio River at Goliad, TX, Lavaca River near Edna, TX, and at Mission River at Refugio, TX, as a part of NASQAN.

Nueces-Southwestern Texas Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Nueces River near Three Rivers, TX, as a part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
8011 Cameron Road
Austin, TX 78753

TEXAS - GULF (12) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Special Studies

Major Drainage	Study Area	State
Colorado River	Lower Colorado basin	TX

BUREAU OF RECLAMATION

RIO GRANDE

La Rinconada Acequia Crossing - Cross drainage and scour studies were completed for the La Rinconada Acequia crossing of the Canada Ancha Arroyo near Espanola, New Mexico. The resulting scour below a new grade control structure is estimated to be 5 feet for the 100 year flood event.

Rio Grande - Groins were completed at Santa Clara on the Rio Grande near the Otowi Bridge. The groins were placed at Santa Clara to help control bank erosion and narrow the width of the river. Two additions sets of groins are planned at this location in 1992 and 1993 (Santa Clara Phase 2 and Santa Clara Phase 3).

Data and analysis were completed for input for modeling of the San Marcial reach above Elephant Butte Reservoir. Work continues on repair of the Rio Grande Conveyance Channel to allow water to be transported down the canal.

RIO GRANDE REGION

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sedimentation Surveys.

1. A hydrographic survey of the sediment ranges at Cochiti Lake and Jemez Canyon Reservoir was conducted in June 1991. A digitized survey (controlled aerial photography) of the sediment ranges at Cochiti Lake was done in August 1991. A ground survey of the sediment ranges at Jemez Canyon Reservoir was done in August 1991. The purpose of the survey was to determine the changes in reservoir storage capacity.

2. The letter report describing and analyzing the reservoir sedimentation resurvey at Cochiti Lake and Jemez Canyon Reservoir are scheduled for completion in February 1992. New elevation-area-capacity tables were adopted at Cochiti Lake and Jemez Canyon reservoir in January 1992.

Sediment Load Measurements. Suspended sediment measurements were made at four stations in the Rio Grande Region. These stations are located on Rio Chama above Abiquiu Dam, below Abiquiu Dam; on Rio Grande below Cochiti Lake; on Jemez River below Jemez Canyon Dam. All samples are secured by the DH-48, DH-59 or DH-49 samplers according to flow conditions. Samples are not usually accrued on weekends and holidays.

Other Investigation. Abiquiu, Cochiti, Galisteo, and Jemez Canyon Dams continued to be operated to control sediment flow in the Rio Grande.

RIO GRANDE REGION

GEOLOGICAL SURVEY

Rio Grande Headwaters Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Rio Grande near Lobatos, CO, as a part of the National Stream Quality Accounting Network (NASQAN).

Rio Grande-Elephant Butte Subregion

1. Suspended-sediment data are being collected at the following stations at this indicated frequency in cooperation with the New Mexico Interstate Stream Commission:

Rio Pueblo De Taos below Los Cordovas, NM (bimonthly)
Rio Chama near La Puente, NM (bimonthly)

Rio Grande below Taos Junction Bridge near Taos, NM (quarterly)

2. Suspended-sediment data are being collected at the following stations at this indicated frequency in cooperation with the Bureau of Indian Affairs:

Rio Chama near Chamita, NM (quarterly)
Rio Grande at Santa Clara, NM (quarterly)

3. Suspended-sediment data are being collected on a daily basis at Rio Grande at Otowi Bridge near San Ildefonso, NM, and at Rio Grande near Albuquerque, NM, as a part of the Federal Collection of Basic Records (CBR) program.

4. Suspended-sediment data are being collected on a daily basis at Rio Puerco above Arroyo Chico near Guadalupe, NM, and at Rio Puerco near Bernardo, NM, in cooperation with the U.S. Bureau of Land Management (BLM), NMISC, and U.S. Army Corps of Engineers (COE).

5. Suspended-sediment data are being collected on a bimonthly basis at Rio Grande at San Felipe, NM, Rio San Jose near Grants, NM, and at Rio Grande at Isleta, NM, in conjunction with the Water Quality Surveillance Program and financed cooperatively by NMISC.

6. Suspended-sediment data are being collected at Santa Fe River above Cochiti Dam, NM (semiannually), Cochiti Lake, NM (annually), and Jemez River near Jemez, NM (semiannually), in cooperation with the NMISC.

7. Suspended-sediment data are being collected on a daily basis at Rio Grande near Bernardo, NM, at Rio Grande at San Acacia, NM, and at Rio Grande at San Marcial, NM, in cooperation with NMISC.

8. Suspended-sediment data for total-load determinations are being collected on a monthly basis at Rio Grande at Albuquerque, NM, at Rio Grande near Bernardo, NM, at Rio Grande at San Acacia, NM, and Rio Grande at San Marcial, NM, in cooperation with NMISC and U.S. Bureau of Reclamation (USBR).

9. Suspended-sediment data are being collected on a quarterly and storm-event basis at Rio Mora near Terrero, NM, as a part of the National Hydrologic Benchmark Network.

10. Suspended-sediment data are being collected on a bimonthly basis at Pecos River above Santa Rosa Lake, NM, and Pecos River near Acme, NM, in cooperation with NMISC.

11. Suspended-sediment data are being collected on a daily basis at Pecos River near Artesia, NM, as part of the Federal CBR program.

12. Suspended-sediment data were collected on a bimonthly basis at Pecos River near Puerto de Luna, NM, in conjunction with the Water Quality Surveillance Program and in cooperation with NMISC.

13. Suspended-sediment data are being collected on a bimonthly basis at Pecos River at Red Bluff, NM, at Rio Grande at El Paso, TX, and at Rio Grande at Fort Quitman, TX, as a part of NASQAN.

Rio Grande-Amistad Subregion

1. Suspended-sediment data are being collected on a periodic basis at Rio Grande at Foster Ranch, near Langtry, TX, and at Devils River at Pafford Crossing, near Comstock, TX, as a part of NASQAN and was changed to a Hydrologic Benchmark Station on October 1, 1986.

Rio Grande Closed Basins Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Rio Tularosa near Bent, NM, as a part of NASQAN.

Lower Pecos Subregion

1. Suspended-sediment data are being collected on a periodic basis at Pecos River near Langtry, TX, as a part of NASQAN.

Lower Rio Grande Subregion

1. Suspended-sediment data are being collected on a periodic basis at Rio Grande River near Brownsville, TX, and at Arroyo Colorado at Harlingen, TX (started October 1, 1986), as part of NASQAN.

2. Suspended-sediment data are being collected on a weekly or more frequent basis at North Floodway near Sebastion, TX, and at Arroyo Colorado Floodway at El Fuste Siphon, south of Mercedes, TX, as part of the Federal CBR program (discontinued September 30, 1983).

Special Studies

A water-quality monitoring plan for the Rio Grande and Red River in Taos County, NM, was initiated in October 1978 by the BLM. The study objectives are to monitor long-term changes in water quality (chemical and sediment) at 12 selected sampling sites. BLM personnel collect monthly samples and the Geological Survey analyzes the samples and publishes the data.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
8011 Cameron Road
Austin, TX 78753

BUREAU OF RECLAMATION

UPPER COLORADO

Gallegos Pumping Plant - A sediment sampling program was established for measuring sediment transport in the Gravity Main Canal of the Navajo Indian Irrigation Project near Farmington, New Mexico. The purpose was to evaluate the sizing requirements for a settling basin to be constructed upstream of the Gallegos Pumping Plant turnout.

Diamond Fork - An analysis was done of the increased sediment load of the Diamond Fork River due to increased transbasin diversions. All estimates were based upon sediment transport equations and computed stream hydraulics. It was concluded that the coarse sediment load (sand and gravel) would increase by 8 acre-feet per year at the Three Forks diversion site.

UPPER COLORADO REGION

GEOLOGICAL SURVEY

Colorado Headwaters Subregion

1. Suspended-sediment data are being collected on a once-a-week basis at Colorado River near Cameo, CO, in cooperation with the Colorado River Water Conservation District.

2. Suspended-sediment data are being collected on a bimonthly basis at Colorado River near Colorado-Utah State line as a part of the National Stream Quality Accounting Network (NASQAN).

3. Suspended-sediment and bedload data are being collected on a daily basis, April through September at Muddy Creek above Antelope Creek near Kremmling, CO, in cooperation with the Colorado River Water Conservation District.

4. Suspended-sediment data are being collected periodically from April through September at Muddy Creek at Kremmling, CO, in cooperation with the Colorado River Water Conservation District.

Gunnison Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Gunnison River near Grand Junction, CO, as a part of NASQAN.

Upper Colorado-Dolores Subregion

1. Suspended-sediment data are being collected on a bimonthly basis level at Colorado River near Cisco, UT, as part of NASQAN.

2. Suspended-sediment data are being collected on a bimonthly basis at Dolores River near Cisco, UT, as a part of NASQAN.

Great Divide-Upper Green Subregion

1. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Green River near La Barge, WY, as part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at Green River near Green River, WY, as a part of the Federal Collection of Basic Records Program.

3. Suspended-sediment data are being collected on a quarterly and storm-event basis at Dry Piney Creek near Big Piney, WY, Big Sandy River at Gasson bridge near Eden, WY, and Bitter Creek above Killpecker Creek near Rock Springs, WY, in cooperation with the Wyoming Department of Environmental Quality.

White-Yampa Subregion

1. Suspended-sediment data were obtained once a week at Yampa River near Maybell, CO, in cooperation with the Colorado River Water Conservation District.

2. Suspended-sediment data are being collected on a 6-week and storm-event basis at Savery Creek near Savery, WY, in cooperation with the Wyoming Water Department Commission.

3. Suspended-sediment data are being collected on a daily basis for the nonwinter season at Muddy Creek near Baggs in cooperation with the Wyoming Water Research Center.

4. Suspended-sediment data are being collected on a quarterly and storm-event basis at Little Snake River below Baggs, WY, in cooperation with the Wyoming Department of Environmental Quality.

5. Suspended-sediment data are being collected quarterly at several stations in the Piceance Creek basin to monitor the potential impact of oil shale development.

Piceance Creek above Hunter Creek near Rio Blanco, CO
Piceance Creek below Rio Blanco, CO
Piceance Creek tributary near Rio Blanco, CO
Piceance Creek above Ryan Gulch, CO
Stewart Gulch above West Fork near Rio Blanco, CO
Willow Creek near Rio Blanco, CO
Piceance Creek near White River, CO
Corral Gulch near Rangely, CO
Yellow Creek at White River, CO

These stations are operated in cooperation with Rio Blanco County.

6. Suspended-sediment data are being collected on a comprehensive level at White River near Watson, UT, in cooperation with the Utah Department of Natural Resources. (Discontinued September 30, 1990).

7. Suspended-sediment data are being collected periodically during spring, summer, and fall at Yampa River above Stagecoach Reservoir and Yampa River below Stagecoach Reservoir, CO, in cooperation with the Upper Yampa Conservancy District.

8. Suspended-sediment data are collected periodically at Sand Wash near Sunbeam, CO, in cooperation with the Bureau of Land Management.

9. Suspended-sediment data are collected on a periodic basis at White River below Boise Creek near Rangely, CO.

Lower Green Subregion

1. Suspended-sediment data are being collected on a monthly basis at San Rafael River near Green River, UT, in cooperation with the U.S. Bureau of Reclamation (USBR).

2. Suspended-sediment data are being collected on a bimonthly basis at Green River at Green River, UT, as part of NASQAN.

Upper Colorado-Dirty Devil Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Colorado River at Lees Ferry, AZ, as part of NASQAN and Arizona Department of Environmental Quality.

2. Suspended-sediment data are being collected on a monthly basis at Bull Creek near Hanksville, UT, in cooperation with the U.S. Bureau of Land Management.

San Juan Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Vallecito Creek near Bayfield, CO, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a daily basis at Animas River at Farmington, NM, as a part of NASQAN, and Animas River at Cedar Hill, NM on a quarterly basis, in cooperation with NMISC.

3. Suspended-sediment data are being collected on a quarterly basis at San Juan River at Shiprock, NM, as a part of NASQAN.

4. Suspended-sediment data are being collected on a quarterly basis at San Juan River near Bluff, UT, as part of NASQAN.

5. Suspended-sediment data are being collected on a monthly basis at Montezuma Creek near Bluff, UT, in cooperation with the U.S. Bureau of Land Management and the Soil Conservation Service.

Special Studies

1. A study on Stagecoach Reservoir, CO, continues in the analysis phase to determine total sediment load to the reservoir.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
375 South Euclid Avenue
Tucson, AZ 85719

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
2617 E. Lincolnway, Suite B
Cheyenne, WY 82001

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

District Chief, WRD
U.S. Geological Survey
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

UPPER COLORADO (14) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Colorado River	Muddy Creek	Muddy Creek	Kane	UT

   b. Special Studies

The Muddy Creek Watershed study is an ongoing joint effort between the Soil Conservation Service and the Bureau of Land Management to determine sediment and salt yield resulting from excess overland flows, rilling and gullying. An environmental impact statement concerning treatment of the watershed will be prepared in the coming year.

The Upper Colorado River Rangeland Salinity Control Project has involved evaluating rangeland watersheds throughout the Colorado River Basin in Utah to quantify nonpoint source sediment and salt yields which eventually impact water quality of the Colorado River System. The evaluation team is composed of technical specialists from numerous federal agencies headed by Utah SCS State Geologist, Robert Rasely. The report describing the character and procedures of the project is completed. A USGS Water Supply Paper about the project is in draft form. Sagers Wash Watershed report is completed. Five other watershed reports are in progress with completion due this spring.

LOWER COLORADO REGION

GEOLOGICAL SURVEY

Lower Colorado-Lake Mead Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at the following sites as part of the National Stream Quality Accounting Network (NASQAN):

    Virgin River at Littlefield, AZ
    Muddy River above Lake Mead near Overton, NV

2. Suspended-sediment data are being collected monthly on a flow event basis, in cooperation with the U.S. Bureau of Land Management, at the following sites:

    Pahranagot Wash near Moapa, NV
    Meadow Valley Wash near Rox, NV
    Las Vegas Wash above detention basin near N. Las Vegas, NV

Little Colorado Subregion

1. Suspended-sediment data are being collected when instantaneous discharge exceed 500 cubic feet per second in cooperation with the U.S. Corps of Engineers (COE) at Little Colorado River near Joseph City, AZ.

2. Suspended-sediment data are being collected on a flow-event basis at Leroux Wash near Holbrook, AZ, in cooperation with the COE.

3. Suspended-sediment data are being collected on a bimonthly basis at Zuni River above Black Rock Res., NM, and Rio Nutria near Ramah, NM, in cooperation with the U.S. Bureau of Indian Affairs (BIA).

Lower Colorado Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bill Williams near Planet, AZ, in cooperation with the U.S. Bureau of Reclamation (USBR), the COE, and the city of Scottsdale, AZ.

2. Suspended-sediment data are being collected on a bimonthly basis as part of NASQAN at Colorado River below Hoover Dam, AZ.

3. Suspended-sediment data are being collected on a monthly basis at Colorado River below Parker Dam, AZ, in cooperation with the Arizona Department of Environmental Quality.

4. Suspended-sediment data are being collected monthly on the Central Arizona Project (CAP) Canal at MP 162.3 at 7th Street at Phoenix, AZ, and quarterly at CAP Canal above Brady Powerplant near Coolidge, AZ, in cooperation with the Arizona Department of Environmental Quality.

5. Suspended-sediment data are being collected monthly at Colorado River at NIB above Morelos Dam near Andrade, CA, as part of NASQAN and Arizona Department of Environmental Quality.

Upper Gila Subregion

1. Suspended-sediment data are being collected on a quarterly and storm-event basis at Mongollon Creek near Cliff, NM, as a part of the National Hydrologic Benchwork Network.

2. Suspended-sediment data are being collected on a bimonthly basis at Gila River near Redrock, NM, as part of NASQAN.

3. Suspended-sediment data are being collected on a bimonthly basis at Gila River at head of Safford Valley, near Solomon, AZ, in cooperation with the Arizona Department of Environmental Quality.

4. Suspended-sediment data are being collected on a monthly basis at Gila River at Calva, AZ, as a part of NASQAN and Arizona Department of Environmental Quality.

Middle Gila Subregion

1. Suspended-sediment data are being collected on a bimonthly basis as a part of NASQAN at the San Pedro River at Charleston, AZ.

2. Suspended-sediment and bed-material data are being collected on a bimonthly basis at Gila River at Kelvin, AZ, and on a monthly basis at San Pedro River below Aravaipa Creek near Mammoth, AZ, in cooperation with the USBR. Bed material data are also collected twice annually at San Pedro River below Aravaipa Creek near Mammoth, AZ under this program.

Lower Gila Subregion

1. Suspended-sediment data are being collected on a monthly basis in cooperation with the USBR at:

   Agua Fria River near Rock Springs, AZ
   Agua Fria River below Lake Pleasant, AZ (during releases from Waddell Dam).

2. Suspended-sediment data are being collected on a monthly basis as a part of NASQAN and in cooperation with the Arizona Department of Environmental Quality at Gila River above diversions at Gillespie Dam, AZ.

Salt Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Wet Bottom Creek near Childs, AZ, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a monthly basis as a part of NASQAN and the Arizona Department of Environmental Quality at:

   Salt River near Roosevelt, AZ
   Verde River below Tangle Creek, AZ

3. Suspended-sediment data are being collected on a bimonthly basis in cooperation with the Arizona Department of Environmental Quality at:

East Verde River near Childs, AZ
Pinal Creek at Inspiration Dam near Globe, AZ
Salt River below Stewart Mountain Dam, AZ
Verde River below Bartlett Dam, AZ

4. Suspended-sediment data are being collected on a monthly basis in cooperation with the Arizona Department of Environmental Quality at:

Verde River near Clarkdale, AZ
Oak Creek at Redrock Crossing, AZ

Special Studies

1. A 5-year study of the mobility of radionuclides and other selected trace elements in the Little Colorado River basin of Arizona and New Mexico started in July 1988. Suspended-sediment data are collected on a flow-event basis at the following stations:

Puerco River near Church Rock, NM
Puerco River at Gallup, NM
Puerco River near Manuellito, NM
Black Creek below West Fork near Houck, AZ
Puerco River near Chambers, AZ
Zuni River above Black Rock Reservoir, NM
Little Colorado River at Woodruff, AZ
Little Colorado River at Holbrook, AZ
Little Colorado River near Joseph City, AZ
Little Colorado River at Grand Falls, AZ
Little Colorado River near Cameron, AZ

2. A long-term, ongoing statewide program in Nevada of investigations of sediment and debris transported by flash floods continued during 1989.

For additional information about U.S. Geological Survey activities within this region, contact the following offices:

3. Suspended-sediment, bedload, and bed material data are collected intensively on an intermittent basis in cooperation with USBR Glen Canyon Environmental Studies II at the Colorado River above National Canyon near Supai, AZ. Suspended-sediment data are collected approximately bimonthly at the following stations:

4. Suspended-sediment data are collected on a flow-event basis at:

Paria River at Lees Ferry, AZ
Kanab Creek near Fredonia, AZ
Little Colorado River at Cameron, AZ

Colorado River at Lees Ferry, AZ
Colorado River above Little Colorado River near Desert View, AZ
Colorado River near Grand Canyon, AZ
Colorado River above National Canyon near Supai, AZ

Colorado River above Diamond Creek near Peach Springs, AZ

5. Suspended-sediment data are collected bimonthly under the auspices of the U.S. Geological Survey Toxics Waste Program at Pinal Creek at Setka Ranch near Globe, AZ.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
375 West Euclid Avenue
Tucson, AZ 85719

District Chief, WRD
U.S. Geological Survey
4501 Indian School Road, NE
Suite 200, Pinetree Office Park
Albuquerque, NM 87110

District Chief, WRD
U.S. Geological Survey
2617 E. Lincolnway, Suite B
Cheyenne, WY 82001

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 224
705 North Plaza Street
Carson City, NV 89701

District Chief, WRD
U.S. Geological Survey
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

District Chief, WRD
U.S. Geological Survey
Bldg. 53, Denver Federal Center
Mail Stop 415, Box 25046
Lakewood, CO 80225

LOWER COLORADO (15) REGION

SOIL CONSERVATION SERVICE

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Oak Wash Draw Detention Dam	McKinley	NM

GREAT BASIN REGION

GEOLOGICAL SURVEY

Bear Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bear River near Corinne, UT, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a comprehensive level in cooperation with the Utah Department of Natural Resources at:

Bear River at Idaho-Utah State line
Little Bear River below Davenport Creek near Avon, UT
Bear River near Collinston, UT

3. Suspended-sediment data are being collected on a quarterly basis at Bear River at Border, WY as part of the National Stream Quality Accounting Network (NASQAN).

4. Suspended-sediment data are being collected on a quarterly and storm-event basis at Bear River above reservoir, near Woodruff, UT, and Smith's Fork near Cokeville, WY, and on a 6-week and storm-event basis at Twin Creek at Sage, WY, in cooperation with the Wyoming Department of Environmental Quality.

Great Salt Lake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Red Butte Creek at Fort Douglas, near Salt Lake City, UT, as part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a quarterly basis at Weber River near Plain City, UT, and at Jordan River at Salt Lake City, UT, on a bimonthly basis as a part of NASQAN.

Escalante - Sevier Lake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Sevier River near Lynndyl, UT, as a part of NASQAN.

2. Suspended-sediment data are being collected on a comprehensive level at Sevier River at Hatch, UT, in cooperation with the Utah Department of Natural Resources.

Black Rock Desert-Humboldt Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Humboldt River near Carlin, NV, as part of NASQAN.

Central Lahontan Subregion

1. Suspended-sediment data are being collected at the following sites as part of NASQAN:

Walker River near Wabuska, NV (bimonthly)
Carson River near Fort Churchill, NV (quarterly)
Truckee River near Nixon, NV (quarterly)

2. Suspended-sediment data are collected monthly or more frequently during runoff events at the following sites as part of the Lake Tahoe Stream Monitoring Program (in cooperation with the Tahoe Regional Planning Agency):

Third Creek near Crystal Bay, NV
Incline Creek near Crystal Bay, NV
Incline Creek at Hwy 28 at Incline Village, NV
Incline Creek above Tyrol Village near Incline Village, NV
Glenbrook Creek near Glenbrook, NV
Logan House Creek near Glenbrook, NV
Edgewood Creek at Palisade Drive near Kingsbury, NV
Edgewood Creek near Stateline, NV
Eagle Creek near Stateline, NV
Trout Creek at Pioneer Trail near South Lake Tahoe, CA
Trout Creek at USFS Road 12N01 near Meyers, CA
Upper Truckee River at Highway 50 above Meyers, CA
Upper Truckee River at South Upper Truckee Road near Meyers, CA
Ward Creek below Page Meadows near Tahoe Pines, CA
Ward Creek below North and South Forks near Tahoe Pines, CA

3. Suspended-sediment data are collected periodically during runoff events at the following sites as part of the Lake Tahoe Stream Monitoring Program (in cooperation with the Tahoe Regional Planning Agency):

First Creek near Crystal Bay, NV
Second Creek at Lakeshore Drive near Incline Village, NV
Wood Creek at Lakeshore Drive near Incline Village, NV
Wood Creek above Jennifer Street near Incline Village, NV
Incline Creek Tributary at Country Club Drive near Incline Village, NV
Third Creek at Village Blvd. at Incline Village, NV
Third Creek below unnamed tributary near Incline Village, NV
Glenbrook Creek at Old Highway 50 near Glenbrook, NV
North Logan House Creek above Hwy 50 near Glenbrook, NV
Edge Creek Tributary near Dagget Pass, NV
Edgewood Creek below South Benjamin Drive near Dagget Pass, NV

4. Suspended-sediment daily stations are being operated at the following sites as part of the Tahoe Monitoring Program (in cooperation with the Tahoe Regional Planning Agency, California Department of Water Resources, and the University of California at Davis):

Trout Creek at South Lake Tahoe, CA
Upper Truckee River at South Lake Tahoe, CA
General Creek near Meeks Bay, CA
Blackwood Creek near Tahoe City, CA
Ward Creek at State Highway 89 near Tahoe Pines, CA

5. Suspended-sediment data are being collected twice-yearly at the following sites in cooperation with the U.S. Army Corps of Engineers:

Martis Creek at Highway 267 near Truckee, CA
Martis Creek Lake near Truckee, CA
Martis Creek near Truckee, CA

Central Nevada Desert Basins Subregion

1. Suspended-sediment data are being collected quarterly at Steptoe Creek near Ely, NV, and South Twin River near Round Mountain, NV, as part of the National Hydrologic Benchmark Network.

Special Studies

1. A long-term, ongoing statewide program of investigations of sediment and debris transport by flash floods continued during 1991.

2. A long-term investigation of sediment and debris hazards related to flooding is in the eighth investigative year at the Nevada Test Site.

For additional information about U.S. Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
333 W. Nye Lane
Carson City, NV 89706

District Chief, WRD
U.S. Geological Survey
Room W-2233, Federal Building
2800 Cottage Way
Sacramento, CA 95825

District Chief, WRD
U.S. Geological Survey
2617 E. Lincolnway, Suite B
Cheyenne, WY 82001

District Chief, WRD
U.S. Geological Survey
1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

District Chief, WRD
U.S. Geological Survey
230 Collins Road
Boise, ID 83702

GREAT BASIN (16) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Truckee River	Evans Creek	Evans Creek	Washoe	NV

   b. Conservation Operations

   Chalk Creek Watershed, Summit County, UT, is an ongoing study by numerous federal and state agencies to determine sediment yield from rangeland and streambank areas within the watershed. Present studies are continuing to determine the best management practices and alternatives to enhance water quality of Chalk Creek.

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Lower Peavine Creek Dam	Washoe	NV

Note: A sedimentation survey was made on the Lower Peavine Creek Dam to determine potential sedimentation rates for a proposed dam on the adjacent Evans Creek Watershed.

BUREAU OF RECLAMATION

PACIFIC NORTHWEST

Bumping Lake Resurvey - A bathymetric resurvey of Bumping Lake on the Bumping River in Washington was completed in June, 1990 between elevations 3309 and 3426. Aerial photogrammetric data collected in October, 1986 between elevations 3395 and 3615 were used with the underwater survey data to develop a topographic map, which provided the basis for revised area and capacity tables completed in March, 1991.

Lake Como Resurvey - A bathymetric resurvey of Lake Como in the Bitter Root Basin in Montana was completed in May, 1991 between elevations 4122 and 4223. Aerial photogrametric data collected in 1991 between elevations 4205 and 4777 will be used with the bathymetric data to produce area and capacity tables in 1992.

Ochoco Reservoir Resurvey - A bathymetric resurvey of Ochoco Reservoir in the Crooked River Basin in Oregon was completed in June, 1990 between elevations 3025.6 and 3092.3. Aerial photogrammetric data collected in November ,1990 between elevations 3051 and 3268 were used with the underwater survey data to develop a topographic map which became the basis for a revised area and capacity table, completed in April, 1991. The 70 year accumulation of sediment in the reservior was 3082 acre feet for a sediment yield rate of 0.15 acre-feet per square mile per year.

Unity Reservoir Resurvey - A bathymetric resurvey of Unity Reservoir on the Burnt River in Oregon was completed in May, 1991 between elevations 3761 and 3817.7. Aerial photogrammetric data collected in 1991 between elevations 3795 and 3850 will be used with the bathymetric data to produce area and capacity tables in 1992.

PACIFIC NORTHWEST REGION

CORPS OF ENGINEERS

North Pacific Division

Portland District

Sedimentation Surveys.

1. Reservoir Surveys.

a. Toutle River, Washington. Monitoring of sediment deposits behind the Mount St. Helens Sediment Retention Structure (SRS) continued in 1991. Sediment range surveys found 8.5 million cubic yards (mcy) of deposition during Water Year (WY) 1991. This brings the total volume of material trapped since November 1987 to 24.9 mcy. Sediment samples indicate that most of the material deposited is in the 0.25mm to 16mm size range, with silts and clays making up less than 5 percent of the deposit. Sediment range surveys and material sampling will continue on an annual basis.

b. Scheduled Resurveys. Sedimentation is not a common problem in Portland District reservoirs. Fern Ridge Reservoir is the only other reservoir scheduled for a sediment range resurvey during WY 1992. This will be the first resurvey of Fern Ridge since the ranges were established in 1947. Applegate Lake and Willow Creek Lake will be resurveyed when funding becomes available.

2. Channel Surveys.

a. Cowlitz and Toutle Rivers, Washington. Channel cross-section surveys were repeated along the lower 20 miles of the Cowlitz River. The surveys were used to determine flood protection levels along the Cowlitz River and, combined with U.S. Geological Survey sediment data from the Toutle River at Tower Road, to monitor the impacts of the SRS.

b. Columbia River, Oregon and Washington. Repeated hydrographic surveys were made along the Columbia River deep-draft navigation channel between Portland/Vancouver and the mouth. These surveys were used to plan maintenance dredging, and to study shoaling and disposal problems.

Walla Walla District

Sedimentation Studies.

1. Lower Granite Pool. Sediment accumulation in the upper end of the reservoir has interfered with navigation and reduced flood protection. Hydrologic and sediment transport studies are continuing with the objective of determining a permanent, long-term solution. This is the 4th year in a previously planned 5-year test and monitoring program in which the environmental effects of in-water disposal of dredged material are being evaluated at mid-depth (20-60 feet) and deep-water (greater than 60 feet) disposal sites. Completion of a deep-water disposal site has been delayed

until early 1992. Due to this delay, an additional year of monitoring will probably be required. This year's monitoring consisted of the following:

a. The sediment disposal sites and ranges through the 1989 test pits were resurveyed.

b. Sediment samples were collected to monitor changes in grain size and depth of deposited sediment at the two disposal sites and four reference sites.

2. Schultz Bar. Condition surveys were performed between RM 100.7 and RM 101.9 on the Snake River to monitor changes in the geometry of a large sandbar which is encroaching on the navigation channel.

PACIFIC NORTHWEST REGION

GEOLOGICAL SURVEY

Kootenai-Pend Oreille-Spokane Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at South Fork Coeur d'Alene River at Cataldo, ID, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a daily basis by a PS-69 at Kootenai River at Porthill, ID, as part of the U.S. Geological Survey waterways-treaty program. Discontinued September 30, 1991.

3. Suspended-sediment data are being collected on a quarterly basis at Hayden Creek below North Fork, near Hayden Lake, ID, as part of the National Hydrologic Benchmark Network.

4. Suspended-sediment data are being collected in cooperation with the Idaho Department of Health and Welfare on a quarterly basis at:

Clark Fork near Cabinet, ID
Pend O'Reille River at Newport, WA
South Fork Coeur d'Alene River near Pinehurst, ID
St. Maries River near Santa, ID
Spokane River near Post Falls, ID

Upper Columbia Subregion

1. Suspended-sediment data are being collected in cooperation with the U.S. Environmental Protection Agency on a daily basis at:

Clark Fork at Deer Lodge, MT
Clark Fork at Turah Bridge near Bonner, MT
Blackfoot River near Bonner, MT
Clark Fork above Missoula, MT

and on a periodic basis at:

Clark Fork near Galen, MT
Little Blackfoot River near Garrison, MT
Flint Creek near Drummond, MT
Rock Creek near Clinton, MT

2. Suspended-sediment data are being collected on a bimonthly basis in cooperation with the Bureau of Indian Affairs at the following stations:

Little Bitterroot River near Camas Prairie, MT
Crow Creek at mouth near Ronan, MT
Mission Creek at National Bison Range at Moiese, MT
Jocko River at Dixon, MT
Flathead River at Perma, MT
Revais Creek below West Fork near Dixon, MT

3. Suspended-sediment data are being collected at the following sites as part of NASQAN:

Clark Fork below Missoula, MT (bimonthly)
Flathead River at Columbia Falls, MT (quarterly)
Flathead River at Flathead, British Columbia (quarterly)

4. Suspended-sediment data were collected on a daily basis at Flathead River at Flathead, British Columbia, in cooperation with the Environment Canada as part of the U.S. Geological Survey watersheds-treaty program. Daily sampling was discontinued July, 1991.

5. Suspended-sediment data are being collected on a periodic basis at Columbia River at Northport, WA, at Columbia River at Vernita Bridge, near Priest Rapids Dam, WA, and at Okanogan River at Malott, WA, as a part of NASQAN.

6. Suspended-sediment data are being collected on a periodic basis at Andrews Creek near Mazama, WA, as a part of the National Hydrologic Benchmark Network.

7. Suspended-sediment data are being collected on a quarterly basis at Columbia River at Richland, WA, in cooperation with the U.S. Department of Energy.

Yakima Subregion

1. Suspended-sediment data are being collected periodically at Yakima River near Union Gap, WA, and at Yakima River at Kiona, WA, as part of NASQAN.

2. Suspended-sediment data were collected on a periodic basis at Buckskin Creek near Gleed, WA, Moxee Drain near Union Gap, WA, Granger Drain at Granger, WA, Sulfur Creek Wasteway near Sunnyside, WA, and Chandler Canal near Prosser, WA, as part of NAWQA.

Upper Snake Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Cache Creek near Jackson, WY, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment and bedload data are collected weekly during spring runoff at Pacific Creek at Moran, WY, in cooperation with Grand Teton National Park.

3. Suspended-sediment data are being collected on a bimonthly basis at Snake River near Heise, ID, as a part of NASQAN.

4. Suspended-sediment data are being collected on a bimonthly basis and bedload data during spring runoff at Snake River above Jackson Lake at Flagg Ranch, WY, in cooperation with Grand Teton National Park.

5. Suspended-sediment data are being collected on a quarterly and storm-event basis at Salt River above reservoir, near Etna, WY, in cooperation with the Wyoming Department of Environmental Quality.

6. Suspended-sediment data are being collected in cooperation with the Idaho Department of Health and Welfare on a quarterly basis at:

Blackfoot River near Blackfoot, ID
Snake River near Sheeley, ID
Marsh Creek near McCammon, ID
Portneuf River at Pocatello, ID
Camas Creek at Red Road near Kilgore, ID.

Middle Snake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Snake River at King Hill, ID, and Boise River near Parma, ID, as a part of NASQAN.

2. Suspended-sediment data are being collected on a quarterly basis at Big Jacks Creek near Bruneau, ID, as a part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected in cooperation with the Idaho Department of Health and Welfare on a quarterly basis at:

Boise River at Glenwood Bridge near Boise, ID
Snake River at Melner, ID
Snake River near Kimberly, ID
Rock Creek near Twin Falls, ID
Snake River near Buhl, ID
Snake River near Murphy, ID
Bruneau River near Hot Springs, ID
Boise River near Twin Springs, ID
Boise River below Diversion near Boise, ID
Snake River near Antone, WA

Lower Snake Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Salmon River near White Bird, ID, and Clearwater River at Spalding, ID, as part of NASQAN.

2. Suspended-sediment data are being collected in cooperation with the Idaho Department of Health and Welfare on a quarterly basis at Lapwai Creek near Lapwai, ID, and Palouse River near Potlatch, ID.

3. Suspended-sediment data are being collected periodically at Snake River at Burbank, WA, as a part of NASQAN.

4. Suspended-sediment data are being collected on a periodic basis from Minam River at Minam, OR, as a part of the National Hydrologic Benchmark Network.

Middle Columbia Subregion

1. Suspended-sediment samples are being collected on a periodic basis at John Day River near McDonald Ferry, OR, as a part of NASQAN.

2. Suspended-sediment samples are being collected in cooperation with the Confederated Tribes of the Warm Springs Reservations on a periodic basis at:

Shitike Creek at Peters Pasture
Shitike Creek near Warm Springs
Warm Springs River near Simnasho
Mill Creek near Badger Bute
Beaver Creek below Quartz Creek
Warm Springs River near Kahneeta

Lower Columbia Subregion

1. Suspended-sediment data are being collected on a periodic basis at Columbia River at Warrendale, OR, and Columbia River at Beaver Army Terminal near Quincy, OR, as a part of NASQAN.

Willamette Subregion

1. Suspended-sediment data are being collected on a periodic basis from Tualatin River at West Linn, OR, and at Willamette River at Portland, OR, as a part of NASQAN.

2. Suspended-sediment samples will be taken at the following Willamette River basin locations during five high-flow events and during winter and summer base-flow periods, each year, from October 1, 1991, through September 30, 1993. These data will be used to define spatial and temporal sediment concentrations, loads and yields in the main stem and tributaries.

Willamette River at Portland, OR
Clackamas River near Clackamas, OR
Tualatin River at West Linn, OR
Willamette River at Salem, OR
Santiam River at Jefferson, OR
Willamette River at Harrisburg, OR
Long Tom River at Monroe, OR
McKenzie River at Colberg, OR
Coast Fork Willamette River near Goshen, OR

3. Samples will be taken from these same Willamette River basin locations for particle size analyses during one high-flow and winter base-flow each year, during the same period.

4. Sediment loads will be calculated using suspended-sediment and discharge relations for the period October 1, 1991, through September 30, 1993.

5. Bedload will be approximated for the Willamette River locations using an appropriate bedload equation.

6. Bed sediment samples will be collected and analyzed for selected trace-organics and trace elements at 14 Willamette River locations on the main stem and tributaries during the summer of 1992. These sample locations have not been determined. Bed-sediment samples will be sieved and only the finer than 62-micron-diameter sediment will be analyzed.

Oregon-Washington Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Rogue River near Agness, OR, Siuslaw River near Mapleton, OR, Nehalam River near Foss, OR, Chehalis River at Porter, WA, and at Queets River near Clearwater,

WA, as a part of NASQAN, and at South Umpqua River at Roseberg, OR, in cooperation with Douglas County and as a part of NASQAN.

Puget Sound Subregion

1. Suspended-sediment data are being collected on a periodic basis at Skagit River near Mount Vernon, WA, and at Puyallup River at Puyallup, WA, as a part of NASQAN.

Special Studies

1. Suspended-sediment, bed-material, and bedload data are being collected on a periodic basis at the following stations:

Green River above Beaver Creek near Kid Valley, WA
South Fork Toutle River at Camp 12 near Toutle, WA
North Fork Toutle River at Kid Valley, WA
Toutle River at Tower Road near Silver Lake, WA
Muddy River below Clear Creek near Cougar, WA

Automatic pumping sediment samplers are also operated at most sites. The goal is to compute daily sediment discharges and to continue evaluation of the sediment systems of streams affected by the 1980 eruption of Mount St. Helens. Instrumentation research is an ongoing part of the sediment-transport studies in the Toutle River. In situ suspended-sediment analyzers are installed at both the North Fork Toutle River near Kid Valley and Toutle River at Tower Road sites. Data from these instruments are being compared to traditional laboratory analysis of suspended-sediment samples. Depth sounding of the mobile streambed continued at the North Fork Toutle River at Kid Valley. Observations of dune migration in fine gravel were summarized in a technical paper. Measurements of dune celerity throughout a storm-runoff event were made with the use of dual depth sounders.

2. Channel geometry data are being collected at 30 sites to support research on erosional processes and evolution of the drainage system.

Sediment-transport and hydraulic data are being collected at stations in the Toutle River basin to describe vertical and horizontal profiles of suspended sediment and velocity. Bedload samples are being collected with enlarged Helley-Smith samplers at several sites. These samples are being compared with samples from several other bedload samplers, including two Helley-Smith configurations, two Chinese bedload samplers, and the VUV sampler. Results of these comparisons should result in suggested bedload samplers for a variety of stream environments. A compilation report containing hydraulic, sediment-transport, and bed-material data for 1980-84 for the Toutle River system was published. Several bedload equations are being tested for use on steep streams. Two reports on these comparisons are in preparation. Methods are continuing to be developed for understanding variations in sediment discharge in time and space. To improve the control of measuring and sampling equipment, stayline are used at the cableways at North Fork Toutle River above Bear Creek, North Fork Toutle River at Kid Valley, Toutle River at Tower Road gaging stations, and Muddy River below Clear Creek near Cougar, WA.

Hydrologic hazard research in volcanic terrain centered around understanding the mechanics, frequency, and magnitude of debris flows originating on the volcanos. Debris flows transport vast amounts of sediment and are only now starting to be recognized and understood. The project office hosted an interdivisional workshop on debris-flow modeling at St. Anthony Falls

Hydraulics Lab, Minneapolis, MN. The study on Mount Rainier was in full operation during 1987 and will culminate in a major professional paper and several journal articles that are in the review stage.

The sedimentation activities covered in the hydrologic hazards of the Mount Hood project fall into two main categories:

(1) Mapping of deposits emplaced through both volcanic (lahars, pyroclastic flows) and nonvolcanic (jokulhlaups, avalanches) means. Deposits are being mapped to provide volume and inundation information and are being stratigraphically located to provide frequency of event information.

(2) Investigation of areas of hydrothermal alteration high on the edifice. Areas of intense alteration are considered to be weak areas of the mountain and subject to collapse and subsequent initiation of clay-rich mass movements. Areas of alteration are being located, mapped, and sampled.

Debris flow monitoring and landslide initiation research are planned for field studies in China under cooperative arrangements between research colleagues at the WRD project office at the Cascades Volcano Observatory in Vancouver, WA, and colleagues in China. Laboratory research on debris-flow rheology was started at the project office by testing rotational shear vane viscometers. Several reports on mass-movement and debris flow rheology are in various stages of completion.

A study to define the sediment sources and processes causing turbidity in the Bull Run watershed was planned in 1987 and started in April 1988. Recent forest management activities have caused concern of possible water supply degradation. Turbidity is a parameter of key importance. Following thorough analysis of existing data, an enhanced monitoring effort using battery-operated continuous turbidimeters will begin. Magnetic minerals from soil profiles, stream channels, and reservoir deposits will be analyzed to determine possible turbidity sources.

3. The Cascades Volcano Observatory, Vancouver, WA, conducts a training activity on sediment-sampling field techniques each year in October. The training is conducted on behalf of the Water Resources Division, but a few slots are reserved for cooperator and other Federal agency personnel to attend. The total attendance at each training session is limited to 24 students.

For additional information about Geological Survey activities within this region, contact the following offices:

District Chief, WRD
U.S. Geological Survey
230 Collins Road
Boise, ID 83702

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 428
301 So. Park Avenue, Drawer 10076
Helena, MT 59626-0076

District Chief, WRD
U.S. Geological Survey
10615 S.E. Cherry Blossom Drive
Portland, Oregon 97216

District Chief, WRD
U.S. Geological Survey
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

District Chief, WRD
U.S. Geological Survey
2617 E. Lincolnway, Suite B
Cheyenne, WY 82001

District Chief, WRD
U.S. Geological Survey
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

PACIFIC NORTHWEST (17) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

a. Public Law-566

Major Drainage	Watershed	Stream	County	State
Columbia River	N. Whitstran	N. Whitstran	Benton	WA

b. Public Law-639

Major Drainage	Watershed	Stream	County	State
Puget Sound	Drayton Harbor		Whatcom	WA

c. Resource Conservation & Development

Major Drainage	Watershed	Stream	County	State
Pacific Ocean	Hoquiam		Grays Harbor	WA

d. Conservation Operations

Major Drainage	Watershed	Stream	County	State
Columbia River	Eloika Lake		Pend Orielle	WA

e. Special Studies

A sedimentation study was performed as part of a river basin investigation of Three-Mile Creek drainage area. Trial structures were installed.

As part of the Nestucca River Basin Study, an estimate of sediment yield was made for the river basin.

f. Idaho State Agricultural Water Quality Program (SAWQP)

Major Drainage	Watershed	Stream	County	State
Snake River	Payette River	Lower Payette River	Payette	ID
Snake River	N. Fk. Payette River	Cascade Reservoir	Valley	ID

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Howard Sediment Basin	Columbia	WA
Hovrud Sediment Basin	Columbia	WA

These two sediment basins are located on two major side drainageways of the Tucannon River. They were constructed as water quality demonstration projects in cooperation with Washington State Department of Ecology, local agencies, and landowners.

BUREAU OF RECLAMATION

CALIFORNIA

Clear Lake Bathymetric Survey Map - A partial bathymetric survey of Clear Lake on the Lost River in the Klamath River Basin was completed in August, 1991 in the vicinity of the fish passage channel connecting the two arms of the reservoir. A topographic map and cross sections were produced from the partial survey showing the location and current condition of the channel.

Folsom Reservoir Resurvey - A bathymetric resurvey of Folsum Reservoir on the American River in California was completed in April, 1991 between elevations 202 and 419. Area and capacity tables will be developed from the aerial photogrammetric data acquired in October, 1990 and the 1991 bathymetric data.

CALIFORNIA REGION

CORPS OF ENGINEERS

South Pacific Division

Los Angeles District

Sediment Sampling Stations. The following sediment sampling stations are operated by the USGS and supported by the District: Santa Ana River at E St., San Bernardino County, CA (Gage No. 11059300), (Santa Ana River Project); Santa Ana River at Santa Ana, Orange County, CA (Gage No. 11078000), (Sarta Ana River Project); Little Colorado River near Joseph City, AZ (Gage No. 09397000), (Little Colorado River at Holbrook, AZ. Project). Sampling methods are described in the USGS Water Resources Data publications. The sedimert records will be furnished to the District if required and/or published at a later time by the USGS in the Water Resources Data reports.

Office Activities.

1. A planning-level sedimentation study of Flamingo and Tropicana Washes in Las Vegas, Nevada, was completed as part of the Las Vegas Wash and Tributaries Feasibility Study. The work included a quantitative analysis of sediment production from alluvial fans and a qualitative analysis to determine the stability of earth-lined collector channels located on alluvial fans. Additionally, a quantitative analysis was performed for four debris basins and four detention basins to determine trap efficiencies and operations and maintenance clean-out volumes and frequencies. Additional work was completed to qualitatively define the clear-water scour potential expected to occur downstream of a proposed detention basin.

2. A detailed sedimentation study was continued for Mission Creek in Santa Barbara, California, as part of the Lower Mission Creek General Design Memorandum. The work completed to date includes sampling and gradation analysis of bed-material as well as a detailed sediment routing analysis upstream of the project reach. The purpose of the sediment routing analysis was to determine the 100-year inflowing gravel load to the project. A flume study was continued at Waterways Experiment Station to study the affect of bed-material movement on hydraulic roughness in supercritical flow. Initial results indicate that hydraulic roughness, in the form of Manning's n-value, increases with increasing concentration of bed-load material. At high concentrations of bed-load material, bed forms may develop, and the flow regimes may change from supercritical to subcritical or critical.

3. A detailed sedimentation study was completed for the Seven Oaks Dam project as part of the Seven Oaks Dam Embankment and Spillway Feature Design Memorandum. The purpose of the study was to (1) aid in designing features that will minimize the transport of coarse sediment into the diversion tunnel during construction of the project, thereby minimizing abrasion damage to the tunnel lining, and (2) establish a rational basis for a debris pool to be maintained throughout the project life. The study included an ideal settling analysis and an estimate of transport capacity by grain size classification for both inflow and outflow from the reservoir.

4. A detailed sedimentation study was initiated for the Santa Paula Creek General Reevaluation Report. The purpose of the study is to estimate the effects of sediment deposition on the capacity of the existing channel of Santa Paula Creek. The study has utilized a special version of the HEC-6 sediment transport computer program to perform sediment routing computations with bed material sizes ranging up to large boulders. Various combinations of antecedent and succedent flows will be analyzed to assess the impact of insufficient time to dredge the channel between storms. This study is scheduled for completion in 1992.

5. A cursory sedimentation analysis was completed for the Calleguas Creek Reconnaissance Report. This analysis featured extraction of data on sediment deposition in Mugu Lagoon from detailed sedimentation studies previously prepared. This data was used to predict the impact of proposed alternatives for flood control on future sediment deposition in the lagoon. The study also included reconnaissance-level design of retention basins to minimize future deposition in the Lagoon.

Sacramento District

Sediment Studies.

1. Arroyo Pasajero, California - Reconnaissance. The proposed project is located along the western margin of the Central San Joaquin Valley. Arroyo Pasajero originates in the coastal mountain ranges and ponds both water and sediment discharges against the California Aqueduct. A sediment engineering investigation (SEI) was initiated in FY 1990 to evaluate potential measures to upgrade existing measures protecting the aqueduct from these water and sediment discharges.

2. Coyote and Berryessa Creeks, California - General Design Memorandum. The proposed flood control project is located in the cities of San Jose and Milpitas, California immediately south of the San Francisco Bay in the Santa Clara Valley. The recommended project includes overflow channels and offset levees on Coyote Creek and concrete-lined channels and offset levee and berm system on Berryessa Creek. SEI of both creeks were initiated in FY 1990. The SEI of Coyote Creek was completed in FY 1991. The SEI of Berryessa Creek should be completed in FY 1992. The SEI's are being conducted to evaluate potential impacts of sediment on project performance and potential project impacts on the sediment transport characteristics of each stream course.

3. Guadalupe River, California - General Design Memorandum. The project consists of channel improvements to the Guadalupe River as it flows through the City of San Jose. The upstream reach of the project will have a concrete-lined bypass channel. A sediment study of project effects reflecting recent design modifications will be completed in FY 1992.

4. Sacramento River Bank Protection Project: Third Phase - Feasibility. The Sacramento River Bank Protection Project extends along the Sacramento River from Collinsville (River Mile 0) to Chico Landing (River Mile 194), the Sacramento River Delta Sloughs and portions of the Feather, Bear, Yuba and American Rivers. The principal purpose of the project is to protect features of the Sacramento River Flood Control Project. The bank protection project

was initially authorized for construction in the early 1960's. The first phase of implementation was completed in the 1970's; the second phase is ongoing. Third Phase studies are underway to determine the need for future bank protection work. Geomorphic studies of the project area are being conducted to develop:

a. A procedure for site prioritization.

b. A design matrix of alternative forms of bank protection which may be applicable to a site.

c. A decision matrix which may be used to evaluate technically feasible bank protection methods identified by the design matrix.

The geomorphic studies are scheduled to be completed in FY 1991.

5. Truckee River, Nevada - General Design Memorandum. The proposed project is located in the Reno-Sparks metropolitan area and extends along an approximate six mile reach of the Truckee River as well as up several tributaries. The flood control project will include levees, flood walls and some channel excavation. An SEI was initiated in FY 1989 to address potential impacts of sediment on project performance. Elements of SEI include a geomorphic analysis of the study area which was completed in FY 1990 and numerical simulation of sediment transport through the study reach using computer program HEC-6 which will be completed in FY 1992. Bed material sediments range up to small boulder in size.

6. Upper Jordan River, Utah - General Design Memorandum. The proposed project is located in the Salt Lake City, Utah metropolitan area and extends along portions of Mill Creek and I-9 Ditch. The flood control project will include a diversion structure, diversion conduit and detention basin. An SEI was completed in FY 1991, to address potential impacts of sediment on project performance. Elements of the SEI include a geomorphic analysis of the study area and numerical simulation of sediment transport through the study reach.

7. Yuba River, California - Feasibility Study. The proposed project is located along the Yuba River, part of the Sacramento River Flood Control Project. The study area was heavily impacted by hydraulic mining in the late 1800's. An SEI was initiated in FY 1991 to evaluate the potential geomorphic and sediment engineering impacts of increasing the level of protection afforded by existing levees in the study area.

Sedimentation Surveys. Routine samples of lake outflows at Black Butte Lake, Pine Flat Lake, Lake Kaweah, Success Lake and Isabella Lake were collected and analyzed for suspended sediment monthly during the year. Discharge records are maintained and published by U.S. Geological Survey.

San Francisco District

Sediment Studies. Maintenance dredging of Federal harbors and channels. Bathymetric surveys of the Alcatraz Disposal Site continued on a monthly basis during the year. Results from these surveys are used in determining disposal management restrictions. The survey data are being used in an attempt to correlate retention at the site with the amount of material disposed and with flows in San Francisco Bay.

As a part of the Long Term Management Strategy (LTMS) study for San Francisco Bay, District personnel were involved in identifying and summarizing numerical sediment modeling technology available for application in San Francisco Bay.

An additional 1991 LTMS activity consisted of preparing a draft sediment budget report for the Bay which includes an estimate of the average annual sediment inflow to the Bay (both historic and future), the compilation of dredging records, the preparation of a bathymetry atlas showing the changes in the bottom of the Bay between 1955 and 1990, and an estimate of the amount of sediment that exits to the ocean.

Quarterly hydrographic surveys were conducted at a possible ocean disposal site for the Humboldt Harbor and Bay maintenance dredging for purposes of determining sediment stability.

A baseline monitoring program and study for detecting unacceptable shoreline changes as a result of possible starvation of the Humboldt Bay north and south spits were completed. The monitoring program consisted of aerial photographic studies and shoreline profiling. Existing data were analyzed to determine historic trends of shoreline changes.

CALIFORNIA REGION

GEOLOGICAL SURVEY

North Coastal Subregion

1. Suspended-sediment and bedload data are being collected in Redwood National Park to evaluate the sediment transport rates caused by both natural processes and logging activities within the park. Data collection began in 1973 in cooperation with the National Park Service. The Park Service is using this data to develop management practices that will reduce erosion rates. The current sampling network includes the following stations:

   Redwood Creek near Blue Lake (daily)
   Lacks Creek near Orick (monthly)
   Panther Creek near Orick (monthly)
   Redwood Creek at Orick (daily)

2. Suspended-sediment data are being collected on a daily basis and bedload data on a periodic basis at Grass Valley Creek at Fawn Lodge near Lewiston and at Trinity River below Limekiln Gulch near Douglas City, in cooperation with the U.S. Bureau of Reclamation (USBR).

3. Suspended-sediment data are being collected on a quarterly basis at Elder Creek near Branscomb, as part of the National Hydrologic Benchmark Network, and at Smith River near Crescent City, as part of National Stream Quality Accounting Network (NASQAN).

4. Suspended-sediment data are being collected on a bimonthly basis at Klamath River near Klamath, Russian River near Guerneville, and at Eel River at Scotia, as part of NASQAN.

5. Suspended-sediment and bedload data are being collected on a periodic basis at Little Grass Valley Creek near Lewiston in cooperation with the USBR.

6. Suspended-sediment and bedload data are being collected on a periodic basis, in cooperation with Mendocino County Water Agency, at Russian River near Hopland and Ukiah.

Sacramento Basin Subregion

1. Suspended-sediment data are being collected on a daily basis at Feather River near Gridley and at Sacramento River at Freeport, in cooperation with the California Department of Water Resources.

2. Suspended-sediment data are being collected on a bimonthly basis at Sacramento River at Keswick, as part of NASQAN.

North Lahontan Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Susan River at Susanville, as part of NASQAN.

San Francisco Bay Subregion

1. Suspended-sediment and bedload data are being collected in the Cull Creek and San Lorenzo Creek Basins to document sediment transported into Cull Creek and Don Castro Reservoirs, respectively, and to test erosion control procedures. Data collection began in the 1979 water year, in cooperation with Alameda Country Flood Control and Water Conservation District, and includes the following stations:

   San Lorenzo Creek at San Lorenzo (daily)
   San Lorenzo Creek above Don Castro Reservoir near Castro Valley (daily)
   Cull Creek above Cull Creek Reservoir near Castro Valley (daily)
   Cull Creek Tributary No. 4 above CC Reservoir (storm event)

2. Suspended-sediment data are being collected on a bimonthly basis at Napa River near Napa, as part of NASQAN.

San Joaquin Basin Subregion

1. Suspended-sediment data are being collected on a daily basis at San Joaquin River at Vernalis, in cooperation with the California Department of Water Resources.

2. Suspended-sediment data are being collected on a quarterly basis at Mokelumne River at Woodbridge, as part of NASQAN, and at Merced River at Happy Isles Bridge near Yosemite, as part of the National Hydrologic Benchmark Network.

Central Coastal Subregion

1. Suspended-sediment and bedload data are being collected on a periodic basis at San Antonio River near Lockwood, and at Nacimiento River near Bryson, in cooperation with Monterey County Flood Control and Water Conservation District.

2. Suspended-sediment data are being collected on a bimonthly basis at Salinas River near Chular and on a quarterly basis at Pajaro River at Chittenden, as part of NASQAN.

3. Suspended-sediment and bedload data are being collected on a periodic basis, in cooperation with the California Department of Boating and Waterways, at the following stations:

   Soquel Creek at Soquel
   San Lorenzo River at Big Trees
   Pescadero Creek near Pescadero
   San Gregorio Creek at San Gregorio

Tulare Basin and South Lahontan Subregions

1. Suspended-sediment data are being collected on a bimonthly basis at Kings River below NF near Trimmer and Kern River at Kernville, as part of NASQAN.

South Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Santa Ana River near San Bernardino and Santa Ana River at Santa Ana in cooperation with the COE.

2. Suspended-sediment and bedload data are being collected on a periodic basis, in cooperation with the California Department of Boating and Waterways at the following stations:

San Juan Creek at San Juan Capistrano
Arroyo Trabuco at San Juan Capistrano
San Luis Rey River at Oceanside

3. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Santa Ana River below Prado Dam as part of NASQAN

4. Suspended-sediment data are being collected on a periodic basis at Ventura River near Ventura and Santa Clara River at Montalvo in cooperation with California Department of Boating and Waterways and Ventura County Public Works Agency.

5. Suspended-sediment data are being collected on a quarterly basis at Los Angeles River at Long Beach and San Luis Rey River at Oceanside as part of NASQAN.

Colorado Desert Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Alamo River near Calipatria as part of NASQAN.

For additional information about U.S. Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
Room W-2233, Federal Building
2800 Cottage Way
Sacramento, CA 95825

CALIFORNIA (18) REGION

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, or sediment damages were made for the following activities.

   a. Public Law-534

Major Drainage	Watershed	County	State
Eel River	Salt River	Humbolt	CA
	This study was a joint effort between SCS, the California State Coastal Conservancy, and private consultants to evaluate sedimentation to a marine estuary.		
San Joaquin River	Orestimba Creek Del Puerto Creek Ingram Creek Hospital Creek Various agricultural drains	Stanislaus	CA
	This Local Implementation Plan project, called the Western Stanislaus Study, incorporates an erosion/sedimentation study on all irrigated land west of the San Joacquin River in Stanislaus County. Furrow erosion from irrigated land is a source of DDT and its derivatives to the San Joacquin River. A furrow erosion model based on Haywood's sediment transport equation was used.		
Stemple Creek	Stemple Creek	Marin	CA
	This study was a joint effort of USDA-SCS, the Resource Conservation District, and the California State Coastal Conservancy to evaluate land treatment measures to halt sedimentation to the Estero de San Antonio.		
San Joacquin River	Root Creek	Madera	CA
	This feasibility study involves flood prevention of a housing development combined with using flood waters for ground water recharge. Sedimentation and erosion were calculated for the proposed structures.		

2. Reservoir Sedimentation Surveys

Reservoir sedimentation surveys were made in the following reservoirs:

Reservoir	County	State
Garzoll	Main	CA
Martin	Sonoma	CA
Azevedo	Sonoma	CA
Nunes	Sonoma	CA

ALASKA REGION

GEOLOGICAL SURVEY

Yukon Subregion

1. Suspended-sediment data are being collected on a periodic basis at the Yukon River at Pilot Station, AK, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected on a periodic basis at the Tanana River at Nenana, AK, as part of NASQAN.

3. Suspended-sediment data and bedload data are being collected on a periodic basis at Lignite Creek above mouth near Healy, AK, as part of a cooperative study with the Alaska Division of Geological and Geophysical Surveys.

Southwest Subregion

1. Suspended-sediment data are being collected on a periodic basis at the Kuskokwim River at Crooked Creek, AK, as part of NASQAN.

South-Central Region

1. A cooperative program with the Municipality of Anchorage, Department of Health and Human Services, initiated in 1988 to collect suspended-sediment data at Little Campbell Creek at Nathan Drive near Anchorage, AK, and Chester Creek at Arctic Boulevard, AK, as part of a long-term sediment monitoring study, was continued in 1991.

2. Suspended-sediment data are being collected on a periodic basis at the Talkeetna River near Talkeetna, AK, as part of the National Hydrologic Benchmark Network.

3. Suspended-sediment data are being collected on a periodic basis at the Copper River at Million Dollar Bridge near Cordova, AK, as a part of NASQAN.

4. A 1991-1992 cooperative study with the Alaska Department of Transportation and Public Facilities on the geomorphology of the lower Copper River includes periodic suspended sediment collection at eight bridges and periodic bedload sampling at four bridges.

Southeast Subregion

1. Suspended-sediment data are being collected on a periodic basis at the Stikine River near Wrangell, AK, as part of NASQAN.

For additional information about U.S. Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
4230 University Drive, Suite 201
Anchorage, AK 99508-4664

HAWAII REGION

GEOLOGICAL SURVEY

Hawaii Subregion

1. Suspended-sediment data are being collected bimonthly at Honolii Stream near Papaikou, Hawaii, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected bimonthly at Wailuku River at Hilo, Hawaii, as a part of National Stream Quality Accounting Network (NASQAN).

Maui Subregion

1. Suspended-sediment data are being collected bimonthly at Kahakuloa Stream near Honokohau, Maui, as a part of NASQAN.

Molokai Subregion

1. Suspended-sediment data are being collected bimonthly at Halawa Stream near Halawa, Molokai, as a part of NASQAN.

Oahu Subregion

1. Suspended-sediment data are being collected at the following sites:

Waikele Stream, Waipahu, Oahu, on a daily basis as part of the Federal CBR program.

Kalihi Stream, at Kalihi, Oahu, quarterly as a part of NASQAN.

Kamooalii Stream below Luluka Stream near Kaneohe, Oahu, on a daily basis in cooperation with the U.S. Army Corps of Engineers.

2. In cooperation with Hawaii State Department of Transportation, daily suspended-sediment data are being collected at the following stations on Oahu:

North Halawa Stream near Kaneohe
North Halawa Stream near Honolulu
Right Branch of Kamooalii Stream near Kaneohe
Luluku Stream at altitude 220 feet near Kaneohe
South Fork Kapunahala Stream at Kaneohe
Haiku Stream near Heeia

Kauai Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Waimea River at Waimea, Hawaii, as a part of NASQAN.

For additional information about Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
677 Ala Moana Boulevard
Suite 415
Honolulu, HI 96813-5412

CARIBBEAN REGION

CORPS OF ENGINEERS

South Atlantic Division

Jacksonville District

Suspended Sediment Sampling at Puerto Rico in cooperation with U.S. Geological survey.

1. Intermittent collection of sample were achieved at Rio Grande de Loiza for the purpose of reservoir sediment study.

2. Daily collection of sample were achieved at Rio Piedras (3 stations) and Quebrada Josefina for the purpose of debris basin design for concrete channel protection project. Daily sample were also obtained at Rio Fajardo for gathering background data for environmental evaluation.

3. New sampling program has been initiated at Rio Caguas for the purpose of designing debris basin.

CARIBBEAN REGION

GEOLOGICAL SURVEY

Puerto Rico Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at the following sites as a part of the National Stream Quality Accounting Network (NASQAN):

Rio de la Plata at Toa Alta, Puerto Rico
Rio Grande de Manati near Manati, Puerto Rico
Rio Grande de Anasco near San Sebastian, Puerto Rico
Rio Grande de Patillas near Patillas, Puerto Rico

2. Suspended-sediment data are being collected on a weekly basis and during high flows at Rio Tanama near Utuado, Puerto Rico, in cooperation with PREQB. The samples from low and high flow were collected by the observer. Automatic samplers were used for samples at middle and high stages at different intervals of time. The data collected was used for developing sediment transport curves and computing daily sediment records.

3. Suspended-sediment data are being collected on a daily basis and during high flows at the following stations in cooperation with the U.S. Army Corps of Engineers (COE):

Rio Piedras at Rio Piedras, Puerto Rico
Rio Piedras at El Senorial, Puerto Rico
Rio Rosario near Hormigueros, Puerto Rico

The data was collected by observers and technicians at low and high stages. Automatic samplers were used for collected data at middle and high flow. The data collected was used for developing sediment transport curves and computing daily sediment records.

Special Studies

1. Suspended-sediment data are being collected on a weekly basis and during high flows at the following sites in cooperation with PRASA and PRDNR to determine total sediment input from Rio Grande de Loiza Basin to Lago Loiza reservoir:

Rio Grande de Loiza at Caguas, Puerto Rico
Rio Gurabo at Gurabo, Puerto Rico
Rio Canas at Canas, Puerto Rico

The data was collected by observers and technicians at low and high stages. Automatic samplers were used for collected data at middle and high flow. The data collected was used for developing sediment transport curves and computing daily sediment records.

2. Suspended-sediment data are being collected on a weekly basis, biweekly, and during high flows at the following sites in cooperation with PRASA to determine the amount of suspended-sediment entering and leaving several reservoirs which are used for water supplies:

Lago La Plata, Puerto Rico
Rio de La Plata at Comerio, Puerto Rico
Rio Guadiana at Guadiana, Puerto Rico
Rio de La Plata below Lago La Plata, Puerto Rico

Lago Cidra, Puerto Rico
Rio Bayamon below Cidra Dam, Puerto Rico

Lago Toa Vaca, Puerto Rico
Rio Toa Vaca above Lago Toa Vaca, Puerto Rico

Lago Loiza, Puerto Rico
Rio Grande de Loiza below Damsite, Puerto Rico

The data was collected by observer and technicians at low and high stages. Automatic samplers were used for collected data at middle and high flow. The data collected was used for developing sediment transport curves and computing daily sediment records.

3. Suspended-sediment data are being collected on a weekly basis and during high flows at the following sites in cooperation with PRASA to determine the load suspended-sediment at different sties with different land uses:

Quebrada Blanca at Jagual, Puerto Rico
Quebrada Salvatierra near San Lorenzo, Puerto Rico
Rio Grande de Loiza at Highway 183 near San Lorenzo, Puerto Rico
Rio Gurabo below El Mango, Puerto Rico
Rio Valenciano near Juncos, Puerto Rico
Rio Bairoa at Bairoa, Puerto Rico
Rio Caguitas near Aguas Buenas, Puerto Rico
Rio Caguitas at Villa Blanca at Caguas, Puerto Rico

The data was collected by observers and technicians at low and high stages. Automatic samplers were used for collected data at middle and high flow. The data collected was used for developing sediment transport curves and computing daily sediment records.

4. Reservoir sedimentation surveys were done at the following reservoir in cooperation with PRASA for determining the actual capacity of the reservoir:

Lago La Plata, Puerto Rico

For additional information about U.S. Geological Survey activities within this region, contact the following office:

District Chief, WRD
U.S. Geological Survey
G.P.O. Box 364424
San Juan, Puerto Rico 00936

LABORATORY AND OTHER RESEARCH ACTIVITIES

ARIZONA

AGRICULTURAL RESEARCH SERVICE

The Southwest Watershed Research Center in Tucson, Arizona, has extensive research in hydrology and erosion. Sample recent progress includes:

1. Improved techniques for estimating soil erosion by water have shown that soil surface cover is a major component in the estimate of soil loss. Erosion prediction models require the user to input slope gradient and soil profile descriptions. If equations expressing the relations between slope gradient, soil profile rock content, and surface rock fragment cover were embedded in these models, then direct user input could be reduced. Measurements of slope gradient, soil profile rock content, surface rock fragment cover, and vegetation type and cover were made on 12 soil-slope complexes on catenas in southeastern Arizona. Correlation analysis showed that both slope gradient and soil profile rock content were significantly ($p< 0.01$) correlated to surface rock fragment cover. Additional analysis indicated that the combined effects of slope gradient and soil profile rock content were better defined by a soil-slope factor (SSF). Two equations were developed to estimate surface rock fragment cover; a logarithmic relation using slope gradient as the independent variable and a hyperbolic equation using the SSF as the independent variable. These equations were used to estimate surface rock fragment cover from a soil-slope complex in southern Nevada. The SSF equation made better estimates of the measured surface rock fragment cover. Development of simple relations describing important erosion processes will improve erosion estimates while simultaneously decreasing time and costs associated with using erosion prediction models.

2. A rangeland soil temporal erodibility study was initiated to evaluate monthly changes in runoff and erosion of grass and shrub covered plots in southeastern Arizona. Rainfall simulations on large plots established on a gravelly, sandy loam soil typic of the region are being made periodically throughout the year. Plot runoff, sediment, soil bulk density, soil surface cover, vegetation canopy cover, and surface roughness data are collected before each periodic rainfall simulation. Soil moisture and temperature and natural precipitation are being measured daily.

3. Many semiarid piedmont hillslopes are vegetated by sparse shrub communities. The shrubs are commonly located atop small mounds of fine material whereas the intervening inter-plant surface areas are covered with desert pavement. The protection afforded by the shrub canopy to the surface beneath the shrubs results in differential rainsplash. More sediment can be splashed into the areas beneath shrubs than can be splashed outward. Small mound surface materials have the same particle size distribution as sediment transported by rainsplash. However, mounds under the shrubs are not wholly accumulation features. Overland flow in inter-plant areas is responsible for transporting soil from these areas. Fine particle removal by rainsplash is an effective water-sorting mechanism for the desert pavement formation in inter-plant areas.

4. The Water Erosion Prediction Project (WEPP) is a new water erosion prediction technology being developed by the USDA-Agricultural Research Service to replace the Universal Soil Loss Equation. Rangeland field

experiments were designed to parameterize the WEPP rangeland erosion model. Included in these experiments were plot treatments designed to separate direct from indirect effects of vegetation canopy on runoff and soil erosion. Nine rangeland sites from different soil and vegetation types were evaluated using rainfall simulation. Natural versus clipped treatment surface characteristics and runoff and erosion responses were compared using regression analyses. Analyses showed that there were no significant differences between natural and clipped plot surface characteristics, runoff ratios, final infiltration rates, or initial rainfall abstractions. Erosion rates were different between treatments with the clipped plots having slightly less erosion than natural plots. Results also indicated that canopy cover was not directly contributing to initial abstractions through rainfall interception loss or significantly affecting runoff or erosion.

5. Initial development of the WEPP watershed model is complete. The model is composed of the WEPP hillslope model and the CREAMS channel component. Enhancements to the channel component include more flexibility in defining the linkage between overland flow elements and channels, and continuous updating of channel parameters.

6. Uncertainty in hydrologic and soil erosion predictions of the WEPP Watershed model due to errors in model parameter estimation was identified through a Monte-Carlo sensitivity analysis. Parameter sensitivity identification provides guidance in the collection of parameter data in places where the model is intended to simulate soil erosion. Changes in model predictions caused by changes in model parameters were quantified for model applications in semiarid rangeland watersheds. The magnitude of the changes in model parameters was defined by the spatial variability of parameters in a watershed. Model sensitivities in predicting overland flow and soil erosion on hillslopes and channels were presented considering rainfall characteristics. The results show that WEPP is very sensitive to storm characteristics and infiltration parameters. Under rangeland conditions dominated by consolidated soils, WEPP is sensitive to the critical shear stress parameter. For rainfall events which result in high runoff rates, soil detachment is more sensitive to the rill erodibility parameter than interrill erodibility parameter.

7. A program which computes infiltration and the overland flow hydrograph on a single, homogeneous plane is the basis of the hillslope hydrology component of WEPP. Infiltration is computed by the Green and Ampt equation and the hydrograph is computed by a semi-analytical method of characteristics solution of the kinematic wave overland flow model. Default parameter estimation values are program supplied for both the infiltration and hydrograph models. Model use as a parameter selection tool is illustrated with rangeland rainfall simulator data.

8. Validation of the WEPP watershed hydrology component was done for rangeland conditions. Validation was designed to isolate the effects of the following subcomponents which make up the hydrology component; rainfall generation and disaggregation, infiltration, peak discharge, and parameter estimation and update. Results show the greatest error comes from the rainfall disaggregation component. If proper parameters are chosen, both infiltration and peak discharge computations produce very good results. Additional work needs to be done on deriving better estimates

of the infiltration parameters, particularly the effective saturated conductivity.

9. A subfactor based regression technique for estimating hydraulic roughness coefficients for shallow overland flow has been developed from simulated rainfall/runoff plots originally collected from erosion studies. The data were collected from 14 different native rangeland areas in the Western United States. A reference table of "effective roughness" coefficients for shallow overland flow is presented with a description of site characteristics. The derived roughness regression equations predict an "effective Darcy-Wiesbach roughness coefficient" for native rangeland that incorporates the effect of rain drop impact, soil texture, random roughness, rocks, litter, and canopy and basal plant cover.

10. Basic model processes represented in the Water Erosion Prediction Project (WEPP) model include both growth initiated and dormancy induced by temperature and plant growth as a function of water stress. Initial validation results indicate that basic governing equations and approaches used in WEPP are effective for modeling plant growth on rangelands. To improve model performance in arid and semiarid regions, new algorithms that incorporate wind and insect herbivore will need to be incorporated for transferring standing dead biomass to litter.

11. The Interagency Rangeland Water Erosion Team (IRWET), comprised of ARS and SCS personnel, was established in April of 1991. The teams responsibility involves enhancement and validation of the rangeland component of the WEPP model by: improving the plant and soil relationships to address vegetation induced spatial variability: support technology transfer between SCS and ARS by developing WEPP parameter data sets for all rangeland sites sampled by the National Range Study Team (SCS personnel); and developing appropriate technical material for SCS and publishing results in appropriate scientific journals.

12. Fire on rangelands used as a management tool or as an unwanted wildfire removes vegetation cover. Surface runoff and sediment production were evaluated immediately after fall and spring season burns at two locations with different soil and vegetation types for two years in southeastern Arizona. The evaluations were conducted with a rainfall simulator at two precipitation intensities. Immediately after a burn there was not a significant change in runoff and erosion; therefore, vegetation cover by itself was concluded not to be a dominate factor controlling surface runoff and erosion. The increase found in surface runoff and sediment production from the burn plots was not significantly greater than the natural variability for the locations or seasons. Significantly higher surface runoff and sediment production was measured in the fall season compared to the spring at one location.

13. Erosion is one of the factors taken into consideration in the decision making process for the selection of land management practices with respect to improving water quality. A new multiobjective decision making method is currently being implemented in the context of a Decision Support System (DSS). The method considers the effects of each alternative practice on surface and ground water quality and the economics of the farm. These effects are predicted by a simulation model with hydrology, erosion/sediment yield, pesticide and nutrient components (modified

GLEAMS) as well as crop growth (EPIC integrated with GLEAMS) and economics (modified CARE). The method combines the use of graphically based scoring functions for the decision criteria and an objective method for ranking the practices.

For additional information contract Leonard J. Lane, Research Leader, Southwest Watershed Research Center, USDA-ARS, 2000 E. Allen Road, Tucson, AZ 85719

GEORGIA

AGRICULTURAL RESEARCH SERVICE

The Southeast Watershed Research Laboratory in Tifton, Georgia has research related to:

1. Tillage systems affect soil properties and soil erodibility. A 4-year study was conducted to determine the effects of different tillage systems on physical properties of the surface zone of a clayey Coastal Plain soil. No-till (NT), moderate-till (MT, Fall chisel plow and spring disk harrow), and conventional-till (CT, fall moldboard plow, spring disk harrow) were used in a winter wheat (Triticum aestivium L.) summer grain sorghum (Sorghum bicolor L. Moench) rotation on a Greenville sandy clay loam. Bulk density, saturated hydraulic conductivity, and soil moisture retention were determined on soil samples collected between crop rows from plots used concurrently for a rainfall simulator study of surface runoff and N movement under the three different tillage systems. Examination of changes in the physical properties of the 0-7.6 cm soil surface zone showed that after 1-1/2 years of tillage treatment and thereafter the NT soil was different from the other two treatments. The NT soil surface zone had significantly greater bulk density, lower saturated hydraulic conductivity, and held more water than the soil surface zones of the other two treatments. Rainfall simulator work on these same treatments showed less surface runoff and N loads from the NT treatment than from the CT treatment. Greater infiltration on the NT apparently occurred primarily in the crack or slit where the crops were planted. With greater water-holding capacity, less surface runoff and more water infiltrating during rainfall events, and reduced evapotranspiration from under the mulch layer, the NT treatment on this soil was beneficial to both soil erosion protection and crop production.

2. Sediment transport from upland agricultural practices into a managed riparian forest buffer system and a restored riparian forest wetland is being measured at two sites on the Coastal Plain Experiment Station near Tifton, GA. At one site, surface runoff is collected in a 3 m wide trough, measured and sampled at a flume, and then re-distributed through another trough. At the other site, samples are collected through 30 cm wide "dustpan" collectors fitted with flow splitters. Preliminary data from three runoff events at the mature riparian forest site shows that sediment concentrations are reduced from about 3500 mg L^{-1} leaving the field to about 330 mg L^{-1} after passing through a 50 m riparian forest buffer system.

For additional information contact Adrian W. Thomas, Laboratory Director, Southeast Watershed Research Laboratory, USDA-ARS, P. O. Box 946, Tifton, Georgia 31793.

GEORGIA

AGRICULTURAL RESEARCH SERVICE

The Southern Piedmont Conservation Research Center in Watkinsville, Georgia has considerable research related to:

1. Long-term cropping systems are necessary to sustain a conservation tillage thrust on Typic Hapludult soils. Eleven major storms occurring over a 19 year period were chosen to demonstrate the hydrologic-agronomic value of multiple crop residues on Southern Piedmont watersheds. These 11 storms account for over 40% of the runoff and soil loss and only 5.4% of the rainfall. Multiple crop conservation tillage was introduced in November 1974 following 3 consecutive years of conventional tillage. During the conventional till period, single storm soil losses exceeded 17 Mg/ha. Following conservation tillage introduction, single storm soil losses ranged from <0.01 to 0.08 Mg/ha. Three to 5-years of conservation tillage was required to decrease runoff associated with major storms and restore crop production. Cumulative crop residues exceeding 140 Mg/ha/17 yrs provide major storm erosivity retarding effects.

2. Rainfall simulation studies were made on three erosion classes of Typic Kanhapludults managed under conventional and conservation tillage systems. Interrill soil loss from conservation tilled grain sorghum was only 12% of that from conventional tillage. Soil loss associated with conventional till grain sorghum was only 37% of that from conventional tilled soybeans. Optimized organic C and water stable aggregates induced in the soil surface with 5-years of continuous conservation tillage total soil losses by 70%.

For additional information contact George W. Langdale, Soil Scientist, Southern Piedmont Conservation Research Center, P.O. Box 555, Watkinsville, GA 30677

IDAHO

AGRICULTURAL RESEARCH SERVICE

The Northwest Watershed Research Center in Boise, Idaho has considerable research related to:

1. Fundamental processes related to erosion from rangelands in the western United States. Activities are related to accounting and predicting the spatial and temporal response induced by climate, vegetation and soils. This is a cooperative effort with the Soil Conservation Service and the Water Erosion Prediction Project (WEPP) to enhance and validate components of the WEPP model for use on rangelands. This work is proceeding under the cooperative effort "Interagency Rangeland Water Erosion Team (IRWET).

2. Micro-environment and process erosion research is also being conducted to enhance our predictive capabilities of mechanical renovation techniques on soil erosion and the micro-environment. This is a cooperative effort with the Bureau of Land Management, Forest Service, and University of Idaho.

3. Suspended sediment from eleven nested watersheds (ranging in size from a few acres to 90 square miles) within the Reynolds Creek Experimental Watershed, is collected along with stream flow, precipitation and meteorological variables. This information is currently being used to validate, enhance and develop the WEPP and SHE models.

For additional information contact Wilbert H. Blackburn, Research Leader, Northwest Watershed Research Center, 800 Park Blvd., Plaza IV, Suite 105, Boise, ID 83712

INDIANA

AGRICULTURAL RESEARCH SERVICE

The National Soil Erosion Research Laboratory in West Lafayette, Indiana has considerable research related to:

Soil Erosion Prediction and Control

1. The revision of the Universal Soil Loss Equation (RUSLE) is being programmed into the field office system of the Soil Conservation Service (SCS). Considerable testing and evaluation of RUSLE has occurred in the last year. Additionally, a workshop concerning technology transfer of RUSLE was held with the Soil and Water Conservation Society (SWCS) in 1991. Apparently, the SWCS will develop a program of technology transfer related to RUSLE.

2. Two releases of the model to replace the USLE (WEPP) have been made in the last year. These models have included new science and new interfaces. Additionally, a number of evaluations and improvements have been made. A set of file builders has been developed for use by those that need more flexibility than allowed by interfaces under development by action agencies. A program was developed to display model output graphically. This allows easy evaluation of all parameters and all outputs produced by the model. A new set of erodibility equations have been developed to predict basic erodibility on rangelands and croplands. These equations give a much better estimate of critical hydraulic shear on rangelands, an area of considerable concern using the past technology. The WEPP model is being completely recoded. Even though reprogramming is not complete, the work to date has resulted in considerable improvement in the model. Code structure and embedded documentation are considerably improved, and run time has been greatly reduced.

3. Work is proceeding in the development of an expert system for parameterizing crop growth models that are indigenous to RUSLE and WEPP. A considerable data base has been developed, with further data base development underway.

4. The potential for controlling rill erosion using a surface applied polymer was studied in the laboratory, and then evaluated in the field under furrow irrigated conditions. The polymer greatly reduced erosion in irrigated furrows in the field test in Kimberly, Idaho. The polymer was applied in low concentrations in the first irrigation water applied to stabilize the soil surface. Work is underway to develop a starch based copolymer that will be more economical and biodegrade more readily.

5. Work is beginning on using geographic information systems to automate inputs and display outputs of continuous simulations models. Spatially distributed models such as the WEPP grid and watershed versions will benefit from the linkage. The time and expense required to develop input files will be greatly reduced. Topographic, soils and land use information required for the models are obtained directly from the GIS. Also, the spatial display of outputs will assist users in interpreting model output.

1. Several experimental studies were conducted in 1991 to examine different aspects of the erosion process. Laboratory experiments examined the effect that water chemistry has upon both interrill and rill detachment. Additionally, use of soil amendments such as phosphogypsum, power-plant gypsiferous byproduct material, polyacrylide (PAM), other polymers, and combinations of these materials was also studied. Use of polymers, both surface-applied and as a addition to furrow irrigation water, showed great promise as an erosion control practice.

2. Several field experimental studies were also conducted in 1991. The objective of the first field experiment was to measure detachment and deposition rates on a sandy soil using standard procedures and using a new large-scale laser scanner. This study was conducted at the Purdue Veterinary Farm south of campus on a sandy soil with a concave slope shape. Simulated rainfall was applied to both ridged and flat plot conditions, and runoff and sediment were measured from the steeper portions of the slope as well as from the end of the slope concavity. The data, which is still to be analyzed, should provide a good validation set for the deposition component of the WEPP erosion model.

3. The purpose of the second field study conducted in 1991 was to examine the role of water chemistry on runoff and soil erosion. For over 50 years scientists have used rainfall simulation as a tool to more rapidly and efficiently evaluate various soil conservation practices. However, most researchers conducting these studies have not considered the effects of applied rainfall simulator water quality on the results of their experiments, usually because water sources available for their research were limited.

4. The purpose of this field study was to examine the effect that two types of water (deionized - which is similar to natural rainfall; and tap water - which is high in electrolyte concentration) would have on hydrology and erosion from a dispersive soil. In addition to the water treatments, some additional treatments were also added in which two types of chemical soil amendments (power-plant byproduct and PAM) were applied to attempt to affect infiltration, runoff and soil loss by altering the applied rainfall chemistry at the soil surface. While the results of this study are still being analyzed, visual observations of the plots during water application indicated that the PAM treatments appeared to significantly improve infiltration as well as stabilize the soil. The findings of this study should have application to reduction of erosion due to irrigation systems as well as effects of water chemistry on previous erosion research results.

5. The third field experiment was designed to check the validity of some of the basic erosion mechanics theory currently used in the Water Erosion Prediction Project (WEPP) computer model. Constant inflow water rates were added to different length rill channels on a sealed silt loam soil. This allowed study of how quickly the sediment load in the flow approaches the transport capacity of the flow, at which no further net detachment should occur. Results from this study showed the relationships in WEPP to be for the most part fundamentally sound.

For additional information contact John M. Laflen, Laboratory Director,
National Soil Erosion Research Laboratory, 1196 SOIL Building,
West Lafayette, IN 47907-1196

IOWA

AGRICULTURAL RESEARCH SERVICE

The National Soil Tilth Laboratory in Ames, Iowa has research related to:

1. Fundamental processes related to the movement of sediments, solutes, and water from agricultural fields and within streams. Research is underway to quantify the processes related to the effect of changing tillage and residue management on surface runoff and sediment losses.

2. Water quality research and technology development. Research is being undertaken to define the distribution of organic and inorganic chemicals within the root and vadose zone and to relate the surface runofff with sediment-bound chemicals or chemicals in solution. Understanding of these processes will relate to the validation and testing of several chemical and hydrologic models.

For additional information contact: J.L. Hatfield, Laboratory Director, National Soil Tilth Laboratory, 2150 Pammel Drive, Ames, IA 50011-4420.

AGRICULTURAL RESEARCH SERVICE

Research activities at the Hydrology Laboratory, Natural Resource Institute in Beltsville, Maryland include the following:

1. Landscape surface features related to erosion and hydrology were measured using an airborne laser profiler. The airborne laser profiler made 4000 measurements per second with a recording accuracy of 5 cm on a single measurement. Digital data from the laser are recorded and analyzed with a personal computer. These airborne laser profiles provide information on surface features of the landscape. Topography and canopy heights, cover, and distribution of natural vegetation were determined in studies in South Texas. Laser measurements of shrub cover along flightlines were highly correlated (r = 0.99) with ground measurements made with line-intercept methods. Stream channel cross sections on Goodwin Creek in Mississippi were measured quickly and accurately with airborne laser data. Airborne laser profile data were used to measure small gullies in a level fallow field and in a field with mature soybeans. While conventional ground-based techniques can be used to make these measurements, airborne laser profiler techniques allow data to be collected data quickly, at a high density, and in areas that are essentially inaccessible for ground surveys. Airborne laser profiler data can quantify landscape features related to erosion and runoff and has the potential be a useful tool for providing data for studying and managing our natural resources.

2. Landsat MSS can provide valuable data on surface suspended sediments in inland lakes and reservoirs. In a related study, chlorophyll in three sediment dominated lakes in agricultural watersheds in the Lower Mississippi Valley was measured and compared with MSS data for 107 dates between December 1976 and August 1988. Chlorophyll-a concentrations ranged from 0.3 to 211 mg/cubic meter for 452 measurements. Suspended sediment concentrations ranged from 1 to 867 mg/l for the same samples. Chlorophyll-a concentrations decreased exponentially as suspended sediment concentrations increased. Radiance and reflectance calculated from MSS band 2 and 3 data increased as a function of increasing suspended sediment concentrations. Radiance in all MSS bands decreased as chlorophyll-a concentrations increased, however no significant pattern of decrease related to chlorophyll-a concentration and MSS data could be determined. Thus measurement of chlorophyll-a with broad band (0.1 micrometer) MSS data in sediment laden waters will not be effective since the detection of the increased absorption of radiation due to increasing chlorophyll is masked by the spectral reflectance due to suspended sediments. Broad band MSS and probably TM data will provide only limited information on chlorophyll in lakes dominated by sediment. Satellite remote sensing of chlorophyll in sediment dominated systems will require high spectral resolution data especially in the chlorophyll absorption areas.

For additional information contact A. Rango, Research Leader, USDA-ARS Hydrology Laboratory, Building 007, BARC-W, Beltsville, Maryland 20705

MINNESOTA

AGRICULTURAL RESEARCH SERVICE

Additional algorithms and software for a continuous simulation version of the AGNPS model and for the grid version of WEPP are being developed and tested. These include new erosion and hydrology portions, winter routines to model the effects of frost and snowmelt, and procedures for entering soil files from the national SCS data base. Output file routines, both tabular and graphic, are almost completed and input routines are currently being debugged. A watershed in West Central Minnesota is being monitored to collect data for validating the models.

Results from two years of field experiments on the impact of different herbicide management techniques on atrazine in runoff showed that by using postemergence rather than preemergence applications, pesticide runoff was significantly reduced. In another study, frozen soil samples taken at the top, middle, and bottom of an atrazine treated section of a field depressional area were analyzed to determine atrazine movement, soil moisture, and bulk density. Information from this study will aid in developing algorithms for describing herbicide movement, via water and sediment, and deposition in undulating till landscapes.

Data on stemflow and preferential flow under corn indicated stemflow as high as 40% of rainfall can occur. Rapid response times and high flow rates were observed beneath corn rows but not in interrow areas. Some flow was observed along roots.

Effects of cyclic freezing and thawing and freeze-drying on aggregate stability of surface soil aggregates resulted in decreased aggregate stability as a function of initial water content, aggregate size, and freeze- thaw history. Freeze-drying increased soil erodibility.

Wind erosion and soil physical properties as affected by tillage and cropping were measure at a wind erosion validation site. About 15 Mg/ha of soil movement was recorded during summer, primarily from rainfall crusted soils. Measured loose wind erodible material on the surface of crusted soils ranged from 0.5 to 15 Mg/ha.

Compaction treatments applied at planting across a landscape continuum showed no effect of surface compaction on yields across the landscape. Effects of wheel traffic on cone penetration resistance (CI) were modeled and soil erosion properties were predicted from CI and soil organic matter content.

For additional information contact Robert A. Young, Agricultural Engineer, North Central Soil Conservation Research Laboratory, North Iowa Avenue, Morris, MN 56267.

MISSISSIPPI

USDA-AGRICULTURAL RESEARCH SERVICE

The National Sedimentation Laboratory in Oxford, Mississippi has considerable research relating to sedimentation activities.

1. Techniques for rehabilitation of stream habitats in unstable sand bed channels have been identified. Rehabilitation projects should be selected and designed with 3 site characteristics considered: habitat deficiencies to be addressed, evolution of the reach in question, and existing stabilization measures. Combinations of stone and woody vegetation are suggested for most situations, with increasing reliance on stone for larger channels. Stone groins that are low enough to be frequently overtopped and long enough to constrict base flows by 30-60 percent may be used to create scour holes for habitat in wide, shallow channels.

2. An ecological and water quality evaluation of the Coldwater River basin in north central Mississippi was conducted as a part of the Demonstration Erosion Control (DEC) Project in the Yazoo Basin. The purpose of the study was to determine water quality in the main channel and tributaries of the system and to evaluate ecosystem integrity for possible changes as the DEC project progresses. Additionally this study was to determine if damages were being sustained to the central wetland corridor of the Coldwater Basin and if so could these detrimental impacts be controlled with DEC type erosion/sedimentation control techniques. The interim results indicate that natural stream sections had consistently lower suspended solids concentrations and exhibited a delayed response to storm flows due to stream-flood plain interaction. Channelized areas with no riparian zones had consistently higher concentrations of nutrients than unaltered reaches. Although current use and residual organochlorine pesticides were detected in less than 10% of the quarterly pesticide samples, arsenic was detected in over 50% of these same samples. Preliminary results point to the uniqueness of the flora and fauna of the wetland corridor sections of the Coldwater Basin and indicate the important role this riparian habitat plays in the ecological health of watershed as a whole.

3. Considerable progress is being made in the description of transport processes in the near-bed region of flows. The Krey model for turbulent diffusivity is being "stretched" from the top of the "laminar sublayer" toward the bed to reduce the thickness of this layer and to increase the turbulent diffusivity at the bed after this layer disappears. Experimental data on velocity distributions have been used to relate the downward "stretch" to the relative roughness of the bed surface. The integrals of products of the predicted fow velocity and sediment concentration over the flow depth are being compared with measurements of the sand loads in laboratory flumes.

4. Transport relationships by shallow flow were developed from laboratory flume experiments for four uniform sizes and a mixture of the four sediment sizes. A dimensionless shallow-flow transport equation was formulated in terms of dimensionless shear stress and densimetric particle diameter similitude number. The behavior of shallow flow, motions of transported particles, interactions between the transporting fluid and transported

particles, and sediment transport rates were also observed and/or measured. The results provide methods for making predictions of shallow-flow sediment transport that are more accurate than those previously available.

5. Sediment deposition in valuable aquatic habitat areas adjacent to lower Mississippi River spur dikes has evidently leveled off. Examination of survey records for 26 dike systems revealed that 14 of the systems had experienced no decrease in aquatic surface area during the period between construction and the mid-1980's. Total surface area of the 26 systems declined 17 percent, most of which occurred in the first two years following construction.

6. Natural woody vegetation which invades riprap revetments on river banks does not always adversely impact revetment durability. Damage rates for bare and unvegetated quarry stone and river cobble revetments along a reach of the Sacramento River during the flood of record were compared. Vegetated revetments experienced less damage than bare revetments of the same age located on banks of similar curvature.

7. Simple experiments and observation of naturally-occurring vegetation indicated the feasibility of using dense plantings of native willow to stabilize sandbars and caving banks in unstable channels. Three planting techniques were then used to place willows adjacent to existing stone training works along a 1-km reach of channel. Willows were planted as dormant posts 1-10 inches in diameter. Average planting rate was 5 willows per man-hour, including time for post harvesting and transport to the site.

8. Processing and disposing of concentrated on-farm animal waste, an important source of water quality deterioration, is a major concern for the Soil Conservation Service and regulatory agencies. A constructed wetland for treatment of dairy farm wastewater was implemented jointly with SCS in DeSoto County, MS during 1990. In-flow and out-flow from three wetland cells were sampled in order to calculate trapping efficiency of nutrients, CBOD, physical and chemical water quality parameters and coliform bacteria counts. Nutrient trapping efficiency varied from 61 % to 69 % for total phosphorus and 84.7 % to 94 % for ammonia. Nitrate trapping efficiency varied from -46 % to 52 %, probably due to conversion of ammonia to nitrate. Carbonaceous biological oxygen demand (CBOD) decreased by as much as 84 % after processing through the wetland. Dramatic reductions in fecal coliform counts appeared to be occurring particularly near the inflow. Constructed wetlands have considerable potential as cost effective on-farm waste management systems. Further research is needed to evaluate long term effectiveness.

9. A knowledge-based system to assist planners select environmental measures for stream alteration projects has been developed. The system, which includes modules for streambank protection, channels, and levees, aids in selection of bank protection techniques and performs rough checks of channel stability.

10. Channel incision can be deleterious to aquatic habitats in small and medium-sized agricultural watersheds. Although incised channels can provide levels of physical habitat heterogeneity comparable to nonincised

channels, they tend to be extremely shallow, have little bank vegetation, and depressed levels of woody debris density.

11. Metribuzin and metolachlor concentrations in shallow ground water and surface runoff were determined and compared for two well-established 5-A soybean watersheds (one no-till and the other conventional-till) in the loessial uplands of northern Mississippi. Although initially relatively high, herbicide concentrations in runoff from both watersheds decreased rapidly to almost undetectable levels. Herbicide losses in runoff were primarily dependent on the amount of runoff in the first runoff event and were independent of established tillage practice, such as no-till, which almost entirely eliminated sediment loss compared to conventional tillage. With regard to herbicides in shallow ground water, the no-till practice provided a greater potential for herbicide leaching into the soil profile. Deeper ground water sampling is ongoing as well as the determination of the relative biodegradation rates of the herbicides found. The need for additional years of data is evident.

12. Shallow (perched) ground water (0.15 to 1.52 m) and surface runoff from a 2.13 ha no-till watershed and a 2.10 ha conventional-till watershed planted to soybeans were sampled during the 1991 water year and analyzed for plant nutrients. Most interestingly, plant nutrient concentrations in shallow ground water were similar for both tillage systems. For example annual mean PO_4-P, NH_4-N, and NO_3-N concentrations for all ground water depths and sites for the no-till watershed were 0.06, 0.10, and 4.50 $mg \cdot L^{-1}$, respectively, compared with 0.04, 0.11, and 5.83 $mg \cdot L^{-1}$, respectively, for the conventional-till watershed. Shallow ground water NO_3-N concentrations for some individual storms did exceed the U. S. Drinking Water Standard of 10 $mg \cdot L^{-1}$ NO_3-N. However, in a riparian zone, only 61 m downslope from the conventional-till watershed, annual mean NO_3-N concentrations in ground water at 0.46, 0.91, and 1.52 m depths were only 0.48, 0.32, and 0.37 $mg \cdot L^{-1}$, respectively. In surface runoff, the annual mean PO_4-P, NH_4-N, and NO_3-N concentrations from the no-till watershed were 0.55, 0.24, and 0.64 $mg \cdot L^{-1}$, respectively, compared with 0.09, 0.12, and 0.53 $mg \cdot L^{-1}$, respectively, for the conventional-till watershed. Higher nutrient concentrations in runoff from the no-till watershed probably reflect the leaching of accumulated surface residues. With the exception of PO_4-P, NH_4-N, and NO_3-N runoff losses were similar for the two watersheds. Losses of PO_4-P from the no-till watershed for the year were 3.80 $kg \cdot ha^{-1}$ compared with 0.80 $kg \cdot ha^{-1}$ from the conventional-till watershed. Runoff from both watersheds, only 2 days after a broadcast application of 0-20-20, had exceptionally high plant nutrient concentrations values which decreased rapidly during subsequent storm events. This 1991 water year study suggests that nutrients from no-till and conventional-till soybeans are not detrimental to either surface or ground water quality. Additional research is needed to define the movement of shallow ground water that for some storms may contain high NO_3-N concentrations. Finally, alternative fertilizer application methods need to be considered to reduce plant nutrient concentrations in surface runoff.

13. Potassium bromide (KBr) was used as a tracer in water applied as simulated rain to 1-m^2 field plots with subsurface drains installed 0.6-m below the soil surface. The plots represented undisturbed pasture and simulated-till conditions and two procedures of installing field drains (horizontal

drilling and trenching). The undisturbed pasture condition with the horizontal-drilling drains showed preferential flow contributed 31% and 17% of its total discharge from the 5- and 3-hour storms, respectively, while the undisturbed pasture condition with trenched drains showed preferential flow contributed only 16% and 9% of its total discharge for the two respective storms. However, the total discharge from the undisturbed pasture condition was 60% higher for the trenched drains as compared to the horizontal-drilled drains which indicates the trenched plot had not healed to its original state. The simulated-till plots for both drain installation procedures produced preferential discharge of 14% and 25% of the total discharge for the 5- and 3-hr storms, respectively. Even though preferential flow contributed relatively small amounts of total drain outflow as compared to the matrix flow, preferential flow contributed on a mass basis 55% and 18% of the bromide for the 5- and 3-hr storms, respectively, under undisturbed pasture conditions and 28% and 35% of the bromide for the two storms under simulated-till. This data support the concept that models used to predict mass balance using only the matrix (Darcian) flow will thus underestimate those chemicals that move like bromide into the soil profile.

14. An acquisition system was developed and constructed to sample and quantify surface runoff and shallow groundwater. The main components of the system for shallow groundwater included hydrologically-isolated erosion plots with subsurface drains, outlets into sumps, tipping buckets mounted under drain outlets, composite water samplers, and a series of sampling piezometers. The main components of the system for surface runoff from standard-sized erosion plots cropped to corn were appropriately-sized collectors, approaches, H-flumes equipped with portable liquid-level recorders, runoff splitters, dataloggers, and composite water samplers. The dataloggers recorded rainfall, runoff, and groundwater discharge volume during storm events and controlled the activation of the water samplers. The advantages of the system included minimum labor requirements for data reduction by taking composite water samples, continuous automation of water sampling during runoff events, and uniform time base for all plots.

15. No-till and conventional-till soybeans were grown from 1984 through 1991 on Loring silt loam soil (*Typic Fragiudalf*) with overland 46-m slopes of about 3% at Holly Springs, MS. Depth to a fragipan layer varied from 30 to 45 cm. During the last five years of the study, no-till soybean yields averaged 44% greater than conventional-till soybean yields. Rainfall simulator experiments during the seventh year of the study indicated much lower rates of erosion from plots with a no-till history as compared to plots with a conventional-till history when tillage consisting of two diskings and harrowing were conducted on all tested areas immediately preceding the experiments. Results from this study indicate that soils overlying a fragipan and with a history of continuous tillage are more susceptible to further erosion than soils protected through a no-till management system. The developing trend for lower yields with conventional-till as compared to no-till indicates a progressive loss of soil productivity due to excessive soil erosion.

16. Experiments on the incipient motion of sand and gravel mixtures with bimodal size distributions were made in a laboratory flume. It was found

that for 100% sand and 100% gravel beds all sizes on the bed were entrained at nearly the same flow strength. For the beds with bimodal mixtures of sand and gravel the entrainment of the gravel sizes was a function of size, while the sand sizes were all entrained at nearly the same flow strength. Similar results have been found for Goodwin Creek. These results are a significant departure from the equal entrainment mobility that has been found by several studies for sediment beds with unimodal size distributions.

17. An erosion model is being modified to include simulation of channel erosion. Current erosion models neglect channel erosion, which is a significant source of sediment transported in a watershed. Goodwin Creek Watershed data is being used for verification and validation of the model. After validation, conservation tillage practices will be imposed on various subwatersheds. The effects of changing conservation tillage practices on erosion in the fields and in the channels will be studied.

18. Approximately ten years of data on the transport of fine sediments in Goodwin Creek are available. This period has been characterized by a reduction of the cultivated land from 30 percent to about 10 percent. This has been accompanied by significant downward trend in the annual loads of fine sediments. No significant change in the runoff/rainfall ratio has occurred. The data are being analyzed for other significant trends and compared with erosion calculations to isolate physical relationships from spurious trends.

19. Stiff grass hedges (*Miscanthus sinesis*) were incorporated into an erosion plot study designed to compare runoff and soil loss from conventional and no-till cotton near Holly Springs, MS. No-till plots had a previous 4-year history of no-till grain sorghum; conventional-till plot history during that time consisted of conventional-till and ridge-till grain sorghum. Stiff grass hedges were transplanted on two no-till plots and two conventional-till plots one month before cotton was planted. Hedges were located 0.5 m upslope from the lower ends of the 5% sloping plots, which were 4 m wide and 22 m long. Rainfall during the 1991 growing season of May through September was 660 mm. Soil losses during this period on conventional and no-till treatments without hedges averaged 54.7 and 2.9 t/ha, respectively. Soil losses for the same treatments with grass hedges were reduced 42 and 45%, respectively. These results indicate that grass hedges have potential for reducing soil losses in cropland in the mid-south.

20. Mean size distribution of the bed load on Goodwin Creek was calculated using the size distributions of the bed load weighted by transport rate and flow frequency and was found to be slightly finer (D_{50} = 6.8 mm) than the bed subsurface (D_{50} = 8.3 mm) over a 9 year period of record. This outcome was not obvious as the size distribution of the bed load sediment ranges from nearly all sand at low flows to nearly the same size distribution as the bed material at high flows. This weighting technique greatly reduced the bias (non-weighted D_{50} = 3.16 mm) in the calculation of the mean bed load size distribution.

21. A stochastic analysis of data from Goodwin Creek on the concentration of sand in transport has been made. The data exhibit standard deviations on the order of the mean for narrow discharge windows. The probability density functions for each increment of discharge suggest essentially the same probability density function with a shape similar to a gamma distribution. This analysis is being used to estimate the number of measurements that will be needed within specified discharge windows for reliable sediment ratings. If the probability density is invariant with flow discharge, temporal variations in the sand load are primarily related to the variations in flow and rainfall.

22. Two sets of nine plots are being used to determine the effects of crop residue placement on runoff and erosion. The treatments, replicated three times on one set of plots consist of fallow, corn (full plant population) and corn (50% plant population). The following spring these residues are partially incorporated into the plow-layer by disking twice and harrowing once; no crop is grown and no further tillage is done during this year. The second set of plots are managed in the same way as the first, except that the annual sequence of growing crops and incorporating residues are reversed. Crops are not grown on both sets of plots during the same year. Two years of runoff and soil loss data have been collected from one set of plots, while data collection began on the second set of plots on October 1, 1991. Rainfall during the 1990 water year (October 1 - September 30) was 1295 mm. Soil losses from plots with fallow, lower rates of incorporated corn residues, and greater rates of incorporated corn residues were 170, 33, and 22 t/ha, respectively. Runoff was 671, 585, and 488 mm, respectively.

23. Sediment yields were measured for three adjacent Nelson Farm watersheds during CY1991. Two were cropped to no-till soybean and the third was managed as a conventional till soybean. During the year, 68.2 inches of rainfall fell on the three watersheds (32% above the long term 30 yr. average). The two no-till watersheds averaged 28.3 inches of runoff and 0.275 t/ac sediment yield while the runoff from the conventional till watershed was 34 inches and the sediment yield was 14.6 t/ac. Average soybean yield from the no-till fields was 26.9 bu/ac and that from the conventional till soybeans was 26.6 bu/ac.

24. Second year results from standard erosion plots on a 4% slope with rows up and downslope at the Nelson Farm showed a reduction in soil loss of 83% and 63% for no-tilled soybeans and ridge-till soybeans when compared with soil loss from the conventional till soybeans. There was no difference in the soybean yields. During CY91, runoff from no-till grain sorghum with volunteer winter cover was 2 times that from no-till grain sorghum with hairy vetch planted as a winter cover. The soil loss from both grain sorghum practices was less than 1 t/ac. During the second year of no-till cotton on the erosion plots, runoff was reduced by 36% and soil loss by 38%. Rainfall was 68 inches during both years. Seed cotton yields from the no-till cotton plots averaged 2370 pound seed cotton/ac.

25. A hydraulic flume was constructed and used to determine the depth of water impounded behind single and double rows (each about 15 cm wide at a height of 5 cm above the soil) of four grasses at three flow rates and three

slopes. The grasses studied were: vetiver (*Vetiveria zizanoides*), eulalia or silvergrass (*Miscanthus sinensis*), switchgrass (*Panicum virgatum*), and tall fescue (*Festuca elatior var. arundinacae*). Flow rates were 0.023, 0.046, and 0.093 cubic meters per second per meter of width; slopes were 0.03, 0.05 and 0.07. As expected, slope had only a slight influence on the depth of water at the hedge, but had a major influence on the location of a hydraulic jump in the approach flow and on the volume of water impounded. Depths of water at the upstream edge of double rows of the grasses at the highest flow rate were: vetiver - 0.40 m, miscanthus - 0.30 m, switchgrass - 0.27 m, fescue - 0.21 m. At this flow rate fescue was completely inundated, portions of miscanthus and vetiver hedges had opened up, while switchgrass was relatively little affected by the flow. When a row of fescue was placed upstream of switchgrass, the depth of ponded water was increased to 0.32 m. These data are being related to grass characteristics such as stem number, stem size, and stem stiffness in order to allow prediction of hedge stage-discharge relationships from measurable vegetation properties. Future research will look into the influence of trapped residues on hedge hydraulic and sediment trapping performance.

26. Infiltration into soils is substantially impaired by the development of surface seals due to the structural degradation of the surface soil by impacting raindrops. An analytical approach of describing infiltration into a sealing soil has been developed in which the water content distribution is approximated by that for a layered soil. The case considered is that of instantaneous ponding (concentration boundary condition) with the developing seal represented by a surface layer having a time dependent thickness. The analysis invokes the zero'th and first moment of the Richard's equation for describing the soil water content profiles in the surface layer (sealing zone) and the bulk soil. The boundary condition at the seal/bulk soil interface is assumed to be the continuity of flux. The result of this analysis shows a good resemblance with experimental determinations of infiltration into sealing soil.

27. The characteristics of rain applied by rainfall simulators can greatly affect the resulting runoff and erosion. Three rainfall simulator nozzles of different drop characteristics were studied at the same three intensities. Some differences in runoff and major differences in erosion resulted among the nozzles at each of the intensities. Simulation of natural raindrop size distributions and impact velocities were found to be especially important. Results of this research emphasize the importance of applying storms with the characteristics of natural rainfall when conducting erosion experiments. They also document the soil loss and runoff differences that occur when rainfall simulators of different characteristics are used to obtain erosion data.

28. An analytical approach of using a spectral series solution for describing infiltration was developed. Several cases were considered: (1) horizontal infiltration with concentration-type (water content) boundary condition, (2) horizontal infiltration with a flux-type boundary condition, (3) vertical infiltration with a concentration-type (water content) boundary condition, and (4) vertical infiltration with a flux-type boundary condition. The flux-type boundary condition was simulated for an instantaneously saturated, fixed crust. The solution technique includes

derivations of the appropriate relationships at singular points of the Richards' equation and the soil water diffusivity function, i. e., at the wetting front tip and the saturation point. For the non-crusted cases, for which data were available, good agreement was found between the experimental observations of the water content distribution and the spectral series solutions. For the crust cases with flux-type boundary conditions, only solutions were offered. All solutions consisted of relatively simple expressions of the water content distribution as a series in which the coefficient and exponent of each term consist of physically significant soil water characteristic parameters.

29. Field and laboratory studies were initiated to investigate the feasibility of incorporating soil genesis and morphology parameters into erosion prediction equations to improve accuracy. Several soil properties including fine and coarse clay distribution, clay mineralogy, iron oxide content, color, and organic matter contents will be compared with soil erodibility data. Regression models will be derived from these various data sets.

For more information, contact George R. Foster, Laboratory Director, USDA-ARS, National Sedimentation Laboratory, P. O. Box 1157, Oxford, MS 38655.

MISSOURI

AGRICULTURAL RESEARCH SERVICE

The Cropping Systems and Water Quality Research Unit in Columbia, Missouri is conducting research to develop alternative farming systems and technologies to control water erosion from cropland soils. Examples of research focus areas follow.

1. Research on three field-sized watersheds (50 to 100 acres) to evaluate the effect of different farming systems on runoff and sediment yields.

2. Research on natural rainfall erosion plots to evaluate the effect of different corn and soybean cropping and tillage systems on runoff and soil loss.

3. Research at the small watershed and plot scales to evaluate the effectiveness of grass hedges in controlling sheet-rill and ephemeral gully erosion.

4. Research using rainfall simulation equipment to determine the effect of key cropping and management variables on interrill and rill soil erodibility parameters.

For more information, please contact E. Eugene Alberts, Research Leader, 246 Agricultural Engineering Building, University of Missouri, Columbia, MO 65211.

NEBRASKA

AGRICULTURAL RESEARCH SERVICE

Research activities of the Soil and Water Conservation Research Unit at the University of Nebraska - Lincoln, include the following:

1. A laboratory study was conducted to measure Darcy-Weisbach roughness coefficients for selected gravel and cobble materials. Varying rates of flow were introduced into a flume in which a given size class of gravel or cobble material was securely attached. Roughness coefficients were calculated from measurements of discharge rate and flow velocity. The laboratory data were used to develop regression equations for relating roughness coefficients to surface cover and Reynolds number. The regression relations, which were developed for values of Reynolds number from approximately 500 to 16,000, were tested using hydraulic data collected on surfaces containing a distribution of size classes. Close agreement between predicted and measured Darcy-Weisbach roughness coefficients were obtained by adding the roughness contributions of individual size classes. Equations were also presented for estimating surface cover from measurements of gravel and cobble mass. Accurate prediction of roughness coefficients for gravel and cobble surfaces will improve our ability to understand and properly model upland flow hydraulics.

2. Random roughness parameters are used to characterize surface micro-relief. In a field study, random roughness was determined following six selected tillage operations. Random roughness measurements agreed closely with values reported in the literature. Darcy-Weisbach and Manning hydraulic roughness coefficients were identified on each soil surface where random roughness values were determined. Hydraulic roughness coefficients were obtained from measurements of discharge rate and flow velocity. The experimental data were used to derive regression relationships which related Darcy-Weisbach and Manning hydraulic roughness coefficients to random roughness and Reynolds number. Random roughness values available in the literature can be substituted into the regression equations to estimate hydraulic roughness coefficients for a wide range of tillage implements. The accurate prediction of hydraulic roughness coefficients will improve our ability to understand and properly model upland flow hydraulics.

For additional information contact James F. Power, Research Leader, USDA-ARS, University of Nebraska, Room 122 Keim Hall, Lincoln, NE 68583-0915.

TEXAS

AGRICULTURAL RESEARCH SERVICE

Research activities at the Grassland, Soil and Water Research Laboratory in Temple, Texas include:

We have been working with SCS in developing more satisfactory modification of USLE for water quality modeling. To properly evaluate the various USLE modifications, we have assembled possibly the most comprehensive small watershed sediment yield data set to date. The data set contains USLE factors, runoff and sediment yield data for 3,695 storms that occurred on 63 watersheds. We used these data to evaluate the original MUSLE and two versions of a four-parameter equation. The original two-parameter MUSLE was developed with data from 778 storms at Riesel, TX and Hastings, NE. We used the same data to develop a four-parameter equation (coefficient plus exponents for runoff volume, peak rate, and watershed area). The third equation was developed using only the small watershed data from the original 778 storms (areas less than or equal to 71.2 ha). This equation is aimed at minimizing channel erosion as a sediment source. Since little or no channel erosion occurs in these small watersheds, the resulting equation should estimate only sheet, rill, and ephemeral gully erosion. We used the 3,695-storm data set to test the three equations. The small watershed equation produced slightly better statistics (prediction efficiency = 0.93) than MUSLE (pe = 0.87) or the four-parameter equation (pe = 0.86). This indicates that channel erosion was not a large component of the sediment yield even on the larger watersheds. The SWRRB and EPIC models will offer options so that users can select MUSLE or the small watershed equation, or supply the four parameters.

For additional information contact J. R. Williams, Hydraulic Engineer, Grassland, Soil and Water Research Laboratory, 808 East Blackland Road, Temple, TX 76502.

WASHINGTON

AGRICULTURAL RESEARCH SERVICE

The following research is being conducted by the Land Management and Water Conservation Research Unit at Pullman, Washington:

1. A small plot and watershed study has been initiated in the Missouri Flat Creek watershed near Pullman. Two sites have been heavily instrumental to determine runoff, soil erosion, infiltration, interflow and deep percolation. The purpose is to establish relationships necessary for calibration of runoff and water quality models to the transition zone between the loessial prairie and mountainous areas of eastern Washington and northern Idaho.

2. A subfactor method of determining crop management factors (C factor in the Revised Universal Soil Loss Equation [RUSLE]) has been developed and output is being used by the SCS in Idaho, Oregon, and Washington. Thirteen years of runoff and erosion plot data from the Palouse Conservation Field Station at Pullman are being used to substantiate and improve the method. Work is continuing to improve the consistency of the relationships and to apply the method to additional crop rotations.

3. Investigations into the effect of soil freezing and thawing on soil shear strength indicate very low surface shear strength during the thawing process. A flume study, in which soil is frozen and thawed under a range of soil moisture tensions, is being conducted to determine relationships between soil loss and applied shear stress. The results of this study, which provide critical shear strength and rill erodibility data, will be used to improve winter erosion prediction with runoff/erosion models. The project was inactive in 1991 but will be reactivated in 1992.

4. Relationships for the si factors of the Revis Universal Soil Loss Equation (RUSLE) have been developed specifically for the non-irrigated cropland of the Pacific Northwest. This will enable greater confidence in the use of RUSLE in this region of unique climate, topography and cropping conditions. Activity in 1991 concentrated on evaluation of contouring and strip cropping practices.

For additional information, contact Donald K. McCool, USDA-ARS, Agricultural Engineering Department, 219 Smith Engineering Building, Washington State University, Pullman, Washington 99164-6120.

CORPS OF ENGINEERS

The Hydrologic Engineering Center

Sedimentation activities at the HEC during calendar year 1991 concentrated on finalizing the documentation and computer software for the numerical model HEC-6, "Scour and Deposition in Rivers and Reservoirs". This version of HEC-6 resulted from continued coordination with the Waterways Experiment Station (WES) and contains developments and enhancements to the program made by WES over the last decade. It is primarily being used on MS-DOS microcomputers. An entirely new users manual and input description has been prepared. This document also contains a comprehensive set of annotated example problems. The new program was released as Version 4.0.0. in June 1991. An interface with the HEC Data Storage System (DSS) is being designed to allow access of DSS-stored hydrographs and graphical presentation of computed results.

HEC continued work on a project to review the performance of structural measures constructed to control flooding on alluvial fans for the Federal Emergency Management Agency (FEMA). With the increased development in the arid western part of the United States, extensive development in taking place on alluvial fans. Many of these fans are exposed to extreme flood hazards associated with flash floods, mud and debris flows, high flow velocity, erosion and channel migration. The question being studied is: How well do typical flood control measures perform on alluvial fans, and how do we evaluate them? Field contacts were made and project reports reviewed. All but one chapter of the report have been completed; these are being reviewed by FEMA. The final chapter, on engineering design of alluvial fan flood control works, will be completed by contract in CY92.

HEC provided information to the Federal Energy Regulatory Commission (FERC) regarding HEC-6 for their "Bilateral Workshop on Understanding Sedimentation Processes and Evaluation".

An engineer from HEC attended the Fifth Federal Interagency Sedimentation Conference and presented a paper titled "Predicting Deposition Patterns in Small Basins."

A new research work unit titled "Land Surface Erosion" began in FY92(Oct 91). This work is aimed at improving the analytical techniques used for developing project area sediment budgets to reduce the uncertainty in prediction of both long-term average annual sediment budgets and single flood event budgets.

An HEC engineer participated in the Corps' Committee on Channel Stabilization meeting in Athens, OH. This meeting and field trip reviewed aggradation problems on the Hocking River. Suggestions were made to the Huntington District for updating flood potential analyses and physical means to increase the sediment transport capacity of the study reach.

CORPS OF ENGINEERS

Waterways Experiment Station

Title of Study:

Shoreline and Beach Topography Response Modeling

Point of Contact:

Mr. Mark Gravens, CEWESCR-P

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

All coast zones

Objectives:

To develop and transfer well-tested and documented shoreline and beach topography response models to field offices. To provide model documentation (including user's manuals, workbooks, and PC models). To provide expert consulting services and training (workshops) to field offices. To enhance and refine GENESIS (GENEralized model for SImulating Shoreline change) and develop the next generation of shoreline and beach topography response models.

Summary of Accomplishments:

The Instruction Report "GENESIS Workbook Version 2.0" (a user's guide to GENESIS and shoreline modeler's handbook which includes 12 utility computer programs for shoreline change modeling and documents a PC based version of RCPWAVE (Regional Coastal Processes WAVE model) was published. The Shoreline Modeling System (SMS) was installed on the WES supercomputer. A SMS workshop was held in November 1991 to release a PC version of SMS. Participated in data collection efforts at Oregon Inlet, North Carolina, involving monitoring of beach response associated with the construction of a groin system. Data will be used to develop and test the next generation of beach topography response models, 3DBEACH.

Title of Study:

Mississippi River at Old River Numerical Sedimentation Study

Point of Contact:

Brad Hall

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

Lower Mississippi River

Summary of Accomplishments:

The purpose of the study is to predict the transport rate of sand-size sediments from the Mississippi River into three lateral perched channels; 1), the Vidalia hydropower entrance channel, 2), the Old River Control Structure entrance channel, and 3), the Auxiliary Control Structure entrance channel. This information is needed to manage the distribution of sediment between the Mississippi River and the Atchafalaya River systems. The problem is highly three dimensional, requiring the use of a 3D numerical model. Also, dynamic long term simulations are required for testing. The model selected for use was the 3D boundary-fitted finite difference model CH3D. A contract was awarded to the University of Iowa to develop the appropriate sediment transport module and install it in CH3D.

Title of Study:

Abiaca Creek, Mississippi Sedimentation Study

Point of Contact:

Gary Freeman

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

West Central Mississippi

Summary of Accomplishments:

The purpose of the study was to evaluate the sedimentation impact of proposed flood control levees on lower Abiaca Creek. A 1D sediment transport model, HEC-6, was used to predict long term (30 years) aggradational/degradational trends under the plan condition. A draft technical report with model results and recommendations was submitted to the District office for review.

Title of Study:

Red River Lock and Dam No. 3 Numerical Sedimentation Study

Point of Contact:

Ron Copeland

Conducted for:

U.S. Army Corps of Engineers

Water Resources Region:

Red River Waterway, Louisiana

Summary of Accomplishments:

A Technical Report was produced on sedimentation in the lock approach channels. A 2D numerical model, TABS-2, was used to predict fine sediment deposition in the upstream and downstream lock approach channels. The numerical model was used to evaluate the effects of various design charges on fine sediment deposition. These included the cross-section shape in the upstream lock approach channel, the distance between the lock wall and the first spillway gate, the number of openings in the ported guard wall, and location of a berm in the upstream channel.

Title of Study:

Red River Lock and Dam No. 5 Numerical Sedimentation Study

Point of Contact:

Gary Freeman

Water Resources Region:

Red River Waterway, Louisiana

Summary of Accomplishments:

The purpose of the study is to estimate deposition patterns and rates in the upstream vicinity of Lock and Dam No. 5 on the Red River Waterway. A 2D numerical sedimentation model (TABS-2) of an eight-mile reach upstream of the lock and dam has been developed and adjusted. Also, the development of a 1D sedimentation model of the entire Lock and Dam No. 5 pool was required to provide suspended sediment concentration information to the TABS-2 model. Sedimentation in the upstream approach channel for a range of flow conditions was estimated and critical locations identified. An ASCE paper describing the modeling approach has been published. A memorandum report describing the model results has been transmitted to the District office.

Title of Study:

Mississippi River at Redeye Crossing Numerical Model Study

Point of Contact:

Nolan Raphelt

Water Resources Region:

Lower Mississippi River, Louisiana

Summary of Accomplishments:

The purpose of the study is to evaluate the effectiveness of training dikes at Redeye Crossing in reducing maintenance dredging requirements. A two dimensional numerical sediment model (TABS-2) has been developed and adjusted. A number of dike plans consisting of four to eleven submerged lateral rock dikes have been tested. The testing procedure includes dynamic, year-long simulations using an average annual hydrograph. ASCE and WEDA papers describing the modeling approach have been published.

Title of Study:

Conemaugh River Lake Sedimentation Study

Point of Contact:

Gary Freeman

Water Resources Region:

Conemaugh River, Pennsylvania

Summary of Accomplishments:

The purpose of the study is to evaluate schemes for reducing deposition rates in the lower portion of the reservoir so that the structure gates can be operated when needed. Site reconnaissance was conducted. The modeling approach developed used the unsteady flow model UNET to perform the hydraulic computations and the HEC-6 sediment transport model as a known-discharge model to perform the sedimentation analysis. An ASCE paper describing the modeling approach has been published.

Title of Study:

Demonstration Erosion Control (DEC) Monitoring Program

Point of Contact:

Nolan Raphelt

Water Resources Region:

Northwest Mississippi Watersheds

Summary of Accomplishments:

A video report was produced, describing the erosional problems existing in northwest Mississippi watersheds, encompassing an area of about 2,000 square miles. The video report also describes the systematic engineering approach being taken to reduce or eliminate the problem. The purpose of the monitoring program is to evaluate the effectiveness of the various engineering solutions, such as high- and low-drop grade control structures, in reducing the sediment problem and develop design tools for sediment reduction studies. The program includes the development of an engineering database/GIS designed to facilitate the sedimentation evaluation process.

FEDERAL HIGHWAY ADMINISTRATION

The Federal Highway Administration (FHWA) concentrated its activities on five major areas: control of stream instability at highway crossings, bridge scour studies, instrumentation and remote methods for bridge scour measurement, control of sediment produced by highway construction, and control of highway water quality. Major efforts were carried out by staff and contract research, and by the various studies in the Highway Planning and Research program (HPR) and in the National Cooperative Highway Research Program (NCHRP). Following is a description of ongoing studies in 1991 in each of the five major areas.

Control of Stream Instability at Highway Crossings - The objectives of these studies are to evaluate the significance of natural stream adjustments on the structural integrity of highway crossings, to provide techniques for resolving the impact of these changes, then to provide guidelines for measures to mitigate stream instability at highway stream crossings.

A. The FHWA hydraulics lab study on sizing riprap to protect bridge piers from local scour was complete. Parola's Ph.D dissertation at Penn State University titled "The Stability of Riprap Used to Protect Bridge Piers" dated May 1990 is based on this study. A Public Roads article "Design of Riprap to Protect Bridge Piers from Local Scour" briefly summarized the results of the study in the September 1990, Vol 54, No. 2 issue. Dr. Parola's dissertation was published in 1991 as an FHWA research report with the same title (Report No. FHWA-RD-91-063).

B. A similar lab study on sizing riprap to protect bridge abutments from local scour was conducted in FHWA's hydraulics lab by Jorge E. Pagan-Ortiz. His M.S. thesis at George Washington University titled "Stability of Rock Riprap for Protection at the Toe of Abutments Located at Floodplains" is based on this study, and was published in 1991 as an FHWA publication with the same title (Report No. FHWA-RD-91-057).

C. A laboratory study to investigate alternatives to riprap for bridge pier scour protection was partially completed in December 1991. Extended footings, grout bags, grout mattresses and tetrapods were included in the experiments. Ms. Lisa Fotherby, a Graduate Research Fellowship student from Colorado State University was analyzing the data. A laboratory report is scheduled for publication in 1992.

Bridge Scour Studies - The objective of these studies is to investigate expected scour at bridges. Goals include developing procedures for assessing vulnerability of bridge scour, developing an improved sediment transport model, and developing prediction equations for pier, abutment and contraction scour at bridges.

A. Field scour studies were being sponsored by 14 State highway agencies using either State or HPR funds. Most of these studies are aimed at reconnaissance prior to flooding and scour monitoring during flooding to document field data. Data from these studies will be fed into the national scour study described in B below. Exceptions to the general nature of these studies are Louisiana and Tennessee. The Louisiana study which was conducted by Louisiana State University focused on developing a computerized system for the organization, analysis and display of routine hydrographic survey data collected by the bridge monitoring teams. The Tennessee study is focused on assessing vulnerability of bridges to scour in the western part of the State.

B. The USGS continued the bridge scour study "Performance of Bridges during Flooding," sponsored by the FHWA. This study, generally referred to as the National Scour Study, awarded in September 1987, was intended to assemble a response team to monitor bridge scour wherever floods might occur in this country. The response team would work with study leaders in the individual States that have scour studies to standardize data collection and serve as a national repository of data. This study is scheduled for completion in 1992, but an extension is anticipated to utilize additional data being collected under the State funded field studies in A above.

C. NCHRP Project 15-11 "Hydraulic Analysis of Bridges on Streams with Moveable Beds and Banks" resulted in development of the BRI-STARS sediment transport model for general scour analysis of highway stream crossings. BRI-STARS is based on the stream tube concept that was originally developed under sponsorship of the Bureau of Reclamation. This initial contract for this NCHRP project was completed in 1990 but a follow-up phase II contract was awarded to debug the BRI-STARS model, add some extra features and provide user support. A third phase is being considered for adding some major enhancements for the model but this phase has not been approved yet.

D. The USGS Connecticut District Office continued the study "Seismic and Radar Scour Equipment," sponsored by the FHWA. This is a continuation of a pilot study on the use of selected geophysical techniques to recreate the scour history of bridge piers and abutments. Equipment and deployment methods being evaluated include the use of color video fathometers, low frequency sonar, and ground penetrating radar for subbottom plotting and for detection of refilled scour holes.

E. An FHWA contract study, "Numerical 2-D Model of Scour Processes," was awarded to the University of Kentucky Foundation in 1991. This 5-year study is to enhance practical and computational aspects of the Finite Element Surface-Water Modeling System: 2-Dimensional Flow in a Horizontal Plane (FESWMS-2DH) microcomputer program and include algorithms that will allow simulation of sediment transport and scour processes at highway stream crossings.

F. Florida continued the HP&R study "Highway Bridge Scour Evaluation of Predictions and Methods." This is an analytical study to determine how applicable the existing bridge scour prediction equations are for the coastal zones of Florida and to evaluate methodology recently developed for the Florida Department of Natural Resources by Sheppard and Niedorada.

G. Several Office of Technology Applications and National Highway Institute (NHI) activities using FHWA research results were completed: HEC-18 on scour at bridges, HEC-20 on stream stability at highway structures, training course on scour and stream stability, and Highways in the River Environment training course and manual. Some of these were available in 1991.

FHWA-IP-90-017 (Hydraulic Engineering Circular (HEC) No. 18), "Evaluating Scour at Bridges," Federal Highway Administration, McLean, Virginia 22101-2296, February 1991.

FHWA-IP-90-014 (Hydraulic Engineering Circular (HEC) No. 20), "Stream Stability at Highway Structures," Federal Highway Administration, McLean, Virginia 22101-2296, February 1991.

H. Demonstration Project #80, "Underwater Bridge Inspection" has been completed. The project was conducted successfully 50 times for bridge inspectors, maintenance personnel and program managers. The objective of the project was to demonstrate state-of-the-art equipment for underwater inspection and detection of scour.

A follow-up demonstration project, "Underwater Repair and Rehabilitation of Bridges" was initiated for development. As opposed to the "show and tell" nature of the previous demo, this project will be designed to assist States in conducting condition surveys of underwater bridge components using state-of-the-art instrumentation for previously identified troubled bridges. Additional assistance in helping the States identify potential repair or rehabilitation strategies will also be available. The demonstration project will be announced in late 1993.

Another new demonstration project, "Scour Monitoring and Instrumentation" was also initiated for development. This project will provide engineers and inspectors with the latest technology and procedures for measuring and monitoring scour at bridges. It will include demonstrating the installation and use of both fixed and portable instrumentation. The demonstration project will be announced in late 1993.

I. The FHWA awarded a contract to the Colorado State University in 1991 to study the effects of gradation and cohesion on bridge scour. The study plan includes extensive laboratory tests for piers and abutments at several scales. The study is expected to yield procedures to correct scour predictions for various bed material conditions that are common in the field. This 3½ year study is scheduled for completion in 1995.

Instrumentation and Remote Methods for Bridge Scour Measurement - The objectives of these studies are to design, develop, and test instrumentation and remote methods for use in monitoring scour and for assistance in maintenance of bridge substructures.

A. The NCHRP study (Project 21-3) "Instrumentation for Measuring Scour at Bridge Piers and Abutments" was continued by Resource Consultants, Inc., Fort Collins, Colorado. It is to develop, test, and evaluate fixed instrumentation for use in monitoring the maximum scour depth at bridge piers and abutments during high flow events. Often the best measure to take for a potential scour critical bridge is to monitor scour during floods, but reliable instrumentation is very limited.

B. A 3-year interagency agreement was entered with the USGS in 1991 for a study entitled "Scour Instrumentation and Deployment Methods." The objective of this study is to develop, test and evaluate portable scour measuring systems for use during floods and to demonstrate the resulting operational systems for application in bridge inspection, in limited scour data collection, and in detailed scour data collection.

C. An FHWA contract study "Remote Methods for Underwater Inspection of Bridge Structures" was awarded to the Sonsub, Inc., Houston, Texas in 1991. It is to design remote operated probe systems for scour monitoring during floods and for inspection, repairing, and maintenance of underwater bridge substructures. One prototype system will be fabricated and field tested to deploy transducers and devices for monitoring scour around bridge substructures and the streambed during floods.

Control of Sediment Produced by Highway Construction - This problem consists of two stages: during construction and just after construction.

A. During construction and after completion of highway construction, immediate and adequate protection against erosion can be provided for slopes and other roadside areas affected by grading. In most regions of the country this has been accomplished with the use of erosion control fabrics and the proper establishment and maintenance of roadside vegetation. There are currently five States conducting eight studies designed to reduce erosion through improved vegetation establishment and maintenance, and through the use of improved erosion control fabrics. The participating States are California, New Jersey, Florida, Oklahoma, and Washington. Tennessee completed its study in 1991.

   USGS Water Resources Investigation Report 91-4106, "Wetland Sedimentation and Vegetation Patterns near Selected Highway Crossings in West Tennessee," D. E. Bazemore, C. Hupp, and T. H. Diehl, USGS Water Resources Division, Nashville, Tennessee, December 1991.

B. In addition to the foregoing studies supported by States in the HP&R program, a contractual effort through the FHWA's Federal Land program at North Dakota

State University completed an investigation of the corrective repair of road edge scour for grassed highway shoulders. The final report was reviewed, and will be published in 1992.

Control of Highway Water Quality - The objectives of these studies are to monitor the highway water pollution parameters, to determine their source and their impact on the environment, and to devise cost-effective means to control them.

A. An FHWA administrative contract research study, "Retention, Detention and Overland Flow for Pollutant Removal from Highway Stormwater," was completed by Versar, Inc., Springfield, Virginia. This research developed performance criteria for mitigation measures using this subject removal mechanism. Laboratory tests and design for laboratory and field validations were conducted. The final report was reviewed, and will be published in 1992.

B. An FHWA administrative contract research study, "Guidelines for Protective Systems for Spills of Hazardous Materials on the Highway System," was completed by the Kansas State University of Manhattan, Kansas. This investigation focused on areas of high risk where spills could result in severe, long term or permanent consequences. The emphasis of the research is on developing implementable procedures and guidelines for effective, practical, and feasible protective systems. The draft final report was reviewed. The final report will be published in 1992.

C. Twelve States continued 22 investigations on effects of highway design, operation and maintenance on water quality impacts and means to reduce such impacts.

Arizona, "Porous Pavements for Control of Highway Runoff."

California, "Effect of Bridge Repainting Operations on the Environment" was completed in 1991. The final report was published: FHWA/CA/TL-90/08, "The Toxicity of Selected Bridge Painting Materials and Guidelines for Bridge Painting Projects," H. Hunt and J. Gidley, California Department of Transportation, Sacramento, California, September 1990.

California, "Use of Vegetation to Reduce the Toxicity of Stormwater Runoff."

California, "Reducing the Volume of Hazardous Waste from Bridge Repainting."

California, "Soil Infiltration Rates for Septic Tank Effluents."

Florida, "Effects of Structural Changes on Water Quality Efficiency of Stormwater Detection Ponds."

Florida, "Maintenance Guidelines for Accumulated Sediments in Retention/Detention Ponds Receiving Highway Runoff."

Florida, "Design and Maintenance of Exfiltration Systems."

Florida, "Activated Carbon Filter."

Georgia, "Bioremediation of Organic Contaminants."

Louisiana, "Accelerated Biodegradation of Herbicides Applied to the Roadside."

Massachusetts, "Effectiveness of Highway Drainage Features for Control of Ground Water Pollution."

New Jersey, "Handling and Mitigation of Acid-Producing Soils."

Ohio, "Effects of Highway Deicing Chemicals on Shallow Unconsolidated Aquifers in Ohio."

Pennsylvania, "Analyses of Pollution Controls for Bridge Painting."

Virginia, "Field Performance of Porous Asphaltic Pavement."

Virginia, "Storm Water Management."

Washington, "Improving the Cost of Effectiveness of Highway Construction Site Erosion/Pollution Control."

Wisconsin, "Hydrological Guidelines for Wetland Resotation and Creation."

If more information is desired about these research studies, inquiries should be addressed to the sponsoring agencies.

GEOLOGICAL SURVEY, CORPS OF ENGINEERS, BUREAU OF RECLAMATION, FEDERAL HIGHWAY ADMINISTRATION, BUREAU OF LAND MANAGEMENT, AGRICULTURAL RESEARCH SERVICE, FOREST SERVICE, AND TENNESSEE VALLEY AUTHORITY

Federal Inter-Agency Sedimentation Project

The Federal Interagency Sedimentation Project (FISP) is undergoing a series of organizational changes following the retirement of three staff members and the transfer of another project member. The Corps of Engineers, St. Paul District, announced its intention to withdraw administrative services to the FISP at the end of fiscal year (FY) 1991. Fortunately, the Waterways Experiment Station (WES), U.S. Army Corps of Engineers, Vicksburg, Mississippi, offered to provide the services which are crucial to the Project's equipment-supply activities. The WES will use funds provided by the U.S. Geological Survey, the Corps, and the other supporting agencies to provide facilities and personnel to support the Project's research and development work which has slowed following the retirements and the transfer of Mr. Joseph Szalona, a 10-year employee with the Project, to the Geological Survey's New Mexico District.

Despite the organizational changes, equipment-supply activities during 1991 were maintained with only brief interruptions. Total sales for the year were $214,690. Purchase orders for sediment equipment should now be addressed to the attention of Ms. Peggy Hoffman, U.S. Army Corps of Engineers, Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199. Equipment is need of repair should be shipped to the attention of Mr. Rocky Fanjoy, St. Anthony Falls Hydraulic Laboratory, Third Avenue S.E. and Hennepin Island, Minneapolis, Minnesota 55414-2196.

The following activities were carried out by the Project during the past year.

The FISP participated in the Fifth Federal Interagency Sedimentation Conference which was held on March 18-21, 1991, in Las Vegas, Nevada. Displays featured standard equipment stocked by the FISP, new equipment under development at FISP, and explanations of the FISP's role in supporting sediment data-collection activities. A paper, "Gages for Measuring Fluvial Sediment Concentration," was also presented as part of the sampling and analysis section of the conference.

A dredge-type bed-material sampler patterned after suggestions by Dave Hubbell was constructed by the FISP and then tested by the Bureau of Reclamation and Bureau of Land Management. The sampler loosens armour layers of bed material with the aid of heavy cutting teeth mounted along the bottom edge of a rectangular frame which holds a sample-collection bag made of heavy-gage plastic screening. The sampler is pulled along a river bottom with a cable attached to a truck or power winch. Tests indicate the sampler is faster and easier to use than a freeze-core sampler if penetration to a depth of about 0.1 meters is required. Even though the teeth and frame are of 1/4-inch steel plate, more bracing will be required to add additional strength.

The FISP ran brief laboratory tests on a modified hydrometer for measuring sediment concentrations. A glass bulb, termed a plummet, was suspended in a column of sediment-laden water. Buoyant forces on the plummet register on an electronic balance which was mounted above the column and connected to the plummet through a thin wire. Weight readings were corrected for water temperature and then converted to sediment concentrations. Don Warren, a senior project engineer with the data-systems group, Tennessee Valley Authority, is developing a controller and data logger so an automatic pilot model can be scheduled for additional laboratory tests. In the new model, all readings will be collected in a batch mode -- a sample will be pumped into the column then, as soon as turbulent eddies subside, weight readings will be stored on a removable magnetic-memory card. After temperature and all temporal readings have been collected, the column will pumped down so the process can be repeated.

TITLE: Movement and Storage of Sediment in River Systems

PROJECT NUMBER: CR 75–102

PROJECT CHIEF: Meade, Robert H.

ADDRESS: U.S. Geological Survey
P.O. Box 25046, MS–413
Denver Federal Center
Lakewood, CO 80225

TELEPHONE: (303)236–4999
FTS 776–4999

PROBLEM: Sediment moves through a river system in response to specific events and changing conditions in the drainage basin. The movement of sediment is usually discontinuous. Episodes of movement are separated by periods of storage that can range from less than 1 year to more than 1,000 years. Understanding the movement and storage of sediment in rivers is important to navigation, flood control, and other aspects of river engineering, as well as to the prediction of the fate of contaminants absorbed on sediment particles.

OBJECTIVE: Assess (1) changes in river-sediment loads over periods of decades or longer and the factors (natural or artificial) that cause the changes; (2) rates at which sediment is stored in river systems and the residence times of sediment particles in storage; and (3) sources, pathways, and sinks of sediment particles in river systems.

APPROACH: (1) Assess long-term changes in sediment loads from data previously collected by U.S.Geological Survey and other agencies; (2) assess sediment storage by repeated (annual) surveys of selected river channels and by comparing old and new maps and aerial photographs of rivers and their flood plains; and (3) assess sources, pathways, and sinks by intensive field studies of selected large and small rivers.

PROGRESS: One sampling cruise was completed on the Mississippi River between Minneapolis, Minn., and New Orleans, La. A resurvey of cross sections in Powder River, Mont., showed small to moderate amount of channel change since last year.

REPORTS PUBLISHED 1986–1991:

Johnsson, M.J., and Meade, R.H., 1990, Chemical weathering of fluvial sediments during alluvial storage—the Macuapanim Island point bar, Solimoes River, Brazil: Journal of Sedimentary Petrology, v. 60, p. 827–842.

Johnsson, M.J., Stallard, R.F., and Meade, R.H., 1988, First-cycle quartz arenites in the Orinoco River basin, Venezuela and Colombia: Journal of Geology, v. 96, p. 263–277.

Leenheer, J.A., Meade, R.H., Taylor, H.E., and Pereira, W.E., 1989, Sampling, fractionation, and dewatering of suspended sediment from the Mississippi River for geochemical and trace-contaminant analysis, in Mallard, G.E., and Ragone, S.E., editors, U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the technical meeting, Phoenix, Ariz., September 26–30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88–4420, p. 501–512.

Marron, D.C., 1987, Effects of sediment transport and depositional processes on the distribution and longevity of a metal-contamination problem in west-central South Dakota: The Earth Scientist, v. 5, no. 2, p. 3—8.

-----1987, Floodplain storage of metal-contaminated sediment downstream of a gold mine at Lead, South Dakota, in Averett, R.C., and McKnight, D.M., editors, The chemical quality of water and the hydrologic cycle: Ann Arbor, Mich., Lewis Publishers, p. 193—209.

-----1988, Field and laboratory data describing physical and chemical characteristics of metal-contaminated flood-plain deposits downstream from Lead, west-central South Dakota: U.S. Geological Survey Open-File Report 88—349, 32 p.

-----1989, The transport of mine tailings as suspended sediment in the Belle Fourche River, west-central South Dakota, U.S.A., in Hadley, R.F., editor, Sediment and the environment: International Association of Hydrologic Sciences Publication 184, p. 19—26.

-----1989, Physical and chemical characteristics of a metal-contaminated overbank deposit, west-central South Dakota, U.S.A.: Earth Surface Processes and Landforms, v. 14, p. 419—432.

Meade, R.H., 1988, Movement and storage of sediment in river systems, in Lerman, A., and Meybeck, M., editors, Physical and chemical weathering in geochemical cycles: Dordrecht, Kluwer Academic Publishers, p. 165—179.

Meade, R.H., Rayol, J.M., Conceicao, S.C. da, and Natividade, J.R.G., in press, Backwater effects in the Amazon River basin of Brazil: Environmental Geology and Water Sciences, v. 13.

Meade, R.H., Weibezahn, F.H., Lewis, W.M., Jr., and Perez-Hernandez, David, 1990, Suspended-sediment budget for the Orinoco River, in Weibezahn, F.H., Alvarez, H., and Lewis, W.M., Jr., editors, The Orinoco River as an ecosystem: Caracas, Impresos Rubel, p. 55—79.

Meade, R.H., Yuzyk, T.R., and Day, T.J., 1990, Movement and storage of sediment in rivers of the United States and Canada, in Wolman, M.G., and Riggs, H.C., editors, Surface water hydrology: Geological Society of America, The Geology of North America, v. O—1, p. 255—280.

Moody, J.A., and Meade, R.H., 1990, Channel changes at cross-sections of the Powder River Between Moorhead and Broedus, Montana, 1975—88: U.S. Geological Survey Open-file Report 89—407, 252 p.

Richey, J.E., Meade, R.H., Salati, Eneas, Devol, A.H., Nordin, C.F., Jr., and dos Santos, Umberto, 1986, Water discharge and suspended sediment concentrations in the Amazon River—1982—1984: Water Resources Research, v. 22, p. 756—764.

TITLE: Effects of Water and Sediment Discharges on Channel Morphology

PROJECT NUMBER: CR 65—105

PROJECT CHIEF: Williams, Garnett P.

ADDRESS: U.S. Geological Survey
P.O. Box 25046, MS-413
Denver Federal Center
Lakewood, CO 80225

TELEPHONE: (303)236—5001
FTS 776—5001

PROBLEM: Channels on alluvial streams change with time. Bed elevations and channel widths may change, meander bends shift both laterally and downstreamward, the sizes of the bed particles may change, instream bars grow and migrate, and the amount and type of vegetation along the river may increase or decrease. Sometimes the change is minor and insignificant, even over decades, but in other cases catastrophic modifications occur in minutes. The transformations can be natural or man-induced, and they can have significant effects on man and the environment.

OBJECTIVE: To determine and analyze the influence of the major governing variables, particularly water and sediment discharges, on channel morphology, and to evaluate how the many relevant variables and results change with time.

APPROACH: (1) Identify the major variables that govern channel morphology; (2) Obtain data sets that span as long a time period as possible; (3) Isolate the effects of different variables and analyze stream channels as dynamical systems, with an eye toward prediction of channel changes.

PROGRESS: Proportions of bedload to total sediment load in rivers vary widely from one time to another at a cross section, from one cross section to another on the same river, and from one river to another, even within the same geographic region. The bedload proportion at most sites showed no significant relation to: (a) suspended sediment concentration, (b) flow depth, (c) channel width, or (d) channel shape (width/depth ratio).

REPORTS PUBLISHED 1986—1991:

Troutman, B.M., and Williams, G.P., 1987, Fitting straight lines in the earth sciences, in Size, W.B., ed., Use and abuse of statistical methods in the earth sciences: New York and Oxford, Oxford University Press (International Association for Mathematical Geology Studies in Mathematical Geology No. 1), p. 107—128.

Waythomas, C.F., and Williams, G.P., 1988, Sediment yield and spurious correlation—toward a better portrayal of the annual sediment load of rivers: Geomorphology, v. 1, no. 4, p. 309—316.

Williams, G.P., 1986, River meanders and channel size: Journal of Hydrology, v. 88, p. 147—164.

-----1988, Paleofluvial estimates from dimensions of former channels and meanders, in Baker, V.R., Kochel, R.C., and Patton, P.C., eds., Flood Geomorphology: New York, Wiley, p. 321—334.)

-----1988, Stream-channel changes and pond formation at the 1974—76 Manti landslide, Utah: U.S. Geological Survey Professional Paper 1311—C, p. 43—69.

-----1989, Sediment concentration versus water discharge during single hydrologic events in rivers: Journal of Hydrology, v. 111, no. 1—4, p. 89—106.

Williams, G.P., and Costa, J.E., 1988, Geomorphic measurements after a flood, in Baker, V.R., Kochel, R.C., and Patton, P.C., eds., Flood Geomorphology: New York, Wiley, p. 65—77.

Williams, G.P., and Rosgen, D.L., 1989, Measured total sediment loads (suspended loads and bedloads) for 93 United States streams: U.S. Geological Survey Open-File Report 89—67, 128 p.

Williams, G.P., and Troutman, B.M., 1987, Algebraic manipulation of equations of best-fit straight lines, in Size, W.B., ed., Use and abuse of statistical methods in the earth sciences: New York and Oxford, Oxford University Press (International Association for Mathematical Geology Studies in Mathematical Geology No. 1), p. 129—141.

-----1990, Comparison of structural and least-squares lines for estimating geologic relations: Mathematical Geology, v. 22, no. 8, p. 1027—1049.

Williams, G.P., and Wolman, M.G., 1986, Effects of dams and reservoirs on surface water hydrology——changes in rivers downstream from dams, in U.S. Geological Survey National Water Summary 1985, Hydrologic Events and Surface-Water Resources: U.S. Geological Survey Water-Supply Paper 2300, p. 83—88.

GEOMORPHOLOGY/SEDIMENT TRANSPORT

TITLE: Hydraulics and Mechanics of Bedload-Transport Processes

PROJECT NUMBER: CR 74—187

PROJECT CHIEF: Emmett, William W.

ADDRESS: U.S. Geological Survey
P.O. Box 25046, MS-413
Denver Federal Center
Lakewood, CO 80225

TELEPHONE: (303)236—5008
FTS 776—5008

PROBLEM: Of all processes operating in river channels, and especially of those of practical concern to engineers and others interested in river-channel behavior, perhaps the least information is available regarding the hydraulics and mechanics of bedload transport. As scientific knowledge of river behavior advances and is applied to management of the nation's rivers, additional understanding of bedload-transport processes will be necessary.

OBJECTIVE: (1) Define (a) spatial and temporal variations in transport rate and particle size of bedload; and (b) the average magnitudes of transport rate and particle size throughout a range of geographic locations, channel geometries, and river hydraulics. (2) Evaluate the adequacy of sampling equipment and field procedures, provide interpretation of bedload-transport processes, and assess the applicability of existing or new predictive techniques in river hydrology. (3) Demonstrate the value of sediment data in designing hydrologic networks and in evaluating regional and temporal trends in water-resources information. (4) Assess the usefulness of numerical simulations as hydrologic tools in fluvial geomorphology. (5) Provide interdiscipline perspectives in evaluation of environmental resources (for example, fishery habitat), impact assessments (for example, alluvial mining), and management alternatives (for example, operating policy). (6) Apply the information to operational programs of the U.S. Geological Survey and other organizational units to assist in the solution of practical problems.

APPROACH: (1) Use continuous sampling of bedload (for example, conveyor-belt bedload trap on the East Fork River near Pinedale, Wyoming) as a control to evaluate spatial and temporal variability factors in bedload transport and to evaluate general relations between sediment movement and river hydraulics. (2) Field calibrate the sediment-sampling efficiency of the Helley-Smith bedload sampler simultaneously with operation of the bedload trap. (3) Use the calibrated Helley-Smith sampler and the concurrent measurements of streamflow hydraulics in the systematic collection of bedload samples from a variety of sand- and gravel-bed streams, and within the laws of general physics, stochastically develop empirical relations of bedload transport and interpret the physical significance of the developed relations. (4) At the conveyor-belt bedload-trap research facility, initiate a tracer study using fluorescent particles (sand to fine gravel) to evaluate (a) residence time of sediment (b) average speed of various sizes of particles (c) depth of bed material involved in transport (d) dispersion of bed material (e) short-term channel changes accompanying sediment transport (f) influence of availability of sediment on transport rate and (g) other related aspects of sediment transport. (5) Extend the fluorescent-tracer study to larger particles (coarse gravel to cobbles) by implanting microradio transmitters in individual rocks and, by periodic and (or) continuous detection by receivers/data loggers, provide time-sequence data on motion and location of separately identifiable particles. (6) Establish field sites for bedload sampling that document varying characteristics of geographic coverage (factors of hydrology, meteorology, soils, biology, and so forth); maintain one or more bedload stations as long-term observation sites so that time-trend data can be evaluated. (7) Initiate and participate, as needed, in studies comparing sampler types, sampling procedures, and analytical techniques to formulate and modify guidelines on equipment needs and field/laboratory practices; provide emphasis on relevancy to WRD mission and on need for consistency of data collection. (8) In conjunction with biologists, chemists, and other scientists, develop a field-oriented strategy for comprehensive environmental assessments; apply developed strategy to specific sites to demonstrate and document sediment-related variables as important ecological factors.

PROGRESS: (1) Field work at the bedload trap and for the fluorescent-tracer study is complete. Bedload-transport rates measured synoptically, vary along a river reach; bedload tonnage, measured seasonally, is about constant throughout the reach. Mean bedload-transport rates relate to streampower (about the 1.6 power of streampower in excess of streampower at initiation of motion), mean bedload-particle speeds are slow (about 0.1 percent of water speed), and lengths of particle movement may be seasonally limited. (2) Radio transmitters were implanted in cobble-size rocks and movements tracked as part of studies on Toklat River, Lignite Creek, and Phelan Creek, Alaska. Bedload-transport rates relate about to the 1.6 power of discharge in excess of discharge at initiation of motion and particle size (mean, modal, and maximum) increased as transport rate increased. Motion sensors allow distinction between periods of motion and periods of inactivity. Generally, brief periods of motion are followed by longer times of rest. Large moving particles (about fist size) travelled about the same distance as smaller particles (about golf-ball size). Particle speeds and distances travelled are in general agreement with observations from East Fork River, Wyoming (3) Long-term data collection continued for the ninth year at Little Granite Creek, Wyoming (in cooperation with the Idaho District, U.S. Geological Survey). Although measured total-sediment loads are among the longest data sets available at a continuous-record gage, the period of record is still short to forecast time trends. Generally, during the period of observation, water runoff has decreased and sediment yields have lessened more dramatically. These facts may be related to short-term weather variability rather than to long-term climate change. (4) Comparisons of equipment and procedures were continued in collaboration with personnel in other countries and from other U.S. Geological Survey offices. (5) In collaboration with other USGS scientists and academia personnel, environmental assessments were conducted on several streams in Yellowstone and Denali National Parks, Wyoming and Alaska. A field procedure to evaluate habitat quality was developed combining geomorphic aspects (river hydraulics, sediment characteristics, topography), water chemistry (pH, conductance, trace elements, organic carbon), and biological factors (benthic drift, invertebrates, fish). (6) Studies of phytoplankton taste and odor problems were established on Fremont Lake; interpretations are in progress.

REPORTS PUBLISHED 1986—1991:

Chacho, E.F., Jr., Burrows, R.L., and Emmett, W.W., 1989, Detection of coarse sediment movement using radio transmitters: XXIII Congress on Hydraulics and the Environment, Ottawa, Canada, August 21—25, 1989, Proceedings: International Association for Hydraulic Research, p. B—367 to B—373.

-----1990, Detection of coarse sediment movement using radio receivers: The Northern Engineer, v. 22, no. 3, p. 5—9.

Emmett, W.W., and Averett, R.C., 1989, Fremont Lake, Wyoming—Some aspects of the inflow of water and sediment: U.S. Geological Survey Water-Resources Investigations Report 88—4021, 25 p.

Gomez, Basil, and Emmett, W.W., 1990, Data that describe at-a-point temporal variations in the transport rate and particle-size distribution of bedload—East Fork River, Wyoming and Fall River, Colorado: U.S. Geological Survey Open-File Report 90—193, 53 p.

Gomez, Basil, Emmett, W.W., and Hubbell, D.W., 1991, Comments on sampling bedload in small rivers: Fifth Federal Inter-Agency Sedimentation Conference, Las Vegas, Nev., March 18—21, Proceedings, p. 2—65 to 2—72.

Long, Yuqian, Emmett, W.W., and Janda, R.J., 1989, Comparison of some methods for particle-size analyses of suspended-sediment samples, Fourth International Symposium on River Sedimentation, Beijing, China, November 1—5, 1989, Proceedings: China Ocean Press, p. 1503—1508.

Mantz, P.A., and Emmett, W.W., 1986, Analysis of the United States Geological Survey sediment-transport data for some California streams: Euromech 192 Conference on Transport of Suspended Solids in Open Channels, Munich, Germany, June 11—15, 1985, Proceedings, p. 177—182.

Nelson, J.M., Emmett, W.W., and Smith, J.D., 1991, Flow and sediment transport in rough channels: Fifth Federal Inter-Agency Sedimentation Conference, Las Vegas, Nev., March 18—21, Proceedings, p. 4—55 to 4—62.

Osterkamp, W.R., Emmett, W.W., and Leopold, L.B., 1990, The Vigil Network—A reviving of interest: American Geophysical Union, Transactions, EOS, v. 71, no. 12, (March 20, 1990), p. 338.

TITLE: Transport and Deposition of Sediments and Sediment-Borne Contaminants in Tidal Rivers and Estuaries

PROJECT NUMBER: CR 81–266

PROJECT CHIEF: Glenn, Jerry L.

ADDRESS: U.S. Geological Survey
P.O. Box 25046, MS—413
Denver Federal Center
Lakewood, CO 80225

TELEPHONE: (303)236–5006
FTS 776–5006

PROBLEM: Sediments that contain large concentrations of nutrients and trace metals are accumulating rapidly in part of the tidal Potomac River, the Potomac Estuary, and the adjacent marginal embayments. Accumulations of sediments and sediment-borne contaminants could limit significantly the use of tidal waters and estuaries for commercial, recreational, and aquacultural purposes. The sediments decrease channel depths and widths to the detriment of commercial and recreational interests, and these sediments also cover and destroy productive shellfish grounds. The nutrients are a factor in the development and maintenance of undesirable eutrophic conditions, including nuisance algae blooms and low concentrations of dissolved oxygen. Sedimentation and eutrophication problems in the Potomac are a consequence of essentially uncontrollable natural and anthropogenic influences. The problems began to develop naturally several thousand years ago when the current rise in sea level drowned the Potomac River and began the evolution of the modern tidal river-estuary system.

OBJECTIVE: (1) Identify modern sources of sediments and nutrients; (2) establish changes with time in sources or supply rates due to natural and anthropogenic influences; (3) determine sediment and nutrient transport and deposition patterns; (4) compute rates of accumulation and amounts of sediments and nutrients in selected hydrologic and geomorphic divisions of the Potomac system; and (5) compare supply and accumulation rates for prehistorical and historical periods with contemporary rates from concurrent transport studies.

APPROACH: Determine areal and stratigraphic distributions of sediments, nutrients, and trace metals by a combination of direct sampling (surface and core) and remote sensing (side-scan sonar and sub-bottom profiling). Analyze sediment samples for indicators of sources (particle size, mineralogy, nutrient and trace-metal concentrations) and accumulation rates (lead-210, 14C pollen concentrations and distributions). Estimate sediment contributions from the shoreline source by use of a combination of field mapping, monitoring, and sampling at selected sites, and by laboratory measurements from available aerial photographs and maps. Integrate data with results from measurements and models of modern sediment and nutrient transport to provide past and present sediment and nutrient budgets for selected reaches of the Potomac.

GEOMORPHOLOGY/SEDIMENT TRANSPORT

PROGRESS: The 1990 water-year was again a period of extensive high water and overbank flooding in the Mississippi River study area. Except along natural levees and steep banks adjacent to the modern channel, deposition of fine-grained sediments controlled by elevation and topography was the dominant sedimentation phenomenon. Extensive erosion of unprotected channel margin banks resulted in up to 3 meters of bank retreat and loss of highly productive crop land. Natural levees in many areas were extensively modified by overbank flows; deposition of coarse sediments prevailed in some areas, but erosion occurred in other areas. Extreme local variability in natural levee areas often appeared to be related to transport and accumulation of logs and other debris. Along protected banks, local pockets of mostly coarse sediment developed after some high stages, but were sometimes removed and didn't develop after the next high stage. In general, it appears that sedimentation along steep channel margin banks may be controlled by the rapidity of rising and falling stage. Efforts to estimate long-term deposition rates using dendrogeomorphic techniques meet with mixed success. In many locations, high and variable deposition rates resulted in development of many zones of adventitious roots that made digging and recognition of an original root zone difficult. A report on Potomac River and estuary sedimentation was completed and revised after colleague review.

REPORTS PUBLISHED 1986—1991:

Glenn, J.L., 1988, Bottom sediments and nutrients in the tidal Potomac system, Maryland and Virginia: U.S. Geological Survey Water Supply Paper 2234-F, 74 p.

Glenn, J.L., Martin, E. Ann, and Rice, Cynthia A., 1986, Sediment data for the computations of deposition rates in the tidal Potomac system, Maryland and Virginia: U.S. Geological Survey Open-File Report 86-318, 73 p.

TITLE: River Mechanics

PROJECT NUMBER: CR 82—273

PROJECT CHIEF: Andrews, Edmund D.

ADDRESS: U.S. Geological Survey
325 Broadway
Boulder, CO 80303—3328

TELEPHONE: (303)541—3002

PROBLEM: The geometry and pattern of river channels adjust to significant changes in the water discharge, size, and quantity of sediment supplied to the channel. When the quantity of water and sediment over a period of years remains relatively constant, the channel geometry and pattern vary about a mean or quasi-equilibrium condition. Major watershed alterations that change the supply of water, sediment, and size of sediment reaching the channel necessitate an adjustment of the channel geometry and pattern. That is, the channel is transformed from one quasi-equilibrium state to another. Between the two quasi-equilibrium states, there is a period of instability. Existing techniques for examining and predicting river channel adjustment have been developed primarily from investigation of quasi-equilibrium rivers. As a result, it is frequently possible to predict with a modest range of uncertainty the future quasi-equilibrium hydraulic characteristics of a river following a change in its watershed. The dynamics and rate of river channel adjustment during the period of instability however, have rarely been studied, and are rather poorly understood. The length of time required for the complete adjustment is commonly a few decades to a century or more. In many instances, such as surface mines, reservoirs, and urbanization, the adjustment period may, in fact, be longer than the duration of the watershed change. In watersheds where various land-use changes occur every several years, river channels may be continually adjusting to different contributions of water and sediment, and thus, never reach a quasi-equilibrium condition. In these rivers, instability is the only significant condition. Consequently, an understanding of the dynamics and rate of river channel adjustment from one quasi-equilibrium state to another is very important to managing fluvial resources. A wide range of social and economic costs may result from significant river channel changes. One of the most frequent and important adverse impacts is damage to the aquatic ecosystem. Aquatic organisms depend upon a particular combination of hydraulic characteristics (that is, their physical habitat) to meet life requirements. When a river channel adjusts to a change in its watershed, the physical habitat of the aquatic organisms in the river may be reduced or even eliminated, either during the period of instability or in the future quasi-equilibrium condition. In order to evaluate the biological impacts of watershed alternation, hydrologists are frequently asked to predict the hydraulic geometry and channel pattern at various times in the future so that changes in the physical habitat can be assessed. In many ways, such an analysis of physical habitat concerns the same questions one would address in an evaluation of the impact of channel change upon engineering works, or navigation. On the other hand, certain aspects of river channel changes are of greater importance to the aquatic ecosystem than the integrity of engineering works. The primary focus of this research project is to understand the dynamics and rate of river channel change as they affect the physical habitat. The results, however, will no doubt contribute to understanding the broader question of river-channel adjustment. The greatest deficiencies in our present knowledge of river channel adjustment as it relates to the aquatic ecosystem appear to be (1) the longitudinal sorting of bed material, especially gravel, (2) the formation of gravel bars, (3) adjustment of channel width, and (4) the rates at which the several hydraulic variables adjust.

OBJECTIVE: Describe the physical processes and rate at which a river channel adjusts in response to a change in the water discharge, sediment size and sediment load supplied to the channel. Concentrate, in particular, on the adjustment of those aspects of river channels known to significantly influence the aquatic ecosystem, that is, the bed-material size distribution, occurrence of bars, and channel width. Describe the hydraulic processes controlling these characteristics of river channels as well as the rate at which they function. Formulate mathematical models of the processes as required for longitudinal routing of water and sediment. Develop new analytical tools for describing river-channel adjustment.

APPROACH: The ideal approach for this investigation would be to observe the transition of a river channel from one quasi-equilibrium state through a period of instability to another quasi-equilibrium state as a result of a known change in the supply of water and sediment. However, this is obviously impractical since adjustment of a river channel may extend from a few decades to a century. Instead, two basic types of field studies will be combined. First, the movement of bed material through a reach of channel will be studied in detail. These investigations will consider the transport of bed material, distance transported, and location (bed, banks, or bar) of deposition for each size fraction. Using measured bedload and suspended transport rates, detailed measurements of flow structure, and mapping of channel features, the movement of bed material through the study reaches will be described. To the extent possible, these observations will be generalized to formulate physically-based models of sediment movement by size fraction. The second part of this investigation will involve reconstructing the sequence and rate of adjustment for historical examples of river channel change. Because of the lack of detailed hydraulic measurements, this portion of the investigation may at times be somewhat descriptive and qualitative. These observations, however, will be vitally important, as they will provide the temporal context in which to view the hydraulic characteristic at a particular point in time.

PROGRESS: During the 1990 fiscal year, significant progress has been made in several areas: flow over bedforms, roughness of poorly sorted beds, incipient motion and marginal sediment transport rates in natural streams, and lateral separation eddies. Ongoing research on the flow and turbulence structure over two-dimensional bedforms led to a recognized need for a larger facility in which to make laboratory measurements. A cooperative effort with University of California at Santa Barbara (UCSB) was initiated and a proposal to the National Science Foundation to fund this laboratory work was prepared. This proposal was funded for a 3-year period beginning in October of 1989. Since then, a computer operated laser-Doppler velocimeter has been assembled at UCSB and a 20 meter flume has been prepared for these experiments, which began in August of 1990. Preliminary measurements have substantially improved our understanding of the turbulence structure of flows over bedforms. The work on roughness of poorly sorted beds is directed toward developing a thorough understanding of grain roughness on naturally-emplaced sediment beds. The first stage of this work consisted of a series of flume experiments wherein measurements of velocity and Reynolds stress over beds composed of well- and poorly-sorted material were made in order to assess bed roughness. Sections of the flume beds were preserved and current work is focussed on the development of stereo-photographic techniques for the determination of bed roughness. In addition, theoretical calculations of roughness and velocity profiles over rough beds have been performed. This work has produced computational models capable of accurate predictions of stage-discharge relations in steep, coarse-bedded channels. This work was also extended to the problem of making accurate predictions of the bed-material transport rate when only a small fraction of the bed particles are entrained at a given time. Bed material transport rates were sampled at five sites in the Front Range of Colorado during the spring of 1989. Using this information a significant improvement in the computation of coarse particle transport has been made. The work on lateral separation eddies consists of a combination of field, laboratory, and theoretical work aimed at understanding the mechanics of flow and sediment transport mechanics in separation eddies. One flume experiment has been completed, and several sites have been studied and analyzed for suitability as sites for a comprehensive field study. A current metering system for this work is being developed in cooperation with the University of Washington. In addition, a numerical model for flow in lateral separation eddies has been constructed and is currently being debugged and prepared for testing in laboratory and natural eddies.

REPORTS PUBLISHED 1986—1991:

Andrews, Edmund D., 1986, Downstream effects of Flaming Gorge Reservoir on the Green River, Colorado and Utah: Bulletin, Geological Society of America, v. 97, p. 1012—1023.

-----1987, Longitudinal dispersion of trace metals in the Clark Fork River, Montana, in Averett, R.C., and McKnight, D.M., eds., Chemical quality of water and the hydrologic cycle: Ann Arbor, Mich., Lewis Publishers, p. 179—191.

-----1990, Effects of streamflow and sediment on channel stability of the Colorado River—A perspective from Lees Ferry, Arizona, in Wolman, M.G., and Riggs, H.C. eds., The Geology of North America, volume 0—1, Surface water hydrology, Boulder, Colorado: Geological Society of America, p. 304—310.

-----1991, Sediment transport in the Colorado River basin, in Marzolf, G.R., ed., Colorado River Ecology and Dam Management: Washington, D.C., National Research Council, p. 43—60.

Andrews, E.D., and Erman, D.C., 1986, Persistence in the size distribution of surficial bed-material during an extreme snowmelt flood: Water Resources Research, v. 22, no. 3, p. 191—197.

Andrews, E.D., and Nelson, J.M., 1989, Topographic response of a bar in the Green River, Utah to variation in discharge, in Ikeda, Syunsuke and Parker, Gary eds., River meandering: Washington, D.C., American Geophysical Union, Water Resources Monograph, v. 12, p. 463—485.

Andrews, E.D., and Parker, Gary, 1987, Formation of a coarse surface layer as the response to gravel mobility, in Hey, R.D., Bathurst, J.C., and Thorne, C.R., eds., Sediment transport in gravel-bed rivers: New York, John Wiley and Sons, p. 269—300.

Andrews, E.D., and Webb, B.W., 1987, Emerging issues in surface water quality research, in Kundzewicz, Z.W., Gottschalk, Lars, and Webb, Bruce eds., Hydrology 2000: Wallingford, U.K., International Association of Hydrological Sciences, Publication no. 171, p. 27—33.

Erman, D.C., Andrews, E.D., and Yoder-Williams, Michael, 1988, Effects of winter floods on fish in the Sierra Nevada, California: Canadian Journal of Fisheries and Aquatic Sciences, v. 45, no. 12, p. 2195—2200.

Helsel, D.R., and Andrews, E.D., in press, Discussion of Trends in freshwater inflow to San Francisco Bay from the Sacramento—San Joaquin Delta by Fox, J.P., Mongon, T.R., and Miller, W.J., 1990: Water Resources Bulletin.

Parker, Gary and Andrews, E.D., 1986, Time development of meander: Journal of Fluid Mechanics, v. 162, p. 139—156.

TITLE: Sediment-Transported Pollutants in the Mississippi River

PROJECT NUMBER: CR 87–309

PROJECT CHIEF: Meade, Robert H.

ADDRESS: U.S. Geological Survey
413 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

TELEPHONE: (303)236–4999
FTS 776–4999

PROBLEM: The source and fate of many pollutant substances in the Nation's largest river system are closely tied to suspended sediment. Accurate prediction of the fate of these pollutants will require more than our present understanding of the interactions between sediments and pollutants and the ways in which large rivers store and remobilize suspended sediment.

OBJECTIVE: Define and understand (1) processes by which pollutant substances, organic and inorganic, are adsorbed onto sediment particles; (2) downstream mixing of pollutants below the confluence of large tributaries with the mainstem; and (3) seasonal storage and remobilization of sediment and pollutants in the Mississippi River system.

APPROACH: Make two to three boat trips per year, beginning above St. Louis, Mo., and ending at New Orleans, La., to sample 15 to 20 cross sections of the Mississippi River and its principal tributaries. Sample cross sections for large volumes of suspended sediment by the equal-width-increment method and other methods. Concentrate and analyze suspended sediment for a large number of organic and inorganic constituents, both natural and manmade.

PROGRESS: A substantial increase in project funding was received, along with a Congressional mandate to extend the project scope to include the upper Mississippi River. Backlogs of analytical work on samples collected during the first seven cruises (1987–1990) were cleared through the laboratories of the participating chemists. Numerous visits were made by project members to agencies to confer with U.S. Fish and Wildlife Service, Corps of Engineers, and agencies of the upper-river states, especially Minnesota, Wis., and Iowa. One full-scale chemical sampling trip on the Mississippi River between Minneapolis, Minn., and New Orleans, La., was completed between June 23 and August 7, 1991.

REPORTS PUBLISHED 1987–1991:

Leenheer, J.A., Meade, R.H., Taylor, H.E., and Pereira, W.E., 1989, Sampling, fractionation, and dewatering of suspended sediment from the Mississippi River for geochemical and trace-contaminant analysis, in Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the technical meeting, Phoenix, Ariz., September 26–30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88–4420, p. 501–512.

Leenheer, J.A., Wershaw, R.L., Brown, P.A., and Noyes, T.I., 1991, Detection of polyethylene-glycol residues from nonionic surfactants in surface water by H- and C-nuclear magnetic resonance spectrometry: Environmental Science and Technology, v. 25, p. 161—168.

Meade, R.H., 1989, Sediment-transported pollutants in the Mississippi River: U.S. Geological Survey Yearbook 1988, p. 20—23.

Meade, R.H., and Stevens, H.H., Jr., 1990, Strategies and equipment for sampling suspended sediment and associated toxic chemicals in large rivers—with emphasis on the Mississippi River: Science of the Total Environment, v. 97/98, p. 125—135.

Pereira, W.E., and Rostad, C.E., 1990, Occurrence, distributions, and transport of herbicides and their degradation products in the Lower Mississippi River and its tributaries: Environmental Science and Technology, v. 24, p. 1400—1406.

Pereira, W.E., Rostad, C.E., and Leiker, T.J., 1989, Preliminary assessment of the fate and transport of synthetic organic agrochemicals in the lower Mississippi River and its tributaries, in Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the technical meeting, Phoenix, Ariz., September 26—30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88—4220, p. 453—464.

-----1990, Determination of trace levels of herbicides and their degradation products in surface and ground waters by gas chromatography-ion trap mass spectrometry: Analitica Chimica Acta, v. 228, p. 69—75.

-----1990, Distributions of agrochemicals in the Lower Mississippi River and its tributaries: Science of the Total Environment, v. 97/98, p. 41—53.

Rees, T.F., 1990, Comparison of photon correlation spectroscopy with photosedimentation analysis for the determination of aqueous colloid size distributions: Water Resources Research, v. 26, p. 2777—2781.

Rees, T.F., and Ranville, J.F., 1989, Characterization of colloids in the Mississippi River and its major tributaries, in Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the technical meeting, Phoenix, Ariz., September 26—30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88—4220, p. 513—522.

-----1990, Collection and analysis of colloidal particles transported in the Mississippi River, U.S.A.: Journal of Contaminant Hydrology, v. 6, p. 241—250.

Rees, T.F., Leenheer, J.A., and Ranville, J.F., 1991, Use of a single-bowl continuous-flow centrifuge for dewatering suspended sediments—effect on sediment physical and chemical characteristics: Hydrological Processes, v. 5, p. 201—204.

Rostad, C.E., Pereira, W.E., and Leiker, T.J., 1989, Determination of herbicides and their degradation products in surface waters by gas chromatography/positive chemical ionization/tandem mass spectrometry: Biomedical and Environmental Mass Spectrometry, v. 18, p. 820—827.

Taylor, H.E., Garbarino, J.R., and Brinton, T.I., 1990, Occurrence and distribution of trace metals in the lower Mississippi River and its tributaries: Science of the Total Environment, v. 97/98, p. 369—384.

GEOMORPHOLOGY/SEDIMENT TRANSPORT

TITLE: Sediment Impacts from Disturbed and Undisturbed Lands

PROJECT NUMBER: CR 79–311

PROJECT CHIEF: Osterkamp, Waite R.

ADDRESS: U.S. Geological Survey
P.O. Box 25046, MS-413
Denver Federal Center
Lakewood, CO 80225

TELEPHONE: (303)236–5036
FTS 776–5036

PROBLEM: The acquisition and meaningful interpretation of sediment data from areas disturbed by land-use activities or natural processes is one of most deficient areas of recognizing nonpoint-source pollution in the United States. The comparison of sediment data from disturbed and undisturbed areas provides a means to (1) evaluate the effects that land-use activities cause, (2) investigate the geomorphic processes that regulate the detachment and transport of sediment, and (3) develop strategies for remedial action to reduce excessive sediment discharges. This information is especially necessary to minimize sediment discharges and sorbed chemical loads from surface-mine, industrial, agricultural, and urban areas.

OBJECTIVE: (1) To evaluate the extent and utility of sediment data from a variety of land-use areas, (2) to predict the movement of sediment from drainage basins affected by those land uses, and (3) to assess existing techniques and develop new ones based on geomorphic principles and the application of statistics, geochemistry, and botany to the limited data available as aids in improving our interpretive capabilities.

APPROACH: Field investigations are being conducted to evaluate available techniques for predicting sediment yields. Of particular interest are the Water Erosion Prediction Project model and the U.S. Department of Agriculture rainfall-runoff model. Research is to be conducted to develop technology for determining (1) predisturbance sediment-delivery ratios (proportion of gross erosion that appears as sediment yield at some place in the watershed) based on factors such as land use, contributing drainage area, runoff, basin morphology, relief, vegetation, and geochemical tracers, (2) sediment yields during disturbance, which are influenced by sediment-control measures used during land-use activity, and (3) sediment-delivery ratios for the post-disturbance period. In cooperation with other agencies and field offices of the U.S. Geological Survey, available sediment and related hydrologic and chemical data are being acquired and interpreted to develop techniques and possibly models to aid in the prediction of sediment impacts from land disturbance.

PROGRESS: Research was completed on the use of beryllium-ten as a natural tracer of sediment movement on the Southern High Plains of Texas and New Mexico. This research demonstrates the use of the isotope to trace eolian transport of sediment and the recharge of ground water through the unsaturated zone. Similar techniques were begun to estimate transmission losses and recharge from ephemeral-stream channels using beryllium-ten at the Nevada Test Site and in the United Arab Emirates.

During fall 1990 and spring 1991, field work was initiated in several localities in the upper South Platte River basin, including Plum Creek, Coal Creek, Turkey Creek and Tucker Gulch. Research on the fluvial geomorphic history of Arthurs Rock Gulch was continued. The emphasis of field investigations was to document the spatial distribution of Holocene fluvial deposits, and to begin work on the geochronology and sedimentology of these deposits. Multiple episodes of overbank-and flash-flooding were recognized in the areas investigated and numerous samples were collected for radiocarbon dating. Radiocarbon ages will be used to determine the temporal framework of alluvial activity in the study area, and a means for correlation of alluvial stratigraphic and proxy paleoclimate records.

REPORTS PUBLISHED 1986—1991:

Hickman, R.E., 1986, Nutrient-sediment relations in streamflow, in Interagency Advisory Committee on Water Data: Fourth Federal Interagency Sedimentation Conference, 1986 [Proceedings], v. 2, p. 8—48 to 8—56.

-----1987, Loads of suspended sediment and nutrients from local non-point sources to the tidal Potomac River and estuary, Maryland and Virginia, 1979—81 water years: U.S. Geological Survey Water-Supply Paper 2234—G, 35 p.

-----1987, Areal variation of suspended-sediment yield within and adjacent to the coalfields of the Eastern Coal Province and the eastern region of the Interior Coal Province: U.S. Geological Survey Hydrologic Investigations Atlas, 3 sheets.

Hupp, C.R., and Osterkamp, W.R., 1987, Geobotanical evidence of debris flows on Mount Shasta, California, in Glysson, G.D., ed., Proceedings of the advanced seminar on sedimentation, August 15—19, 1983, Denver, Colo.: U.S. Geological Survey Circular 953, p. 12—16.

Hupp, C.R., Osterkamp, W.R., and Thornton, J.L., 1987, Dendrogeomorphic evidence and dating of recent debris flows on Mount Shasta, northern California: U.S. Geological Survey Professional Paper 1396—B, 39 p.

Hupp, C.R., and Simon, Andrew, 1986, Vegetation and bank-slope development: Fourth Federal Inter-Agency Sedimentation Conference, Las Vegas, Nev., Proceedings, v. 2, p. 5—83 to 5—92.

Lane, L.J., and Osterkamp, W.R., in press, Estimating upland recharge in the Yucca Mountain area: American Society of Civil Engineers National Conference in Irrigation and Drainage Engineering, Proceedings.

Miller, A.J., 1986, Photogrammetric analyses of channel adjustment: Fourth Federal Inter-Agency Sedimentation Conference, Las Vegas, Nev., [Proceedings], v. 2, p. 5—11 to 5—20.

-----1991, Channel instability in a strip-mined basin: Fifth Federal Inter-Agency Sedimentation Conference, Las Vegas, Nev., [Proceedings], p. 10—1 to 10—8.

Osterkamp, W.R., (compiler), 1989, A tribute to John T. Hack by his friends and colleagues, in Tinkler, Keith ed., History of geomorphology from James Hutton to John Hack: Boston, Allen and Unwin, p. 283—291.

-----1989, Fluvial processes in river engineering (book review): EOS, Transactions, American Geophysical Union, v. 20, no. 4, p. 51.

-----1989, Sediment storage and movement on the southern High Plains of Texas as indicated by beryllium—ten—Sediment and the Environment: International Association of Hydrological Sciences Publication 184, p. 173—182.

-----1990, Channel narrowing following a catastrophic flood in a sand-bed stream: EOS, v. 71, no. 17, p. 510.

-----1990, Gentry Playa—origin by hydrologic processes, in Gustavson, T.C., ed., Tertiary and Quaternary stratigraphy and vertebrate paleontology of parts of northwestern Texas and eastern New Mexico: Bureau of Economic Geology Guidebook 24, The University of Texas at Austin, p. 32—35.

-----1990, Seepage weathering and sapping of the southern High Plains escarpments, Texas and New Mexico, in Higgins, C.G., and Coates, D.R., eds., Groundwater geomorphology; the role of subsurface water in earth-surface processes and landforms: Boulder, Colo., Geological Society of America Special Paper 252, p. 300—305.

-----in press, The vigil network—a means of observing landscape change in drainage basins: International Association of Hydrological Sciences Journal, v. 36, no. 3, p. 281—294.

Osterkamp, W.R., Carey, W.P., and Hupp, C.R., 1987, Sediment impacts from coal mining, northeast Tennessee, in Glysson, G.D., ed., Proceedings, U.S. Geological Survey Advanced Seminar on Sedimentation: U.S. Geological Survey Circular 953, p. 30—32.

Osterkamp, W.R., and Costa, J.E., 1986, Denudation rates in selected debris-flow basins: Fourth Federal Interagency Sedimentation Conference, Las Vegas, Nev., v. 1, p. 91—99.

-----1987, Changes accompanying an extraordinary flood on a sand-bed stream, in Mayer, L., and Nash, D., eds., Catastrophic flooding: Boston, Mass., Allen and Unwin, p. 201—224.

Osterkamp, W.R., Emmett, W.W., and Leopold, L.B., 1990, The vigil network, a reviving of interest: EOS, v. 71, no. 12, p. 338.

-----in press, The vigil network—a means of observing landscape change in drainage basins: Journal of Hydrological Sciences, International Association of Hydrological Sciences.

Osterkamp, W.R., Fenton, M.M., Gustavson, T.C., Hadley, R.F., Holliday, V.T., Morrison, R.B., and Toy, T.J., 1987, Great Plains, in Graf, W.L., ed., Geomorphic systems of North America: Boulder, Colo., Geological Society of America, Centennial Special Volume 2, p. 163—210.

Osterkamp, W.R., Hack, J.T., Hupp, C.R., Olson, C.G., and Sherwood, W.C., 1989, Geomorphology and plant ecology of the Shenandoah Valley; Field Trip Guidebook T350, 28th International Geological Congress: Washington, D.C., American Geophysical Union, 18 p.

Osterkamp, W.R., and Hupp, C.R., 1987, Dating and interpretation of debris flows by geologic and botanical methods at Whitney Creek gorge, Mount Shasta, California, in Costa, J.E., and Wieczorek, G.F., eds., Debris flows/avalanches—process, recognition, and mitigation: Geological Society of America Reviews in Engineering Geology, v. 7, p. 157—163.

Osterkamp, W.R., Hupp, C.R., and Blodgett, J.C., 1986, Magnitude and frequency of debris flows, and areas of hazard on Mount Shasta, northern California: U.S. Geological Survey Professional Paper 1396—C, 21 p.

Osterkamp, W.R., and Parker, R.S., 1991, Sediment monitoring in the United States: Fifth Federal Inter-Agency Sedimentation Conference, Las Vegas, Nev., [Proceedings], p. 1—15 to 1—23.

Osterkamp, W.R., and Wood, W.W., 1987, Playa-lake basins on the Southern High Plains of Texas and New Mexico, Part I. Hydrologic, geomorphic, and geologic evidence for their development: Geological Society of America Bulletin, v. 99, p. 215—223.

Parker, R.S., and Osterkamp, W.R., 1989, Designing an national sediment network—Research needs: EOS, v. 70, no. 43, p. 1105.

Waythomas, C.F., in press, Magnetic susceptibility of fluvial sediment, lower Fox River, northeastern Illinois, and implications for determining sediment source area: U.S. Geological Survey Water Resources Investigation Report.

Waythomas, C.R., and Jarrett, R.D., 1991, Recurrent late-Quaternary flooding in Arthurs Rock Gulch, Colorado Front Range Foothills near Fort Collins, Colorado, in Morel-Seytoux, H.J., ed., Proceedings of the 11th Annual American Geophysical Union Hydrology Days: Colorado State University, Hydrology Days Publication, p. 61.

Waythomas, C.F., Jarrett, R.D., and Osterkamp, W.R., in press, Late Quaternary fluvial activity and climate variability in the Colorado Front Range foothills and piedmont: Current Research in the Pleistocene, v. 8.

Wood, W.W., and Osterkamp, W.R., 1987, Playa-lake basins on the Southern High Plains of Texas and New Mexico, Part II. A hydrologic model and mass-balance arguments for their development: Geological Society of America Bulletin, v. 99, p. 224—230.

TITLE: Sediment-Water Chemistry in Large River Systems: Biogeochemical, Geomorphic, and Human Controls

PROJECT NUMBER: CR 88-313

PROJECT CHIEF: Stallard, Robert F.

ADDRESS: U.S. Geological Survey
325 Broadway
Boulder, CO 80303—3328

TELEPHONE: (303)541—3022

PROBLEM: Rivers are a major pathway to the ocean for erosion products and human wastes. The mechanisms that control the composition of river-borne materials are only imperfectly understood because erosion and the subsequent transport of material by rivers are mediated by a wide variety of closely linked chemical, biological, and physical processes. Moreover, in developed river systems such as those in the United States, these processes are subject to pervasive human-related perturbations. There is a need to develop, through field and theoretical studies, a comprehensive and integrated description of these processes for large river systems in a form that is useful to researchers in many disciplines.

OBJECTIVE: Describe how the biogeochemical and physical aspects of erosion and transport processes are reflected in the composition of river-borne materials for particular large river systems and develop general theoretical models that can be applied to rivers in general; evaluate the extent to which human activity has affected the river systems. Study how various chemical phases, natural or human-introduced, organic or inorganic, are partitioned between solid and dissolved loads in rivers and estuaries as the result of weathering, particle-surface reactions, biological uptake or release, atmospheric exchange, and storage during transit. Evaluate the dispersal pathways of river-borne substances through river systems and estuaries into and across the coastal marine environment.

APPROACH: Assemble, primarily from maps and data bases, current and historic chemical, geomorphic, biological, and demographic data for an entire river system. Identify phenomena that are especially important in controlling the composition of phases containing the major elements (H, C, O, Na, Mg, Al, Si, S, Cl, K, Ca, Ti, Fe) and certain minor indicator elements (N, F, P, Mn, Sr, Zr) to provide the conceptual framework for solving specific research objectives. Undertake field surveys, design sampling and analytical procedures, and create computer tools to manipulate and model data as part of these investigations. Formulate small scale field and laboratory studies to aid data interpretation as deemed necessary.

PROGRESS: In FY-1991, project efforts focused on initiating research, related to the Global Change Program, on the biogeochemistry of humid tropical watersheds. Research is concentrated on investigations of nutrient cycles, gas exchange, and weathering and erosion processes in small watersheds in northeastern Puerto Rico, at the Luquillo Experimental Forest (LEF), and in central Panama, at the Barro Colorado Nature Monument (BCNM). The LEF is the site of a recently initiated project funded under the Water, Energy, and Biogeochemical Budgets (WEBB) Program of the U.S. Geological Survey, Water Resources Division (WRD) and run through the Caribbean District Office of WRD. The BCNM is under the stewardship of the Smithsonian Tropical Research Institute (STRI) which presently shares funding for the work. The experimental is designed to compare natural and developed environments. Sampling is organized using a quasi-nested-basin approach. Microwatersheds have been selected on contrasting lithologies. The microwatersheds are used to identify and characterize processes in detail. Larger watersheds are used for the hydrologic and chemical budgets, because the spatial distribution of agricultural development and of many important hillslope processes, such as landslides, is sufficiently patchy and uneven that it is impossible to select representative micro-watersheds. The larger watersheds are contrasted with geologically matched nearby watersheds that have been agriculturally developed. The primary objective of the studies of weathering and erosion is to use long-term chemical sampling and physical monitoring to characterize the processes that control the distribution and transport of major, important-minor, and nutrient elements through soils, downslope, and out of the watershed. Phenomena of interest to global-change research include the fixation, storage, and export of carbon and nutrients as related to biogeochemical and geomorphic processes within the watersheds. Research efforts are apportioned between the study of soil-sediment-water interactions and the study of atmospheric trace gas-soil interactions. During FY-1991, there were six field trips to Puerto Rico. Sample analysis and data reduction continues for long-term studies of the Mississippi, Orinoco, and Amazon River systems.

REPORTS PUBLISHED 1988—1991:

Brantley, S.L., Crane, S.R., Crerar, D.A., Hellmann, R., and Stallard, R.F., 1986, Dislocation etch pits in quartz, in Davis, J.A., and Hayes, K.F., eds., Geochemical processes at mineral surfaces: Washington, D.C., American Chemical Society, p. 635—649.

Jewell, P.W., and Stallard, R.F., 1990, Geochemistry and paleooceanographic setting of central Nevada bedded barites: Journal of Geology, v. 99, p. 151—170.

Jewell, Paul W., and Stallard, Robert F., 1991, Geochemistry and paleoceanographic setting of central Nevada bedded barites: Journal of Geology, v. 99, p. 151—170.

Johnsson, M.J., and Stallard, R.F., 1989, Physiographic controls on the composition of sediments derived from volcanic and sedimentary terrains on Barro Colorado Island, Panama: Journal of Sedimentary Petrology, v. 59, p. 768—781.

-----1990, Physiographic controls on the composition of sediments derived from volcanic and sedimentary terrains on Barro Colorado Island, Panama-Reply: Journal of Sedimentary Petrology, v. 60, p. 799—801.

Johnsson, M.J., Stallard, R.F., and Lundberg, N., 1990, Petrology of fluvial sands from the Amazonian foreland basin, Peru and Bolivia. Discussion: Geological Society of America Bulletin, v. 102, p. 1727—1729.

Johnsson, M.J., Stallard, R.F., and Meade, R.H., 1988, First-cycle quartz arenites in the Orinoco River basin, Venezuela and Colombia: Journal of Geology, v. 96, p. 263—277.

Keller, M., Mitre, M.E., and Stallard, R.F., 1990, Consumption of atmospheric methane in soils of central Panama. Effects of agricultural development: Global Biogeochemical Cycles, v. 4 p. 21—27.

Koehnken, Hernandez, L., and Stallard, R.F., 1988, Sediment sampling through ultrafiltration: Journal of Sedimentary Petrology, v. 54, p. 758—759.

Maest, A.S., Crerar, D.A., Stallard, R.F., and Ryan, J.N., 1990, Metal and nutrient behavior in the Raritan estuary, New Jersey, U.S.A., the effect of multiple freshwater and industrial waste inputs: Chemical Geology, v. 81, p. 133—149.

Murnane, R.J., and Stallard, R.F., 1988, Germanium/silicon fractionation during biogenic opal formation: Paleoceanography, v. 3, p. 461—469.

-----1990, Germanium and silicon in rivers of the Orinoco drainage basin, Venezuela and Colombia: Nature, v. 344, p. 749—752.

Murnane, R.J., Leslie, B., Hammond, D.E., and Stallard, R.F., 1989, Germanium geochemistry in the southern California borderlands: Geochimica et Cosmochimica Acta, 53, p. 2873—2882.

Stallard, R.F., 1988, Weathering and erosion in the humid tropics, in Lerman, A., and Meybeck, M., eds., Physical and chemical weathering in geochemical cycles: Dordrecht, Holland, Kluwer Academic Publishers, p. 225—246.

Stallard, R.F., Koehnken, L., and Johnsson, M.J., 1990, Weathering processes and the composition of inorganic material transported through the Orinoco River system, Venezuela and Colombia, in Weibezahn, F.H., Alvarez, H., Lewis, W.M., Jr., eds., El Rmo Orinoco como ecosistema/The Orinoco River as an ecosystem: Caracas, Venezuela, Impresos Rubel, C.A., p. 81—119.

Yan, L., Stallard, R.F., Key, R.M., and Crerar, D.A., 1990, The chemical behavior of trace metals and 226Rn during estuarine mixing in the Mullica River estuary, New Jersey, U.S.A., a comparison between field observations and equilibrium calculation: Chemical Geology, v. 85, p. 369—381.

TITLE: Response of Fluvial Systems to Climatic Variability

PROJECT NUMBER: WR 89-200

PROJECT CHIEF: Webb, Robert H.

ADDRESS: U.S. Geological Survey
1675 W. Anklam Road
Tucson, AZ 85701

TELEPHONE: (602) 629-6821
FTS 762-6821

PROBLEM: Understanding of the effects of climatic variability is important to development of water resources, mitigation of flood hazards, and interpretation of landforms. Climatic variability, which is characterized by increased variance and skew of a climatic signal, may be more important to water-resources evaluation than change in mean climatic conditions. Changes in variability of climate have greater effects on the probability of occurrence of extreme events, such as floods or droughts, than do changes in mean conditions. Understanding of climatic variability is of paramount importance towards estimation of flood frequency, sediment-transport rates, and channel change.

OBJECTIVE: (1) Define the extent of historic climatic variability in the western United States over the past century; (2) identify specific time periods of statistically stationary precipitation, discharge, flood frequency, and sediment transport; and (3) assess the net effects of climatic variability on fluvial systems.

APPROACH: Assess historic climatic variability through regionalization of temporal climatic signals including temperature and precipitation amounts and intensity. Determine proxy synthetic records such as tree-ring widths, varved oceanic sediment, and nonanthropogenic changes in vegetation. Examine general circulation of the atmosphere for long-term changes. Examine generation mechanisms for specific storm types, which include tropical cyclones and winter frontal storms, for frequency changes in time. Develop paleoflood records for rivers that are sensitive to climatic variability. Use regional flood frequency, streamflow, and precipitation models to assess effects of variability.

PROGRESS: A conceptual framework for addressing the spatial and temporal effects of climatic variability on fluvial systems has been developed. Climatic patterns that affect winter flooding in the southwest have been identified, and work is proceeding on identification of the frequency with which this climatic patterns have occurred. Development of a new absolute dating technique involving cesium-137 is proceeding with promising results. This method, when proven, will be used in conjunction with dendrochronology to estimate sediment storage in alluvial channels during the last 50 years. Hydroclimatic analysis of flood frequency is proceeding with efforts concentrated on statistical methods of mixed population analysis. Analysis of frequency of tropical cyclone floods in the southwestern United States is proceeding, with identification of periods of reduced rainfall from this storm type occurring in the Four Corners region of the southwest after 1942. Two publications documenting this work are in press and two are in preparation.

REPORTS PUBLISHED 1989—1991:

Gray, J.R., Webb, R.H., and Hyndman, D.W., 1991, Low-flow sediment transport in the Colorado River, in Fan, S.S., and Kuo, Y.H., eds., Proceedings of the Fifth Federal Interagency Sedimentation Conference: Washington, D.C., Federal Energy Regulatory Commission, v. 1, p. 4—63 to 4—71.

Hyndman, D.W., Roberts, R.A., and Webb, R.H., 1991, Modeling sediment transport in an ephemeral river, in Fan, S.S., and Kuo, Y.H., eds., Proceedings of the Fifth Federal Interagency Sedimentation Conference: Washington, D.C., Federal Energy Regulatory Commission, v. 2, p. 8—101 to 8—108.

Nelson, D.J., Webb, R.H., and Long, Austin, 1990, Stick-nest rat (Leporillus: Muridae) middens from central Australia, in Betancourt, J.L., Van Devender, T.R., and Martin, P.S. eds., Fossil packrat middens: the last 40,000 years of biotic change: Tucson, Ariz., The University of Arizona Press, p. 428—434.

Webb, R.H., and Betancourt, J.L., 1990, Climatic effects on flood frequency—an example from southern Arizona, in Betancourt, J.L., and MacKay, A.M., eds., Proceedings of the Sixth Annual Pacific Climate (PACLIM) Workshop, March 5—8, 1989: California Department of Water Resources, Interagency Ecological Studies Program Technical Report 23, p. 61—66.

-----1990, The spatial and temporal distribution of radiocarbon ages from packrat middens, in Betancourt, J.L., Van Devender, T.R., and Martin, P.S. eds., Fossil packrat middens—the last 40,000 years of biotic change: Tucson, Ariz., The University of Arizona Press, p. 85—102

-----1990, Climatic variability and flood frequency of the Santa Cruz River, Pima County, Arizona: U.S. Geological Survey Open-File Report 90—553, 69 p.

Webb, R.H., Pringle, P.T., and Rink, G.R., 1989, Debris flows in tributaries of the Colorado River in Grand Canyon National Park, Arizona: U.S. Geological Survey Professional Paper 1492, 39 p.

Webb, R.H., and Rathburn, S.L., 1989, Paleoflood hydrologic research in the southwestern United States: Transportation Research Board Record 1201, p. 9—21.

Webb, R.H., Smith, S.S., and McCord, V.A.S., in press, Historic channel change of Kanab Creek, southern Utah and Northern Arizona: Grand Canyon Natural History Association Monograph.