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MEMORANDUM

To: Files

From: Paul Matuska
Hydraulic Engineer, Boulder Canyon Operations Office

Subject: Accounting for Water use by the City of Needles, CA

In an effort to account for the Colorado River water used by the City of Needles (Needles) in a manner consistent with the established Law of the River, the Bureau of Reclamation and the City of Needles have developed the following methodology. The methodology utilizes available flow measurement data, and estimates values which cannot be measured. The methodology was developed in 2001 with factors derived from 2001 flows, and was adopted as the method used to calculate Needles consumptive use beginning in calendar year 2002. It will be used until conditions change, additional information becomes available from Needles, or study results provide data that can be used to improve assumptions.

Consumptive use is the amount of water diverted from the mainstream of the Colorado River less the amount of such water that returns to the river and becomes available for other users in the United States or in satisfaction of treaty obligations with Mexico. Diverted water returns to the mainstream either by means of conveyances, measured or unmeasured, or through the soil as unmeasured ground water flow. The accounting methodology presented here describes the measured diversions, the measured returns and the assumptions and calculations used to estimate unmeasured returns.

The City of Needles is able to divert water from the river through five wells, located in the flood plain adjacent the river, and numbered 6, 8, 10, 11, and 12. In addition to delivering its own domestic supply, Needles delivers water to the Fort Mojave Tribe at locations in California and Arizona. Water delivered by Needles to the Fort Mojave Tribe is not charged against Needles diversion or entitlement. As a result, Needles net diversion from the river is calculated as: total pumpage from the well field, less water delivered to the Fort Mojave Tribe in California and Arizona, increased by line loss. For 2003, the total amount diverted was 2,646 acre-feet; of the total, 62 acre-feet was delivered to the Fort Mojave Tribe, which yielded a net diversion of 2,584 acre-feet.

Effluent from the wastewater treatment plant represents the single measurable component of the water that Needles returns to the river. Treated effluent is discharged into percolation basins located in sandy material adjacent the flood plain. A portion of the amount of water discharged into the infiltration basins is provided as a return credit. Return flow is calculated as the discharge less 20% evaporation (factor provided by Needles, will be reviewed in the future). For 2003, total waste water plant discharge to the percolation basins was 634.4 acre-feet. Evaporation was calculated as 126.9 acre-feet, yielding a measured return of 507.5 acre-feet.

Needles is also credited with returns from three sources which are not measured. Estimates are made for unmeasured returns from 1) percolation to ground water from irrigation of the golf course and city parks, 2) losses from the City's water distribution system, and 3) septic tank discharge from homes not connected to the city sewer system.

1) Percolation was calculated from diversion and evapotranspiration (ET) estimates made at the golf course and applied to the city parks. Percolation returns are calculated as measured delivery, minus irrigation losses, minus ET of the irrigated turf. Irrigation efficiency at the golf course was improved by the 2000 installation of a new and more efficient system. In 2001, the following values were used to calculate an ET rate that would be used in the future: the measured delivery was 984 acre-feet; irrigation efficiency was estimated as 80% for a net application of 787 acre-feet. The ET rate for Bermuda/rye grass (derived from the LCRAS program) was used to calculate the amount of water required for golf course irrigation. ET rate is calculated as the annual sum of the daily ET coefficients times the daily reference ET. Turf ET is calculated as the ET rate times the area of turf. Using 2001 figures, there were 120 acres of turf times the ET rate for Bermuda grass over seeded with rye (56 inches) divided by 12 inches per foot yielded an ET of 560 acre-feet for the turf at the golf course. The figure of 560 acre-feet of annual ET will be used until recalculated. Using the figures above, golf course returns are calculated as 787 acre-feet of water applied minus 560 acre-feet of ET results in 227 acre-feet of returns from the golf course in 2003.

City park returns are calculated as 50 percent of the total deliveries to commercial accounts multiplied by a 34 percent percolation or return factor. In 2003, 760 acre-feet were delivered to commercial accounts, yielding a calculated return of 129 acre-feet. Upon review of the three years of data available at the writing of this memo, the 34% factor appears to be in error and will be adjusted for the 2004 reporting year.

2) Distribution system losses are calculated as the difference between the net diversions and the sum of the water delivered to City accounts. In 2001, the net diversion was 2763 acre-feet and the total amount of water metered to all accounts was 2600 acre-feet; the difference is 163 acre-feet, or 5.9 percent of diversion. Line loss will be calculated as 5.9 percent of diversion until recalculated.

3) Septic tank returns for the 210 residential customers who are not on the sewer system are considered a constant, and is calculated from 2001 delivery records. We apply the 40 percent unmeasured return flow factor developed for the LCRAS program to the average amount of water delivered to each user. From the 2001 delivery records, this return will remain constant at 210 units times 0.6 acre-feet per unit, times 40 percent return factor, yielding a return of 50acre-feet.

In 2003, Needles unmeasured returns were 570 acre-feet: 227 acre-feet from the golf course, 129 acre-feet from city parks and landscape, 164 acre-feet of distribution loss, and 50 acre-feet from residences on septic tank.

As noted above, consumptive use is calculated as net diversion minus the sum of returns. Using 2003 values, 2583 acre-feet of water were diverted, minus 507 acre-feet of measured returns, minus 570 acre-feet of unmeasured returns. This calculation yields a consumptive use of 1506 acre-feet. This methodology will be applied to the data supplied by Needles in their annual water use report. I recommend revising the percentage factors and ET rate after a longer period of record is available, or at a minimum of every 5 years.

cc: Ms. Ruth M. Thayer
Group Manager
Boulder Canyon Operations Office