RECLAMATION *Managing Water in the West*

June 2012
Research and
Development Office
Newsletter 2012–02

The Knowledge Stream

Technology Transfer Issue

"The first step in winning the future is encouraging American innovation. None of us can predict with certainty what the next big industry will be or where the new jobs will come from. Thirty years ago, we couldn't know that something called the Internet would lead to an economic revolution. What we can do—what America does better than anyone else—is spark the creativity and imagination of our people."
Strategy for American Innovation, 2011

www.whitehouse.gov/administration/eop/nec

Research Director's Message

This edition of the Knowledge Stream focuses on technology transfer (T^2), moving research discoveries into public and commercial use. In the President's October 28, 2011 memo, *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*, all Federal agencies are asked to increase their emphasis on innovation and on sharing their inventions and technology with the public and industry. This aims to strengthen our nation and its economy by taking greater advantage of the fruits of Federal research. In this edition, we highlight how new inventions and technologies developed by Reclamation scientists—with taxpayer funds—are made available for broad use by the public and U.S. industry. The technology transfer process can be as simple as publishing papers about our new technologies or as complex as patenting the technology and negotiating agreements and licenses with industry to commercialize and market the invention.

Innovation can take many forms, however. Every day, Reclamation employees find innovative ways to meet the challenges of providing water and power to a growing population in the West—ways of doing our jobs better, faster, and cheaper. Not all of these innovations may require patents, but all are still important to improving the way we do business. The Research Office recently conducted a Reclamation-wide "crowd-sourcing" event, the *2012 Reclamation Research Jam*, to tap more broadly into the innovative ideas of employees. We were pleased and surprised with the number of staff who shared ideas or identified issues that might become a focus of research.
See page 5 to find out more of what we heard.

Many of the problems and issues identified during the Research Jam are potential targets for research proposals as part of our FY2013 Science and Technology Program call for proposals to all Reclamation employees. See page 4 for this important part of our Research and Development Program.

Research and Development Office Director Curt Brown presents Tim Randle with the "People's Choice Award" for his top-vote getting idea to study sediment impacts in reservoirs. *See page 5.*

U.S. Department of the Interior
Bureau of Reclamation

The newsletter is available at
www.usbr.gov/research/docs/ks-2012-2.pdf
To subscribe via email, contact us at
research@usbr.gov

Print Options and Instructions

This document is designed to be read either electronically via PDF or printed in color or black and white. Please forward it to your colleagues and friends.

You have three options for printing parts or all of this document:

1. Print individual research updates on one sheet of paper by printing double-sided for the two-page updates.

2. Print the whole document double-sided, corner stapled on 8.5” x 11” paper.

3. For magazine-style, instruct your print professional to print the document double-sided, head-to-head, saddle-stitched on 17” x 11” paper.

Your suggestions for improvements are always welcome.
Please email them to jakervik@usbr.gov.

Thanks.

Jake Akervik,
Communication and Information Systems Coordinator, Research and Development Office

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Annual Call for Proposals

Review and Selection Process

April – June

Reclamation researchers submitted pre-proposals for FY2013 on May 2. Full proposals are due June 28.

July – August

Reclamation offices review proposals for their relevance to our overall mission and current priorities.

Technical experts outside of Reclamation, such as private-sector and non-profit subject matter experts and university scientists, also review proposals. This review focuses on technical soundness, contribution to the field of investigation, and the reasonableness of the budget.

September

Members of the Science & Technical Committee from various disciplines across Reclamation meet over four days to review all proposals in concert with the relevancy and technical reviews to make funding decisions. Some proposals are fully funded immediately, while others may be conditionally funded (i.e., they must first be revised to address an identified weakness or an administrative requirement).

Research Proposal Contact

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Science and Technology Program's Annual Call for Proposals

Any Reclamation employee who sees a technical problem or challenge that could be addressed through research and development is invited to submit a proposal to the Science and Technology Program. A memorandum calling for proposals was issued on April 19, 2012, and is available at: www.usbr.gov/research/science-and-tech/proposals/callmemo.

Last year, we received 158 proposals from throughout Reclamation, and 111 proposals were funded for a total of $8.8 million. Our aim is to fund research proposals that will best provide the tools and solutions Reclamation needs to effectively manage water and power in the Western United States. See the sidebar for the proposal process.

Research to address Reclamation mission challenges is divided into four broad areas.

- **Water Operations Decision Support:** Develop solutions and tools that help Reclamation water managers make effective reservoir and river system operational and planning decisions through better integration, evaluation, understanding, and presentation of critical data and information.
- **Environmental Issues in Water Delivery and Management:** Improve the reliability of Reclamation water deliveries by producing effective solutions, tools, and practices that Reclamation water managers can use to prevent water conflicts with the environmental demands on water supplies.
- **Water and Power Infrastructure Reliability:** Improve the reliability of Reclamation water storage, water delivery, and hydropower facilities by producing or advancing effective solutions, tools, and practices that Reclamation facility managers can use to cost effectively maintain, modernize, and extend the life of Reclamation's aging infrastructure.
- **Conserving or Expanding Water Supplies:** Enhance water supplies for Reclamation stakeholders with new technologies, solutions, and practices that expand, liberate, or conserve water supplies.

Within these areas, four high-priority topics are currently receiving added attention:

- **Climate Change and Variability**
- **Mitigating the Impact of Invasive Mussels on Water and Power Operations**
- **Using Advanced Water Treatment Technology to Stretch Water Supplies**
- **Expanding the Generation of Renewable Energy**

2012 Inaugural Research Jam

An Online Crowdsourcing Event to Gather Innovative Ideas

Each year, the Science and Technology (S&T) Program sends a call to all Reclamation employees to submit research proposals that can help Reclamation more effectively manage water and power. Hundreds of proposals are submitted each year. However, we have been concerned that many staff may be aware of problems or challenges that could be addressed through research, but they don't have time or the technical background to develop a research proposal. We wanted to provide these people an easy way to identify issues or ideas to our office without needing to submit a full proposal.

To meet this goal, the S&T Program executed a "Reclamation Research Jam 2012" to facilitate involvement and innovation from all Reclamation employees. From Monday, February 6, though Friday, February 17, 2012 all Reclamation employees were given access to a web site where they could quickly and simply submit ideas, could view other's suggestions, and could vote and comment on all ideas. The process used the same IdeaScale web service recently used by the White House to gather thousands of cost-saving ideas from Federal employees.

The online "jam" concept was popularized by IBM starting in 2001. IBM realizes that employees are their most valuable resource for ideas, and ideas often lead to innovation, research and development, and patents—in other words, solutions for making things better, faster, and cheaper. So, every so often, IBM gets some of their 300,000+ employees together to "jam"—or share ideas. This approach has helped IBM lead the world in patents for a record 19 years in a row as of January 2012.

We have started working with the submitters of the top five vote-getting ideas (listed below) to help move their ideas forward. Examining ways to address sedimentation in our reservoirs was the most popular idea, with 32 votes. This idea, submitted by Tim Randle, received the "People's Choice Award" trophy (photo page 1).

Post-Jam Category	Idea	Votes
Sustainability	Reservoir Sedimentation and Sustainable Reservoirs	32
Hydropower	Overhaul Procurement Processes for Power-Generating Facilities	31
Business Intelligence	Data Stewardship in Reclamation	26
Business Intelligence	Get a Handle on all that Data and Build a Knowledge-Base	25
Business Intelligence	Web Services for Reclamation Hydrologic Data (tied for 5th)	22
Sustainability	Green Cement (tied for 5th)	22

We are working with others in Reclamation to pursue the remaining ideas. Ideas that fall outside the scope of research and development are being shared with the appropriate Reclamation offices. All the ideas will also be published as part of the upcoming S&T Call for Proposals so that researchers can consider them as possible targets for their own proposal. Where research or tools already exist to address the submitted issue, we are providing that information back to participants.

"Innovation is simple: pursue solutions that are better, faster, and cheaper than before—whether it is something new, something old that is new again, or just something new to you or your organization. Research and science are catalysts for new ideas and positive risks, which are crucial to encouraging innovation and innovative culture."
Jake Akervik, Communication and Information Systems Coordinator

Jam by the Numbers:

- **1 trophy**
- **98 ideas**
- **161 comments**
- **805 votes**
- **353 participants**
- **All 5 Reclamation regions participated, including Washington, D.C., and Denver, Colorado**

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TECHNOLOGY T^2 TRANSFER

The President's Directive

"Innovation fuels economic growth, creation of new industries, companies, jobs, products and services, and the global competitiveness of U.S. industries. One driver of successful innovation is technology transfer, in which the private sector adapts Federal research for use in the marketplace. One of the goals of the "Startup America" initiative, which supports high growth entrepreneurship, is to foster innovation by increasing the rate of technology transfer and the economic and societal impact from Federal research and development (R&D) investments."

Presidential Memo, October 28, 2011

More Information

Start Up America
www.whitehouse.gov/economy/business/startup-america

Streamlining Our Technology Transfer Process

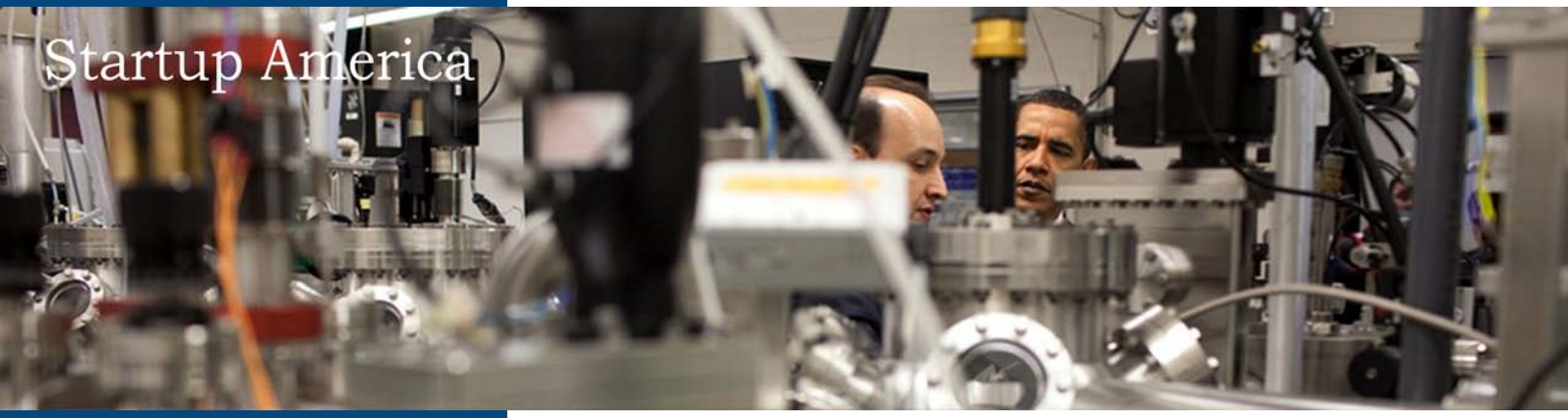
President Obama has directed all Federal agencies to make greater efforts to move the results of Federal research into the marketplace and to put innovative ideas to work in the hands of agencies, the public, and American industry. The President's memo on October 28, 2011, *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*, stresses the importance of innovation and how the government, the American people, and businesses can work together to sustain long-term economic growth and national competitiveness. See the memo at www.whitehouse.gov/the-press-office/2011/10/28/presidential-memorandum-accelerating-technology-transfer-and-commerciali.

This memo calls for agencies that conduct research and development to improve the results from their technology transfer (T^2) and commercialization activities. The Department of the Interior (Department) has submitted a five-year plan to streamline our licensing and other T^2 and commercialization procedures.

The Department is updating its general policy and procedures for T^2 that apply to all bureaus. The Department, U.S. Geological Survey, and Reclamation's Research and Development Office are the core Department team developing T^2 policy and procedures. The goal is to finalize T^2 policy and procedures by 2013. Reclamation is currently drafting our own guidelines in parallel with the new Departmental policy.

As part of this effort, the Department has delegated authority for signing T^2 agreements to Bureau Directors. This allows them to negotiate licenses and other agreements related to intellectual property and enter into Cooperative Research and Development Agreements (CRADA) with non-Federal entities. This authority may also be re-delegated, where appropriate, to the "lowest levels in the organization to better address issues and strengthen communications."

Reclamation is also engaging partners, including universities, industry consortia, economic development entities, and State and local governments. These local and regional partnerships can enhance successful technology innovation networks and facilitate commercialization.



The Goal of Technology Transfer

Getting Research Results to Users

Technology transfer (T^2) is the process of moving ideas, inventions, or technologies developed with taxpayer dollars into the broadest productive use by or for the American public. Successful T^2 ensures that the development of Federal technologies provides economic, environmental, and social benefits that can make the U.S. more competitive in world markets. Federal agencies that perform research, development, or engineering work must seek to enhance public and industry awareness, adoption, and use of their technologies. Under these authorities, Federal employees who perform or manage research, development, or engineering work are responsible for making T^2 happen.

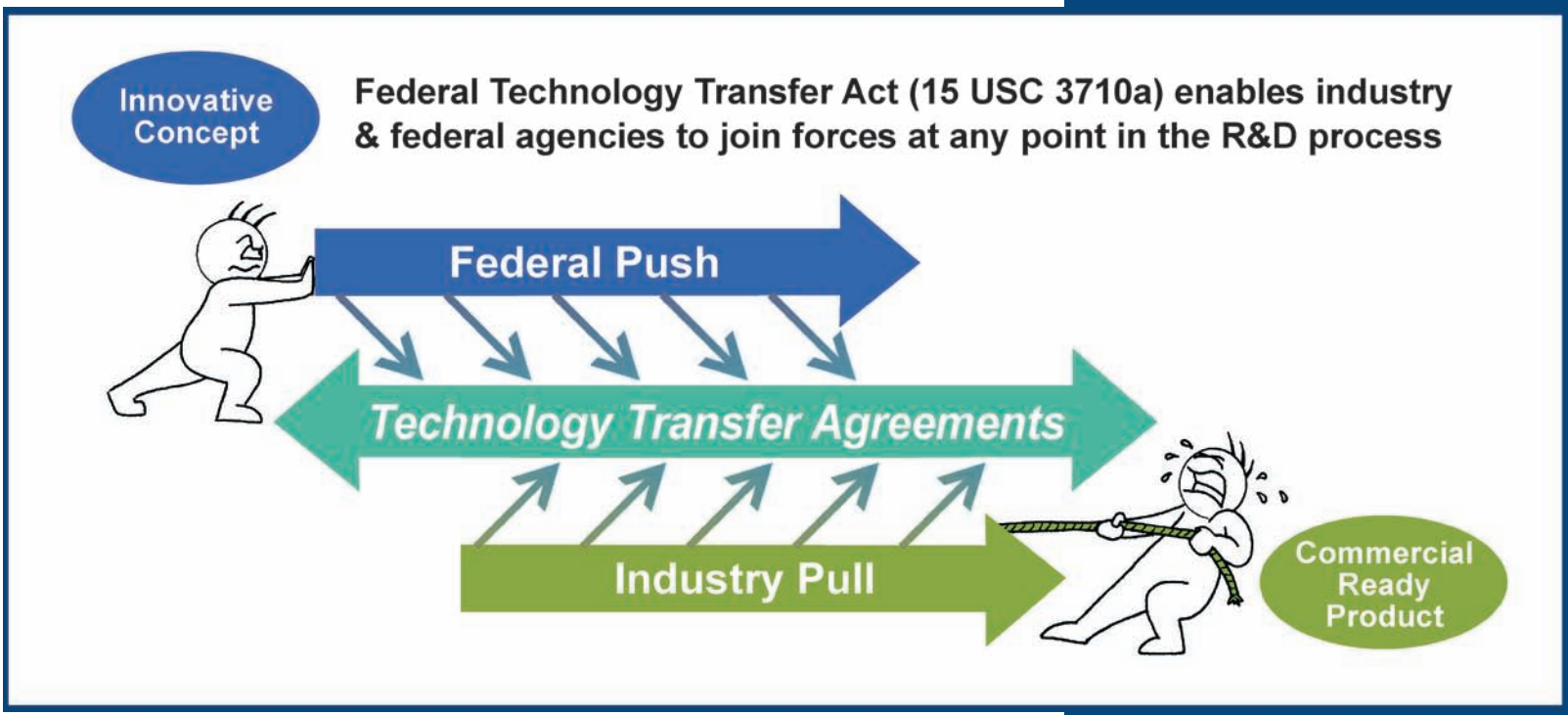
Winning with Technology Transfer

Federal T^2 legislation authorizes Federal agencies, the private sector, and other non-Federal entities to work together in developing innovations that can be broadly used. T^2 creates many "win-win" situations:

- Reclamation and private and non-Federal collaborators win because T^2 helps us combine research resources and capabilities.
- Reclamation inventors win because their inventions can more easily be commercialized to help solve a problem and make a wide impact on the public. Inventors can receive monetary rewards authorized under the Federal Technology Transfer Act from patented and licensed technologies.
- The public wins because new inventions, products, or services are made to help improve their health, environment, and quality of life.

Reclamation's T^2 objective is to make sure the American public and non-Federal entities have access to Reclamation research, talent, facilities, and technologies. The intent is to make sure that publically funded advancements in technology have the broadest positive impact on the public and U.S. economic competiveness.

More Information
Reclamation's Technology Transfer site: www.usbr.gov/research/tech-transfer



What is Technology Transfer?

"Our free enterprise system is what drives innovation. But because it's not always profitable for companies to invest in basic research, throughout our history, our government has provided cutting-edge scientists and inventors with the support that they need. That's what planted the seeds for the Internet. That's what helped make possible things like computer chips and GPS. Just think of all the good jobs—from manufacturing to retail—that have come from these breakthroughs."
2012 State of the Union Address

Installing flow deflectors at Choke Canyon Dam is just one way Reclamation's Research and Development Program has put basic research into action. See the featured patent on page 13.

Defining Technology Transfer Terms

Technology transfer (T^2) includes a range of activities designed to disseminate scientific and technical information and knowledge from within Reclamation to the public and industry. The technology transfer laws provide a legal foundation for many kinds of collaborations between Federal agencies, universities, industry, and other organizations.

This issue of the Knowledge Stream describes many of Reclamation's T^2 activities and uses several terms specific to T^2 laws and processes:

- **Invention.** Synonymous with discovery or technology. Any art, process, machine, manufacture, design, or composition of matter, or any new and useful or unique improvement thereof, or any variety of plants, whether or not patentable under the patent laws of the United States or any foreign country.

- **Intellectual Property.** Intellectual property refers to creations of the mind: inventions; literary, musical, and artistic works; and symbols, names, images, and designs used in commerce. Such creations may receive trademark, copyright, or patent protection.

- **Patent.** A property right granted by the Government of the United States of America to the patent owner to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States for a limited time (usually 20 years, but can be less) in exchange for public disclosure of the invention when the patent is granted.

- **Federal Laboratory.** In accordance with 15 USC3710a(d)(2), a "Federal laboratory" is defined as a facility or a group of facilities owned, leased or otherwise used by a Federal agency, a substantial purpose of which is the performance of research, development, or engineering by employees of the Federal Government. See page 16 for a description of Reclamation's "living laboratories" and research laboratory facilities.

Publicize and Communicate

For many Reclamation discoveries, immediate publication is the most appropriate way to transfer these technological advances for Reclamation, government, industry and public to use. Reclamation presents results through many avenues, including journal articles, press releases, technology updates, conferences, and workshops. See page 11 for some recent examples of publicizing and communicating our results.

We also provide training and hold workshops to share Reclamation advances as well as other innovations. For example, our workshops for Reclamation and industry advances in radio-telemetered control and monitoring systems technologies for irrigation districts greatly helped districts understand technologies to put them into practice. Mike Delka, Manager, Bostwick Irrigation District, Nebraska, reported: " . . .the most important aspect of the workshop was to provide an exposure that was unavailable anywhere else. That exposure gave a basic understanding and comfort level with which we could go forward."

Protect and Partner

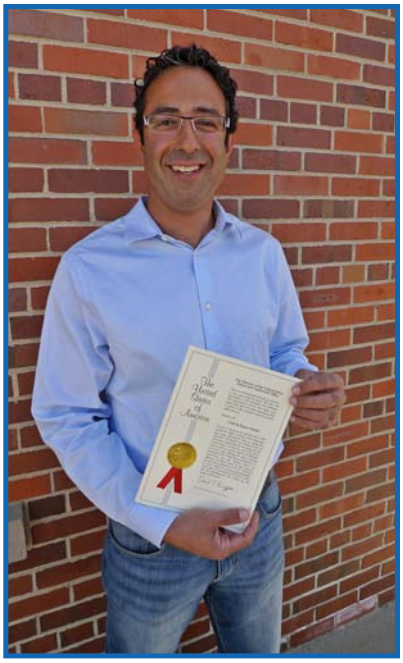
Sometimes, significant investment is needed from non-Federal entities to mature, mass produce, service, or market Federal inventions and technology. In these situations, protecting, patenting, and licensing Reclamation's technologies may be necessary in order to attract and protect any investments made by industry to develop a commercial product. Legal protection then provides incentives for industry to work with Reclamation and to invest their resources in manufacturing and marketing a commercial product. See page 12 for examples of technology transfer through protecting and partnering.

Patents

A patent allows the patent owner to control the rights to the technology through licensing and other agreements for the life of the patent, which is about 17–20 years. The patent for a new cellulose acetate membrane is an example of one of Reclamation's patents that not only has implications for water treatment, but for many other processes as well (sidebar). See pages 12 and 13 for our list of patents.

Licenses

A license is an agreement between the patent owner and another party interested in using or selling the patented technology. Through a license, the Federal government can grant a non-Federal entity the right to make, use, and sell the patented technology. In return for this right, the licensees are usually required to provide a reasonable fee to the government. Licensees must demonstrate they have the financial and other resource capabilities to achieve the commercialization objectives of the license. See page 15 for examples of technology transfer through licensing.



Saied Delagah holding the patent for the new cellulose acetate membrane. Robert Riley and Andrew Murphy (other inventors) are not shown.

Other Types of Technology Transfer Agreements

Other research agreements authorized under the Federal Technology Transfer Act, 15 USC 3710 (a), can be used to collaborate with non-Federal entities:

Cooperative Research and Development Agreements (CRADA). Under CRADAs, non-Federal cooperating entities can seek to further develop and commercialize Reclamation's technology, merge Reclamation's technology with the non-Federal entity's technology, or jointly discover and develop a new technology. CRADAs provide the collaborator the first right to negotiate an exclusive license to inventions made under a CRADA and provide confidentiality for information generated under a CRADA for up to five years. The collaborator can provide the resources (funds, personnel, equipment, or materials) for developing and commercializing a new product, process, or service. Reclamation can provide similar resources or other in-kind resources, but can't provide funding. Reclamation will enter into a CRADA when the objective relates to its mission in water and power deliveries. See page 14 for examples of technology transfer through CRADAs.

Featured Patent:

New Generation Membrane

(U.S. Patent No. 8,123,9455)

Reverse osmosis cellulose acetate membranes in reverse osmosis desalination plants to remove salt and purify water. Food and beverages, pharmaceuticals, medical uses, and chemical products also use these membranes.

However, due to impurities in the membrane that result from existing manufacturing processes, cellulose acetate membranes allow more salt passage and require higher pressure than other types of membranes. High operating pressures consume more energy and adequate salt removal can require additional treatment. These can both increase operating costs. Because of these limitations, cellulose acetate membranes are used in only 25 percent of reverse osmosis water desalination plants.

Reclamation and Separations Systems Technologies researchers have developed new cellulose acetate membranes that can remove three times more salt at lower operating pressures than existing cellulose acetate membranes. This new cellulose acetate membrane can be a drop-in replacement for existing membranes. Reclamation partnered with Techcomm (see page 17) to enter into a MTA with an industry partner to evaluate membrane performance.

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Featured CRADA

Recycle Lime Sludge into *"Green"* Concrete

Reclamation's Yuma Area Office recently entered into a CRADA with Envirock, Inc., to explore whether sludge from the Yuma Desalting Plant can be used in a new "green" concrete mix formulation. This collaboration may have a broad impact for the nation's water treatment industry by helping to reduce operating costs and improve sustainability. The "green" concrete mix is designed to incorporate industrial waste products into a concrete that is expected to be lighter and stronger than commercially available formulations.

Recycling these waste materials into a commercially marketable resource can reduce the volume of material that needs to be disposed. Reclamation maintains a system to dispose of this sludge, so if a process is developed to reuse it, the agency could avoid the costs of disposal, as well as future costs to expand or rehabilitate the disposal facilities.

The annualized capital savings could exceed $1 million per year. Reclamation has provided samples of sludge to Envirock, who is working on combining the sludge to develop suitably new, strong and durable "green" concrete formulations.

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Other Types of Technology Transfer Agreements (continued)

Facility Use Agreement (FUA) allows collaborators to use specialized Government facilities, equipment, and/or capabilities that are not readily available from the private sector. Reclamation has specialized facilities, which are described on page 16.

Material Transfer Agreement (MTA) allows for the exchange of a quantity of a unique material between Reclamation and another party for research or commercial testing. It does not transfer title to the material and, at the conclusion of time limited use, the material is either returned or destroyed. The MTA requires that the recipient abide by all applicable Federal standards, including those for handling biological, radiological, and other hazardous materials.

Transfer of Material Cooperative Research and Development Agreement (MTA-CRADA) allows Reclamation and its researchers to provide, receive, or exchange a quantity of unique material to a non-Federal party and exchange limited technical or scientific expertise to accomplish a mutual objective with or without reimbursement. Intellectual property may be anticipated. The collaboration must have a mission value to the Federal laboratory and some technical or commercial significance for the collaborator.

Research Agreements and Funding

FY 2011 Active Technology Transfer Agreements

Agreement	Total
CRADAs	**4**
MTA-CRADAs	**3**
MTAs	**2**
Patents	**17**
Patent Licenses	**5**

Total funding received from non-Federal entities through CRADAs, MTA-CRADAs, and patent licenses is about $872,900 as of calendar year January 2012.

Agreement	Total Partnership Contribution ($)
CRADAs	$768,000
MTA-CRADAs	$18,900
Patent Licenses	$86,000
Total	$872,900

Publicize and Communicate

Sharing Reclamation's Research

One T^2 approach is to make technology freely available via public dissemination. Reclamation shares our knowledge, technology, and expertise with the public and industry via publications, web postings, professional conferences, online social networking, and other forums.

Recent Conferences

New Energy, New Water Conference, December 2011. This conference, sponsored by Reclamation and the New Mexico Water Resources Research Institute, was held in Alamogordo, New Mexico. Experts from several continents attended, bringing attention to the important links between renewable energy sources and desalinating brackish ground water. Discussion groups focused on solar, geothermal, wind, and other renewable energy sources, water resources, infrastructure needs, as well as institutional and environmental impacts. See http://wrri.nmsu.edu/publish/dr/xxxv1.pdf

The Technical Workshop on Large Wood Applications and Research Needs in River Restoration, February 2012. This facilitated workshop was held in Seattle, Washington. Researchers focused on identifying large wood research and monitoring needs relevant to river restoration projects. Researchers developed lists of research needs, potential methods, and collaborations on the key topics of planning at a reach scale with a geomorphic context, designing at a local scale, and implementation and monitoring guidance.

Recent Research Bulletins

Our research bulletins synthesize available information in a particular research area or summarize a research product and are on our Web site at www.usbr.gov/research/science-and-tech/research/results. Recent bulletins include:

Using USGS LiDAR for Aquatic Habitat Mapping and Hydraulic Modeling: USGS LiDAR can measure channel depths to provide accurate representations of aquatic environments.

Power System Stability Improvements: Improving generator controller and power system performance through improved data analysis.

Evaluation of River-spanning Rock Ramp Performance and Evaluation of River-spanning Rock Weir Performance: Design guidelines will improve performance and reduce repairs and replacement costs.

Downscaled Climate and Hydrology Projections Website: New daily climate and Western U.S. hydrology projections are now available.

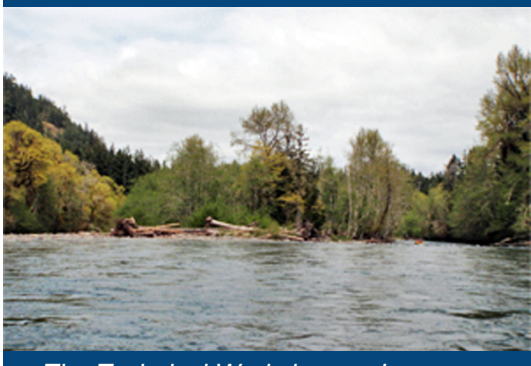
Desalination and Water Purification Research Program 2012 Awards: Facilitates partnerships to develop more effective, environmentally sensitive ways to increase water supplies.

Adding Materials to Concrete to Reduce Shrinkage Cracking: This new method can eliminate or reduce cracking in concrete.

"The New Water, New Energy Conference will bring researchers closer to providing people in remote locations reliable access to subsurface water resources now unavailable."
Sam Fernald, WRRI Director

"We want to get the word out that these are great ideas, so others will want to join in."
Kevin Price, Advanced Water Treatment Coordinator, Reclamation

New Energy, New Water Conference, December 2011, tours Reclamation's Brackish Groundwater National Desalination Research Facility



The Technical Workshop on Large Wood Applications and Research Needs in River Restoration, February 2012, held in Seattle, Washington.

Chlorine-Resistant Polyamide Membranes

Reverse osmosis polyamide membranes are used to desalinate and purify seawater, wastewater, and surface water. Chlorine helps prevent biofouling, but rapidly degrades polyamide membranes. Reclamation, Separations Systems Technologies, and University of Denver researchers have collaboratively developed a new group of chlorine-resistant polymers to create chlorine-resistant membranes. This new polyamide membrane chemical formulation increases the life of the membrane and can lower replacement costs. This new membrane can be made in existing manufacturing facilities and can be a drop-in replacement for existing membranes.

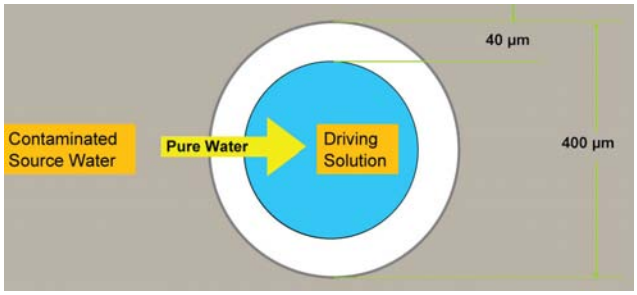
Several of the prototypes tested indicated superior chlorine resistance and transport properties equal to or better than traditional polyamide membranes. Reclamation upscaled and manufactured the new membrane and is now conducting long-term testing at several pilot water treatment facilities. Through the facilitation by TechComm, Reclamation has entered into a MTA with Dow Chemical Company to evaluate performance of the membrane. (U.S. Patent No. 7,806,275 and U.S. Patent Application No. 11/203,990).

Working with Reclamation's Patents and Patents Pending

Reclamation has these protected technologies available for further development or licensing:

Advanced Water Treatment

Forward Osmosis. Compared to reverse osmosis and other traditional forms of desalination, forward osmosis can significantly reduce the capital and energy costs of purifying water. Reclamation is engaged in collaborative research and development aimed at addressing the barriers to forward osmosis technologies. We have filed a patent for a driving solute and have made significant progress developing a two-stage process that removes and recycles the driving solute back to the forward osmosis extractor, producing potable water that is free of salts and the driving solute. We have also developed cellulose ester hollow-fiber forward osmosis membranes that are thin, strong, and offer more desalting surface area per unit volume as compared to flat sheets (U.S. Patent Application No. 11/865,897).



In forward osmosis, the driving solution pulls purified water from contaminated source waters across a thin, strong, hollow fiber membrane.

Other advanced water treatment patents are featured elsewhere in this newsletter:

- New Generation Reverse Osmosis Cellulose Acetate Membrane (U.S. Patent No. 8,123,9455) (page 9)
- Chlorine-Resistant Polyamide Membranes (left side bar)

Water Operations Decision Support

Chemical Metering System. An automated system that controls a desired level of chemicals in any open or closed flow stream with fluctuating flow rates (U.S. Patent No. 5,902,749).

Continuous Flow Monitor. An easy-to-use, low-cost flow recording device for agricultural water users to measure the amount of water used or diverted. It provides a continuous readout and recording of water flow measurements in water measurement devices including flumes or weirs (U.S. Patent No. Patent 6,907,779).

Conserving or Expanding Water Supplies

Catch Cup. A device that evaluates sprinkler performance for irrigation users to adjust their sprinkler systems to apply the proper amount of water for conserving water. Currently, over 16,000 catch cups have been sold under a non-exclusive license with Utah State University (U.S. Patent No. Patent 6,779,399).

Water and Power Infrastructure Reliability

Flexible Flux Probe. An inexpensive, printed circuit on a 1-x 2-inch thin flexible film that measures electromagnetic flux in an electric generator to detect and diagnose problems with the generator. Currently, over 150 flux probes have been sold under a non-exclusive license with Iris Power Engineering (U.S. Patent No. 6,466,009).

Hydrophilic Polyurethane Impregnated Rubber for Sealing Water Leaks. A material used to seal cracks in a dam or other water delivery systems (U.S. Patent No. 6,541,106).

Thin Concrete Repair Compound. A cement repair material used for repairing cracks in outdoor concrete structures. The cement repair material is comprised of a unique combination of cements, fibers, and new concrete admixtures to improve on existing concrete repair materials. It is designed to be less expensive and longer lasting (U.S. Patent No. 6,749,680).

Thin Mortar Repair System for Affected Concrete. A cement repair composition used to repair thin concrete (U.S. Patent No. 6,858,075).

Clamshell Gate. A heavy duty fluid control valve used to restrict fluid discharge flow at the outlets of large hydraulic conduits particularly in river, dam, and canal outlet works (U.S. Patent No. 6,969,044).

Modified Isbester (MI) Flow Gate Valve. A modification of the patented Clamshell Gate that improves sealing performance at reduced fabrication cost. The MI Valve is a gate valve unit that controls the flow of fluid through an opening in a conduit developed for hydraulic outlet works (U.S. Patent No. 6,588,728 B2).

Armorwedge Block. A concrete block system that offers increased erosion protection from the forces of flowing water for structures such as such as canal embankments, levees, emergency spillways, and embankment dams. Applications are intended for low head situations and where an erosion induced failure of the structure represents a low hazard to life and property (U.S. Patent No. 5,544,973).

Steel Support. A metal reinforcement used to repair or modify wooden frame structures to enable large electrical and/or mechanical infrastructure (e.g., mechanical pipes, bundle of electrical cables) to pass through. This uses a unique steel support to allow cutting of wooden structures without reducing the strength of the wooden structure (U.S. Patent No. 6,848,231).

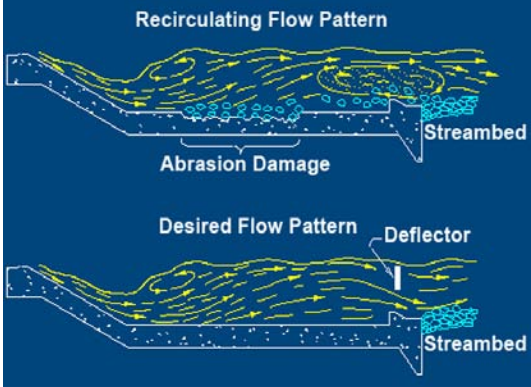
Acoustic Travel-Time Tomography. A non-destructive, affordable and accurate method to locate cracks, voids, structural damage, and other anomalies deep inside concrete structures. (U.S. Patent No. 6,105,430).

Non-Contact Inspection System Using Lasers. This method uses laser technology to place sensors on the face of large concrete structures to locate cracks, voids, structural damage inside concrete structures (U.S. Patent No. 6,823,737 B2).

Flow Deflectors to Prevent Stilling Basin Abrasion Damage

Stilling basin abrasion damage is a widespread problem for river outlet works and spillways at Reclamation dams and other dams worldwide. Recirculating flows can draw abrasive materials (sand, gravel, rock, etc.) into a stilling basin from the streambed. Turbulent flows continue to move them against the concrete surface, causing severe abrasion damage.

The stilling basin flow deflector is a water flow control system using a reinforced steel plate panel that is placed across the downstream portion of a stilling basin to change the water flow pattern within a basin to reduce abrasion damage (U.S. Patent No. 7,192,217).



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Protect and Partner

Invasive Quagga and Zebra Mussels

More Information
www.usbr.gov/research/science-and-tech/research/results/Mussels_NovFinal.pdf

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Working with Reclamation's CRADAs

Control Invasive Quagga and Zebra Mussels

Invasive quagga and zebra mussels have the potential to impair or interrupt water and hydropower deliveries as well as create long-term ecological impacts. Mussels can attach to virtually all submerged surfaces and clog water intakes, piping, cooling water systems, and fire protection systems. This impacts related instrumentation and equipment. Reclamation is engaged in a number of research and development activities to address mussel-related issues and impacts (see sidebar photo). One such effort involves developing, through a CRADA with Marrone Bio Innovations, Inc. (MBI), a promising new treatment product called Zequanox™. Reclamation's Research and Development Office is evaluating the efficacy of Zequanox™ at Reclamation's Davis Dam in collaboration with Lower Colorado Region Dams Office and Technical Service Center. Zequanox™ is derived from the dead form of a naturally occurring bacteria, *Pseudomonas fluorescens*, which has been shown to selectively kill invasive mussels. The bacteria were discovered and patented by New York State Museum with whom MBI has a license agreement to mature and commercialize the technology. If successfully commercialized, this product may have the potential to provide an environmentally preferred alternative to conventional chemicals (such as chlorine) for the control of mussels at hydropower facilities.

Impaired Waters

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Aerial view of the Yuma Desalting Plant complex.

Turn Impaired Waters into Useable Waters

The Colorado River is the principal source of water for irrigation and domestic use in Arizona, southern California, and southern Nevada. Ensuring adequate water availability for this region of the country is an ongoing challenge. Reclamation entered into a CRADA with Metropolitan Water District of Southern California, Southern Nevada Water Authority, and the Central Arizona Water Conservation District to help address this challenge. The CRADA objective is to research best methods and new processes for purifying a variety of impaired source waters so that they can be added to the overall water supply of the Colorado River by using Reclamation's Yuma Desalting Plant in Yuma, Arizona. CRADA partners conducted the research at the Water Quality Improvement Center, which is a Reclamation water treatment research center co-located at the Yuma Desalting Plant.

Most of the testing is complete, and the partners are working on compiling the research results into a final report. The research results would serve to advance the capabilities to purify waters. These results can apply not only along the Colorado River, but at other national and international desalination and water reuse facilities. Members of the project team will deliver presentations about the project at various conferences including: American Membrane Technology Association (AMTA) or American Water Works Association (AWWA) Conference in Glendale, Arizona, the AWWA Annual Conference and Exposition in Dallas, Texas, and the Arizona Water Association Conference in Glendale, Arizona. In addition, information from the project will be used to help in long-term planning related to potential future operations of the Yuma Desalting Plant.

Working with Reclamation's Licenses

Conserving Water—Over 16,000 Catch Cups Sold

Reclamation's Upper Colorado Regional Office in Salt Lake City, Utah has developed inexpensive and easy-to-use catch cups (U.S. Patent No. 6,779,399), an associated one-page pamphlet, and an instructional video to help homeowners and landscape professionals irrigate their lawns correctly and reduce overwatering. Reclamation has a non-exclusive license agreement with Utah State University and has currently sold over 16,000 catch cups to irrigation professionals throughout the U.S. and has improved irrigation efficiency, which results in lower water bills, improved landscape health, reduced water pollution, and reduced fertilizer use.

The catch cups measure the amount of water collected across an irrigated area (see sidebar photo). Water measurements are used to evaluate sprinkler performance so that sprinkler systems may be adjusted to apply the optimal amount of water. Along with the catch cups, the watering guide and video can be used by the homeowners to irrigate their lawns correctly and reduce over watering. Reclamation's catch cups are superior to similar products and are easier to use than everyday cans or containers.

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Residential Sprinkler Catch Cup Models

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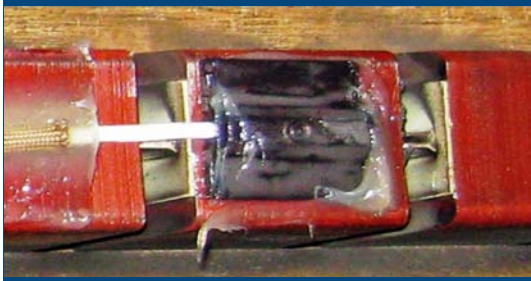
Flexible Magnetic Flux Probe—Over $150,000 in Sales

Reclamation's Hydropower Technical Services Group has developed and patented an inexpensive, small, flat, flexible magnetic flux probe that can detect deteriorating insulation in large-scale spinning electrical generators (U.S. Patent No.6,466,009). Reclamation has a non-exclusive license agreement with Iris Power LP, and currently over 150 probes have been sold in the U.S. at a sale price of $1,000 per unit. These units have improved generator reliability and reduced maintenance costs.

The probe consists of a thin, flexible pickup coil on the back side with an electrostatic shield on the front side (see picture in sidebar). The pickup coil, which is used to measure the magnetic flux, is composed of printed circuit board traces etched onto a flexible substrate. The flexible substrate is very light and thin, allowing easy installation into the air gap. If the probe ever happened to come loose during generator operation, the flexible substrate would not damage the generator. This probe provides for consistent and uniform electrical and magnetic characteristics, thus eliminating the need for calibration.

Flexible Magnetic Flux Probe Mounted on Generator Stator



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Protect and Partner

Using Reclamation's Research Facilities

Reclamation has specialized facilities, equipment, and capabilities for testing or conducting research on water, power, or related needs. These facilities can be made available to industry and other organizations through Facility Use Agreements.

Reclamation's extensive water storage, water delivery, and hydropower facilities offer unsurpassed living laboratories for field tests, evaluations, and demonstrations. Research and development partnerships also have access to Reclamation's hydraulic, material testing, water treatment, and other laboratories.

Technical Service Center (TSC) Laboratory

The TSC lab in Denver, Colorado, provides research and development facilities/ services for:

- Desalination and water purification systems, including: design and installation, membrane evaluation, and pilot and demonstration testing.
- Hydraulic analysis, design, research, and testing.
- Materials engineering, including research and testing on the physical design properties of concrete, soils, rock, geotextiles, and coatings for corrosion control methods.

For more information, see www.usbr.gov/research/AWT/Denver_WaTER_lab.pdf.

Water Quality Improvement Center (WQIC)

This 12,000-square-foot research facility serves as a field site to investigate new and improved water purification technologies. WQIC is in Yuma, Arizona, at the southern end of the Colorado River. This research facility offers resources including lab space, equipment, and experienced engineers and technicians knowledgeable in water treatment processes and operations. Collaborators interested in using this facility can also conduct their research or testing under a variety of feedwaters including surface and brackish agricultural and ground waters from the Colorado River. For more information, see www.usbr.gov/lc/yuma/facilities/wqic/yao_facilities_wqic.html.

Brackish Groundwater National Desalination Research Facility (BGNDRF)

This 40-acre research facility is designed to conduct research on cost-effective advancements on desalination and alternative energy technologies. BGNDRF is at Alamogordo, New Mexico. This research facility focuses its research on brackish ground water desalination, small-scale rural water systems, renewable energy integration, concentrate management, oil and gas produced waters, and agricultural uses. This facility offers resources including lab space; spacious conference rooms; equipment; and experienced scientists, chemical and environmental engineers in process development, design, construction and testing. For more information, see www.usbr.gov/research/AWT/BGNDRF.

Photos on sidebar:
Denver Lab (Yuliana Porres), WQIC, and BGNDRF facilities

Protect and Partner

Partnering with Agricultural Research Services

In 2007 Reclamation entered into an interagency agreement with the U.S. Department of Agriculture-Agricultural Research Service Office of Technology Transfer (ARS). Reclamation's collaboration with ARS has led to many productive research and technology transfer agreements between Reclamation, industry representatives, and other non-Federal organizations.

Reclamation and ARS share similar research missions for providing water management solutions for irrigated agriculture, our collaboration on research and technology transfer avoids duplicating research efforts and better leverages resources. This close, hands-on working relationship has significantly increased the efficiency, value, and impact of Reclamation's technology transfer capability and paves the way for future collaborative research for our common stakeholder interests.

Under the interagency agreement, ARS provides technology transfer consultation expertise, execution of a specific number of research agreements, training materials, marketing assistance, and licensing negotiations. Reclamation capitalizes on the breadth of ARS' experience over the past 21 years, their policies and procedures, the profound diversity of education and training realized by over 40 technology transfer personnel, and the full "team" infrastructure. This staff includes eight in-house Patent Advisors who have many collective years of preparing, filing, and obtaining patents in the broad areas of agriculture, including mechanical and measurement patents, chemistry, biotechnology, plant patents, etc. Furthermore, ARS' extensive experience includes managing over 1,200 CRADAs, over 350 licenses (with over 100 products on the market), over 750 patents, and assisting and supporting four licensees through infringement issues.

About our Partners

ARS

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's chief scientific in-house research agency. Our job is finding solutions to agricultural problems that affect Americans every day, from field to table. Our scientists frequently collaborate with research partners from universities, companies, other organizations and other countries.

USDA





Partnering with TechComm

TechComm is a public-private partnership that focuses on developing and commercializing emerging technologies to solve pressing national needs, create innovative products, create jobs, and stimulate economic growth. Reclamation, working with ARS, enlisted TechComm's assistance to seek commercial partners for the three advanced water technologies:

- New Generation Reverse Osmosis Cellulose Acetate Membrane (page 9)
- Chlorine-Resistant Polyamide Membranes (page 12)
- Forward Osmosis (page 12)

TechComm™ Technology Commercialization & Manufacturing

TechComm

TechComm, established in 2010, represents a coalition of government agencies and their Federal labs, as well as industry, academic, corporate, and venture capital affiliates. TechComm facilitates:

- **The transfer of Federal patented technology to industries for commercial use and manufacturing**
- **Cooperative research between Federal labs with both universities and industries**

More Information and Training

Federal Laboratory Consortium

Today, approximately 300 Federal laboratories and centers and their parent departments and agencies are FLC members. The FLC promotes transferring research from Federal laboratories to the marketplace by:

- **Providing training, advice, and assistance to T^2 professionals**
- **Providing a clearinghouse for Federal technologies**
- **Facilitating network capabilities between laboratories, regional advisory groups, and industry professionals**
- **Assisting in developing T^2 mechanisms**

More Information on Technology Transfer

To help accelerate T^2, a number of Federal and non-Federal organizations that provide connections to Federal laboratories, industry, academia, and state and local government.

Federal

Federal Laboratory Consortium (FLC) (www.federallabs.org).
Chartered by Congress in 1986, this is a nationwide network of over 300 Federal laboratories and research and development centers.

The Interagency Workgroup on Technology Transfer (IAWTT).
Established in 1987 (Executive Order 12591), this workgroup consists of members of the Federal laboratories to coordinate T^2 activities across the Federal agencies, exchange information internally, and develop and disseminate information to the public and potential partners relevant to T^2. Currently, the National Institute of Standards and Technology (NIST) facilitates the IAWTT with participants from various Federal agencies. Under the Presidential Memorandum issued on October 28, 2011, the IAWTT is instructed to develop plans that establish performance goals to increase the number and pace of effective T^2 and commercialization activities in partnership with non-Federal organizations. The group will also be responsible for recommending opportunities to improve T^2 from Federal laboratories and for seeking new and innovative ways to transfer Federal technologies.

Non-Federal

Association of University Technology Managers (AUTM) (www.autm.net).
This nonprofit association is a nationwide network of more than 2,700 professionals involved in technology transfer. AUTM members are mainly from universities but also have members representing institutions, teaching hospitals, industry, and government organizations. It provides T^2 publications, public education, results of research activities, as well as training through their annual and regional meetings, on-line courses, and other professional development courses.

Licensing Executives Society (LES) (www.lesusacanada.org).
This professional organization has over 5,000 members involved in the transfer, marketing and licensing of technologies. LES members are made up of professionals in law (mainly business and intellectual property), academia, industry, and government. It focuses on networking and training in licensing practices, law, regulation, and issues related to licensing.

Side photo: Chuch Hennig, Deputy Director, Research and Development presenting at the May 2012 Federal Laboratory Consortium National Meeting.

Recent Reclamation Products

To get information generated by research quickly into the hands of end users and the broader public, our researchers and partners publish their results in peer-reviewed journals, technical memoranda, research reports, and other venues. We also present our results at conferences and workshops. Access these documents electronically at www.usbr.gov/research/docs/2012.html. Below is a list of reports published since the previous edition of the Knowledge Stream.

Environmental Issues in Water Delivery and Management

Lai, Yong. **Coupling a Two-Dimensional Model with a Deterministic Bank Stability Model.** ylai@usbr.gov

Nelson, Mark. **Restoring Habitat for Riparian Birds in the Lower Colorado River Watershed: An Example from the Las Vegas Wash, Nevada.** snelson@usbr.gov

Sabatine, Shiana. **Evaluation of Parameter and Model Uncertainty in Simple Applications of a 1D Sediment Transport Model.** trandle@usbr.gov

Ruark, Morgan. **"A Method for Assessing Impacts of Parameter Uncertainty in Sediment Transport Modeling Applications."** trandle@usbr.gov

Water and Power Infrastructure Reliability

Bissonnette, Benoit, Tim Dolen, Alex Vaysburd, and Kurt Von Fay. **Development of a Test Method to Evaluate Cracking Tendency of Repair Materials, Phase I Report.** kvonfay@usbr.gov

Bissonnette, Benoit, Alex Vaysburd, and Kurt Von Fay. **Development of Test Methods to Evaluate Cracking Tendency of Repair Materials—Field Study Phase II.** kvonfay@usbr.gov

Chugh, Ashok. **Discussion of Three-dimensional Slope Stability Analysis of Embankment Dams.** See also Canadian Geotechnical Journal, Vol. 49, Issue 3, pp. 374-380, 2012. achugh@usbr.gov

Gillespie, Timothy, David Godaire, and Tim Gumina. **Bond Quality of Fiber Reinforced Polymer Concrete Strengthening Systems**. kvonfay@usbr.gov

Harpman, David. **Advanced Algorithms for Hydropower Optimization (Phase 1 Report).** dharpman@usbr.gov

Hurcomb, Doug. **Reclamation's Seepage Barrier Experience - A Cursory Scoping Study.** dhurcomb@usbr.gov

Von Fay, Kurt. **Report of Findings, Laboratory Evaluation of Concrete Thin Repair Materials.** kvonfay@usbr.gov

Conserving or Expanding Water Supplies

Kubly, Dennis and Douglas Clark. **An Adaptive Management Workshop Manual to Assist in the Prevention, Management, and Resolution of Water Resource Conflicts, Version I.** dclark@usbr.gov

Hattendorf, Mary. **Urban Conservation Opportunity Efficient Turf Irrigation.** fliljegren@usbr.gov

Liljegren, Fred. **Real Deal Reports and Publications. Includes two published papers and a Masters study.** fliljegren@usbr.gov

Robertson, Steve. **Discussion of Earth Pressure Measurements on Buried HDPE pipe.** srobertson@usbr.gov

Idea Scale tag cloud for the Research Jam. See page 5.