PROBLEMS AND NEEDS

Introduction

Salinity ultimately becomes a major problem in many irrigated areas. Areas with high saline soils, such as southwestern Colorado, have affected water quality since irrigation was first attempted because the irrigated land and diffused source areas contain large natural deposits of salts. Figure 2 below shows the distribution of saline soils in the Mancos Valley. Salinity concentrations in the Colorado River adversely affect downstream irrigated crop production and other water uses. The problem is especially severe for water delivered to California, Arizona, and the Republic of Mexico.

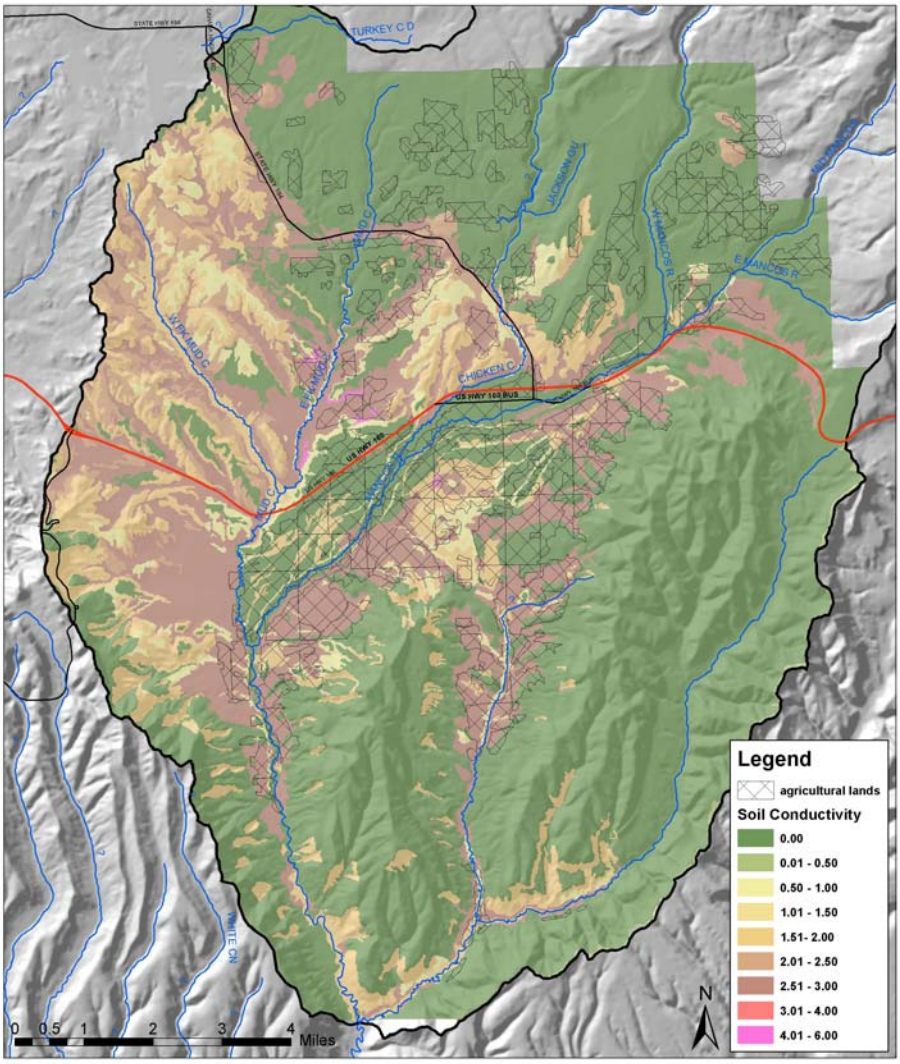

Figure 5. (Soil conductivity of the Mancos Valley (in mmhos/cm))

Mancos Valley Salinity; Hydrologic Study Report, Steven E. Yochum, PE, Hydrologist, NRCS Northern Plains Engineering Team, 2004

Recognition of the water quality problem in the region has caused a number of studies to be made since 1960 by the Division of Water Supply and Pollution Control, U.S. Public Health Service. Studies by the Environmental Protection Agency (1971) produced a series of reports on "The Mineral Quality Problem in the Colorado River Basin." Salinity in the river also is documented by the Bureau of Reclamation (1972, 1974, and 1983) Status Reports - Colorado River Water Quality Improvements Program, and U.S. Geological Survey Professional Paper 441, "Water Resources of the Upper Colorado River Basin - Technical Report" by Irons, et al. (1965).

Section 303 of the Clean Water Act requires adoption of water quality standards applicable to interstate waters. The Act's objective is "to restore and maintain the chemical, physical, and biological integrity of the Nation's water" (Section 101), and the Administrator of EPA is required, in cooperation with other Federal, State, and local agencies, "to develop comprehensive programs for preventing, reducing, or eliminating the pollution of navigable waters and ground waters (Section 102a)."

The seven states of the Colorado River Basin, acting through the Colorado River Basin Salinity Control Forum, developed and agreed upon water quality standards for salinity. These standards developed in 1975 included numeric criteria as well as a basin-wide plan of implementation for salinity control (1975 Forum report). Each of the basin states adopted the 1975 water quality standards which were subsequently approved by EPA. The 1975 report described the rationale for selecting the criteria and the gauging station locations, as well as a detailed basin-wide plan of implementation for salinity control.

The Forum reviewed Section 303(c) of the Clean Water Act water quality standards in 1978. The Forum determined that the 1975 criteria were appropriate. The Forum also reviewed and modified the plan of implementation in 1978. The State of Colorado adopted the numeric criteria and issued a policy statement supporting the implementation plan.

Salt Loading

Analysis of U.S. Geological Survey water quality and quantity data indicates the Mancos Valley Project Area contributes an average of approximately 42,300 to 43,000 tons of salt annually to the Colorado River. The record from 1969 through 1998 covers a range of wet and dry years. The range in salt loading values was from a low of approximately 10,000 tons per year in 1977 a drought year, to a high of approximately 75,000 tons per year in 1973 and 1987. Most all of these salts are leached from the soils and underlying shale layers. Typical salt constituents include sulfate, calcium, sodium, magnesium, chloride, and potassium (refer to associated document referenced in Appendix D, Mancos Valley Salinity: Hydrologic Study Report, pages 11 and 12).

The primary human-related contribution is deep percolation from irrigation and seepage from water delivery and tailwater return flow systems. This accounts for approximately 26,000 tons of salt annually.

Irrigation water, classified by components related to the irrigation process, is defined as follows:

(1) Seepage - Water losses from the off-farm and the on-farm supply and field head ditches and tailwater return flows.

(2) Deep percolation - The irrigation water which moves through and below the root irrigation zone and is not available for plant growth.

(3) Tailwater Runoff - The irrigation water leaving the field as surface flow and discharging into drainage channels. Some runoff seeps from tailwater pickup ditches or it may be intercepted and reused.

(4) Crop Use (seasonal net application) - The water consumptively used by the crop (evapotranspiration). It is the water supplied by irrigation, exclusive of precipitation, which is stored in the root zone of plants and must be replenished periodically to sustain plant growth.

(5) Field Irrigation Efficiency (efficiency of irrigation) – Volume of water available to the crop divided by the volume of water applied multiplied by 100.

Both natural runoff and irrigation contribute to the problem, either by concentrating salts or by salt loading. Salt concentration is caused by removal of water from the river system through consumptive use by irrigated crops and other vegetation, and by evaporation; mineral constituents are thereby concentrated in the water that remains. Salt loading occurs as groundwater dissolves subsurface minerals while flowing through the salt-laden soils and shale layers. Although both salt concentration and salt loading are at work, salt loading is the major cause of the salinity increase.

Salt loading from irrigated cropland is related to subsurface return flows. The irrigation water applied is generally of good quality and most fields are irrigated in excess of normal crop needs. Deep percolation of excess irrigation water results in substantial return flows percolating through layers of Mancos shale which contain large quantities of crystalline salt. The concentration of dissolved salts (solids) transferred to the percolating water seriously degrades the quality of water delivered to the Colorado River.

Of the average 42,300 to 43,000 tons of salt that the Mancos Valley delivers annually to the Mancos River which is tributary to the Colorado River system, approximately 26,000 tons comes from irrigation activities associated with the irrigation systems studied. The remaining 16,300 tons represents the salt produced from other sources. Of the 26,000 tons of salt loading associated with the ditch system, approximately 14,500 tons are related to ditch seepage off-farm, while about 11,500 tons are related to deep percolation of irrigation water on-farm.