

Bureau of Reclamation
Science and Technology Program
Long-Term and Annual Performance Goals and Measures

I. Science and Technology Program Goal:

The goal of Reclamation's Science and Technology Program is to be the best in the West at facilitating the development and use of new scientific and technical solutions that contribute significantly to a safe, affordable, sustainable, and ample water and power supply. We are passionate about seeing innovative solutions make a difference for water in the West and we want our stakeholders to be thrilled with our contributions.

To accomplish this goal, we collaborate with other agencies and organizations that have common outcome objectives and bring multi-objective perspectives, other resources, and a broader range of expertise to focus and solve the problems and challenges facing our stakeholders. We collaborate on R&D with other agencies or organizations that have the lead role in research, or managing resource issues, when their research outputs could impact water and power supply outcomes to Reclamation stakeholders. Our role in these collaborations is advocacy for Reclamation stakeholders.

Our applied R&D is solution-oriented and combines key engineering and scientific problem solving expertise with the strong basic research contributions of others.

We contribute to safe, affordable, sustainable, and ample water and power supply by developing and deploying (put to use) solutions that liberate water for increased use, or more dependable beneficial use, for Reclamation stakeholders. This provides increased flexibility for our water managers and water users to stretch water supplies within the context of water law, regulations, policies, and market mechanisms for maximum use and value.

II. How Do We Help Liberate Water, Generate Power, And Manage Costs?

- Solutions that increase or recover water storage or water delivery capacity
- Solutions that prevent Reclamation water facilities receiving notices of violation under environmental requirements as defined by Federal and State law
- Solutions that conserve water for other beneficial uses by our stakeholders
- Solutions that optimize and improve the efficiency of our water and power operations to stretch and use every drop of water multiple times
- Solutions that convert saline or other impaired waters to useable waters, or sustain beneficial uses of existing waters
- Solutions that extend the life, or increase the reliability of our water storage, water delivery, and power facilities so that continued beneficial uses of project waters are dependable.
- Solutions that decrease, or help manage operational costs, so that water and power supplies remain affordable.

III. How Do We Measure Our Contributions?

Science and Technology Program funding is divided between four main areas of research and development that have been customized to focus on the particular challenges facing Reclamation stakeholders:

- Improving water and hydropower infrastructure reliability and efficiency
- Improving water delivery reliability and efficiency
- Improving water operations decision support with advanced technologies and models
- Enhancing water supply technologies

We have established long-term and annual outcome and output goals, and performance measures, for each of these research focus areas. The effectiveness of the total S&T Program will be measured by the sum of the contributions from each focus area.

A. Output Goals

Annual output goal measures are based on annual production relative to annual program funding creating a production efficiency ratio (production per unit of cost) as a performance measure. Each research focus area has two, common output-based goals that support the program goal of facilitating the development and use of new science and technology solutions for water in the west:

- Partnership Contributions - A surrogate goal that measures the value others place in the outputs and outcomes of the research. This is a common goal for each focus area. The goal is to increase the efficiency of leveraging S&T Program resources by at least 5% each year over the previous year resulting in a cumulative 35% increase by the end of FY2010 as a six-year long-term goal. Currently, the S&T Program typically achieves a 1:1 or greater level of leveraging.
- Science & Technology Bulletins - A brief electronic bulletin targeted at end-users and peers about S&T Program findings, and relative findings from others, that could facilitate use of new solutions and knowledge for western water and power supplies. This is a common goal for each research focus area. The goal is to increase the efficiency of posting of substantive S& T Bulletins on the S&T Program web-site by at least 5% each year over the previous year resulting in a cumulative 35% increase by the end of FY2010 as a six-year long-term goal.

B. Outcome Goals

Research focus areas have at least one of three possible R&D outcomes. Goals for the FY2005 – FY2010 reporting period are shown below:

Goal	FY2005	FY2005- 2010
Water Liberated	41,500 acre-feet	871,500 acre-feet
Operational Cost avoidance	\$406,000	\$8.5 million
Kilowatts Generated	12.5 million KWH	262.5 million KWH

All focus areas establish a long-term and annual outcome goal based on water liberated. However, the outcomes of certain components in each focus area are more directly measurable in terms of avoided costs or additional power generation. To provide a common metric all focus areas set goals in terms of the economic value to the American public. The S&T Program has established a minimum 10:1 return on the R&D investment as the basis for our outcome goals. In other words, the overall program goal would be to return \$10 of economic value for every \$1 of S&T Program investment. The goal targets for each focus area are linked to the annual S&T Program budget allocated to that focus area. The goals for each focus area are aggregated to establish S&T Program goals.

C. Calculating Actual Annual Contributions Toward Outcome Goals – Researchers track up to the initial five deployments of new R&D outputs that they produce under a specific research project. The quantity of water liberated, costs saved, power generated, and associated economic returns that are produced by those deployments are calculated and included as a contribution to the focus area and program goals. An on-line S&T Program benefit calculator is being developed that will facilitate easy, consistent, and credible quantification of the contribution that each deployment makes toward the overall program outcome goals.

If a focus area does not have cost avoidance or power generation goals because the primary goal of the focus area is water liberation, researchers are allowed to credit their contribution in terms of cost avoidance or power generation when their research deployments generate these benefits. This reflects that the overall program goal is to achieve a minimum 10:1 return on the S&T investment in terms of water, power, and/or cost avoidance.

After the initial five deployments of a research output, we consider the R&D output to be adopted as standard practice and discontinue tracking of additional deployments and benefits that could be attributed to the research investment. Tracking the initial five deployments also provides a framework for establishing a reasonable, time bound criteria for which to establish ambitious, consistent, and achievable long-term performance measures and targets.

Outcome goals are set using mid-range values for water and energy. Actual contributions toward goals will be calculated based on the actual value of water and energy, associated with the particular deployment of an S&T Program output, to the extent that such information is available and dependable.

The investment of others that collaborate with us will not be included in the overall benefit calculation. Partner contributions are typically the result of our ability to bring S&T Program funding to the effort. Without the S&T Program investment, the partnered effort may not occur. If it did occur without S&T Program involvement, the ability for Reclamation to influence the research and deploy the benefits for Reclamation stakeholders is diminished. As such, partner resource contributions are considered a return on our S&T Program investment. For simplicity, it is conservatively not included in the calculation of the economically based water liberation, cost avoidance, or energy generation goals.

D. Case History Examples of Goal Contribution Calculations

Water Liberation Case History 1 - Preliminary results of S&T Program partnered research with the Pacific Northwest Region, Yakima Nation, and others on the Yakima Project showed that reduced discharge did not harm spring Chinook salmon egg survival. As a result, Reclamation can reduce discharges by 50 cfs after spawning is complete. Between November 15 and February 15, the reduced discharge results in 8,925 acre-feet available for irrigation later in the year. This water liberation contribution occurs each year in the future.

Water Liberation Case History 2 – The S&T Program, Reclamation’s Mid-Pacific Region and others partnered on developing fish pump and fish screening technologies on the Tracy Fish Salvage Facilities and the Red Bluff Pumping Plant. These technologies were deployed in the newly constructed A Canal fish screen on the Klamath Project in southern Oregon. The fish screen facility is a key requirement of the Biological Opinion issued by the Fish & Wildlife Service to recover endangered shortnose and Lost River Suckers in Upper Klamath Lake. During a typical irrigation season, the A Canal transports nearly 250,000 acre-feet of irrigation water used on Klamath Project farms. Use of the fish screen will liberate these waters for continued, reliable irrigation deliveries for years to come.

Water Liberation Case History 3 --Modern crack sealing technologies are being evaluated at Pueblo Dam as part of a S&T Program project. By stopping all the water leaks, about 600 gals/min of water can be liberated (1,000 acre feet annually). In addition, several thousand dollars will be saved each year in reduced O&M expenses, since the leaking water damages expensive equipment and electrical conduits and controls. Using these modern materials investigated and tested, new concrete materials will be used for underwater repairs at Canyon Ferry Dam and Redbluff Dam. The new materials make it feasible to place high performance concrete underwater to repair damage to the stilling basins. It is anticipated that additional implementation at these sites will pay for the entire investment based on this case history alone.

Operational Cost avoidance Case History 1 - The S & T program partnered with Reclamation’s Ephrata Field Office, Cornell University, and others to develop a biocontrol method for purple loosestrife that saved Reclamation and stakeholders \$455,000 per year as compared to the alternative chemical control methods available to them. This savings occurs each year into the future producing a present worth value of \$7,280,000 from the deployment of this research output. This invasive plant impedes water delivery by excessive growth in irrigation canals. The biocontrol agent, beetles, eat this invasive plant reducing water impedance. Reclamation avoids costs of chemical loosestrife control each year because the beetles continue to control the plant in and around wasteways of the Columbia Basin Project.

Ancillary S&T Program Benefits - These case studies shows the value of technological development where it is currently deployed. This research output can be applied at many locations throughout the U.S., thus providing more value to Reclamation and the American public.

Many other benefits accrue from our research outputs. For example, in water liberation case history 1, we showed the benefit to Reclamation stakeholders in terms of water provided. But other benefits are also realized by this research. First, the research was conducted with spring Chinook salmon. Spring Chinook are not listed on the Endangered Species List partly because of this and many other management actions taken by Reclamation over the years to avoid harm to these salmon. Thus, Section 7 consultation is not needed for spring Chinook in the Yakima River basin. This avoids substantial costs necessary to participate in such consultations. In addition, the Yakima basin has seen several pieces of litigation against Reclamation for fisheries related issues and river management. The research in the case study provides information and an evaluation that supports Reclamation decisions to store water. Thus, litigation costs are avoided.

E. Goal and Performance Measure Implementation Schedule

Action	Schedule	Comment
Establish and vet goals	FY2003	Goals are vetted with stakeholders and researchers
Implement tracking protocols and procedures	FY2003	Ensures quality control, consistency, and researcher awareness/understanding
Partial Year Baseline of goal targets	FY2003	Targets baselines for outcome and output goals will be established to the extent possible during the first year of goal and tracking implementation
Full Year Baseline of goal targets	FY2004	Envisioned as the most reliable baseline year. FY2004 baseline will incorporate refinements and improvements learned from FY2003 initial benchmark exercises
Goal Reporting Period	FY2005 to FY2010	Annual and long-term progress toward outcome and output goals will be reported during this time frame. Goals and reporting period beyond 2010 will be updated and/or established starting in FY2008

E. Detailed Summary of Outcome Goal Calculations and Linkage to Budget

S&T Program Water Liberation Goals for FY2005 – FY2010						
R&D Focus Area	Economic Value of Water		Annual Investment and Corresponding Break Even Return on the Investment		Outcome Goals	
	(1) Mid-Range Annual Value of Water (\$/Acre-foot)	(2) Corresponding Present Value of Water (\$/Acre-foot)	(3) Annual S&T Program Investment (\$)	(4) Threshold Return on Investment Present Value S&T Program Outcome Benefits necessary to Achieve a 1:1 B/C Ratio (acre-feet)	(5) Annual Goal Annual S&T Program Outcome Benefits to Achieve a 10:1 B/C Ratio (acre-feet)	(6) Long-Term Goal Six-Year Accumulation of Annual Outcomes to Achieve a 10:1 B/C Ratio (acre-feet)
Improving Water Delivery Reliability	125	2000	\$4,300,000	2,150	21,500	451,500
Enhancing Water Supply Technologies (includes Desal Act)	125	2000	\$1,900,000	950	9,500	199,500
Improving Infrastructure Reliability	125	2000	\$650,000	325	3,250	68,250
Improving Water Operations Decision Support	125	2000	\$1,450,000	725	7,250	152,250
Total			\$8,300,000	4,150	41,500	871,500

S&T Program Cost Avoidance and Power Generation Goals for FY2005 – FY2010						
R&D Focus Area	Economic Value of Hydropower		Annual Investment and Corresponding Break Even Return on the Investment		Outcome Goals	
	(1) Mid-Range Annual Value of Power (\$/KWH)	(2) Corresponding Present Value of Power over 50 years (\$/KWH)	(3) Annual S&T Program Investment (\$)	(4) Threshold Return on Investment <i>Present Value S&T Program Outcome Benefits necessary to Achieve a 1:1 B/C Ratio</i>	(5) Annual Goal <i>Annual S&T Program Outcome Benefits to Achieve a 10:1 B/C Ratio</i>	(6) Long-Term Goal: <i>Six-Year Accumulation of Annual Outcomes that Correspond to a 10:1 B/C Ratio</i>
• Cost Avoidance Goals			\$650,000	\$40,625	\$406,500	\$8,537,000
• Power Generation Goals	\$.035	\$.56	\$700,000	1,250,000 KWH	12,500,000 KWH	262,500,000 KWH

Column (1): The economic value of water in the West is generally in the range of \$50 to \$200 per acre-foot annually depending on location and specific use (e.g. agricultural, municipal water supply, etc. The midrange value is \$125/acre-foot. Generally, the economic value of a KWH ranges from 2 to 5 cents with a midrange value of 3 ½ cents.

Column (2): What does the present value of water and power mean? Many one-time research investments will result in a stream of annual outcomes(benefits) each and every year. Under the “time value of money” principle, dollars received in the future are less valuable than dollars received today. Using the federal discount rate of 5.875 percent and recognizing that benefits after 50 years contribute only marginally to total investment value, the present value of the annual stream of benefits is about 16 times the single year benefit. [Column (1) x 16]

Column (3): The annual level of planned S&T Program investment based on the current understanding of priorities and the current S&T Program funding proposal. Funding levels shown represent planned levels of investment for FY2005. As FY 2005 approaches, these figures and corresponding goals may be adjusted as FY2005 approaches based on enacted S&T Program funding levels, updated steering team priorities, administration priorities, and the strength and merit of actual proposals.

Column (4): The quantity of water or power, based on the present worth values, that would need to be produced by the deployment of S&T Program outputs during the initial year of deployment and every year thereafter, in order to justify the annual S&T Program investment (i.e. 1:1 Benefit/cost ratio). [Column (3) ÷ Column (2)]

Column (5): The S&T Program has established a 10:1 return on the R&D investment as minimum annual and long-term outcome goals for all R&D focus areas. In other words, the goal would be to return \$10 of value for every \$1 of R&D research investment [Column (4) x 10]

Column (6): S&T Program deployments(research outputs put to use) that produce outcomes on an annual basis will accumulate over time. In other words, one deployment can produce the same outcome benefits during the initial year of deployment and every year thereafter into the future. Over a 6-year long-term goal period, the cumulative effects equal 21 times the annual contributions [Column (5) x 21]. The cumulative effects are demonstrated in the table below:

Cumulative Effects of Achieving an Annual Goal of 10,000 Acre-Feet of Water Liberation Each Year Over a 6-year Goal Period							
Accumulation Period	Goal Outcome Achieved for FY2005 Investment	Goal Outcome Achieved for FY2006 Investment	Goal Outcome Achieved for FY2007 Investment	Goal Outcome Achieved for FY2008 Investment	Goal Outcome Achieved for FY2009 Investment	Goal Outcome Achieved for FY2010 Investment	TOTAL 2005-2010 Accumulation of Annual Outcome Benefits
FY2005	10,000						
FY2006	10,000	10,000					
FY2007	10,000	10,000	10,000				
FY2008	10,000	10,000	10,000	10,000			
FY2009	10,000	10,000	10,000	10,000	10,000		
FY2010 <u>1/</u>	10,000	10,000	10,000	10,000	10,000	10,000	
TOTAL	60,000	50,000	40,000	30,000	20,000	10,000	210,000 <u>2/</u>

1/ The outcome benefits from the annual investment continue each year into the future beyond 2010 and continue to add to the overall cumulative total benefits. FY2010 represents the end of the reporting period, not the end of the benefit stream

2/ The 6-year cumulative affect is 21 times the annual goal. Deployed R&D outputs that produce a one-time cost avoidance, or delays a one-time expenditure will also count toward the goal in the present worth terms of this savings.

Improving Water Delivery Reliability
S&T Program Focus Area Long-Term and Annual Performance Goals

Mission: Facilitate the development and use of innovative solutions that address operational and environmental concerns before Reclamation water deliveries to our customers are impacted.

We liberate water for Reclamation water managers and water users by improving the dependability of water deliveries by:

- Developing methods to improve passage and reduce entrainment of ESA listed species and other aquatic species
- Finding innovative means to manage aquatic systems to avoid future ESA listings and remove species currently listed
- Developing techniques for managing invasive species that consume water or impede water deliveries
- Developing tools, models, and methods that impact usability of water supplies.
- Developing and improving sediment management and restoration practices to sustain and improve storage and water delivery capacity

FY2005 Budget Proposal: \$4,300,000

I. Long Term Outcome Goal: To liberate water for dependable, beneficial use for Reclamation stakeholders.

Long-Term Outcome Target: Liberate 451,500 acre-feet of water. By the end of FY2010, achieve a 10:1 economic return on the federal S& T Program investment over a six-year period through the deployment of each year's R&D outputs. For annual budgets at the FY2005 Proposal Level, the 10:1 return would contribute to the cumulative liberation of 451,500 acre-feet of water over a six-year, goal reporting period. The benefits from these deployments will continue to accumulate each year well beyond the six year period adding to the overall benefit stream from the S&T investment.

FY2005 Outcome Target: Liberate 21,500 acre-feet of water. Achieve a 10:1 economic return on the federal investment by contributing to the permanent annual liberation of 21,500 acre-feet of water through the deployment of S&T Program outputs in FY2005.

II. Annual Output Goal 1: Increase leveraging efficiency of S&T Program resources by at least 5% each year over FY2004 year.

III. Annual Output Goal 2: Increase efficiency of posting substantive S&T Bulletins on the S&T Program website by 5% over FY2004.

Enhancing Water Supply Technologies
S&T Program Focus Area Long-Term and Annual Performance Goals

Mission: Facilitate the development and use of innovative solutions that stretch and expand useable water supplies and optimize water delivery efficiencies.

We liberate water by adding to the pool of water that Reclamation water managers and water users have available for increased operational flexibility by:

- Improving methods that optimize groundwater storage and use.
- Developing cost effective desalination and other water purification technologies that convert impaired waters to usable waters
- Developing methods that increase irrigation water delivery efficiencies and management practices.
- Developing methods that prevent water delivery system losses
- Improving our ability to facilitate water marketing and other institutional mechanisms to expand and manage water supplies.

FY2005 Budget Proposal: \$1,900,000 (includes \$100,000 proposed under Desal Act)

I. Long-Term Outcome Goal: To liberate water for dependable, beneficial use for Reclamation stakeholders.

Long-Term Outcome Target: Liberate 199,500 acre-feet of water. By the end of 2010, achieve a 10:1 economic return on the federal S& T Program investment over a five-year period through the deployment of each year's R&D outputs. For annual budgets at the FY2005 Proposal Level, the 10:1 return would contribute to the cumulative liberation of 199,500 acre-feet of water over a six-year period. The benefits from these deployments will continue to accumulate each year well beyond the six year period adding to the overall benefit stream from the S&T investment.

FY2005 Outcome Target: Liberate 9,500 acre-feet of water. Achieve a 10:1 economic return on the federal investment by contributing to the permanent annual liberation of 9,500 acre-feet of water through the deployment of S&T Program outputs in FY2005.

II. Annual Output Goal 1: Increase leveraging efficiency of S&T Program resources by at least 5% each year over FY2004 year.

III. Annual Output Goal 2: Increase efficiency of posting substantive S&T Bulletins on the S&T Program website by 5% over FY2004.

Improving Reservoir and River Operations Decision Support S&T Program Focus Area Long-Term and Annual Performance Goals

Mission: Facilitate the development and use of innovative solutions that provide water managers practical, reliable tools and information to operate Reclamation reservoirs and rivers systems as efficiently as possible.

We liberate water by adding to the pool of water that Reclamation water managers and water users have available for increased operational flexibility by:

- Developing methods to predict, model and manage extreme and operational flood events
- Developing methods to forecast and monitor water supplies and water demands
- Developing models that and methods to evaluate operational trade-offs between competing demands for water.
- Developing and improving capability to use geospatial data analysis of critical water resources data for effective planning and decision making.

FY2005 Budget Proposal: \$1,450,000

I. Long-Term Outcome Goal: To liberate water for dependable, beneficial use for Reclamation stakeholders.

Long-Term Outcome Target: Liberate 152,250 acre-feet of water. By the end of Fy2010, achieve a 10:1 economic return on the federal S& T Program investment over a six-year period through the deployment of each year's R&D outputs. For annual budgets at the FY2005 Proposal Level, the 10:1 return would contribute to the cumulative liberation of 152,250 acre-feet of water over a five-year period. The benefits from these deployments will continue to accumulate each year well beyond the six year period adding to the overall benefit stream from the S&T investment.

FY2005 Outcome Target: Liberate 7,250 acre-feet of water. Achieve a 10:1 economic return on the federal investment by contributing to the permanent annual liberation of 7,250 acre-feet of water through the deployment of S&T Program outputs in FY2005.

II. Annual Output Goal 1: Increase leveraging efficiency of S&T Program resources by at least 5% each year over FY2004 year.

III. Annual Output Goal 2: Increase efficiency of posting substantive S&T Bulletins on the S&T Program website by 5% over FY2004.

Improving Infrastructure Reliability S&T Program Focus Area Long-Term and Annual Performance Goals

Mission: Facilitate the development and use of innovative solutions that protect and enhance our facilities to ensure Reclamation remains a viable, low-cost provider of water and power in the Western United States.

We liberate water, generate power, and avoid costs for Reclamation water and power managers and users by:

- Improving the capability to assess the condition of our facilities
- Improving the ability to reduce the affects of aging and deterioration on our facilities
- Improving methods to affordably and reliably repair and maintain our facilities
- Improving capability to reduce public and employee safety risks
- Improving hydropower generation efficiency and dependability

FY2005 Budget Proposal: \$2,000,000

Subdivided to:

Power Generation: \$700,000

Water Liberation: \$650,000

Operational Cost Savings: \$650,000

I. Long Term Outcome Goal 1: Increase power generation capacity for Reclamation power managers and users

Long-Term Outcome Target: 262.5 million KWH. By the end of FY2010, achieve a 10:1 economic return on the federal S& T Program investment over a six-year period through the deployment of each year's R&D outputs. For annual budgets at the FY2005 Proposal Level, the 10:1 return would contribute to the cumulative generation of 262.5 million KWH of power. The benefits from these deployments will continue to accumulate each year well beyond the six-year period adding to the overall benefit stream from the S&T investment.

FY2005 Outcome Target: Generate 12.5 million KWH. Achieve a 10:1 economic return on the annual federal investment by contributing to the permanent annual generation of 12.5 million KWH of power through the deployment of S&T Program outputs in FY2005.

II. Long Term Outcome Goal 2: Avoid or reduce operational costs for Reclamation facility managers and water and power users so that limited funds can be used most effectively, and water and power benefits remain affordable

Long-Term Outcome Target: Avoid \$8.5million in operational costs. By the end of Fy2010, achieve a 10:1 economic return on the federal S& T Program investment over a six-year period through the deployment of each year's R&D outputs. For annual budgets at the FY2005 Proposal Level, the 10:1 return would contribute to the cumulative avoided costs of \$8.5million. The benefits from these deployments will continue to accumulate each year well beyond the six-year period adding to the overall benefit stream from the S&T investment.

FY2005 Outcome Target: Avoid \$407,000 in operational costs. Achieve a 10:1 economic return on the annual federal investment by contributing to the permanent annual avoidance of \$407,000 through the deployment of S&T Program outputs in FY2005.

III. Long Term Outcome Goal 3: Liberate water for dependable, beneficial use for Reclamation stakeholders.

Long-Term Outcome Target: Liberate 68,250 acre-feet of water. By the end of FY2010, achieve a 10:1 economic return on the federal S& T Program investment over a six-year period through the deployment of each year's R&D outputs. For annual budgets at the FY2005 Proposal Level, the 10:1 return would contribute to the cumulative liberation of 68,250 acre-feet of water over a five-year period. The benefits from these deployments will continue to accumulate each year well beyond the six-year period adding to the overall benefit stream from the S&T investment.

FY2005 Outcome Target: Liberate 3,250 acre-feet of water. Achieve a 10:1 economic return on the federal investment by contributing to the permanent annual liberation of 3,250 acre-feet of water through the deployment of S&T Program outputs in FY2005.

IV. Annual Output Goal 1: Increase leveraging efficiency of S&T Program resources by at least 5% each year over FY2004 year.

V. Annual Output Goal 2: Increase efficiency of posting substantive S&T Bulletins on the S&T Program website by 5% over FY2004..