ARIZONA
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El Niño News

Publication Focuses on Arizona El Niño Happenings

This special supplement provides news and information about El Niño. In a sense, the publication will serve as an *El Niño Times*, informing Arizona water professionals and others interested in water affairs of plans, projects and activities relating to weather affected by El Niño. The publication will concentrate on events occurring in Arizona but also will provide more general information about El Niño and its expected effects.

Managing water resources in Arizona is challenging, even under the most favorable of circumstances. El Niño represents a wild card, an added and uncertain complexity. At this point in time, what effects El Niño will have on our region is unclear; indeed, it is not guaranteed that we will experience any special El Niño climatological disruptions. Although the warming of the waters off the west coast of South America which fuels El Niño has been documented, and is "unprecedented in amplitude" at the present stage in the develop-

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The normally dry Santa Cruz River in Tucson became a raging torrent during 1983 El Niño rains. The above view is from St. Mary's Bridge on October 2. Weather officials emphasize that flooding does not always accompany El Niño events. (Photo: P. Kresan)

Salt River Project Plans for El Niño Surface Water Bonus

The Salt River Project will pump less groundwater during the remainder of the year in anticipation of a surface water bonus from El Niño. SRP's original plan for this year called for the utility to pump 184,000 acre-feet of groundwater. With anticipated El Niño storm activities and the likelihood of greatly increased precipitation, SRP will pump only 137,000 acre-feet, saving 41,000 acre-feet of groundwater and, at the same time, increasing flood capacity.

An additional 41,000 acre-feet will be drawn down from the SRP reservoir system to make up for the reduced amount of groundwater to be pumped. "This makes room for the additional rain we are expecting and also reduces the probability of spilling excess water next spring," says Dallas Reigle, SRP senior hydrologist.

Along with preserving groundwater resources, the SRP plan is expected to save the utility about $1 million in pumping costs this year. A heavy rainfall this season also will provide a payoff next year. "If we have a wet winter and reservoirs fill up we will be able to reduce pumping next year to about 70,000 to 80,000 acre-feet total for the year," Reigle says. About 180,000 acre-feet would typically be pumped.

Reigle says that if expected rains do not occur, SRP still will have adequate water supplies in the reservoirs to meet next year's needs. "That is one reason we were able

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ment cycle, any prediction of the possible location and magnitude of effects from this El Niño are subject to the same uncertainties affecting all current weather forecasting.

Water resource officials, however, cannot afford a wait-and-see attitude, especially since many experts are predicting that this El Niño event will be the biggest, most potent in recorded history and will deliver extremely heavy rains to Arizona. El Niño might be the big water event of the year, and possibly also of next year. Water officials in various capacities, whether flood control, dam and/or and river management, fish and wildlife protection, or delivery of water supplies, not to mention those concerned with disaster relief, need to take stock of the current situation and possibly plan for a worst- case scenario.

Some plans and activities already are occurring. Contrary to the oft-noted adage that everyone talks about the weather but no one does anything about it, some water officials are in fact preparing for possible El Niño conditions. This publication will report on these plans and activities, as they are occurring in Arizona.

We invite readers to provide information about projects and activities being planned and worked out to prepare for possible El Niño effects as well as any El Niño-related information of interest to people in the state. Suggested topics also are welcomed.

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to reduce groundwater pumping. It saves some money, and there is no large effect on our water operations next year."

"If we don't have a wet winter then next year we will probably have to pump as much as we originally intended to pump this year to make up for the reduction this fall. We are taking somewhat of a gamble this year. But it is not anything we can't recover from."

Along with providing financial and groundwater savings, the plan also will help control flooding. Compared to previous years, SRP now is better able to cope with extreme flows. Construction at Roosevelt Dam has provided extra storage and flood control space not available in 1993, the year of the last big flood event.

Reigle, however, remains cautious. He says the new construction "will not eliminate the possibility of flood events because we still have not appreciably changed the Verde reservoir system." Peak flows from previous large precipitation events came from the Verde River watershed, although more volume comes from the Salt River. Horseshoe and Bartlett are the two SRP dams on the Verde River.

The Verde River reservoir system will be tapped to compensate for the cutback in groundwater pumping. Of the 41,000 acre-feet to be drawn from SRP reservoirs, about 30,000 acre-feet will come from Bartlett Reservoir, with the remainder from reservoirs on the Salt River. This will result in storage being available in Bartlett Reservoir in the event of heavy flows.

Precipitation from strong El Niño events can compound flooding problems or, as described by Reigle, it "can produce our great nemeses, and that is rain on snow. That releases tremendous volumes of water in a very short period of time. During previous El Niño years we have had above-normal snowpack. El Niño brought warm tropical storms into the area and warm rain fell on snowpack. We then had a lot of flooding throughout the Phoenix metropolitan area."

"Reducing groundwater pumping is a bold step," Reigle says. "We have never done anything like this before. We have never changed our operations to this extent based on a weather forecast."

According to John Keane, SRP official, SRP in the past only modified reservoir reservations based on very short-term forecasts, usually of only a few days. Long-term forecasts were notoriously unreliable to use as the basis for reservoir releases.

"The strategy was not to fire until you see the whites of their eyes," says Keane. "When we start seeing the water hitting the gauges way up stream, then we could afford to believe it."

SRP is responding to projections that this El Niño may be the strongest to occur in recorded history. In making its plans SRP also looked at previous El Niño events, the amount of rainfall that occurred during those years and the resulting runoff.

SRP feels more secure this year in making plans contingent upon expected future rainfall because El Niño forecasting is much more advanced than during previous occurrences. This El Niño has received extensive coverage, with more information provided on its development and likely effects throughout the world. During previous El Niño seasons, forecasting was limited and insufficient information was available to guide water resource planning.

El Niño represents one more challenging variable for SRP to deal with at a time when it is managing wide swings between dry and wet years within a relatively short period of time. "A problem we have operationally is that 1993 was the wettest winter in history and 1996 was the driest year," Reigle says. "And we have had both extremes within four years. Trying to manage a reservoir system under those conditions is tricky at best."

What Are the Odds?

Not all El Niños bring heavy fall and/or winter precipitation to Arizona and the West. In any given year, the chance of Arizona having a wetter than average winter is about 50 percent. This generally increases to about 65 to 75 percent during an El Niño event. Because of especially strong El Niño signals evident this year, some forecasters say the chance of above average precipitation during 1997-98 is more like 80 percent. Those still drying out from Nora's charge through Yuma and Baghdad might put the odds a little higher.

El Niño Effects Are Many and Varied

To many people, El Niño is an abstraction, the result of a complex interaction of clouds and storms, regional winds, oceanic temperatures and ocean currents along the equatorial Pacific. No concrete image of El Niño comes to mind until the weather changes. Then wind, rain, flooding, unseasonable temperatures or drought become El Niño effects. It is by its effects that El Niño becomes known.

El Niño effects are many and varied, noticeable in science, public policy making and even in social and cultural affairs. A review of the following El Niño topics or areas of interests will help explain the phenomenon and some of its implications.

El Niño's Occurrence in the West

The West can expect varied El Niño effects. The swath stretching east from Southern California, across Arizona, southern Nevada and Utah, New Mexico and into Texas can expect more frequent and abundant rainfall. Research of El Niño's impact on winter precipitation in Arizona's south-central climate zone – an area that includes Pinal and Maricopa counties – shows winter precipitation during El Niño years to be almost double than among non-El Niño years.

In contrast, the Pacific Northwest, including Washington, Oregon, and the mountainous portions of Idaho, western Montana, and northwest Wyoming, can anticipate a drier winter. This area extends into Canada and generally coincides with the Columbia River Basin. Positioned between the expectant dry and wet areas is a region of indeterminate El Niño influence. Northern California, southern Oregon, northern Nevada and Utah, southern Wyoming and much of Colorado may have neither a particularly wet nor dry winter. A large portion of this area lies within the Colorado River watershed. El Niño's influence is most prevalent from October through March or April.

Winter temperatures accompanying El Niño tend to be unseasonably warm along the West Coast, from Washington and northern Oregon across the northern tier to Idaho and Montana. Cooler than normal temperatures can be expected in Arizona and in the far southeastern portion of the West, particularly in southeastern New Mexico.

With the likely occurrence of cooler temperatures and heavy precipitation in the Southwest, deeper snowpack can be expected in the higher elevations. Snowpack is the source of much of the streamflow in the West. Since there is a delay between when snow falls and when it melts, however, the effects of El Niño on stream flow may not be apparent until spring or summer.

Special El Niño editions of the **Arizona Water Resource** newsletter will be published during fall/winter 1997-98, the expected El Niño season. The University of Arizona's Water Resources Research Center publishes the newsletter, with financial support from the **U.S. Geological Survey, Water Resources Division, AZ District.**

Editor: Joe Gelt
Reporter: Jim Henderson
Publisher: Gary Woodard

WRRC Acting Director: Peter Wierenga

Water Resources Research Center
College of Agriculture
The University of Arizona
350 N. Campbell Avenue
Tucson, Arizona 85719
520-792-9591, Fax: 520-792-8518
Email: wrrc@ccit.arizona.edu

El Niño and Flooding

The occurrence of El Niño is not synonymous with flooding. Floods in Arizona result from various conditions including heavy summer thunderstorms, strong winter low pressure systems and remnants of tropical storms. These conditions can exist independent of El Niño. El Niño, however, increases the likelihood of strong winter storms and causes tropical storm remnants to move into Arizona. It is not surprising then that some of the largest floods in Arizona history occurred during El Niño events. In sum, flooding is not a sure thing during El Niño, but the odds of one occurring increase substantially.

A number of flood fatalities have occurred during recent months, increasing concern about flooding. Six Mexican immigrants drowned in a sewer drain beneath the streets of Douglas, and flood waters swept 11 hikers to their deaths in a canyon near Page. Because of these events, many people are acutely aware of the hazards of flooding. This awareness may increase concern about El Niño and flooding. People feel forewarned and fear the worst.

El Niño and Arizona Water Resources

El Niño events may be responsible for projecting a rosier, more optimistic picture of Arizona water resources than is justified. El Niño occurrences have followed an unusual pattern during the last 20 years. Not only did more El Niño events occur during this time period than were typical during earlier periods, but one of the biggest El Niño events on record occurred during this period. In fact, some scientists believe the period from 1990 to 1995 may have been three separate El Niño events in a row. In general, the El Niño events of 1982, 1986 and 1991 showed a tendency to develop over a large region of the central and eastern Pacific during the latter part of the year, and then to continue well into the next year.

Some scientists do not believe the current El Niño fits this pattern. Some view this year's event as similar to those that occurred in the more distant past, such as in 1972 and before. These events followed what seems to be a more typical El Niño pattern of passing through a life cycle rather rapidly. With this year's event, El Niños may be reverting to this more traditional pattern.

This suggests that the last 20 years have been exceptionally wet due to more frequent El Niño events. This time span also was a period of rapid growth for Arizona. The water needed to support this growth may have come, at least partly, from El Niño events that may not continue with the same frequency in the future. Because of past El Niños, Arizona may have a false picture of its available water resources. Others believe that El Niño is part of a global climate change and that such weather patterns are here to stay.

USGS Set to Measure El Niño Recharge

El Niño may bear gifts, its potentially heavy rains replenishing the state's surface water resources and possibly its groundwater reserves. Whereas increases in surface water are readily measurable in reservoirs, determining the occurrence and extent of groundwater recharge is more problematic.

Heavy El Niño rains do not ensure natural groundwater recharge. Heavy rains that occur regularly with intervals of clear weather may not penetrate more than several feet below the surface because of the high evaporation rate in the desert. Conditions more favorable to natural recharge would be gradual snowmelt or persistent rainfall occurring over time, followed by cold, cloudy weather. Such conditions are possible, but not ensured with El Niño events.

Also a slow, steady rain more readily percolates through the soil. This type of rainfall is not necessarily characteristic of El Niño events, which tend to drop heavy precipitation, resulting in vigorous runoff.

Recharge is enhanced, however, if sufficient precipitation occurs to cause rivers to flow, a likely result of El Niño rains. Past El Niño events have caused vigorous flows in the Santa Cruz, Salt, Gila and other rivers in the state.

When recharge does occur, measuring the amount then presents a challenge to researchers. USGS hydrologists have several studies underway that will help determine natural recharge during expected El Niño rains. Recharge will be measured along a mountain front and within an ephemeral stream. Both are important recharge areas.

The USGS site at Garden Canyon is monitoring drainage from one of the largest watersheds in the Huachuca Mountains. Its waters flow to the San Pedro River. Don Pool, USGS hydrologist, has been measuring recharge events and seasonal changes in groundwater storage at the site for a few years. Total storage change is the equivalent of recharge. "We have not had any big flows yet to measure," says Pool. "We have been waiting for a major event." El Niño may prove to be the awaited event for providing measurable precipitation.

Another USGS recharge monitoring site is located in northwest Tucson, along an ephemeral stream near Canyon del Oro. El Niño likely will provide the first major storm event for measuring recharge at this site as well. It is an area of poorly consolidated alluvium, and probably more infiltration will occur here than at the Garden Canyon site.

Pool uses gravity surveys to determine the amount of water in the subsurface. Gravity increases with the mass of an object; e.g., the force of gravity is stronger on Jupiter, the largest planet, than on Earth. The mass in the subsurface increases with volume of water stored. By measuring the gravitational field in the recharge area and comparing the information with data from a control site with no storage capacity, changes in the volume of water due to recharge can be detected.

Pool says that one of the major water issues in the West is to get a better handle on recharge rates, and the USGS projects represent major efforts in this area.

El Niño rains may play a part in helping hydrologists better understand the issue.

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The University of Arizona
Water Resources Research Center
Tucson, Arizona 85721

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