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California Hydroelectric Energy Outlook for 2006

STAFF REPORT

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Hydro Energy Summary for California

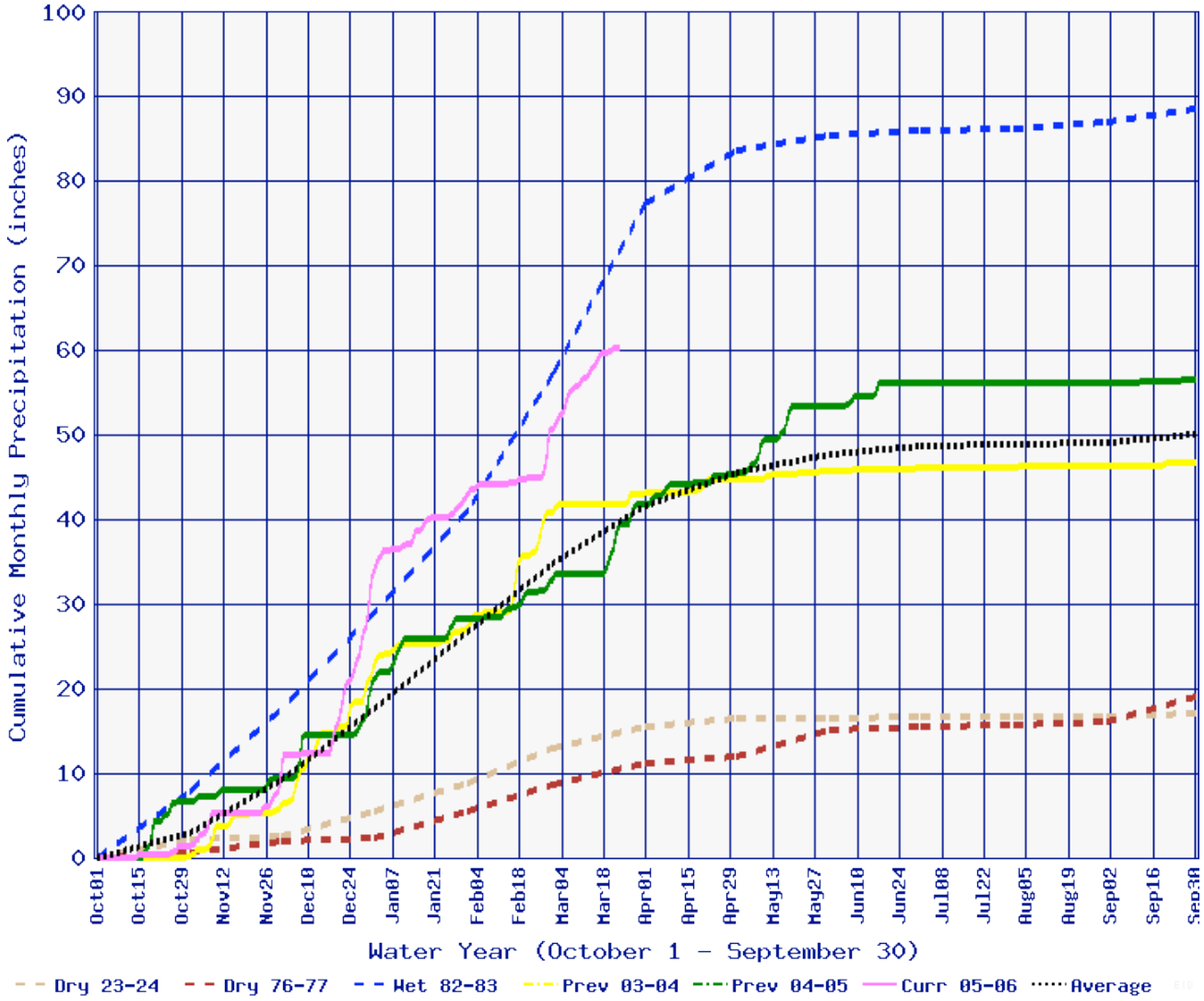
This water year is shaping up as the first “wet” year of the millennium on the Pacific slope. For calendar year 2006, statewide production of hydroelectric energy is forecast to be 118 percent of average. Water supplies in California are well above average, and the outlook this year for California’s hydro generation is excellent. Lower elevation reservoirs are generally full to their allowable capacity for this time of year. The snowpacks that supply fuelwater for high elevation utility-owned powerplants are generally at or near average. Rainfall in California is significantly above average. The warm-wet year developing thus far has led to early runoff in many rivers. Energy output is likely to be above average through spring and early summer.

For the summer months, hydro’s contributions to capacity and energy supplies will likely be very dependable, and slightly above average in total output. There are still significant opportunities in the next two months to boost the Sierra snowpacks. These snowpacks constitute the largest natural reservoir in this summer-dry climate. The chances of adverse hydro conditions occurring in California during 2006 are nil.

California Water Supplies and Hydropower

Precipitation amounts in northern and central California have been well above average. For example, precipitation in the Northern Sierra this year has been 154 percent of average. Figure 1 shows cumulative precipitation for eight stations in the Northern Sierra, from Blue Canyon (east of Sacramento) north to Shasta Dam. The current water year (shown with a **pink line**), began with a very dry October. (This happens often, and it rarely matters.) The current 2005-06 Water Year shows a dramatic stair-step pattern. Most precipitation has come during a few stormy periods: early November, after November 26, the two-week period starting mid-December, and at the beginning of March. As shown in Figure 1, total precipitation in the Northern Sierra by March 1, 2006 already exceeded average precipitation for the entire year, and cumulative precipitation was not far off the record wet year of 1982-83. The lowest two lines in Figure 1 show the record dry water years of 1923-24 and 1976-77.

Figure 1
Northern Sierra Precipitation, Average of 8 Stations, to March 24



---- Average (annual total = 50 inches)
From California Department of Water Resources,
http://cdec.water.ca.gov/cgi-progs/current/PLOT_ESI

Besides being wetter than average, winter storms have also been warmer. More often than is typical, precipitation in the mountains has come as rain. The rainy period in late December helped recharge the multi-purpose storage reservoirs around the rim of the Central Valley. By early January, many hydro plants were running full out. This helped to depress the wholesale market price of energy, at times, displacing generation from more expensive natural gas-fired units.

During these peak winter runoff events, many hydro plants that would normally be used as spinning reserve were instead generating full time, using all the water their

penstocks could handle. This caused a minor price jump in the ancillary services markets normally filled by hydro resources. There was also some spill around turbines, and some rivers were at flood stage. As of March 6, 2006, the 13 key reservoirs around the Central Valley had storage equal to 117 percent of average for that date. Many reservoirs are close to the limits established for their flood control benefits. The only headroom for improvement in the near-term outlook for California hydropower is for continued buildup of the Sierra snowpack.

As of March 20, 2006, the water content of the Sierra snowpack was 119 percent of average for that date. This number comes from daily measurements at "snow pillows" that automatically communicate the weight lying above them. These 117 active snow pillows are like buried truck scales at high elevation, with telemetry. This snowpack estimate relies on just over 100 sampling points in the vast Sierra Nevada. The manual snow course surveys done with auguring tools and bigger sample sizes are far more accurate—and challenging to collect. The manual surveys are normally completed about the first of the month (or a little before, if a big storm is on the way). As of March 1, 2006, the manual snow survey data indicated the water content of the snowpack was just 85 percent of average. Then another big storm arrived.

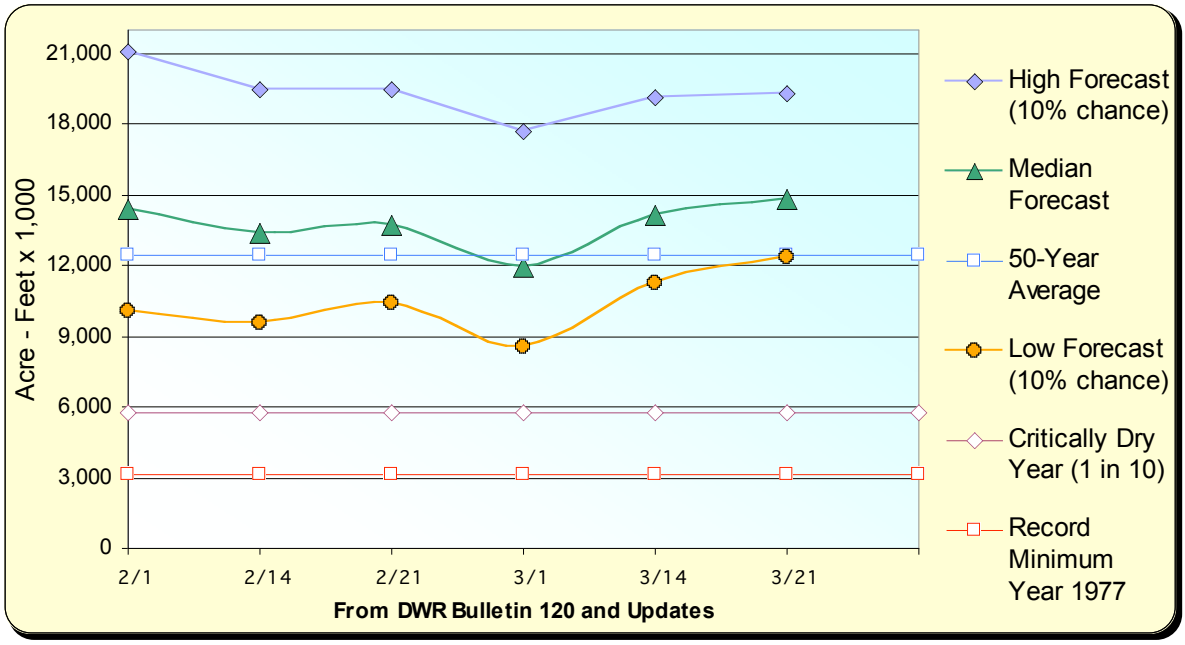
The three Sierra snowpack regions are now remarkably consistent north to south, 125 to 115 percent of average respectively. The most recent storms have been colder than usual, and have been more generous to the northern Sierra. The snowpack among individual watersheds is more varied. A big snowpack provides no extra hydropower if the drainage is undeveloped. That holds true for the Walker River basin, with snowpack at 133 percent of average on March 1, 2006, and zero installed capacity to capture potential energy as runoff flows into Nevada. The "workhorse" rivers in the central Sierra all had better than average snowpack for this date: 105 percent on the Mokelumne, 109 percent on the Stanislaus, 106 percent on the Tuolumne, and 101 percent on the upper San Joaquin. (And the snowpack in all these watersheds improved during March.)

At least through the end of February, the important Feather River watershed was showing the effects of a warm-wet winter pattern. On March 1, 2006, Lake Oroville storage was at 117 percent of average, and above the lake, precipitation (rain and snow combined, at 10 gages) was at 147 percent of average. However, the Feather River snowpack was only at 86 percent of average on March 1, 2006. Fortunately, the Feather River has healthy amounts of storage at Lake Almanor for Pacific Gas & Electric Co. (PG&E) to optimize the energy values in the upper watershed. In addition, the California Department of Water Resources (DWR) has healthy amounts in storage at Lake Oroville to balance water deliveries and flood risk reductions, meeting downstream environmental standards, and generating more electricity on-peak within the constraints of those higher-ranking priorities.

Figure 2 illustrates how this year's runoff forecasts have changed from February 1, 2006, to March 21, 2006. Figure 2 shows expected spring runoff, April through July,

for 13 major hydropower rivers, from the Pit River in the southern Cascades, to the Kern River in the southern Sierra.

Figure 2
Changing Forecasts through March 21, 2006
For April-July Runoff



For the winter months, ending in February, the Tule River watershed in the southern Sierra was also showing the results of a diminished snowpack. Precipitation in the Tule River was at 82 percent of average, while the snowpack was just 57 percent of average. Fortunately, California utilities do not depend much on low and mid-elevation watersheds like the Cosumnes, Calaveras, Chowchilla, Fresno, and Tule rivers. On the Tule, the combined nameplate capacity of PG&E and Southern California Edison hydropower plants is less than 9 megawatts (MW).

Average runoff for the Tule River is just 65,000 acre-feet. As of March 1, 2006, the median forecast for runoff in this small, low to mid-elevation watershed was 37,000 acre-feet, 54 percent of average. But the range of uncertainty about Tule runoff volumes was high: There was a 10 percent chance it could be less than 19,000 acre-feet, and a 10 percent chance it would be more than 79,000. This range of uncertainty is greater than it is on larger rivers, partly because the sample size of hydrologic data is much smaller. This kind of uncertainty is reflected in the aggregate numbers shown in Figure 2. As spring continues, and the opportunities for more storms run their normal climatic course, this uncertainty will diminish. In contrast to the Tule, the high elevation watersheds in the Sierra show much more resilience to normal weather variability.

Pacific Northwest

Water conditions elsewhere on the Pacific Slope are mostly at or above average. In the Northwest, total Columbia River runoff at The Dalles for January through July is likely to be 107 million acre-feet, which would be 100 percent of the 1971-2000 average. For the April-August period, it will likely be 98 percent of average. Upstream from The Dalles, the outlook for water supplies and energy production is even better. Precipitation in the Snake River watershed has been 131 percent of average thus far. Runoff at Hells Canyon during April-September is forecast to be 109 percent of average. On the Pend Oreille, April-September runoff will likely be 101 percent of average. At Grand Coulee, the median estimate is 96 percent.

The latest 30-day outlook for the Pacific Northwest calls for below normal temperatures, and above normal precipitation. For the next 90 days, however, “equal chances” describes the best knowledge of predicting deviations from normal in that timeframe. While spring is near in California, it comes later to the Pacific Northwest, with more time for the upsides to develop or continue in that rain-blessed region. Staff estimates that hydro energy from the Pacific Northwest in 2006 will be about 105 percent of average. This has importance for load-serving entities in California. It means that substantial quantities of non-firm energy will be available for sale and export to California. Surplus energy from run-of-river plants in the Northwest will be especially abundant during May-July (when runoff peaks in the Northwest), and it will also be available in the later summer months when loads peak in California. Markets and long-distance transmission will work to the economic benefit of both regions.

Colorado River

The hydrologic outlook for the Upper and Lower Colorado Basins is much improved after years of prolonged drought. Projected inflows to Lake Powell during April-July are forecast to be 105 percent of average. But releases from Lake Mead will reduce surface elevation to 1,128 feet this summer, affecting gross head and generating capacity at Hoover Dam.

For many years, April-September dependable capacity at Hoover has been 1,840 MW, nicely timed to match summer air conditioning loads in Southern California and the West. This year, May-September, Hoover turbines can be counted on for 1,689 MW, of which approximately 57.6 percent provides firm power to California utilities. (See http://www.usbr.gov/lc/region/g4000/24mo.pdf for the 24-month U.S. Bureau of Reclamation forecast.) Farther downstream, Lake Havasu and Lake Mohave will be kept full as usual, so dependable output from Parker (90 MW) and Davis (255 MW) powerplants will continue unchanged. In central Arizona into

New Mexico, drought conditions have developed early and then diminished somewhat, but the effect on hydropower production from that area is not significant.

Conclusion

Northern and Central California are “wet” this year for the first time this century, and hydro conditions in the Pacific Northwest are above average. Not all of this water supply will be converted to energy; during peak snowmelt periods in late spring, there will likely be spill on many rivers. However, with assured abundance of water supplies, reservoirs will fill to design levels, and gross head in lower elevation reservoirs will be higher than usual into late summer months.

California hydroelectric energy for this calendar year is expected to be at least 118 percent of average, equal to about 49,000 Gigawatt hours (GWh) statewide, which would be the highest statewide total since 1995, and the third highest total since 1983 (the record wet year). Energy Commission staff estimates hydroelectric generation in the Pacific Northwest this year will be about 105 percent of average.

Compared to multiyear averages, “water deliveries” for the year are about 75 percent complete, so conditions will continue to change at least slightly near term. A final outlook will be prepared in early May.

Acknowledgments

The timely hydrologic forecasts and data compilations provided by the California Department of Water Resources provide the most essential tracking tools for hydroelectric energy forecasting. The insights of agency and utility hydrologists and portfolio managers are gratefully appreciated. This statewide energy forecast is tempered and informed by the forecasts of individual agencies and utilities, some very public, and others proprietary and confidential. Errors in theory, method, interpretation and presentation remain the ownership of the author.