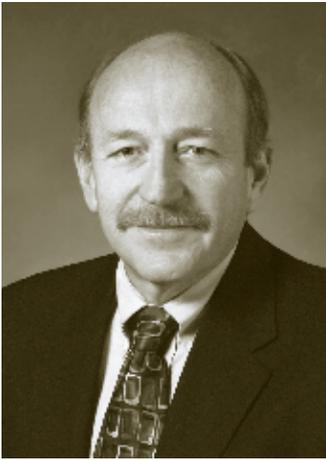


# Climate Change Impacts on California's Water



*A Special Edition from:*

DWR|NEWS People (Fall 2008)



**D**uring the July 2008 HydroVision 2008 Conference, Director Lester Snow made the following presentation:

It really is an interestingly opportune time for this conference...a unique opportunity to discuss climate change, water management, energy.

I noticed one of the subtopics or subtitles of

the conference is Anticipating Change and it's interesting because we do need to anticipate change but what we need to get more people to recognize is that change already happened.

Those that would deny climate change are not even looking at the newspaper...they're not even realizing what is happening today...and that has been a challenge for us.

You know hydropower is an essential part of California's power and water management system...and therefore, and a lot of people don't get this, it's an essential part of the state's economy.

The State Water Project, which is one of the largest water projects in the country...certainly the largest operated by any state, has over 50 percent of its power as clean hydro. It varies from year to year...I think we average probably around 57 percent. It's not only the clean energy but it's also our ability to supply water.

But, as I already mentioned, climate change has already changed our hydrograph. It's not something that's in the future...it's a reality now that many of you recognize. By 2050, conservative estimates are that we'll lose 25 to 40 percent of the Sierra snowpack...completely changing the way we have to manage the system.

While no one year is an indicator of climate change or a manifestation, this year was one of the odder years we've had for intense snowfall and snowpack accumulation in January and February...and then the system shut off. If those patterns had continued, we would have had a well above normal snowpack year.

Instead, we're in a critically dry year and in the throes of a drought.

What we also know about climate change is that future droughts are going to be longer and drier. That doesn't seem to be a question...it's just how much longer and how much drier.

Current flood peaks and future flood peaks are going to be higher than we've experienced in the past. Our water management world has changed...and continues to change. The past is no longer a basis to predict the future...and that may be the most difficult thing to instill in people. They want to look at the past and do a trend and say that's how we plan for the future...and that is not going to be adequate. We must adapt for water supply, for ecosystem health, and for clean power.

**Governor Arnold Schwarzenegger** has been a consistent leader on climate change and greenhouse gas reduction. The Greenhouse Gas Reduction bill, AB 32, those of us in the state...that's how we refer to it, is a landmark piece of legislation aimed at substantially reducing greenhouse gases.

He is a supporter of national action, and increasingly... even just within the last week, a major critic of federal inaction that has not put this country in the forefront of dealing with greenhouse gases. Governor Schwarzenegger is also an ardent supporter of water infrastructure investment...including the construction of additional major reservoirs in this state and finding that balance between investing in hardscape, as it might be, as well as in soft practices to reduce greenhouse gases.

The time for action is now...it's not for some time in the future when it's more convenient. Our understanding of these changes has increased greatly over the last several years...phenomenally, actually...over the last several years. As I said a moment ago, we can no longer rely on the past to predict the future. We must plan for change. We must lead to a new way of managing our precious water resources.

We are resource managers...natural resource managers... even if we're a dam operator controlling the flows in the rivers... we're managing the precious natural resource. So we have to be interested in the health of the watershed, the health of the ecosystem, water quality, flood management, availability and reliability of clean power...those are all our responsibilities.

It's an exciting time and I refer to it as an *opportunity rich environment*. So every time we get a new court action restricting the way we can operate our system...or we have drought...it's an opportunity to implement change.

*Finally, on behalf of Governor Schwarzenegger, I want to welcome you to this State Capitol...to California. Enjoy the conference, enjoy Sacramento, and anticipate change...because it's already here.*

*Thank You.*



## *DWR Plans for Possible*

# CLIMATE CHANGE IMPACTS ON CALIFORNIA'S WATER

*By Margarita Macias*

**D**uring the past two years, California has moved rapidly to begin addressing the growing and complex threat that climate change poses to the state, with the Department of Water Resources (DWR) playing a central role in the State's efforts. DWR Director **Lester A. Snow** states quite firmly that "planning for and adapting to the uncertainty that climate change brings to water resources is the most significant challenge before California's water managers this century."

"Future droughts will likely be more severe," he says, and "future floods will be bigger."

Director Snow goes on to say that "the California water community must immediately broaden its focus on climate change to include a diverse suite of actions for climate change *adaptation*. Water supply and flood management agencies must act now to accommodate changes already here due to warming temperatures."

*"Future droughts will likely be more severe... future floods will be bigger."*

**DIRECTOR  
LESTER A. SNOW**

*Above: Lake Oroville in 2008.*

Determining how California water resources can potentially be impacted by climate change and what to do about it are issues now being addressed by a team under the direction of DWR's Executive Manager for Climate Change, **John Andrew**.

"We believe that we have already started to realize some climate change effects in California," says Andrew, "particularly in the areas of flood management and sea level rise."

"We're seeing flood peaks on Central Valley Rivers that are higher than anything we've witnessed in the last century and these higher flows could have a significant impact on our levee system, particularly levees in the Delta which are not in the best shape."

Projected sea level rises would also compound the danger to the Delta's fragile levees.

"Within the last century, sea levels have risen seven inches," states Andrew. "It's projected that in the next half-century, sea levels will rise anywhere from seven to more than 20 inches. This kind of sea level rise will not only have a dramatic effect on the Delta, but on our coastlines as well."

## Visible Effects of Climate Change

A healthy snowpack is essential to ensuring an ample California water supply. In the Sierra Nevada, the winter snowpack holds an average 15 million acre-feet of water that is released in the spring and early summer. Using historical climate and hydrologic data and climate modeling, DWR projects that the Sierra snowpack will experience at least a 25 percent reduction by mid-century. That, obviously, would have a significant effect on statewide water supplies, by shifting more runoff from the spring to the winter, when it may be unable to be stored as water supply.

At the same time the overall snowpack is expected to diminish, rising temperatures may melt the snow earlier in the year, and storms may result in more direct rain runoff. Coupled with more intense storms due to climate change, these factors could result in major Central Valley flood events.

Andrew says these and other potential climatic changes pose daunting challenges for California's water managers, but the actual scope of the problem is still uncertain and even somewhat unknown. Nonetheless, DWR and other State authorities have already taken steps to address climate change issues and make California water resources sustainable in the long term.

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*In September, DWR's Executive Manager for Climate Change John Andrew spoke during the Climate Change Adaptation Policy Workshop sponsored by DWR, the Western Governor's Association and the Western States Water Council. Technical approaches and policy and management implications were discussed.*



## DWR Initiatives

Within California, there has been recognition at both the Executive and Legislative levels regarding the role climate change could play in the lives of Californians. In September 2006, **Governor Schwarzenegger** signed Assembly Bill 32, which mandated that by 2020 California reduce carbon emissions to 1990 levels — a 25 percent reduction.

Once the emissions reduction mandate was given to State agencies, DWR joined the California Climate Action Registry in 2007 to calculate the size of its carbon footprint. "That was the first step in determining what our emissions are at DWR," says Andrew, "and how we could potentially reduce them."

A carbon footprint is defined as the total amount of greenhouse emissions related to a company's business operations. Greenhouse gas (GHG) emissions are believed to be contributory factors in climate change.

So, all of DWR's activities from daily operation of State Water Project facilities to the purchasing of office supplies are being measured and calculated.

One major SWP area targeted for reduction is energy consumption. The SWP's initial carbon footprint was calculated at less than one percent of the State's total, mainly because the SWP generates and uses hydroelectricity — which has no carbon footprint and is essentially clean energy. But DWR also uses power generated by less pristine technologies, including the coal-burning Reid-Gardner plant in Nevada.

On that subject, Andrew says: “In the 1970’s, DWR sought to diversify its energy consumption in response to the ongoing oil crisis. In 1983, we started using electricity from the Reid-Gardner plant. DWR gets about 1.4 billion kilowatt-hours from Reid Gardner while its electricity needs range to more than eight billion kilowatt-hours. We’ve estimated that when our Reid-Gardner contract expires in 2013, our carbon footprint will be reduced well over 30 percent below our 1990 levels, which is more GHG emission reductions—and sooner—than that required by AB 32.”

Along with eliminating Reid-Gardner from DWR’s power portfolio, many climate change adaptation strategies are in the works. They include initiatives focusing on water use efficiency, system re-operation, carbon sequestration, sustainable business operations, and incorporating climate change into planning and decision-making.

## Planning for Climate Change at the Local Level

Statewide meetings for *California Water Plan Update 2009* are underway, and according to Andrew, one of the most effective tools to help local communities prepare for potential climate change issues is Integrated Regional Water Management (IRWM). DWR’s IRWM Program is designed to create a water plan unique to the needs and available resources of a particular region.

A number of California regions have already put regional water resources management in place. *California Water Plan Update 2005* identified these regional plans as an effective way to manage water resources at the local level.

When regions use Integrated Regional Water Management Planning, it allows them to diversify their individual water portfolios, which helps them prepare for potential climate change impacts. Such regional planning also allows greater flexibility when addressing statewide water needs.

*In September, the Climate Change Adaptation Policy Workshop was held in Irvine.*

“IRWM planning is different from the way that we used to do business,” says Andrew. “We used to build huge dams and canals and think on a more statewide scale. Now we have more flexibility at the local level to meet the needs of individual regions.”

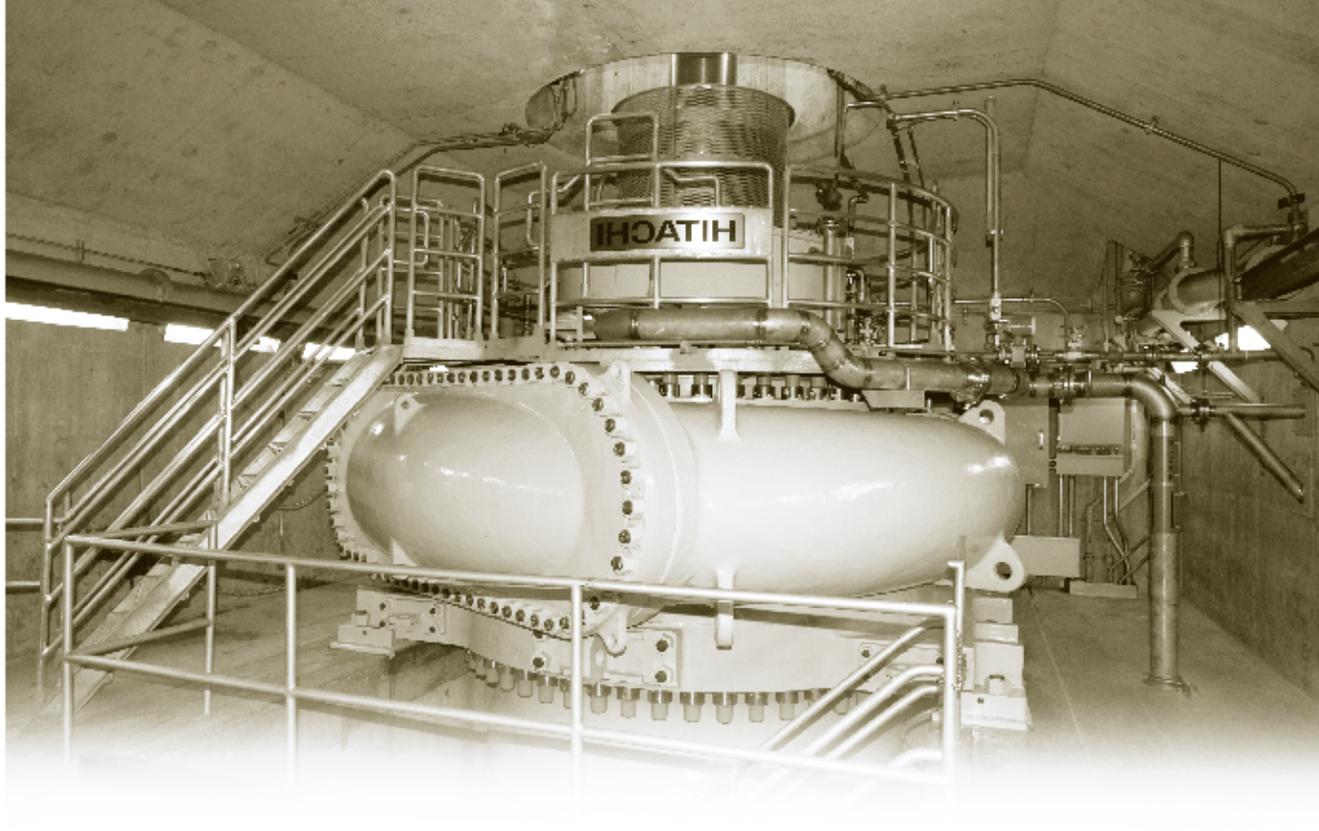
DWR Director Snow says: “As Californians move beyond recognition of the impacts of climate change, state and regional water managers must simultaneously embrace both mitigation and adaptation approaches. While some climate change predictions are indeed dire, the good news about climate change is that adapting to its impacts is complementary to adapting to the other major changes—in population, land use, and the economy—in California’s future.”

In October, 2008, DWR released its climate change white paper, entitled “Managing an Uncertain Future; Climate Change Adaptation Strategies for California’s Water,” available at [www.climatechange.water.ca.gov](http://www.climatechange.water.ca.gov)

## DWR’s Climate Change Matrix Team

### Executive Sponsor: Mark Cowin

Linda Ackley	Veronica Hicks
Manucher Alemi	Arthur Hinojosa
Curtis Anderson	Ray Hoagland
Michael Anderson	Jeanine Jones
John Andrew	Rich Juricich
Tracy Billington	Elissa Lynn
Nikki Blomquist	Dave Mraz
Steve Bradley	Mike Myatt
Francis Chung	Amy Norris
Rob Cooke	Roy Peterson
Holly Cronin	Jessica Pearson
Gordon Enas	Glen Pearson
John Engstrom	Steve Roberts
Y-Nhi Enzler	Maury Roos
Megan Fidell	Greg Smith
Tom Filler	Rick Soehren
Dan Flory	Jim Spence
Mike Ford	Harry Spanglet
Dan Fua	Michael Werner
Jim Goodridge	Rick Ramirez
Dale Hoffman-Floerke	



# DWR GREENING

*By Amy Norris*

**W**hen it comes to climate change and water management, the Department of Water Resources (DWR) has two challenges, adaptation and mitigation. DWR hydrologists have been exploring the impacts of climate change on water supply for some time. Proposed adaptations, such as additional reservoir storage and water conservation, are well known. Mitigation, or reducing the greenhouse gases caused by water management and business practices, has been a more recent goal.

**Veronica Hicks** is the Chief of the recently formed State Water Project (SWP) Power and Risk Office. The Office evolved from a single project team that was created in 2004 to assess the State Water Project's future energy needs. The team was tasked with identifying energy resources to replace long-term power contracts that were expiring, as well as aligning newly developed business practices with existing standard utilities practices.

*“This represents another milestone in our efforts to increase the energy efficiency of the State Water Project and reduce the carbon footprint of our operations.”*

DIRECTOR LESTER A. SNOW

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*DWR's first pump replacement project was completed at the A.D. Edmonston Pumping Plant. This first pump alone will save energy equivalent to that generated by a 12-acre solar panel farm.*

In 2006, the Legislature adopted Assembly Bill (AB) 32, which mandates a program of regulatory and market mechanisms dedicated to achieving quantifiable, cost-effective reductions in Greenhouse gas (GHG) emissions in California. Energy efficiency and renewable energy are essential elements for meeting AB 32 goals. It was a natural step to create the new office from the project team already investigating the SWP's future energy requirements.

According to Hicks, DWR soon began focusing on ways to reduce its carbon footprint. "The SWP supports the intent of the Legislature and Governor's Office in their goals to

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*"The CCAR is a private non-profit organization originally formed by the State to develop and promote accurate and consistent GHG reporting standards and tools for organizations."*

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reduce carbon emissions. DWR joined the California Climate Action Registry (CCAR) in June 2007. We began the detailed work to gather documentation and refine our analysis of carbon emissions from power sources that we use."

The CCAR is a private non-profit organization originally formed by the State to develop and promote accurate and consistent GHG reporting standards and tools for organizations. CCAR members voluntarily measure, verify, and publicly report their GHG emissions. This information is used to identify the best and most efficient way to further reduce GHG emissions. 2008 is DWR's first year reporting to the CCAR for GHG emissions for calendar year 2007.

In 2006, the SWP derived an average of over 50 percent of its energy from clean, renewable hydroelectric generation. When DWR's power contract expires in 2013 for energy from Reid-Gardner, a coal fired plant in Nevada, it will be replaced with cleaner energy sources. Possible sources include energy from state-of-the-art combined-cycle natural gas plants, and renewable resources, such as wind, solar and geothermal, and more hydro.

Additionally, DWR has undertaken extensive energy efficiency improvement projects at Hyatt Powerplant and Edmonston Pumping Plant to make generators and pumps run as efficiently as physically possible, resulting in substantial energy savings. In May of 2008, the first pump replacement project at the A.D. Edmonston Pumping Plant was completed. This project replaces four of the 14 pumping units at the plant to improve State Water Project (SWP) energy efficiency. When completed in 2011, the replacement of the four Edmonston pumps, combined with the efficiency improvements already done at Hyatt Powerplant in Oroville, will save enough energy to power 33,000 households for a year, or the equivalent to taking 11,000 cars off the road.

"This represents another milestone in our efforts to increase the energy efficiency of the State Water Project and reduce the carbon footprint of our operations," said **DWR Director Lester A. Snow**, speaking at A.D. Edmonston Pumping Plant, located about 30 miles south of Bakersfield.

Hicks says that SWP emissions are "comparatively on the low end of the scale." In fact, because of its large hydro-generation resources and a relatively small increase in project capacity, GHG emissions associated with the SWP's operations have not increased significantly since 1990.

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*When completed in 2011, the replacement of the four Edmonston pumps, combined with the efficiency improvements already done at Hyatt Powerplant (left) in Oroville, will save enough energy to power 33,000 households for a year, or the equivalent to taking 11,000 cars off the road.*

Consequently, DWR currently meets the goal of AB32, which is to reduce emissions to 1990 levels by 2020. After the Reid Gardner contract expires, the SWP will produce more than 30 percent below its level of GHG emissions in 1990.

The SWP faces some unique challenges when it comes to reducing emissions according to the goals of AB 32. Hicks explains, "Though it generates electricity, the SWP is not an electrical utility that provides power to retail customers. Our primary mission is flood control and water delivery; it is water that drives the power side," said Hicks.

"Especially with the drought and the Wanger decision, we have limited windows of time when we can move water. A lot of renewables like wind power are intermittent. It's not a firm supply." In other words, DWR cannot rely solely on renewable energy because the water must be moved during timeframes when renewable sources may not be producing the energy needed. The SWP needs a firm source of power to guarantee water supply reliability.

When it comes to quantifying DWR's emissions through the CCAR, the SWP is only part of the equation. The Department is also measuring its fuel use in everything from vehicles, generators, backhoes to leaf blowers. Electricity consumption is also measured for each of its buildings, whether leased or owned by the Department.

Hicks says it was actually an easier job to quantify emissions from the SWP than the business operations side. **John Engstrom**, DWR Facilities Planning and Development Manager, has the difficult job of presiding over gathering the business operations data, interpreting it, and coordinating with Veronica's staff to log it into the online CCAR database.

"Not all data was centrally located in our enterprise business system, 'SAP,' said Engstrom. "We could find records of fuel purchases, but how was it used? CCAR wants to know whether it was burned in a leaf blower, generator, or a van. We had to work with field divisions and outlying areas to help us collect more detail."

Besides gathering data for CCAR, Engstrom and his team have made strides in implementing 10 initiatives for greening business operations. These include Purchasing Services Office disseminating environmentally preferable purchasing practices to our Department's buyers to encourage more eco-friendly purchasing; organizing a green week to bring more awareness to green operations; reducing DWR's junk mail with the help of mailroom staff and a non-profit Web site; and promotion of electronic resources that can be found on the Web. In addition, the Division of Technology Services is planning in the near future to update the Data Center to reduce electricity use.

Engstrom is also working on a green policy for the Department that will include increasing energy efficiency for buildings, reducing greenhouse gases for the vehicle fleet and continuing to promote greening DWR workplace practices, procedures and maintenance.

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*After contract expiration for the Reid Gardner plant (below), State Water Project will produce more than 30 percent below its level of Greenhouse gas emissions in 1990.*



*“We’re being very proactive about educating ourselves and quantifying, reporting and managing our emissions.”*

VERONICA HICKS



Other State action that affects DWR’s business practices is the Governor’s Executive Order S-20-04 which preceded AB 32, and required the greening of buildings. It requires reduction of grid-based energy, such as electricity and natural gas, 20 percent by 2015. DWR has complied with the first phase by listing our buildings, which have meters registering gas and electricity use, on the Energy Star portfolio system overseen by Department of General Services. The next phase is looking at ways to reduce energy.

The new SWP Southern Field Division Headquarters in Pearblossom is an exciting new project that will exceed the requirements of S-20-04. It is planned to be the Department’s first LEED (Leadership in Energy and Environmental Design) Gold Rated building. The 20,000 square foot building is being designed in-house by Division of Engineering architects and engineers, who are also overseeing the construction.

Legislation of the last few years, such as AB 32, and Executive Orders like S-20-04, have led to exciting changes and real action towards reducing DWR’s carbon footprint.

Now that DWR’s data has been submitted to the CCAR registry, data must be independently verified by a certified consultant. Engstrom is hopeful DWR will pass this phase of the process, though many entities fail on their first, or even second try. Despite some limitations, he credits SAP with what he hopes will be the Department’s success.

“We’re a pretty complex organization for tracking energy because DWR purchases power for its SWP facilities. We also have a large fleet, and a lot of facilities. Trying to collect that and make sure it meets verifiers is intensive. SAP was a very useful tool to extract data. Other departments are using paper invoices to collect data for reporting to CCAR.”

Hicks concluded, “We can be proud because the SWP is doing its part to minimize greenhouse gas. We are able to reach these goals and we already have a fairly clean portfolio while balancing the need to move water when it needs to be moved. We’re being very proactive about educating ourselves and quantifying, reporting and managing our emissions.” ■

## DWR CELEBRATES “GREEN WEEK”

To educate DWR staff on sustainable practices to transform their workplace and homes, DWR employees participated in their first annual “Green Week” on April 21-26.

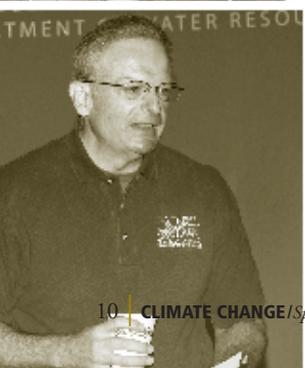
As part of this week of promoting a “greener” environment, employees found tips on AquaNet for each day.

- Monday -The focus was the 3R’s – Reduce, Reuse, and Recycle. It promoted cleaning office areas by allowing reuse and recycling of unneeded office supplies and old paperwork.
- Tuesday – Earth Day and DWR’s role in promoting its principles with respect to our mission.
- Wednesday – Environmentally Preferred Purchasing (EPP). The article reviewed where and how to purchase products with high recycled content.

- Thursday – Carbon Footprint (DWR’s CCAR registry)
- Friday – E-waste education- How, what, and where to recycle electronic waste products.
- Saturday – E-waste drop off day, Saturday, April 27th - This day was a voluntary effort for all employees to participate in disposing electronic items. Items dropped off by employees that day included TV’s, computers, stereos, cell phones, and any other acceptable electronic waste.

If you have any questions, contact Nate Frank at the DWR Green Team at [DWR\\_Green\\_Team@water.ca.gov](mailto:DWR_Green_Team@water.ca.gov)





# DATA COLLECTION

## *for Climate Change*

*By Elissa Lynn and Mike Anderson*

*Plans are being made to improve current measurement arrays and to create new network capability in the future.*

California possesses a diverse and complex climate; analyzing its change over time requires a great deal of data. While data collection is conducted by a dozen major State and federal agencies, as well as local agencies, the Department gathers a vast amount of valuable water resource information itself including snow surveys, stream flows, groundwater levels, tide elevations, temperature records, rainfall totals, and runoff rates. Divisions involved in data collection include Planning and Local Assistance (DPLA), Environmental Services, Flood Management, and Operations and Maintenance. Plans are being made to improve current measurement arrays and to create new network capability in the future. Continuing long-term records, tracking currently unmeasured variables, and optimizing technology and dissemination are key goals looking toward the future.

*Above: Sacramento River at Ord Ferry gauge during the flood of February 1958.*

## Stream gauging

Department staff are working hard to implement advanced technology to collect and disseminate data to help water managers resolve California's complex water challenges. DPLA's Northern District currently maintains a network of 54 stream gauging stations located primarily within the Sacramento River watershed that provide time-series water surface elevation and discharge data as well as some water quality data. About twenty of these gauges are funded by the Department of Water Resources (DWR) Division of Flood Management, and are equipped with radios to provide real-time data. Numerous flood events have been documented by these gauges over the years. The Sacramento River Ord Ferry gauge has been maintained by the Department for its entire period of record beginning in the 1920's, and is currently maintained by DPLA's Northern District. The instruments used at the sites today provide a significant technical improvement over those used in earlier periods. **Danny Cervantes** has about nine years of experience maintaining stream gauging stations with the Northern District during his 18 years with the State. He says not only has the data quality improved, but so has the technology. "It's night and day. Now you can download the data for pda, laptop, or even use a flash card. Plus the software programs let you make sure it's solid, and well Q/A, Q/C'd." Analysis of climate change trends in surface flow will be heavily dependent on the accuracy of these types of measurements.

O&M's Oroville Field Division maintains a number of stream gauges that were originally installed by other governmental agencies, as well as several of its own. The gauges provide calibrated data for a wide range of analyses such as flow and depth frequency and duration, design of bridges and water diversion facilities, water supply availability, and quality of fisheries habitat. This data is all quality controlled, which means rigorous analysis is done on it to remove errors and outliers, thus providing the highest quality data set possible. All the gauges, especially those with long records can also be used to analyze annual or seasonal runoff trends over the last century. One of the oldest is the Feather River near Oroville gauge that was installed by the United States Geological Survey (USGS) in 1902, making it a great candidate for climate study.

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*Danny Cervantes, Water Resources Technician II, works on a recently installed gauge located on Mill Creek near Los Molinos.*

DPLA's Central District is responsible for collecting a wide range of data categories ranging from surface water and climatology to ground water and water use. This information can be used to document climate change impacts and support the development of actions to advance policy decisions and future water management actions. Stage recorders that measure affects of ocean tides on river levels, water temperatures, and salinity intrusion all can correlate to factors associated with sea level rise. Central District has 75 surface water data collection sites, including 40 tide stations, eight stream flow stations, and 18 stage stations. Recent and ongoing projects include testing radar technology, vertical control datum conversion, sensor modernization, replacing stilling wells with design analysis bubbler systems, and safer high-water flow measurements. These improvements will allow for better data sharing and coordination in integrated regional water management. But in light of climate change, questions may need to be answered going forward. Are these networks sufficient for addressing climate change? In what way do these work, or do they need to be augmented?

The California Water Plan Update (Bulletin 160) is the only document that computes statewide supply and demand, and DPLA is directly responsible for these calculations. Climate



change will increase reliance on accuracy, availability and assessment of these figures. Central District Chief **Karl Winkler** says “Water’s so valuable that we need to diligently explore available technology and coordination opportunities to support data management actions to assist with these statewide calculations. Future conditions will require that we work with more demanding tolerances.” In the meantime, DPLA data collectors strive to advance efforts to coordinate and optimize collection efforts and associated evaluations.



## Stage Measurement

Water surface elevation (tide or stage) measurements in the Delta will be critical in determining the impact of sea-level rise in California. Higher sea-level puts additional stress on the aging levee infrastructure. Between DPLA’s Central District and Division of Environmental Services (DES), the Department operates over 100 collection stations in the Delta estuary, according to **Bob Nozuka**, Central District Resources Assessment Branch Chief. A few of the oldest data records go back to the 1920’s, but the bulk of gauges were installed in the 1940’s and 50’s, when the Department became more heavily engaged in the Delta. Five additional stations are being installed this fall in the South Delta, near Tracy Boulevard. Another important set of data are tide forecasts. The Department works with the National Weather Service (NWS) to produce annual navigational tide tables for the ports of Stockton and Sacramento. These tide tables are used by river pilots who navigate deep sea cargo ships entering the ports from San Francisco Bay. Daily tide forecasts are also made that account for weather and outflow conditions. Together, the long-term water elevation records, annual tide tables, and daily tide forecasts will be valuable tools for climate change projections and adaptation efforts in the Delta.

## Groundwater

Another water variable that is becoming more critical, and may be impacted by climate change is available ground water. DPLA’s San Joaquin District (SJD) conducts between 1,000 and 1,200 ground water site surveys per year. **Mike McGinnis** of SJD says these readings account for about one third of the groundwater measurements taken in the District. The others are conducted by the Bureau of Reclamation and local water districts. Other DPLA District offices also collect groundwater measurements. With current concerns about drought, these valuable measurements can provide information for climate change adaptation. Mike says, “In previous droughts such as 1987 to 1992, the groundwater elevations can drop three to five feet per year and fifteen to twenty feet over the entire drought period in some wells in the San Joaquin Valley unconfined aquifer.” How these basins fare during changeable supply periods will allow for better water management policies in the future.

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*Water Resources Technician II Charlie Peery uses a water level meter to measure the ground water level in a monitoring well at a project on Red Rock Ranch near Huron, California. After measuring the ground water level, the bucket on the right will be used to collect some of the ground water for water quality samples to be sent to Bryte Lab for analysis of total dissolved solids, dissolved selenium, and some mineral constituents.*

*...valuable snowmelt data can be used, “as the first line of defense against flooding, for water supply forecasts, and also to measure climate change.”*

DAVE RIZZARDO



## Snowmelt

Water supply impacts are of great concern in the State, which gets 60 percent of its agriculture and urban water supply from the Sierra Nevada Mountains. Data collected for forecasting water supply conditions in California includes snow water content, snow depth, precipitation and stream runoff. Supplemental information such as temperature, relative humidity, solar radiation, and wind is also provided by some automated sensors. This data enables forecasters to project statewide snowmelt runoff. Recent shifts tell us about climate change impacts in the Sierra Nevada. Less of the water year's runoff is occurring in the April-July (A-J) period, which represents the snowmelt portion of runoff. Over the last century, there has been a reduction in A-J runoff for both the Sacramento and San Joaquin River Systems, but the reduction has been more pronounced in the Sacramento River System, due to its lower average watershed elevation. This indicates a trend toward warmer winter storms with higher snow levels which produce less snow. Warming temperatures cause seasonal snow lines to rise to higher elevations, at the approximate rate of 500 feet for every 1°C (2°F) increase in temperature. Few observations are in place to track the dynamics and location of the rain/snow transition zone. This zone plays a critical role in both the snowpack and flood dynamics, so additional investment in high-terrain monitoring is needed for climate studies.

Across California, there's been a shift in the peak snowmelt runoff on the Sacramento and San Joaquin River Systems to about one week earlier since the first half of the 20th century. **Maury Roos**, Chief Hydrologist in the Division of Flood Management puts the estimate of average loss of snowpack so far at around 10 percent of 20th century “normal” levels. Using the figure 1°C warming leads to a 500 foot elevation in the snow level, projections are for a loss of at least 25 percent of snowpack by the middle of this century. This is based on current temperature trends and average climate model projections of CO<sup>2</sup> induced warming.

*Above/Below: Snow survey being conducted at Phillips Station along Highway 50 by Frank Gehrke (right) and Dave Hart of the Division of Flood Management 's Hydrology Branch.*

Measuring Sierra Nevada snowpack and water content is one of the Department's well-known data collection activities. **Dave Rizzardo**, Chief of the Snow Surveys Section in the Division of Flood Management, says valuable snowmelt data can be used, “as the first line of defense against flooding, for water supply forecasts, and also to measure climate change.” Many of the 268 snow courses are actually measured during the season by cooperating agencies, but Department personnel do maintain most of the courses used in the program. Near the first of the month from January through May, cooperative snow surveyors trek into the Sierra; in some cases to very remote locations. A snow sampling tube with a cutter end is driven through the snowpack, measuring depth. By weighing the snow core, the water content (water equivalent) is obtained. The same points are sampled several times each winter to observe changing conditions throughout the season. There are also 129 automated snow sensors (pillows) up and down the Sierra Nevada. Many of the telemetered sites also provide precipitation, air temperature, wind, and solar radiation data, which will be useful in California climate change detection and analysis.



## Flood Control

There is an increased risk of flooding for the state in a warmer climate. Higher snow lines will compound flooding potential because of increased volume of direct runoff in the watershed. The Division of Flood Management is expanding a pilot program that will benefit present-day flood risk reduction, as well as assist in climate change adaptation. During flood situations, it can be helpful to conduct reservoir releases in a well-timed fashion. The Forecast-Coordinated Operations (F-CO) program allows operators to make controlled releases ahead of and during major flood events allowing for more water supply storage during the flood season (October through April). The F-CO program is considered one of the most cost-effective measures to improve flood control. It will help minimize the risk of exceeding river channel capacity and increase the warning times to communities along the major California rivers and downstream of flood control reservoirs without impacting the water supply of the upstream reservoirs. Conserving storage is critical if the expected climate change impacts of higher snowlines, decreased snowpack, and earlier snowmelt are realized. This may lead to updates to applicable water control manuals (or at least flood control curves) issued by the U.S. Army Corps of Engineers (USACE).

The pilot project for F-CO is taking place over the Yuba-Feather River System, and is a collaboration between the Department, USACE, the Yuba County Water Agency, and the California-Nevada River Forecast Center (CNRFC). Key initiatives are to enhance communication between local, state and federal agencies; improve data gathering and

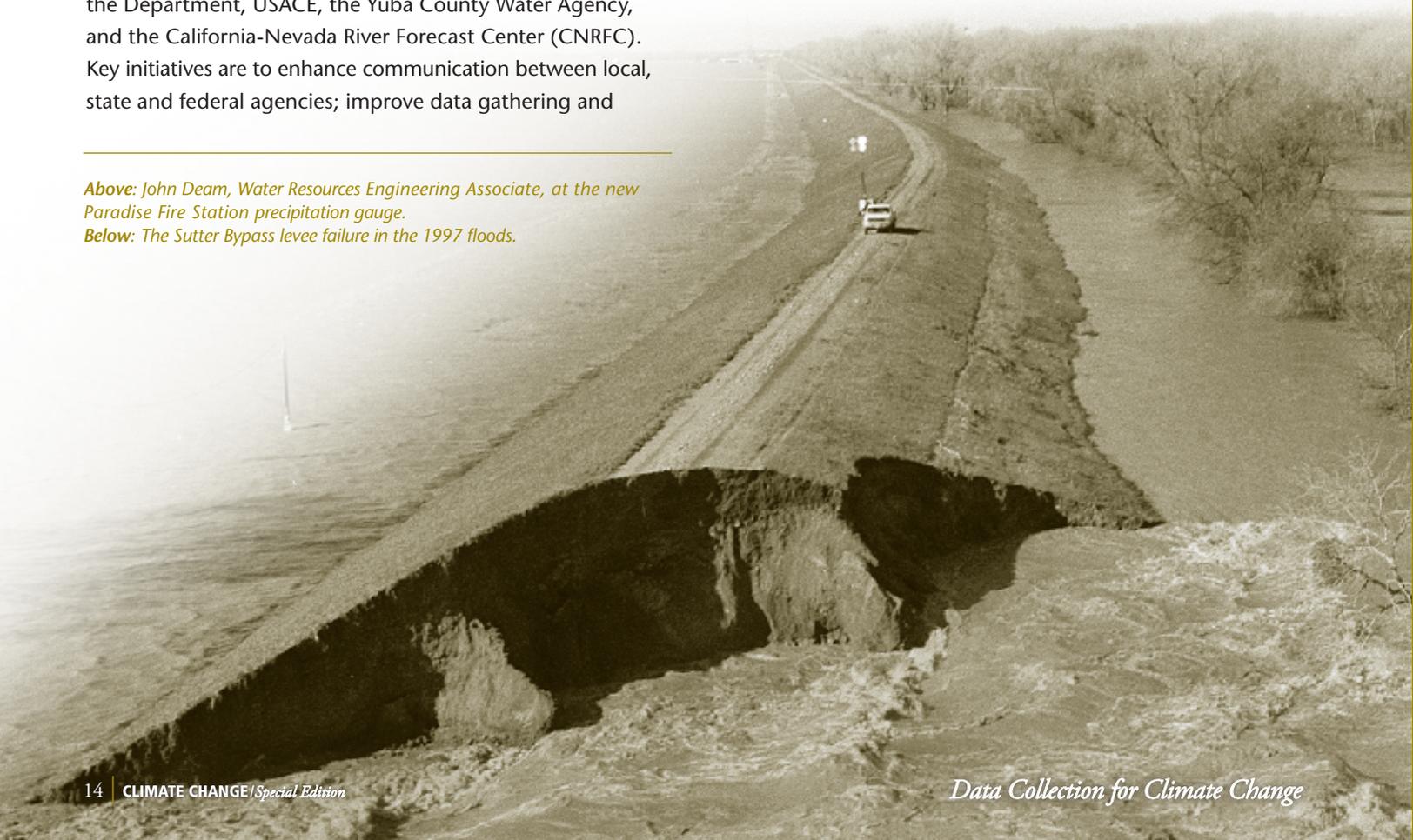


exchange; and utilize the most recent advancements in weather and river forecasting. Twelve new precipitation gauges, two new snow pillows and five new stream gauges were put into place between 2005 and 2007 for this endeavor. As F-CO expands into the San Joaquin System over the next few years, the program anticipates installing additional sensors for temperature, snow, rain, and stream flow. Since southern Sierra mountains have a higher average elevation than those in the north, this would make an interesting area of research on changing snowpack and runoff. Although it would take some time to establish a long-term record, these new gauges will be a valuable investment for flood concerns today, as well as for climate analysis in the future.

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*Above: John Deam, Water Resources Engineering Associate, at the new Paradise Fire Station precipitation gauge.*

*Below: The Sutter Bypass levee failure in the 1997 floods.*



# EARLY HISTORICAL ACCOUNTS

By Amy Norris

In keeping with its tradition of leadership on water issues, DWR has been at the forefront of climate change study and impacts on water management. It is predicted that temperatures will rise from one to six degrees Celsius in the next 100 years. It is now widely held that the rise in temperature will directly impact water resource management in California by causing a loss of at least 25 percent of the snowpack, a rise in sea level that will pose risk to Delta levees, and potential intrusion of salty water into the Delta and groundwater basins.

DWR's investigation into the impacts of climate change began over 20 years ago. **Maury Roos**, DWR's Chief Hydrologist, led the earliest investigations into the possibility that warming could be impacting the state's water resources.

In March of 1987, Roos wrote a paper for the Pacific Climate Workshop that identified changes he had discovered in the Sierra snowmelt. He and **Bob Burnash** with the National Weather Service had discussed the possibility that greenhouse gases might lead to climate change. Though both were initially quite skeptical, Roos believed if there were something to it, he would see a change in the snowmelt ratio, and he did find one.

In January of 1989, the American Association for the Advancement of Science (AAAS) held a meeting in San Francisco to discuss climate change. In an effort to acquaint the water community with climate change issues presented at the San Francisco meeting, they contacted Roos to set up a seminar at DWR's headquarters office.

In December of 1989, the impact that warming could have on snowpack was first discussed at a snow cooperators meeting in Oakhurst, California. Roos then worked with **Kari Smith** of the California Energy Commission, on the water portion of the CEC's report on climate change in California. The report covered greenhouse gases,



*“It is now widely held that the rise in temperature will directly impact water resource management in California...”*

MAURY ROOS

warming and identified potential loss of snowpack as the most likely and significant change for water. Sea level rise and the possibility of more floods were also mentioned.

Roos presented papers at the Oceans Conference in Seattle in September of 1989, and another at the 1990 Western Snow Conference which was later published in their annual Proceedings.

However, with the 2005 update of Bulletin 160-the California Water Plan, climate change finally became a major issue. Water Plan stakeholders requested climate change be more thoroughly represented than it had been in the previous 1993 and 1998 Updates. DWR complied with a chapter that addressed Global Climate Change and its impact on snowpack changes, hydrologic patterns, sea level

rise, rainfall intensity, water demand and aquatic life.

In 2006, DWR also published the report, “Progress on Incorporating Climate Change into Management of California’s Water Resources.” This report grew from Governor Arnold Schwarzenegger’s Executive Order S-3-05 establishing greenhouse gas emissions targets for California, and requiring biennial reports on potential climate change effects on several areas, including water resources.

The effect of warming on precipitation is of greatest concern to water resource managers. Historically, the state has 15 million acre feet of water storage in snowpack. Currently, about 10 percent of that snowpack or 1.5 million acre-feet, has already been lost.

DWR is still trying to provide leadership to the water community. According to Roos, there now seems to be broad support for the idea that things are changing and changing fast enough to warrant more investigation, adaptation and mitigation. A number of DWR people are now actively involved in climate change work. ■

## Other Data Collection

Another great source of data is the California Irrigation Management Information Service (CIMIS) network. CIMIS is a program in the Office of Water Use Efficiency that works in partnership with the District Offices and local farmers. The network was established to assist farmers in determining their irrigation needs for crops. **Jan Carey** with Central District reports that there are strong cooperative efforts in place with local entities to maintain these many stations. This growing network began in 1982, and is now archiving sufficient data for climate analyses. One-hundred thirty solar-powered automated CIMIS stations are in place statewide recording solar radiation, air temperature, relative humidity, wind speed, and, through calculation, evapotranspiration.

Evapotranspiration (ET) is the loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues). ET is especially valuable in climate change studies, as warmer temperatures will lead to changes in the amount of water needed by plants, and the amount contributing to atmospheric cloud production. With 20-million Internet visits in 2007, it is likely this data is already being tapped for climate studies. The Web address for CIMIS information is [www.cimis.water.ca.gov](http://www.cimis.water.ca.gov).

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*Jan Carey of the Land and Water Use and Conservation Section in Central District explains how the California Irrigation Management Information Services (CIMIS) network works during the California State Fair.*

Real-time data from each of these networks is collected and made available on the California Data Exchange Center (CDEC) at <http://cdec.water.ca.gov/>

In addition to that collected by the Department, data provided by external agencies is also posted, making it a robust real-time data source. For additional data, and quality-controlled data unavailable in real-time, the Water Data Library is the site to check. <http://wdl.water.ca.gov>

In addition to these products, State Climatologist **Mike Anderson** takes this data and creates monthly reviews of California's climate. These reviews are posted on the state climatologist Web site near the middle of the month at <http://www.water.ca.gov/floodmgmt/hafoo/csc/>





On August 28, 2008, the DPLA Data Collection Team meeting was held at the California State Fair. Using "California's World Class Delta" as a backdrop, the group reviewed collection methods, equipment, data management and accessibility to assist water managers in evaluating complex water resources management challenges and assist in policy formation.

## Partnership

The Department sees partnership as a key to developing a larger climate change database. The National Weather Service Cooperative Observer (NWS Co-Op) Program has long been considered the premier climate data network nationally, with data being processed and archived at the National Climatic Data Center. In an attempt to address deficiencies in the NWS Co-Op network with respect to monitoring for climate change, the National Oceanic and Atmospheric Administration (NOAA) started a program known as the Climate Reference Network. The program aims to install and maintain high quality precipitation and temperature measuring stations for homogeneous measurements that can tie into historical observations for the purpose of climate change detection and monitoring. Currently California has three sites operating with an additional four planned or in the process of being installed. Department personnel work with NOAA and members of the Western Region Climate Center to coordinate these activities.

Partnership in other agencies' weather and climate programs can also add to the data collected. Over the next five years, Department personnel, Scripps Institute of Oceanography, and NOAA's Earth System Research Laboratory (ESRL) will be adding to the network of extreme precipitation observation. New instrumentation of soil moisture, snow level radar and atmospheric water vapor sensors are being installed at several locations across the state. In addition, NOAA's ESRL will be developing computer modeling tools to make use of the data to assist both state and federal forecasters with the timing and location of extreme precipitation events. This data will be useful for studies involving peak flows, flood events, and basic climatology of the region.

## Looking Ahead

The future of the Department's data collection as it relates to climate change will be to build upon current networks, invest in data analysis and archiving, establish better monitoring of the critical rain/snow transition line, contribute to or augment the atmospheric monitoring networks of partner agencies, establish an interim range of sea level rise estimates for short-term planning purposes, and identify further research and modeling studies necessary for small- or regional- scale climate change assessment. Executive Manager for Climate Change, **John Andrew**, says, "The uncertainty that remains in the rate and magnitude of long-term climate change must be reduced. There are currently large gaps in our hydrologic observational network in areas of California most subject to climate change. Improved data collection and a robust monitoring network will help identify trends, provide for better real-time system management, evaluate and, if necessary, correct adaptation strategies."

Anticipated changes in California's climate will create many challenges in the field of water resources. The tremendous effort of Department employees in maintaining, archiving and disseminating data will help the State monitor and document California's climate.

**Danny Cervantes** of DPLA's Northern District puts it this way, "How do you predict the future if you don't keep track of the past?" While looking at the past is part of the solution, for climate change the past may not even be sufficient for predicting the future. Therefore, stable funding for longer periods will be key to determining, and adapting to climate change in the future. ■

# THE CALIFORNIA STATE CLIMATOLOGIST

By *Elissa Lynn*

**D**isorder may be too harsh a word to describe **Dr. Michael Anderson's** cube, but it's not an easy place to navigate. With records dating back to the 1870's, some of it on aging yellow vellum, his desk is the repository of California's climate history. His favorite archive is the Southern Pacific Railroad snow charts from before the turn of the century. Six-foot long scrolls flecked with blue ink graph the snowfall and snow depth over Truckee, Summit, Cisco, Emigrant Gap and Blue Canyon. You'll find a copy of the original archive of the United States' hottest, yet disputed, temperature record; Death Valley (Greenland Ranch at the time) 134°F, on July 10, 1913. There are microfiche files of the federal climate program that was ended in the 1970's, hand-written and leather-bound logs of Santa Maria's weather in the 1940's, and a faded, original Bulletin 56, Survey of Mountainous Areas dated 1955, which led to the selection of the Feather River as the top of the State Water Project.

This material is all part of the State Climatologist's Office and Program. It is rare to find a state climatologist housed within a State agency. Thirty-nine state climatologists are on university campuses. But in California, the Office is maintained in the Division of Flood Management. Dr. Anderson's goal is for the Office to become the focal point for hydrometeorologic climate data for California. He's coordinating with the Western Regional Climate Center (Reno, Nevada) and various national programs, including the National Weather Service, the U.S. Department of Agriculture, and the National Climatic Data Center.

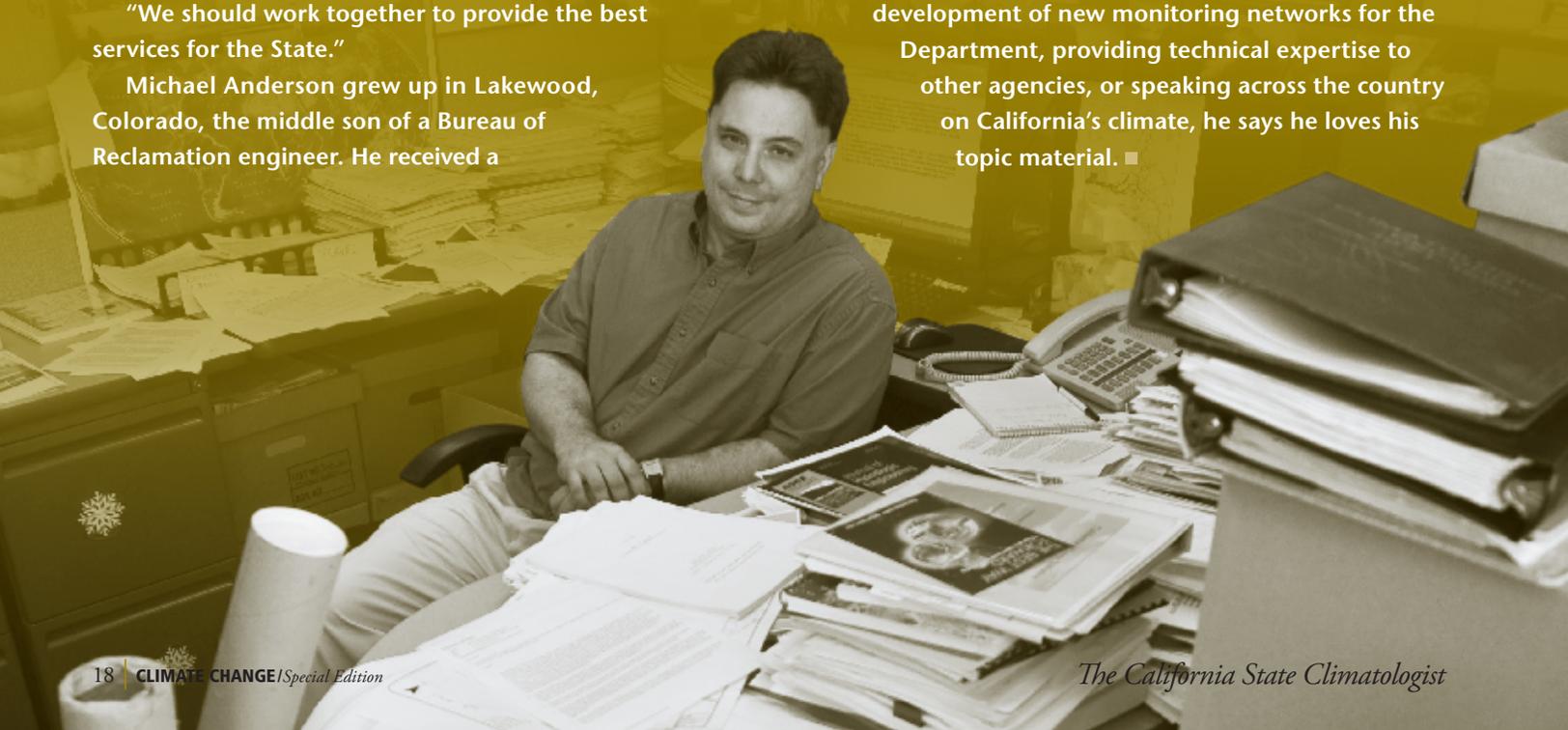
"We should work together to provide the best services for the State."

Michael Anderson grew up in Lakewood, Colorado, the middle son of a Bureau of Reclamation engineer. He received a

Bachelor of Science in Civil Engineering in 1991 from Colorado State University, graduating cum laude. He got his Master's from the University of California, Davis in 1993. His Ph.D. thesis, "On the Physics of Drought," was completed in 1998.

Shortly after coming to the Hydrology and Flood Operations Office as an engineer, managers found out about his atmospheric sciences background, and asked him to take on the role of State Climatologist. Prior to Dr. Anderson's tenure, **Bill Mork**, State Meteorologist from the early 1980's until 2005, carried out the climate duties. **Jim Goodridge** held the post from 1953 to 1983, and was registered as California's State Climatologist with the National Climatic Data Center. Mr. Goodridge, incidentally, is now a retired annuitant living in Chico. He still updates and contributes data to the program.

Revival of the Office took approximately one and a half years. Reinstatement as a recognized office by the American Association of State Climatologists was completed in 2007, and Dr. Anderson's position was established by DWR in 2008. The Office monitors and distributes climate related data to interested parties, conducts climate-related outreach activities and educational materials, and supports climate research within the state. Of course, climate change is one of the key issues that the Office plays a role in. (See Data Collection article, page 12). Dr. Anderson's schedule looks a lot like his desk; quite crowded! Whether assisting in the development of new monitoring networks for the Department, providing technical expertise to other agencies, or speaking across the country on California's climate, he says he loves his topic material. ■



# RISAS, CLIMATE RESEARCH, & DWR

By Jeanine Jones

The Regional Integrated Sciences and Assessments (RISA) program of the National Oceanic and Atmospheric Administration (NOAA) was established in the mid-1990s to support research that addresses climate-related issues of concern to decision-makers at state or regional levels. NOAA funds university-based RISA centers that help provide an information translation function from the academic sector to users of climate information. NOAA now funds eight RISA centers (commonly just referred to as RISAs) nationwide – and DWR is working with three of them – the California Applications Program at the Scripps Institution of Oceanography, the Western Water Assessment at the University of Colorado, and the Climate Assessment for the Southwest at the University of Arizona. The RISAs provide information about natural climate variability and human-induced climate change, often in the form of newsletters or climate forecasts. They are also intended to provide NOAA with information on designing a proposed national climate service, a new federal function that could become the climate equivalent of the National Weather Service.

Climate change and water is a key focus area at these three RISAs. DWR has worked with the RISAs on subjects such as global climate model output information for the 2006 Climate Action Team report to the Governor and the Legislature, articles for DWR's 2008 drought update report, and a 2008 science workshop on U.S.-Mexico border region climate change for the Border Governors Conference. DWR has also entered into a Memorandum of Agreement (MOA) with NOAA, acting on behalf of the three RISAs, for coordination of climate-related research. As the MOA notes, "Improving the understanding of climate and climate variability is vital to management of California's water resources. The state's water supply availability is determined by natural climate variability, evidenced in droughts and cyclical patterns such as the El Niño-Southern Oscillation. Understanding natural climate variability, as well as that stemming from human-induced climate change, is essential for operating the state's water supply and flood control projects and for adapting to climate change."

The RISA program is important to DWR and to other water agencies because it is currently the only program that serves the critical role of identifying, translating, and transitioning potentially relevant research funded by the federal Climate

Change Science Program to actual resource managers and other end users. Presently, periodic assessment reports prepared by the Intergovernmental Panel on Climate Change are the only comprehensive source of broadly accepted information on expected future impacts of climate change, but the assessment reports present information only at the global scale. Climate scientists at the RISAs work closely with the user community on practical applications of current research at the state and regional scale, and help form networks with others in the academic community willing to work on real-world problems. DWR is, for example, collaborating with its three RISA partners to produce a "Water Year 2009 Crystal Ball Science Workshop" scheduled for November 21st. The purpose of this event is to use best-available science – from global climate models, from National Weather Service forecast products, from ongoing climate observations, and from paleoclimate analogs – to estimate likely water supply conditions in the coming year – wet, dry, or average. ■



*Left to Right: DWR Director Lester Snow presented DWR's first-ever awards for Climate Science Services at the Climate Change Water Adaptation Summit in Santa Monica in 2007 to Brad Udall (Western Water Assessment, University of Colorado), Jeanine Jones of DWR, and Gregg Garfin (Climate Assessment for the Southwest (CLIMAS), University of Arizona). The award's purpose is to recognize ongoing assistance provided by members of the academic community who have been working closely with DWR on planning for climate variability and change. (Not in photo are award recipients Connie Woodhouse of CLIMAS and Daniel Cayan and Michael Dettinger, both of the California Applications Program.)*



## *California Hosts Border Governors Conference,* **CLIMATE CHANGE A FOCUS**

*By Jeanine Jones*

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*California is honored  
to host this conference  
and I am honored  
to be your chairman.  
Together we have  
accomplished a great  
deal over this past year.*

GOVERNOR  
ARNOLD SCHWARZENEGGER

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In August, California hosted the XXVI Border Governors Conference (BGC) in Hollywood. The BGC is an organization composed of the 10 U.S. and Mexican states that share the border – California, Baja California, Arizona, Sonora, New Mexico, Chihuahua, Coahuila, Texas, Nuevo León, and Tamaulipas. The purpose of the organization is to provide a venue for the states to discuss and resolve the unique issues they face in the border region, which, based on the 10 states’ combined economies, ranks as the third largest economy in the world.

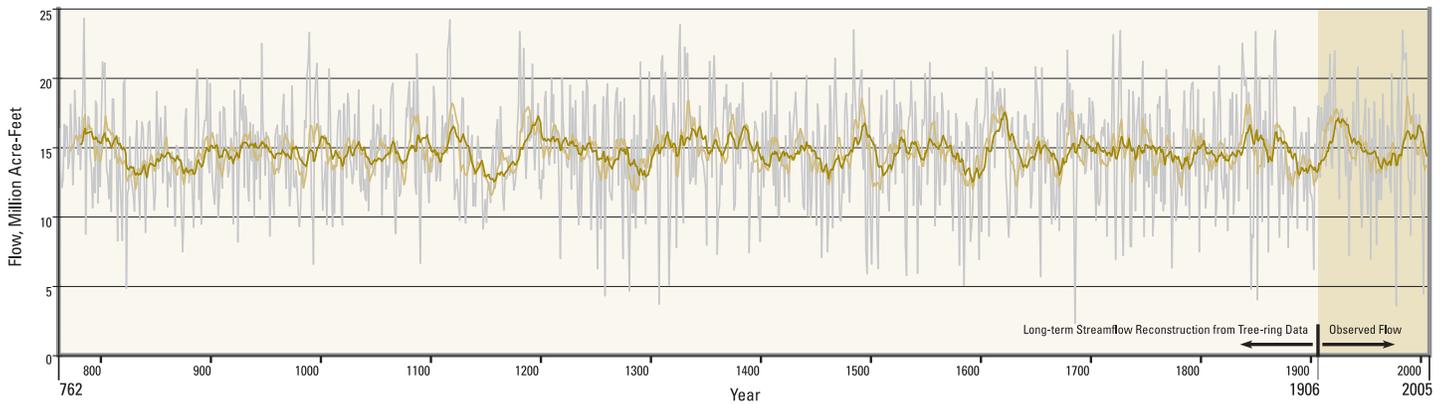
“California is honored to host this conference and I am honored to be your chairman. Together we have accomplished a great deal over this past year. The Mexican border states have joined our Western Climate Initiative, for instance, to help fight global warming. We are working with the federal governments to tackle the problem of millions of abandoned scrap tires that pose a public health and environmental risk

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*Above: Moderator Judy Maben (right) of the Water Education Foundation and panel speakers during the May 2008 Water Education Foundation Border Water Infrastructure Conference sponsored by DWR and WEF in San Diego*

Annual Flow —  
 10 Running Year Mean —  
 20 Running Year Mean —

### Colorado River at Lee Ferry



and we have begun discussions on managing water resources during drought conditions,” said **Governor Arnold Schwarzenegger** at the conference.

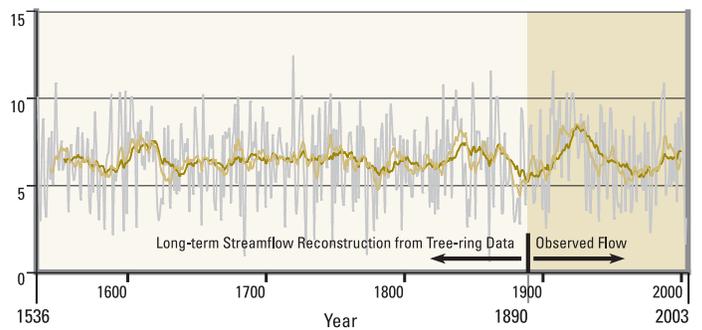
The responsibility for hosting the conference – where the governors of all 10 states meet and ratify joint declarations (see sidebar) that constitute an annual work plan for actions of mutual interest -- alternates between the U.S. and Mexican states. Last year the host state was Sonora; next year’s host will be Nuevo León. The joint declarations are developed and implemented by 10-state work tables that meet throughout the year and cover subjects such as water, agriculture, tourism, health, education, and energy. Within California DWR is responsible for supporting the recently created Water Work Table. This year and next year California and Nuevo León are the co-chairs of the Water Work Table.

Each year the BGC host governor selects a theme or priority topics for the year. The selected priority topics for the XXVI conference were economic development, green technology, and climate change. To carry out the climate change topic for the Water Work Table, DWR sponsored a science workshop on border-area climate change with the University of Arizona, and used information derived from that workshop to publish a special report on border water and climate change. Copies of the bilingual report are available from DWR’s publications desk or online at <http://www.water.ca.gov/news/newsreleases/2008/081508bgcreport.pdf>

As described in the report, the border region – which is arid and whose population growth rates outstrip national averages – is vulnerable to climate change impacts.

The international Colorado River and Rio Grande basins are the major river basins of the U.S. southwest/Mexican northwest, with a relatively small percentage of the high elevation headwaters area in each basin being responsible

### Upper Rio Grande River at Del Norte, CO



### Border State Population Estimates and Projections (millions)

State	2005 Estimate	2030 Projection
California	36.1	46.4
Arizona	5.9	10.7
New Mexico	1.9	2.1
Texas	22.9	33.3
Baja California	2.8	5.1
Sonora	3.3	3.8
Chihuahua	2.5	3.1
Coahuila	4.2	5.4
Nuevo Leon	2.4	2.8
Tamaulipas	3.0	3.8

Source: U.S. Census Bureau and Consejo Nacional de Población



## THE BORDER GOVERNORS

Arizona	<b>Janet Napolitano</b>
Baja California	<b>José Guadalupe Osuna Millán</b>
California	<b>Arnold Schwarzenegger</b>
Chihuahua	<b>José Reyes Baeza Terrazas</b>
Coahuila	<b>Humberto Moreira Valdés</b>
New Mexico	<b>Bill Richardson</b>
Nuevo León	<b>José Natividad González Parás</b>
Sonora	<b>Eduardo Bours Castelo</b>
Tamaulipas	<b>Eugenio Hernández Flores</b>
Texas	<b>Rick Perry</b>



for contributing the majority of the runoff used throughout the basins. Projected warming and drying due to climate change will further stress already over-allocated resources available from these river systems. The U.S. southwest/Mexican northwest lies within a region that some climate scientists characterize as a zone of potentially expanding desertification due to changes in atmospheric circulation patterns stemming from human-induced climate change.

Drought is already a commonplace event in the border region and a recurring aspect of natural climate variability. Long-term records of reconstructed runoff in both the Colorado River and Rio Grande basins indicate that the basins have experienced droughts more severe than those in the relatively short period of the measured historical record. Interest in managing drought is a common theme among the border states; accordingly one of the joint declarations from the XXVI BGC (see sidebar) calls for the Water Table to hold a binational science conference on drought in 2009, while one of the declarations from last year called for the Rio Grande states to develop a proposed definition of “extraordinary drought” for purposes of administering the 1944 U.S. – Mexico water treaty. (DWR will be organizing the 2009 drought conference, which will be held in San Diego in March.)

The border states are also keenly interested in improving water infrastructure to help cope with water supply challenges and to meet growing urban needs. Joint declarations adopted by the governors last year, for

*The Border Water Infrastructure Conference sponsored by DWR and the Water Education Foundation in San Diego.*



California Speakers during the Border Water Infrastructure Conference included Rita Sudman (far left photo on page 24), Halla Razak of the San Diego County Water Authority (second to right), and Jeanine Jones of DWR (right).

example, called for increased federal appropriations for maintaining existing federal and international water infrastructure, and for improving efficiencies of water conveyance infrastructure. Recognizing the high level of interest in border water infrastructure and the large unmet needs for financing infrastructure improvements, DWR held a bilingual border water infrastructure conference in San Diego in May with the Water Education Foundation and prepared a bilingual video titled “Border Infrastructure, the Crucial Ingredient” which was shown at the XXVI BGC. A key point made at the conference was the need to focus on investigation of regional infrastructure projects (such as regional conveyance projects), a subject of interest for the Water Table. Historically, federally-funded financial assistance made available in the border region has been geared toward assistance for smaller individual projects, such as water and wastewater treatment plants for individual communities.

The 10-minute border water infrastructure video, developed in part from information at the conference, provides views on priority areas for infrastructure investment, and can be seen at <http://www.water.ca.gov/news/>

The Water Work Table plans to coordinate closely in development of plans for improving water infrastructure with partner international agencies – the North American Development Bank (NADB) and Border Environment Cooperation Commission (BECC) – that administer infrastructure financial assistance. NADB and BECC have documented nearly \$1 billion of drinking water and wastewater infrastructure needs in the border region. ■

*“The border region – which is arid and whose population growth rates outstrip national averages – is vulnerable to climate change impacts.”*

**2005 Population Estimates (millions), Selected Municipalities**

Municipality	2006 Estimate
San Diego	2.9
Las Vegas	1.7
Phoenix	3.9
El Paso	0.72
Tijuana	1.4
Mexicali	0.85
Ciudad Juárez	1.3

Source: U.S. Census Bureau and Consejo Nacional de Población  
U.S. figures are for metropolitan statistical areas

## 2008 WATER WORK TABLE JOINT DECLARATIONS

- Organize and convene bi-national science conference on drought in 2009, to include the consideration of factors such as climate variability and change, and share information on present and future water supply needs.
- Urge the federal governments of both countries to improve the infrastructure of the hydrometric and climatological monitoring network in the United States-Mexico border region.
- Pursue greater engagement with the federal governments of both countries in reviewing requests for financial assistance and seek joint state-federal decision-making processes regarding how water infrastructure projects are funded in the United States –Mexico border region.

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STATE OF CALIFORNIA • DEPARTMENT OF WATER RESOURCES

## **DWR Mission** | *Statement*

To manage the water resources of California  
in cooperation with other agencies, to benefit  
the State's people, and to protect, restore, and  
enhance the natural and human environments.