RECLAMATION

Managing Water in the West

Technical Service Center Accomplishments for FY 2008

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center, Denver, Colorado

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Executive Summary

The Technical Service Center (TSC) provides engineering, scientific, and technical expertise to address water resources issues and to develop and maintain Reclamation's infrastructure and systems. Our vision is to be the world-recognized center of technical excellence in water and related resources.. Superior product delivery and customer service are strategic goals of the TSC.

Last year the TSC completed dozens of designs, studies, and analyses; performed Value Program studies; supported safety, program management, financial management, and strategic vision efforts; developed control and computer software; authored numerous publications; and received national recognition. This report provides further details on these and other recent accomplishments.

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Introduction

Last year, the TSC completed dozens of designs, studies, and analyses; performed Value Program studies; supported safety, program management, financial management, and strategic vision efforts; developed control and computer software; authored numerous publications; and received national recognition. Highlights of some of these projects are briefly described in the following sections.

Engineering and Construction

Our engineering expertise is respected and used worldwide. Our engineering designs, studies, and analyses support construction and operation and maintenance (O&M) of Reclamation's dams, canals, powerplants, and other facilities. Highlights include:

- **Drop 2 Reservoir Project.** The TSC completed designs for the canals and structures portion. The concrete lined canal is 7.5 miles, with a capacity of 1800 cfs and boasts several large structures, a pipe crossing under Interstate 10, and an 8,000 cfs reservoir. (86-68312, 86-68140)

- **Leadville Mine Drainage Tunnel.** The Water Conveyance Group assisted in the by providing analysis for the tunnels and by lending assistance to design of the pump discharge line. (86-68140)

- **Engineering and O&M Guidelines for Crossings - Bureau of Reclamation Water Conveyance Facilities (Canals, Pipelines, and Similar Facilities)**. These are general guidelines for Reclamation to follow when reviewing the engineering and O&M factors in outside entity requests for authorization to cross (encroach upon) Reclamation lands <http://intra.usbr.gov/~tsc/guidance/design/crossingguide.pdf>. (86-68140)

- **Eagle Canyon Pipeline.** This pipeline is part of the Battle Creek Salmon and Steelhead Restoration Project in northern California. This project replaces a portion of the unlined Eagle Canyon Canal with HDPE pipe, designed to be leak proof to prevent waterborne pathogens from reaching the nearby Mt. Lassen Trout Farm. (86-68140)

- **Shasta Dam Raise Feasibility Study.** The TSC designed two Union Pacific Railroad bridges, a spillway bridge, and roadwork requirements at the right wing dam. (86-68140)

The TSC also provided electrical design technical oversight for design and/or construction for many projects, including:

- Durango Pumping Plant and Ridges Basin Dam
- Savage Rapids, Bear Creek, and Chiloquin Pumping Plants
- Generator rewind and excitation system replacement at Shasta Powerplant
- Shasta Switchyard modification
- Replacement of power transformers at Grand Coulee
- Hungry Horse unit protection upgrades
- Installation of digital excitation systems at the Estes and Flatiron Powerplants (Colorado Big Thompson Project). 86-68430

Research, Analyses, and Studies Expertise

The TSC offers a wide range of research and analyses, tailored to each project and study, to solve Reclamation's water resource challenges. TSC experts published peer reviewed articles, technical reports, and PhD. dissertations. Highlights include:

- **Quagga mussel research and response.** The TSC has worked closely with the S&T Program, the Office of Program and Policy Services, the Washington office, and regional and area offices to guide Reclamation's response to the recent quagga mussel invasion in the Western States. Research activities are focusing on early detection and control. The TSC is evaluating existing information to help guide decisions on future research and appropriate facility responses. (86-68210)

- **Desalination Research.** The TSC continues to lead Reclamation's activities in desalination research. Research conducted and/or coordinated by the TSC led to at least a dozen research reports being added to Reclamation's desalination research website. Several final reports were also completed for the Water Reuse Foundation. (86-68211)

- **Sacramento/San Joaquin Delta Fish Studies.** The TSC completed 4 fish life history reports for California Dept. of Water resources related to the propose salinity gate project in the Sacramento/San Joaquin Delta, California. (86-68290)

- **Yakima River Basin Water Storage Feasibility Study Draft Planning Report/EIS.** The TSC's multidisplinary analysis included economics, T&E species, cost estimating, noise, air quality, climate change analyses, writing/editing. (86-68270)

- **Odessa Subarea Special Studies.** The TSC provided designs, cost estimates, writing/editing.

- **Tracy Abandoned Intake Channel Project.** Completed the Draft NEPA Compliance document. (86-68290).

- **Long Lake Valley Offsite Storage Project.** Completed the wetland delineation at Agency Lake. (86-68290).

Fisheries studies included:

- A test site to evaluate the effects of cathodic protection on young salmonids

- A motion sensing video fish monitoring system in the Malad River fish ladder window for Idaho Power Company

- An evaluation plan and test system for a non-physical fish barrier study

- The Dual Frequency Identification Sonar (DIDSON) imaging project for endangered Pallid Sturgeon on the Upper Missouri River, Montana

- Tracy Fish Collection Studies (86-68290)

Avian studies included:

- The first year of Yellow-billed Cuckoo surveys on the middle Rio Grande, New Mexico.

- The Willow Flycatcher habitat model, which ties vegetation classes, distance to water, and other suitable factors into predicting (86-68290)

Dam Safety

The TSC helps Reclamation to ensure dam safety by performing inspections for safety deficiencies, analyses that use current technologies and designs, and corrective actions if needed based on current engineering practices. Highlights include:

- **Hungry Horse Dam Structural Analysis.** The TSC recently completed the most sophisticated structural analysis undertaken to date on Hungry Horse Dam to better understand the relative movement of the dam and potentially unstable foundation blocks under earthquake loadings. The TSC completed a refined risk analysis based on a 3-dimensional finite element analysis of the dam and the discontinuities in the foundation. This analysis identified a lower level of risk at which expensive modifications were not warranted. The Consultant Review Board complimented our state-of-the-art analysis and agreed with the conclusions. (86-8110)

- **Research into the Interaction of Soils and Structures.** During a seismic event, soil pressures on concrete side walls in embankment dams can increase and cause possible deformation or collapse of the walls. Once this occurs, a large portion of the soil embankment can be exposed to the potentially erosive action of water flowing through the spillway. Since the spillway is normally located in line with the dam core, the erosive action could erode the dam core leading potentially to a substantial dam failure. In FY08, The TSC used 2-D finite element analysis to better model the behavior of soil pressures on walls during a seismic event. Further research will concentrate on evaluating 3-D models to better understand the 3-D effects and possibly reduce the pressures on the walls. (86-8110)

- **Seismic Evaluation of Major Plants.** In August 2008, TSC engineers in the Building Seismic Safety Program completed the seismic evaluation of the structural and nonstructural systems at the C.W. "Bill" Jones (Tracy) Pumping Plant. A three dimensional finite element model with an earthquake time history loading was used to more accurately predict the behavior of the structure during a significant earthquake. Using state-of-the-practice analytical tools and techniques, the analysis of the plant identified no structural deficiencies. (86-8110)

- **Truckee Canal.** The TSC analyzed risks at the Truckee Canal. Analyses included forensic chemical grouting and water conveyance. Forensic chemical grouting near the area of the Truckee Canal breach helped determine the locations of various voids in the existing canal. (86-8180, 86-68140) The chemical grout worked very well in intercepting, filling, and showing the location of various voids. The voids were well casted,

revealing numerous tunnels and dens, and old deteriorated vegetation roots were also filled with grout. This was so effective that even the small root hairs and nodules were also filled with grout. Grout was observed throughout the area to the depth of injection. (86-68170)

Grouting Truckee Canal. The white areas are chemical grout filled voids that are suspected rodent burrows.

- **Folsom Dam Phase II Safety of Dams Modifications.** The TSC completed conceptual designs and drawings for a 0.4 mile long, by 40-foot wide haul road to facilitate excavation of the auxiliary spillway , relocating approximately 1,300 feet of the Natoma Pipeline, and redirecting surface drainage on the south side of the auxiliary spillway excavation. (86-68140)

Operations and Maintenance

The TSC helps Reclamation operate and maintain projects to ensure deliveries of water and power consistent with environmental and other requirements, and to honor state water rights, interstate compacts, and contracts with Reclamation's users. Highlights include:

- **Ditchrider's Handbook.** Under the Canals in Urbanized Areas Program, the TSC has produced a draft Ditchrider's Handbook, instructing ditchriders on safe canal operations as well as the signs that could indicate

that a canal may be in distress. The Water Conveyance Group is also working on a separate training module to accompany the Ditchrider's Handbook. (86-68140)

Supervisory Control and Data Acquisition Systems include:

- **Brackish Water National Desalination Facility**. The TSC designed, installed, and performed functional testing of the Supervisory Control and Data Acquisition (SCADA) and administrative networks and implemented security requirements for the networks.

- **Eastern Colorado Area Office SCADA and administrative networks**. The TSC has completed the design and is installing and testing a fiber optic system for as well as telephone systems between all their powerplants. (86-68440)

Powerplant Operation and Maintenance activities include:

- **Testing digital governors, excitation systems, and realignment tests.** The TSC initiates and records tests of every feature of the equipment (discovering and solving problems in over two-thirds of all systems tested), works with the vendors to improve their digital algorithms, and applies test signals to obtain signatures for power system simulations as required by the North American Electric Reliability Corporation and the Western Electricity Coordinating Council. These efforts help ensure that Reclamation, as a major participant in the Western power grid, does not contribute to or cause electric power system disturbances which may result in costly power system blackouts/outages. (86-68440)

- **Protective relays.** The TSC up is redesigning parts of the control and installing new protective relays at Hungry Horse Dam. This work involves updating and as-building protection schematics and equipment wiring diagrams throughout the powerplant and revising these prints to incorporate the new protective relaying package. (86 68440)

- **Winding failures.** The TSC assisted field office personnel with the diagnosis and testing of winding failures Flatiron G1 and Glen Canyon PowerPlant.

Training

The Technical Service Center offers a wide variety of training, and classes in FY)8 included:

- **Hydropower.** Training and lecture services to Reclamation, Western Area Power Administration, and the Corps of Engineers included: synchronous machines, excitation systems, automatic generation control, governors, personal protective grounding, arc flash, infrared scanning and analysis, etc. (86-68440)

- **Safety Evaluation and Visual Inspection of Existing Dams—International Technical Seminar and Study Tour** (September 15–25 2008). Trains personnel responsible for dam safety to incorporate the lessons of the past and conform to the most advanced technical state-of-the-art. Provides professional personnel with a comprehensive guide to establishing or enhancing a visual inspection/evaluation program and increase the technical capabilities of those responsible for safety evaluations.

- **Water measurement and canal operations workshops**. The Hydraulic Laboratory offers courses, including:

    - Basic Principles and Developments in Flow Measurement (January 15–17, 2008)

    - Modern Methods in Canal Operation and Control (January 28–February 1, 2008)

- **Earth School** (February 2008)**.** A three-day course features instructions and hands-on training in visual identification of soils using the Unified Soils Classification System, laboratory and field soils testing methods, geologic logging, and common earthwork construction testing methods.

Tim Gonzales and Lalena Weasel at Earth School, February 2008.

- **Introduction to Visual Classification of Soils** (February 2008). Lectures are primarily on soil classification characteristics, with some logging and sample preparation discussion. The afternoons are spent in hands-on training.

Safety

Safety continues to be a high priority for the TSC. Actions TSC took to improve safety for TSC and other Reclamation employees include:

- **Arc flash potential.** Arc flashes are releases of concentrated electrical energy from an arcing fault. The TSC calculated the arc flash potential of the electrical equipment at specific powerplants. To comply with National Fire Protection Association, Inc. (NFPA) "Standard for Electrical Safety in the Workplace", NFPA 70E, arc-flash studies including required calculations were performed and completed for Grand Coulee Powerplants and Switchyards, Eastern Colorado Area Office Powerplants, Black Canyon Powerplant, and Snake Creek Pumping Plant. (86-68440) An increased vigilance is required for the safety of employees when working in close proximity to energized electrical equipment. Approximately 80 percent of electrical injuries are the result of arc flash. Standards and practices require flash protection boundaries for all electrical equipment in a switchyard or facility be identified and labeled. (86-68440)

Collaboration and Partnership

The TSC works with other Reclamation offices; other Federal, State, tribal, and local governments; universities; non-governmental organizations; and others to provide excellent technical analyses and reports. Some of these collaborative projects in FY08 were:

- **Seismic Rehabilitation Designs of the Provo Area Office.** The TSC completed a significant seismic rehabilitation design of the Provo Area Office as part of the Building Seismic Safety Program (BSSP). Previous seismic evaluations concluded that this 57,000 square foot building, which is staffed with 170 full time Reclamation employees, could present a significant life safety risk under a design level earthquake. TSC teamed up with Provo Area Office engineering personnel to develop a comprehensive rehabilitation design using sate-of-the-art analyses and earthquake mitigation technologies. (86-8110)

- **Brackish Groundwater National Desalination Research Facility in Alamogordo, New Mexico.** The TSC worked with the New Mexico State University to test pilot plants and fund projects of national interest at that facility..

- **Truckee River Operating Agreement.** TSC technical assistance to the Department of the Interior, Department of Justice, and the States of California and Nevada has culminated in the signing of the Truckee River Operating Agreement September 6, 2008. TROA will modify the operations of Federal and private reservoirs on the Truckee River upstream of Reno, Nevada, enhancing the flexibility and coordination of those operations while ensuring existing water rights are served and flood control and dam safety requirements are met.

  The agreement has been 18 years in the making and is the keystone of the Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990. TSC staff was involved from 1991 to 2008 in completing the EIS/EIR and water storage contract negotiations. TSC involvement in consisted of work in hydrology, water quality, recreation, economic and social analyses, cultural resources, sedimentation, Indian trust resources, and writing/editing. TSC staff provided exceptional technical assistance and support to bring these TROA efforts to completion. TSC efforts include responding to voluminous comments on the Final EIS/EIR, rewriting portions of the Final EIS/EIR sections, and being a team members and players on the TROA Storage Contract negotiations. (86-68270)

- **Wadi Arab Dam EAP and Tabletop Exercise, North Shuna, Jordan.** TSC staff worked with the Jordanian counterparts to draft an Emergency Action Plan at the Wadi Arab Dam. This dam has the highest population at risk (approximately 12,000 located within 3 kilometers from the dam) in the entire Kingdom of Jordan. Until this project was completed, there were no EAPs in existence in Jordan. The EAP was drafted and exercised in May of 2008. The project is complete, and the EAPs have been distributed. The Jordan Valley Authority will use the EAP developed by Reclamation for Wadi Arab Dam as a guide for the remainder of their dams in Jordan. A personal letter of appreciation was received by Patrick Wanker from the Ministry of Water and Irrigations Secretary General thanking him for helping to establish the Kingdom of Jordan's first Dam Safety Program. (86-68250)

- **Grand Coulee and North Dams Functional Exercise.** TSC participated in the first joint exercise between BC Hydro (Canada) and Grand Coulee Dam in March 2008. The exercise posed a problem at a dam on the Canadian side of the Columbia River that would impact not only Grand Coulee Dam but all dams along the Columbia River all the way to the

Pacific Ocean. As a result, a formalized method has been developed to track communications between the United States and Canada. (86-68250)

Recognition

Reclamation's Engineer of the Year Award winner is Dr. John England of the Technical Service Center, Flood Hydrology and Meteorology Group (86-68250). John has pioneered the research, development and application of new techniques to estimate extreme flood probabilities for dam safety, and he has overseen their use in Reclamation's risk analysis procedures.

Manuals and Publications

Ahlers, D., Reed,G. and Siegle R., A long-term Assessment of Livestock Impacts on Riparian Vegetation Elephany Butte Project Lands. Technical Memorandum, U.S. Department of the Interior Bureau of Reclamation Technical Service Center, Denver, Colorado, 67pp.+ appendices.

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Lemmasson B.H., Haefner J.W.and Bowen M.D. The Effect of Avoidance Behavior on Predicting Fish Passage Rates through Water Diversion Structures. 2008, Ecological Modeling Volume 08, 11pp.

Moore, S.D., and D. Ahlers, 2007 Southwestern Willow Flycatcher Study Results - Selected Sites Along the Rio Grande From Velarde to Elephant Butte Reservoir, New Mexico, U.S. Department of the Interior - Bureau of Reclamation, Denver, Colorado, and Albuquerque Area Office, New Mexico, 89 pp.

Portz, D.E. Ph.D. Dissertation - 2007. Fish-holding-associated Stress in Sacramento River Chinook Salmon (Oncorhynchus tshawytscha) at South Delta Fish Salvage Operations: Effects on Plasma Constituents, Swimming Performance, and Predator Avoidance. Doctoral Dissertation, University of California, Davis.

Ryan, S., Moore, D. and R. Siegle, 2007. Results of Brown-Headed Cowbird Control Program Monitoring 1999-2006 – Final Report Alamo Lake State Wildlife Area and Bill Williams River National Wildlife Refuge, Arizona, Technical Report, U. S. Bureau of Reclamation, Lower Colorado Regional Office, Boulder City, Nevada, and Technical Service Center, Denver, Colorado, 53 pp.

Moore S.D. Preble's Meadow Jumping Mouse Survey, 2008. Technical Memorandum No. 86-68290, U.S. Department of the Interior Bureau of Reclamation, Eastern Colorado Area Office , Loveland Colorado, 34 pages

Sutphin, Z.A., Bridges, B.B., Baskerville-Bridges, B. and R.C.Reyes, 2007. Evaluation of Current and Historical 10-Minute-Count Screens at The Tracy Fish Collection Facility, Tracy, California, , Tracy Fish Collection Facility Studies, Volume 31, U.S. Bureau of Reclamation, Mid Pacific Region and Denver Technical Service Center, 45 pp..

Sutton, R., 2007. McKay Creek Fish Habitat Asessment, 2008, Technical Memorandum No. 86-68290-08-0 1, U.S. Department of the Interior Bureau of Reclamation, Lower Colombia Area Office, Portland, Oregon 83pp.

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Tracy Series Reports

Volume 34 - Sutphin, Zak, 2008. High Pressure Injection of a Photonic Marking Agent: Mark Retention and Effects on Survival in Juvenile Striped Bass, Morone saxatilis, and Adult Delta Smelt, Hypomesus transpacificus, Tracy Fish Collection Facility Studies, Volume 34, U.S. Bureau of Reclamation, Mid Pacific Region and Denver Technical Service Center.

Volume 38 - Wang, J.C.S, 2007. Spawning, Early Life Stages, and Early Life Histories of the Osmerids Found in the Sacramento-San Joaquin Delta of California, Tracy Fish Collection Facility Studies, Volume 38, U.S. Bureau of Reclamation, Mid Pacific Region and Denver Technical Service Center.

Volume 39 - Karp, C., and J. Lyons. 2008, Evaluation of Fish Holding at the Tracy Fish Collection Facility, Tracy, California, Tracy Fish Collection Facility Studies, Volume 39, U.S. Bureau of Reclamation, Mid Pacific Region and Denver Technical Service Center.

Volume 40 - DeMoyer, C., 2007. Hydraulic Performance Evaluation of the Replacement Primary Bypass Intakes and Transition Boxes at Tracy Fish Collection Facility, Tracy Fish Collection Facility Studies, Volume 40, U.S. Bureau of Reclamation, Mid Pacific Region and Denver Technical Service Center. (86-68290)