

Prepublication Copy—Subject to Further Editorial Correction

Managing Construction and Infrastructure in the 21st Century Bureau of Reclamation

Committee on Organizing to Manage Construction and Infrastructure in the 21st Century
Bureau of Reclamation
Board on Infrastructure and the Constructed Environment
Division on Engineering and Physical Sciences

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
WASHINGTON, D.C.
www.nap.edu

Executive Summary

In the more than 100 years since President Theodore Roosevelt signed the Reclamation Act in 1902, the U.S. Bureau of Reclamation (Reclamation) has compiled an enviable record, and it can take justifiable pride in having brought water and electrical power to the arid regions of the 17 western states. Over the course of the twentieth century, Reclamation participated in such monumental undertakings as the construction of the Hoover and Grand Coulee dams as well as the development of many other dams, reservoirs, hydroelectric plants, and massive irrigation systems. These facilities and infrastructure systems have provided the water and power that enabled the development and growth of agriculture, industry, commerce, cities, and towns in the West.

Reclamation is now the largest water wholesaler in the country, providing municipal and industrial water to more than 31 million people and irrigation water for 10 million acres that produce 60 percent of the nation's vegetables and 25 percent of its nuts and fruits (USBR, 2005). It is the second-largest producer of hydroelectric power, generating 42 billion kilowatt-hours of electricity annually. The bureau also partners in the management of more than 300 recreation sites.

Major water and power systems are now in place, and relatively few large new projects are anticipated. As a consequence, the bureau's focus and workload have shifted from building infrastructure to operating, maintaining, repairing, and modernizing it, and from constructing dams to evaluating dam safety, mitigating the risk of dam failure, and addressing environmental issues. Reclamation's budget has been level while at the same time the cost of maintaining and repairing existing infrastructure is rising, in part owing to aging facilities, normal wear and tear, and increased stakeholder attention to environmental issues.

As the West has grown, the demand for water and power has also grown. At the same time, laws have been enacted to protect ecosystems and mitigate the impacts of development on fish and wildlife. These events and others have created an operating environment in which water rights issues, water and power user interests, environmental concerns, American Indian tribal rights, and other considerations play a more and more important role in decision making, project management, and customer and stakeholder relations. Reclamation works with a broad range of stakeholders, some of whom have opposing objectives and values.

As part of the sustained effort to reinvent government, Congress has mandated that all federal executive agencies become more customer-service-oriented, more cost-effective, and more accountable for the results of their programs. Congress has also enacted legislation that expands agencies' options for procuring and delivering goods and services and, in some instances, for financing projects. Additionally, initiatives have been undertaken to downsize the federal workforce and outsource to the private sector work traditionally conducted by government employees. In response to these initiatives, Reclamation reorganized in the mid-1990s in order to streamline its management structure and eliminated many senior management positions. Services were centralized for the sake of efficiency and economy, and operational authority was delegated to field offices. Centralized oversight was loosened dramatically as mandatory procedural directives and standards were eliminated to allow greater flexibility in decision making

and to empower field managers and staff to work more closely with Reclamation's customers. Reclamation also instituted some measures to manage its services through fee-for-service and cost recovery programs.

In the coming decades, population and development in the West are projected to continue to increase. As growth occurs, more land in agricultural use is likely to be used for municipal and industrial development. These changes will spur demand for more water and power resources, and that demand may outstrip the supply. Reclamation will be challenged to find ways to manage water and power so that it can meet future demand. Reclamation's tasks will involve water conservation; dam safety; expanding the existing capacity for desalination, water storage, and transmission; removing dams; enhancing the recovery of endangered species; restoring environmental quality; constructing new facilities to implement American Indian water rights settlements; and operating, maintaining, repairing, and improving existing facilities. These changing and expanding requirements will occur at a time when personnel with the most technical expertise and the best institutional memory regarding specific projects and stakeholders will be eligible to retire.

Reclamation has recognized the challenge for the twenty-first century and the necessity of making the transition from a construction organization to a resources management organization. Although Reclamation's mission continues to be the effective management of power and water in ways that protect the health, safety, and welfare of the American public and are environmentally and economically sound, achieving these objectives is a dynamic, complex, and uncertain matter.

OVERVIEW OF THE STUDY

At the request of Department of the Interior, the National Research Council (NRC) appointed the Committee on Organizing to Manage Construction and Infrastructure in the 21st Century Bureau of Reclamation, a group of experts from the public and private sectors and academia to advise Reclamation and the department on the "appropriate organizational, management, and resource configurations to meet its construction, maintenance, and infrastructure requirements for its missions of the 21st century." The full statement of task is presented in Chapter 1.

To accomplish its tasks the committee met as a whole four times from February to August 2005 and conducted small-group site visits to offices and projects in each of the five Reclamation regions. The committee received briefings from and had discussions with Reclamation representatives, Reclamation's customers and other stakeholders, and representatives of organizations with missions similar to Reclamation's.

During the course of this study the committee observed that each of the five Reclamation regions presents different organizations, capabilities, and workloads. In general, the regions appeared to be functioning well in the face of the usual challenges in this type of endeavor. Staff morale and loyalty to Reclamation's mission are commendable. Nevertheless, Reclamation, like most federal agencies, is challenged by changing requirements and the need to maintain its core competencies.

Each of the five regions is responsible for sustaining a significant portfolio of facilities. The committee saw examples of excellence; however, in general, the regions

will need to evaluate their asset inventory and manage their assets more aggressively and engage in constructive relationships with customers and stakeholders. If Reclamation wants to demonstrate consistency throughout the organization under its style of decentralized management, it will need clear, detailed policy directives and standards to enable all elements to implement a uniform, structured approach. A delicate balance needs to be maintained so as not to impede decentralized units from demonstrating initiative and increasing their capabilities. At the same time, the committee emphasizes that the bureau as the owner has the responsibility to ensure that its facilities are planned, designed, constructed, and managed with a level of quality that is consistent throughout the organization.

The committee believes that Reclamation will continue to have a need for centralized technical services, research, and oversight to support the local management of resources but also sees a need to evaluate the size and organization of the central units to ensure that services are delivered efficiently and at a reasonable cost to Reclamation customers. Both the organization and quantity of services provided at the central, regional, and area offices are affected by the current practice of outsourcing services for constructing, operating, and maintaining facilities and infrastructure that are not inherent to the government's roles and responsibilities.

The committee recognizes that organizations can and do take on a variety of forms with varying degrees of success. Some will function successfully despite their form, while others will falter even as they deploy the best of theoretical forms. The internal culture and history of an organization play a significant role in determining the appropriate structure and the ultimate outcome. The committee believes that the organization of Reclamation is appropriate for its customer-driven mission to deliver power and water. The committee also believes that there are opportunities for Reclamation to improve the construction and management of its facilities and infrastructure and the management, development, and protection of water and related resources in an environmentally sound manner in the interest of the American public. These opportunities are described in the following findings and recommendations.

FINDINGS AND RECOMMENDATIONS

Centralized Policy and Decentralized Operations

Finding 1a. For the past decade many of Reclamation's functions have been decentralized and directed by regional office directors and area office managers. Concurrent with implementation of the decentralized organizational model, Reclamation-wide directives, known as Instructions, were withdrawn, although in some cases they continue to be used for guidance in the field. Mandatory requirements that replace the Instructions have been and continue to be developed and published as policy and directives in the *Reclamation Manual*.¹ However, some issues either have not been addressed or need additional detail. This has led to inconsistencies in understanding and implementing the functions to be performed at each level of the organization, the

¹ The *Reclamation Manual* is a Web-based collection of policies and directives that is continually updated and revised. Available at <http://www.usbr.gov/recman/>.

standards to be applied, and the authority and accountability at each level. Consistently implementing Reclamation's mission will require clear statements of policy and definitions of authority and standards.

Finding 1b. Reclamation's customers and other stakeholders want close contact with empowered Reclamation officials. They also want consistency in Reclamation policies and decisions and decision makers with demonstrated professional competence.

Finding 1c. Decentralization has meant that in some area and project offices housing a dedicated technical group are staffed by only one or two individuals. The committee is concerned about the effectiveness of such small units and whether their technical competencies can be maintained.

Recommendation 1a. To optimize the benefits of decentralization, Reclamation should promulgate policy guidance, directives, standards, and how-to documents that are consistent with the current workload. The commissioner should expedite the preparation of such documents, their distribution, and instructions for their consistent implementation.

Recommendation 1b. Reclamation's operations should remain decentralized and guided and restrained by policy but empowered at each level by authority commensurate with assigned responsibility to respond to customer and stakeholder needs. Policies, procedures, and standards should be developed centrally and implemented locally.

Recommendation 1c. The design groups in area and project offices should be consolidated in regional offices or regional technical groups to provide a critical mass that will allow optimizing technical competencies and providing efficient service. Technical skills in the area offices should focus on data collection, facility inspection and evaluation, and routine operations and maintenance (O&M).

Technical Service Center

Finding 2a. The Technical Service Center (TSC) is a large, centrally located, highly structured organization with numerous separate subunits. Many Reclamation customers and stakeholders believe that its costs are excessive, it imposes overly stringent requirements, it too often fails to complete specified work on time, and it sometimes executes projects in a manner contrary to the concept of decentralization. The size of TSC is perceived to be excessive and its organization to be inefficient.

Finding 2b. TSC's response to criticisms has been to benchmark itself against private sector architecture and engineering (A&E) organizations and to adopt some private sector business practices. In an effort to remain cost competitive, TSC has developed a business plan that provides some services that are not inherently governmental.² A strategy of

² The basic definition of an inherently governmental function from the Office of Management and Budget Policy Letter 92-1 is as follows: "As a matter of policy, an 'inherently governmental function' is a function that is so intimately related to the public interest as to mandate performance by Government employees.

cost averaging, which blends the costs of specialized technical services and oversight with those of other services such as collection of field data and development of construction documents, will continue to subject the TSC to fire from Reclamation customers and its private sector competitors and is inconsistent with current federal outsourcing initiatives.

Finding 2c. Regional offices, area offices, water and power beneficiaries, and other stakeholders all perceive an ongoing need for a centralized, high-level center of science and engineering excellence within Reclamation. The committee believes that a thorough review and evaluation of the TSC and its policies and procedures could result in a smaller, more efficient and effective TSC.

Recommendation 2a. The commissioner should undertake an in-depth review and analysis of the TSC to identify the needed core technical competencies, the number of technical personnel, and how the TSC should be structured for maximum efficiency to support the high-level and complex technical needs of Reclamation and its customers. The proper size and composition of the TSC are dependent on multiple factors, some interrelated:

- Forecast workload,
- Type of work anticipated,
- Definition of activities deemed to be inherently governmental,
- Situations where outsourcing may not be practical,
- Particular expertise needed to fulfill the government’s oversight and liability roles,
- Personnel turnover factors that could affect the retention of expertise, and
- Needs for maintaining institutional capability.

This assessment and analysis should be undertaken by Reclamation’s management and reviewed by an independent panel of experts, including stakeholders.

Recommendation 2b. The workforce should be sized to maintain the critical core competencies and technical leadership but to increase outsourcing of much of the engineering and laboratory testing work.

Recommendation 2c. Alternative means should be developed for funding the staff and operating costs necessary for maintaining core TSC competencies, thereby reducing the proportion of engineering service costs reimbursable by customers.

Reclamation Laboratory and Research Activities

These functions include those activities that require either the exercise of discretion in applying Government authority or the making of value judgments in making decisions for the Government.” See Chapter 3 for a detailed discussion.

Finding 3. Reclamation’s laboratory and research activities came of age during the era of large dam construction in the twentieth century, when much of the needed expertise resided in the federal government and there were no laboratories capable of handling the necessary work. The needs for large materials, hydraulics, and geotechnical laboratories are much different today because the types of capabilities needed to carry out Reclamation’s mission have evolved and are available from other organizations (government, university, and private). Although the need for research on the environmental and resource management continues to grow, the committee believes that the size of the laboratory organization and its physical structure may be too large.

Recommendation 3a. Reclamation’s Research Office and laboratory facilities should be analyzed from the standpoint of which specific research and testing capabilities are required now and anticipated for the future; which of them can be found in other government organizations, academic institutions, or the private sector; which physical components should be retained; and which kinds of staffing are necessary. The assessment should also recognize that too much reliance on outside organizations can deplete an effective engineering capability that once lost is not likely to be regained. In making this assessment Reclamation should take into account duplication of facilities at other government agencies, opportunities for collaboration, and the possibility for broader application of numerical modeling of complex problems and systems.

Recommendation 3b. Considering that many of the same factors that influence the optimum size and configuration of the TSC also apply to the research activities and laboratories, Reclamation should consider coordinating the reviews of these two organizations.

Outsourcing

Finding 4a. From its inception, Reclamation has been an organization that has undertaken difficult, highly technical projects with a talented and dedicated workforce of engineers and craftsmen. Reclamation’s tasks have changed and the composition of its workforces have changed accordingly, but it continues to be an organization that primarily executes engineering and construction for O&M and some rehabilitation and modernization. Reclamation has been outsourcing some of its O&M functions, primarily in nontechnical areas, but could outsource more. The committee believes that many of Reclamation’s activities are not what would generally be considered essentially governmental. The committee further believes that although water operations policy decisions are essentially governmental, implementation of these decisions is not and could be almost completely outsourced.

Finding 4b. Decisions on which personnel to use—area, regional, TSC, or contractors—tend to be made at the regional level and on an ad hoc basis. Decisions often hinge on the availability of federal employees to do the work. There is increasing pressure on Reclamation to allow water districts, Indian tribes, and other customers to undertake their own planning, design, and construction management functions.

Recommendation 4. Reclamation should establish an agency-wide policy on the appropriate types and proportions of work to be outsourced to the private sector. Operations and maintenance and other functions at Reclamation-owned facilities, including field data collection, drilling operations, routine engineering, and environmental studies, should be more aggressively outsourced where objectively determined to be feasible and economically beneficial.

Planning for Asset Sustainment

Finding 5a. The committee observed effective systems for planning and executing facility O&M in some regions. The 5- and 10-year plans based on conditions assessments and maintenance regimes form the core of the process. The result is an infrastructure that appears able to support Reclamation's mission for the foreseeable future.

Finding 5b. The O&M burden for an aging infrastructure will increase, and the financial resources available to Reclamation, its customers, and contractors may not be able to keep up with the increased demand. Some water customers already find full payment of O&M activities difficult, and major repairs and modernization needs, if included in the O&M budget, impose an even greater financial burden that cannot be met under the current repayment requirements. Long-term sustainment will require more innovation and greater efficiency in order to get the job done.

Finding 5c. The committee observed extensive efforts and success in benchmarking Reclamation's hydropower activities; however, there appears to be little effort to benchmark the O&M of water distribution facilities. The committee believes that benchmarking can help improve the efficiency of Reclamation's water management and distribution activities as well as those of the water contractors responsible for transferred works.

Recommendation 5a. Because effective planning is the key to effective operations and maintenance, Reclamation should identify, adapt, and adopt good practices for inspections and O&M plan development for bureauwide use. Those now in use by the Lower Colorado and Pacific Northwest regions would be good models.

Recommendation 5b. Reclamation should formulate comprehensive O&M plans as the basis for financial management and the development of fair and affordable repayment schedules. Reclamation should assist its customers in their efforts to address economic constraints by adapting repayment requirements that ease borrowing requirements and extend repayment periods.

Recommendation 5c. Benchmarking of water distribution and irrigation activities by Reclamation and its contractors should be a regular part of their ongoing activities.

Project Management

Finding 6a. Reclamation does not have a structured project management process to administer planning, design, and construction activities from inception through completion of construction and the beginning of O&M. Projects are developed in three phases: (1) planning (including appraisal, feasibility, and preliminary design studies), (2) construction (including final design), and (3) operations and maintenance, with each phase having a different management process.

Finding 6b. The *Reclamation Manual* includes a set of directives for managing projects, but it is incomplete, and there is insufficient oversight of its implementation. Central oversight of some projects is being developed in the Design, Estimates, and Construction Office, but policies and procedures have not yet been developed.

Finding 6c. Reclamation needs to recognize project management as a discipline requiring specific knowledge, skills, and abilities, and to require project management training and certification for its personnel who are responsible for project performance. The committee observed the appointment of activity managers in the Pacific Northwest region who were responsible for communications and coordination among project participants for all phases of the project. These activity managers appeared to be beneficial for the execution of projects, but the committee believes that a project manager with responsibility and authority to oversee projects from inception to completion could be even more effective.

Finding 6d. Reclamation has long-standing experience and expertise in planning, designing, and constructing water management and hydroelectric facilities, yet recurring problems are affecting the agency's credibility for estimating project costs. The cost estimating problems associated with the Animas–La Plata Project are a notable example. This project was submitted for appropriations with an incomplete estimate and became a serious problem for Reclamation. Comprehensive directives on the cost estimating process have been drafted but have not yet been published. These directives require that a feasibility estimate must be completed before a project is submitted for appropriations.

Recommendation 6a. Reclamation should establish a comprehensive and structured project management process for managing projects and stakeholder engagement from inception through completion and the beginning of operations and maintenance.

Recommendation 6b. Reclamation should develop a comprehensive set of directives on project management and stakeholder engagement that is similar to TSC directives for agency-wide use.

Recommendation 6c. Reclamation should establish a structured project review process to ensure effective oversight from inception through completion of construction and the beginning of O&M. The level of review should be consistent with the cost and inherent risk of the project and include the direct participation of the commissioner or his or her designated representative in oversight of large or high-risk projects. The criteria for review procedures, processes, documentation, and expectations at each phase of the

project need to be developed and applied to all projects, including those approved at the regional level.

Recommendation 6d. A training program that incorporates current project management and stakeholder engagement tools should be developed and required for all personnel with project management responsibilities. In addition, project managers should have professional certification and experience commensurate with their responsibilities.

Recommendation 6e. Reclamation should give high priority to completing and publishing cost estimating directives and resist pressures to submit projects to Congress with incomplete project planning. Cost estimates that are submitted should be supported by a design concept and planning, environmental assessment, and design development documents that are sufficiently complete to support the estimates. Reclamation should develop a consistent process for evaluating project planning and the accuracy of cost estimates.

Acquisition and Contracting

Finding 7. Different Reclamation regions employ a different set of contracting approaches and use a variety of contracting vehicles to meet their acquisition needs. These range from indefinite delivery/indefinite quantity (IDIQ) contracts with multiple vendors to reverse auction or performance-based contracting techniques to achieve more cost-effective results. In addition, regions are employing innovative approaches for maintaining stakeholder involvement in the contracting process.

Recommendation 7. Reclamation should establish a procedure and a central repository for examples of contracting approaches and templates that could be applied to the wide array of contracts in use. This repository should be continually maintained and upgraded to allow staff to access lessons learned from use of these instruments.

Relationships with Sponsors and Stakeholders

Finding 8. The committee believes that the key to effective relationships between Reclamation and its sponsors and stakeholders is open communication and an inclusive process for the developing measures of success. In addition, the more transparent and consistent the processes used by Reclamation, the easier it will be to obtain buy-in from sponsors and stakeholders. The Lower Colorado Dams Office's interactions with its coordinating committee of sponsors illustrates the beneficial effects of these factors and their contribution to successful operations of the project.

Recommendation 8. Making information readily available about processes and practices, both in general and for specific projects and activities, should be a Reclamation priority. Successful practices, such as those used in the Lower Colorado Dams Office, should be analyzed and the lessons learned should be transferred, where practical, throughout the bureau.

Workforce and Human Resources

Finding 9a. Reclamation and other federal agencies recognize that successful outsourcing of technical services requires maintaining technical core competencies to develop contract scope, select contractors, and manage contracts, and that it is necessary for agency personnel to execute projects as well as to receive continuing training in order to maintain those competencies.

Finding 9b. Reclamation's current work is dominated by two categories of tasks: (1) the operation, maintenance and rehabilitation of existing structures and systems and (2) the creation and brokering of agreements among a variety of groups and interests affected by the management of water resources. The need to include a broad spectrum of stakeholders, particularly groups that represent environmental issues and American Indian water rights, considerably alters both the tasks of the agency and the skills required to accomplish them.

Finding 9c. Reclamation employees appear on the whole to be more motivated by complex technical tasks than by tasks that are socially and politically complex. However, an increasing proportion of the work that employees at all levels engage in involves tasks that are socially and politically complex. Reclamation's current mission requires personnel to be equipped to address both technical uncertainties and the ambiguities of future social and environmental outcomes.

Recommendation 9a. Reclamation should do an analysis of the competencies required for its personnel to oversee and provide contract administration for outsourced activities. Training programs should ensure that those undertaking the functions of the contracting officer's technical representative functions are equipped to provide the appropriate oversight to ensure that Reclamation needs continue to be met as mission execution is transferred.

Recommendation 9b. In light of the large number of retirements projected over the next few years and the potential loss of institutional memory inherent in these retirements, a formal review should be conducted to determine what level of core capability should be maintained to ensure that Reclamation remains an effective and informed buyer of contracted services.

Recommendation 9c. Reclamation should recruit, train, and nurture personnel who have the skills needed to manage processes involving technical capabilities as well as communications and collaborative processes. Collaborative competencies should be systematically related to job categories and the processes of hiring, training, evaluating the performance of, and promoting employees.

Recommendation 9d. Reclamation should facilitate development of the skills needed for succeeding at socially and politically complex tasks by adapting and adopting a small-

wins³” approach to organizing employee efforts and taking advantage of the opportunities to celebrate and build on successes.

Alternative Scenarios for Future Infrastructure Management

Finding 10. While the committee recognizes that the major changes suggested by the alternative scenarios are inappropriate for immediate implementation, the continuation and intensification of identified trends, as described in this report, could lead to a need for dramatic changes in Reclamation's operations and procedures in the years to come. The three future scenarios presented in this report—(1) a centrally located project management organization, (2) outsourced O&M, and (3) federal funding and local execution—provide a basis for anticipating future trends and preparing for future change.

Recommendation 10. Reclamation should consider the suggested future scenarios as a basis for analyzing longer-term trends and change.

REFERENCE

U.S. Bureau of Reclamation (USBR). 2005. Bureau of Reclamation-About Us. Available at <http://www.usbr.gov/main/about/>. Accessed July 29, 2005

³ A small-wins strategy involves working on complex social problems by laying out tasks that can be accomplished without a huge amount of coordination. This strategy puts more control in the hands of individuals, reduces anxiety levels, and makes it possible for people to succeed in ways that can be celebrated and built upon. (See pages 4-12 to 4-13 for a description of this strategy.)