

Memorandum

To: Transfer File 72440 - US Geothermal

From: Jeff Peppersack

Date: August 28, 2006

Re: Calculation of Historic Consumptive Use

This memo addresses the historic consumptive use for irrigation based on crop history information provided by Doug Glaspey of US Geothermal (letter of August 15, 2006).

Crop types were historically a mix of alfalfa and grain. Will assume 50% alfalfa and 50% winter grain. Use ET data from Allen and Brockway, 1983 for Malta and Strevell stations.

Malta 786 mm/season for alfalfa and 759 mm/season for spring grain

Strevell 702 mm/season for alfalfa and 725 mm/season for spring grain

Average 743 mm/season or 2.44 afa – irrigation requirement

Irrigation system was historically hand and/or wheel line sprinklers. IDWR standards provide for 60 to 75% efficiency. Windy conditions are prevalent based on wind data noted in US Geothermal letter. Will assume 60% efficiency resulting in just over 4 afa per acre total diversion volume (4 afa authorized under water rights).

US Geothermal letter indicates estimate of 15% of gross application would be lost to consumptive spray and surface evaporation losses from sprinkler system beyond published irrigation requirements. Result is $2.44 + 0.15(4.0) = 3.04$ or roughly 3.0 afa per acre total consumptive use. The 15% value seems excessive based on published literature for sprinkler system losses.

High winds can increase water losses for sprinkler systems, but not all the losses are consumptive. Non-uniform application due to wind can result in deep percolation or runoff losses, which are not generally consumptive losses. Non-uniform application can result in crop stress in some areas and actually decrease crop water consumption. The Irrigation Association reported the following in their publication entitled, IRRIGATION (1983, p. 217).

“Wind can cause water application rates to be greater than under low wind conditions for portions of the area. Measurements made in Idaho showed that with a 2.9-mile (4.7 km) per hour average wind velocity, the soil absorbed the water in all parts of the wetted area. When the wind velocity averaged 13 miles (20.9 km) per hour, 40 percent of the wetted area under a lateral having the same nozzle size and sprinkler operating pressure exceeded the intake rate of the soil and runoff occurred.”

ET and irrigation requirement estimates in Idaho such as Allen and Brockway (1983) include losses due to crop transpiration and evaporation from plant and soil surfaces. Water use and losses affected by climatic conditions such as wind and relative humidity are already accounted for in the estimates.

The American Society of Agricultural Engineers reported the following in their publication entitled, DESIGN AND OPERATION OF FARM IRRIGATION SYSTEMS (1983, p. 604).

“Wetted-foliage evaporation under sprinkler irrigation has been studied with full-cover crops of alfalfa, oats, sudangrass and ryegrass under arid conditions with the findings that evapotranspiration from the wetted foliage was about equal to that from nonwetted, actively growing foliage with adequate soil moisture.”

“The water evaporating from the wet canopy compensated for the transpirational requirement, which would normally be withdrawn from the root zone; therefore, it is not a loss.”

In addition, the Food and Agriculture Organization reports, for sprinkler irrigation, in their publication, GUIDELINES FOR PREDICTING CROP WATER REQUIREMENTS (1975, p. 99):

“ET (crop), including the direct evaporation of water from wet leaves, of recently sprinkled crops with full crop cover does not greatly exceed predicted ET (crop) rates. Transpiration by the crop may be greatly reduced during application but will be compensated by increased evaporation from the wet leaves and soil surface. However, the higher evaporation from wet leaves does not lead to a significant increase in water loss.”

Additional soil surface evaporation due to high winds prior to crop canopy cover may be warranted, but only for newly seeded crops and for short durations at the beginning of the irrigation season.

Additional consumption due to evaporation from sprinkler spray is not generally accounted for in published estimates of crop water use. High winds can increase evaporation from sprinkler spray. The American Society of Agricultural Engineers reports in their publication, DESIGN AND OPERATION OF FARM IRRIGATION SYSTEMS (1983, p. 600):

“Calculated evaporation losses of sprinkler water between nozzle and crop or soil surface range from less than 1 percent to a maximum of 6 percent, depending on droplet size and atmospheric conditions. Most calculations fall in the lower end of this range, suggesting evaporation losses are about 1 to 2 percent of the amount of discharged water.”

The American Society of Agronomy reports in their publication, IRRIGATION OF AGRICULTURAL LANDS (1967, p. 894):

“Evaporation losses from the spray depend on temperature, wind, humidity, and on the fineness of the spray which in turn depends on nozzle sizes and pressure. Such losses have been estimated to range from 2% to 8% of the volume of water discharged by the sprinklers.”

Based on published values, spray losses greater than a few percent may not be justified.

It should be noted that published crop consumptive use estimates are based on well-watered, fertilized, healthy crops. Actual crop consumptive use based on existing field conditions may not fully realize the estimated potential ET values. In conclusion, additional consumption due to sprinkler spray losses could be offset by under-irrigation due to non-uniform application in windy areas. Published values for irrigation water consumption should be used unless higher values can be justified using a well-documented analysis based on actual field conditions.