2/15/93

Pump Mitigation Proposal
BLR Pumpers

Development of Specific Mitigation Parameters

An essential element of the mitigation plan proposed by the Big Lost River Pumpers Association is the determination of a depletion factor to use in determination of the quantity of water depleted from Big Lost River streamflows due to pumping activities. Because of lack of many essential data elements it is impossible at the present time to make a precise determination of the depletion factor for any individual well or even for any group of wells. The best that can be done with current information is an estimate of the depletions on an annual basis for all of the wells operating in the Big Lost River Valley.

The recently published report commonly referred to as the "Ralston Report" documents statistical (not cause and effect) relationships between annual streamflows and annual pumping volumes for periods of similar water conditions. From these relationships and the best available information on surface water deliveries to canal headings (from watermaster reports), this report indicates a "depletion" relationship in which depletions due to pumping, expanded irrigation acreage, and conversion of irrigation practices are lumped together.

During January and February of 1993 Dr. James H. Milligan and Mr. David Shaw worked on a procedure for separating the depletion effects of pumping from other depletion effects to establish a depletion factor useful as a starting point in determining amounts of water needed for mitigation of impacts on surface water streamflows due to pumping. The procedures used and the final depletion factor are described below.

Shortly after the time of construction of the Mackay Reservoir various study efforts established that there were about 10,000 irrigated acres above the reservoir and about 24,000 irrigated acres below the reservoir, or a total of about 34,000 irrigated acres served by the Big Lost River. As these reported acreages were determined during the 1930's we assumed that all of these acres were at the time being served solely from surface water flows (i.e., no groundwater pumping to service these acreages).

Again, various reports have established that the volumes of water necessary to meet the consumptive use requirements of crop production average about 2.0 acre-feet per acre, based on the crop rotations typical in the Big Lost River Valley. Assuming a water conveyance efficiency of 70% (documented in some studies) and an irrigation efficiency of 40% (typical for surface irrigation practices of earlier years), the diversion requirement to serve the estimated 34,000 irrigated acres amounts to about 7 acre-feet per acre or 238,000 acre-feet. The actual depletion due to consumptive use for the same irrigated acreage would be 2.0 acre-feet per acre or 68,000 acre-feet, leaving about 170,000 acre-feet of the diverted water to return to the system.

A recent survey completed by Dan Holden of the U.S.D.A. Soil Conservation Service (SCS) shows that in the Big Lost River Valley there are now (1991) a total of 63,109 acres of irrigated lands of which 15,115 acres are surface irrigated and 47,994 acres are sprinkler irrigated. These numbers show an increase of 29,109 acres over the "original" 34,000 acres irrigated and conversion or expansion of 47,994 acres to sprinkler irrigation. Due to the expansion and conversion effects, the original 68,000 acre-feet of depletion is no longer valid.

By assuming that the irrigation efficiency for sprinkler irrigation is about 70%, the diversion requirement for irrigating 47,994 acres of sprinkler-irrigated lands is about 215,973 acre-feet. Again using the diversion requirement of 7.0 acre-feet per acre for present surface irrigated acres totalling 15,115 acres, the diversion requirement for these acres is 105,800 acre-feet. Thus the total irrigation diversion requirement is now about 321,778 acre-feet. Likewise the total depletions for the total consumptive use on 63,109 acres is about 126,220 acre-feet, or a total increase in depletions of 58,220 acre-feet.

Of the original 34,000 acres irrigated by surface water methods, only 15,115 acres are now irrigated by this method, indicating a conversion of 18,885 acres to sprinkler irrigation. Due to increased efficiency of irrigation by sprinklers, this conversion represents a water savings of about 56,655 acre-feet. Assuming that this "extra" water is applied to new acres by sprinkler methods, this water could be applied to an additional or expanded area of 14,163 acres. These are new acres served by the surface water resource (the river) due to differences in irrigation efficiencies between surface application methods and sprinkling. Thus the total acreage serviceable by the original water used on 34,000 can now irrigate 34,000 plus 14,163 or about 48,163 acres.

Since the SCS estimates that the total irrigated acreage is now 63,109 acres, the difference between this area and that which could be served by the same amount of water originally diverted from completely allocated surface water sources must now be irrigated by pumping from groundwater. This difference is about 14,945 acres.

The 14,163 new acres serviced from surface water sources and the 14,945 acres serviced from groundwater represent a total expanded acreage of about 29,108 acres. The new acres irrigated from groundwater represent about 51% of the total new acres. The pumped water for these acres irrigated from groundwater would also represent about 51% of the surface water depletions due to expanded irrigation acreage (the remaining 49% of the depletion being credited to the expanded acres irrigated from the surface water resource).

Using the depletion relationship developed and shown in the "Ralston Report" as

$$Depletion = [0.575\ Q_{pump} - 14{,}000] \tag{1}$$

Where Depletion = total depletion of streamflows annually from all sources

Q_{pump} = the annual volume of water pumped

the depletion assignable to pumping becomes

$$Depletion_{pump} = 0.295(Q_{pump}) - 7188 \tag{2}$$

However, this equation was derived in part from the regression equation relating pumpage to flow. The regression needs to be revised with 1998-2003 data and will need to be non-linear. (See graph in Ralstn paper).

Applying this depletion relationship to the volume of water reportedly pumped in an average year during recent years, or about 47,000 acre-feet, the calculated surface water depletion due to pumping would be about 6687 acre feet, or about 14% of the volume pumped. Different depletion volumes and percentages are calculated for different years due to different volumes pumped. It was agreed that an appropriate depletion percentage (or depletion factor) to use until further information was developed to refine the estimate would be 13%.

In the pumping mitigation plan, the depletion factor would be used only to determine the volume of mitigation water to be committed to the watermaster at the beginning of each irrigation season. The mitigation volume committed would be based on the total estimated volume of pumped water to be used by the members of the Big Lost River Pumpers Association prior to the beginning of the irrigation season.

The actual amount of water used in the mitigation plan would depend, however, on the call of the senior water rights holders and would be prorated over the irrigation season in such a manner that the amount of mitigation water actually committed on a daily basis early in the irrigation season would be reduced in proportion to that actually committed in the latter part of the irrigation season. Thus, if the irrigation season were shortened due to a killing frost or due to a different crop mix, the total volume of mitigation water used would be less than that initially committed.

Shaw and Milligan both recognize that many assumptions have been made in arriving at a depletion factor to be used in the mitigation plan and that better information in the future will likely require modification of the factor used and even of the mitigation procedures. We encourage the water users to become involved in providing the necessary support for this better information.

Some Examples of What Mitigation Means

Example No. 1 - Irrigation completely by pumping

This example is intended to show the extreme case example where all irrigation water for a field is being supplied by pumping (assumed irrigation period is 160 days).

Acreage irrigated: 640 acres
Irrigation requirement:

640 Ac x 4.0 AF/Ac. = 2,560 AF or 1,290 cfs-days or 400 inches for 160 days

Mitigation requirement:

0.13 x 2560 AF = 333 AF or 168 cfs-days or 52 inches for 160 days

Example No. 2 - Pumping for supplemental irrigation

This example is intended to show the mitigation impacts when pumping is only a supplemental irrigation operation.

Acreage irrigated: 640 acres
Irrigation requirement:

640 Ac. x 4.0 AF/Ac. = 2,560 AF or 1,290 cfs-days or 400 inches for 160 days

Surface water available = 1,500 AF
Pumping requirement = 2,560 - 1,500 = 1,060 AF or 534 cfs-days or 167 inches for 160 days

Mitigation requirement:

0.13 x 1,060 AF = 138 af or 69.6 cfs-days or 21.7 inches for 160 days