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Coping with the Biggest Water Year Ever on the Sacramento River System

by Maurice Roos, ChiefHydrologist, California Department of Water Resources, Sacramento, California (mroos@water.ca.gov)

Editor's note: This paper was presented during the recent /CID International Executive Council Meeting, Saskatoon, Canada, August 2018.

Water year 2016-17 produced the biggest runoff amount of record on the Sacramento River of Northern California. The volume slightly exceeded the previous record from 1983; the volume of runoff was estimated to be 37 .82 million acre-feet, for the October through September water year period. In the southern half of the Central Valley, San Joaquin River runoff in 1983 was 15.01 maf, slightly more than the 2017 runoff of 14.84 maf. The Sacramento River system relies on a system of levees and flood bypasses to handle excessive flow, along with flood control operation of six reservoirs in the foothills.

Guidance for reservoir operators is provided by state and federal flood forecasters in a joint program in the California-Nevada River Forecast Center in Sacramento.

Precipitation accumulation for the Sacramento River basin is monitored by a set of

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A Turning Point: Reclamation and Recreation

by Patricia Rettig, Water Resources Archive, Colorado State University Libraries, Fort Collins, Colorado

> *"These people, the Easterner, the Southerner, the Midwesterner, the lawyer, the doctor, the merchant, the butcher, the baker, the candlestick maker, should be enlisted in the cause for recreation through reclamation. "-/val Goslin, November 30, 1961*

Many people recognize the decade of the 1960s as a time of significant change in the United States. However, few probably think of the pivot the Bureau of Reclamation took to embrace recreation as part of its prime advocacy for dam-building projects.

In the earliest decades of the U.S. Bureau of Reclamation (formed in 1902 as the Reclamation Service), recreation was not a consideration. Dams were built for the single purpose of creating reservoirs to store water for irrigation. As time went on, other benefits were added to projects, including power production, flood control, and recreation. The 1930s construction of Hoover Dam included all of these multipurpose features. By the late 1950s, the Bureau was incorporating "recreation functions and values in its project planning" even though no national policy required

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President's Message

I recently completed my first year as one of nine Vice Presidents of the International Commission on Irrigation and Drainage (ICID). In looking back at the last year, I learned quite a bit about ICID. Being a member of USCID means that you are automatically a member of ICID. Since we are doing a membership challenge for USCID, I thought it would be useful to describe some of the benefits that come with being an ICID member through USICD.

First of all, ICID is made up National Committees (NC) from countries around the world. USCID is the NC from the United States. That means you are automatically a member of ICID when you join USCID. ICID has one meeting and several regional conferences throughout the year. For example, the next annual meeting will be held September 1-7, 2019, in Bali. The next regional conference is the 9th International Micro-Irrigation Conference, January 16-18, 2019, in Aurangabad, India. These meetings are a great place to meet colleagues and network. They are also an opportunity to get involved with the various Working Groups of ICID. Working Groups are focused on investigating a certain topic. Examples are the Working Group on Irrigation Development and Management and the Working Group on

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Inside ...

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The United States Committee on Irrigation and Drainage is a National Committee of the International Commission on Irrigation and Drainage.

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The Mission of USCID is to promote progressive and sustainable irrigation, drainage and flood control practices in support of food and fiber production and public safety, recognizing that sustainability embodies economic, social and environmental goals.

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ICID News and Activities

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ICID Meets in Saskatoon, Canada

The 69th ICID International Executive Council Meeting was held August 12-17, 2018, in Saskatoon.

USCID was well represented at the Meeting. The U.S. delegation was led by USCID President Brian Wahlin. Also attending were members Frank and Ethel Dimick, Chuck Kohlaas, Martin and Jan Roche, Maury Roos, Sam Schaefer, Blair Stringam, Tom Trout, and Darell and Suzanne Zimbelman.

During the IEC Meeting, reports of the Permanent Committees on Technical Activities, Finance and Strategy and Organization were presented. **Brian Wahlin** was appointed Chairman of the Committee on Strategy and Organization. Marco Arcieri (Italy), Kamran Emami (Iran) and Ahmed El Bouari (Morocco) were elected Vice Presidents, replacing Charlotte de Fraiture (The Netherlands) Ian William Makin (United Kingdom), and Abdelhafid Debbarh (Morocco), whose three-year terms ended. Best Paper in the 2017 issues of *Irrigation and Drainage*, and WatSave Awards were presented. The IEC approved World Heritage Irrigation Structure nominations from China, India, Italy, Japan and Sri Lanka.¤

Larry Stephens, Laurie Tollefson (Canada), and Maurine and Peter Lee (UK) enjoy a reception hosted by the Australian National Committee in Saskatoon.

ICID to Meet in Bali during 2019

The Indonesian National Committee of ICID will host the 3rd World Irrigation Forum and the 70th ICID IEC Meeting, September 1-7, 2019, at the Bali Nusa Dua Convention Centre, Bali, Indonesia.

The week's activities will include ICID workbody meetings, social events, exhibition, and technical tours. A post-meeting study tour will also be offered.

The triennial World Irrigation Forum brings together multiple types of stakeholders involved in irrigation, including policy makers, experts, research institutions, non-governmental organizations and farmers.

WIF3 will focus on the theme, ***Development for water, food and nutrition security in a competitive environment*** and will cover a wide range of topics under three sub-themes:

- Enabling policy environment for water, food and energy security
- Role of civil society and NGOs with focus on farmers and extension facilities
- Improving agricultural water productivity with focus on rural transformation

A call for papers has been issued, and abstracts are due February 1, 2019. Visit www.icid.org/WIF3_Call_for_Papers.pdf for more information.¤

Nominations Sought

Nominations are invited from ICID National Committees for selection of **World Heritage Irrigation Structures** that includes both old operational irrigation structures as well as those having an archival value. During the 69th International Executive Council meeting held in Saskatoon, 14 World Heritage Irrigation Structures were approved for inclusion in the ICID Register of Heritage Irrigation Structures. Visit the ICID website at www.icid.org/icid_his1.html to view.

Nominations for the annual **WatSave** awards are also invited. WatSave awards recognize outstanding contributions to water conservation or water saving in agriculture across the world. Awards are given to individuals or a team of individuals, and nominations must demonstrate actual realized savings.

WatSave awards are given in four categories:

- Technology
- Innovative Water Management
- Young Professionals
- Farmer

Please contact USCID, info@uscid.org, for more information on submitting nominations for either the World Heritage Irrigation Structures award or the WatSave awards.¤

Reclamation Focus is on Infrastructure

The Trump administration has made it clear that the era of building ambitious water storage projects is not over.

During a recent conference of the Idaho Water Users Association, Bureau of Reclamation Commissioner Brenda Burman told attendees that the administration and Interior Secretary Ryan Zinke are "very focused" on infrastructure, and Reclamation wants to partner with water users to bring new projects forward. "We are here and ready to work on projects, infrastructure in the West. Take advantage of that. It's not that big a window. It's going to go by incredibly fast," she said.

The Fiscal Year 2019 appropriations bill recently signed by the President provides more than $1.5 billion for Reclamation, representing an increase of more than $400 million over the agency's FY 2018 budget. The legislation includes $134 million for water slorage projects authorized in the Water Infrastructure Improvements for the Nation **(WINN)** Act, which is overseen by the Bureau of Reclamation.

As a further indication of his commitment to water infrastructure projects, on October 19 Trump ordered the government to speed up environmental reviews and streamline regulations that he says are hindering work on major water projects in California and other Western states. Trump signed a memorandum aimed at helping the Central Valley Project and the California State Water Project in California, the Klamath irrigation Project in Oregon and California, and the Columbia River Basin system in the Pacific Northwest.

Delbert Smith, Manager, Water Resources Planning and Operations Support, Bureau of Reclamation, gave a presentation during the recent USCID 11th International Conference on Jrrigation and Drainage in Phoenix. He identified nine Reclamation infrastructure storage priorities for California:

- Friant-Kern Capacity Correction
- Upper San Joaquin River Basin Investigation
- Del Puerto
- San Luis Low Point
- BF Sisk Dam Raise
- Los Vaqueros Expansion Study - Phase 2
- Alder Creek
- North of Delta Off-Stream Storage
- Shasta Dam Raise

The renewed commitment to infrastructure projects comes as good news to many water stakeholders in the West.:tt

Drought Response Program

The Bureau of Reclamation is proactively addressing drought. Through its Drought Response Program, Reclamation is supporting a proactive approach to drought by providing assistance to water managers to develop and update comprehensive drought plans and implement projects that will build long-term resiliency to drought.

Through contingency planning, Reclamation provides financial assistance on a competitive basis for applicants to develop a drought contingency plan or to update an existing plan. Most of these plans are structured to address three questions:

- How will we recognize the next drought in the early stages?
- How will drought affect us?
- How can we protect ourselves from the next drought?

The planning process is also structured to encourage an open and inclusive planning effort that employs a proactive approach to build long-term resiliency to drought.

Reclamation also funds projects that provide for drought resiliency. These projects assist communities prepare for and respond to drought. Typically, these types of projects are referred to as "mitigation actions" in a drought contingency plan.

Reclamation will fund projects that will build resiliency to drought by:

- Increasing the reliability of water supplies
- Improving water management
- Providing benefits for fish and wilcllife and the environment

Reclamation continues to undertake emergency response actions under the Drought Response Program to minimize losses and damages resulting from drought. Emergency response actions are crisis driven actions in response to unanticipated circumstances.

Eligible emergency response actions are limited to temporary construction activities and other actions authorized under Title I that do not involve construction of permanent facilities, including water purchases and use of Reclamation facilities to convey and store water.

For more information, visit www .usbr.gov/drought.:tt

Missouri Report

Larger-than-average releases from all Missouri River Mainstem System projects, including Gavins Point, will continue through the fall. "Due to this year's high runoff and the water currently being stored in the reservoirs, Gavins Point releases will remain near 58,000 cfs for the remainder of the navigation season to ensure evacuation of all stored flood waters prior to the 2019 runoff season," said John Remus, Chief of the Corps of Engineers Missouri River Basin Water Management Division.

The 2018 runoff forecast in the Missouri River Basin above Sioux City, Iowa, is 40.6 million acre feet, 160 percent of average. The Missouri River Mainstem reservoir system storage was 62.2 MAF as of October 1, occupying 6.1 MAF of the 16.3 MAF flood control zone.

The six 11aiusl11 power planls generated 1,222 million kWh of electricity in September, compared to the long-term average of 9.3 billion kWh.:tt

Biggest Water Year (continued)

eight stations in the mountain watershed (Figure 1). The 8-station Northern Sierra record for WY 2017 is shown in Figure 2, including that of the two previous years. The water year starts in October; that month was very wet November was less than normal, then December was above average, followed by a very wet January and February, which were both far above average. March was near average, followed by a very wet April. Several atmospheric rivers generated large flood flows, including the storms causing the Oroville spillway failure. The mountain snowpack (Figure 3) was 160 percent of average on April 1, not a record but a very big pack. Figure 4 shows the historical record of the snowpack on the first of April, usually the time of maximum accumulation.

By and large these very large runoff flows were handled well to avoid much

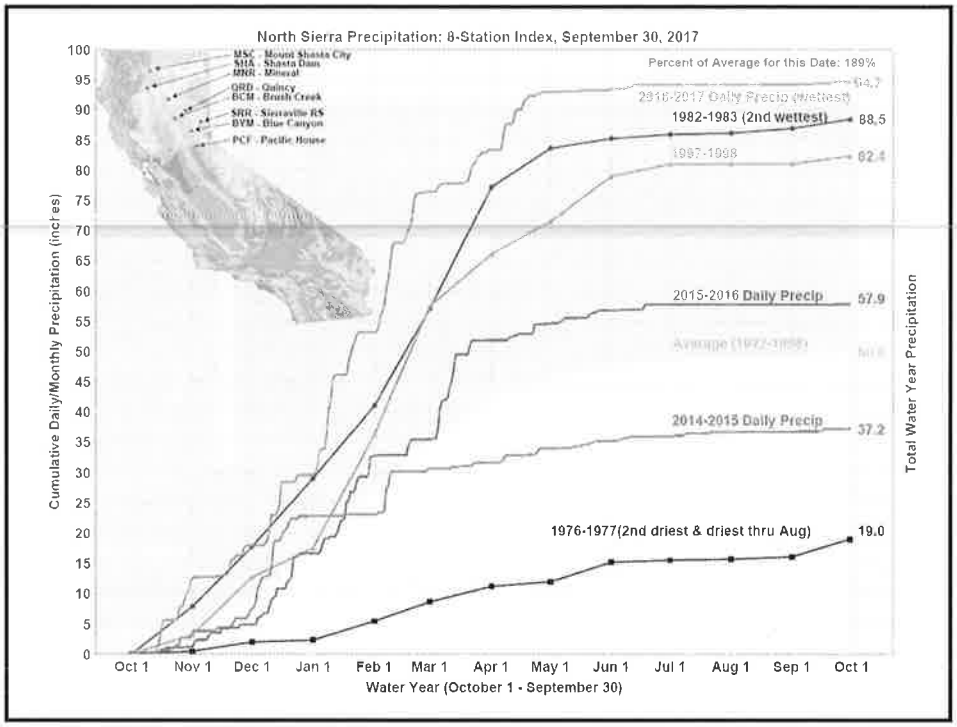

Figure 1. Northern Sierra 8-Station Precipitation Index Chart.*

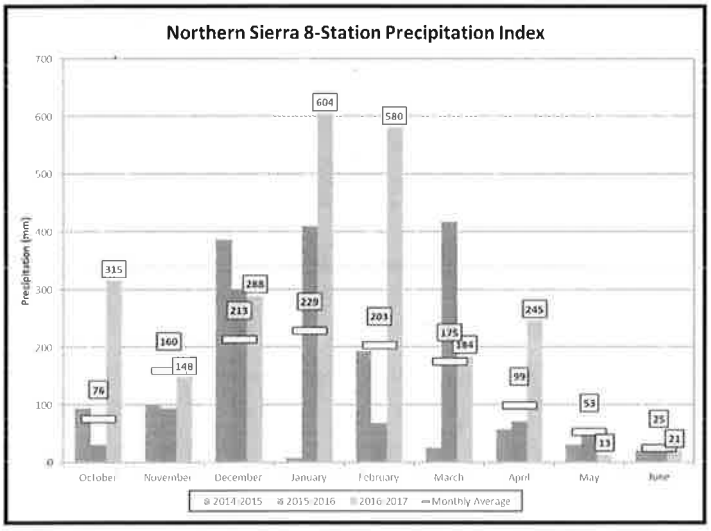

Figure 2. Northern Sierra 8-Station Precipitation Index.

flood damage by temporary flood storage in six reservoirs and in the Sacramento River and bypass floodways. An important part of the operation was guidance to reservoir operators on anticipated runoff for the major mountain rivers including the forecasts of snowmelt runoff in the spring and early summer. Typically, operational forecasts by the California-Nevada River Forecast Center (a joint federal-state operation in Sacramento) are made during the rainy season of reservoir inflow and uncontrolled stream runoff out to five days and updated a couple of times a day during storms. The projected snow level is an important component of the runoff forecasts and, later, the snow volume is a major factor in refilling major foothill reservoirs later in the spring.

The Sacramento River system (Figure 5) is sized for winter flood flows; peak snowmelt rates are quite a bit less but can be a problem due to seepage to farm lands near the valley rivers. The smaller capacity of the San Joaquin River flood system to the south, about one tenth that of the Sacramento, can be impacted by high rates of snowmelt in the spring, so the snowmelt forecasts are of more importance there. Figure 6 shows the monthly pattern of unimpaired (natural) runoff for the Sacramento River system in water year 2017.

As floods go, the 2017 Feather River flood at Oroville was not a record, ranking fourth in 115 years of record. The peak daily inflow was about

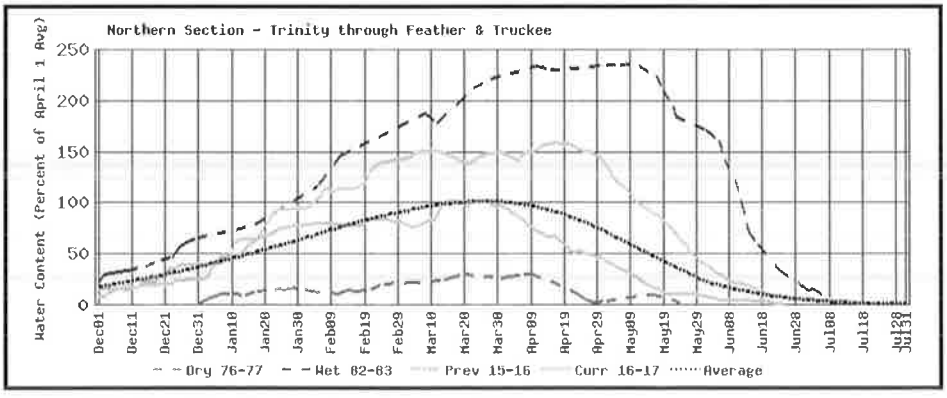

Figure 3. 2017 Water Year Northern Sierra Snowpack Buildup.

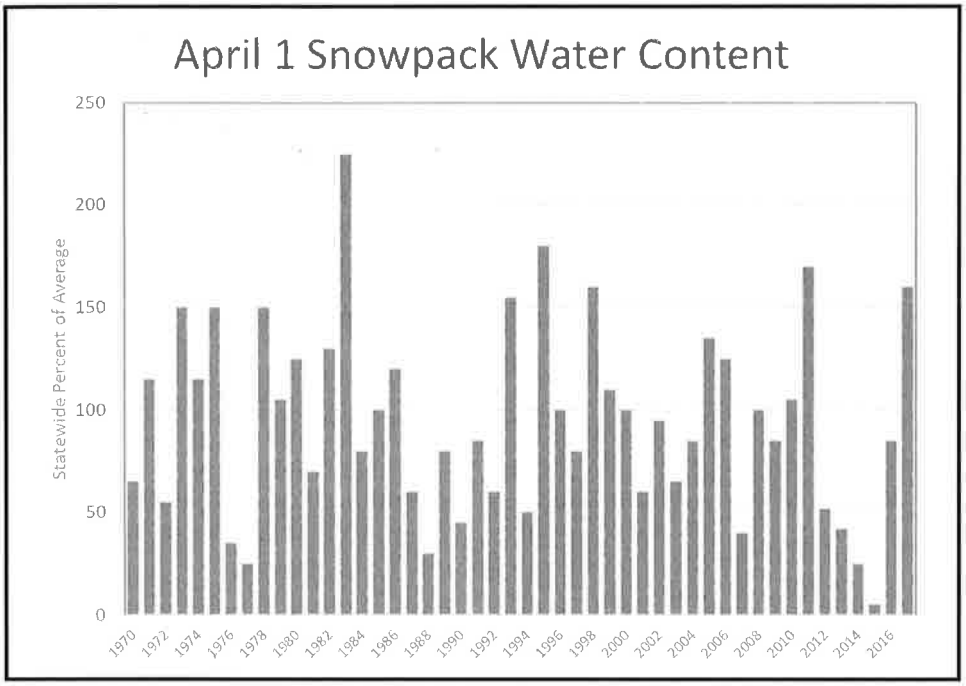

Figure 4. Statewide April 1 Snowpack Water Content (1970-2017).

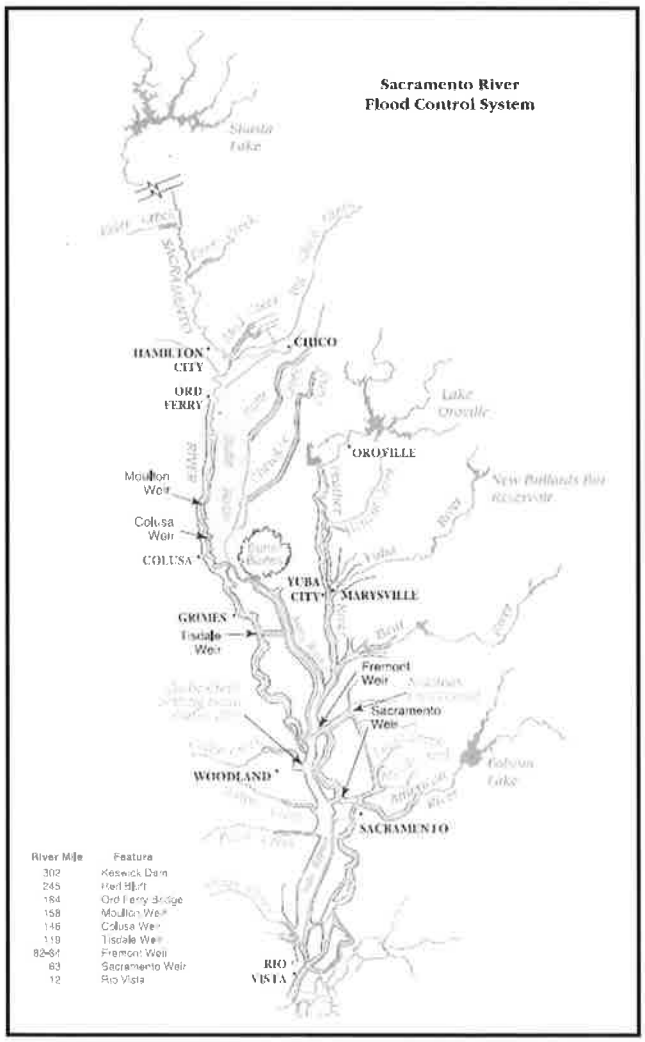

Figure 5. Sacramento River Flood Control System.

155,000 cfs on February 9. For reference, the flood in early January 1997 was considerably larger, at 274,000 cfs. Lake Oroville started the flood season less than half full in December of 2016. By mid-January, inflow had increased lake storage into the flood control pool and so modest spillway flood control releases were made. Then there was a lull for a couple of weeks until the second week of February which saw a major winter storm with high snow levels and high flood runoff. The spillway gates were then opened further, but it was a big surprise when a hole developed in the spillway as the storm was underway. A decision was made to use the auxiliary emergency spillway. Erosion at the base of it began to progress faster than expected, so the county sheriff's office issued a mandatory evacuation order for the Oroville area. To ease pressure on the emergency spillway, the main spillway was reopened with outflows of about 100,000 cfs and emergency spillway overflow soon stopped. However, these spillway releases badly damaged the lower portion of the main spillway which had to be largely rebuilt the following dry season (Figure 7).

As one might expect, there was a lot of coordination during the season with meteorologists, flood forecasters and reservoir and levee system operators during the season carried out through the state-federal flood center. During the height of the season, daily weather and flood forecast briefings in the Flood Center were made available to all major groups involved in reservoir and flood operation by phone and video. This sharing of operational information is a vital component of flood and water supply operations in Central California.

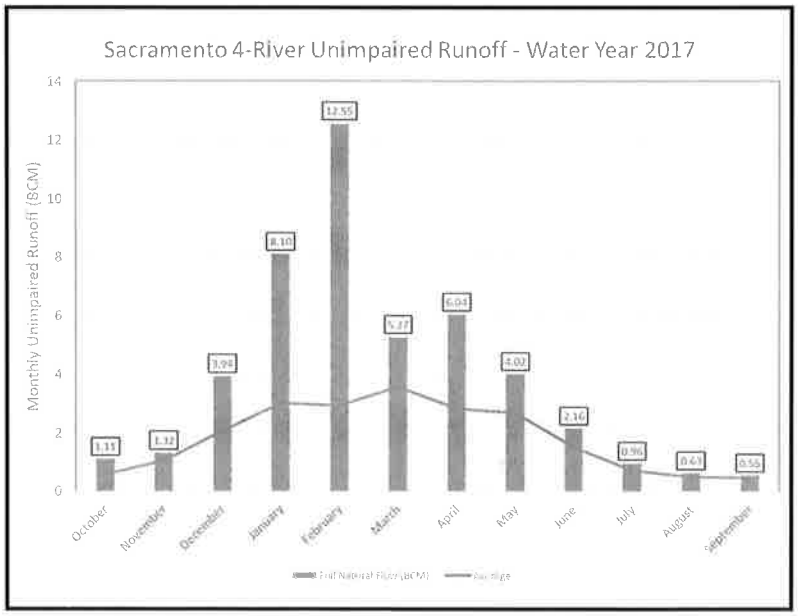

Figure 6. Sacramento 4-River Unimpaired Runoff for Water Year 2017.

Figure 7. Oroville Spillway on February 27, 2017.

The final chart, Figure 8, shows the variability of the runoff history of the Sacramento River system during the last 60 years.

*Note: Color versions of the figures may be obtained by contacting USCID, info@uscid.org.¤

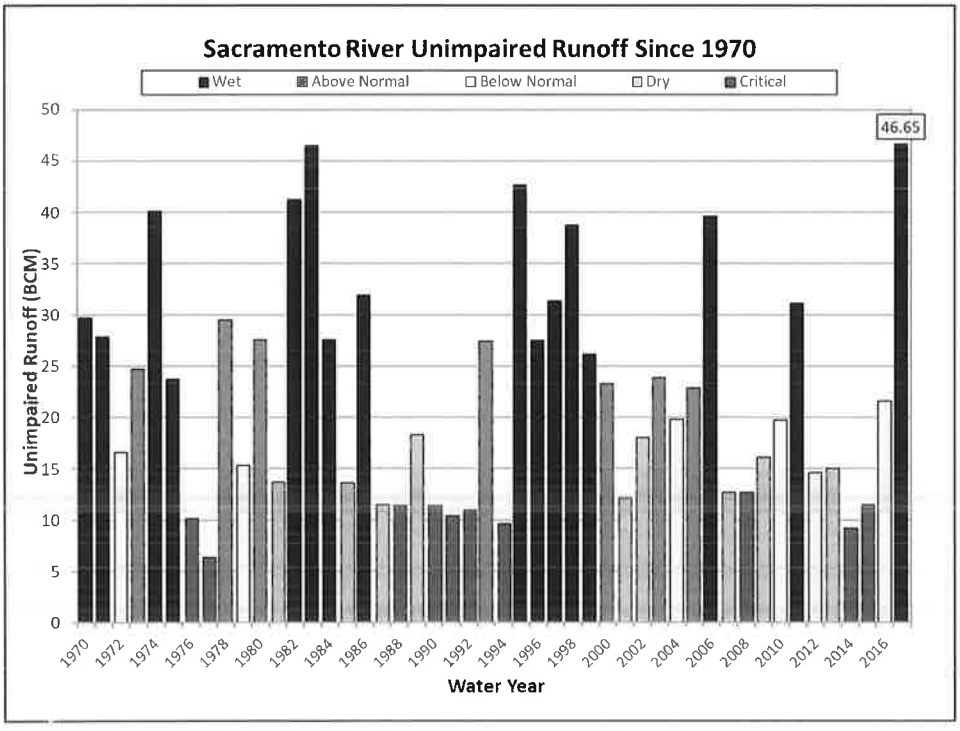

Figure 8. Sacramento River Region Unimpaired Runoff (1970-2017).

Reservoir Sediment Competition Announced

The Bureau of Reclamation is launching a new prize challenge seeking new or improved techniques to remove sediment from reservoirs in a cost-effective manner. Sedimentation in reservoirs can be a significant problem by limiting the active life of reservoirs by reducing available water storage capacity or flood control benefits. Sedimentation also impacts dam outlets, reservoir water intakes, water quality, recreation, upstream flood stage, and downstream habitat.

This is a theoretical challenge where solvers provide ideas on sediment collection, transport or delivery to the downstream river. Solvers are asked to submit their idea with detailed descriptions, drawings, illustrations, specifications, supporting data or literature.

In this first stage, a total prize pool of $75,000 is available. If this first stage produces winning concepts and Reclamation determines a second stage is beneficial, it will launch a subsequent challenge where participants will be asked to present their proposal and provide a working prototype. In addition to an anticipated higher monetary award, Reclamation will invite industry, non-profit organizations, and venture capital representatives to the Stage 2 presentations and testing.

Submissions for this competition must be submitted by January 4, 2019. To learn more, go to www.usbr.gov/research/challenge/index.html.¤

A General Description of Irrigation Water Charging in the U.S.

by Blair L. Stringam, Chairman of USCID Committee on Technical Activities, and New Mexico State University, Las Cruces, New Mexico.

Editor's note: This paper was prepared for the ICID WATSave Working Group.

Introduction

This paper is a general description of irrigation water charging in the United States. The term "general description" is emphasized because there are numerous irrigation water supply organizations in the U.S. and there are slight differences in pricing methods in many of these organizations.

Water Supply Organizations

There are two basic irrigation canal water supply organizations (WSO) in the United States. They are either canal companies or irrigation districts. Both organizations generally oversee the operation and maintenance of a water supply system that conveys water from a water source to the water users that are associated with the organization.

WSOs are organized from a local membership of individuals that receive water from the organization. The majority of these organizations are fully funded by the members of the WSO. The WSO manages a water supply system that may consist of a river diversion and a series of canals that convey water to individual farm fields or they may have a dam and canal system that transports water to farm fields. It should be noted that water that is diverted from natural streams into irrigation canals often has a different cost when compared to water that is diverted from a dam into a canal delivery system. Also, water that is pumped into a canal distribution system will likely have a different cost when compared to water that flows by gravity into a canal system.

WSO Expenses

These WSOs usually have a board of directors, a general manager, office personnel and gate tenders or ditch riders. The board of directors are usually elected from the group of water users that are members of the WSO. Each year the manager of the organization determines the projected expenses for the coming irrigation season. Many of these expenses are listed below:

- Organization staff salaries and benefits
- Staff training costs
- Building maintenance costs
- Building rent
- Machinery maintenance and replacement costs
- Vehicle costs
- Insurance
- Yearly operation costs
- Canal structure maintenance costs
- Canal maintenance costs
- Canal upgrade costs
- Canal structure replacement costs
- Chemical expenses to control aquatic weeds and weeds on canal banks
- Water storage costs
- Water pumping costs
- Major future system upgrades

It should be noted that not all of these expenses apply to every canal company. In addition there may be expenses that have not been included in this list.

Once the manager determines all of the yearly costs, they are presented to the board of directors which approves these costs or considers adjustments that may have to be applied. When the costs are totaled, they are used to determine the cost of operation for the WSO. These expenses are then divided over the number of people that receive water from the organization.

Assessments

However, there are often additional considerations when assessing costs for each water user. Most WSOs are legally entitled to a natural water source based on the amount of water that is available and on the number of other WSOs and municipalities that also have a right to the natural waters in the area. Water users that are part of a WSO will have a right to a portion of the total water that the organization has available for that particular season. The water user right is either based on the amount of irrigable acres that they have registered with the WSO or their right is based on an historical water use that is tied to them personally or to the property that they own and or irrigate. Some WSOs have a total number of shares and members of the organization own shares in the organization.

The total amount of money that the water user is assessed to pay by the WSO is usually based on the water right of the individual land owner or on the amount of irrigable acreage for that water user or the number of shares that are held in the organization.

The assessed fee has to be paid in order for the water user to receive his proportion of the water. It should be noted that the water assessment is not usually determined based on the total amount of water that is provided to the user that year. Instead the individual pays an assessment based on the total irrigable acres or water right or shares that are held by the individual water user. In some cases, the irrigation water organization may not be able to deliver the full amount of water that is normally available for the irrigation season. If that is the case, the individual water users receive less water in proportion to the water right or the irrigable acreage or shares that their water allotment is based on. If this is the case, the water user still has to pay the assessed fees regardless of the amount of water that is delivered. This is done because the irrigation conveyance system still has to be maintained even if there is less water provided.

In some cases, WSOs have hydropower generation systems within their system. The organization collects revenue from selling the power that is generated and these funds are used to offset the irrigation water conveyance costs. This

means that the water users pay less for the water that they use because the generation revenue pays some of the system costs.

In some cases, the WSO has a right to more water than the users can use in an irrigation season. If this is the case, they can sell the excess water to other WSOs or to municipalities. The sale of this water also helps to offset the water delivery cost and reduces the water costs to the water users.

In addition, water users may be able to sell water that they don't need to other water users or to other organizations. The ability to do this varies between WSOs and different US states based on laws within the state and the WSO. This sale of water can happen because water users have a right to an amount of water from the WSO. This gives them the right in many areas to sell the water if they decide that they will benefit more from the sale of water than from growing a crop.

It should be mentioned that a few WSOs simply charge the water user for the amount of water that is delivered. This charge is based on the total operation costs of the organization and the water user is simply charged based on the cost of delivering the water for the season. In this case there may be a difference in charges based on the total amount of water delivered to the water user.

Acequia System

There is a third method of delivering irrigation water, whereby charging for water is partially or completely accomplished through water users providing labor to the WSO. This method is based on a very old water delivery system/method called an Acequia. An Acequia is a community water supply organization that supplies water to water users in the area. Some of these organizations were established in New Mexico and southern Colorado when the Spanish settled in those areas more than 400 years ago.

The Acequia management consists of a Majordomo and 3 or more commissioners that oversee the distribution of water in the Acequia to the water users. This management group is selected from the group of water users that live within the Acequia. Acequia water users are expected to contribute labor particularly at the beginning of the irrigation season where the water conveyance system is cleaned and prepared for the coming water delivery year. There is a strong sense of community that is established in the Acequia where, individual users understand that if they divert water at the wrong time, it seriously affects other members of the Acequia. The individual members also understand that if they do not provide the necessary labor that is needed to maintain the Acequia it damages their ability to receive water as well as limits their neighbor's access to water.

When an Acequia needs major upgrades, the individual members are all assessed to help pay for the upgrade. Sometimes these upgrades require the Acequia to acquire a loan. The members of the Acequia would then be required to each make payments to pay off the loan.

Summary

As mentioned earlier, this is a general description of water charging from irrigation water supply organizations in the United States. In many cases there are variations in water charging between organizations because many of these organizations were established under different states, varied local laws and histories.¤

ICOLD Award

During the 2018 ICOLD Congress, USCID Executive Vice President Larry Stephens received the ICOLD Honorary Member Award, ICOLD's highest recognition. He served as USSD Executive Director from 1985 to 2016.

In his nomination, Mike Rogers, now President of ICOLD, noted that after assuming leadership of USSD, Stephens led a resurgence of the role of USSD in ICOLD. "Stephens instilled the importance of the critical connection between USSD and ICOLD in the operations of the USSD Board and its membership . . . he is well known and respected around the world for his participation and dedication to USSD and ICOLD, and ICOLD has truly been served by his hard work and dedication."¤

http://www.uscid.org

Updated USCID Website

by Steve Macaulay, Secretary, USCID, and Geosyntec Consultants, Inc.

www.uscid.org

During the past several months the USCID website has been updated in several respects. We have uploaded panel presentations from the June 2015 Reno conference and the October 2017 Sacramento conference. Both panels addressed emerging issues with groundwater, including interactions with surface water and new groundwater management requirements and efforts. We believe this information is useful to members and non-members alike. Of course, seeing all the presentations from our annual conferences is only possible by attending the conference, where you'll benefit from dialogue among panelists, Q&A between speakers and the audience, and of course networking with your colleagues.

We have made additional efforts thanks to Larry to keep fresh news on the website. The "USCID News" link is now in the main menu of the home page for better access. In order to give nonmembers a sense of value they'll receive as members, we also have included a link to a PDF of one of our past newsletters. As always, all newsletters are mailed to members. One of the issues the Board discussed last year was whether to convert to an electronic version of the newsletter. What we found was that many members really preferred a newsletter they could hold in their hand and keep handy for reference. This also works for our advertisers.

Consider looking at our website on a regular basis, for an update on news, links to sponsoring agencies and corporate sponsors, news on upcoming conferences, and of course our members-only page.¤

A Practical Approach to Water Budgets

by Owen E. Kubit, Provost & Pritchard Consulting Group, 2505 Alluvial Avenue, Clovis, California (okubit@ppeng.com).

Editor's note: The following paper was presented during the October 2017 USCID Conference in Sacramento, California.

Introduction

Water budgets are important tools for water managers to track water uses and losses, estimate groundwater overdraft, and evaluate the success of water conservation programs. California's Sustainable Groundwater Management Act (SGMA) will require many water areas to develop detailed water budgets. As a result, many California water agencies are evaluating different approaches to developing water budgets. In general, there are two types of water budget models: analytical models and numerical models. Analytical models include spreadsheets or other simple analysis tools. From here on, discussions on analytical models will be limited to spreadsheets. Numerical models, also called dynamic models, include more complex modeling programs, such as the united states geologic survey's modflow or the California Department of Water Resources' integrated water flow model (IWFM). Each type of model has pros and cons, which are discussed below.

Sustainable Groundwater Management Act

In 2014, California enacted landmark legislation known as the Sustainable Groundwater Management Act (SGMA) in response to years of groundwater overdraft throughout much of the state. The Act requires that medium- and high-priority groundwater basins achieve groundwater sustainability by 2040. In these areas, the Act requires the formation of local groundwater sustainability agencies that must assess local groundwater conditions and develop groundwater sustainability plans. These responsibilities are left in the hands of local authorities, but state intervention is possible if local authorities fail to meet the regulations.

Despite the importance of groundwater to the state, California lacked a statewide framework for regulating groundwater until the passage of SGMA in 2014. Prior To SGMA, groundwater was largely managed on a voluntary basis, and sustainable groundwater use was only required in a limited number of adjudicated basins. As a result, many agencies never saw the need, or took the effort, to develop a groundwater model or detailed water budget. Therefore, many agencies will need to develop new water budgets or enhance their current water budgets.

SGMA Water Budget Requirements

SGMA will require a water budget that evaluates historical, current and projected groundwater conditions. The water budget will need to be re-evaluated every five years. Annual reporting will also be required, but minimum reporting requirements only include the following:

- Groundwater levels
- Groundwater pumping
- Surface water use
- Total water use
- Change in groundwater storage.

The California Department of Water Resources does not mandate use of a numerical model for the water budgets and states the following:

"*If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.*" (State of California, 2016)

Published regulations and personal communication with the California Department of Water Resources clearly show that analytical models are permitted, but numerical models may be necessary to meet SGMA requirements. During a 2016 meeting with DWR staff on SGMA modeling requirements they emphasized two key points: 1) selection of a model approach is up to the local agency; and 2) numerical models are considered by DWR to generally be more accurate than analytical models. However, they also suggested that a combined approach using both analytical and numerical models may be the best alternative.

Comparison of Spreadsheet Models and Numerical Models

Spreadsheet and numerical models each have advantages and disadvantages. In general, spreadsheets are flexible, easily audited, do not require a modeling expert to modify, and may be appropriate for simple analyses. Numerical models can evaluate more complex situations, and therefore may be more accurate and suitable for modeling large areas.

The California Department of Water Resources provides a good summary of the pros and cons of both types of models below:

"Similar to the question of whether models should be used during GSP development is the question of the appropriate level of model complexity. Simple models require fewer data, less complex software, and are, therefore, often less expensive, and have much shorter run times. These characteristics are advantageous when focusing on a single undesirable result. However, simple models may overlook important system components and the interconnectedness of undesirable results, and may be difficult to calibrate to historical data. Complex models can incorporate more data and professional judgment. Therefore, they often result in a more accurate representation of the groundwater system. However, complex models are more expensive and difficult to build, require more data and more technical expertise, and the complexity can lead to a false impression of accuracy; a complex model may in fact be less accurate." (DWR, December 2016a)

Figure 1 illustrates several primary characteristics of water budget models. These characteristics are discussed below as they relate to spreadsheet and numerical models. The discussions are based on common knowledge of the two types of models, as well as the author's professional experience.

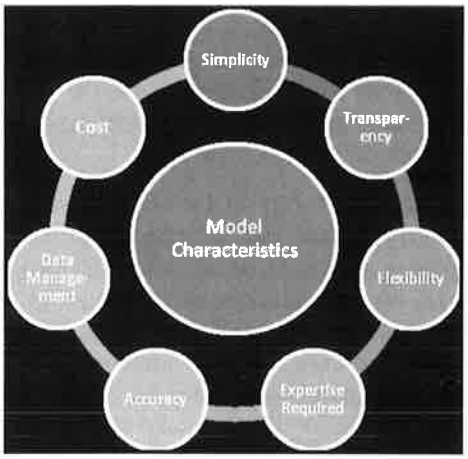

Figure 1. Water Budget Model Characteristics

Simplicity

Spreadsheets. Spreadsheets are generally simpler than numerical models. They have streamlined input, output and graphing capabilities. Spreadsheet models typically have simpler programming. They are also simpler since they are not as prone to extensive elaboration; in other words, spreadsheet formats limit the size and complexity of a usable model.

Numerical Models. Numerical Models are generally considered complex and require special software and modeling experts to compile or update. Numerical models can also accommodate large amounts of data and model complex processes.

Transparency

Spreadsheets. Spreadsheet models are valued for their transparency. In comparison, they are easier to follow and understand, easier to audit, and may be easier for government agencies to review too. The data and results can be easily communicated to water managers and the general public. Spreadsheets can also show the different stages in the development of the data so the results are easier to check and understand.

Numerical Models. Numerical models are less transparent due to their complexity and the nature of the software used. In the author's experience, these models are transparent to the modeler, yet that is because they have spent significant time collecting data, building the model and running simulations. That level of understanding is difficult to transfer to other parties that are interested in the model, but were not involved in the model development. This can result in a perception that the model is a 'black box,' with little to no understanding on how the model works. The black box perception can be addressed through education, involving the model sponsor in the model development, adequate model documentation, and post-processing of data. A common problem arises when the model sponsor chooses not to stay engaged in the model development since they hired a consultant to perform the work, yet they must have significant involvement if they are to understand a complex model.

Flexibility

Spreadsheets. Spreadsheets are very flexible and can be easily modified by anyone familiar with basic spreadsheet operations. They are easily customized and tailored to fit specific projects.

Numerical models. Numerical models are not as flexible as spreadsheets, however, with some effort they can be quite versatile. Each modeling program has its limitations that must be worked around. Some flexibility is also lost because modeling experts are required to operate them.

Expertise Required

Knowledge of water budgets is a required whether one uses a spreadsheet or numerical model. Water budgets require both hydrogeologists and water resources engineers with expertise in groundwater, surface water, water management, urban water use and agricultural water use.

Spreadsheets. Virtually all engineers and geologists use and understand spreadsheets. The spreadsheet functions needed to develop a water budget are common and simple. This simplicity can allow water agencies to create or update their own water budget models. Advanced spreadsheet functions, such as Visual Basic programming, can be used, but are not required for a water budget spreadsheet.

Numerical Models. Numerical models require specialized training and a fair amount of experience to be proficient. This can limit who can create and perform regular updates to the models. In most cases specialized consultants perform this work. These consultants commonly work full time on hydrologic models as a specialty.

Accuracy

Spreadsheets. Spreadsheet models can be limited in their accuracy since they are usually based on simple equations, a simplified framework, and limited dataset. In fact, if only limited data is available, then a numerical model may have little to no advantages over a spreadsheet model.

Spreadsheet models that consider interactions between different parameters are difficult to develop. DWR addresses this issue as follows:

"*Often only one component of a groundwater system is evaluated at a time, and this approach omits the evaluation of potential interactions with other components. For example, a spreadsheet could use a simple equation to estimate the aquifer drawdown in one location based on pumping at another location, without considering the potential influence of nearby streams.*" (DWR, December 2016a)

Stanford University (November, 2016)) also states that "*The assumptions required to model groundwater systems using analytical solutions limit their application to relatively simple systems.*"

Lastly, most spreadsheet models are based on an annual time-step, while numerical models often use a monthly time step, which helps to better simulate actual conditions and improve accuracy. Spreadsheets models use annual time-steps since monthly simulations become overwhelming with the spreadsheet's data management capabilities.

Numerical Models. Numerical models can be more accurate than analytical models since they can: 1) better

accommodate large data sets; 2) better accommodate a more frequent time-step; and 3) more efficiently process interactions between parameters. In other words, numerical models can perform large, complex analyses. However, numerical models, while typically more accurate than spreadsheet models, are still an approximation at best. A common problem results from unrealistic expectations. Model sponsors often expect very accurate results after having invested considerable time and money into a numerical model.

Cost

Much of the cost for preparing a water budget model involves collecting, reviewing and organizing the large amount of data needed. This effort is required for any type of model.

Spreadsheets. Development costs for spreadsheet models are often less than numerical models simply because spreadsheet models are less complicated, and their data management capabilities can limit how large or complicated the model is. They also use software that is readily available and that most water mangers already have. The model sponsor can often create the model themselves, and reduce the need for outside consultant costs.

Numerical models. Numerical models typically require a specialty consultant to prepare and regularly update. If the model is needed to simulate a project or proposed scenario then more consultant costs will be incurred. They may also require commercial software programs, or at least commercial programs that interface with public software.

Summary

Table 1 provides a summary of the strengths of different characteristics for spreadsheet and numerical models. They both have clears pros and cons. Spreadsheets are favorable for their simplicity and transparency, while numerical models are superior in accuracy and data management.

Special Uses for Spreadsheet Models

Numerical models have superior modeling capabilities compared to spreadsheets. In fact, many guidelines on water budget models fail to even discuss analytical models, and treat numerical models as the only viable option. Numerical models are generally preferred for large complex water budgets, due to inherent limitations with spreadsheet programming. However, due to their simplicity, transparency, and lower costs, spreadsheet models offer advantages in several situations. Following are several scenarios when spreadsheet models may be suitable, either as a replacement for, or as a supplement to, a numerical model.

Characteristic	Spreadsheet Models	Numerical Models
Simplicity	●	○
Transparency	●	◎
Flexibility	●	◎
Expertise Required	◎	○
Accuracy	◎	●
Data Management	○	●
Cost	◎	○

● - Excellent
◎ - Good/Fair
○ - Poor

Table 1. Strength of Model Characteristics: Spreadsheet Models versus Numerical Models.

Initial Assessment

Engineering projects are usually designed in phases (reconnaissance-level design, feasibility-level design, preliminary design, then final design). The benefits of a phased approach include the ability to solicit input at different stages, and modify the approach before going too far. Likewise, water budgets can be performed in phases. A spreadsheet model can be an excellent first iteration in complex water budget. They can offer the opportunity for a quick, inexpensive, initial assessment, and provide a strong conceptual understanding of the water budget. They can also help with identifying initial parameters and data gap analysis. DWR (2016a) stated that analytical models are "*most suited to initial scoping studies*," but also states that analytical models "*may be limited when used as the only modeling tool.*"

Simple Analysis

Water budgets are sometimes prepared for small areas (less than a few square miles) or idealized basins. In some cases, these water budgets only include a few parameters. For instance, if the area has no surface water supply or natural water bodies, then numerous parameters related to surface water usage, surface water seepage, and seepage impacts to groundwater flows can be ignored. In addition, in small areas some simplifying assumptions can sometimes be made, such as groundwater inflow being equal to groundwater outflow. In these cases, a spreadsheet model may be sufficient due to the simplicity of the analysis, and there may be few benefits from using a numerical model.

In a well-known paper on modeling, Box (1976) stated: "*Since all models are wrong the scientist cannot obtain a "correct" one by excessive elaboration . . . Just as the ability to devise simple but evocative models is the signature of the great scientist so overelaboration and overparameterization is often the mark of mediocrity.*" In fact, a spreadsheet can inhibit excessive elaboration since it has limited abilities to manage and organize large amounts of data, and generally uses simplified equations.

Interim Analysis/Annual Reporting

Numerical models are often expensive to develop and update. Periodic model updates, such as every five years, are reasonable. Annual updates to a numerical model may or may not be warranted. For instance, if a model is developed and calibrated with 50 years of data the model sponsor may not want to take the time and cost to update and calibrate it with 51 years of data. Water budget and modeling frequency should consider how often major management decisions, such as adjustment of safe yield, are made. SGMA requires that models be reviewed every five years, however, on an annual basis only groundwater levels, groundwater storage, surface water deliveries, and groundwater pumping need to be

reported. Spreadsheets can offer a practical tool for these annual reports. A simple spreadsheet analysis for estimating change in groundwater storage is presented later in this paper.

Check Numerical Model

A spreadsheet model can be an effective way to provide a general check on the results of a numerical model. This can provide greater assurance to the model sponsor, especially if they feel the numerical model is a 'black box,' and they do not sufficiently understand the data used in the model or how the model works. Spreadsheets and numerical models use different approaches, so it should be expected that results will differ, but spreadsheets can be used for a general comparison. If the comparisons are reasonably similar, then it can provide greater comfort to the model sponsor. If the results differ significantly, it could potentially identify parameters that require double checking, or the need for additional analyses.

Case Studies

Two case studies involving the use of spreadsheet water budget models are described below. These both involve water agencies in the San Joaquin Valley of California.

Case Study No.1. In this case study, a water district wanted to begin efforts to comply with SGMA, and, in particular, was interested in a detailed accounting of their water budget. The water budget could help them assess their current conditions, and the magnitude of new funding, policy changes and project development needed. The local groundwater basin includes numerous water agencies, and they had not yet decided on their overall approach for a water budget model (software package, local versus regional model, etc.). Rather than wait, the water district prepared a conceptual water budget using MS Excel. They considered this a 'no-regret' task, since the work they performed in identifying parameters, collecting data, and performing a data gap analysis would ultimately be needed, regardless of the direction the region ultimately selected. The water budget was prepared for under $20,000. Their water budget proved very useful in identifying major water budget parameters and data gaps. The results will also be useful for comparison to future numerical or regional models.

Case Study No. 2. In the second case study, an irrigation district desired a transparent water budget model that staff could update annually. The area was already covered by a regional numerical model prepared by the USGS that covered numerous agencies. However, the regional model covered a large area and was not focused on their district. They were also not involved in the model development, had no ability to rerun the model, and had limited documentation on model inputs and results. A local spreadsheet model was developed that was more practical for agency staff, who eventually became familiar with the assumptions and basis for all the model inputs. However, the regional model was still useful since it included several assumptions and data sets that filled in data gaps in the spreadsheet model.

Groundwater Storage Change Calculations

A simplified method for estimating change in groundwater storage is presented below that is transparent and does not require a full water budget. This method uses changes in groundwater levels and regional specific yield values developed by the USGS.

USGS has developed specific yield values for the entire Central Valley of California in several USGS publications (USGS 1959 and USGS 1989). In these publications, standard specific yield values were identified for soil descriptions commonly used by drillers (e.g., sand, fine sand, silt, clay, etc.). Regional specific yield values were then developed by summarizing the stratigraphy in hundreds of well completion reports, and using the estimated specific yield values for soil textural classes. Specific yields are reported for three intervals: 0 to 50 feet, 50 to 100 feet and 100 to 200 feet below ground surface.

The process for calculating change in groundwater storage includes the following steps:

1. Calculate average depth to groundwater for each Township based groundwater level measurements.
2. Multiply the height of water within each depth zone by the specific yield for that depth zone and by the area of that Township within the study area.
3. Sum the total storage change for all Townships.
4. Compare the storage change from one year to the next.

This methodology is illustrated in Table 2.

Many water budgets focus on estimating groundwater overdraft, especially water budgets prepared for SGMA. Groundwater levels are a straight-forward indicator of overdraft, and they are the net result of all the parameters found in a water budget (e.g., groundwater pumping, groundwater flow, recharge, seepage). Hence, the method described above can estimate overdraft without the numerous assumptions and complex analyses found in a water budget. This method is also practical for annual reporting. Water budgets can be useful for illustrating why overdraft is occurring (e.g., sources of recharge and groundwater withdrawals), but may not be needed on an annual basis.

Conclusions

Spreadsheet models and numerical models have pros and cons for water budget analyses. Spreadsheets are

			Specific Yield (%)			Depth to Water (ft)		
Township	Range	Area (Acres)	0'-50'	50'-100'	100'-200'	Avg. Depth	Annual Change	Change in Storage (AF)
32	21	23,040	10.6	12.2	10.9	134	-1.7	-4,270
32	20	10,400	12.2	11.1	9.6	88	-0.9	-1,040

Table 1. Groundwater Storage Change Calculation.

favored for their simplicity, transparency and low cost. Numerical models can be more accurate and can better simulate interactions between different hydrologic processes. However, numerical models are more complex, costlier and require a modeling specialist. The California Sustainable Groundwater Management Act will require many groundwater basins to prepare or update water budgets. Spreadsheets may be more practical for a small or simple water budget. They can also supplement a numerical model if they are used as an initial assessment to gain a general understanding of the water budget, and as a general check on the results of a numerical model. Spreadsheets can also be used to estimate overdraft using groundwater level and specific yield data, and avoid the need for a water budget model update every year. Therefore, a combined approach to water budgets using numerical models and spreadsheet analysis may be the most efficient and practical approach.

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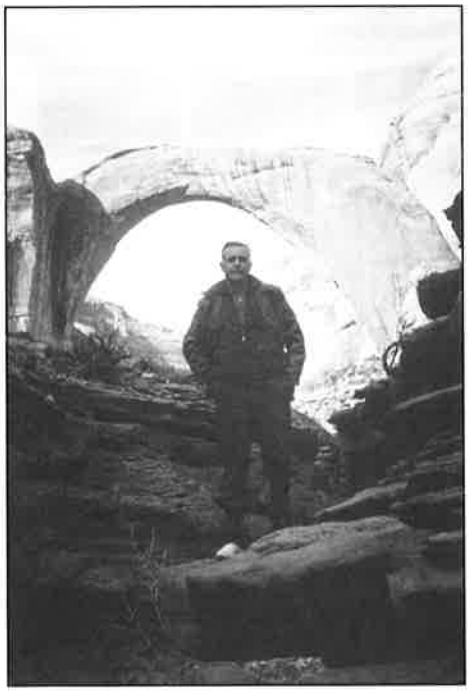
A Turning Point (continued)

it. As part of that planning process, the Bureau partnered with the National Park Service for recreational development.

Earlier in the 1950s, a surging post-war economy coupled with a new national highway system spurred a boom in outdoor recreation across the country. The population was also growing rapidly, and visits to both national parks and Reclamation reservoirs saw exponential growth. The prediction was for more of the same, with economic benefits accompanying the increasing recreation.

"The handwriting is on the wall," Gilbert Stamm said in a 1961 speech. At the time, this Colorado State University alumnus served as the chief of the Division of Irrigation and Land Use at the Bureau of Reclamation. He would lead the Bureau as commissioner a dozen years later.

The Tenth Annual Irrigation Operators Conference held in Boise, Idaho, provided the occasion for Stamm's remarks, titled "Recreation: Its Place in Irrigation Development, Present and Future." He said further, "We will enjoy much broader support for Reclamation development if we recognize these recreation benefits and accommodate them to the greatest degree possible."



Gilbert Stamm visiting Rainbow Bridge, 1965.

A colleague of Stamm's with a focus on water projects in the Upper Colorado River Basin shared the same view. In his own speech also given in 1961, Ival Goslin echoed the predicted trend of increasing visits to water-based recreation facilities. He stated, "Bear in mind that this trend will continue because the facts show that people prefer their relaxation in conjunction with water." At the time, Goslin was the executive secretary of the Upper Colorado River Commission. His remarks, titled "Recreation and Reclamation," were made to the Annual Meeting of the Colorado River Water Users Association in Las Vegas.

Bureau officials and others with reclamation interests in the West witnessed two unpredicted events affecting their work in the late 1950s. One was the vast increase in outdoor recreation, a trend mentioned by both gentlemen having aims to finance and build western reservoirs. This inclusion may have been motivated by Congressional creation in 1958 of the Outdoor Recreation Resources Review Commission, a body that was preparing to recommend federal policies. Both men mentioned the commission's pending report.

The other, perhaps more significant, event of the late 1950s curiously escaped mention by both men. Though its culmination was a full five years before both speeches, it was hardly a forgettable occurrence. Perhaps neither wanted to highlight it for their audiences though, as it had proved a challenge to operations as usual.

In 1956, opposition to a Bureau dam proposed downstream of Echo Park on the Green River in Colorado garnered defeat. Conservation groups rallied, for the first time in American history, to actively oppose the dam, waging heated political battles as yet unwitnessed by dam proponents. Though Goslin alluded to it, neither man explicitly said the writing was on the wall for such opposition to remain if not increase as American environmentalism found its footing.

Ival Goslin at Echo Park, 1954.

While we may not be able to know the reasons behind this omission by both speakers, it gives us something to think about. In the times of trending recreation at reservoirs, raising specific awareness about past opposition would not help the cause of building more dams. But linking that public desire for recreation with the agency desire for dams was a new approach that possessed great potential to be effective.

Because both Stamm and Goslin were speaking to water users, they addressed some challenges of including recreational aspects in planning for new reservoirs or being retroactively implemented at existing facilities. Conflicting interests included recreators requesting minimum fluctuations during summer, which went against the needs of irrigators. Goslin pithily put it: "I recently visited a reservoir where there was a bitter three-way battle with overtones that included the fishermen who were ready to shoot the water ski enthusiasts, who, in turn, were ready to commit anything from a good cussing to mayhem on the farmers who were lowering the water surface in order to irrigate their crops."

Looking to the future, Stamm advocated working "to obtain needed authority and to develop plans and procedures for the inevitable increase in future recreational use of project reservoirs." He raised some questions that policy could address. Goslin suggested that government evaluators were not yet paying proper attention to recreation needs: "Our bureaucrats charged with evaluating project benefits have kept their heads in the sand, too long oblivious to the national, state and local benefits of recreation. Application of the foot to the posterior of an ostrich might

Ival Goslin at Glen Canyon Dam gates, June 1980.

be the proper solution for removal of this bird's head from the sand."

The two speakers concluded with different outlooks for their audiences. Stamm advised his audience of irrigators that, as the ones directly affected, they should pay attention to emerging legislation and push for appropriate policies and procedures, especially when the costs of creating and maintaining recreational facilities could fall on the irrigators. Goslin's perspective goes back to the quote at the start of this article. He thought the recreating public should be educated about the mutually beneficial relationship enabled by reclamation projects.

Speeches of water leaders can give insight into the issues of their times. Also occurring at the time of these speeches was the construction of Glen Canyon Dam, which was a compromise in the Echo Park battle and which would form Lake Powell, drawing more recreators to that part of the Colorado River than had ever been there before. Times were changing, with many consequences.

The two speeches examined here are in collections at the Water Resources Archive in Colorado State University's Morgan Library. These speeches, and more like them, are available through the Archive's website https://lib.colostate.edu/water).

Additional thousands of documents and photographs on recreation, reclamation, and more are accessible via the Archive. For more information, consult the Water Resources Archive website or contact the archivist (970-491-1939; patricia.rettig@colostate.edu).¤

President's Message (continued)

Water Saving in Irrigated Areas. So, if you are looking to participate in professional society work on an international basis, ICID can help out!

ICID is also making a strong effort to get Young Professionals more involved. The Young Professionals in ICID have a very active LinkedIn group. There are also many tracks and presentations in the ICID conferences that are geared towards Young Professionals.

ICID also has some great newsletters that you can sign up for. I particularly like their e-bulletin, which comes out about twice a week and has short blurbs on interesting topics along with links to more detailed stories. ICID has also scanned all their older publications and you can download their publications at no charge. In addition, ICID is working on allowing all of its members free access to the ICID *Journal on Irrigation and Drainage* via Wiley. The details are still be worked out, but I hope that USCID members will receive their free access to that journal sometime in 2019.

Another resource available to USCID members is the Irrigation and Drainage Products and Services Directory, where, you can find a list of people or companies throughout the world that provide certain services (e.g., pumps, canal lining, engineering services, etc.). You can register your company to be included in the directory for free.

ICID provides its members access to the Multilingual Technical Dictionary, which translates technical words into a wide variety of languages. This could be quite useful if you are trying to translate a technical document or communicating with people from other countries.

ICID also maintains an Online Public Access Catalog (OPAC) that stores difficult to obtain, low circulation reports and papers and makes them available to ICID members at no charge. Many of the documents in the OPAC can be directly downloaded.

So, as you can see, there are quite a wide variety of benefits for being a USCID/ICID member. I encourage you to take our membership challenge and recruit some new members!

Brian Wahlin
President, USCID¤

Davids Engineering Celebrates 25 Years

In 1993 Bill Clinton was president, Jurassic Park had just come out in the theaters, and California was pulling out of a six-year drought.

That same year a small firm in Northern California was incorporated as Davids Engineering. From the beginning, its roots have been grounded in agricultural water management. The firm continues to provide innovative and practical engineering and scientific services to the managers of western water, whether they are public agencies, private landowners, or non-governmental organizations. From its initial focus on water management planning, Davids Engineering has gradually broadened its technical capabilities to encompass field services and data management, facilities design and construction management, and remote sensing and GIS services. With offices in Davis and Chico, California, the firm has completed approximately 400 projects for nearly 180 clients in California, other western states and overseas.

More recently, Founder and President Grant Davids has gradually been handing off firm operations to partners Bryan Thoreson (21 years) and Byron Clark (12 years). Bryan now handles day-to-day firm operations while continuing to manage projects, and Byron takes on an increasing project management role while maintaining close involvement in a range of technical tasks. Grant remains involved as a senior consultant while also pursuing interests and activities outside of Davids Engineering. Other staff members continue to grow into technical specialties and project management roles with increasing responsibility.

As Davids Engineering turns 25 this year, we continue to recognize that we owe our success to our talented team and loyal clients. We are proud of our commitment to serve managers of western water and look forward to many more years of supporting the important work they do. We thank our clients for the privilege of service over the past 25 years and we look forward to continued service for the next 25 years and beyond.

Davids Engineering is dedicated to the idea that agricultural sustainability is best achieved through the dual goals of enhancing the productivity and profitability of agricultural enterprises and improving environmental stewardship.

— Grant Davids, Founder and President¤

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News of Members

Megh R. Goyal is the 2018 recipient of the ASABE Netafim Award for Advancements in Microirrigation for his work introducing microirrigation technology in the Caribbean, North and South America, and India through publications, research, and extension activities for the scientific and farming fraternity. Goyal is the senior editor-in-chief at Apple Academic Press in Oakville, Ontario. He is also a retired professor of agricultural and biological engineering, University of Puerto Rico at Mayagüez.

R. Wayne Skaggs received a Superior Paper Award from ASABE for his paper,"Coefficients for Quantifying Subsurface Drainage Rates," published in *Applied Engineering in Agriculture.*

David K. Thaemert is now a Senior Lecturer in Civil Engineering Hydraulics and River Engineering at the University of Hertfordshire, United Kingdom. He may be contacted at dthaemert@pvpressco.com.

Thomas Trout was recently inducted as a member of the ASABE 2018 Class of Fellows. He also received the Award for Advancement of Surface Irrigation.

John A Wiersma is now General Manager of the Henry Miller Reclamation District #2131, Dos Palos, California.¤

USCID Notes

by Larry D. Stephens,
Executive Vice President

As reported in the page 3 article, USCID was well represented during the ICID IEC Meeting in Saskatoon last August. Congratulation to **Brian Wahlin** who was appointed Chairman of the ICID Permanent Committee on Strategy and Organization. In this position Brian is one of the five people in ICID's management team, joining the Chairs of the Permanent Committee on Finance and the Permanent Committee on Technical Activities, the President and the Secretary General.

As noted in the box to the right, USCID's 2019 Conference will be held in Reno during the first week of November. An e-mail message to members was sent recently, inviting you to join the Planning Committee for the Reno Conference. The Planning Committee will have three co-chairs: **Sam Schaefer**, GEI Consultants, **Del Smith,** Bureau of Reclamation, and **Therese Ure**, Schroeder Law Offices. I hope many of you will join the Planning Committee. You will find it a worthwhile professional experience and a great way to network with other USCID members.

The last 2018 issue of the *USCID Newsletter* will feature USCID's 11 International Conference on Irrigation and Drainage, held in Phoenix during October. The Conference was quite successful, thanks to the leadership of Co-Chairmen **Brian Wahlin** and **Eduardo Bautista**.

A reminder: mailed with the dues invoices was a note from **Sam Schaefer**, Membership Committee Chairman, challenging each of you to recruit one new member of USCID. You can review membership details on the USCID website. And, there is an online membership application form. Also available for your recruiting efforts is an excellent brochure. Send me an e-mail (stephens@uscid.org) if you would like some copies of the brochure.

Thanks to many of you have already paid your USCID dues. With one payment came a note from friend and former Bureau of Reclamation colleague **Paul Tilp**, mentioning that he was continuing his membership and that he is now 92 years old. He asked if any USCID members are older than he is. An interesting question! I explored the database of members. We have the date of birth for about half of our members. There are four members older than Paul, who joined USCID in 1971. Here is a summary of my review of ages of USCID members:

Born during the 1920s	5 percent
Born during the 1930s	18 percent
Born during the 1940s	18 percent
Born during the 1950s	10 percent
Born during the 1960s	12 percent
Born during the 1970s	6 percent
Born during the 1980s	14 percent
Born during the 1990s	17 percent

Another note about membership: **John Priest** joined USCID in 1959, so John has been a member for 59 years he is the longest tenured member! I am one of the members born during the 1930s and I joined during 1967. I have attended 48 consecutive ICID IEC Meetings and look forward to my 50th in Sydney during 2020.

USCID Meetings

November 4-8 2019, USCID 12th International Conference on Irrigation and Drainage, Reno, Nevada.

ICID Meetings

January 16-18, 2019, 9th International Micro Irrigation Conference, Aurangabad, India.

September 1-7, 2019, 70th IEC Meeting and 3rd World Irrigation Forum, Bali, Indonesia.

September 22-28, 2020, 71st IEC Meeting and 24th Congress, Sydney, Australia.

A Call for Papers for the Reno Conference will be online early in January. Since the USCID Board of Directors decided to have one major conference annually, rather than the former practice of two, the conferences have had increased attendance and more papers. Plan now to participate.¤