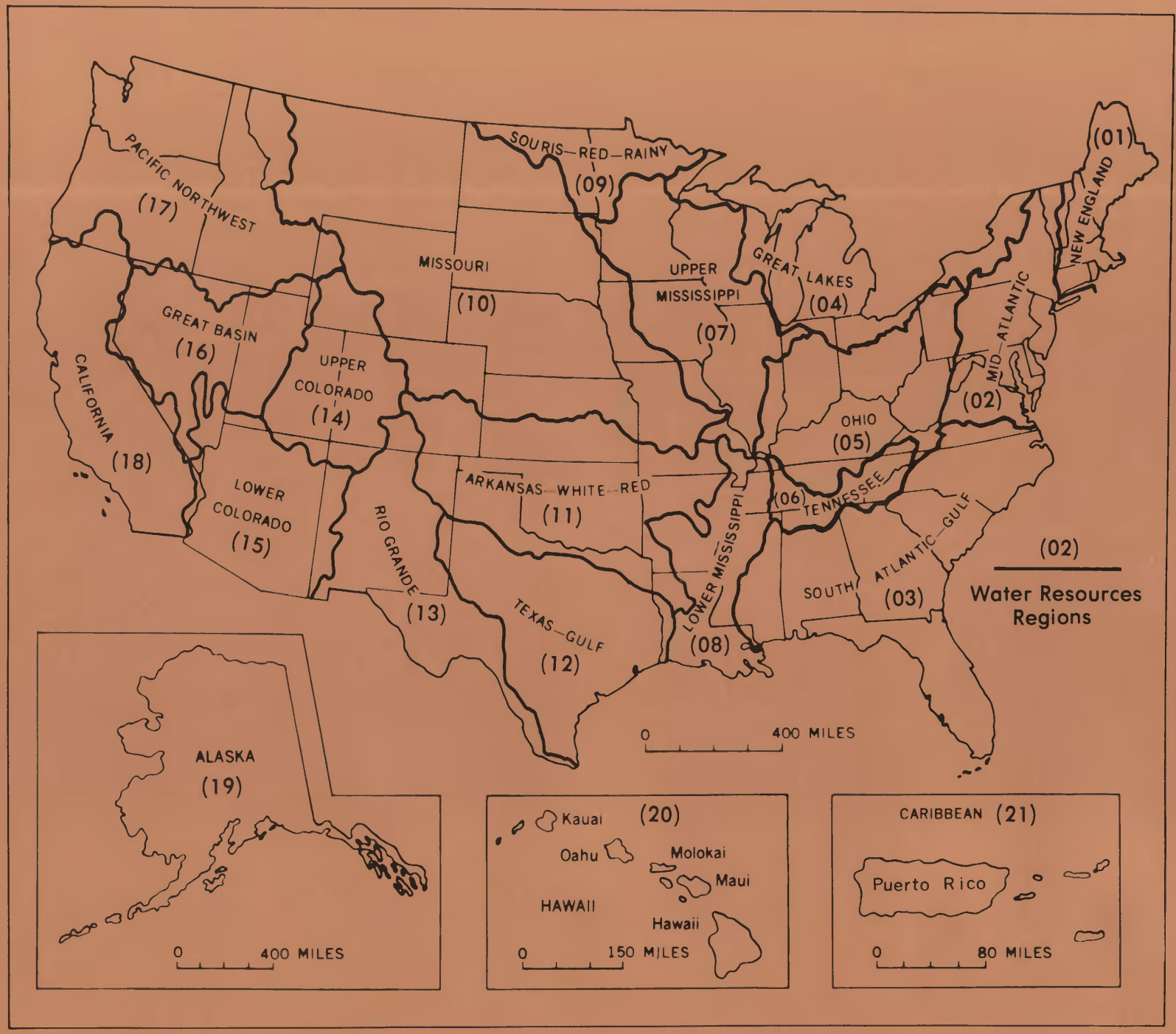
INTERAGENCY ADVISORY COMMITTEE ON WATER DATA

NOTES ON SEDIMENTATION ACTIVITIES CALENDAR YEAR 1987

U.S. DEPARTMENT OF THE INTERIOR
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 1987

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

U.S. DEPARTMENT OF THE INTERIOR
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Water Resources Division
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Reston, Virginia 22092

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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 Ground Water. 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.

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SERVICE CHARGES

Charges for NAWDEX services are assessed at the option of the organization providing the requested data or data service. Search assistance services are provided free by NAWDEX to the greatest extent possible. Charges are assessed, however, for those requests requiring computer services, extensive personnel time, duplicating services, or service costs accrued by NAWDEX from other sources in the course of providing services. In all cases, charges assessed by NAWDEX Assistance Centers will not exceed the direct costs incurred in responding to the data request. Estimates of cost are provided by NAWDEX upon request and in all cases where costs are anticipated to be substantial.

ADDITIONAL INFORMATION

For additional information concerning the NAWDEX program or its services, contact:

Program Office
National Water Data Exchange (NAWDEX)
U.S. Geological Survey
421 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

Telephone: 703/860-6031
FTS 928-6031

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 at Presumpscot River near West Falmouth, ME, as a part of NASQAN.

Merrimack Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Merrimack River above Lowell, MA, 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.

2. Suspended-sediment data are being collected on approximately a daily basis at Stony Brook near Suffield, CT, Salmon River near East Hampton, CT, and Coginchaug River at Rockfall, CT, to determine daily sediment loads. The data collection is being done in cooperation with the State of Connecticut Department of Environmental Protection.

Massachusetts-Rhode Island Coastal Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Charles River at Dover, MA, at Blackstone River at Millville, MA, and 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, and at Quinebaug River at Jewett City, 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.

Special Studies

1. Daily suspended-sediment sampling continued at the Housatonic River near Kent, CT, in the Connecticut Coastal Subregion, as part of a study to determine the rate and methods of PCB transport in the river. The study is being conducted in cooperation with the State of Connecticut Department of Environmental Protection.

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

District Chief, WRD
U.S. Geological Survey
150 Causeway Street, Suite 1309
Boston, MA 02114

NEW ENGLAND REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following Public Law 566 watersheds:

Major Drainage	Watershed	County	State
St. Johns River	Prestile Stream	Aroostock	ME
Penobscott	Upper Penobscott	Penobscott	ME
Thomas	Yantic	New London	CT

2. Special Studies

   a. Massachusetts Westport River Rural Clean Water Project

      Monitoring of Water Quality is continuing for bacteria and suspended solids and the effects of Best Management Practices.

   b. Rhode Island - An evaluation of management alternatives for solid and nutrient loading in vegetated filter strips began at the University of Rhode Island Agricultural Experiment Station. Initial greenhouse and laboratory studies were started in 1987. Field data collection will begin in 1988.

MID ATLANTIC REGION

CORPS OF ENGINEERS

North Atlantic Division

Baltimore District

Sediment Survey - Jennings Randolph Reservoir. An instrumented sediment survey was performed at Jennings Randolph (formerly Bloomington) Reservoir to quantify sediment accumulation at that project. Final survey cross-sections will be forthcoming from the contractor.

Sediment Removal

Project	Stream	Location	Amount Removed (Cubic Yards)
Arkport Dam	Canisteo River	Intake channel	2,348
Almond Lake	Canacadea Creek	Vicinity of N.Y. Rte. 21 Bridge	40
Binghampton N.Y.	Pierce Creek	N.Y. upper unpaved channel	105
Canisteo N.Y.	Purdy Creek	Check dam	7,854
		Confluence with Bennett Creek	1,200
Corning N.Y.	Cutler Creek	Upper channel & drop structure	494
Hornell N.Y.	Canisteo River	Lower end of paved channel	1,770
	Chauncey Run	Check dam	1,426
	Confluence Canisteo & Chauncey Run	Check dam	232
	Crosby Creek	Check dam	9,011
Lisle N.Y.	Confluence Tioughnioga River and Dudley Creek		140
Whitney Point Village N.Y.	Tioughnioga River	Channel	200
Tioga Lake	Tioga River	Lamb's Creek boat launch	30
		Total Removed	24,870

New York District

The District conducted sediment tests at the following locations.

Project Name & Number	Grain Size	Bulk Sediment	Elutri-ate	Bioassay	Bioaccumu-lation	E T
Eastchester Creek,NY (#6)	X	X	X	X	X	-
Flushing Bay & Creek,NY (#9)	X	X	X	X	X	-
Bay Ridge & Red Hook Channels, NY (#34):						
Bay Ridge Channel	X	X	X	X	X	-
Red Hood Channel	X	X	X	X	X	-
Gowanus Bay	X	X	X	X	X	-
Buttermilk Channel,NY (#36)	X	X	X	X	X	-
East River,NY (#37):						
South Brothers Is. Channel	X	X	X	X	X	-
Newtown Creek,NY (#39):						
Main Channel	X	X	X	X	X	-
Dutch Kills	X	X	X	X	X	-
Saugerties Harbor,NY (#47)	X	X	X	-	-	?
Hudson River,NYC to Waterford NY (#48):						
Castleton to Hudson	X	X	X	-	-	?
New York & New Jersey Channels (#63):						
Arthur Kill	X	X	X	X	X	-
Perth Amboy Anchorage	X	X	X	X	X	-

Philadelphia District

Sediment Load Measurements - Prompton Reservoir. An analysis was completed to determine the sedimentation rate of the Prompton Reservoir which is being studied for possible modification to add water supply storage. Determination of the sedimentation rate was necessary in order to determine the estimated 100 year accumulation of sediment volume within the reservoir for allocation of inactive storage. Three methods were utilized to determine the sedimentation rate at Prompton Reservoir. They were as follows:

a. Analysis of accumulated sediment from three sedimentation surveys that have ben taken during the 26 year life of the existing project. This analysis indicated a sedimentation rate of 7.58 acre-feet per year.

b. Analysis of accumulated sediment reported in reservoirs in the geographical location of Prompton Reservoir. This analysis indicated a

sedimentation rate of 7.57 acre-feet per year.

c. The U.S. Geological Survey, Harrisburg, PA under contract performed a sediment analysis for the Prompton Reservoir Modification Study. They collected weekly base flow samples and approximately sixty storm samples over the course of seven storms. This analysis indicated a sedimentation rate of 4.30 acre-feet per year.

The results of the three methods of determining sedimentation rates were compared and a rate adopted for use in determining long term sediment storage requirements. Because the sedimentation rate determined from sedimentation surveys closely matched the value determined in the regionalized analysis of watersheds with characteristics comparable to those at the study site, a value of 7.58 acre-feet per year was chosen as the design sedimentation rate for the modified Prompton Reservoir Project.

MID-ATLANTIC REGION

GEOLOGICAL SURVEY

Richelieu Subregion

1. Suspended-sediment data are being collected on a periodic 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.

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.

Lower Hudson-Long Island Subregion

1. Suspended-sediment data are being collected on a bimonthly basis and once during each of five storm events at Passaic River at Little Falls, NJ, and quarterly at Raritan River at Queens Bridge at South 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.

Delaware Subregion

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

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

3. Suspended-sediment data were collected once during each of five high-water events during 1987 at Passaic River at Little Falls, NJ.

4. Bottom material data (carbon, metals, organochlorine pesticides) are being collected at 32 sites in New Jersey on a yearly schedule.

Susquehanna Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Susquehanna River at Danville, Lewisburg, and Harrisburg as part of NASQAN.

2. 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 daily basis at Choptank River near Greensboro, MD, as part of the Federal Collection of Basic Records (CBR) program, Chesapeake Bay River-Input Monitoring project, and as a part of NASQAN.

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 and in cooperation with the Maryland Geological Survey.

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 and in cooperation with the Washington Suburban Sanitary Commission.

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.

Lower Chesapeake Subregion

1. Suspended-sediment data are being collected on a daily basis on Rappahanock River at Remington, VA, as a Federal sediment index station.

2. Suspended-sediment data are being collected bimonthly at Rappahannock 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.

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, nutrient, and pesticide data were collected during 1987 from the Little Conestoga Creek near Morgantown and near Churchtown, from a 25-acre corn and alfalfa field and from a 50-acre corn field that were selected for conservation treatment with best management practices. Automatic samplers are used at each of the sites.

2. Sediment data are being collected with automatic samplers from three streams in the lower Susquehanna River basin as part of a study of nutrient discharges. Samples are also obtained from an additional four streams during storms.

3. Suspended-sediment data are being collected with automatic samplers from two 200-acre agricultural basins in the noncarbonate region of southeastern Pennsylvania. The study is designed to evaluate the effects of best management practices on sediment and nutrient discharge.

4. Suspended-sediment data are being collected with automatic samplers from seven agricultural fields ranging in size from 1.5 to 14 acres. Data are collected at five stream gages using both automatic and manual samplers. These data are being collected throughout the Patuxent River basin, MD, to provide loading factors and calibration/verification data for the Hydrological Simulation Program-Fortran (HSPF) model of the watershed.

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
P.O. Box 1107
Harrisburg, PA 17108

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

MID - ATLANTIC REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following watersheds:

   a. Public Law 566

Major Drainage	River	County	State
Atlantic Coastal	Love Creek	Sussex	DL
York	Pamunky	King & Queen	VA
James	Hayes Creek	Rockbridge	VA

   b. River Basin Investigations

Major Basin	Basin Reported	State
Lake Champlain Richelieu	Lower Lake Champlain (Direct Drainage)	VT

2. Reservoir Sedimentation Surveys

Reservoirs	Counties	State
N. Br. Cowanesque River, PA-406	Potter	PA
Neshaminy Creek, PA-620	Bucks	PA
Liganore	Frederick	MD

3. Special Studies

   Vermont

   LaPlatte River Watershed Water Quality Comprehensive Monitoring and Evaluation (CM+E) continuing.

   St. Albans Bay Watershed Water Quality (CM+E) continuing.

   New Jersey

   Study of sediment damages made to Wildwood Lake, Morris County.

SOUTH ATLANTIC-GULF REGION

CORPS OF ENGINEERS

South Atlantic Division

Charleston District

Coastal Shoreline Monitoring. Monitoring of coastal shoreline changes for the jetty systems at Little River and Murrells Inlets, South Carolina, continued through 1987. The second five-year monitoring period for Murrells Inlet, South Carolina, was completed in October 1987. A report for the initial phase of the Murrells Inlet Monitoring Program was published in February 1987 by the Corps Coastal Engineering Research Center in Vicksburg, Mississippi. The second five-year monitoring period for Little River Inlet was continued during 1987. Anticipated date for the report covering the initial monitoring phase is January 1989. The monitoring of the projects is being performed to determine the effect that a weir jetty system has on littoral transport processes and adjacent shorelines. Data being gathered for monitoring these projects include:

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

The data, which is gathered on a regular basis, is forwarded to the Coastal Engineering Research Center at US Army Engineers Waterways Experiment Station in Vicksburg, Mississippi, for analysis and report preparation.

Charleston Harbor Section 111 Study. The Section 111 study for the Charleston Harbor jetties at Charleston, South Carolina has been completed. Evaluation of the changes in the rate of beach erosion in the vicinity of the jetties was made on the basis of historical data extracted from USC&GS surveys and charts. Due to the age of the jetties and various manmade alterations affecting Charleston Harbor, the following time frames were selected for determining the changes in the rate of erosion:

a. 1851-1857 (Before construction of Charleston Harbor jetties)
b. 1860-1869 (During construction of Charleston Harbor jetties)
c. 1900-1910 (Post-construction of Charleston Harbor jetties)
d. 1921 (Post-construction of Charleston Harbor jetties)
e. 1963-1965 (Post-construction of Charleston Harbor jetties)
f. 1985 (Post-construction of Charleston Harbor jetties)

The Coastal Engineering Research Center at the US Army Engineers Waterways Experiment Station in Vicksburg, Mississippi, was instrumental in furnishing support to the District in analyzing the historical data, which shows that 57 percent of the erosion occurring at Folly Beach is contributable to the presence of the Charleston Harbor Jetties.

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 114 cross sections across the canals plus seven cross sections across the Santee river and a photographic history of bank erosion. The monitoring is to be done annually for the first three years, then again in the fifth year of operation and thereafter at five-year intervals unless conditions warrant otherwise. The third annual survey will be taken in April 1988. A scour hole occurred immediately off the end of the stilling basin following initial start-up of the powerhouse in 1985. 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 placing a five-foot layer of riprap across the channel bottom. During 1987, another scour hole formed downstream of the initial scour hole. Plans are being developed to riprap this area in the wet during 1988.

Bank-to-bank cross sections are also being taken at 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 fresh water 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 cross sections are to be taken annually for a five-year period. The third set of cross sections were taken during the period February to July 1987.

Mobile District

Sedimentation Surveys. The sedimentation range networks in Demopolis, Gainesville, Aliceville, Columbus, and Aberdeen Lakes were resurveyed during the year. These lakes are located on the Tennessee-Tombigbee Waterway. Additionally, the retrogression ranges downstream of Allatoona Dam on the Etowah River, Buford Dam on the Chattahoochee River, and Carters Dam on the Coosawattee River were resurveyed. The data was collected by standard land survey procedures combined with hydrographic surveys by fathometer and soundings. The data is computerized and will be retrieved for use in various hydrologic and sedimentation studies.

Sediment load Measurements. The collection of suspended sediment samples on a daily basis was continued on the Tombigbee River at Columbus, Aberdeen, Amory, and Fulton, Mississippi.

The ongoing program of collecting suspended samples also includes periodic sampling at 24 stations. Eleven of these are operated by U.S. Geological Survey at the following locations:

Alabama	Alabama River at Montgomery, AL
	Black Warrior River near Northport, AL
	Tombigbee River at Gainesville, AL
Florida	Apalachicola River at Chattahoochee, FL
Georgia	Chattahoochee River near Whiteburg, GA
	Chattahoochee River at West Point, GA
	Flint River at Newton, GA
	Oostanaula River at Resaca, GA

Etowah River near Kingston, GA

Mississippi — Noxubee River at Macon, MS
Town Creek near Nettleton, MS

Bed material samples were collected at numerous study and gaging stations within the Mobile District. Grain size analyses were utilized in bed load computations 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. Tombigbee River Bendway Management Study. A coordinated study of cut-off bendway sedimentology continued during the year. The study is an interagency effort aimed at preserving the ecology of bendways by minimizing sediment deposition. A draft report of the study recommending management techniques of the cut-off bendways has been prepared.

2. Tombigbee River (East Fork) Study. A comprehensive study of the hydraulics of the Tombigbee River (formerly East Fork) from its confluence with the Tennessee-Tombigbee Waterway navigation channel in Aberdeen Lake upstream to its headwaters has been published. The study describes the natural hydraulic and sediment processes and the impacts of man-induced changes on the flood plain.

3. Apalachicola, Chattahoochee, and Flint Rivers. An ongoing sedimentation data collection program is being conducted in support of the "Apalachicola, Chattahoochee, and Flint Rivers Navigation Maintenance Plan". The published plan is an agreement between the states of Alabama, Florida, and Georgia, and the U.S. Army Corps of Engineers, Mobile District. Seventy sedimentation ranges on the Apalachicola River were surveyed during the year. Bed material samples were collected at 27 of the sedimentation ranges and suspended samples were collected at 7 locations in accordance with the plan.

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 870,000 cubic yards being pumped northward to Wrightsville Beach and 1,128,000 cubic yards placed on Masonboro Island to the south. No dredging has been accomplished in the inlet since that time.

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 in March 1988 and is scheduled to be completed in May 1988. An estimated total of 920,000 CY will be removed from the trap and placed in the northern 5,300 feet of Carolina Beach.

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 2 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.

Reservoir Sedimentation. B. Everett Jordan Project. The first sedimentation resurvey of B. Everett Jordan Lake began in November 1987. This survey will incorporate both land and hydrographic survey data and will determine the extent of sediment deposition in Jordan Lake since impoundment on 4 February 1982. The survey is expected to be finished by mid-1988.

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 being collected on a daily basis at the main station on the Chicod Creek and on a monthly basis at three sites in the Chicod Creek watershed near Grimesland, NC, in cooperation with the U.S. Department of Agriculture, Soil Conservation Service. These data will be used to determine changes caused by channelization which was completed in 1981.

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

3. Suspended-sediment data are being collected monthly and during floods at six headwater stations on the Neuse River to determine the quality of inflow into the new (1983) 12,500-acre Falls Reservoir. This effort is part of a cooperative program with the U.S. Army Corps of Engineers (COE).

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.

2. Suspended-sediment data are collected bimonthly at 15 small headwater sites of the Haw River in cooperation with the city of Greensboro. The data will be used to define the effects of runoff from the city on primary receiving waters.

3. Suspended-sediment data are being collected on a monthly basis and during floods at five sites in the Grove Creek basin, near Kenansville, NC, to define effects of channel modifications, in cooperation with the North Carolina Department of Human Resources.

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.

Santee-Edisto Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Lakes Marion-Moultrie Diversion Canal near Pineville, SC, and at Edisto River near Givhans, SC, and quarterly at Coosawhatchie River near Hampton, SC, as a part of NASQAN.

2. Suspended-sediment data are being collected on a monthly basis at Crawl Creek near Pineville, SC, 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 three 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 six 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 sites 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 four 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 bimonthly or quarterly basis at three 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.

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 about a 6-week basis at Town Creek at Nettletown, MS, and at Noxubee River at Macon, MS, in cooperation with the COE.

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 at 15-minute intervals during storm runoff from two 6-acre farm tracts used to evaluate land-management practices in northern Guilford County, NC. Sediment data are also collected at a 600-acre multiuse site and a 34-acre forested site in conjunction with the program, conducted in cooperation with the Guilford County Soil and Water Conservation District.

3. Suspended-sediment data are collected monthly and more frequently during high flows at 10 forested basins across North Carolina. Sizes of basins range from 0.6 to 7.5 square miles. Conducted in cooperation with the North Carolina Department of Natural Resources and Community Development, the data will help define background levels of sediment in the State's streams.

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

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

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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
P.O. Box 2857
Room 436, Century Postal Station
300 Fayetteville Street Mall
Raleigh, NC 27602

District Chief, WRD
U.S. Geological Survey
1835 Assembly Street, Suite 677A
Columbia, SC 29201

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

SOIL CONSERVATION SERVICE

1. Studies of gross erosion, sediment yields, and/or sediment damages were made for the following Public Law 566 activities.

Major Drainage	Watershed	Stream	County	State
Alabama	Choccolocco	Choccolocco Creek	Calhoun Talladega Cleburne	AL
Apalachicola	Little Kolomoki-Factory Creeks	Tribs to the Chattahoochee Rivers	Early	GA
	North Lanier (continuation)	Chestatee & Chattahoochee Rivers	White Hall Lumpkin	GA
	Chickasawhatchee Creek	Flint River	Terrell	GA
	Turkey Creek (continuation)	Turkey Creek	Dooly Houston	GA
Ochlockonee	Bridge Creek	Bridge Creek	Colquitt	GA
Ogeechee	Upper Fifteen Mile	Upper Fifteen Mile	Emanuel	GA
	Upper Lotts Creek	Lotts Creek	Bulloch	GA
	Ogeechee Area	Ogeechee R. Tibutaries	Screven	GA
Witheacoochee	Piscola Creek	Piscola Creek	Thomas Brooks	GA
Mobile-Tom-bigbee	Town Creek	Town Creek	Lee Pontotoc Pentiss Union	MS

Major Drainage	Watershed	Stream	County	State
Neuse River	Black Creek	Black Creek	Johnston Wake	NC
Neuse River	Upper Contentnea	Contentnea Cr.	Franklin Johnston Nash Wake Wilson	NC
Ashley-Combahee-Edisto River Basin	Coosawhatchie-Jackson	Coosawhatchie River & Jackson Br. -a tributary to Salkehatchie River	Allendale	SC
Pee Dee River Basin	Black Cr.	Black Cr.	Chesterfield Darlington	SC
Ashley-Combahee-Edisto River Basin	South Edisto	South Fork Edisto River	Bamberg Barnwel	SC
Santee River Basin	Stoney Fork-South Fork	Stoney Fork & South Fork-Tributaries to Fishing Creek	Chester York	SC
Pee Dee River	Scape Ore	Scape Ore Swamp-Tibutary to Black River	Kershaw Lee	SC
Ashley-Combahee Edisto River Basin	Ridge	Shaw Creek & South Fork Edisto River	Aiken Edgefield Saluda	SC
Savannah River Basin	Tokeena	Beaverdam Cr. & Coneross Cr. Tributaries of Seneca & Tugaloo River	Anderson Oconee	SC

2. Reservoir sedimentation Surveys

Reservoir	County	State
Rvoty Creek #21	Putnam	GA

GREAT LAKES REGION

CORPS OF ENGINEERS

North Central Division

Buffalo District

Cattaraugus Creek Final Feasibility Report. Plan 3A of the Cattaraugus Creek Final Feasibility Report provides for an overflow channel at the creek mouth with maximum dimensions of 5000 ft in length and 1000 feet in width by two-to-three feet in depth. The lakeward end of the channel would require excavating the beach adjacent to N. Breakwater berm to elevation +5.5 ft LWD. The expected shoaling at the mouth of this elevated bypass channel was determined by an investigation of the accretion/degradation of the N. Breakwater fillet since completion of the Cattaraugus Breakwaters in Fall 1982. Using survey information obtained under the Monitoring of Completed Coastal Projects (MCCP) program, an estimated annual shoaling rate of 11000 cu. yds. was determined and used to assess the economic viability of this proposed plan.

Ashtabula River Water Quality. Water quality regarding suspended sediment concentration at the Ashtabula area water supply intake was studied as a function of future dredging of the Ashtabula River. Results show the harbor water would not spill over the west breakwall and contaminate the intake area, but under certain combinations of NE winds and river flows, suspended material that is restricted in settling by waves may leave the harbor area and follow the west breakwall to the intake area.

Buffalo River Sedimentation Study. The Buffalo River and its tributaries drain a watershed of approximately 408.6 square miles. Sediment erosion from the uplands and stream channel results in continuous filling of the lower Buffalo River including the Federal navigation channel. Sediment deposition in the lower reaches of the river is also influenced by the level of Lake Erie.

The purpose of this analysis was to study shoaling of the navigation channel if dredging is no longer performed. The computer model HEC-6, "Scour and Deposition in Rivers and Reservoirs", developed the Hydrologic Engineering Center, Davis, California was used for this analysis. The study resulted in 1) new thalweg elevations to be used in other studies for new HEC-2 backwater analysis to determine the associated water surface elevations upstream of the navigation channel and 2) a general procedure for evaluating the impact of modifying dredging program or analyzing other district streams.

Based upon the results of the sedimentation analysis, it was concluded that the lower Buffalo River from the upper end of the Federal navigation channel to mouth would continue to accumulate for the 25 year period chosen for the study. The total increase in deposition varied from 1 to 10 feet throughout the navigation channel and indicated an overall average rate of accumulation of 0.3 feet/year.

Cattaraugus Creek Sedimentation Analysis. The Cattaraugus Creek Watershed in western New York State, has a long history of flooding often created by ice jamming. One alternative that was considered in the Cattaraugus Creek Final

Feasibility Report was the construction of an ice retention structure. A sedimentation analysis was performed to estimate the amount of sediment expected to deposit immediately upstream of the proposed structure. The amount predicted was used to determine dredging costs for maintenance.

Significant changes in river morphology of the lower reaches of Cattaraugus Creek over the past 50 years indicate that the bedload transport is relatively substantial. It is anticipated that the proposed ice retention structure will change the flow regimen and the areas of erosion and deposition in the creek.

A quantitative analysis of sediment transport in the vicinity of the ice retention structure was performed using a computer model, HEC-6, Scour and Deposition in Rivers and Reservoirs. The input sediment curves, the flow duration curve, the rating curve and the bed particle size distribution from the available field data were used as the boundary conditions for the analysis of existing conditions without the structure. The effects of the proposed ice structure were analyzed. Results of the model that simulated the regulation of the structure indicate that a total of 56,000 tons of sediment is predicted to accumulate in one year.

Irondequoit Bay Harbor, New York. The construction of the Irondequoit Bay Small Boat Harbor was completed in 1986. A scour hole developed at the northerly end of the west Breakwater at Irondequoit Bay Harbor, New York. Soundings performed in September 1987 indicated depths of 30 feet immediately adjacent to the head of the breakwater as compared to depths of between 12 and 13 feet in May 1986. Emergency repairs were taken during November-December of 1987 by placement of 6,000 tons of stone on the scour hole to insure integrity of the structure. Additional investigations will be conducted in the spring of 1988 to determine the extent of the scour hole and whether the condition has changed since the last soundings were performed.

Environmental Analyses of Harbor Sediments for O & M Program.

1. Sediment Testing. Sediment and water samples were obtained from the following list of project locations within the District. Sediment testing that included bulk chemical, elutriate and bioassay was completed for Vermilion, Oswego, Olcott, Oak Orchard and Buffalo Harbors. In addition, testing for EP Extraction, groundwater, quality algal uptake and abiotic concentration of contaminants was performed at Buffalo. Acute and Sublethal Bioassay of sediments for possible open-lake disposal was performed for Toledo Harbor, Ohio.

Project	Test Description	No. of Sites	Cost($)
Vermilion, OH	Bulk Chem., Elutriate, Bioassay	12	13K
Oswego, NY	" " "	20	22K
Olcott, NY	" " "	8	13K
Oak Orchard, NY	" " "	7	11K

Project	Test Description	No. of Sites	Cost($)
Buffalo, NY	Bulk Chem., EP Extraction, Column Leachate, Groundwater	12 Sed 13 Water	45K
Buffalo, NY	Algal (Cladophora) uptake and Abiotic Concentration of Contaminants	21	30K
Toledo, OH	Acute and Sublethal Bioassay of open-lake Disposal	125	50K

2. Sediment and Water Quality Testings. Specific water quality and sediment testing projects are summarized in the followings.

a. Buffalo Harbor. Two new sampling techniques were tested in Buffalo Harbor to assess the rate at which contaminants may be leaching from the three confined disposal areas.

The first of these techniques involved the sampling of the alga cladophera from the inside and outside surfaces of the dike walls. Significant differences in concentration between the inside and outside in comparison to the control areas (the inside of the harbor wall) would be an indication of the migration of contaminants through the dike walls. There were no significant concentrations of organic chemicals measured in the cladophera no matter where it was growing in the harbor. Metals were readily measured in all samples, but there was no indication of contamination by leachate from the dikes.

The second technique involved the placement of isooctane filled polyethylene bags on the inside and outside of the dikes and at the control areas. The organic solvent filled bags have a very strong affinity for organic chemicals which they encounter in the water column. These samples, known as Static Abiotic Samplers or SAS, demonstrated that they can detect contaminants in the water column even when they cannot be detected by conventional analysis of a water sample. Two samples taken from a ground water monitoring well in the Small Boat Harbor Dike demonstrated the presence of 8 organic compounds which were not detected by analysis of the water. As with the cladophera, though, there was no indication of leaching of contaminants from the CDF's. A final report on the results of this testing will be provided in late January 1988.

b. Toledo Harbor. The State of Ohio requested a supplementary sampling and analysis program for the Toledo Harbor Channel due to the fact that dredged material from this channel is being open water disposed. Four bioassays which are new to our testing program were used: Chironomous tentans growth reduction, ceriodaphnia reticulata reproduction, pimphales prameleus seven day larva survival and microtox. These four bioassays are very sensitive for variation in toxicity and are capable of discrimination between organic and metallic contamination. A final report on the results of these bioassays will be available in April 1988.

In addition to the bioassay studies, open-lake disposal of 500,000 cy of dredge material from the navigation channels occurred this year. The 1986

data involving alleged high inputs of phosphorus with associated algal blooms have been fully analyzed and the analysis does not indicate water quality violations directly attributable to dredge disposal activities.

The Ohio EPA approved the 401 Water Quality certification for 1987, allowing all non-polluted dredged material to be disposed open-lake. Also, the Ohio EPA has developed a five year plan, which calls for a phased-in cessation of open-lake disposal, for the disposition of dredged material from the Toledo Harbor channels.

The following established conditions will be utilized in 401 certifications from 1988 through 1991.

Year	Open-Lake Disposal (cy)	Confined Disposal Alternative/Use/(cy)
1987	500,000	500,000
1988	300,000	700,000
1989	100,000	900,000
1990	0	1,000,000
1991	0	1,000,000

Currently, alternative sites for open-lake disposal and reuse of dredged materials are being considered.

c. Times Beach CDF, Buffalo, NY. Specimens of songbird, water foul, muskrats, and other terrestrial animals, which reproduce or spend much of their life cycle at the site, were obtained in 1986. These samples were analyzed in 1987 for organic and heavy metal toxicants found in lower food chain organisms to determine the extent of bio-magnification through food chains.

Fairport Harbor Section 111 (Mitigation of Shore Damage Due to Federal Navigation Projects) Littoral Analysis. A sediment budget is currently being developed for the shoreline of Lake Erie from the Chagrin River to Fairport Harbor. This work is being performed by Coastal Engineering Section as part of the Fairport Harbor Section 111 Reconnaissance Report. The preliminary findings of this analysis follow.

Much of the data used in this analysis was obtained from the report entitled "Lake Erie Shore Erosion, Lake County, Ohio: Setting, Processes, and Recession Rates From 1876 to 1973", by Charles H. Carter, Ohio Department of Natural Resources, Division of Geological Survey. That report contains information on bluff stratigraphy, bluffline recession rates, composition of the till layer, and composition of the sand layer in the bluff. Based on that information, it was determined that the average annual losses from the bluff between the Chagrin River and Fairport Harbor for the period 1937 to 1973 were 53,600 c.y./yr. of till from the till layer and 13,760 c.y./yr. of sand from the sand layer. Assuming that 20% of the till layer in this reach is sand and gravel, erosion of the till releases 10,720 c.y./yr. of sand and gravel. Assuming that only the sand coarser than .125 mm is beach building material, erosion of the sand layer releases 8,475 c.y./yr. of this coarser sand. Therefore, combining these quantities, assuming that 15% of the total is lost offshore, and that 65% of what remains moves alongshore to the east, the littoral drift to the east is 10,605 c.y./yr., say 10,600 c.y./yr.

Based on the analysis of lake survey charts from 1876 and 1974, it was determined that the total accretion updrift of the west breakwater over this period was approximately 7 million c.y. Although this averages to approximately 71,000 c.y./yr., it is not considered to be representative of the current rate of littoral drift for this reach. The installation of Cleveland Electric Illuminating Company's intake structures in 1952 shut off the longshore movement of sand from the southwest. Therefore, the quantity previously stated, i.e., 10,600 c.y./yr., is assumed to be representative of the current rate of littoral drift feeding the updrift side of the west breakwater. This analysis assumes that the contribution of littoral drift from the Chagrin River is negligible. This assumption is based on information contained in the five reports entitled "U.S. Geological Survey Water-Data Report" for the water years 1977 to 1981, prepared in cooperation with the State of Ohio and with other agencies.

A more recent analysis of lake survey charts from 1978 to 1983 showed that there was an average annual erosion of the fillet updrift of the west breakwater of 67,500 c.y./yr. over this five year period. However, aerial photographs from 1978 and 1987 show that the beach portion of the fillet grew over this nine year period. A possible explanation for this apparent discrepancy is that during periods of high lake levels, large quantities of material were permanently lost from the fillet. At the same time, additional material from the fillet was stored in offshore bars. Then, during the recent period of rapidly lowering lake levels, that is since March 1987, these offshore bars have moved into the nearshore zone and accreted on the beach portion of the fillet.

Additional quantities of accretion, erosion and removal of littoral material in the vicinity of Fairport Harbor are identified below.

An average annual quantity of 22,134 c.y. of material was dredged annually from the outer shoal at the entrance channel to Fairport Harbor from 1981 to 1985. Of this, 20,540 c.y. is considered to be beach building material.

In addition, once outer shoal is formed, it is suspected that large quantities of littoral material move over the shoal and past the entrance channel and continue downdrift offshore. Similarly, it is believed that additional quantities of material move around the west breakwater and move shoreward into the entrance channel. This is in addition to the material which is dredged from the outer shoal. Sediment samples and additional data on dredging quantities within this area are necessary to compute this amount.

An average annual quantity of 6,100 c.y. of sand was blown or washed over the west breakwater from the fillet, as evidenced by the analysis of the 1978 and 1983 lake survey charts. There is probably additional sand which is blown or washed over the west breakwater, but falls into the navigation channel. This quantity cannot be obtained from lake survey charts, and has not been computed.

Chicago District

Sedimentation Programs.

1. Waukegan Harbor, Illinois. The District conducted a sediment sampling program by contract at the Waukegan Harbor approach channel during September-

October 1987 in relation to proposed dredging of the approach channel. Five cores were taken in the approach channel. Three grab samples were taken north and east of the area to be dredged to determine background conditions. The sediment from the approach channel was found to be suitable for open lake disposal. The contractor's report is available from District files.

The District also conducted sediment sampling of the Waukegan inner harbor by contract in September 1987. The District contracted analysis of these sediments separately to the Waterways Experiment Station (WES) Environmental Laboratory. A report on this sediment and its interstitial water will be prepared by WES in relation to proposed maintenance dredging and disposal of these sediments. The data will be available in District files.

2. Indiana Harbor, Indiana. The District funded a research program by the Corps' Waterways Experiment Station in relation to maintenance dredging of Indiana Harbor. The report of these studies, "Disposal Alternatives for PCB-contaminated Sediments from Indiana Harbor", was published in 1987, and includes analyses of sediments, evaluations of dredging and disposal alternatives, and development of new testing protocols for contaminated sediments. The report is available from the district, WES, and through NTIS.

3. Michigan City, Indiana. A sediment and water quality monitoring program was conducted by the District during dredging and disposal at Trail Creek, Michigan City, Indiana. The dredged sediment was sampled weekly and analyzed by Corps laboratory contractor. The data is available from the District files.

Operations and Maintenance Surveys. In 1987, 142 hydrographic surveys were completed at Great Lakes harbors, channels and rivers. Condition surveys were made at 98 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. Twenty three "prior" and twenty one "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.

Special Studies.

1. Hopper Dredge Studies. This study was conducted during August and September 1987. Two locations were chosen, one in a sandy area, and one in a silty area, on the Saginaw River. Three stations on board the dredge were monitored: hopper inflow, hopper contents, and hopper overflow. Additionally, plume monitoring was conducted in the river to compare background conditions on the impact of dredging with and without overflow. Results of this study are expected in January 1988.

2. Dye Study. A dye study was conducted by the Waterways Experiment Station in the south cell of the Signaw Bay CDF during August and September 1987. Results indicated low seepage rate along most of the south dike wall with an area of higher seepage beginning near the weir and extended about 1,000 feet west.

3. Field Verification of PCB Mass Balance Model. As part of an inter-

agency CDF Workgroup, a model was developed to estimate the loss of dissolved PCB by pond water seeping through permeable dikes. Field and laboratory testing was conducted to verify these procedures and determine the response characteristics of pond water dissolved PCB concentration to disposal operations. Samples were collected at the CDF during August and September 1987. Laboratory analysis will be completed in FY 88. At the same time, the U.S. Fish and Wildlife Service and the Environmental Protection Agency conducted bio-uptake studies using caged animals. The organisms were placed inside and outside the CDF walls and will be tested for uptake of PCBs and other pollutants.

Sediment Bioassessment Study. The Detroit District is working with the St. Paul District and the State of Wisconsin to develop and evaluate a bioassessment protocol to be used for the regulatory testing of dredged material. This group recently collected sediment samples at two Great Lakes Harbors which will be used to evaluate several techniques. Testing will include acute lethality testing, chronic toxicity testing, and bioaccumulation exposures.

Detroit District

Sediment Sampling Activities. Environmental Analysis. In 1987, sediment samples were obtained at the following locations for environmental analysis. Bulk chemical, elutriate and benthos testing were completed at Muskegon Harbor, St. Joseph (Whirlpool) and Point Mouillee in support of Operations and Maintenance confined disposal facility (CDF) projects. Bulk chemical, elutriate and benthos testing were completed at Ashtabula, Big Suamico, Clinton River, Grand Marais, Indiana Harbor, Port Washington, Presque Isle, St. Marys River, Sturgeon Bay and Two Rivers. Bulk chemical, elutriate and benthos testing were completed at Duluth-Superior and Saginaw River as part of a routine, periodic sediment testing program.

Elutriate testing included tests for nutrients, metals and chlorinated organics. The sampling and analysis were conducted to determine the present level of sediment contamination and to evaluate the most appropriate method of disposal of dredged material.

Sedimentation Surveys. Section 111 Monitoring. Hydrographic surveys were conducted at the following harbors in 1987.

Harbor	Number of Surveys	Survey Lines
White Lake, MI	1	8
Muskegon, MI	1	8
St. Joseph, MI	1	24
Holland, MI	1	12
Grand Haven, MI	1	13
Ludington, MI	1	16

The surveys were accomplished as part of the formal monitoring program in support of O&M Section 111 beach nourishment activities. The surveys were made along established range lines, using automated positioning and survey equipment, from the shoreline to the 20 foot depth contour. The reach of shoreline surveyed extends on either side of each harbor to a distance of 2 to

3 miles. The surveys document nearshore conditions at the time of the survey and, when compared with previous surveys, show changes that may have occurred in the bathymetry.

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).

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 Tahquamenon 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.

4. Suspended-sediment data are being collected on a periodic and storm-event basis at the Fox River at Appleton, WI, and intermittently at the Fox River outlets from Lake Winnebago at Neenah, WI, and at Menasha, WI. These data are being collected in cooperation with the Wisconsin Department of Natural Resources.

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.

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 Kalamazoo 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, and on a quarterly basis at Muskegon River near Bridgeton, 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.

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, 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, Honey Creek at Melmore, OH, and Huron River at Milam, OH, in cooperation with the Ohio Department of Natural Resources.

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

4. Suspended-sediment data are being collected on a daily basis at Vermilion River near Fitchville, OH, in cooperation with the Ohio Environmental Protection Agency.

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.

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.

2. Suspended-sediment data (quantity and quality) are being collected in the Irondequoit basin, Monroe County, NY, to determine the effects of the instream impoundment on streamflow and water quality in a small residential headwater basin.

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

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Indianapolis, IN 46254

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following Public Law 566 watersheds:

Major Drainage	Watershed	Stream	County	State
St. Joseph River	Pigeon Cr.	Pigeon Cr.	Steuben	IN
Rainy Lake	Echo Lake	Morris Finstad Wildlife Pond	St. Louis	MN

CORPS OF ENGINEERS

OHIO RIVER DIVISION

Huntington District

Sedimentation Surveys.

1. Tom Jenkins (Burr Oak) Lake, East Branch of Sunday Creek, Ohio. A letter report on the 1984 sedimentation investigation of reconnaissance scope was submitted in 1987. Fathometer profiles, without horizontal control, were obtained along 13 sediment ranges within the seasonal pool. The resurvey indicated that sedimentation in the seasonal pool area was not excessive.

2. Delaware Lake, Olentangy River, Ohio. A letter report on the 1984 sedimentation investigation of reconnaissance scope was submitted in 1987. Lake bottom profiles without horizontal control were obtained along 12 sediment ranges within the seasonal pool area. The resurvey indicated that sedimentation in the seasonal pool area was not excessive.

3. Dillon Lake, Licking River, Ohio. A letter report on the 1984 sedimentation investigation of reconnaissance scope was submitted in 1987. Uncontrolled fathometer profiles within the seasonal pool were obtained along 13 sediment ranges. The resurvey indicated that the rate of sedimentation in the seasonal pool area was not excessive. A detailed resurvey of the seasonal pool area was recommended since sedimentation has adversely affected boating in the upper portion of the lake.

4. Alum Creek Lake, Alum Creek, Ohio. A letter report on the 1984 sedimentation investigation of reconnaissance scope was submitted in 1987. Fathometer profiles, without horizontal control, were obtained along 14 sediment ranges within the seasonal pool. The resurvey indicated that sedimentation in the seasonal pool area was not excessive.

5. R. D. Bailey Lake, Guyandot River, West Virginia. A report on the 1984 sedimentation resurvey of 14 sediment ranges in the seasonal pool area and three sediment ranges downstream of the dam was submitted in 1987. The resurvey indicated that the rate of sedimentation for the 4.50-year period between the time impoundment of the minimum pool began in February 1990 and the August 1984 resurvey was 0.90 acre-foot per year per square mile of contributing drainage area. This rate is greater than expected, so a resurvey has been scheduled for 1990.

6. North Fork of Pound Lake, North Fork of Pound River. Uncontrolled fathometer profiles at 15 sediment ranges at North Fork of Pound Lake were obtained in 1987. A report is currently being prepared.

7. Bluestone Lake, New River, West Virginia. Uncontrolled fathometer profiles at 14 sediment ranges at Bluestone Lake were obtained in 1987. A report is currently being prepared.

8. Grayson Lake, Little Sandy River, Kentucky. A resurvey of 21 sediment

ranges at Grayson Lake was conducted in 1987. Current ground profiles were obtained for 19 sediment ranges upstream of the dam and for two sediment ranges downstream of the dam. A report on the resurvey is currently being prepared.

9. Beech Fork Lake, Twelvepole Creek, West Virginia. A resurvey of 16 sediment ranges at Beech Fork Lake was conducted in 1987. Current ground profiles were obtained for 13 sediment ranges upstream of the dam and for three sediment ranges downstream of the dam. A report on the resurvey is currently being prepared.

10. North Branch of Kokosing River Lake, North Branch of Kokosing River, Ohio. A resurvey of sediment ranges at North Branch of Kokosing River Lake was conducted in 1987. Current ground profiles were obtained for seven existing sediment ranges upstream of the dam, for three new sediment ranges upstream of the dam and for two existing sediment ranges downstream of the dam. A report on the resurvey is currently being prepared.

Other Sediment Measurements.

1. Fishtrap Lake, Levisa Fork, Kentucky. Suspended sediment data were collected by the District at the Levisa Fork at Big Rock, Virginia, gaging station and at gaging station on five tributary streams in the Fishtrap Lake Drainage Basin.

2. Dewey Lake, Johns Creek, Kentucky. Suspended sediment data were collected by the District at the Johns Creek at Meta, Kentucky, monitoring station and at gaging stations on two tributary streams in the Dewey Lake Drainage Basin.

3. R. D. Bailey lake, Guyandot River, West Virginia. Suspended sediment data were collected by the District at the Clear Fork and the Baileysville monitoring stations.

4. Yatesville Lake, Blaine Creek, Kentucky. Suspended sediment data were collected by the District at the Blaine Creek at Blaine, Kentucky monitoring station.

Louisville District

Sedimentation Surveys.

1. Cave Run Lake, Licking River, Kentucky. The Cave Run Lake sedimentation report is currently near completion. Preliminary results show an annual rate of sedimentation of 0.42 acre-feet/square mile, which is consistent with the original project design rate of 0.5.

2. Buckhorn Lake, Middle Fork Kentucky River, Kentucky. Field work for the sedimentation survey was completed during 1987. The report is currently being prepared.

3. Mississinewa Lake, Mississinewa River, Indiana. Field work for the sedimentation survey was completed during 1987. The report is currently being prepared.

Other Sediment Measurements. The sedimentation basins upstream of Carr Fork were flown in the Fall of 1987 to determine the extend of filling so estimates can be made for the possible removal of material. The basins have reduced the sediment entering Carr Fork Lake from 2.19 to 1.6 acre-feet/square mile/year.

Nashville District

Sedimentation Surveys.

1. Cheatham L&D, Cumberland River, Tennessee. Analysis of the Summer 1987 resurvey has been completed. The report has not yet been completed, but preliminary indications are there is no appreciable sediment deposition.

2. Dale Hollow Lake, Obey River, Tennessee. A reconnaissance survey was conducted on the reservoir in June 1987. Analysis of the data has been initiated.

3. Laurel River Lake, Laurel River, Tennessee. Preliminary results from September 1985 sediment range network resurvey show a deposition rate well in excess of the design deposition rate of 0.3 acre-feet per square mile per year. Checks on the results are being made.

4. Old Hickory L&D, Cumberland River, Tennessee. Results of the September 1985 sediment range network resurvey were determined. Total deposition from June 1954 to September 1985 was 25,800 acre-feet or five percent of the original storage volume at flood pool.

5. Lake Cumberland, Cumberland River, Kentucky. Calculations related to the late 1986 resurvey were completed in 1987.

Other Sediment Measurements.

1. Upper Cumberland River Basin. USGS continued sediment grab sampling in 1987 at Harlan, Pineville, and Barbourville, Kentucky. Two samples are taken during all flood events while samples during normal flows are taken at least two times per week. These samples are necessary for possible sedimentation studies and analysis of construction efforts under Section 202 (PL 96-367) work.

2. Martins Fork Lake, Martins Fork, Tennessee. A sediment transport study for the reservoir continued in 1987. This study is being conducted by WES with use of the computer model HEC-6. The resulting report is expected at any time. It will define long-term effects of cumulative deposition and possible remedial actions. Monitoring of suspended sediment at a site three miles upstream of Martins Fork Dam is being conducted by USGS. The WES report will address future reservoir resurvey and gaging needs.

3. Middlesboro, Kentucky. Sediment grab sampling by USGS at Middlesboro continued in 1987. Section 202 (PL 96-367) work will use the sampling for investigation of structural solutions to flooding at Middlesboro. Sampling sites are located at Mile 0.6 of Stoney Fork and on Bennetts Fork at Middlesboro. Sampling frequency on Stoney Fork is at least twice weekly during normal flows and two to three times during rising flows. Samples are

analyzed for concentrations and if visible sand is present sand separation is performed. Continuous sediment monitoring is conducted on Bennetts Fork. Monitoring began on Bennetts Fork in 1985 and sampling began on Stoney Fork in 1986. "Grab" samples are also obtained at the Middlesboro gage. A resurvey of the 28 sedimentation ranges in the Middlesboro Diversion Canal was made in June 1987. The SPF profile was determined using the 1987 resurvey and HEC-2. The profile is now at the top of levee for most of the canal length. In the coming year, we plan to investigate potential solutions to the deposition problem using Section 202 and O&M funds.

4. Corbin, Kentucky. A partial resurvey was conducted on the ranges for Lynn Camp Creek at Corbin. Cross-section comparisons were made with original surveys of October 1973 and May 1975. The survey of June 1982 was also compared with that of 1987. In 1982, all ranges now in Lynn Camp Creek were resurveyed or established. The sediment range comparisons of 1987 with 1973, 1975, and 1982 show little if any sediment deposition.

Pittsburgh District

Sedimentation Surveys.

1. Allegheny Lake, Allegheny River, Pennsylvania and New York. A selected range sedimentation survey was completed in FY 1987. A report is being prepared.

2. M. J. Kirwan Lake, Mahoning River Basin, Ohio. The report on a selected range resurvey was submitted. The sedimentation rate was reported to be 109 acre-feet per year.

3. Tionesta Lake, Tionesta Creek, Pennsylvania. A selected range sedimentation survey was completed in FY 1987. The report is currently being prepared.

4. East Branch Clarion River Lake, Clarion River, Pennsylvania. A selected range sedimentation survey was completed in FY 1987. The report is currently being prepared.

5. Mosquito Creek Lake, Mosquito Creek, Ohio. A selected range sedimentation survey was completed in FY 1987. The report is currently being prepared.

OHIO REGION

GEOLOGICAL SURVEY

Upper Ohio Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at Allegheny River at New Kensington, PA, Monangahela River at Braddock, PA, Beaver River at Beaver Falls, PA, 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 East Branch Shade River near Tuppers Plains, OH, West Branch Shade River near Harrisonville, OH, and West Branch Shade River near Burlingham, OH, in cooperation with Ohio Department of Natural Resources.

3. 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.

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.

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 near quarterly basis at Kanawha River at Winfield, WV, as a part of NASQAN.

2. Suspended-sediment data were collected on a daily and storm-event basis at Elk River at Sutton, WV. Also, suspended-sediment data were collected on a periodic basis and during selected storm events at Buffalo Creek at Clay, WV, Big Sandy Creek near Clendenin, WV, Little Sandy Creek near Elkview, WV, and Blue Creek near Quick, WV, in cooperation with the West Virginia Department of Natural Resources, Water Resources Division (discontinued March 1987).

3. Suspended-sediment data were collected on a periodic basis and during selected storm events at Elk River below Webster Springs, WV, Back Fork at Webster Springs, WV, Elk River near Webster Springs, WV, Left Fork Holly River near Replete, WV, and at Right Fork Holly River at Guardian, WV, in cooperation with the West Virginia Department of Natural Resources, Water Resources Division (discontinued September 1987).

4. Suspended-sediment data were collected on an event basis at Soak Creek at Sophia, WV, in cooperation with the U.S. Soil Conservation Service.

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

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 near 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.

3. Suspended-sediment data were collected on a daily basis, and more frequently during storm events, at Levisa Fork near Grundy, VA, in cooperation with the U.S. Army Corps of Engineers (COE), Huntington District (discontinued September 1986).

Great Miami Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Whitewater River at Brookville, 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 quarterly basis at Upper Twin Creek at McGaw, OH, and 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.

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 were collected quarterly at White River near Centerton, IN, as part of NASQAN.

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
Bennett Fork at Middlesboro, KY
Stony Fork at Middlesboro, KY
Yellow Creek near Middlesboro, KY
Cumberland River at Barbourville, KY
Cumberland River near Pineville, KY
Cumberland River at Cumberland Falls, KY
Cumberland River at Williamsburg, KY
Martins Fork above Smith, KY
South Fork Cumberland River near Stearns, 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 Alpines, 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.

Special Studies

1. Suspended-sediment data were collected with automatic samplers at two sites draining small basins (less than 100 acres) in Ritchie County, WV. These data are part of a study to evaluate the effects of sediment control measures on soil erosion and sediment transport in areas of intensive oil and gas well development in Ritchie County (discontinued September 1987).

2. Suspended-sediment data were collected with an automatic sampler from a tributary site in the Big Sandy Creek basin in Fayette County, PA, during 1987. The data were collected as part of a study to evaluate the effects of surface mining on the Big Sandy Creek basin of southwestern Pennsylvania.

3. Suspended-sediment data were collected with automatic samplers at three sites in the Indian Creek basin in Westmoreland and Fayette Counties, PA. The data were collected as part of a study to evaluate the impacts of surface mining on Indian Creek.

4. A study of course material movement and channel adjustment in the South Fork Cumberland River basin, TN, is being conducted in cooperation with the Tennessee Division of Surface Mining and Reclamation.

5. Hillslope processes were monitored in areas surrounding a low-level radioactive waste disposal site in Fleming County, KY, and erosion rates will be calculated. Methods used to measure these processes included erosion flumes and erosion nails to determine direct ground surface lowing and

Gerlach-trough sediment traps to determine slopewash in terms of weight from an area of slope. Measurements were made from fall 1984 to fall 1987.

6. The Indiana Division of State Parks requested sediment surveys of Versailles and Whitewater reservoirs and an analysis of sediment sources. From the completion of Versailles Lake in 1956 to 1987, 42 percent of the reservoir volume has been filled in with sediment. The sedimentation rate for the same period was 1.4 percent of reservoir volume being filled per year.

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
P.O. Box 1107
Harrisburg, PA 17108

District Chief, WRD
U.S. Geological Survey
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

Chief, Virginia Office, WRD
U.S. Geological Survey
3600 West Broad Street, Room 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

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made for Public Law 566 work plans in the following watersheds:

Major Drainage	Watershed	Stream	County	State
Ohio River	Massac	Massac Creek	McCraken	KY
Cumberland	South Fk. Little River	Little R.	Christian	KY
Lake Cumberland	Falls Creek	Falls Creek	Wayne	KY
Salt Lake	Brashears Creek	Brashears Creek	Spencer Shelby Henry	KY
Cumberland - Red	Sulphur Fork Creek	Sulphur Fork Creek	Robertson Summer Montgomery	TN
Little Wabash River	Lake Mattoon	Little Wabash River	Coles Cumberland	IL
Great Miami River	Four Mile Creek	Four Mile Creek	Preble Butler	OH

2. Reservoir Sedimentation Surveys

Reservoir	Counties	State
Saul-Mathay, PA-459	Mercer	PA
Upper Decker Creek 4	Preston	WV
Lake Ann	Trumbull	OH

3. Special Resources Studies

a. Southeast Kentucky River Basin

County	State
Letcher	KY
Bell	KY
Harland	KY

Some of the objective of the study are to:

Identify areas with present and potential loss of productivity caused by severe erosion and with potential to be treated using USDA programs with and without cost sharing.

Identify sediment sources with resulting downstream deposition effects.

Make economic analysis of areas with loss of productivity caused by severe erosion and sedimentation to determine applicability of USDA programs.

Identify forest resources with loss of productivity caused by severe erosion and sedimentation.

b. Big River Area

County	State
Daviess	KY
Henderson	KY
McLean	KY
Webster	KY

Landsat Thematic Mapper (TM) data with 30 meter resolution was used to discriminate land cover, a significant variable in the Soil Loss Equation (USLE). Other pertinent information required for the USLE was obtained from various sources.

The purpose of this project was twofold; 1) to map major land cover categories and 2) to determine potential erosion in the five county area and the Highland creek watershed. Specifically, Landsat TM data were digitally processed to determine land cover categories which were input along with other variables in the USLE to provide potential erosion estimates.

c. A series of 18 maps titled "Impacts of Erosion and Conservation in Ohio" were published. The series cover the entire state of Ohio, and were based on erosional data from the National Resources Inventory.

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.

Middle Tennessee-Hiwassee Subregion

1. Suspended-sediment data are being collected in the Tennessee River basin in Georgia at 3 sites on a monthly basis and at 13 sites on a semiannual basis as part of the Office of Surface Mining Coal Hydrology program.

Lower Tennessee Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Tennessee River at Pickwick Landing Dam, TN, and at Tennessee River at Highway 60 near Paducah, KY, 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 at 15-minute intervals for three sites located in Asheville, NC. This data will be used to characterize urban stormwater quality in the mountaineous Asheville area.

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

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

District Chief, WRD
U.S. Geological Survey
P.O. Box 2857
Room 436, Century Postal Station
300 Fayetteville Street Mall
Raleigh, NC 27602

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

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
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

TENNESSEE REGION

SOIL CONSERVATION SERVICE

1. Upland erosion Rate Studies were make for the following activities:

   a. Public Law 566 - Land Treatment Watersheds

Major Drainage	Watershed	County	State
Elk River	Beans Creek	Lincoln Franklin	TN
Clinch River	Middle Fork of Holston River	Washington	VA

   b. River Basin Investigations

Major Drainage	Study Area	Counties	State
West Eight Basin	Eight County Area West of Tennessee River	Henry, Carroll, Benton, Henderson, Chester, McNairy, & Hardin	TN

UPPER MISSISSIPPI REGION

CORPS OF ENGINEERS

North Central Division

Chicago District

Chicago River-North Branch, Illinois. The District contracted the Corps Waterways Experiment Station to prepare a report titled "Sediment and Pore Water Studies of Chicago River-North Branch Sediment" in relation to proposed maintenance dredging. Completed in August 1987, the report provides sediment-specific information needed to assess losses of PCBs from Chicago River-North Branch sediment during dredged disposal operations. The data is available in District files.

Rock Island District

Suspended Sediment Sampling. Suspended load sampling is being conducted at 23 stations, 3 located on the Mississippi River and 20 on its tributaries, including 3 on the Illinois River and its tributaries. Nineteen long-term stations are operated and maintained directly by the District. Four 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.

Sedimentation Surveys. The survey of sedimentation ranges in Coralville Lake was completed in 1984. A report detailing the results of that survey was published in February 1987. Additionally a report detailing the results of a 1984 survey of Saylorville Lake was published in December 1987.

St. Paul District

Both suspended and bedload measurements were conducted daily at six stations by the U.S. Geological Survey under the sponsorship of the District and published in their Water Resources Data. These stations are at Anoka, MN on Mississippi River; near Big Stone City, MN on Whetstone River; near Odessa, MN on Yellow Bank River; at Mankato, MN on Minnesota River; at Winona, MN on Mississippi River and at McGregor, IA on Mississippi River.

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, and on a daily basis March through August at Whetstone River near Big Stone City, SD, and at Yellow Bank River near Odessa, 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 periodic and storm-event basis to determine daily loads at Duncan Creek near Tildon, WI, in cooperation with the Wisconsin Department of Natural Resources.

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

Upper Mississippi-Black-Root Subregion

1. Suspended-sediment data are being collected on a bimonthly basis at North Fork Whitewater River near Elba, MN, as a part of the National Hydrologic Benchmark Network.

2. Suspended-sediment data are being collected on a weekly basis at Mississippi River at Winona, MN, in cooperation with the COE.

3. Suspended-sediment data are being collected on a bimonthly basis at Durand and 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 Wisconsin River at Muscoda, WI, as part of NASQAN.

Upper Mississippi-Iowa-Skunk-Wapsipinicon Subregion

1. Suspended-sediment data are being collected on a daily basis at the following in cooperation with the Iowa Geological Survey:

Iowa River at Iowa City, IA
Ralston Creek at Iowa City, IA
Skunk River at Augusta, IA

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

3. 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.

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- and bedload-sediment data are being collected on a storm-event basis at an inlet to a detention pond that discharges to Lake Wingra in Madison, WI. Suspended-sediment data are being collected on a storm-event basis at the two outlets from the detention pond. These data are being collected in cooperation with the Wisconsin Department of Natural Resources.

4. 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 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 at the following stations:

North Fork Salt River near Hunnewell, MO
Middle Fork Salt River at Paris, MO
Salt River near New London, MO

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

3. Suspended-sediment data are being collected eight times a year at Cuiver 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:

Kankakee River at Momence, IL
Iroquois River at Chebanse, IL
Des Plaines River at Riverside, IL
Du Page River at Shorewood, IL
Fox River at Algonquin, 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 every other day, 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 every other day, 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 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.

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 bimonthly basis at Meramac River near Eureka, MO, as part of NASQAN.

Special Studies

1. Suspended-sediment data were collected monthly at Mississippi River at Bemidji and near Bemidji, MN, in cooperation with the Minnesota Department of Natural Resources. The data are being collected as part of a water-quality study being conducted by local groups.

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
1400 Independence Road
Mail Stop 200
Rolla, MO 65401

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

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

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following watersheds:

   a. Public Law 566.

Major Drainage	Watershed	Stream	County	State
Sangamon River	Lake Decatur	Sangamon R.	Macon Piatt	IL
St. Croix River	Trout Brook	E. Schuester Pond	Washington	MN
Minnesota River	Credit R.	Wally Hilgrenberg Pond	Scott	MN
Mississippi River	Sauk River	Hoboken Cr.	Stearns	MN
Mississippi River	Sauk River	Ashley Cr.	Todd	MN

   b. River Basin Investigations

Major Basin	Basin Reported	State
Upper Mississippi	Kaskaskia	IL
Upper Mississippi	Peoria Lakes	IL

2. Reservoir Sedimentation Surveys.

   Reservoir sedimentation surveys were make in the following reservoirs:

Reservoir	County	State
Hamaugh-Martin #1	Brown	IL
Lake Jacksonville	Morgan	IL
Lake Kinkaid	Jackson	IL
Lake Carroll	Carroll	IL
Shoal Creek #2	Montgomery	IL

3. Special Studies.

a. A study of land voiding due to gully erosion was completed for Bonpas Creek Watershed in Edwards, Wabash, Richland, and Lawrence Counties, Illinois.

b. Secci -disk Stream turbidity surveys were completed for:

Major Drainage	Watershed	Stream	County	State
Minnesota River	Redwood R.	Three-mile Cr.	Lyon	MN
Mississippi River	Minnesota R.	Redwood R.	Lyon	MN

c. Field reviews of erosion damages from the July 20 and 23, 1987 record storms were performed in the Twin Cities area and at the Blue Lake Sewer Interceptor Washout in Eden Prairie; Anoka, Dakota, Hennepin, and Ramsey Counties, MN.

d. A Watershed erosion map was generated for South Zumbro Dam Site BR-1 by the Olmsted County Planning Department, Olmsted County, MN.

CORPS OF ENGINEERS

Lower Mississippi Valley Division

Memphis District

Sediment sampling continued at the 15 stations previously established in the St. Francis Basin and the station previously established hear Colt, Arkansas, in the L'Anguille River Basin. Suspended sediment samplers DH76TM, DH78, D74ALTM and bed sampler BMH60 was 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 11 ranges: Mississippi River at Coochie, LA, semimonthly; Mississippi River at Tarbert Landing, MS, semimonthly; Old River Outflow Channel near Knox Landing, LA, semimonthly; Atchafalaya River at Simmesport, LA, 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, weekly; Atchafalaya Basin, Lake Long below Bayou La Rompe, weekly; Atchafalaya Basin, Little Tensas below Blind Tensas Cut, weekly; Atchafalaya Basin, East Access Channel above Chicot Pass, weekly.

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.

Office Investigations. For the District, WES is performing an investigation of the Atchafalaya Bay, incorporating both physical and mathematical models to study the bay hydrodynamics and the effects the Atchafalaya River will have in the future. Two sediment models are being used to forecast long-term evolution of the delta, HAD-1 and STUDH. HAD-1 is a pseudo two-dimensional sediment computations program using steady state hydraulics. STUDH is a sediment transport program using unsteady two-dimensional flows in the horizontal plane.

A computer Data Base System is being used to store hydrographic data for the period of record in the District. It is also used to analyze, store, and retrieve sediment data.

The District has a contract with Louisiana State University to study the subaerial growth rates of the Atchafalaya Bay Deltas. The task involves the use of remotely sensed data to update the growth rates of the deltas.

From January - December 1987, the District collected monthly sediment samples in the vicinity of the Old River Control Complex in conjunction with the first

year of operation of the Old River Auxiliary Structure. Suspended sediment and bed-material samples were taken in the Old River Auxiliary Structure inflow channel; bed-material samples were taken in the Old River Control Structure inflow channel and Mississippi River at Mile 312.

St. Louis District

The first resurvey of the upstream sedimentation and downstream retrogression ranges at Mark Twain Lake was completed. The data analysis will be completed this FY if funds become available.

The Report of Sedimentation for the 1984 resurvey at Lake Shelbyville and the 1982 and 1984 resurveys at Carlyle Lake are complete pending approval.

The data obtained for the 1985 resurvey of upstream sedimentation and downstream retrogression ranges at Rend Lake is currently being analyzed. The report should be complete by the end of this FY and forwarded for approval.

Vicksburg District

Sedimentation Surveys. channel geometry, such as cross sections and profiles, were made 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 materials 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. Sedimentation data were collected at approximately 40 stations during 1987. Bed materials were collected using either BM-54, BMH-60, or drag bucket bed material samples, 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 early 1987, velocity and sediment data acquisition continued during periods of high flow at Lock and Dam No. 1. This data acquisition included identifying velocity magnitudes and directions with a biaxial velocity mater and obtaining both suspended sediment and bed material

samples. The results of these measurements were utilized in verification of numerical model results, evaluation of completed sediment control measures, and extending the existing Red River sediment data base.

b. A sediment investigation utilizing the 2-dimensional (TABS-II) numerical model was completed in 1987 to determine the most feasible and effective design of modifications to the Lock and Dam No. 1 structure and the dam outlet channel. The purpose of these modifications is to improve the sediment control both at the structure and in the downstream approach channel. The modification includes a downstream extension of the existing timber wall ,construction of a silt barrier parallel to the riverside lock wall, raising the low area landside of the lock, and realignment of the right bank of the dam outlet channel. Plans and specifications have been prepared and work will be initiated in 1988.

c. A sediment study was continued to determine the impact of the influx of sediment from bank caving above Shreveport, LA, on the Red River Waterway system. The study includes comparison of bankline movement and channel cross sections over time to quantify bank caving throughout the Shreveport, LA, to Index, AR, reach. Also, a determination of the expected reduction in sediment influx due to construction of bank stabilization measures is included.

d. During 1987, work on the TABS-II numerical models for Locks and Dams Nos. 2 and 3 was completed and continues, respectively. The numerical model studies for Locks and Dams Nos. 4 and 5 were initiated. The purpose of these numerical models is to aid in the design of the structures and adjacent channels by identifying probable sediment transport characteristics for alternative features.

2. Demonstration Erosion Control Project. Several studies and a comprehensive data collection program are underway as part of the DEC. The DEC is a joint effort between the District and the Soil Conservation Service to reduce flooding, erosion, and sedimentation problems in six watersheds in the Yazoo River Basin. These consist of:

a. Detailed geomorphic and sediment transport studies were continued in 1987 for Batupan Bogue, Hotophia Creek, and Hickahala Creek watersheds as part of the development of technical work plans for these watersheds.

b. Automatic suspended-sediment sample stations have been installed in all six DEC watersheds. Stations on Batupan Bogue and Otoucalofa Creek have been in operation for approximately 2 years and stations on Hickahala Creek, Senatobia Creek, and Hotophia Creek have been operational for approximately 2 years. Stations on Fannegusha Creek, Long Creek, and Harland Creek went into operation in early 1987. These are being maintained and operated by U.S. Geological Survey for the District.

c. A comprehensive data collection program was continued for Goodwin Creek. WES has completed an initial assessment of the Goodwin Creek sediment data and is continuing the study to develop procedures for the determination of total sediment load which could be applied to DEC watersheds and other Yazoo River watersheds for the District.

3. Shoccoe Dam GDM. A sediment investigation to determine the amount of deposition which can be expected to occur if the proposed Shoccoe Dam Project is constructed was initiated in 1987. HEC-6 will be utilized with the results to be included in the Shoccoe Dam GDM.

4. Upper Yazoo Projects (UYP). A sediment investigation to aid in formulating a detailed work plan for developing the sediment control plan for the UYP was initiated and completed in 1987. A major part of this study was to develop a preliminary assessment of the relative cost of grade-control construction on the tributaries to mainstem Yazoo River versus dredging of the main channel to remove sediment deposition. The KUWASER mathematical model developed by Colorado State University for the Yazoo River sedimentation study (CSU, 1978, 1979, 1983) was used in this analysis.

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 at Obion, TN, and at Hatchie River at Bolivar, TN, as a part of the National Stream Quality Accounting Network (NASQAN).

2. Suspended-sediment data are being collected once every other week at eight stations in the Obion-Forked Deer River basin as a part of a study on the adjustment of fluvial systems following dredging and straightening.

Lower Mississippi-St. Francis Subregion

1. 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.

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 a automatic PS-69 sampler at North Fork Tillatoba Creek near Teasdale, MS, in cooperation with the U.S. Soil Conservation Service.

3. 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
Senatobia Creek at Senatobia, MS
Batupan Bogue at Grenada, MS
Peters (Long) Creek near Pope, MS
Fannegusha Creek near Howard, 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, at Red River near Simmesport, 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, and bimonthly at Boeuf River at Fort Necessity, 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 4-H Camp near Denham Springs, LA, Tangipahoa River at Robert, LA, Lower Grand River at Bayou Sorrel, 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 monthly at Atchafalaya River near 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 sites as a part of NASQAN.

Mississippi River at Belle Chasse, LA
Mississippi River near St. Francisville, LA

3. 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

4. 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. Eight sites are collected on a monthly basis, one of which is also sampled daily. 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. In cooperation with the U.S. Soil Conservation Service, an intensive study of channel adjustment and sediment transport is being conducted on the Cane Creek basin in the Hatchie River basin. Two stations on Cane Creek have been equipped with PS-69 samplers.

3. In cooperation with the Tennessee Department of Transportation, a study to model the effects of man-induced channel adjustments in the fluvial channels of western Tennessee is being conducted. Bed-material samplers are collected twice annually at low flow. Bank material is sampled for particle-size distribution, Atterberg limits, density, moisture content, and dispersion. In situ shear strength tests are carried out with a borehole shear tester for the purpose of modeling bank stability and rates of channel widening.

Simon, Andrew, and Hupp, C. R., 1987, Geomorphic and vegetative recovery processes along modified Tennessee streams: An interdisciplinary approach to disturbed fluvial systems: in Forest Hydrology and Watershed Management, International Association of Hydrologic Sciences, Pub. No. 167, p. 251-262.

Simon, Andrew, and Robbins, C. H., 1987, Man-induced gradient adjustment of the South Fork Forked Deer River, West Tennessee: Environmental Geology and Water Sciences, v. 9, no. 2, p. 109-118.

4. In cooperation with the Tennessee Department of Transportation, a study on the effects of bridge structures on wetland sedimentation is being conducted. Bed-material samples are collected twice annually at low flow to determine dominant particle sizes. Samples of overbank deposits are collected along transects and artificial substrates serve to monitor recent deposition rates. Historical deposition is determined through exhumation of buried root collars and through dendro-chronology. The effects of bridge structures are analyzed through step-backwater and sediment-transport computations.

5. In cooperation with the Tennessee Department of Health and Environment, Division of Construction Grants and Loans, a study of runoff from agricultural production areas to tributaries to Reelfoot Lake is being conducted. Daily suspended-sediment concentration data are being collected at one site in the North Reelfoot Creek basin, and storm-event sampling is being conducted at one site each in the South Reelfoot Creek basin and the Running Slough basin.

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

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
A-413 Federal Building
U.S. Courthouse
Nashville, TN 37203

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determination of sediment yields were made for the following Public Law 566 activities:

Major Drainage	Watershed	Stream	County	State
Lower Mississippi	Lower Caney Bayou	Caney Bayou	Chicot	AR
Lower Mississippi	Boydsville	Big Creek	Clay	AR
Big Black River	Whites Creek	Whites Creek	Webster	MS
Wolf River	North Fork Wolf River	North Fork Wolf River	Fayette Hardin	TN
Loosahatchie River	Big Creek	Big Creek	Shelby Tipton	TN
	Beaver Creek	Beaver Creek	Shelby Tipton Fayettee Haywood	TN
Obion River Middle Fork	Spring Creek	Spring Creek	Weakley Carroll Henry	TN

CORPS OF ENGINEERS

North Central Division

St. Paul District

Sediment loads were measured by the U.S. Geological Survey at two river stations (near Kindred, ND on Sheyenne River and at Walhalla, ND on Pembina River) under the District sponsorship.

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). Additional periodic suspended-sediment data were collected at Souris River near Verendrye, ND.

2. Daily observer sediment concentrations are collected as part of the U.S. Fish and Wildlife Service Refuge Monitoring Program at the following gaging stations:

Souris River near Bantry, ND
Willow Creek near Willow City, ND
Stone Creek near Kramer, ND
Deep River below Cut Bank Creek near Upham, ND
Boundary Creek near Landa, ND
Souris River near Westhope, ND

The samples at the above sites are collected during a 2-month period coinciding with the spring snowmelt.

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, 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

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following Public Law 566 watershed:

Major Drainage	Watershed	Stream	County	State
Red River of the North	Red Lake R.	Burnham Cr.	Polk	MN

MISSOURI

BUREAU OF RECLAMATION

James River Stabilization Studies. - Under contract the Bureau of Reclamation is evaluating the stability of the James River in North Dakota under existing conditions and if the channel is used to convey Garrison Diversion Unit water deliveries. The final product will include recommendations for riverbed and bank stabilization measures where required.

During 1987, the contractor collected suspended sediment samples at five stations on the James River and at one location on Bear Creek. Six to eight samples were collected at each site. In addition, bed and bank material samples were collected throughout the study reach from New Rockford to Oakes.

The flow-duration, sediment rating curve method was used to compute annual sediment loads at the five stations on the James River. Sediment loads were found to be very small under existing and project conditions ranging from 450 to 4,000 tons per year presently.

The stability analysis will be completed in 1988.

Arrowwood Wildlife Refuge Resurvey. - An underwater mapping was completed of the four impoundments forming the refuge. New topographic maps and area-capacity tables were prepared. Although the original mapping is questionable, an estimate was made that 4,650 acre-feet of sediment had deposited on the refuge between 1937 and 1985. This sediment volume is equivalent to an annual sediment yield rate of 0.07 acre-foot per square mile per year from the 1,400 square mile drainage basin.

Diamond Creek Dike Impoundment Sediment Study. - Diamond Creek Dike will be used to keep the new Buffalo Bill Reservoir from inundating a developed area. During periods of Diamond Creek runoff, the dike will store water temporarily outside of the reservoir. A sediment yield rate curve of drainage area versus yield was used to estimate an annual sedimentation rate of 8.4 acre-feet per year for the impoundment. A sediment depth of 10 feet at the discharge pumping plant was recommended for setting the pump intakes.

Platte River Environmental Studies. - A study of the morphologic changes of the Platte River in central Nebraska continued. Sediment transport rates at different locations were developed from available data using the Modified Einstein Procedure. These sediment rating curves were then used to calibrate predictive sediment transport equations for the purpose of mathematically modeling river channel change. These aspects of the study will be completed in 1988.

Aerial photo interpretation was used to track the historical channel narrowing which has occurred on the Platte River. This analysis indicates that the channel narrowing has dramatically slowed or ceased leading to the conclusion that equilibrium has again been attained under the present flow-sediment regime.

Sediment Inflow Study for Narrows Reservoirs. - A new sediment inflow study was prepared for the proposed Narrows Reservoir based on a combined flow-duration, sediment rating curve analysis and sediment yield rate curve for the ungauged areas. The sediment inflow rates were 240 acre-feet per year from the South Platte River and 270 acre-feet per year from the Kiowa Creek drainage. Using appropriate adjustments for reservoir compaction resulted in 50-year and 100-year accumulations of 23,500 acre-feet and 47,000 acre-feet in the conservation pool of the reservoir. The predicted depth of sediment at the dam is 19 feet after 100 years.

MISSOURI BASIN REGION

CORPS OF ENGINEERS

Missouri River Division

Kansas City District

Sediment Load Measurements. The measurements of suspended sediments were continued at seven stations through the water year. The Missouri District of the U.S. Geological Survey collects monthly points, depth integrated, and bed samples on the main stem of the Missouri River at St. Joseph, Kansas City, and Herman, Missouri. The Kansas District of the U.S. Geological Survey also collects sediment samples on the Kansas River at Ft. Riley and Eudora, Kansas, but these samples are only collected during near bankfull events. Therefore, depending on climatic factors and/or lake releases, samples may or may not be collected during a water-year. The method used in sampling of the suspended material consists of collecting a continuous composited depth integrated sample at 6 to 10 verticals across the width of the channel. Both of these programs are performed under the cooperative stream gauging program. The remaining two stations are located on the Smokey Hill River. One station is located below Kanopolis Lake to measure outflowing materials and the other is an inflow station to Kanopolis Lake.

Lake and Reservoir Sediment Activities.

1. Stockton.

a. The initial resurvey of this lake was performed during this reporting period. The underwater data were acquired via offshore range-azimuth hydrographic instrumentation. Conventional topographic surveying methods were used for land extensions or for surveying the flood pool ranges. The interfaced range-azimuth instrumentation eliminates the need for monument maintenance near the multipurpose pool. This system is programmed to compute State-plane coordinates as soundings are being collected. The coordinates can be re-entered into the system prior to the next survey and hypothetically the exact range line can be resounded. Deviations are dependent upon external surface forces prevalent, e.g., wind or wave action applied to the sounding vessel upon the date of resurvey. Utilizing this capability, several supplemental aggradation ranges were set-up and sounded for both future resurveys and for contouring the bed of the water body. These supplemental ranges were located at sites predicted on valley geometry. Entering the additional sections allows for ease in computations, increases in accuracy, and increases the confidence of the results. The original elevation-capacity relationship of the lake was reconstituted using the original range sections. A second reconstitution of the elevation-capacity relationship was made using the additional supplemental ranges, which were in this case, developed from the original topographic maps and by interpolating between the original surveyed ranges for a best fit. The resurveyed sections were then used to recompute changes in incremental capacity and the total accumulated capacity. A comparison of the original capacity and the present capacity, after 17 years of operations, indicates a total storage loss of 15,600 acre-feet. The distribution of the deposited materials between the multipurpose and the flood control pools is approximately 81% and 19% respectively. Core samples were

also collected at the original aggradation ranges. The sampling design was based on a statistical distribution assuming the wet densities of the deposited materials were known. Results of the density analyses indicate the assumed densities used in the collection design were valid. The cores samples collected were to be analyzed for both density and gradation. However, since the District reprogrammed the funds remaining at the MRD laboratory near the end of the 1987 fiscal year these analyses could not be made. Therefore, assigned sediment unit personnel performed the density analyses at the District's geology laboratory. Since funding for the sediment laboratory analyses has also been reprogrammed for the current fiscal year, no gradation analyses will be performed. Mechanical size gradation of the historic data indicates the inflowing particle distribution: clay = 40%; silts = 56%; sand = 4%. The texture of the sampled materials, the ability to knead the materials and the rapid dehydration are all physical characteristics of clayey minerals. Therefore, it probably can be assumed that the historic size distribution is appropriate for the recent deposits. During the sample collection wire weight and sounding measurements were taken to verify the depth and generally locate the sampling site or a given range line. Normally, wire weight measurements would have been collected across the range to verify the hydrographic soundings. Because, of previous errors detected, personnel from the sediment unit accompanied the survey party to insure that vertical controls were established and maintained.

b. All but four of the initial degradation were resurveyed. The four ranges which were not surveyed are located on various properties owned by one individual. Also, numerous supplemental ranges have been installed in order to assess the channel degradation that has occurred. The above referenced individual constructed a cut-off channel across a meander which has had a sever impact on the upper Sac River. Within this cut-off, five ranges were established. Several miles below the project and above an existing old mill dam, the District constructed a cut-off channel which eliminated a large meander. Eight supplemental ranges were established above and below the cut-off prior to its construction. All of these supplemental ranges are also located on this individual's lands. Access to these monuments or access to cross his lands for the purpose of surveying are not available officially to personnel of the Corps. Bed and bank samples were collected at surveyed ranges for gradation analysis. Since laboratory funds were reprogrammed these analyses will be held until funds become available.

2. Kansas Lakes. In August 1987, some preliminary hydrographic soundings were made at Kanopolis, Milford, Tuttle Creek and Perry Lakes. The primary interests were at Tuttle Creek and Perry Lakes. Several large inflows had been routed through these lakes since the last resurvey and visual observation indicated a rather rapid migration of the deltas farther into the lakes. The results of these surveys are as follows:

a. Tuttle Creek Lake.

(1) The last complete resurvey of the lake was performed in June 1983. That survey indicated the break line depicting the leading edge of the delta's topset slope and the foreset slope to be 1.3 miles uplake from the mouth of Fancy Creek. At the present time the leading edge of the topset slope appears to be an extension of the left bank bluff line of this tributary. The actual physical location of the delta's leading edge in 1983

had been delayed almost 10 years over the original forecasted location made in the late 1950's and the early 1960's. This delay in the delta migration has been due to impediments remaining in the Blue River Floodplain, i.e., tree lined fence rows and/or other wooded and forested areas. These restrictions, over time, caused more of the inflowing sediments to be accumulated in the flood pool than had been originally estimated. The initial allocation for sediment storage was based on a dry lake with the sediments being deposited below elevation 1061. The design was later changed to a multipurpose project, but the sediment distribution was not adjusted to reflect the change in design purposes. However, as a practical consideration for operational purposes, a distribution of 2/3 and 1/3 was assumed for the respective multipurpose and flood control pools. The observed sediment distribution of the 1973 and 1983 surveys indicate the following: below elevation 1061, 52% and 48%; between elevations 1061 and 1075, 37% and 34%; and above elevation 1075, 11% and 18%.

(2) Review of the inflow records since 1983 indicate 11.7 million acre-feet of watershed runoff was intercepted during this period. This 4 year inflow volume is equivalent to 8.6 years of normalized inflows. The attendant sediment volume measured from the soundings, plus flood pool extrapolation, amounted to approximately 36,500 acre-feet. This volume is equivalent to 7.8 years of average sediment inflow and is nearly twice the annual sediment inflow rate of 4700 af/yr used in the original design.

b. Perry Lake. A scenario nearly identical to Tuttle Creek can be used to depict the inflowing sediment volume at this project. The last survey of Perry Lake was in June 1979. Since that survey, a total of 5.7 million acre-feet of runoff has been routed through the project in the past 8.1 years. Equating this volume to the average annual inflows shows this to be equivalent to 16.7 years of watershed runoff. The measured multipurpose pool and extrapolated flood pool accumulation of sediment since 1979 has been approximately 24,900 acre-feet. This sediment volume would require a time period of 17.8 years to accumulate under average conditions. Soundings indicate the break between the foreset and topset slope has migrated a little over a mile deeper into the lake during this time period.

c. Milford Lake. The last survey made at this project was performed in January 1980. From January 1980 through August 1987, basin runoff or inflows of 6.3 million acre-feet have been routed through this lake. This volume is equivalent to 10.5 years of normalized flows. Although, the data collected at this project has not been completely analyzed, it is estimated that 19,100 acre-feet of sediment has been deposited. This is equivalent to 12 years of average annual sediment deposits, (design rate of 1600 af/yr).

d. Kanopolis Lake.

(1) The examination at this lake was primarily due to the results of a recent outlet works inspection. Divers found a considerable sediment deposit located uplake of the intakes. Because of the findings of this inspection the project manager requested the sediment unit to collect a few hydrographic soundings in the inlet channel. Soundings revealed sediment deposits were encroaching on the apron of the intake headwall. Approximately 100 feet uplake of the intake tower a deposit depth of 12 feet was determined as compared to the original inlet channel flowline. Additional soundings spaced about 100 to 150 feet apart were collected uplake to the junction of

the diverted inlet channel and the Smokey Hill River Channel. These soundings indicated the deposit varied in depth from 12 feet to 15 feet at the entrance of the intake channel. This is based on a comparison with the original channel flowline. The intake area and inlet channel have ben dredged previously, but evidently no soundings were collected nor could other evidence be found to determine the depths to which material had been removed. Therefore, these soundings were compared to the original design channel flowline in order to determine the depths of the deposit.

(2) A cursory examination of the established aggradation ranges was also made at this time. Range 1, which is located immediately above the face of the dam, indicated no change in depth since the last resurvey made in 1982. Range 2, approximately 3500 feet uplake of Range 1, was sounded and the same conclusions were drawn from the data. Based on the volume of inflow since the lake was drawn down for riprap repairs in early 1983 some incremental changes in the bed elevation should have been detected. Successive range lines were examined until navigation depth limited further access. The results of the sounding indicated an extension of the delta into the lake since 1982 with some additional deposits on the topset slope of the main delta. Little change had occurred in the lower pool. Based on these soundings, along with several wire weight measurements, it appears the 1982 soundings of the ranges resurveyed in the multipurpose pool were inaccurate. Hence, the reported loss in capacity as computed from that survey may be too high.

3. Harry S. Truman Reservoir. Extensive hydrographic soundings were made during the summer period in an attempt to locate the formation of a delta in the Osage River Arm near Osceola, Mo. Very erratic deposit formations were found both uplake and downlake of Osceola, Mo. These variable deposits occurred both in the channel and in the old river flood plain. A few core samples of these deposits were collected and the specific weights of the extracted materials were found to be very light. In all probability, either the heavy inflows experienced at the project resuspend these materials, if deposited, or the energy of the almost daily peaking power releases from Stockton Lake has been sufficient to resuspend these light weight materials. It appears, based on these findings, that further study may be required to understand the cause of the erratic deposit formation observed in the soundings.

Omaha District

Sediment Load Measurements. The District operated 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 operates the stations under a cooperative stream gaging program and includes computation and publication of sediment load records. In addition, they collect suspended sediment samples, bed material samples, 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. This data will be used to document the bed material load being transported by the Missouri River.

Groundwater Measurements.

1. Niobrara River. Four observation wells are read weekly tc monitor groundwater changes associated with lake headwater aggradation effects in Lewis and Clark Lake, including the effects of delta growth at the mouth of the Niobrara River.

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

3. Pierre, South Dakota. Nine observation wells were installed in 1983 in response to local complaints of high ground water levels. Two additional wells were installed in December 1985 as part of the Pierre-Fort Pierre Ice Affected Flooding Study. Data from these wells have been used to predict the groundwater levels associated with aggradation. Readings are taken once every two weeks.

4. Garrison Project. Nineteen wells immediately downstream of Garrison Dam were read monthly. Data from these wells was used for the Garrison Additional Hydropower Study, and will be used in the future to assess interrelationships between river stages and groundwater levels. All but four of these wells were discontinued in November 1987.

5. Fort Peck Project. Twenty-two wells immediately downstream of Fort Peck Dam were read monthly. Data from these wells was used for the Fort Peck Additional Hydropower Study, and will be used in the future to assess interrelationships between river stages and groundwater levels. All but four of these wells were discontinued in November 1987.

6. Buford-Trenton Irrigation District. Fourteen wells are read monthly, quarterly, or bi-weekly to monitor the effect of Missouri River stage increases on local groundwater levels.

7. Yellowstone Confluence. Seventeen wells were installed in the vicinity of the confluence of the Missouri and Yellowstone Rivers during 1987. Data from these will be used to monitor the effect of Missouri River and Yellowstone River stage increases on local groundwater levels.

Reservoir Sediment Activities.

1. Fort Peck Project. A resurvey of 12 of 122 total ranges on the lake was completed under A-E contract. This survey was a continuance of the 1986 contract, which was delayed by late summer rains. In addition, six ranges surveyed during 1986 were resurveyed to determine aggradation and channel changes caused by the flooding. These profiles have ben used to identify the amount and location of sediment accumulation and to update reservoir areas and capacity volumes for use by the Reservoir Control Center.

2. Garrison Project. A resurvey of 44 ranges in the Lake Sakakawea headwaters was completed under A-E contract, including 9 ranges on the Yellowstone River. In-house labor associated with this survey included locating sediment range monuments, replacing destroyed monuments, repainting

location markers, and bed material data collection. Data collected will be used to determine aggradation trends and effects in the headwaters. When the 1987 data is combined with survey data to be collected during 1988, reservoir areas and capacity volumes will be updated for use by the Reservoir Control Center. A water surface profile of the degradation reach was measured by Corps personnel. This profile was made during a steady discharge of 16,000 cfs and will be used to identify changes in water surface slopes and help determine stage discharge rating curve trends at recording gages located in the area. Other work completed by Corps personnel included an underwater reconnaissance survey of ranges located in the Little Missouri River Arm of the lake. This data was used to determine the feasibility of a proposed recreation site. An additional work item completed for the Corps by the U.S. Geological Survey was collection of discharge and suspended sediment data for use in a study to identify areas of deposition or resuspension during steady flow conditions, determine sources of suspended sediment loads, and identify areas (if any) experiencing net annual deposition.

3. Oahe Project. A sediment range monument coordinate survey was completed under A-E contract. This survey involved determining state plane coordinates, measured from U.S.G.S. triangulation points using survey-traverse methods, at 226 monument locations (113 range lines). One-hundred-ninety-nine of the total 226 monuments were located and surveyed. The coordinates are to be used to replace missing monuments when traditional survey methods are not possible. Also, a reconnaissance hydrographic survey was made of Oak Creek, a tributary of the lake, in the vicinity of Walpala, South Dakota on the Standing Rock Indian Reservation. The data will be used to determine aggradation conditions in the tributary arm, and the contribution of sedimentation to annual spring flooding in the village.

4. Salt Creek Project. A complete inhouse hydrographic resurvey was made of Salt Creek Site No. 8., Wagon Train Lake. This data will be used to update reservoir areas and capacity volumes for use by the Reservoir Regulation Section. In addition, range monuments were located and replaced or restored as necessary.

5. Papillion Creek Project. A complete inhouse hydrographic resurvey was made of Papio Creek Site 11, Glen Cunningham Lake, and all range monuments located and replaced of restored as necessary. This data has been used to update reservoir areas and capacity volumes for use by the Reservoir Regulation Section.

6. Bear Creek Project. A complete inhouse hydrographic resurvey was made of Bear Creek Lake. In addition to the survey, all range monuments were located and replaced or restored as necessary. This data will be used to update reservoir areas and capacity volumes for use by the Reservoir Regulation Section.

Special Studies.

1. Aggradation Impacts Cherry Creek Intake Structure. An assessment of sedimentation conditions associated with renovating the service gates at Cherry Creek Dam in Denver, Colorado was completed. Past flushing operations at the dam had been shown to effectively remove deposited sediments in the vicinity of the existing service gates. Concerns were raised regarding the

susceptibility of two proposed gate renovations to sedimentation problems and the feasibility of continued flushing. From the assessment it was concluded that the proposed gates would be subject to recurring problems from sediment accumulation, but that continued flushing operation would likely be effective.

2. Aggradation Assessment Bear Creek Intake Structure. An assessment of sedimentation conditions at the low level intake gates at Bear Creek Dam near Denver, Colorado was completed. Operations Division was concerned over potential siltation problems effecting low level gate operation during low flow releases from the dam. The study determined that the bed would aggrade to the level of the low intake in approximately 25-30 years, causing significant O&M problems, requiring dredging or other removal alternatives.

3. Aggradation Assessment Bowman-Haley Intake Structure. A study of sediment deposition rates near a proposed low level intake pipe at Bowman-Haley Dam in North Dakota was completed. The low level intake has been proposed as a solution to combat water quality problems. From the assessment it was determined that the deposition rate in the vicinity of the proposed intake is one-half foot per year. It was suggested that deposition be monitored on a regular basis and that annual flushing operations be explored as a means of prolonging the intake's usable life.

4. Little Missouri Bay Recreation Plan. Ultimate erosion limits, aggradation conditions, and their impacts on recreation facilities at the Little Missouri Bay Recreation Area were determined. The estimate of ultimate erosion at the site was 100 feet landward at the headlands and slightly less in the embayments. From this estimate it was determined that some proposed recreation facilities would have to be moved. The aggradation assessment was an update of a study completed in 1986, changed to reflect additional cross section data obtained in a reconnaissance survey of the underwater portion of the bay. This update increased the usable life estimate of the project (i.e., lake access capability) 10 years from 1995 to year 2005 for a pool elevation of 1840 feet m.s.l. and from year 2000 to year 2010 for a pool elevation of 1845 feet m.s.l.

5. Shoreline Erosion Studies. Ultimate shoreline erosion limits were determined at Lake Oahe (40+ site), Lake Audubon (20+ sites), Lake Sharpe (2 sites), Lake Francis Case, Lewis and Clark Lake , and Holmes Lake, in support of Operation and Planning divisions. The proliferance of this type of study has reinforced the need for a consistent, accurate method to predict shoreline erosion at Omaha District lakes.

6. U.S. Forest Service Land Interchange. Erosion rates and the ultimate erosion takeline for a 34 mile reach of Sakakawea were determined, The work was done as part of a request for a land interchange by the U.S. Forest Service. Due to the extent of the reach and imposed time limits, a comprehensive study of erosion in the area could not be made. However, using rates computed at sediment range lines located throughout the reach, it was possible to project general erosion rates and ultimate limits along segments of the study area.

7. Fort Peck Boundary Study. A revision of the Fort Peck Project guide contour line was completed. This study was done to identify Corps' lands, not

necessary for flood control, hydropower, recreation, etc., to be turned over to the Bureau of Land management. From the dam to 1960 river mile 1877 an elevation of 2254 feet m.s.l. (maximum operating pool plus reasonable additional freeboard) was suggested. Upstream of this point the suggested contour elevations were stepped up in 5 foot increments. The step-up locations and elevations were determined from a preliminary assessment of the future 100 year delta combined with backwater analysis. The ice affects were accounted for by adding an increment, taken from stage probability analysis, to the open water profile. The final guide taking line, to be determined by Real Estate Division, will be based upon 40-acre blackouts.

8. Papio Site 11 Recreation Facilities Review. A review of bike paths and other recreation facility locations was completed. This study was done in response to letter from the City of Omaha concerning the loss of recreation facilities to shoreline erosion. From analysis of aerial photos and review of construction plans it was determined that the bicycle paths were built much closer to the water's edge than originally planned, and that sediments lost correspond to locations identified as critical erosion sites in an early DM. If the bike paths had been built as planned, the existing and potential loss to erosion would not be as great as that experienced.

9. Area-Capacity Study--Fort Peck Lake. Area-capacity analysis was performed at Fort Peck Lake. The total volume lost since 1937 is 869,760 acre-feet, or approximately 17,750 acre-feet per year. The original sediment depletion estimate was 2,255 acre-feet per year. While the measured depletion rate is nearly eight times greater than the original estimate, it should be noted that the original estimate was based upon limited data and even at the current measured depletion rate, the reservoir has a remaining life of about 1050 years.

A major sedimentation problem encountered at Fort Peck Lake has been the buildup of unslightly delta deposits, exposed during low pool periods, in the reach between the Musselshel River and Robinson Bridge. The deposits have raised river stages in the backwater reach, causing concern among U.S. Fish and Wildlife officials about rising groundwater levels in James Kipp state Park. In the downstream portions of this reach the delta formation has caused poor boating access to open water, with the possibility of complete channel closure within 30 years. Another problem encountered is the loss of boating access in recreation area (Hell, Snow, and Squaw Creeks and Musselshell Bay) brought about by tributary deposition. The possibility of channel closures and resultant relocation and/or abandonment of the sites exists.

10. Area-Capacity Study--Blue Stem Lake (Salt Creek No. 4). Area-capacity analysis was completed for three surveys of Blue Stem Lake located near Lincoln, Nebraska. Between 1964 and 1973 the total volume lost to sediment was 99 acre-feet for an average annual depletion rate of 11 acre-feet. The sediment depletion rate increased nearly threefold to 31 acre-feet per year between 1973 and 1984, for a long term average of 22 acre-feet per year since closure. This rate compares well to the original design estimate of 26.6 acre-feet per year. The increase in the rate of sedimentation between 1973 and 1984 is likely attributable to larger runoff events recorded in the western Salt Creek basin area in the 1973-1984 span of time than the 1964-1973 span. While no unforeseen sediment related problems have occurred to date at this project, local interests have voiced concerns over sediment deposition in

the upper reaches of the reservoir, and the impacts on recreational use.

11. Area-Capacity--Yankee Hill Lake (Salt Creek No. 10). Area-capacity analysis at Yankee Hill Lake located near Lincoln, Nebraska shows a long term sediment depletion rate of 13 acre-feet per year below the maximum pool elevation of 1267.8 feet m.s.l. This rate, based upon 19 years of record, compares favorable to the original design estimate of 14.3 acre-feet per year. Because hydrologic events experienced during this period are considered representative of a true statistical population, this measured rate is believed to be a good estimate of a long term average. The rate of depletion increased significantly in the time period 1973-1985 when compared to the 1966-1973 span. As with other Salt Creek basin lakes, this increase is most likely due to the lager runoff events experienced during 1973-1985. No unforeseen sediment related problems have occurred to date at this project, however, local interests have expressed concern over delta growth and shoreline erosion impacts on recreational use.

12. Area-Capacity--Pawnee Lake (Salt Creek No. 14). Area-capacity analysis was completed at Pawnee Lake located near Lincoln, Nebraska. The reservoir storage increased from a 1966 volume of 37,662 acre-feet to a 1972 volume of 37,752 acre-feet; an increase of 90 acre-feet. Between 1972 and 1981 the volume decreased 953 acre-feet, an average of 116 acre-feet per year. Survey error or inaccuracy is the probable cause of the unexpected increase in reservoir capacity between the first two surveys. The large increase in deposition from 1972 to 1981 was most likely caused by the larger runoff events occurring during that period as compared to the 1966-1972 span. The measured depletion rate of 64 acre-feet per year since closure is somewhat less than the design estimate of 85 acre-feet per year. While no unforeseen sediment related problems have occurred to date, local interests have expressed concerns over delta growth and shoreline erosion and their impacts on recreational use.

13. Area-Capacity--Glen Cunningham Lake (Papio Site 11). Ares-capacity analysis was completed for Glen Cunningham Lake located near Omaha, Nebraska. The reservoir capacity below the maximum pool elevation of 1147.0 feet m.s.l. decreased 559 acre-feet between 1976 and 1987, for an annual depletion rate of 51 acre-feet. The original design depletion estimate for this lake is 36.7 acre-feet per year, ranging from 84 acre-feet per year during urban construction to 9 acre-feet per year following urbanization. While urbanization of the basin has been limited to date, the slightly higher than expected depletion rate can be attributed to wetter than normal conditions experienced in the basin during the period of record. The only major sediment related problem experienced to date has been the loss of recreation facilities to shoreline erosion, as discussed in an earlier section.

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 are being 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.

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 Little Peoples Creek near Hays, MT, Big Sandy Creek at Reservation Boundary near Rocky Boy, MT, and Lodge Pole Creek at Lodge Pole, MT, and bimonthly at Big Sandy Creek near Havre, MT, in cooperation with the Bureau of Indian Affairs.

3. 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.

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.

Upper Yellowstone Subregion

1. Daily suspended-sediment data are being collected on a seasonal schedule in cooperation with the Montana Department of Health and Environmental Sciences at the Yellowstone River at Corwin Springs, MT.

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 are being collected on a daily basis during storm events for the nonwinter season at East Fork Nowater Creek near Colter, WY, in cooperation with the Wyoming State Engineer.

4. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Wind River at Riverton, WY, as part of NASQAN.

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 Broadus, 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 Federal CBR program.

3. Suspended-sediment data are being collected on a daily basis during storm events for the nonwinter season at Dead Horse Creek near Buffalo, WY, in cooperation with the Wyoming State Engineer.

4. Suspended-sediment data are being collected on a 6-week and storm-event basis in cooperation with the U.S. Bureau of Land Management at the following sites:

South Fork Power River near Kaycee, WY
Salt Creek near Sussex, WY
Power River at Sussex, WY
Power River at Arvada, WY

5. 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 Otta 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 daily basis at Yellowstone River near Sidney, MT, in cooperation with the COE.

2. 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.

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 on Brush Creek near Beulah, ND, and Buffalo Creek tributary near Gascayne, ND, as part of a State monitoring program for coal development.

3. 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.

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 daily basis during storm events during the nonwinter season at Black Thunder Creek near Hampshire, WY, in cooperation with the Wyoming State Engineer.

3. Suspended-sediment data are being collected on a 6-week and storm-event basis in cooperation with the U.S. Bureau of Land Management at the following sites:

Dry Fork Cheyenne River near Bill, WY
Cheyenne River near Dull Center, WY
Belle Fourche River below Moorcroft, WY

4. Suspended-sediment data are being collected on a storm-event basis at miscellaneous sites.

5. 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.

Missouri-White Subregion

1. Suspended-sediment data are being collected on a periodic basis at Missouri River at Pierre, SD, and at Missouri River below Fort Randall Dam, SD, as a part of NASQAN.

2. Suspended-sediment data are being collected on a daily basis at Bad River near Fort Pierre, SD, and at White River near Oacoma, SD, in cooperation with the COE.

3. Suspended-sediment data are being collected on a monthly basis at Little White River near Vetal, SD, and Little White River above Rosebud, SD, in cooperation with the U.S. Bureau of Reclamation (USBR).

Missouri-Andes Creek Subregion

1. Suspended-sediment data are being collected on a monthly 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 monthly 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 approximately a bimonthly basis at Niobrara River at Mariaville, NE, in cooperation with the USBR.

2. Suspended-sediment data are being collected on approximately a bimonthly 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 program.

2. Suspended-sediment data are being collected on a periodic basis at James River near Manfred, ND, James River near Grace City, ND, Lake Juanita tributary near Grace City, ND, James River above Arrowhead Lake near Kensal, ND, Kelly Creek near Bordulac, ND, James River at Jamestown, ND, and James River near Heela, SD, as part of the Garrison Diversion Refuge Monitoring Program.

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

4. Suspended-sediment data are being collected on a periodic basis at James River at Ashton, SD, Snake Creek near Ashton, SD, Wolf Creek near Ree Heights, SD, Turtle Creek near Tulare, SD, Medicine Creek near Zell, SD, and James River at Huron, SD, in cooperation with the USBR.

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, 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 6-week and storm-event basis at North Platte River near Goose Egg, WY, in cooperation with the U.S. Bureau of Land Management.

South Platte Subregion

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

2. Suspended-sediment data are being collected during high-flow periods at North Fork Cache La Poudre River at Livermore, CO.

Platte Subregion

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

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 Geological Survey.

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.

Republican Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Beaver Creek at Cedar Bluffs, KS, South Fork Sappa Creek near Brewster, KS, Prairie Dog Creek above Keith Sebelius Lake, KS, and White Rock Creek near Burr Oak, KS, in cooperation with the Kansas Water Office.

2. 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 6-week basis at Smoky Hill River at Enterprise, KS, Big Creek near Hays, KS, Saline River near Russell, KS, North Fork Solomon River at Glade, KS, and South Fork Solomon River above Webster Reservoir, KS, in cooperation with the Kansas Water Office.

2. Suspended-sediment data are being collected on a bimonthly basis at South Fork Solomon River at Osborne, KS, as part of NASQAN (beginning October 1, 1986).

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 monthly basis and on a storm-event basis as part of the Lower Kansas River basin NAWQA study at the following sites:

West Fork Big Blue River near Dorchester, NE
Big Blue River at Barneston, NE
Little Blue River at Hollenberg, KS

4. Suspended-sediment data are being collected on a 6-week basis at Little Blue River near Barnes, KS, in cooperation with the Kansas Water Office.

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

6. Suspended-sediment data were collected on a bimonthly basis from January to September at Kansas River at DeSoto, KS, and Big Blue River near Manhattan, KS, as part of NASQAN.

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

Kansas River at Fort Riley, KS
Kansas River at Wamego, KS
Kansas River at Topeka, KS
Kansas River at Lecompton, KS
Kansas River at Eudora, KS
Kansas River at DeSoto, KS

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 6-week basis at Dragoon Creek near Burlingame, KS, and Pottawatomie Creek near Garnett, KS, in cooperation with the Kansas Water Office.

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.

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. A study to determine relations between sediment production and peak discharge for a storm-runoff event continued in Wyoming. Three stations were equipped with Manning samplers and were operated during the year for the study.

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
1950 Constant Ave., Campus West
Lawrence, KS 66046

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
821 East Interstate Avenue
Bismarck, ND 58501

District Chief, WRD
U.S. Geological Survey
P.O. Box 1125
Cheyenne, WY 82003

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

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

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
Federal Building, Room 317
200 4th Street, S.W.
Huron, SD 57350

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determinations of sediment yields were made in the following watersheds:

   a. Public Law 566.

Major Drainage	Watershed	Stream	County	State
Missouri River	Willow-Cravens	Cravens	Ray	MO
Missouri River	W. Fork Grand	West Fork	Andrew Gentry Nodaway Worth	MO
Missouri River	Frene Cr.	Frene Cr.	Gasconade	MO
Missouri River	E. Yellow	E. Yellow Cr.	Sullivan Linn Chariton	MO
Arkansas River	Hickory Cr.	Hickory Cr.	Newton	MO
Little Nemaha R.	South Branch	L. Nemaha R.	Johnson Lancaster Otoe	NE
Nemaha River	Middle Big Nemaha		Johnson	NE
Elkhorn River	East-West-Dry	Maple Creek	Stanton Colfax Cumming Dodge Platte	NE
Big Blue River	Soap Creek	Soap Creek	Gage	NE
Big Sioux River	Rock Creek	Kanaranzi Cr.	Nobles Rock	MN
Missouri River	Roy's Creek	Roy's Creek	Brown Nemaha Richardson	KS NE

b. River Basin Investigations

Major Basin	Basin Reported	State
Platte River	Sandhills Cooperative Study	NE
White River/Hat Creek and Missouri R. tribs.	Nebraska Special Study	NE
Statewide	Nebraka Watershed Evaluation Cooperative River Basin Study	NE

c. Flood Plain Management Studies

Project Name	Counties	State
Lower Wood River	Buffalo, Hall, Merrick	NE

2. Reservoir sedimentation surveys

Reservoir	County	State
B-5	Larimar	CO
B-6	Larimar	CO

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sedimentation Resurveys

1. An aerial survey was done at Trinidad Dam in March of 1987. The aerial survey at John Martin Dam was completed in December 1987. The results of these surveys will be included in the letter reports scheduled for completion in 1988.

2. The new elevation-area-capacity table for Trinidad Dam was adopted on 1 November 1987. New elevation-area-capacity tables for Conchas and John Martin Reservoirs were also adopted on 1 January and 1 February 1988 respectively.

Sediment Load Measurements.

1. Suspended sediment measurements were made at two stations (Arkansas River below John Martin Reservoir and Purgatoire River below Trinidad Lake near Trinidad) in the region.

2. Bed material samples were collected at each of the reservoirs during the hydrographic surveys. The samples were analyzed for percent sediment, water content, density and grain size. The results of the bed samples analyzed show 28 percent silt, 72 percent clay, 0 percent sand, and a dry unit weight of 47.5 lbs/cu ft at John Martin Reservoir. At Trinidad Dam the results are 6.5 percent sand, 31.8 percent silt, 61.7 percent clay and a dry unit weight of 62.3 lbs/cu ft. The results at Conchas show 1 percent gravel, 8 percent sand, 43 percent silt, 48 percent clay and a dry unit weight of 62.1 lbs/cu ft.

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

Little Rock District

Sediment Load Measurements. 27 Sediment measurements were obtained 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 River. The concentration in percent of weight records were maintained.

Tulsa District

Sedimentation Surveys. A reconnaissance sedimentation survey was performed on Keystone Lake, Oklahoma, to determine if the need for a detailed survey is needed. The reconnaissance survey indicates significant sediment deposition has occurred, probably due to the October 1986 and May 1987 floods, and the currently used capacity data for Keystone are no longer valid. Detailed

sedimentation resurveys of Santa Rosa Lake, New Mexico, for Albuquerque District and Stillhouse Hollow Lake, Texas, for Fort Worth District were performed. The data collected during the 1986 resurvey of Conchas Lake, New Mexico was completed and forwarded to Albuquerque District in February 1987. Data for Santa Rosa Lake and Stillhouse Hollow Lake have been completed and forwarded to their respective district offices. A new hydrographic survey system was acquired by the District during 1987. Delivery of the system was made in late December and installation and testing will be performed in the spring of 1988.

Sediment Load Measurements. The suspended sediment sampling program consists of 45 stations. Presently there are 37 operational stations in the Arkansas River Basin and 8 operational stations in the Red River Basin. Samplers DH-48 and DH-49 were used.

Other Investigations. Several requests for sediment data involving local flood control projects within the District were made during 1987. These requests require visual inspection of the area to obtain the sediment data necessary to perform an evaluation of the effects of sediment within the project area. Efforts have been made to contract the analysis of reservoir sediments (ENG Form 1787) with possible award of a contract in early 1988.

ARKANSAS-WHITE-RED REGION

GEOLOGICAL SURVEY

Upper White Subregion

1. 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.

2. 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).

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 Corps of Engineers (COE):

Purgatoire River near Thatcher, CO
Taylor Arroyo below Rock Crossing near Thatcher, CO
Chacauco Creek at mouth near Timpas, CO
Bent Canyon Creek at mouth near Timpas, CO
Purgatoire River at Rock Crossing near Timpas, CO
Burke Arroyto Trib near Thatcher, CO
Big Arroyo near Thatcher, 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:

Monument Creek above North Gate Boulevard at U.S. Air Force Academy, CO
Monument Creek at Palmer Lake, CO
Monument Creek at Pikeview, CO
Monument Creek at Bijou Street at Colorado Springs, CO
Fountain Creek near Colorado Springs, CO
Fountain Creek at Colorado Springs, CO
Fountain Creek at Secrity, CO

Middle Arkansas Subregion

1. Suspended-sediment data are being collected on a 6-week basis at the following sites in cooperation with the Kansas Water Office:

Rattlesnake Creek near Macksville, KS
Cow Creek near Lyons, KS

Little Arkansas River at Alta Mills, KS
North Fork Ninnescah River above Cheney Reservoir, KS
South Fork Ninnescah River near Pratt, KS
South Fork Ninnescah River near Murdock, KS
Slate Creek at Wellington, KS
Arkansas River at Arkansas City, KS
Whitewater River at Towanda, KS

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

3. Suspended-sediment data are being collected on a 6-week basis at Little Arkansas River at Valley Center, KS, in cooperation with the COE.

Upper Cimarron Subregion

1. Suspended-sediment data are being collected on a 6-week basis at Crooked Creek near Nye, KS, in cooperation with the Kansas Water Office.

2. Suspended-sediment data are being collected at Cimarron River near Kenton, OK, Cimarron River near Englewood, KS, and Cimarron River near Forgan, OK, in cooperation with the U.S. Bureau of Reclamation (USBR).

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 basis at Lightning Creek near McCune, KS, and at Neosho River near Parsons, KS, in cooperation with the Kansas Water Office.

2. 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

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

4. 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
Sand Creek at Okesa, OK
Caney River near Ramona, OK
Verdigris River near Claremore, OK
Birch Creek below Birch Lake near Barnsdall, OK
Hominy Creek below Skiatook Lake near Skiatook, OK
Bird Creek near Sperry, OK

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)
Revuelto Creek near Logan, NM (bimonthly)

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.

3. Suspended-sediment data are being collected on a bimonthly basis at the Canadian River above New Mexico-Texas State line as a 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 data are being collected at Canadian Sandy Creek near Ada, OK, and Little River near Bowlegs, OK, in cooperation with the USBR.

3. 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
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 Arkansas Subregion

1. Suspended-sediment data are being collected at Arkansas River at Tulsa, OK, and on a bimonthly basis at Arkansas River at Dam 13 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.

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, at Prairie Dog Town Red River near Wayside, TX, and at Prairie Dog Town Fork Red River near Childress, TX (discontinued September 1986), 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
North Wichita River near Truscott, TX
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 on a quarterly basis at Little River at Millwood Dam, near Ashdown, AR, and at Sulphur River south of Texarkana, AR, and 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.

5. Suspended-sediment data are being collected on a daily basis at Bayou Pierre near Lake End and on a monthly basis at Grand Bayou near Coushatta, LA, as a part of a lignite study for the Louisiana Office of Public Works.

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
1950 Constant Avenue - Campus West
Lawrence, KS 66046

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

District Chief, WRD
U.S. Geological Survey
505 Marquette NW, Room 720
Western Bank Building
Albuquerque, NM 87102

District Chief, WRD
U.S. Geological Survey
215 Dean A. McGee Avenue
Room 621
Oklahoma City, OK 73102

District Chief, WRD
U. S. Geological Survey
649 Federal Building
300 East 8th Street
Austin, TX 78701

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

ARKANSAS - WHITE - RED REGION

SOIL CONSERVATION SERVICE

1. Studies of sediment damages and determination of sediment yields were made for the following activities.

a. Public Law 566

Major Drainage	Watershed	Stream	County	State
Arkansas River	Choska Drainage	Porter	Waggoner	OK
Red River	Little Beaver	Littel Beaver Buckhorn Hell Stage Stand Rock Morton	Grady Stephens Cotton	OK
Red River	Lower Bayou	Lower Bayou	Love	OK
Arkansas River	Bois d'Arc	Bois d'Arc	Kay	OK
Arkansas River	Brazil Creek	Brazil	Leflor	OK
		Wildhorse	Haskell	OK
		Owl Rock Jefferson	Latimer	OK
Cimarron River	Wild Horse Cr.	Wild Horse	Payne	OK

b. River Basin Investigations

Major Basins	Basin Reported	State
Red River	Southwest Oklahoma	OK

2. Special Studies

Project Descriptions	Counties	State
a. Lugert-Altus Irrigation and Drainage Study	Southwest Oklahma	OK
b. Ephemeral Gully Erosion Study program for state wide application in field and area offices	All	OK

TEXAS-GULF REGION

CORPS OF ENGINEERS

Southwestern Division

The SWD Laboratory processed a total of 1,848 bottled samples for determination of percent of sediment and 30 bed load material samples for Tulsa, Albuquerque, and Little Rock Districts.

Fort Worth District

1. The following reports were submitted to the Southwestern Division Office for approval.

a. Report on Sedimentation, Bardwell Lake, Waxahachie Creek, Trinity River Basin, Texas, Resurvey of August 1981.

b. Report of Sedimentation, Proctor Lake, Leon River, Brazos River Basin, Texas, Resurvey of May 1986.

2. The resurvey of Stillhouse Hollow Lake, Lampasas River, Brazos River Basin, Texas has been completed in November 1987. Analysis of survey data and sediment computations are underway.

Galveston District

A total of 185 inplace 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
Gulf Intracoastal Waterway	82
Miscellaneous	6
Sabine-Neches Waterway	15
Houston Ship Channel	12
Freeport Harbor	6
Corpus Christi Ship Channel	25
Trinity River	7
Texas City Channel	32
Total	185

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 accumulations.

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 Bayou Grand Cane near Stanley, LA, Bayou Castor near Logansport, TX, and Bayou San Patricio near Benson, LA, as a part of a lignite study for the Louisiana Office of Public Works. Suspended-sediment data is also being collected at Bayou Grand Cane near Stanley, LA, and Bayou Castor near Logansport, TX, on an event basis with a PS-69.

3. 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
649 Federal Building
300 East 8th Street
Austin, TX 78701

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

SOIL CONSERVATION SERVICE

1. Studies of sediment damage and determination of sediment yields were made for the following Public Law 566 activity:

Major Drainage	Watershed	Stream	County	State
Nueces County	Sulphur Creek	Sulphur Creek	Bee Kenedy Live Oak	TX

2. Reservoir Sedimentation Survey:

Reservoir	County	State
Gordon Lake	Taylor	TX

RIO GRANDE

BUREAU OF RECLAMATION

Siphon Scour Study for Rio de Truchas Crossing of the Garcia Acequia. - Based on computed hydraulics for the 100-year flood peak discharge, the depth of scour at the Rio de Truchas crossing of the Garcia Acequia was estimated to be 3 feet. The bed material has a mean diameter of 2.5 mm.

RIO GRANDE REGION

CORPS OF ENGINEERS

Southwestern Division

Albuquerque District

Sedimentation Surveys

1. A hydrographic survey of the sediment ranges at Cochiti Reservoir was conducted in October 1986, and August 1987. The purpose of the 1986 survey was to determine the changes in overall reservoir storage. The purpose of the 1987 survey was to determine the effects the 1987 spring runoff had on the data in the reservoir when compared to the 1986 resurvey. The letter report describing and analyzing the reservoir sedimentation resurvey at Cochiti Reservoir is scheduled for completion in calendar year 1988.

2. A hydrographic survey was conducted at Santa Rosa Dam on the Pecos River in August 1987. The purpose of the survey was to revise the elevation-area-capacity table. The resurvey is considered a partial survey and will be discussed when the initial sediment survey report for Santa Rosa Dam is done (scheduled for FY89).

3. The new elevation-area-capacity tables for Cochiti Reservoir were adopted on January 1988.

Sediment Load Measurements

1. 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.

2. Bed material samples were collected at Cochiti during the hydrographic surveys. The samples were analyzed for percent sediment, water content, density and grain size. The results of the bed samples analyzed show 25 percent silt, 71 percent clay, 4 percent sand and a dry unit weight of 36 lbs/cu ft at Cochiti Dam.

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 on a bimonthly basis at Red River below Questa, NM, and Rio Hondo near Valdez, NM, and at Rio Bueblo de Taos below Los Cordouas, NM, in cooperation with the New Mexico Interstate Streams Commission (NMISC).

2. Suspended-sediment data are being collected on a bimonthly basis at Rio Chama above Abiquiu Reservoir, NM, and at Rio Chama near Chamita, NM, in cooperation with the U.S. Army Corps of Engineers (COE) and Rio Chama near La Puerte, NM, in cooperation with the NMISC.

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 Grande below Cochiti Dam, NM, in cooperation with the Bureau of Indian Affairs.

5. Suspended-sediment data are being collected on a daily basis at Arroyo Chico near Guadalupe, NM, at Rio Puerco above Arroyo Chico near Gaudalupe, NM, and at Rio Puerco near Bernardo, NM, in cooperation with the U.S. Bureau of Land Management (BLM), NMISC, and COE.

6. 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.

7. Suspended-sediment data are being collected at Santa Fe River above Cochiti Dam, NM (quarterly), Cochiti Lake, NM (annually), and Jemez River near Jemez, NM (semiannually), in cooperation with the NMISC.

8. 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.

9. 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.

10. 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.

11. 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.

12. Suspended-sediment data are being collected on a bimonthly and intermittent basis at Pecos River below Sumner Dam, NM (formerly called Alamagordo Dam), in cooperation with NMISC, and as a part of NASQAN.

13. Suspended-sediment data are being collected on a daily basis at Pecos River near Artesia, NM, as part of the Federal CBR program.

14. 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.

15. 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, and at Mimbres River near Mimbres, 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
505 Marquette, N.W., Room 720
Western Bank Building
Albuquerque, NM 87102

District Chief, WRD
U.S. Geological Survey
649 Federal Building
300 East 8th Street
Austin, TX 78701

SOIL CONSERVATION SERVICE

1. Reservoir Sedimentation Surveys

Reservoir	County	State
Sandia Mountains Tributaries Site No. 1	Sandoval	NM

UPPER COLORADO

BUREAU OF RECLAMATION

Green River Endangered Species Habitat Studies. - A sediment sampling program was initiated in 1986 to describe the sediment transport regime of the Green River in the vicinity of Vernal, Utah. Since the closure of Flaming Gorge Reservoir in 1963, the annual hydrograph of the Green River has been altered. Three sampling locations have been established to collect suspended sediment and bed material samples in an effort of quantify the sediment transport characteristics of the Green River from its exodus from Split Mountain Canyon downstream to just below its confluence with the White River. This data is being collected to establish the relative stability of the Green River channel through this reach which is an important nursery habitat for the endangered Colorado squawfish.

During 1987, five complete sediment data sets were collected at each of the three sites. The data consist of hydraulic measurements, suspended sediment concentration and size, and bed material size analyses. These data were used to compute total sediment transport relationships for all sites.

Photo interpretation was completed to evaluate changes in channel width since closure of flaming Gorge Dam for the Green River from Split Mountain to Sand Wash. This interpretation indicated that the active channel had narrowed less than 5 percent since closure almost 25 years ago and that the channel is stable under the present flow regime.

Salem Bench Pipeline Scour Study. - Four cross drainage sites of the Salem Bench Pipeline were evaluated for potential bed scour during 100-year flood conditions. The estimated scour depths are 5 feet at 3 sites and 4 feet at the other. Representative bed material size ranged from 0.01 mm to 0.3 mm.

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 throughout the year at Rock Creek near Crater, CO, Rock Creek at McCoy, CO, and Muddy Creek at Kremmling, CO, in cooperation with 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.

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.

White-Yampa Subregion

1. Suspended-sediment data were obtained once a week at Yampa River near Maybell, CO.

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. Daily suspended-sediment data and periodic bedload data are being collected during the snowmelt runoff period in cooperation with the Wyoming Water Department Commission at the following stations:

Battle Creek near Encampment, WY
East Fork Savery Creek near Encampment, WY
Big Sandstone Creek near Savery, WY

4. Suspended-sediment data are being collected quarterly at Williams Fork River at mouth near Hamilton, CO, in cooperation with Moffat County.

5. Suspended-sediment and bedload data are being collected six times per year at the following sites in the coal mining region of the Yampa River basin:

Middle Creek above Dam Site near Oak Creek, CO
Yampa River above Dam Site near Oak Creek, CO
Martin Creek above Dam Site near Oak Creek, CO

These stations are operated in cooperation with the Upper Yampa Water Conservancy District.

6. 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 below Rio Blanco, CO (periodic)
Piceance Creek tributary near Rio Blanco, CO (periodic)
Piceance Creek above Ryan Gulch, CO (periodic)

These stations are operated in cooperation with Rio Blanco County.

7. 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.

8. Suspended-sediment data are being collected on a daily basis during spring, summer, and fall at Yampa River near Oak Creek, CO, in cooperation with the Upper Yampa Conservancy District.

Upper Colorado Subregion

1. Suspended-sediment data are being collected on a comprehensive level primarily during the runoff season at West Divide Creek near Raven, CO, in cooperation with the Colorado River Water Conservation District.

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 monthly basis at Price River near Woodside, UT, in cooperation with the USBR.

3. 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 monthly basis at Colorado River at Lees Ferry, AZ, as part of NASQAN and Arizona Department of Environmental Quality.

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.

3. Suspended-sediment data are being collected on a daily basis at San Juan River at Shiprock, NM, as a part of the U.S. Geological Survey Coal Hydrology Program.

4. Bedload data are being collected on a comprehensive level at East Fork San Juan River above Sandy Creek near Pagosa Springs, CO.

5. Suspended-sediment data are being collected on a quarterly basis at San Juan River near Bluff, UT, as part of NASQAN.

Special Studies

1. A study to determine relations between sediment production and peak discharge for a storm-runoff event continued in Wyoming. Existing sediment data are being used in the study.

2. A study in cooperation with the Colorado River Water Conservation District to define the sediment characteristics in the White River will entail collecting suspended-sediment data quarterly at the following sites:

North Fork White River at Buford, CO
South Fork White River at Budges Resort, CO
Wagon Wheel Creek at Budges Resort, CO
South Fork White River near Budges Resort, CO
South Fork White River near Buford, CO
White River below Meeker, CO
White River above Crooked Wash near Rangely, CO
Boise Creek near Rangely, CO

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

4. Two studies continue in the analysis phase to determine total sediment load at potential reservoir sites.

5. A study to determine source areas of sediment and define current sediment load in Fountain Creek in the Colorado Springs, CO, area continued.

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

District Chief, WRD
U.S. Geological Survey
Federal Building, FB-44
300 West Congress
Tucson, AZ 85701

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
505 Marquette, N.W., Room 720
Western Bank Building
Albuquerque, NM 87102

District Chief, WRD
U.S. Geological Survey
P.O. Box 1125
Cheyenne, WY 82003

District Chief, WRD
U.S. Geological Survey
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

SOIL CONSERVATION SERVICE

1. Studies of erosion problem areas, sediment damages, sediment related water quality problems and determinations of sediment an salt yields were made for the following watersheds:

a. Public Law 566

Major Drainage	Watershed	County	State
Virgin River	Southern Kolob Terrace	Kane	UT

b. River Basin Investigations

Major Basin	Basin Reported	State
Colorado River	Montezuma Creek	UT

LOWER COLORADO

BUREAU OF RECLAMATION

Black Mountain Pipeline Scour Study. - A scour analysis was made for two natural drainage crossings of the Black Mountain Pipeline, a feature of the Tucson Aqueduct. The streambed material had representative mean diameters of 0.10 and 0.15 mm. The estimated scour depths for the 100-year flood peak passage were 4 feet and 5 feet, respectively.

Tucson Aqueduct, Reach 6 Pipeline, Scour Studies. - The following table summarizes the results of the estimated scour depths for natural cross drainages along the Reach 6 Pipeline. All depths are for passage of the 100-year flood peak.

Drainage Area	Station (ft)	Discharge (ft^3/s)	D_{50} (mm)	Scour Estimate (ft)
5	14+80	990.	0.210	4.
5	24+10	990.	0.210	4.
6	47+20	530.	0.250	4.
7	73+20	570.	0.360	3.
8	97+20	1790.	0.125	6.
8	125+90	1790.	0.250	4.
8	136+10	1790.	0.250	4.
8	148+30	1790.	0.140	6.
9	189+80	1040.	0.170	5.
9	194+70	1040.	0.170	4.
9	198+70	1040.	0.170	5.
9	215+60	1040.	0.220	4.
9	224+30	1040.	0.145	3.
10	242+50	410.	0.170	3.
11	375+35	220.	0.250	3.
11	381+40	220.	0.300	3.

Sediment Loading for Waddell Siphon. - As a part of the construction of New Waddell Dam, a replacement structure for the downstream diversion dam will be built on the Agua Fria downstream from the Waddell Siphon. A sediment transport analysis concluded that the material stored behind the old diversion structure would be moved downstream to the new structure resulting in an additional loading of 50 feet of sediment over the siphon barrel.

Santa Cruz River Siphon Scour. - Because of design changes, the depth of scour over the Santa Cruz River Siphon of the Tucson Aqueduct was reevaluated. With the proposed levees in place, the estimated depths of scour are 9 feet for the 100-year flood and 11 feet for the Pima County design discharge of 80,000 ft^3/s.

Tucson Pipeline/Tunnel Siphon Scour. - Three cross drainages of the Tucson Pipeline in the vicinity of the Tucson Tunnel were evaluated for scour potential. The analysis indicated potential scour depths of 3, 4, and 5 feet at the sites for 100-year peak discharges. Representative mean bed material diameters were in the range of 0.3 to 0.4 mm at the three sites.

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
Virgin River above Halfway Wash near Riverside, NV (discontinued September 1986)
Muddy River above Lake Mead near Overton, NV

Little Colorado Subregion

1. Suspended-sediment data are being collected on a monthly basis at Little Colorado River at Greer in cooperation with Arizona Department of Environmental Quality.

2. Suspended-sediment data are being collected on a daily basis in cooperation with the U.S. Corps of Engineers (COE) at Little Colorado River near Joseph City, AZ.

3. Suspended-sediment data are being collected on a flow-event basis at Leroux Wash near Holbrook, AZ, in cooperation with the COE.

4. Suspended-sediment data are being collected on a monthly basis at Zuni River above Black Rock Res., NM, in cooperation with the U.S. Bureau of Reclamation (USBR) and at Rio Puerco at Gallup, NM, on a semiannual basis in cooperation with the New Mexico Interstate Stream Commission (NMISC).

Lower Colorado Subregion

1. Suspended-sediment data are being collected on a quarterly basis at Bill Williams near Planet, AZ, in cooperation with the USBR.

2. Suspended-sediment data are being collected as part of NASQAN at Colorado River below Hoover Dam, AZ.

3. Suspended-sediment data are being collected monthly at Colorado River at NIB above Monelps 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 monthly basis at San Francisco River at Clifton, AZ, in cooperation with the Arizona Department of Environmental Quality.

4. Suspended-sediment data are being collected on a quarterly 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 data are being collected on a monthly basis at Gila River at Kelvin, AZ, and San Pedro River below Aravaipa Creek, near Mammoth, AZ, in cooperation with the USBR.

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 bimonthly basis as a part of NASQAN and the Arizona Department of Environmental Quality at:

Salt River near Roosevelt, AZ
Verda River below Tanogla, AZ
Gila River above diversions, at Gillespie Dam, AZ
Gila River near Dome, AZ

3. Suspended-sediment data are being collected on a monthly basis in cooperation with the Arizona Department of Environmental Quality at:

Pinal Creek near Globe, AZ
Verda River near Clarkdale, AZ
Oak Creek at Redrock Crossing, AZ
Salt River below Stewart Mountain Dam, AZ
Verda River below Bartlett Dam, AZ

Special Studies

1. A long-term, ongoing statewide program in Nevada of investigations of sediment and debris transported by flash floods continued during 1985.

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

District Chief, WRD
U.S. Geological Survey
Federal Building
301 West Congress Street, FB-44
Tucson, AZ 85701

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 227
705 North Plaza Street
Carson City, NV 89701

District Chief, WRD
U.S. Geological Survey
505 Marquette NW, Room 720
Western Bank Bldg
Albuquerque, NM 87102

District Chief, WRD
U.S. Geological Survey
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, UT 84104

SOIL CONSERVATION SERVICE

1. Special Studies

A procedural giude for computing sediment storage requirements for small reservoirs was prepared and distributed to Soil Conservation Service field offices in Arizona.

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 Run near Collinston, UT

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, 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 bimonthly at the following sites as part of NASQAN:

Humboldt River near Carlin, NV
Humboldt River near Imlay, NV
Humboldt River near Rye Patch, NV (discontinued September 1986)

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 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 1986.

A long-term investigation of sediment and debris hazards related to flooding is in the fifth 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
Federal Building, Room 224
705 North Plaza Street
Carson City, NV 89701

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
Room W-2234, Federal Building
2800 Cottage Way
Sacramento, CA 95825

District Chief, WRD
U.S. Geological Survey
230 Collins Road
Boise, ID 83702

SOIL CONSERVATION SERVICE

1. Special Studies

a. Great Basin Area, Great Salt Lake River Basin, Jordan River Drainage, Squaw canyon Watershed, Utah County, Utah. This study was performed in support of an Emergency Watershed Project, with the Forest Service, on a mountain forest fire area to rate sediment yield for the design of a debris basin to protect urban areas.

b. Great Basin Area, Great Salt Lake River Basin, Jordan River Drainage, Lake Mountain-West Mountain-Cedar Valley Watershed, Utah County, Utah. This study was performed with the Bureau of Land Management to rate relative sedimentation-erosion condition on public lands for management-planning purposes.

PACIFIC NORTHWEST

BUREAU OF RECLAMATION

Mann Creek Reservoir. - A 100-year sediment inflow to the reservoir was estimated using the flow-duration, sediment rating curve procedure. The sediment rating curve was developed from suspended sediment samples collected from Mann Creek in 1984-85. The estimated annual sediment inflow to the reservoir is 3,520 tons per year.

Oroville-Tonasket Pumping Plants. - Settling basins were analyzed for the five river pumping plants in existence along the Okanogan River. Alternative basin sizes were recommended for remaining 95 percent of the suspended sediment of 0.0625 mm size and 75 percent of the suspended sediment of 0.032 mm size. The sediment inflow was predicted based upon existing suspended sediment concentration data at the pumping plant sites and both weekly and monthly pumping rates.

PACIFIC NORTHWEST REGION

CORPS OF ENGINEERS

North Pacific Division

Portland District

Sedimentation Surveys.

1. Reservoir Surveys.

a. Mount st. Helens Sedimentation Retention Structure (SRS). This structure began to retain sediments on 19 November 1987 when the diversion conduit was closed. Water was impounded to a maximum depth of 50 feet and extended almost a mile upstream. This initial impoundment effectively trapped all bed material and a delta rapidly formed. Periodic surveys, to monitor the delta formation and the gradations and characteristics of the deposits are being done and will continue indefinitely. Surveys to measure the depth and volume of deposition will be done each year after the winter storms.

b. Willow Creek Reservoir. There are severe water quality problems at this site, and a concern that the evident delta formations also indicate a sedimentation problem. Therefore, selected sediment ranges were surveyed in June 1987. There has been approximately 38 a-f of total deposition in this reservoir during the 3 years of operation. This is considerably less than the projected rate of 28 a-f/year (0.3 a-f/year/square mile of drainage area) as shown in Design Memorandum No. 6, and there is no evident problem with sedimentation.

2. Channel Surveys.

a. Reports. The following two reports, relative to the permanent solution to the sedimentation problem created by the 1980 eruption of Mount St. Helens, were prepared and submitted for review during 1987:

(1) Design Memorandum No. 14 "Kelso Levee Improvement". This report describes the hydraulic requirements and the design criteria for this feature of the overall plan.

(2) Design Memorandum No. 15 "Base-Plus Dredging". This report describes the sedimentation conditions, the dredging and disposal program, and the subsequent monitoring to assure the authorized levels of flood protection will be maintained for developed areas along the lower Cowlitz River.

b. Surveys.

(1) Toutle/Cowlitz River. Field surveys and data collection included bed material samples along the full reach of this river system; suspended sediment samples in the Cowlitz River at Kelso; repeated cross-section surveys of the Cowlitz and lower Toutle Rivers; and water surface levels of the lower Cowlitz River during flood times.

(a) In addition, the District partially funded the USGS

gaging stations on the Toutle River at Tower Road, Kid Valley, and Elk Rock.

(b) The above data was used in the preparation of the two Mount St. Helens design memoranda, in monitoring the impacts of the SRS, and in determining the levels of flood protection along the Lower Cowlitz River.

(2) Columbia River. Field surveys and data collection included velocity and suspended sediment measurements, bed load sampling, and hydrographic surveys. This data was used to monitor the effectiveness of experimental equipment for skimming off the top of sand waves, to monitor the impacts of ship waves on erosion of shoreline dredged disposal areas, and in other studies to identify shoaling problems and reduce dredging costs in the Columbia River navigation channel.

3. Equipment Used. Most sediment samples and water measurements were taken with standard P-61, P-63, D-74, and BM-54 samplers; Helley-Smith bedload samplers; Pipe dredges; Price velocity meters; and VADA directional meters. Hydrographic surveys were made by special survey boats equipped with electronic fathometers.

Walla Walla District

Sedimentation Surveys

1. Lower Granite Lock and Dam. Condition surveys were performed at proposed 1988 dredging and inwater disposal sites. These surveys were close interval soundings performed along the southern half of the Snake River channel upstream of Red Wolf Bridge (River Mile 137.2) extending upstream and including all of the confluence area to R.M. 139.64 on the Snake River and to R.M. 0.59 on the Clearwater River, and several middepth and deep-water disposal sites between R.M. 119 and 120.5 on the Snake River.

All sediment ranges (0.07 through 0.36) on Asotin creek and sediment ranges 145.15 through 145.38 on the Snake River were resurveyed in July as part of a study of the effects of sedimentation on the Asotin Creek water surface profile near the confluence with the Snake River.

A survey consisting of 16 channel cross sections was performed on the Snake River between R.M. 140.20 and 141.5 to evaluate the effectiveness of this reach as a sediment trap.

2. Little Goose Lock and Dam. Condition surveys were performed on the Snake River between R.M. 100 and 102 in February and again in August to monitor downstream movement of a sandbar which interferes with navigation.

3. McNary Lock and Dam. Resurveys of the 28 existing sediment ranges on the Columbia River, 23 ranges on the Walla Walla River, and the 4 ranges at the mouth of the Yakima River were began in 1986 and completed in the first half of 1987.

Sediment Collection Activities. As part of an inwater dredge disposal monitoring program in the lower Granite pool, 16 sediment samples were collected in the proposed dredging areas on the Snake River near the Clearwater confluence, and 6 samples were collected downstream of R.M. 120.5

The samples were analyzed for grain size distribution, volatile solids, oil and grease, heavy metals, and pesticides. Dr. David Bennett, under Corps contract with the University of Idaho, also collected substrate samples at several sites throughout the reservoir as part of a study of shallow, middepth, and deep-water habitat studies in conjunction with the inwater dredge disposal test.

Other Investigations

1. A project study is continuing to determine the impacts of sedimentation, dredging, and inwater disposal on the Lower Granite pool in order to determine the most effective method of maintaining adequate freeboard on the Lewiston levees.

2. A study is in progress to determine methods of maintaining navigation through the Shultz Bar reach of the Snake River (R.M. 100 through 102). Sediment buildup in this reach has reduced the depth of the navigation channel and created a hazard to upstream barge traffic.

3. A study of the effects of sedimentation on the channel capacity of Willow Creek near Middleton, Idaho, was performed for the Federal Emergency Management Agency. Sediment samples were collected at nine locations, and resurveys of channel cross sections were performed as part of the study.

4. Studies evaluating the adequacy and future maintenance of the Jackson Hole levee system were begun in 1987 and will continue in 1988. These studies will involve some sediment sampling and geomorphic analysis of the Snake River near Jackson, Wyoming.

PACIFIC NORTHWEST REGION

GEOLOGICAL SURVEY

Kootenai-Pend Oreille-Spokane Subregion

1. Suspended-sediment data are being collected on a periodic 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, and as part of NASQAN.

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.

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

and on a periodic basis at:

Little Blackfoot River near Garrison, MT
Flint Creek near Drummon, MT
Rock Creek near Clinton, MT
Blackfoot River near Bonner, MT

2. Daily suspended-sediment data was collected from January to April at the following sites under a Federal Energy Regulatory Commission permit with Montana Power Company:

Blackfoot River near Bonner, MT
Clark Fork above Missoula, MT

3. 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 Cemas Prairie, MT
Crow Creek at mouth near Ronan, MT
Mission Creek at National Bison Range at Moiese, MT
Jocke River at Dixon, MT
Flathead River at Perma, MT

4. 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)

5. Suspended-sediment data are being collected on a daily basis at Flathead River at Flathead, British Columbia, in cooperation with the Montana Bureau of Mines and Geology.

6. 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.

7. 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.

8. 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.

9. Suspended-sediment data are being collected monthly and weekly during spring runoff at Clark Fork near Cabinet, ID, in cooperation with the Idaho State Department of Health and Welfare.

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 and NAWQA.

2. Suspended-sediment data are being collected on a periodic basis at Yakima River at Cle Elum, WA, Yakima River at Umtanum, WA, Naches River at North Yakima, WA, Sulphur Creek Wasteway near Sunnyside, WA, and Yakima River near Grandview, WA, as a part of NAWQA.

Upper Snake Subregion

1. Suspended-sediment data are being collected on a bimonthly 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 Granite Creek and Little Granite Creek near Bondurant, WY, and Pacific Creek at Moran, WY, as part of a special research project.

3. Suspended-sediment data are being collected on a bimonthly basis at Snake River near Heise, ID, as a part of NASQAN.

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.

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 at Snake River at Burbank, WA, as a part of NASQAN.

3. 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, and at Deschutes River near Biggs, OR, as a part of NASQAN.

Lower Columbia Subregion

1. Suspended-sediment data are being collected on a periodic basis at Columbia River at Warrendale, 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.

Oregon-Washington Coastal Subregion

1. Suspended-sediment data are being collected on a periodic basis at Fogue River near Agress, 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.

Oregon Closed Basins Subregion

1. Suspended-sediment data were collected on a periodic basis at Donner and Blitzen Rivers near Frenchglen, OR, 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:

North Fork Toutle River above Bear Creek near Kid Valley, WA
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
Clearwater River near mouth, 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 were 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. Design and construction of an observation platform was completed on the right bank of the research site at Kid Valley. Longitudinal depth sounding from the platform will facilitate measurements of bedload, velocity profiles, and suspended-sediment profiles during rapidly changing flows.

2. Channel geometry data are being collected at 20 sites to support research on erosional processes and evolution of the drainage system. An enlarged data-collection program for 1990 is in the formulation stages that would document 10 years of post-eruption recovery at Mount St. Helens.

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 were conducted in field and laboratory settings, respectively, in Japan under cooperative

arrangements between research colleagues at the WRD project office at the Cascades Volcano Observatory in Vancouver, WA, and in Japan. 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. Research continued on a suitable approach for a steep-slope hydrodynamic computer model. The model is intended as the basis for a dynamic sediment transport computer model for rivers in mountainous terrain, such as that found in the Pacific Northwest. An approach using the method of characteristics seemed promising, but failed to conserve mass. A new numerical method that preserves the desirable features of the method of characteristics, but that also conserves mass, has been found.

4. A study of sediment transport in the lower Puyallup, White, and Carbon Rivers of western Washington evaluated the effects of three sediment control alternatives. The comparison was made by modeling the influence of each alternative using sediment transport computer model HEC-6 of the U.S. Army Corps of Engineers. The model was modified for the study to enhance numerical approximations of sediment transport, deposition, and scour, in order to better match observed data. The model showed that sediment traps were somewhat effective but inefficient at controlling sand deposition downstream, and were ineffective in alleviating localized gravel deposition. The current practice of gravel mining appears to be a reasonable approach for removing widely dispersed gravel deposits. Nonintervention appears most appropriate for those river reaches that are actually degrading rather than aggrading.

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

State Chief, WRD
U.S. Geological Survey
847 NE 19th Avenue
Suite 300
Portland, OR 97232

District Chief, WRD
U.S. Geological Survey
P.O. Box 1125
Cheyenne, WY 82003

District Chief, WRD
U.S. Geological Survey
Federal Building, Room 428
301 So. Park Avenue, Drawer 10076
Helena, MT 59626-0076

State Chief, WRD
U.S. Geological Survey
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

SOIL CONSERVATION SERVICE

1. Studies of sediment yields and determinations of sediment damages were made in the following watershed:

   a. Resource Conservation and Development

Project	County	State
Radthrum	Shoshone	ID
Franklin C.A.T.	Franklin	ID
Corral Creek	Gooding	ID

   b. Conservation Operations

Major Drainage	Watershed	County	State
Puget Sound	Chimacum Creek	Jefferson	WA

2. Reservoir Sedimentation Studies

Reservoir	County	State
Magic	Gooding	ID

3. Special Studies

Imhoff cone procedures were performed to determine the amount of suspended sediment entering the Columbia River, Franklin County, Washington. Fourteen sites selected at the base of advancing landslides were sampled monthly during a four month period.

CORPS OF ENGINEERS

south Pacific Division

Los Angeles District

Reservoir Sedimentation. "Reservoir Sedimentation Summary" sheets (ENG Form 1787), for Big Dalton, Painted Rock and Thompson Creek Flood Control Basins; Blanchard, Dunsmuir, Golf Club, Irving, May No. 1, May No. 2, Starfall, Ward and Zachau Debris Basins were completed.

Sediment Sampling Stations. The following USGS sediment sampling stations are funded in part by the District: Santa Ana River at Mentone, CA (Gage No. 11051500); Santa Ana River near E St., San Bernardino County, CA (gage No. 11059300); Little Colorado River and Holobrook, AZ near Joseph City (Gage No. 09397000).

Office Activities

1. Completed the sediment transport analysis for the lower Santa Ana River, California, as part of the Santa Ana River Phase II GDM. The purpose of this study is to analyze the hydraulic design of the proposed improvement to ensure that the project will function properly under sediment loads imposed by a variety of flow conditions. The analysis consists of a sediment yield analysis of the canyon watershed, a qualitative and quantitative assessment of the river, and a detailed sediment analysis.

2. Currently in progress is the sediment discharge analysis into the Pacific Ocean as part of the Coast of California Storm and Tidal Wave Study (CCSTWS). The on-going study efforts are concerned with the San Diego Region, encompassing the streams and watersheds draining to the California coast from the U.S. Mexican International Border to Dana Point. The study efforts are designed to provide quantification of average annual sediment discharges for existing watershed conditions as well as for the hypothetical 2-, 10-, 50-, 100, and 200-year frequency floods. The second of three phases was completed in 1987. The third (final) phase is currently being conducted by the Architect-Engineering firm of Simons, Li, and Associates.

3. Completed the study (draft) for the Prediction of Debris Yield for Southern California Watersheds. The purpose of the study was to establish a comprehensive and updated approach to the design and analysis of debris basins.

4. Completed the Migration Potential Analysis of Depleted Uranium in a Stream Bedload Environment at Yuma Proving Grounds (YPG), Arizona. The purpose of this study was to assess potential surface water contamination, resulting from the release of Depleted Uranium (DU) contaminants into the environment. Quantitative results delineating the extent of contamination of DU particles entering the Imperial Wildlife Refuge, 8 km. to the South West of the basin, during a 20 year period was presented, subject to conceptually realistic scenarios. This study was conducted by the Architect-Engineering firm of ENTEC Engineers, Inc.

5. Completed the sediment transport analysis of the Santa Ana River above Prado Dam as part of the Seven Oaks Phase II General Design Memorandum. The purpose of the study was to analyze the impacts on channel stability, structures, pipelines, and other facilities resulting from construction of the dam. The study was conducted by the Architect-Engineering firm of Simons, Li, and Associates.

Sacramento District

Sediment Sampling

1. Routine samples of lake outflows were collected and analyzed for suspended sediment at Black Butte, Pine Flat, Kaweah, Success and Isabella Lakes. For analyses, grab samples obtained in one-gallon containers were used. U.S. Geological Survey maintain and publish discharge record.

2. Samples for total sediment load were collected at Pena Creek, Dry Creek but discontinued 30 Sept. D-49 or P-61 samplers were used to collect suspended sediment, and Helley Smith sampler for bedload measurement.

sediment studies.

1. Cache Creek Basin, California - C, P&E Study. The proposed project involves enlarging the outlet channel of Clear Lake in the upper part of the basin (i.e., watershed) and enlarging the existing sediment basin in the lower basin. A sediment Engineering (S.E.) Investigation was conducted to evaluate the impact of proposed upper basin project features on the creek channel morphology through Capay Valley, downstream of Clear Lake. A sediment monitoring program initiated in October 1983 was concluded in 1986 and included streamflow and total load sediment gage data at the upstream and downstream boundaries of Capay Valley. Sediment transport routings and geomorphic studies using these data and that from previous programs were completed this year to evaluate project impacts. A preliminary report, outlining the results of the S.E. Investigation, was issued in October 1987.

2. Corte Madera Creek, California - Construction. The project consists of channel improvements to Corte Madera Creek located in Marin County, California. Units 1-3 of the project were completed in 1971. Unit 4 construction is scheduled to initiate in FY 88. The concrete-lined channel portion of Units 2-3 has reduced channel capacity due to sediment deposition. A sediment monitoring program in the concrete-lined channel in conjunction with an HEC-6 analysis of the entire project was initiated in October 1987 and will be completed in FY 88. The study will evaluate the capacity of the concrete-lined channel with completion of Unit 4 and a periodic maintenance program to remove accumulated sediments. The study will also evaluate (a) the effectiveness of a proposed sediment trap in Unit 4, and (b) if the walls of the concrete-lined channel require raising to restore the design channel capacity.

3. Dry Creek (Sonoma County), California - Construction. An S.E. Investigation of Dry Creek, between the Warm Springs Dam and its confluence with the Russian River was completed. This reach has a history of bank erosion and other sediment transport related problems. Before dam closure, some bank and bed stabilization works were authorized and constructed. The

purpose of the S.E. Investigation was to determine project impacts on the sediment transport and channel morphology of the study reach and how best to proceed with future (if necessary) bank and/or bed stabilization works. the investigation took a multi-disciplinary approach to analysis of Dry Creek problems, including consideration of the hydraulic, hydrologic, sediment transport and geomorphic aspects of the creek and its contributing watershed. In conjunction with the S.E. Investigation, a data collection program in the basin was concluded this year and included collection of streamflow and total load sediment data at two stations. A preliminary report, outlining the results of the S.E. Investigation, was issued in May 1987.

4. Guadalupe River, California - GDM. 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 with the flow split controlled by weirs on both the bypass channel and natural channel. The weir on the natural channel will have ports to pass fishery flows and a portion of the sediment load. However, it is anticipated that deposition will occur upstream of the weirs. A sediment monitoring program in FY 88 will provide information on existing conditions and input to a sediment study of project effects on the channel. The study will be completed in FY 88.

5. Little Dell Lake, Utah - GDM. The Little Dell Lake, Utah Project is located on Dell creek in Sale Lake County approximately 8 miles east of Salt Lake City. The project will provide flood control, M&I water supply, and recreational benefits to the Salt Lake City Area. An integral part of the project is the Parleys Creek Diversion Conduit, which diverts flows from Parleys Creek into Little Dell Lake. In 1987, a sediment engineering investigation was performed to evaluate the impact of sediment load on the diversion conduit and intake. A streamflow and sediment monitoring program was conducted on Parleys Creek during the 1987 snowmelt and cloudburst season. This data and additional data from adjacent drainage basins was analyzed and a preliminary report by the USGS was issued in the fall of 1987.

6. Sacramento River Geomorphic Study - Construction. Bank protection measures on the Sacramento River are proposed for two reaches: In the Butte Basin flowage area, the vicinity of the Butte Basin "flow split" area; and Chico Landing to Red Bluff. The purpose of these measures is to preserve the historical division of flows into the main leveed floodway of the Sacramento River and into the natural overflow area of Butte Basin. Due to changes to the Sacramento River course in this vicinity, concern has been raised that this division of flow might change, possibly routing floodflows in excess of design capacity down to leveed floodway and endangering the integrity of the overall Sacramento River flood control system. In the Chico Landing to Red Bluff reach, bank protection measures are proposed as part of an overall comprehensive program for channel stabilization. A detailed geomorphic study was initiated this year regarding these questions.

7. Sacramento River Fish Gravel Study - Construction. Historically, the upper Sacramento River has been a prime water course for fish spawning. This is due to a number of reasons, including flow and temperature conditions and suitability of riverbed material. Typically, suitable size and gradation of bed material, (i.e., fish spawning gravels) ranges from 0.5 to 6 inch size. Recently, concern has been raised that proposed bank protection measures in

the upper Sacramento River would deprive the river of an important source of the fish spawning gravels - the eroding banks. A study was concluded and a report issued in May 1987 addressing these concerns and identifying what impacts, if any, there would be on the fish spawning habitat.

8. Wildcat/San Pablo Creek (Contra Costa), California - GDM. An S.E. Investigation to determine the impacts that proposed flood control channels would on channel morphology and sediment transport in the project area was concluded. The proposed channels (2) would carry a relatively coarse bedload and empty into environmentally sensitive tidal marshes. In the original selected plan, a sediment debris basin was incorporated into one of the project channels to preserve its flood conveyance capability and protect the downstream marsh from coarse bedload deposition. In a modified plan developed during plans and specifications for the project channels, a transition zone was added to one of the project channels near its mouth to capture any remaining coarse sediments, not captured by the upstream sediment debris basin, before they can flow into the environmentally sensitive marsh. In addition, the downstream reaches of both project channels were widened to encourage deposition of sediments in the channels prior to their exit into the marsh areas. The results of the S.E. Investigation are reported in the Hydraulic DM Supplement to the project dated June 1987.

San Francisco District

Sediment Studies.

1. Alcatraz Dredge Material Disposal Site. As first reported in 1985, numerous studies were implemented as a result of material accumulation at the Alcatraz disposal site. In July 1985, all study activities related to the disposal of dredged material were consolidated into the Disposal Management Program (DMP). Monthly bathymetric surveys are continuing at the Alcatraz site. Survey data to date have indicated retention of material disposed at the Alcatraz site. Material is still accumulating at the site. Two dredge material retention studies were completed at Alcartraz during 1986-87. Contractor reports on these studies are available in the District's Environmental Branch.

District sediment transport studies are continuing to address both short-term and long-term transport of disposal material. The Waterways Experiment Station of disposal at Alcartraz using a model called DIFID, Disposal from Instantaneous Dump. This model determines the short-term fate of discharged dredged materials. To address our long-term goal, a numerical model to simulate long-term hydrodynamic circulation and sediment transport has been selected. The selected model is "TABS-II" and the District has set boundary conditions and has calibrated the proposed hydrodynamic model. The District, along with WES, is now working on calibration of a near field sedimentation model.

2. San Lorenzo River Study. The deposition of sediment in the San Lorenzo River Flood Control Project, constructed in 1962, has substantially reduced the flood-carrying capacity of the project. WES was contracted in 1985 to analyze the actual carrying capacity of the river during various flood events using the sediment model HEC-6, with special emphasis on re-creating the January 1982 flood event which was estimated to have a return frequency of

about once in thirty years. WES was also asked, as a part of the study, to determine the average annual sediment load based on 47 years of record using the calibrated HEC-6 model. Based on the results of the WES study, the District published a report in March 1987 proposing various alternative plans to return the flood control channel to its original capacity. A reconnaissance study will be conducted in 1988-89 to evaluate structural, non-structural and dredging alternatives. A feasibility study is scheduled to start in FY 1989.

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)
Redwood Creek above Panther Creek (monthly and storm event)
Panther Creek near Orick (monthly)
Coyote Creek near Orick (monthly)
Little Lost Man 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 Califronia Department of Water Resources and the Bureau of Reclamation, respectively.

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 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 and Grass Valley Creek near French Gulch, in cooperation with the U.S. Bureau of Reclamation.

Sacramento Basin Subregion

1. Suspended-sediment and bedload data are being collected in Capay Valley to evaluate the impact of enlarging the Clear Lake outlet channel on the Cache Creek Channel Morphology. Data collection began in October 1983, in cooperation with the U.S. Army Corps of Engineers (COE). The current sampling program includes the following stations plus survey and bed- material data collected at 10 cross sections in Capay Valley (discontinued September 1986):

Cache Creek at Yolo (storm event)
Cache Creek at Capay Bridge (storm event)
Cache Creek near Brooks (daily)
Cache Creek above Rumsey (daily)

2. Suspended-sediment data are being collected on a daily basis at Feather River near Gridley, in cooperation with California Department of Water Resources, and at Sacramento River at Freeport, in cooperation with the COE.

3. Suspended-sediment data are being collected on a bimonthly basis at Sacramento River at Keswick, as part of NASQAN.

North Lahontan Subregion

1. As part of the Tahoe Monitoring Program, suspended-sediment data are being collected from seven streams that drain into Lake Tahoe. The relation of sediment discharge to algae growth in the lake is being studied by the University of California at Davis. The sediment data collection program is in cooperation with the California Department of Water Resources and the University of California at Davis, and includes the following daily sediment stations:

Upper Truckee River at South Lake Tahoe
General Creek near Meeks Bay
Blackwood Creek near Tahoe City
Ward Creek at Highway 89

2. Suspended-sediment data are being collected on a daily basis and bedload data on a periodic basis at Edgewood Creek near Stateline and Logan House Creek near Glenbrook, as part of a sediment budget study in the Lake Tahoe Basin in cooperation with the Tahoe Regional Planning Agency.

3. Suspended-sediment data are being collected on a periodic basis at Martis Creek at Highway 267 near Truckee, Martis Creek Lake near Truckee and Martis Creek near Truckee, in cooperation with the COE and at Sagehen Creek near Truckee, in cooperation with the University of California at Davis.

4. 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 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 daily basis and bedload data on a periodic basis at Pena Creek near Geyserville, Dry Creek near Geyserville, and Russian River near Guerneville, in cooperation with the COE.

3. Suspended-sediment data are being collected on a daily basis and bedload data on a periodic basis at Permanete Creek and WF Permanente Creek near Monte Vista to evaluate the sediment transport rates caused by both natural processes and limestone quarrying activities within the Permanente Creek basin. Data collection began in October 1984, in cooperation with Santa Clara Valley Water District.

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

5. Suspended-sediment data are being collected twice per year at two stations on Los Gatos Creek and bed-material data are being collected twice per year at 12 stations in the Guadelupe River basin, as part of the Santa Clara County Water Quality Study. Data collection began in 1982, in cooperation with the Santa Clara Valley Water District.

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.

3. Suspended-sediment data are being collected at 11 stations on a biweekly basis and at 33 stations on a synoptic basis, as part of the data- collection program for the San Joaquin River Water Quality Study. Bed- material data are also being collected at 24 stations, once or twice per year. Data collection began in 1985, in cooperation with the U.S. Bureau of Reclamation.

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 and bedload data are being collected on a periodic basis at four streams between Half Moon Bay and Monterey Bay, in cooperation with the Department of Boating and Waterways. The cooperator will use this data and estimates of sediment loads from discontinued sediment stations to develop a management plan for beach areas along the California coast. Data collection began in October 1985 and was discontinued September 1986:

San Gregorio Creek at San Gregorio
Salinas River near Spreckels
Pescadero Creek near Pescadero
San Lorenzo River at Big Trees

3. 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.

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, and on a quarterly basis at Owens River near Big Pine, as part of NASQAN.

South Coastal Subregion

1. Suspended-sediment data are being collected once per year at 10 stations in the Santa Monica Mountains, as part of the Santa Monica Mountains Water Quality Study. Data collection began in 1982 in cooperation with the National Park Service.

2. Suspended-sediment data are being collected on a daily basis and monthly estimates of bedload discharge are made at Santa Ana River at Santa Ana, and San Juan Creek at San Juan Capistrano, in cooperation with Orange County Environmental Management Agency.

3. Suspended-sediment data are being collected on a daily basis at Santa Ana River near Mentone and on a periodic basis at Santa Ana River near San Bernardino, in cooperation with the COE.

4. Suspended-sediment and bedload data are being collected on a periodic basis, in cooperation with the California Department of Boating and Waterways and the COE, at the following stations:

Carmel Creek near Del Mar
Carroll Creek near La Jolla
Los Penasquitos Creek near La Jolla
Arroyo Trabuco at San Juan Capistrano
San Luis Rey River at Oceanside
San Diequito River near Del Mar
San Mateo Creek at San Onofre

5. Suspended-sediment data are being collected on a bimonthly and storm-event basis at Santa Ana River below Prado Dam, in cooperation with Orange County Environmental Management Agency.

6. Suspended-sediment data are being collected on a daily basis and monthly estimates of bedload discharge are made at Ventura River near Ventura, in cooperation with California Department of Boating and Waterways.

7. Suspended-sediment are being collected on a quarterly basis at Los Angeles River at Long Beach and Santa Clara River at Los Angeles-Ventura County Line, 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
2800 Cottage Way
Sacramento, CA 95825

SOIL CONSERVATION SERVICE

1. Studies of erosion and sediment yield were made in the following river basins:

Major Basin	Basin Reported	State
Feather River	East Branch North Fork Feather River	CA
San Joaquin River	Arroyo Honda Salt Creek Cantua Creek	CA
Suisun Bay	Mt. Diablo Creek	CA

ALASKA REGION

GEOLOGICAL SURVEY

Northwest Subregion

1. Suspended-sediment and bed-material data are being collected on a periodic basis at Kobuk River near Kiana, AK, as part of the Collection of Basic Records (CBR) program.

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 periodically at the Tanana River at Nenana, AK, as part of NASQAN.

3. Suspended-sediment and bedload data are being collected on a periodic basis at Lignite Creek above mouth near Healy, AK, as part of the Federal CBR program.

Southwest Subregion

1. Suspended-sediment data are being collected on a periodic basis at Kuskokwim River at Crooked Creek, AK, as part of NASQAN.

South-Central Region

1. A cooperative study with the Alaska Department of Transportation and Public Facilities was initiated in 1986 to determine annual suspended-sediment inflow to Campbell Lake via Campbell Creek. Suspended-sediment and bedload data were obtained at three sites during the 1985 water year.

Report: Lipscomb, S. W., 1988, Sediment discharge data for the lower reach of Campbell Creek, Anchorage, Alaska: U.S. Geological Survey Open-File Report 88-81, 12 p.

2. Suspended-sediment data are being collected on a periodic basis at 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 Copper River near Chitina, AK, as a part of NASQAN.

4. A cooperative study with the Municipality of Anchorage was initiated in 1985 to determine sediment movement into, within, and out of Eklutna Lake. Suspended-sediment samples are being collected daily and bedload samples are being collected periodically.

Southeast Subregion

1. As part of the cooperative program with the U.S. Forest Service, suspended-sediment data are being collected on a periodic basis at the following sites:

Rocky Pass Creek near Point Baker, AK
Greens Creek near Juneau, AK
Kadashan River above Hook Creek near Tanakee, AK

2. Suspended-sediment data are being collected on a periodic basis at the Stikine River near Wrangell, AK, as part of NASQAN.

3. A cooperative program with the City and Borough of Juneau, to obtain suspended-sediment samples at Gold Creek near Juneau, was initiated in 1984 and continued in 1987.

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 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 Aiea
Right Branch of Kamooalii Stream near Kaneoha
Luluku Stream near Kaneohe
South Fork Kapunahala Stream at Kaneoha
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
P.O. Box 50166
Honolulu, HI 96850

CARIBBEAN REGION

GEOLOGICAL SURVEY

Puerto Rico Subregion

1. Suspended-sediment data are being collected on a bimonthly basis when flow is above normal at 59 sites in cooperation with the Puerto Rico Environmental Quality Board (PREQB).

2. 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):

Río de la Plata at Toa Alta, PR
Río Grande de Manatí near Manatí, PR
Río Grande de Anlasco near San Sebastián, PR
Río Grande de Patillas near Patillas, PR

3. Suspended-sediment data are being collected on a weekly basis and during high flows at Río Tanamá near Utuado, PR, in cooperation with PREQB.

4. Suspended-sediment data are being collected on a daily basis at Río Rosario near Hormigueros PR, and during high flood events at at Rio Fajardo near Fajardo, PR, in cooperation with the U.S. Army Corps of Engineeers (COE).

Special Studies

1. Suspended-sediment data are being collected on a weekly basis and during high flows at the following sites in cooperation with PREQB, COE, Puerto Rico Department of Natural Resources (PRDNR), and Puerto Rico Aqueduct and Sewer Authority (PRASA) to determine the sediment load from those small basins to Lago Loíza, a water-supply reservoir:

Quebrada Blanca at Jagual, PR
Quebrade Salvatierra near San Lorenzo, PR
Quebrade Caimito near Juncos, PR
Quebrada Maney near Guarbo, PR
Río Turabo Borinquen, PR

2. Suspended-sediment data are being collected on a daily basis at the following sites in cooperation with PREQB, PRASA, PRDNR, and COE as part of a project to determine the sediment load at these three proposed dam sites:

Río Cayaguas at Cerro Gordo, PR
Río Valenciano near San Lorenzo, PR
Río Grande de Loi,za at Quebrada Arenas, PR

3. Suspended-sediment data are being collected daily at the following sites in cooperation with PREQB, PRDNR, PRASA, and COE to determine total sediment input from Río Grande de Loíza Basin to Lago Loíza reservoir:

Río Grande de Loíza at Caguas, PR
Río Gurabo at Gurabo, PR

4. Bed-material samples will be collected twice a year at the following sites in cooperation of PREQB, PRDNR, PRASA, and COE as part of a project to determine the total bed-material discharge from these subbasins to Lago Loíza:

Río Grande de Loíza at Quebrada Arenas, PR
Quebrada Blanca at Jagual, PR
Quebrada Salvatierra near San Lorenzo, PR
Río Cayaguas at Cerro Gordo, PR
Río Turabo at Borinquen, PR
Río Grande de Loíza at Caguas, PR
Quebrada Caimito near Juncos, PR
Río Valenciano near Juncos, PR
Quebrada Mamey near Gurabo, PR
Río Gurabo at Gurabo, PR

5. Twelve sedimentation surveys will be conducted at 12 water-supply reservoirs to investigate the impact of sediment deposition on the reservoirs capacity.

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

District Chief, WRD
U.S. Geological Survey
G. P. O. Box 4424
San Juan, PR 00936

LABORATORY AND OTHER RESEARCH ACTIVITIES

AGRICULTURAL RESEARCH SERVICE

ARIZONA

Research activities at the Aridland Watershed Management Research Unit in Tucson, Arizona include the following:

1. A revision of the Universal Soil Loss Equation (USLE), now nearing completion, significantly changes information in Agriculture Handbook No. 537 published in 1978. Although most changes in the rainfall-runoff term R are not significant, a later release will include isoerodent data for the western United States based on an analysis of about 1,400 stations. Changes are also being made in Florida and a correction will be allowed in heavy rainfall areas where much of the rainfall impacts on a ponded water situation with the result that the kinetic energy affecting splash erosion is reduced. The soil erodibility term, K, although still developed with the nomograph representing soil physical characteristics, will be made time varying to reflect freeze-thaw phenomenon. The average annual value will then be weighted by the distribution of annual EI in a manner similar to that used for soil loss ratios used to reflect the crop stage.

   The cover management term, C, will be computed using a subfactor approach, the product of four terms. The subfactor terms reflect prior land use, plant canopy, surface cover (including erosion pavement) and surface roughness. New algorithms have been developed which reflect the ratio of interrill to rill erosion and permit description of different values for construction sites, etc., where rilling is prevalent. The technology has also been refined to permit easy calculation of the topographic term, LS, for complex slopes in contrast to the simple (uniform) slope used heretofore. Finally, the P-factor values have been expanded considerably to reflect new crop rotations and to permit specific application to ridge-furrow agronomic practices. The most significant change will include the development of a computer program to ease the calculations with adaptation to PC technology using a floppy disk.

2. The USDA Water Erosion Prediction Project (WEPP) with lead responsibility under L. J. Lane is making excellent progress to develop a physically-based erosion technology to replace the USLE. The fundamental erosion mechanics algorithms used to describe detachment and transport of sediment in interrill areas and detachment, transport, and deposition in rill (concentrated flow) areas have been programmed for solution on a PC. Furthermore, the hydrology routine which describes runoff using a Green and Ampt infiltration calculation is performed on synthetically generated climatic sequences for daily precipitation amount and duration, maximum-minimum temperature and solar radiation. Detailed soil data and tillage practices are also included which permit plant growth simulation and residue decay as they affect surface characteristics.

   Data files are being prepared using rainfall simulators to determine model parameter values for a wide variety of in-situ conditions on rangelands and cultivated croplands. The rangeland portion of the field work, now in its second year and handled from the Tucson location, included 23 soil-vegetation sites throughout the western half of the United States in the first year and will concentrate on repeated experiments at some sites and evaluation of range condition classes in the second year.

   For additional information, contact Dr. Kenneth G. Renard, Research Hydraulic Engineer, USDA-ARS, Aridland Watershed Management Research Unit, 2000 E. Allen Road, Tucson, AZ 85719.

COLORADO

Research Activities within the Hydro-Ecosystem Research Unit in Fort Collins, Colorado include the following:

1. A physically-based computer model was developed to quantify the cause and effect relationship between the survival of anadromous salmon species and the quality of aquatic habitat supported by gravel-bed streams. This study was carried out under the sponsorhip of SCS. The computer model is site-specific to the Tucannon River Basin in southeastern Washington. Since two-thirds of the 1500 sq km. Tucannon River Basin is devoted to agriculture, erosion from cultivated fields contributes most of the fine sediments transported by the river. These fine sediments (including organic matter) have seriously affected salmonid spawning areas, food chain, and aquatic habitats in the Tucannon River, that once supported highly valuable salmon and steelhead populations. A computer model that estimates the sediment yields expected from all parts of the watershed under alternative management practices has been developed. A significant drop in sediment yields was achieved by stabilizing all channels and by implementing various levels of conservation cropping systems. A second model uses the output from the sediment yield model to simulate the intrusion of fine sediments into spawning grounds. Both models are currently being exercised to quantify the rehabilitation of the spawning environment and increase salmon and steelhead populations with proper soil and water conservation measures. These models were developed as part of the ARS contribution to the cooperative study.

2. A physically-based computer model was developed to quantify the cause and effect relationship between the survival of anadromous salmon species and the quality of aquatic habitat supported by gravel-bed streams. This study was carried out under the sponsorship of SCS. The intragravel stage of the life cycle of salmonid fish is a critical period during which they are most susceptible to injury from high levels of fine sediments in the gravel substrate. Excessive amounts of fines may injure the ova, reduce oxygen supplying intragravel flow, and inhibit the removal of embryo metabolic wastes. Furthermore, increased amounts of fines exert a biochemical oxygen demand that reduces the supply of oxygen to salmonid eggs, and entrap the fry within the gravel as they try to emerge. The present model simulates all the important processes that affect intrusion of fine sediment and dissolved oxygen transport and consumption in spawning habitat. All model components have been calibrated and verified to various degrees using data collected in the Tucannon River Watershed, Washington. These preliminary tests included evaluation of model responses under pristine and existing watershed conditions, and have demonstrated that the model design is correct and exhibits the expected responses. A full report on the model formulation and development has been prepared which includes model formulation, evaluation, users guide, and software support documentation. The present version of the model meets every one of the specifications and objectives set forward by the user (USDA Soil Conservation Service) at the onset of the project. Since no further development has been requested by SCS, this research project has been terminated.

3. The simplified process (SP) model for runoff and sediment yield from unit surfaces (Hartley, D.M. 1987. Simplified process model for water and sediment yield from single storms, part I - model formulation, Transactions of the ASAE, 30(3):710-717 and Hartley, D.M., 1987. Simplified process model for water and sediment yield from single storms, part II - performance, Transactions of the ASAE 30(3):718-723) continues to undergo testing as a result of dissemination of the model to researchers and land managers in the United States and Canada. Preliminary results of tests on bare soil at the Colorado State University Outdoor Rainfall and Runoff facility and on short grass prairie at the Central Plains Experimental Range indicate that the model provides reasonable estimates of water and sediment yield for a variety of vegetation and soil conditions. Documentation and a computer diskette containing Fortran-77 source code, sample data set and output can be obtained by contacting David M. Hartley, USDA-ARS, Hydro-Ecosystem Research Unit, P.O. Box E, Fort Collins, CO 80522.

4. A dimensionally consistent, simple and efficient mathematical model of the time and space distribution of raindrop induced shear stress has been developed. The model simulates the shear stress field caused by a raindrop falling on a thin pool of water, as a function of the drop size; drop velocity; pool depth; and surface tension, gravity and viscous forces. The model was developed from an analysis of results of numerical experiments conducted with a finite difference solution to the Navier-Stokes equations. The simple, 'algebraic' model, mimics the behavior of the more complex, finite difference model quite closely and compares fairly well with laboratory measurements of peak shear stress and total shear momentum per unit area.

5. A theoretically based, physically verified model of channel headcut migration is currently being developed. The model is scaled toward rills in agricultural fields but is applicable to larger channels carrying intermittent flow such as gullies or arroyos. Observation shows that, if present in a given channel reach, a headcut produces the dominant proportion of total sediment load, yet no present erosion models include headcut erosion. Theoretical formulation of the model draws heavily on previous studies concerning scour from impinging jets. Given channel slope, flow rate, drop height and soil resistant strength, a plunge pool basin is eroded at the headcut base undermining its face and causing upstream migration. This rate is at least quasi-steady given steady inputs. Preliminary experimental verification in a 10 cm wide flume containing agricultural soil is very encouraging and full scale physical modelling is currently underway. A completed project in the form of a PhD dissertation is expected in May 1989.

6. A rainfall event with an approximately 200-year recurrence interval was simulated on a plot at the Colorado Plains Experimental Range. The site is a shortgrass prairie dominated by buffalograss, blue grama grass and prickly pear cactus that has received light to moderate grazing for many years. Total ground cover on the plot averaged 8[illegible] percent. The quarter standard (36.25 x 6 feet) plot had a sandy loam surface texture and a 6 percent slope. The simulated storm's rainfall intensity pattern was based on the time-intensity characteristics

derived from the recording raingage trace of a recent extreme rainfall event that occurred near Cheyenne, Wy. August 1, 1985. The storm's depth was determined by statistical analysis of 41 years of local rainfall records. Because the rainfall simulator used reproduced only 40 percent of the energy of natural rainfall, two simulator runs were designed. The first disregarded energy and simulated total depth and depth distribution through time. This run provided a realistic storm runoff hydrograph and volume estimates. The second run disregarded depth and simulated total energy distribution through time and the maximum 30minute intensity of the design storm. Field results were compared with estimates calculated using the USLE and the Simplified Process (SP) models. The SP model consistently provided estimates that were closer to the observed values than did the USLE. Observed sediment losses were found to be quite low, ranging from 17.5 (depth simulation run) to 120 (energy simulation run) pounds per acre. Approximately one inch of runoff was obtained from the 4.8 inches of rain applied during the 3.25 hour storm. Runoff was 10 inches from the 14 inches applied during the 4 hour energy simulation run.

7. Sediments eroded from a plot during and after simulated rainfall events of varying intensity and duration were collected using the indoor rainfall simulation facility at the National Soil Erosion Lab, West Lafayette, IN. The two soils selected for the study were a forest soil that had been cropped for a number of years, and a grassland soil that had been cropped for a number of years. Sediments were analyzed for aggregate size distribution, aggregate stability, and particle size analysis. Aggregates within each of the size classes were analyzed for organic C, N and P content, and are currently being analyzed for labile N and humic acid/fulvic acid ratio. Preliminary results indicate that the organic matter content of macroaggregates eroded from the plot is higher than the organic matter content of eroded microaggregates. These results are in agreement with the findings of other researchers who have analyzed the association of organic matter with aggregate size in grassland soils.

For additional information, contact Donn G. DeCoursey, Research Leader, USDA-ARS, Northern Plains Area, P. O. Box E, Fort Collins, CO 80522.

GEORGIA

Research activities at the Southern Piedmont Conservation Research Center, Watkinsville, Georgia, include the following:

1. The Universal Soil Loss Equation (USLE) has been employed by the U.S. Department of Agriculture and conservationists around the world to estimate sheet and rill erosion for many decades. In very recent years, scientists and conservationists have generally concluded that the USLE needs to be upgraded in the short term and eventually be replaced. One of the primary reasons for the inadequacy of the USLE is that it underestimates total erosion since it fails to account for the loss of soil from ephemeral gullies. A field was selected by the Soil Conservation Service to study soil loss from ephemeral gullies. The 13-acre field was positioned on a predominantly Cecil sandy loam (clayey kaolinitic, thermic Typic Hapudults) landscape. The field had two well-defined drainage channels where at times, incised gullies formed to depths approaching 2 feet. During the study soybeans were planted in the summer, followed by untilled fallow during the winter months. During the study the calculated soil loss for this field which contained no conservation measures was 27.7 tons/acre/year according to an USLE estimate. An aerial photogrammetric method was employed to measure soil volume changes for the gullies. The table shows the changes in soil volume for ephemeral gullies A and B over a period of nearly 2 years. Their respective drainage area were 3.0 and 2.0 acres. The 1st and 2nd dates of the aerial photographs bracket the period for the rainfall and soil volume change. The positive volume changes represent the filling of the gullies with soil by tillage, whereas the negative changes represent soil removed by erosion. Using such data bases of erosion, topographic features, soils information, cropping practices and rainfall along with geographic information systems software, we are studying the erosional processes.

TABLE - SOIL VOLUME CHANGES FOR EPHEMERAL GULLIES A AND B

Test Period	Date of Photograph 1st Date	Date of Photograph 2nd Date	Rainfall Inches	Gully A tons*	Gully B tons*
1	7/6/84	12/31/84	20.5	-23.9	-51.0
2	12/31/84	5/13/85	15.4	-57.2	-15.9
3	5/13/85	6/27/85	3.0	+89.9	+47.8
4	6/27/85	5/21/86	28.0	-33.5	-28.7
5	5/21/86	5/22/86	0	+81.9	+47.8

*Tons converted from volume based on estimated soil density of 90 lbs/ft^3.

For additional information, contact Adrian W. Thomas, Research Leader, USDA-ARS, Southern Piedmont Conservation Research Center, P. O. Box 555, Watkinsville, GA 30677.

INDIANA

Research activities at the National Soil Erosion Research Laboratory in West Lafayette, Indiana, include the following:

1. National Soil Erosion Research Laboratory personnel are developing new generation water erosion prediction technology for use by the USDA-Soil Conservation Service, USDA-Forest Service, and USDI-Bureau of Land Management, and other organizations involved in soil and water conservation and environmental planning and assessment. In particular, the project will develop improved erosion prediction technology based on modern hydrologic and erosion science that will be process oriented and conceptually a significant improvement over the Universal Soil Loss Equation (USLE). If the project is fully successful, the user will choose the technology developed by this project over the USLE. The technology will be ready for testing by USDA's Soil Conservation Service (SCS) in 1989 and for use by SCS district conservationists and others in 1992.

2. A field study is being conducted to investigate the effects of incorporated-crop residue and tillage condition on rill erosion, using simulated rainfall and added inflow. Just after incorporation, rill erosion rates were significantly reduced as incorporated residue amounts increased from 0 to 4.5 t/ha. One year after incorporation of residue, there was a significant 32 percent decrease in soil loss as residue rates increased from 0 to 4.5 t/ha. on freshly-tilled conditions. There were no significant differences in soil loss rates because of the residue, for the consolidated soil condition. Natural soil consolidation may have masked any residue effect. Average soil loss from freshly-tilled conditions was almost twice the loss from consolidated conditions.

3. A computer simulation model was developed to predict soil erosion rates when incorporated residue acts as a stable grade control in a rill. The model was verified using data collected from laboratory rill erosion experiments. Sediment load rates and rill geometry were measured in sixteen rills, each with a different combination of four discharge rates and four residue spacings.

The simulated results compared well to measured sediment load rates, changes in rill width over time, and final rill slope. The simulated results underpredicted the total eroded sediment volume and average rill width, and overpredicted the rate of change in rill slope.

4. Transport and deposition of sediment in ridge-furrows formed in both a silt loam and a sandy soil is being studied. Nine simulator troughs were orientated up and down, instead of the normal across slope pattern, to provide intensities varying from 2.5 in/h to 10 in/h. Low slope gradients (0.5 - 4%) and high rainfall intensities were selected to induce deposition in the furrows. The field data collected will be used to validate or modify the sediment transport and deposition relationships for the USDA Water Erosion Prediction Project.

For further information, contact John M. Laflen, Research Leader, USDA-Agricultural Research Service, National Soil Erosion Research Laboratory, Purdue University, West Lafayette, IN 47907.

IOWA

Research activities at the USDA group at Iowa State University in the area of Sedimentation Activities have all been associated with the USDA Water Erosion Prediction Project (WEPP).

1. Field data were collected on 18 cropland soils in 12 Western States in the summer of 1987 for the Water Erosion Prediction Project. A rotating boom rainfall simulator was used to determine rill and interrill erosion rates. Infiltration and insitu soil strength data were also collected. Aerial photogrammetry was used to evaluate changes in the rill geometry throughout the data collection period. Soil samples were collected at each site and were analyzed by the soil testing laboratory of the Soil Conservation Service in Lincoln, NE. Additional samples were collected for future investigation and can be obtained from the National Soil Erosion Laboratory at Purdue University. The results thus far are summarized below:

2. Two methods of measuring rill hydraulic radii were compared. These methods were with the rill meter and by photogrammetry. Results show that the rillmeter method gave lower readings with less variability than did the photogrammetric method on the one soil analyzed.

3. The rill and interrill erodibility properties of the soils were calculated and related to other measurable soil properties. Interrill erosion rate was modelled by the equation Di = Ki 1 2 where Di is the interrill detachment rate, Ki is interrill erodibility coefficient, and I is rainfall intensity. Ki was found to be best predicted by the clay content, the cation exchange capacity, and the torvane shear device reading for a given soil with a coefficient of determination of 0.65. The rill erosion rate was modelled by the equation Dr - Kr (tau - tauc) where Dr is the rill erosion rate, Kr is the rill erodibility, tau is the hydraulic shear of the flowing water, and tauc is the critical shear below which there is assumed to be no erosion. Kr was best predicted by the clay content, the silt content, and the torvane shear device reading for a given soil with a coefficient of determination of 0.65. Tauc was best predicted by the cation exchange capacity, the depth of the A horizon, and the antecedent moisture content of a soil with a coefficient of determination of 0.40.

4. The rill erosion data was studied in greater detail for 9 soils. The best hydraulic parameter for determining soil erodibility was the energy of flowing water per unit area. A model was proposed in the form of Dr = Ke(Ep -Epc) where Dr is the rill erosion rate, Ke is the rill flow energy erodibility coefficient, Ep is the energy flow rate per unit area, and Epc is the critical energy flow rate. Ke was predicted by the specific surface of the soil and the water content at 1/3 bar, with a coefficient of determination of 0.75, and Epc can be predicted by the organic carbon and the clay content with a coefficient of determination of 0.85.

For additional information contact D. C. Erbach, Research Leader, USDA-ARS, 213 Davidson Hall, Iowa State University, Ames, Iowa 50011.

IOWA

Research activities at the Watershed Research Unit in Treynor, Iowa, include the following:

Fourteen years of record comparing sediment yields from ridge tilled and conventionally tilled fields cropped to corn at Treynor, Iowa, are available. In this period, there was an average of 1.8 Mg/ha sediment yield from the ridge tilled field compared to an average of 14 Mg/ha from two conventionally tilled fields. A terraced watershed, using parallel terraces with pipe outlets, was observed for the same period. Corn using ridge tillage was grown on this watershed. Sediment yields averaged 0.9 Mg/ha on this watershed.

For additional information contact Allen T. Hjelmfelt, Jr., Research Leader, USDA-ARS, Watershed Research Unit, Midwest Area, 269 Agricultural Engineering Building, University of Missouri, Columbia, MO 65211.

MARYLAND

Research activities at the Hydrology Laboratory Research Program in Beltsville, Maryland include the following:

1. The feasibility of using airborne laser measurements of surface topography as method for providing information on ephemeral gullies was investigated. Laser profile data were obtained over control fields with both artificial and natural gullies and recorded at 4000 pulses per second at nominal aircraft speeds of 25 and 50 meters per second and at aircraft altitudes of 50, 100, and 200 meters. A moving average filter was used to remove the random variations and surface microroughness effects. Analysis of the data from the artifical and natural gully fields clearly indicated the location and cross section of gullies as small as 30 cm wide and 15 cm deep. These results demonstrated the feasibility of the approach because test conditions were what would be considered ephemeral gullies.

2. Landsat multispectral scanner (MSS) data for 27 dates between January 1983 and June 1985 for Moon Lake in Mississippi were analyzed to determine if Landsat MSS digital data could be used to estimate suspended sediment concentrations in the surface waters of a small agricultural lake. The study showed that good estimates of suspended sediment concentrations can be made using Landsat MSS digital data especially in the range of concentrations between 50 and 250 mg l^{-1} which are the critical concentrations for assessing conservation needs. Suspended sediment concentrations greater than 250 mg l^{-1} were underestimated by most of the equations indicating that a saturation of reflected solar radiation at higher suspended sediment concentrations. Thus a technique using Landsat MSS digital data can be developed to monitor the landscape to locate those reservoirs with critical suspended sediment concentrations quickly. Soil and water conservation efforts can then be concentrated on the watershed of those reservoirs where suspended sediments is greatest.

3. Research is being conducted in support of the USDA Water Erosion Prediction Project (WEPP). The primary areas of responsibility are the development of the water balance and infiltration components of the model. Analysis of the 1987 agricultural and rangeland field experiments is being conducted to determine the effects of surface conditions on infiltration parameters. Also, research is beginning to determine rangeland rilling patterns.

For additional information contact A. Rango, Research Leader, USDA-ARS Hydrology Laboratory, Building 007, BARC-W, Beltsville, Maryland 20705.

MISSISSIPPI

Research activities at the USDA National Sedimentation Laboratory in Oxford, Mississippi include the following:

1. Weather Bureau data were used to establish that one-day rainfall events of 76 mm or more had an average occurrence of about once every nine and six months, respectively, in the North Central and Coastal Climatic Regions of Mississippi. These findings are important because extreme one-day rainfall in Mississippi causes flooding and severe soil erosion problems. Knowledge of expected frequencies and magnitudes can be used in the design of flood control structures, drainage works, and farm conservation practices.

2. Rates of interrill soil erosion were determined for Grenada silt loam soil. Equations were derived with erosion as a function of weight of surface residue and also with erosion as a function of percent cover. An interrill mulch factor equation, $MF = \exp(bC)$, was derived. Mulch factor (MF) is the ratio of soil loss with a given percentage of mulch cover to soil loss with no mulch. C is percent cover, and b is a coefficient. Values of b for interrill soil losses were about 0.015 for dry and wet antecedent conditions as compared to 0.025 for the relationship given in the literature for combined rill and interrill soil erosion.

3. Sand and gravel move down an ephemeral stream short distances with each succeeding runoff event. These coarse sediments move as individual particles but appear as dunes and gravel beds that change form during transport. Original identifications of bed forms were made and their effect on sediment transport rate fluctuations and the size of sediment in transport were characterized. These findings have important implications for bed load sampling techniques in alluvial streams. Large errors in measured rates may be the result if improper sampling methods are used.

4. Shear stress in a gravel-bed laboratory channel was shown to decrease and then increase with increasing sediment transport rate. This change in bed shear stress was caused by the varying coarseness of surface. In the runs with low transport rates, the surface of the bed material was coarser, thus exerting greater drag on the flow and causing high bed shear stresses, while in the runs with higher transport rates the surface of the bed material was finer, so bed shear stresses were lower. This finding will be useful in refining coarse sediment transport relations.

5. Methods of analyzing highly variable data for general trends compatible with model development have been restricted to classical analysis-of-variance methods. A new method of filtering data for average trends has been devised. It is being used routinely for the Goodwin Creek sediment transport data. The method has been extended to provide a more physical meaningful way to describe the frequency spectra of variable data. The technique is being extended to describe three-dimensional properties associated with bed forms. It is also applicable to topographic analyses.

6. Improved descriptions of the mechanics of fluid flow, especially in the near-bed region, have been developed. A complete vector form for the general momentum equation for fluid flow was derived. Previous formulations involved approximate tensor expressions. This derivation supports the validity of more practical approximations for flow with suspended sediment. Also, classical models for the velocity distribution in the fully turbulent outer zone of flow have been extended to include the transition zone and the dominantly viscous zone near the bed. This should provide the crucial key to the description of flow and sediment suspension in the near-bed zone and lead to a more reliable model for bed material transport.

7. All of the data collected in the Goodwin Creek Research Watershed is directed toward building a complete watershed database which in turn is used to gain a better knowledge of watershed erosion, sediment transport and channel instability problems. Technical findings derived from the database are available for use by action agencies for expanding and improving stream channel stabilization design criteria and procedures. The database also provides the information needed to test concepts and to calibrate and verify models of watershed streamflow and sediment transport processes. The database is continuously updated.

8. The long-term effects of channel instability on environmental quality in highly erosive bluffline streams were investigated by evaluating significant water quality and environmental parameters. This research not only provides documentation of offsite damages from watershed degradation but also is providing watershed planners with essential information for decision-making on priority conservation needs. In addition, the research will be used to evaluate the efficiency of channel and watershed management practices in the Demonstration Erosion Control Project in the

Yazoo Basin, which is an interagency collaborative project of the Corps of Engineers, the Soil Conservation Service, and the Agricultural Research Service.

9. The attenuation of methoxychlor and endosulfan concentrations and loads were measured in surface runoff from a unit source area through the main channel (3.5 km) downstream of Goodwin Creek, a 2140 hectare complex watershed. Downstream decreases in pesticide concentrations could not be fully explained by dilution. Pesticide concentrations in the flow were combined with the few data reported from other research (total of four pesticides and five streams in three states) to develop an exponential routing function similar to sediment routing functions now in use. This information on chemical routing through complex watersheds is needed for development and improvement of models to predict pesticide transport in runoff from agricultural lands.

10. Crop residues are a key component of most conservation tillage systems. Rainfall leaching of these residues, which can contribute significant quantities of soluble plant nutrients to agricultural runoff, can be described as functions of residue loading, and of rainfall intensity and amount. Developed mathematical functions describe the leaching kinetics of nutrient release from residues as functions of time and cumulative runoff during storm events. This research aids in development of agricultural chemical transport models, increases understanding of nutrient cycling in agricultural ecosystems, and provides a much-needed link between model components of residue decomposition and release of nutrients to surface and subsurface flow.

11. Investigations of farm ponds and watershed lakes documented the effects of agricultural runoff on downstream water resources and results of applying various watershed conservation practices. Results of this research include: (1) Documenting that wetlands serve as effective filtering mechanisms by trapping large amounts of sediments and pollutants; (2) Measuring the sediment trapping efficiency of small impoundments; (3) Documenting that sedimentation rates vary measurably with different cropping practices; (4) Providing high-quality ground truth that allowed for major improvement in predicting suspended sediment concentrations in surface waters from satellite imagery; (5) Combining the knowledge acquired in field observations and controlled experiments to produce an accelerated algal-clay flocculation of suspended sediment; and (6) Documenting specific water quality changes that occurred with changes in watershed

practices. This research correlates water quality and watershed practices and history and quantifies the positive influence that conservation activities have on watershed water quality.

12. Thirty-eight cross sections along the lower 2.5 mile length of Goodwin Creek, northwestern Mississippi, have been surveyed quarterly to document the magnitude of channel bank changes. This length of channel represents about 20% of the large channels in the total watershed. Bank erosion in the surveyed channel length amounted to 37,000 tons annually, equivalent to an annual sediment production of 7 tons per acre for the entire Goodwin Creek Watershed. Fine sediments (less than 0.062 mm) produced by this bank erosion amounted to 41% of the annual fine sediment yield of the watershed.

13. Total sediment yield for the ephemeral gully study area planted to soybeans (Goodwin Creek Watershed, northwestern Mississippi) amounted to 10.6 tons per acre for the 1985-1986 growing season. Of this total, 77% was produced by two large July storms. Peak discharges for these two large events was about 3 cfs/acre whereas those for the other events ranged from 0.4 to 1.2 cfs/acre. Erosion due to ephemeral gully development amounted to 6.6 tons/acre and that calculated using the USLE amounted to 22.5 tons/acre. Assuming equal transport of sediment from these two sources, the composite delivery ratio was 37%. Results contribute to development of efficient and effective upland erosion control systems.

14. A major portion of sediment eroded from agricultural soils or from other sites that contain appreciable clay may be in the form of aggregates. A method has been developed for determining size distributions of such undispersed sediment, whether primary particles or aggregates, without relying on pipette withdrawals or hydrometer analyses of the finer undispersed sediment. This method also evaluates the portions of each sediment size class that are primary particles or aggregates. The approach involves use of the size distribution of coarse sediment as determined by wet sieving, size distribution of the dispersed total sediment sample, some special sieve analyses of sediment finer than sand, and deductive reasoning. The resulting sediment size distributions give the physical size of the sediment for all size groups rather than a composite of physical size for the sieved portion and equivalent size for the aggregates. Since aggregates have a different density than primary particles of the same size, results from

this method are better for sediment transport applications and for modeling sediment movement.

15. The aggregates that erode from agricultural soils generally contain a slightly higher percentage of clay than the nonsand portion of the original soil or total sediment. Thus, sediment control practices that trap the coarse sediment from well-aggregated soils can prevent much of the loss of the fine clay particles and any attached chemical nutrients or pollutants.

16. A method was developed for using the CREAMS model to estimate the soil conserved by a diversion constructed above an intensively cropped bottomland. The method uses actual site conditions, but some parameters have to be weighted and averaged. This method enables action agencies and other users to evaluate the effectiveness of a proposed diversion for different typical situations.

17. The Technology Applications Project (TAP) in the Watershed Processes Research Unit at the National Sedimentation Laboratory is continuing development of techniques and methods for storing and recalling the many types of data describing the hydrologic characteristics of watersheds. A Geographical Information System (GIS) has been purchased and will be used to interleave "Raster" and "Vector" format data for concurrent analyses. Procedures are being developed to automate the design phase of watershed planning through the use of the digitally stored data. Rapid computations in automated watershed planning will permit management to consider the effects of more alternative solutions.

For additional information contact Neil L. Coleman, Director, USDA-ARS, National Sedimentation Laboratory, P. O. Box 1157, Oxford, MS 38655.

MISSOURI

Research activities at the Watershed Research Unit in Columbia, Missouri, include the following:

1. Soil samples were collected from 11 soybean- and corn-plot pairs on a Udollic Ochraqualf that had been cropped continuously for five years. Soil was packed in 0.3- by 1.0-m beds and placed under a variable intensity rainfall simulator. After 96 mm of constant intensity rainfall, four storms were applied at rates of 13, 38, 76, and 114 mm/h to determine interrill erodibility (K_i) values. Differences in runoff, soil loss, and K_i values between the soybean- and corn-cropped soils were not significant. Soil splash from a single waterdrop and soil strength were determined on crusted and remolded samples. Differences in splash and strength between the soybean- and corn-cropped soils were not significant for the crusted samples. For the remolded samples, however, splash was significantly higher ($p<0.01$) and strength was significantly lower ($p<0.01$) for the soybean-cropped soil.

2. The effects of winter cover crops on runoff, soil loss, dissolved N and P losses, and soybean grain yield were studied for three years on a Udollic Ochraqualf. Treatments consisted of no-till soybeans with 1) canada bluegrass (Poa compressa L.), 2) chickweed (Stellaria media), 3) downy brome (Bromus tectorum), and 4) no cover crop (control). Runoff was reduced 66, 56, and 80% for the chickweed, canada bluegrass, and downy brome treatments, respectively, relative to the control. Soil loss was reduced 61, 97, and 95% for these treatments, respectively, relative to the control. Cover crops reduced dissolved N and P losses by 20 to 88% relative to the control. Lower plant populations and delayed plant development decreased soybean grain yield for the cover crop treatments from 3 to 67% relative to the control.

For additional information contact Allen T. Hjelmfelt, Jr., Research Leader, USDA-ARS, Watershed Research Unit, Midwest Area, 269 Agricultural Engineering Building, University of Missouri, Columbia, MO 65211.

NEBRASKA

Research activities at the Soil and Water Conservation Research Unit at the University of Nebraska-Lincoln, Nebraska, include the following:

1. Runoff rate, runoff velocity, sediment concentration and soil loss rate of rills or overland flow channels were measured at selected downslope distances on plots with varying rates of sorghum and soybean residue. Runoff rate, runoff velocity and soil loss rate usually increased with downslope distance. In general, the presence of greater amounts of crop residue reduced sediment concentration and soil loss rate along the entire slope length. Substantial variations in runoff rate, runoff velocity, sediment concentration and soil loss rate were found with downslope distance on some residue treatments.

2. Runoff samples for determination of size distribution of sediment were collected under simulated rainfall conditions at selected downslope distances on plots covered with sorghum and soybean residue at rates ranging from 0.00 to 6.73 t/ha. The effects of surface residue and slope length on size distribution of sediment were evaluated. Substantial movement of sediment in the form of aggregates was found for each of the residue treatments. Significant differences in size distribution of sediment occurred between residue treatments. For a given residue rate, differences in sediment size distribution were found between sorghum and soybean residue. Size distribution of sediment was also determined to be significantly different at selected downslope distances.

For additional information, contact James F. Power, Research Leader, USDA-ARS, University of Nebraska, Room 122 Keim Hall, Lincoln, NE 68583-0915.

OKLAHOMA

Research activities at the Water Quality and Watershed Research Laboratory in Durant, Oklahoma include the following:

1. A model simulating soil N, P, and C cycling was formulated and incorporated into the Erosion-Productivity Impact Calculator model (EPIC), previously developed to assess the effect of erosion on soil productivity. Crop uptake and transformations among several inorganic and organic pools of N, P, and C are simulated. Accurate simulations of long-term changes (more than 50 years) in plant available soil nutrients, organic P and N, and fertilizer requirements and recommendations for maize and wheat were obtained for a range of soils in the continental U. S. To predict the movement of soil in runoff, the modified Universal Soil Loss Equation (MUSLE) was employed for several grassed and cropped watersheds in 3 Major Land Resource Areas of the U. S. MUSLE and measured soil losses were similar over study periods of 3 to 5 years. Annual total P and N losses, predicted using the logarithmic relationship between enrichment ratio (nutrient content of eroded soil/source soil) and soil loss, were similar to measured values. Reasonable estimates of changes in soil fertility and productivity as a result of 50 years of erosion (20 Mg/ha/yr average soil loss) were obtained with EPIC.

2. The use of soil magnetic susceptibility (MS) was investigated as an indicator of erosion and deposition within a watershed. Magnetic susceptibility is the ratio of induced magnetism within a sample to the electric field into which the samples brought into contact. The variability of MS across the landscape is a function of soil drainage and the parent material in which the soil formed. For a given parent material, MS decreases from well drained to poorly drained landscape positions. On the soils of the Southern Plains highest MS are present in the topsoil and decrease with depth.

   The MS of runoff sediments, lakebed sediments, and soils under different management practices, (native prairie to cultivation) were studied. Differentiation between lake sediment and the underlying buried soil using MS allowed estimation of sedimentation rate during the last 50 years. However other sediment-soil parameters were easier to interpret than MS. Identification of eroded areas within a cultivated field were inferred by differences in frequency dependency of MS. However, confounding between geologic erosion with man accelerated erosion was a problem. Because of the high variability of MS within a watershed, quantitative estimation of erosion, and identification of sediment source, both for lakebed sediments in a large watershed (1800 ha) and field edge deposition in a small watershed (1.6 ha) were not possible. However, use of a MS tracer for soil redistribution has good potential.

3. Research concerning the remote sensing of suspended sediment in Lake Chicot waters has been carried out in three stages; (1) laboratory measurements were made under carefully controlled conditions using a large optical tank facility where sediments collected from the lake bed were resuspended, (2) hand-held spectroradiometer measurements were made at 25 nanometer intervals in the visible and near infrared spectrum over the lake at various times providing various concentrations of suspended sediments, and (3) data obtained from 76 environmental satellite (LANDSAT) scenes over a period of 11 years were analyzed and correlated with ground truth data. The hand-held radiometer results show that reflectance in the near infrared region, 700-950 nanometers, is nearly proportional to suspended inorganic sediment at low concentrations. The laboratory results indicate the reflectance to be wavelength dependent and to possess definite nonlinear behavior as the concentrations increase. A physical analysis shows this behavior to fit an exponential model. The LANDSAT data shows similar reflectance response to suspended sediments at the same wavelengths with the added benefit of providing a synoptic image. This same mathematical model fits data obtained from Kerr Reservoir in North Carolina, Lake Chicot in Arkansas and a number of similar small lakes in Oklahoma.

4. Properties of suspended sediment in 16 lakes in south central Oklahoma are being determined in order to improve Landsat measurements of sediment concentrations. Average concentrations range from 15 to 165 mg/L. Percent ash ranges from about 65 at low sediment concentrations to 90 at high sediment concentrations. Mean particle diameter, which is determined by photon correlation spectroscopy on those samples with more than 40 mg/L of suspended sediment, ranges from 0.4 to 1.5 microns. The persistently turbid lakes generally have particle diameters less than 0.8 micron. Although the color of the turbid lakes ranges from milky gray to reddish brown, color seems to have little influence on the spectral reflectances observed by Landsat. The measurements, coinciding with Landsat images, began in July, 1987, and are intended to continue until July, 1989.

5. Measurement of sedimentation rates in lakes and wetlands is needed in planning and management. Sedimentation rates were measured in three lakes and one wetland using cesium-137, a fallout product of nuclear testing, which tags sediment and therefore can be used as a tracer. Sedimentation measurements in a wetland of Reelfoot Lake, Tennessee indicated an increase in sedimentation beginning shortly after World War II from increases in acreage planted in soybeans and stream channelization. Samples from Reelfoot Lake revealed and average sedimentation rate of 1.3 cm 1 yr in the past 30 years. Sediment investigations at Tecumseh Lake in Oklahoma revealed a reduction in sedimentation which corresponded to a sift from the watershed being plant in cotton to row being planted in grass. Sediment samples indicated a sedimentation rate of 0.3 cm/yr in the past 30 years. The average sedimentation rate at Lake Taneycomo in Missouri was found to be about 1 cm/yr near the dam. Samples indicated was being redistributed and washed from the up stream part of the lake and sediment deposition patterns in the lake were characteristic of river system.

6. The enrichment of several P forms (Bray I, labile, inorganic, and organic), N, C, and K in runoff sediment was investigated for six soils of varying physical and chemical composition, using simulated rainfall (60 and 120 mm h^{-1}). Differing enrichment ratios (ER) for C, N, and organic P (2.00, 1.61, and 1.47 avg for the six soils) indicate that erosion may reduce the C/N/organic P ratio of the remaining surface soil. Average ERs, for Bray I (2.45) and labile P (2.89) were significantly greater than for the other P forms (1.48). This was attributed to less aggregation of sediment compared to source soil for the major proportion (70%) of the runoff events studied. Phosphorus desorption-sorption characteristics, buffer capacity (1.49), sorption index (1.56), equilibrium P concentration (1.80), and exchangeable K (2.46) were also enriched in runoff sediment compared to source soil. The logarithm of ER for each P form, N, C, and K was related to logarithm of soil loss, which ranged from 10 to 800kg ha^{-1}. Statistically significant differences between regression equations for each nutrient indicate that more than one equation is needed to estimate different nutrient ERs. Nutrient ER was related to clay and specific surface area ER of the sediment. This is to be expected as the nutrients described are chemically associated with clay-sized particles. These have potential use in estimating the effect of erosion on soil fertility.

7. Development of the climate generator used in the WEPP (Water Erosion Prediction Project) models has progressed to the inclusion of 1000 U. S. climate stations with greater than 25 years of daily precipitation and temperature records. These data locations have been selected and generator parameters are being developed. The generator now has the capability to generate maximum storm intensity and the time of occurence of the maximum intensity during the storm. These two values are used to disaggregate the total storm precipitation into incremental rainfall amounts required by the Green-Ampt infiltration technology used in the WEPP family of models. The generator will be tested against measured precipitation data at selected locations and by comparison of generated runoff using generated climate data and the WEPP profile model output with measured runoff volumes and peak runoff rates from selected experimental watersheds. Climate elements generated are storm occurence, amount, duration, maximum intensity, time to peak, maximum and minimum air temperature, and solar radiation.

For additional information contact Dr. Frank R. Schiebe, Laboratory Director, USDA-ARS, Water Quality and Watershed Research Laboratory, P. O. Box 1430, Durant, OK 74702.

PENNSYLVANIA

Research activities at the Northeast Watershed Research Center at University Park, Pennsylvania include the following:

1. Soil loss estimates with the Universal Soil Loss Equation (USLE) are generally used on mined and reclaimed sites to determine if conservation practices and holding ponds are needed. Decision to proceed is based on whether or not computed values exceed a standard tolerance level. A novel procedure describes an alternative approach where a probability of exceeding a tolerance level is calculated and compared with potential risk of misclassifying the site. High probability coupled with low risk of misclassifying the site are ample justification for implementing conservation practices. Low probability must be evaluated against the risk of misclassifying the site. If the risk is high, conservation practices may still have to be implemented; but if the risk is low, conservation practices are probably not required. Results are illustrated on an actual site in Pennsylvania.

For additional information contact Andrew S. Rogowski, Soil Scientist, USDA-ARS, Northeast Watershed Research Center, 110 Research Building A, University Park, PA 16802.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
Southern Plains Area

Research activities at the Grassland, Soil and Water Research Laboratory in Temple, Texas, include:

1. Volume I "EPIC, The Erosion-Productivity Impact Calculator--Model Documentation" is near completion. EPIC modifications of 1987 include: 1) a power parameter added to the exponential distribution to more accurately simulate extreme rainfall events; 2) a method for estimating winter wheat vernalization requirement added; 3) a multi-period operation mode added to aid in long-term (approximately 1000 year) simulations; 4) an automatic soil layer splitting scheme developed to provide better soil description, especially when thick subsurface layers are exposed; 5) a mode of operation added to estimating a probability distribution of crop yields using static soil properties and a variety of weather sequences. Extensive testing with corn, wheat, rice, sunflower, soybean, and barley showed that observed and EPIC-simulated yields were similar. Experimental work gave mean biomass/intercepted photosynthetically active radiation ratios of 3.1, 2.5, 2.1, 3.9, and 3.2 g/MJ for wheat, sunflower, rice, corn, and sorghum. Investigation of environmental factors indicated that high temperatures late in grain filling can decrease sorghum yield by 30%. Environmental conditions early in grain filling apparently do not control potential sorghum grain weight. The EPIC model was adapted to simulate loblolly pine growth and tested in 56 locations from Texas to Virginia. Results indicate the model is performing acceptably for various soil and climate conditions.

2. Simulations using the EPIC model were used to test hypothesis that erosion increases yield variability and associated risk of yield loss due to drought. We found that the percent variability increased as yields decreased due to erosion; however, the absolute variability did not. The impact of alternative erosion control practices on yield and erosion for selected West Texas counties is being examined through a set of EPIC simulations for use in a Texas Tech University study. EPIC simulations were used to examine the effects of increased carbon dioxide and associated climate change on crop yield and erosion. Most areas simulated experienced increased yield and decreased erosion. Other EPIC analyses in progress include the impact of furrow diking on water and soil conservation; impact of low input, primarily reduced nitrogen and cropping practices, on erosion and crop yield; further analyses of climate change impacts; the soil conservation potential of alternative tillage and cropping; the impact of alternative levels of soil conservation on the productivity of selected soils over their entire productive life; and the model effect on yield of soil properties at or below the rooting zone. Soils data available for use in simulation was increased and methods for estimating soil water parameters were improved.

3. Work continued on developing and testing the SWRRB model. SWRRB was tested on several large watersheds, and the results showed that the model can realistically simulate water and sediment yields under a wide range of soils, climate, land use, topography and management conditions. A decision support system was developed to aid in selecting inputs to SWRRB. The system accesses large data bases, interfaces with expert systems, gives explanations, and provides graphics. A simulation language called SLAM II was used to develop a queuing theory model for simulating runoff and soil water movement on small watersheds. Final testing of the SWRRB model will continue. Documentation and a User Manual have been prepared for SWRRB and should be published in the near future.

For additional information Jimmy R. Williams, Hydraulic Engineer, USDA-ARS, 808 East Blackland Road, Temple, TX 76502.

WASHINGTON

The following research is being conducted by the Land Management and Water Conservation Research Unit at Pullman, Washington:

1. Analysis of historical and recent data from both natural and simulated rainfall soil erosion plots across the entire U.S. coupled with theoretical analysis has produced new slope length and steepness relationships for the Universal Soil Loss Equation. Different relationships are developed for conditions where the ratio of rill to interrill erosion is expected to be low, moderate, or high. In general, this corresponds to range and forest land, cropland, and highly disturbed sites. Another set of relationships is developed for conditions where runoff over thawing soil dominates the erosion process. The relationships make the Universal Soil Loss Equation applicable to a wider range of conditions and should improve erosion prediction.

2. Runoff plots have been installed at the Palouse Conservation Field Station at Pullman on various crop treatments including conventionally tilled, conservation tilled, and direct stubble seeded winter wheat, and various primary tillages of wheat stubble. The purposes are (1) determine the effect of crop treatments on runoff and soil loss; (2) determine relative magnitudes of sheet and rill erosion; and (3) develop a residue effectiveness relationship. Instrumentation includes frost depth gages to determine the effect of crop treatment on frost depth and subsequent runoff and erosion during periods of thawing soil.

3. A subfactor method of determining crop management factors (C factor in the USLE) has been developed and output is being used by SCS in Idaho, Oregon, and Washington. Ten years of runoff and erosion plot data from the Palouse Conservation Field Station at Pullman is being used to substantiate and improve the method. Work is continuing to improve the consistency of the data and to apply the method to additional crop rotations.

4. Shallow frozen soil is a major factor causing runoff and severe erosion in the Pacific Northwest and other States of the U.S. where intermittent frost occurs, but is very unpredictable due to many influences in a short time span. A detailed mathematical model has been developed and tested which computes a simultaneous solution of the vertical soil heat and water (SHAW) budget for two meters above and below the soil surface to account for the hourly impacts of climate, residues, snow cover, and tillage. This research model has proven to be quite accurate on farmland studies over the two test years. Further parameter methodology and sensitivity analyses will aid in broader applications.

5. 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.

6. Breakpoint precipitation data are extremely sparce in the western U.S. This has necessitated calculating rainfall erosivities from an empirical relationship. A recent study indicated the feasibility of using 15- and 60-minute precipitation data to estimate EI values that would be calculated form breakpoint data. Research is being conducted to apply the method to the entire western U.S. where orographic effects and the scarcity of data have hampered efforts to improve erosion prediction.

For additional information, contact Donald D. 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 calender year 1987 focused upon improvements to, and applications of, the numerical model HEC-6, "Scour and Deposition in Rivers and Reservoirs". A major development was the public release of HEC-6 for operation of MS-DOS microcomputers. The microcomputer version of HEC-6 contains all the functionality of the mainframe version. Support and guidance for applications of HEC-6 was provided to many Corps and public users of the program.

Coordination was initiated with the Corps' Waterways Experiment Station (WES) to integrate enhancements to HEC-6 developed at WES into the version distributed and maintained by HEC so that there will be a single version of the program. It is planned to release this combined version of HEC-6 in the summer of 1988 in conjunction with HEC's training course on Sediment Transport.

Initial design of an integrated river analysis system was undertaken. The objective is to assemble a set of computer based tools, using existing models such as HEC-2 and HEC-6, to allow engineers to analyze riverine problems at multiple levels of detail using a consistent data structure. Initial work focused on improvements to HEC-2.

HEC coordinated with the Association of State Flood Plain Managers regarding selection and design of appropriate procedures for defining flood risk for ephemeral streams and on alluvial fans. A document was prepared for the Federal Emergency Management Agency (FEMA) regarding floodway determinations in unique situations. Some of these situations involve alluvial streams and alluvial fans. The results of this work is being published in an updated version of HEC Training Document No. 5, "Floodway Determination Using Computer Program HEC-2."

Project applications of HEC-6 performed at the HEC included the following:

1. Cache Creek, California. Used HEC-6 to simulate the response of a meandering stream to upstream flow regulation. The numerical modeling effort was supplemented with a thorough geomorphic study of the stream.

2. Kaskaskia River, Illinois. This study is an update of a previous application that involves the analysis of impacts of a navigation project on upstream stream behavior and prediction of future dredging requirements.

Work was also performed at the HEC using two-dimensional flow (RMA-2) and sediment (STUDH) models (these models are the primary components of WES's TABS-II system). Applications included the following:

1. Cache Creek, California. Used 2-D flow and sediment simulation to develop a sediment management plan for the sediment settling basin.

2. Columbia River, Oregon and Washington. Used the 2-D flow model to evaluate management alternatives to reduce maintenance dredging. Will use the sediment simulation module in the future if required.

CORPS OF ENGINEERS

Waterways Experiment Station

Title of study:

Field Measurement of Sediment Transport Rates in the Nearshore Zone

Point of Contact:

Dr. N. Kraus, WESCR

Conducted For:

U.S. Army Corps of Engineers

Water Resources Region:

All coastlines

Location:

WES: Field Research Facility, Duck, NC; Louisiana coast

Objectives:

Accurate field measurements of sediment transport rates in the surf zone are lacking. The primary reason is the hostile environment of the surf zone, and inadequacy of previous measurement techniques. The purpose of this study is to develop measurement techniques for the transport rate and collect comprehensive and synoptic data on the sediment transport rate and its forcing agents of waves, currents, and winds.

Summary of Accomplishments:

A new type of sediment trap was developed and then deployed in two major field data collection projects (DUCK85 and SUPERDUCK) held at the Coastal Engineering Research Center's Field Research Facility. A technical paper on sample weighing method was published. A full-scale laboratory flume experiment on the characteristics of the sediment trap was performed. At SUPERDUCK, six or seven traps were simultaneously deployed across the surf zone to measure the vertical and lateral distributions of the longshore sand transport rate, together with measurements of the currents and waves. A preliminary analysis of the data has been made. The transport rate data were found to be of high quality and very consistent. A more accurate sediment transport rate formula than the one presently used was developed. Analysis is continuing and results are very positive.

Title of Study:

Shoreline Change on the North New Jersey Coast

Point of Contact:

Dr. N. Kraus, WESCR

Conducted for;

U.S. Army Corps of Engineers, New York District

Water Resources Region:

North New Jersey Coast

Location:

WES

Objectives:

A model for estimating shoreline change and longshore sand transport rates along the northern coast of New Jersey was developed. The model allows representation of large numbers of groins, beach fill, seawalls, and other real world effects. A storm-induced dune erosion numerical model was also developed and implemented for this coast.

Summary of Accomplishments:

The wave field along the coast has been estimated by use of the Wave Information Study hindcasts and a newly developed model of combined refraction and diffraction (RCPWAVE). A data set comprised of 3 years of breaking wave height and angle at 150-m intervals along the coast was thus prepared for driving the shoreline change simulation model. The study area presently encompasses two reaches, Sea Bright to Ocean Township (16 miles) and Asbury Park to Manasquan Inlet (11 miles). A generalized shoreline change numerical model and dune erosion model developed at WES is being used to simulate shoreline change and dune erosion in these reaches.

Title of Study:

Physical Hydraulic Movable-Bed Modeling

Point of Contact:

Dr. J. Fowler, WESCW-P

Water Resources Region:

Coastlines with sediment transport

Location:

WES; Field Research Facility, Duck, NC

Objective:

To evaluate state-of-the-art technology in movable-bed modeling of coastal processes and to define/improve limits of accuracy and applicability.

Summary of Accomplishments:

Testing of a 3-D model of a temporary groin located at the Field Research Facility in Duck, N.C. was completed. Results showed that for most reasonable 3-D model scales, some distortion will be required. Fine sands were used as the movable-bed material. The same facility is being used to conduct 3-D studies on scour problems at rubble-mound structures.

A multisection 15-ft-wide flume, for modeling various materials simultaneously, was used to obtain a set of data to evaluate effect of sand size in models and test results were documented. Results showed that best results were obtained with fine to very fine sands in the range of 0.1-0.25 mm mean diameter.

A survey on coastal scour problems was completed and preliminary two-dimensional tests were conducted to look at scour at and near coastal structures. A draft report with annotated bibliography was completed and design for additional two- and three-dimensional tests was also accomplished.

Title of Study:

Advance Maintenance in Rivers

Point of Contact:

Mr. Mike Trawle/CEWES-HR-M

Conducted for:

Office, Chief of Engineers

Water Resources Region:

All inland navigation channels and harbors

Location:

WES

Objectives:

The overall objective of this investigation is to evaluate the effectiveness of advance maintenance dredging in reducing dredging frequency and associated costs in inland channel and harbor maintenance and to establish guidelines for governing this practice.

Summary of Accomplishments:

New start in FY 88. A literature survey to determine the state of the art has been initiated. A survey of Corps field offices to establish current practice in each District has been initiated.

Title of Study:

Goodwin Creek Watershed Sediment Data Analysis

Point of Contact:

Mr. John Ingram/CEWESHS-H

Conducted for:

U.S. Army Engineer District, Vicksburg

Objective:

Develop a total sediment load measurement procedure which can be applied to point-source sediment data collected at Goodwin Creek and the Demonstration Erosion Control (DEC) Watersheds. And, develop techniques and software for analyses of rainfall-runoff data to determine the parameters necessary to calculate Snyder coefficients for determining unit hydrographs for ungaged watersheds.

Summary of Accomplishments:

A total sediment load measurement procedure which uses point-source suspended-sediment data was developed and tested with field data. The procedure, TSL (Total Sediment Load), was compared to the modified Einstein procedure (MEP) which uses depth-integrated suspended-sediment data for measuring total sediment discharge. The TSL procedure provides total sediment load measurements that are similar in magnitude to both turbulence flume measurements of total sediment load and MEP. Preparation of a draft report on TSL was initiated. Analyses of Snyder unit graph parameters for the Goodwin Creek Watershed were made using composite Thiessen weighted hyetographs, consistent and automated baseflow separation techniques and state plane coordinates on all geometric computations. One paper on Snyder type coefficients for small watersheds was presented and published at the American Society of Civil Engineers, 1987 Engineering Hydrology Symposium.

Title of Study:

Barrier Island Sedimentation Studies

Point of Contact:

Dr. D. K. Stauble

Water Resources Region:

All barrier coastlines

Summary of Accomplishments:

Two technical report were produced on shoreline mapping of the South Carolina and northern New Jersey coasts. A sedimentation study investigating the interchange of sediment between the beach and offshore shoal in the vicinity of St. Lucie Inlet, Florida, was produced as a miscellaneous paper. Another MP was completed on the use of oolitic sand as a tracer for coastal sand sources. A technical report on the Holocene stratigraphic history of the southern New Jersey coast found that the main source of sediments to the backbarrier marsh came from shelf sediments transported into the marsh through the inlets. A new photogrammetric technique for studying the location and movement of offshore bars was examined in a miscellaneous report. An EM on Beach Erosion control and Shore Protection Studies was completed for field use in defining beach erosion and planning remedial measures.

Title of Study:

Stable Flood-Control Channel Design

Point of Contact:

Mr. John Ingram/CEWESHS-H

Conducted for:

Office, Chief of Engineers

Objective:

Develop stable flood-control channel design guidance for use in the design offices of the Corps of Engineers

Summary of Accomplishments:

A report on a nationwide inventory of USAE flood-control channels was prepared. Field data from five sand bed flood-control channels were collected and analyzed. Work was continued on the preparation of a design document for feasibility level studies for flood-control channels. Interim results were presented in several training courses. One paper was presented and published at the American Society of Civil Engineers, 1987 national Conference of Hydraulic Engineering.

ENVIRONMENTAL PROTECTION AGENCY

Washington, DC

State Nonpoint Source Assessment Reports and Management Programs

Pursuant to Subsection 319 of the Water Quality Act of 1987 (WQA), the Administrator of EPA transmitted to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate a report on activities and programs implemented and progress made in reducing pollution in navigable waters of the U.S. caused by nonpoint sources of pollution, much of which involve sediments. Information provided in this report include activities of EPA and the States to clarify specific requirements of Section 319, laying the groundwork for orderly and timely development and submission by States of approval nonpoint source (NPS) Assessment Reports and Management Programs, and conducting a variety of outreach activities to ensure informed, effective participation by all interested and affected groups. Special attention was paid to the development of assessment and reporting procedures and formats to enhance their effectiveness for documenting water quality improvements resulting from State efforts under Section 319. In this way, future reports will be able to address the progress being made in reducing pollution in navigable waters resulting from nonpoint sources.

Nonpoint Source Pollution Technical Assistance to States

During 1987, EPA has provided several forms of technical assistance to the States and other participants. Headquarters collaborated with the Chesapeake Bay Program in developing and publishing a study entitled "Chesapeake Bay Nonpoint Source Programs". Other technical guidance documents developed by EPA will also help States to meet the requirements of Section 319. One of these is a NPS monitoring and evaluation procedures and protocols needed to accurately and reliably measure and document the water quality impacts of NPS pollution, much of which involves sediments. The final guide will be available in late 1988. The other technical guidance document is an annotated reporting format for use by States in reporting NPS assessment data for inclusion in EPA's Water Body System (WBS), the computerized data system which will be used to store and track all data for the biennial Section 305(b) Water Quality Inventory. This format has been designed specifically to maximize its utility for documenting water quality improvements resulting from State efforts under Section 319 for inclusion in future versions of this report.

Clean Water Strategies for Nonpoint Source Control

Immediately following passage of the Water Quality Act (WQA) of 1987, EPA recognized that this act offered a special opportunity to implement important new water quality initiatives in concert with ongoing core CWA programs and to intensify efforts to protect two other water resources -- wetlands and ground water. Specifically, States were asked to address important new responsibilities in the areas of surface water toxics, NPS pollution such as sediment, clean lakes and estuaries. Therefore in

consultation with the States and other interested parties, EPA developed guidance on, and encouraged the States to adopt, a State Clean Water Strategy (SCWS) process to guide State implementation of the WQA, including Section 319. The SCWS process involves three steps: completing an integrated, comprehensive assessment of impaired waters; targeting or identifying the sequence for protecting water resources; and converting ideas and actions into a strategic management plan(s). An important element of the process is establishing early, effective involvement of public interest groups, elected officials, the media and others who may be interested and able to assist in the process. Opening the process can lead to new data, information and ideas, and can also generate a broad-based coalition of support for implementation activities. Guidance for the implementation of Section 319 has specifically been developed to fit within and support the SCWS process.

For additional information, contact Bob Thronson, Nonpoint Sources Branch, Office of Water, USEPA, Washington, DC 20460: Telephone (202) 382-7103 - (FTS) 382-7103.

Development of Numerical Sediment Criteria

EPA's Office of Water Regulations and Standards has been actively pursuing the development of numerical sediment criteria. These criteria are intended to assist in assessing the toxicity of and to aid in making decisions concerning contaminated sediments. These criteria are driven by biological and human health effects and are intended to be as protective as existing water quality criteria.

Considerable progress has been made with this effort, and as a result the methodology used to develop sediment criteria for non-polar organic contaminants will be presented to EPA's Science Advisory Board for review in 1988 and for metal contaminants at a later date. In an effort to better understand the role sediment criteria will be playing in evaluating hazardous waste sites and to develop insight on how to better focus future sediment criteria development activities, several pilot studies were conducted. These pilot studies focused on using interim sediment criteria developed for 11 contaminants and applying these criteria at active Superfund sites with contaminated sediment problems.

For additional information, contact Chris Zarba, Standards Branch, Office of Water, USEPA, Washington, DC 20460; telephone 202-475-7326 - (FTS) 475-7326.

United States Environmental Protection Agency - Region V Water Division In-Place Pollutant Initiative

The Region initiated the development of an In-Place Pollutant Initiative in 1987. The goal of this Initiative is to develop a framework for the clean-up of contaminated sediments in Region V, with emphasize on inland waterways. The various steps and activities necessary to reach the stage where remedial activities are ready to commence are outlined by the Initiative. Once these procurement activities are completed, resources will then be able to be optimally expended to conduct remedial actions. The Initiative is divided into two phases. Phase I involves developing a coordinated Region V/State effort to address the in-place pollutant issues of concern. Preliminary activities will include information gathering, prioritization, and development of consistent sediment sampling procedures. The results should indicate the scope and extent of the in-place pollutant problem in the Region. Phase II involves the evaluation of various control technologies, and the development of a comprehensive framework for management and control of in-place pollutant problems. Implementation requires a major effort in coordinating in-place pollutant programs issues. The Initiative will be implemented in calendar year 1988. For further information contact Marc Tuchman Water Division Region V.

Region V State Programs For Contaminated Sediments

This Draft report provides a summary of State's programs in Region V which either provide data on sediment quality by assessing the degree and nature of contaminates in sediment throughout the State, or have been used to direct site-specific clean ups of in-place pollutant sites. The six Region V States are Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Sediment quality data are generally collected through 401 certification or through water quality monitoring programs within each State. Site specific actions have been implemented under numerous programs within the six Region V State. This Report will be finalized in calendar year 1988. For further information contact Marc Tuchman Water Division Region V.

Clean Lakes Program

The Region funded eight Clean Lakes projects that had sediment related problems. Three of the projects were for restoration/protection and the remaining were diagnostic/feasibility studies to determine the extent of the sediment problem. For further information please contact Tom Davenport Water Divison.

AGNPS Model Development

The Region funded the development of two modelling components for the AGNPS (Agricultural Nonpoint Source) model. These components were; waterbody modelling capability and annual basis. Both of these components will enhance the model is capability for simulating sediment transport. The development of the AGNPS model is a joint Federal and State effort. These components will be operational in 1989. For more information contact Tom Davenport, Water Division.

ESTIMATION OF THE EFFECTS OF THE CONSERVATION RESERVE PROGRAM ON WATER QUALITY IN A SMALL MINNESOTA WATERSHED

The federal Conservation Reserve Program (CRP) pays farmers to remove highly erodible land from crop production for ten years and plant permanent vegetative cover. As a result of the soil conserved and agrichemical use eleminated on CRP land, the program is expected to have beneficial effects on water quality. The primary purpose of this project is to estimate the reduction in nutrient and sediment loads to a small watershed as a result of enrolling land in the CRP. Related objectives are to: 1) determine how well the CRP is capturing those parcels of land in the watershed which appear to be contributing most to nonpoint source (NPS) pollution problems and 2) estimate the potential reduction in NPS pollution if CRP land enrollments were specifically targeted for that purpose. This project was funded by Headquarters and is being managed by the Region. For more information contact Tom Davenport, Water Division.

Lake Restoration Guidance Manual Technical Supplement 1 - Monitoring

The Region, with Headquarters funding, initiated the development of a manual to assist lake managers in designing and implementing monitoring programs for determining the effectiveness of lake restoration. The manual has a section entitled; "Eutrophication/Sedimentation" and "Determination of Sedimentation and Sediment Quality". There is also a section pertaining to soil erosion and sediment transport. The manual will be completed in 1988. For more information contact Tom Davenport, Water Division.

FEDERAL HIGHWAY ADMINISTRATION

The Federal Highway Administration (FHWA) concentrated its activities on five major areas: evaluation of embankment stability subject to flood overtopping, control of stream instability at highway crossings, bridge scour studies, 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 (HRP) and in the National Cooperative Highway Research Program (NCHRP).

Evaluation of Embankment Stability Subject to Flood Overtopping- The objective of these studies are to evaluate stability of embankments subject to flood overtopping and to determine expected rates of erosion when damages do occur. Various types of embankment materials and various types of protective measures are considered for these studies. In the overall design framework for highway stream crossings, these studies provide guidelines for risk analysis and lowest total expected cost design.

A. Simons, Le and Associates (SLA) continued a study sponsored jointly by FHWA and the U.S. Bureau of Reclamation under contract DTFH61-83-C-00131, "Overtopping Damage Minimization." This study is a follow-up to a completed FHWA study on Embankment Damage due to Flood Overtopping. In 1987, SLA completed testing on several protective measures for embankments subject to flood overtopping. Protective measures included in the study were gabion mattresses, 4" thick geoweb filled with 1/2" gravel and covered with netting, soil cement placed in 3' wide lifts, enkamat with a geotextile liner and filled with asphalt, and cable-tied concrete blocks. The cable-tied block concept was tested earlier by the British under the sponsorship of the Construction Industry Research and Information Association (CIRIA) and was recommended as a good alternative for embankment protection. We are currently working with SLA to do some additional experiments with the cable-tied blocks. Representatives from SCS, the Corps of Engineers, TVA and the BOR have expressed interest in sponsoring the additional work on cable tied blocks.

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. Sponsored by FHWA, the USGS completed a study on "Evaluation of Design Practices for Riprap Used in Protection of Highway Crossings." Two reports from that study were published in 1986. A third report dealing with recommended design practices was partially drafted but was not published by USGS. FHWA awarded a follow up implementation contract to the Sutron Corporation to revise the FHWA hydraulic engineering circular (HEC-11) on riprap design procedures based on the USGS results. A draft of that circular is currently being updated.

B. FHWA was conducting a small scale laboratory study to determine riprap sizes needed to stabilize existing scour holes around bridge piers. This study is scheduled for completion in 1989.

Bridge Scour Studies - The objective of these studies is to investigate expected scour at bridges. Goals include developing procedures for assessing vulnerability of bridge to 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 Arkansas, Arizona, Louisiana, Oklahoma, Delaware, Virginia, Maryland and Washington State using either State or HP&R funds. 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 study described in B below. Washington State completed a preliminary study in 1987 and published report WA-RD-118, "Riverbed Scour at Bridge Piers" which includes some enlighting but controversial conclusions about the effects of gradation of natural bed material on the expected scour depth. The current study objective is to get more field data during flood conditions to evaluate those conclusions.

B. A bridge scour study "Performance of Bridges during Flooding" was awarded to the USGS. This study features a team of investigators who will go to flood sites to monitor stream bed movement during floods. The team of investigators will work with study leaders in the individual States that have scour studies to standarize data collection and to serve as a national repository of data.

C. Simons and Associates was awarded a NCHRP study (Project 15-11) "Hydraulic Analysis of Bridges on Streams with Moveable Beds and Banks" which will develop a sediment transport model that utilizes the stream tube concept proposed by Molinas. The three year study was awarded during the summer of 1987.

Control of Sediment Produced by Highway Construction - This problem consists of two stages: during construction and just after construction.

A. Sponsored by FHWA, the Native Plants, Inc. of Salt Lake City, utah completed the study on "Accelerated Recovery Vegetation on Roadway Slopes After Construction." This study was for Federal lands such as those of Indian reservations, national forest, national parks, and areas under purview of the Bureau of Land Management. Low volume roads prevail. Emphasis of study was the restoration of vegetation, partly for aesthetic reasons, but also for erosion control by using appropriate plantings or seeding native to the area. Most of the study considered barren and infertile areas commonly found among western mountains and deserts. The final reports were published in 1987 and are available from NTIS.

Ostler, W.K., and Allred, K.L., "Accelerated Recovery of Native Vegetation on Roadway Slopes Following Construction:

Volume I. General Principles" FHWA/DF-87/003
Volume II. Representative Sites" FHWA/DF-87/004
Volume III. Bibliography" FHWA/DF-87/005

B. It is equally important that upon completion of highway construction, immediate and adequate protection against erosion 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 six States conducting studies designed to reduce erosion through improved vegetation establishment and maintenance, and through the use of improved erosion control fabrics. The participating States are Arizona, California, Colorado, Florida, Georgia, and Oklahoma.

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. The Alaska Department of Transportation and Public Facilities continued the HPR study to evaluate the effectiveness of roadway drainage structures for fish passage.

B. The FHWA administrative contract to identify effective alternatives for mitigating highway stormwater runoff pollution was completed by Versar, Inc. of Springfield, Virginia in 1986. This state of the practice study developed an interim design guide for four mitigation practices: Overland flow through grassed swales, retention basins, infiltration basins and wetlands. It also identified effective and noneffective design and operational practices for mitigation of highway runoff pollution. A guideline manual along with an executive summary, literature summary and research report were established in 1986, and are available from NTIS. Work was continued in 1987 to incorporate the guidelines into a Hydraulic Engineering Circular.

C. In order to draw together the results of all the research on characterization of highway stormwater runoff, FHWA contracted with Woodward Clyde Consultants to develop a "Design Procedure to Estimate Pollutant Loading from Highway Stormwater Runoff." This study was continued in developing a computer model to estimate pollutant loading and will include a procedure to evaluate the potential impact to water resources.

D. An FHWA administrative contract research study, "Retention, Detention and Overland Flow for Pollutant Removal From Highway Stormwater," was continued by the Versar, Inc. Springfield, Virginia. This research will develop performance criteria for mitigation measures using this subject removal mechanism. It will conduct laboratory tests and design for laboratory and field validations.

E. An FHWA administrative contract research study, "Guidelines for Protective Systems for Spills of Hazardous Materials on the Highway System," was continued by the Kansas State University of Manhattan, Kansas. This investigation will focus 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.

F. Seven States continued investigations on effects of highway design, operation, and maintenance on water quality impacts and means to reduce such impacts.

Florida, "Assimilative Capabilities of Highway Stormwater Runoff Retention Ponds."

Florida/USGS, "Wetlands for Stormwater Treatment."

Florida/USGS, "Impacts of Stormwater Management Practices on Ground Water."

Florida, "Effects of Structural Changes on Water Quality Efficiency."

Florida, "Effects on Groundwater Quality Caused by Processed Highway Runoff."

Massachusetts, "Effectiveness of Drainage Features for Control of Ground Water Pollution."

Washington, "Implementation of Highway Runoff Quality Research Results."

Arizona, "Porous Pavements for Control of Highway Runoff."

California, "Effect of Bridge Repainting Operations on the Environment."

California, "Use of Vegetation to Reduce the Toxicity of Stormwater Runoff."

California, "Effects of Bridge Repainting Operations on the Environment."

Tennessee, "Deposition of Sediments in Wetlands of Bridge Crossings."

Ohio, "Environmental Impact of Highway Snow and Ice Removal in Ohio."

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, AGRICULTURAL RESEARCH SERVICE, FEDERAL HIGHWAY ADMINISTRATION, BUREAU OF LAND MANAGEMENT, AND TENNESSEE VALLEY AUTHORITY

Federal Inter-Agency Sedimentation Project
St. Anthony Falls Hydraulic Laboratory
Minneapolis, Minnesota

Committee D-19 of ASTM (American Society for Testing and Materials) voted on and approved a new guide entitled "Core-sampling submerged, unconsolidated sediments". The guide, which was written under sponsorship of the Sedimentation Project, discusses equipment and procedures for collecting core samples and also discusses processes for dissecting and preserving the cores. Before the guide can be published, it must be approved by Society Ballot which is scheduled for 1988.

The Sedimentation Project continued to develop and test vibrational-type sediment-concentration gages. A vibrational gage of the U-tube type is still operating on the Toutle River near Mount St. Helens. The success of this venture led the project to buy components for three more gages which Joe Beverage plans to install in 1988. Project personnel continued work on a straight-tube version of the vibration-type sediment-concentration gage. John Skinner described the latest version of the instrument in a report entitled "Error correcting techniques for the model-B sediment-concentration gage". The report describes characteristics of the gage, explains the theory of its operation, analyzes factors influencing the frequency readings, and discussed the process of calculating sediment concentrations from records of vibrational frequency, water temperature, water conductivity, and river stage.

A special controller for the PS-69 pumping sampler was designed, built, and then sent to the USGS at Vancouver, Washington. Instead of operating on electronic feedback principles, this special controller works on preset time intervals programmed on motor driven cam switches. The new controller is simpler than the older feedback controllers; however, the operator must fine-tune the time setting in the field. Don Benson added a "low-voltage detector" to the list of sampler accessories. Low voltage from weak batteries causes malfunctions in battery-powered pumping samplers. A weak battery is difficult to detect because its voltage drops momentarily while the sampler is starting but then returns to normal between sampler operations. The low-voltage detector senses this momentary drop and latches a warning signal that alerts the operator of an impending problem.

Joe Szalona ran a series of tests on a new frame for bedload samplers. Instead of having three bars to hold the nozzle and tail assemblies together, the new frame has only one bar. Several other parts on the original "sampler" frame have been eliminated in an effort to reduce manufacturing costs. Tests focused on charting and comparing flow patterns in critical regions near the sampling nozzles. The project now plans to organize field tests for comparing sediment-sampling efficiency.

Calibration, distribution, and repair of samplers and laboratory equipment continued at a good pace during 1987. Corps of Engineers personnel with the project supplied about 81 major pieces of sampling equipment.

CR098 SEDIMENT TRANSPORT PHENOMENA

TITLE: Measurement and Prediction of Sediment Transport Phenomena

PROJECT NUMBER: CR 74-098

LOCATION: Topical Research

PROJECT CHIEF: Stevens, Herbert H., Jr.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: In alluvial streams, for every different hydrologic condition, the bed configuration, sediment transport, and hydraulic characteristics mutually change to achieve quasi-equilibrium. These changes affect the ability of the stream to convey given quantities of water, accommodate navigation, transport and dilute solid and solute wastes, support aquatic biota, and perform a variety of other similar functions. As yet, the relation between pertinent hydraulic and sedimentologic variables are not completely understood; hence, the extent to which important variables, particularly bedform roughness and sediment transport, will change in response to natural or man-induced alterations to the flow regime cannot be predicted with desired reliability. As a result, optimum utilization and management of a waterway usually is not assured; often, modifications intended to enhance the utility of a waterway are ineffective or have adverse effects. Lack of understanding is due in part to inadequate instrumentation for measuring the bedload transport. This problem is particularly acute in areas where resources are being mined for energy development.

OBJECTIVE: Provide a more complete understanding of sedimentation phenomena in alluvial streams and the response of such streams to imposed changes through the use of improved instrumentation. In particular, consider the interrelationships between bed-form characteristics and the transport of bed-load and bed-material load.

APPROACH: Initially, analyze existing data to relate bed-form characteristics and hydraulic and sedimentologic variables, and develop one or more bedload samplers to permit accurate measurements of bedload transport. The development of bedload samplers will be accomplished through a comprehensive testing and calibration program with prototype samplers in a specifically designed laboratory facility capable of continuously measuring the discharge of bedload particles from 2 to 64 millimeters in diameter under different flow conditions. Later, study the characteristics of bed-forms, sediment transport, and other pertinent variables as required to meet specific needs. Use acoustic instrumentation, including side-scan sonar, to measure bed-form configuration and movement. Use suitable bedload samplers, and suspended-load samplers, to define transport rates. Finally, analyze information to define criteria for predicting bed-form conformation and to provide a better understanding of sediment-transport phenomena. Study both sand-bed and gravel-bed streams.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

PROGRESS: Data collected during laboratory calibration of bedload samplers were used to study the effect of length of sampling time and to make a spectral analysis of bed forms. The distribution of samples collected using varying sampling time periods closely agreed with the results using Eirstein's distribution equation.

REPORTS PUBLISHED:

Hubbell, D. W., and Stevens, H. H., Jr., 1987, Laboratory data on coarse-sediment transport for bedload sampler calibrations: U.S. Geological Survey Water-Supply Paper 2299, 31 p.

Hubbell, D. W., Stevens, H. H., Jr., Skinner, J. V., and Beverage, J. P., 1986, Characteristics and use of Helley-Smith type bedload samplers: U.S. Geological Survey Open-File Report 86-415W, videotape.

CR102 SEDIMENT IN RIVERS

TITLE: Movement and Storage of Sediment in River Systems

PROJECT NUMBER: CR 75-102

LOCATION: Nationwide

PROJECT CHIEF: Meade, Robert H.

HEADQUARTERS OFFICE: Lakewood, CO

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 one year to more than one thousand. 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 in the upper Missouri River basin; and (3) assess sources, pathways, and sinks by intensive field studies (including tracer studies) of selected small rivers.

PROGRESS: One field excursion on the Apure River (Orinoco tributary) in Venezuela to sample sediment movement during the early rising stage (May 1986) was completed. A resurvey of cross sections in Powder River, Mont., showed very little change in a year of low runoff. An investigation of the distribution and fate of heavy metals associated with fluvial sediment in the channel and floodplain downstream from the Homestake Mine in South Dakota was continued. Preliminary results indicate that approximately one-third of the mining tailings discharged to the river have been incorporated within the floodplain.

REPORTS PUBLISHED:

Marron, D. C., 1987, Floodplain storage of metal-contaminated sediments downstream of a gold mine at Lead, S.D., in Averett, R. C., and McKnight, D. M., eds., The chemical quality of water and the hydrologic cycle: Chelsea, Mich., Lewis Publishers, p. 193-209.

Marron, D. C., and Popenoe, J. H., 1986, A soil catena of schist in northwestern California: Geoderma, v. 37, p. 307-324.

Richey, J. E., Meade, R. H., Salati, Eneas, Devol, A. H., Nordin, C. F., Jr., and Santos, U. de M., 1986, Water discharge and suspended sediment concentrations in the Amazon River, 1982-1984: Water Resources Research, v. 22, no. 5, p. 756-764.

CR105 CHANNEL MORPHOLOGY

TITLE: Effects of Water and Sediment Discharges on Channel Morphology

PROJECT NUMBER: CR 65-105

LOCATION: Topical Research

PROJECT CHIEF: Williams, Garnett P.

HEADQUARTERS OFFICE: Lakewood CO

PROBLEM: Channels in alluvial streams change with time. Bed elevations and channel widths may change, meander bends may shift both laterally and downstreamward, the sizes of the bed particles may change, instream bars may grow and migrate, and the amount and type of vegetation along the river may increase or decrease. Sometimes the change is insignificant, even over decades, but in other cases catastrophic modifications occur in minutes. The transformations can be natural or human-induced, and they can have significant effects on humans and the environment.

OBJECTIVE: Determine and analyze the influence of the major variables, particularly water and sediment discharges, governing channel morphology.

APPROACH: Study the effect of large contribution of sediment to stream channels. Make field surveys and aerial-photograph analysis, preferably time-sequential, of stream reaches that have received exceptionally large sediment inputs. Document channel response, with a view toward eventually developing a general model of channel response.

PROGRESS: (1) With B. M. Troutman, completed a lengthy statistical manuscript on estimation and prediction of straight-line geologic relationships. The ordinary least squares (OLS) and structural-analysis (SA) methods of fitting straight lines to data were examined with respect to how closely each of these methods (a) estimates the parameters of "true" straight-line relations and (b) predicts values of the dependent variable. As expected, SA is superior to OLS for estimation of the true line. Differences between the two line-fitting methods decrease as error in X becomes small relative to error in Y. Also as expected, OLS is better than SA for predicting the dependent variable; again the difference grows smaller as X takes on less error relative to Y. (2) Completed first draft of a study of suspended sediment-water discharge relations for single hydrologic events (e.g., a flood) in rivers. Many features of the sediment-concentration water-discharge relation for a hydrologic event can be brought out by treating "smoothed" temporal graphs (discharge and concentration over time) as frequency distributions. Such distributions were analyzed qualitatively in terms of mean, spread, and skewness. Comparing concentration/discharge ratios on the discharge hydrograph's rising and falling limbs at a given discharge provides a consistent, reliable theory for explaining and categorizing the more common types of concentration/discharge relations. Five categories of these relations emerged: single-valued

line (straight or curved), clockwise loop, counterclockwise loop, single line plus loop, and figure eight. Of these, only the clockwise loop and perhaps the counterclockwise loop have received notable attention in previous studies for a single hydrologic event. (3) Assembled a valuable and unique set of sediment-transport data for nearly 100 U.S. stream sites, representing a wide variety of environments. The data set is unique in that it will be the first one to present the total sediment load of streams along with the two main components of load--bedload and concurrently-measured suspended load. The associated hydraulic variables (water discharges, mean velocities, etc.) also are being listed. The entire data set will be published as a basic data open-file report; compilation is about 90 percent finished as of July 1987. The report will form the basis of various journal articles and other research papers.

REPORTS PUBLISHED:

Williams, G. P., 1986, River meanders and channel size: Journal of Hydrology, v. 88, p. 147-164.

Williams, G. P., and Wolman, M. G., 1986, Effects of dams and reservoirs on surface-water hydrology--changes in rivers downstream from dams, in National Water Summary 1985, Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, p. 83-88.

CR187 BEDLOAD TRANSPORT RESEARCH

TITLE: Hydraulics and Mechanics of Bedload-Transport Processes

PROJECT NUMBER: CR 74-187

LOCATION: Topical Research

PROJECT CHIEF: Emmett, William W.

HEADQUARTERS OFFICE: Lakewood, CO

PROBLEM: Of all processes operating in river channels, especially those of practical concern to engineers and others interested in river-channel behavior, perhaps the least understood are the hydraulics and mechanics of bedload transport. Before continuing advances in river-channel behavior can be made, the movement of bedload sediment must be understood.

OBJECTIVE: (1) Define spatial and temporal variations in bedload-transport rate for a single stage of flow; (2) define change in average magnitude of transport rate over a range in flow; (3) define change in average magnitude of transport rate over a range in channel geometry; and (4) analyze the data to evaluate the applicability of available bedload equations, suggest new coefficients for the existing equations, or propose new relations for predicting rates of bedload transport.

APPROACH: Use a conveyor-belt bedload-transport facility on the East Fork River near Pinedale, Wyo., as a control to evaluate variability factors in bedload transport and to field calibrate the Helley-Smith bedload sampler; to use the calibrated Helley-Smith sampler in the systematic collection of bedload samples, along with the concurrent measurements of streamflow hydraulics, from a variety of sand- and gravel-bed streams, and, within the laws of general physics, develop empirical relations of bedload transport and interpret the physical significance of the developed relations. Initiate at the conveyor-belt bedload-trap research facility a tracer study utilizing fluorescent particles to evaluate (1) residence time of sediment, (2) average speed of particles, (3) depth of bed material involved in transport, (4) dispersion of bed material, (5) short-term channel changes accompanying sediment transport, (6) influence of availability of sediment on transport rate, and other related aspects of sediment transport.

PROGRESS: (1) Measurements of bedload transport and associated hydraulic characteristics have been completed for the East Fork River, Wyo. Equipment and procedures have been described and process data are being analyzed and interpreted. (2) Six new field sites have been selected and bedload data are being collected at these sites by the U.S. Geological Survey. In addition to these six sites and the East Fork River site, several other sites provide information to the core data base.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

REPORTS PUBLISHED:

Mantz, P. A., and Emmett, W. W., 1986, Analysis of United States Geological Survey sediment transport data for some California streams: Euromech 192 Conference on Transport of Suspended Solids in Open Channels, Munich, Germany, 1985, Proceedings, p. 177-182.

CR266 ESTUARY SEDIMENTATION/EUTROPHICATION

TITLE: Transport and Deposition of Sediments and Sediment-Borne Contaminants in Tidal Rivers and Estuaries

PROJECT NUMBER: CR 81-266

LOCATION: Topical Research

PROJECT CHIEF: Glenn, Jerry L.

HEADQUARTERS OFFICE: Lakewood, CO

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 may 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 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 levels 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 subbottom profiling). Analyze sediment samples for indicators of sources (particle size, mineralogy, nutrient and trace-metal concentrations) and accumulation rates (lead-210, carbon-14 pollen concentrations and distributions). Estimate sediment contributions from the shoreline source using a combination of field mapping, monitoring, and sampling at selected sites, and using laboratory measurements from available air 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 Potomac reaches.

PROGRESS: Bottom sediments collected from the transition zone were resuspended at other sites in the estuary where water-column characteristics differed greatly from those at the sampling site. Samples from each site were analyzed for total carbon and total phosphorus after approximately 8 days of resuspension. Statistical tests failed to establish significant differences in mean total carbon in original and resuspended samples from the transition zone and from anoxic near-bottom waters in the estuary; however, samples from oxic near-surface waters in the estuary had significantly less total carbon. Total phosphorus analyses were inconsistent, probably because of laboratory analytical errors.

REPORTS PUBLISHED:

Glenn, J. L., and Rice, C. A., 1986, Sediment data for computations of deposition rates in the tidal Potomac system, Maryland and Virginia: U.S. Geological Survey Open-File Report 86-279, 80 p.

CR273 HYDROLOGICAL-BIOLOGICAL INTERACTIONS

TITLE: The Interface of Hydrological and Biological Processes in Rivers

PROJECT NUMBER: CR 82-273

LOCATION: Topical Research

PROJECT CHIEF: Andrews, Edmund D.

HEADQUARTERS OFFICE: Lakewood, CO

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 remains relatively constant over a period of years, the channel geometry and pattern vary about a mean or quasiequilibrium 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 and transform the channel from one quasiequilibrium state to another. Between the two quasiequilibrium states, there is a period of instability. Existing techniques for examining and predicting river-channel adjustment have been developed primarily from investigation of quasiequilibrium rivers. However, the dynamics and rate of river-channel adjustment during the period of instability rarely have been studied and are understood poorly. The length of time required for the complete adjustment is commonly a few decades to a century or more. In watersheds where various land-use changes occur every several years, the river channel may be adjusting continually to a different supply of water and sediment. An understanding of the dynamics and rate of river channel adjustment from one quasiequilibrium state to another is very important to managing fluvial resources. One of the most frequent and important adverse impacts of river-channel changes is damage to the aquatic ecosystem. 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. In order to evaluate the biological impacts of watershed alteration, hydrologists frequently are asked to predict future hydraulic geometries and channel patterns so that changes in habitat can be assessed. The primary focus of this project is to understand the dynamics and rate of river-channel change as they affect the physical habitat. 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 due to a change in the water discharge, sediment size, and sediment load supplied to the channel concentrating on those aspects of the river channel known to influence significantly the aquatic ecosystem--the bed-material size distribution, the 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. Develop mathematical models of the processes as required for longitudinal routing water and sediment. The ultimate goal of the project is to develop new analytical tools for describing river-channel adjustment.

APPROACH: Because adjustment of a river channel may extend over a few decades to a century, it is impractacal to observe the transition of a river channel from one quasiequilibrium state to another quasiequilibrium. The approach will be to study the movement of bed material through a reach of channel in detail, considering the transport of bed materials, distance transported, and location (bed, banks, or bar) of deposition for each size fraction. Two or three small, self-formed, gravel-bed streams will be selected for this part of the investigation that are also sites of active aquatic ecology research programs. Bedload-transport rates, tracer particles, and maps of channels features will be used to describe the movement of coarse bed material through the study reaches, and formulate a physical model of gravel movement by size fraction. In addition, the sequence and rate of adjustment will be reconstructed for historical examples of river-channel change to provide the temporal context in which to view a hydraulic characteristic at a particular point in time. Ideally, the study of hydraulic processes and aquatic ecology can be undertaken on the same river reaches that are used to reconstruct the historical data.

PROGRESS: Winter floods in the Sierra Nevada mountains kill buried eggs of brook trout and Paiute sculpin because bed-material transport increases greatly when high flows are constrained by snowbanks. From studies in 1952-61 in Sagehen Creek, Calif., winter floods were known to cause low populations of brook trout. In February 1982, dead Paiute sculpin were collected while sampling bedload during a rain-on-snow flood. Population estimates by electrofishing at nine permanent stations the following summer showed that density (3,586/hectare (ha)) and biomass (12.9 kilograms per hectare (kg/ha)) of Paiute sculpin were lower than the respective means (12,017/ha, 40.3 kg/ha) obtained during previous studies from 1952-61. These estimates were also below those obtained in 1956 after the largest winter flood during 1952-61. Brook trout fry also were less abundant in 1982 than the 10-year mean or the 1956 mean. Maximum flow depths, rather than discharge, were the likely cause of fish mortality. Winter floods are severe because accumulated snowpack increases the effective height of the streambank and confines a larger part, perhaps all, of a rain-on-snow flood within the channel. As a consequence, shear forces on the bed increase and bed-material transport increase rapidly. This increase is due primarily to an increase in the number of particles entrained by the flow at any instant. These conditions kill many benthic-living fishes such as the Paiute sculpin or buried eggs of fall-spawning fishes such as the brook trout.

WRD FEDERAL RESEARCH PROJECTS.....GEOMORPHOLOGY & SEDIMENT TRANSPORT

REPORTS PUBLISHED:

Andrews, E. D., 1986, Downstream effects of Flaming Gorge Reservoir on the Green River, Colorado and Utah: Geological Society of America Bulletin, v. 97, p. 1012-1023.

Andrews, E. D., 1987, Longitudinal dispersion of trace metals in the Clark Fork River, Montana, in McKnight, D. M., and Averett, R. C., eds., Chemical quality of water and the hydrologic cycle: Chelsea, Mich., Lewis Publishers, p. 210-223.

Andrews, E. D., and Parker, Gary, 1987, Formation of a coarse layer as the response to gravel mobility, in Hey, R. D., Bathurst, J. C., and Thorne, C. R., eds., Gravel-Bed Rivers: New York, John Wiley, p. 269-300.

NR081 INTERAGENCY SEDIMENTATION PROJECT

TITLE: A Study of Measurement and Analysis of Sediment Loads in Streams

PROJECT NUMBER: NR 39-081

LOCATION: Topical Research

PROJECT CHIEF: Skinner, John V.

HEADQUARTERS OFFICE: Minneapolis, MN

PROBLEM: Knowledge of factors governing the movement and deposition of sediment in streams and reservoirs is of major importance to Federal and State agencies involved in development of water and land resources of the Nation. A knowledge of the sediment discharge of streams is essential to the efficient design and operation of projects for the storage and use of streamflow. Movement of sediment also affects aquatic life and the transport of certain types of chemical pollutants. Complexity of sediment phenomena are such that comprehensive investigations are essential to support accurate conclusions.

OBJECTIVE: Develop new techniques for measuring and analyzing the sediment discharge of rivers. Coordinate studies to meet the common needs of two or more agencies. Serve as (1) a focal point for establishing standard methods for sediment discharge measurements; (2) a center for developing both manual and automatic samplers; and (3) a center for procuring, calibrating, and stocking sediment equipment used by federal agencies.

APPROACH: Use knowledge of hydraulics, physics, and electronics to develop new techniques for collecting sediment data. Evaluate new equipment under laboratory and field conditions. Distribute technical reports that explain research activities and manuals that explain equipment operation to all interested agencies.

PROGRESS: (1) An experimental sediment-concentration gage was installed on the Toutle River near Tower, Wash. Measured sediment concentrations ranged from 200 to 30,000 mg/L (milligrams per liter) during the initial 5 months of sampling. The probable measurement errors within the range of observed values are estimated to $\pm$ 200 mg/L. (2) Tests on an experimental frame for bedload samplers indicate certain dimensions are critical: the nozzle must be about 6.5 centimeters upstream of the frame to eliminate flow interference. (3) A special valve for point-integrating suspended-sediment samplers was designed and field tested to depths of about 5 meters. The new valve not only maintains ideal flow rates but also eliminates metallic contact with the sample water. (4) A paper describing techniques and equipment for collecting core samples was completed. Topics include terminology of core sampling, characteristics of different samplers, types of core distortions, methods for detecting and eliminating distortions, and techniques for dissecting and

preserving samples. The paper, which was recently accepted by the American Society for Testing and Materials committee on sediments, is being considered by the main committee. (5) A device for measuring particle-size distributions with X-rays is being evaluated by investigators at the USGS office in Iowa City, Iowa, as well as by several investigators at laboratories in Canada and Europe. In general, mean diameters obtained with the X-ray analyzer are smaller than mean diameters obtained by the pipet analyzer.

REPORTS PUBLISHED:

Beverage, J. P., 1987, Determining true depth of samplers suspended in deep, swift rivers, in A study of methods used in measurement and analysis of sediment loads in streams: U.S. Army Engineer District, St. Paul, 56 p.

Hubbell, D. W., Stevens, H. H., Jr., Skinner, J. V., and Beverage, J. P., 1987, Laboratory data on coarse-sediment transport for bedload-sampler calibrations: U.S. Geological Survey Water-Supply Paper 2299, 31 p.

Skinner, J. V., 1986, Measurement of scour-depth near bridge piers: U.S. Geological Survey Water-Resources Investigations Report 85-4106, 33 p.

Skinner, J. V., 1987, Report II-Progress Report--Temperature effects in vibrational-type sediment concentration gages, in A study of methods used in measurement and analysis of sediment loads in streams: U.S. Army Engineer District, St. Paul, 48 p.

Szalona, J. J., 1986, Report HH-Progress Report--Description and test of a straight-tube fluid-density gage for measuring suspended-sediment concentrations in streams, in A study of methods used in measurement and analysis of sediment loads in streams: U.S. army Engineer District, St. Paul, 29 p.

NR107 SEDIMENT IMPACTS FROM COAL MINING

TITLE: Geomorphic and botantical impacts of sediment due to natural and unnatural land disturbance

PROJECT NUMBER: NR 84-107

LOCATION: Topical Research

PROJECT CHIEF: Osterkamp, Waite R.

HEADQUARTERS OFFICE: Reston, VA

PROBLEM: Increased sediment yields from naturally stressed areas, such as mass-movement sites and devegetated lands, and man-stressed areas, such as mine spoils, urban areas, and agricultural lands, is one of the largest problems being addressed by agencies such as the U.S. Office of Surface Mining and U.S. Soil Conservation Service. The acquisition and interpretation of sediment data are among the most deficient areas that must be considered by these agencies. The impacts on geomorphology and botany that are caused by natural and induced sediment movement are sometimes intense; knowledge of these impacts is beneficial for understanding the effects of naturally occurring sediment movement.

OBJECTIVE: (1) Predict movement of sediment from naturally and unnaturally disturbed areas; assess existing techniques and develop new ones based on geomorphic, botanical, and statistical principles as aids in improving interpretive capabilities; evaluate geomorphic, botanic, and hydrologic changes caused by sediment movement from disturbed areas.

APPROACH: (1) Develop technology for determining amounts and rates of movement of sediment from disturbed areas based on factors such as land use, runoff, basin and landform morphology, and botanical indicators; (2) conduct research on the effect on landforms and vegetation of sediment movement using vegetation age, damage, and patterns of occurrence as indicators of the magnitude, frequency, and time of occurrence of destructive hydrologic events; (3) investigate the influence that ground-water movement exerts on sediment transport and changes in landforms by analyzing near-surface and subsurface rates of water and sediment movement (including piping, sapping and seepage erosion) in dynamic hydrologic systems; and (4) conduct research on the interactions between hydrology, water chemistry, and geochemistry as determinants of sediment movement through a hydrologic system, in conjunction and close coordination with other research and district personnel.

PROGRESS: Continuing studies in the Plum Creek basin, Colorado, have led to understanding how sand-bed streams adjust following historic flooding; the role of islands in causing channel narrowing has been defined. Investigations on Mount Shasta, Calif., are indicating that debris-flow activity on the mountain correlates better with warm summer temperatures than with heavy precipitation, such as during El Nino years. These findings offer the possibility of increasing our ability to predict debris flows and their hazard.

WRD FEDERAL RESEARCH PROJECTS..GEOMORPHOLOGY & SEDIMENT TRANSPORT

REPORTS PUBLISHED:

Osterkamp, W. R., and Wood, W. W., in press, 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.

Wood, W. W., and Osterkamp, W. R., in press, Playa lake basins on the Southern High Plains of Texas and New Mexico: Part II. A hydrologic model and mas-balance arguments for their development: Geological Society of America Bulletin.

Osterkamp, W. R., and Costa, J. E., in press, Changes accompanying an extraordinary flood on a sand-bed stream: Proceedings, 18th Annual Geomorphology Symposium--Catastrophic Flooding.

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 Costa, J. E., 1986, Denundation rates in selected debris-flow basins: Fourth Federal Interagency Sedimentation Conference, Las Vegas, Nev., v. 1, p. 91-99.

Osterkamp, W. R., ed., in press, Chapter 6, Great Plains, Geomorphic systems of North America: Decade of North American Geology Centennial Volume, Geological Society of America.

Hupp, C. R., Osterkamp, W. R., and Thornton, J. L., in press, 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 Osterkamp, W. R., 1987, Geobotanical evidence of debris flows on Mount Shasta, Calif., 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.

Osterkamp, W. R., Carey, W. P., and Hupp, C. R., 1987, Sediment impacts from coal mining, northeast Tennessee, 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. 30-32.

Osterkamp, W. R., and Hupp, C. R., in press, Dating and interpretation of debris flows by geologic and botanical methods at Whitney Creek gorge, Mount Shasta, Calif.: Geological Society of America Reviews in Engineering Geology, v. VII.

LABORATORY AND OTHER RESEARCH ACTIVITIES

U.S. GEOLOGICAL SURVEY

Hydrologic Instrumentation Facility
Stennis Space Center, Mississippi

The Hydrologic Instrumentation Facility (HIF) is responsible for research, development, testing, evaluation, procurement, warehousing, distribution, repair and calibration for instrumentation used by the Water Resources Division of the Geological Survey. Activities in 1987 associated with Sedimentation are as follows:

1. Warehouse - Procurement, stocking and distribution of sediment-sampling and related equipment and parts continued with 12 samplers, 394 nozzles, and 5,844 other parts/accessories being distributed.

2. Modification to P-61 sampler and BP-76 control unit - Cooperative work with John Skinner, Interagency Sedimentation Project, to provide an improved control valve for the P-61 sampler.

3. Scour Instrumentation - A conductivity-type scour sensor is installed at a site in Arkansas where one scour event occurred in December 1987. Two ultrasonic sounding devices were procured for possible application in measuring and recording depths during scour events at bridge piers.

4. Automated Suspended-Sediment Monitors - A EUR-CONTROL Model MEX-31? optical solids meter was discontinued in New Mexico when the range in concentration of suspended sediment proved to be too great for the range of the instrument. Five water-sediment samples were submitted to Laser Technologies for particle size analysis on the lab tech 100 instrument. Investigation continues on using the speed-of-sound relationship with sediment in water to determine the concentration of suspended sediment.

5. Suspended-Sediment Dewatering - Disk-type and bowl-type centrifuge systems were procured and assembled to assist researchers involved in evaluation of these as dewatering devices for surface-water toxics studies. A backwash filter system using peristaltic pumps was developed and assembled for test and evaluation.

6. Laboratory Tests - Thinwall silicone tubing was found to be the most suitable for the solenoid pinch valve assembly on the P-61 sediment sampler.

7. Sediment samplers for Heavy Metals Studies - A paint having strong abraison resistance and strong bonding was found. This paint, along with a painting process, should provide improved resistance to peeling and resulting metal leaching.

REPORTS:

Wagner, C. R., 1987, Annual Report 1987, Hydrologic Instrumentation Facility, 71 p.

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