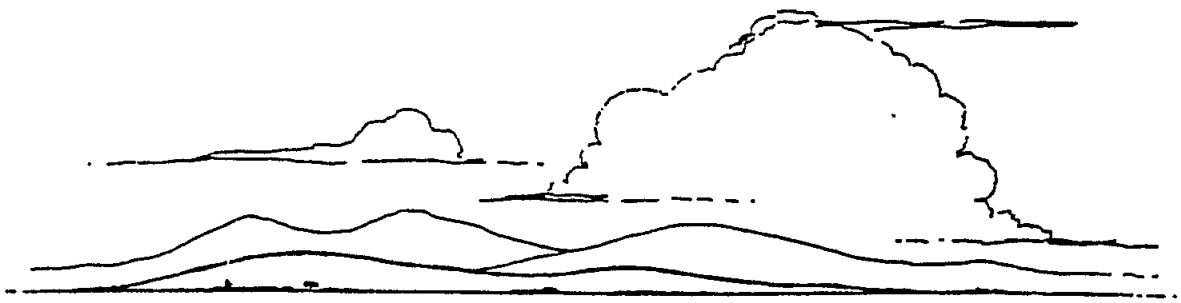
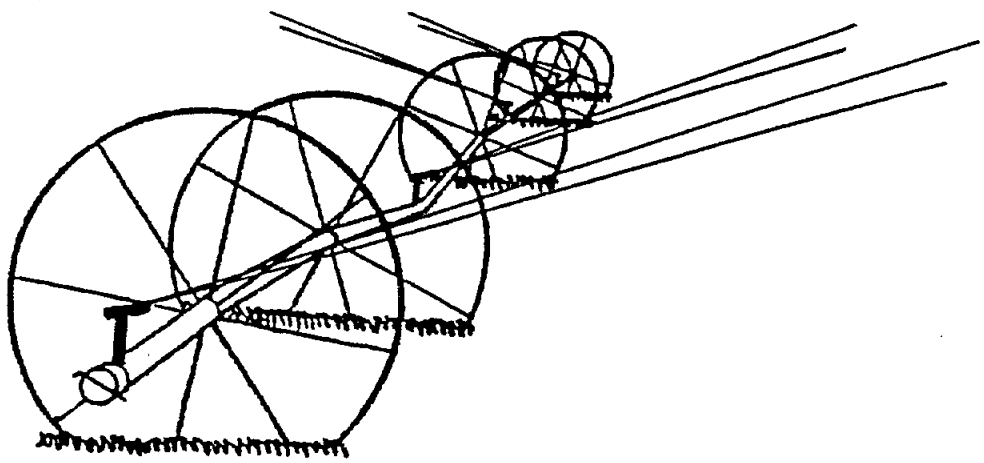
APPENDIX R

Detailed Procedure to Calculate the Consumptive Irrigation Requirement (CIR) and Other Irrigated Agriculture Information

Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1995

Prepared by
Brian C. Wilson, P.E.
and
Anthony A. Lucero





New Mexico State Engineer Office
Technical Report 49
September 1997

Chapter 4

Irrigated Agriculture

4.1. INTRODUCTION

The procedure presented in this report for quantifying irrigation withdrawals and depletions addresses many facets of irrigation that are often overlooked. It recognizes the need for the separation of irrigation water requirements by type of irrigation system and source of water. Application of the original Blaney-Criddle method for determining the consumptive irrigation requirement of a cropping pattern is described in detail and includes discussion of methods which are used to adjust estimated crop water requirements to account for water supply shortages and other factors. A computational aid which lists the equations used to compute irrigation withdrawals and depletions is provided. Causes of poor irrigation efficiency are identified, and an overview of what can be done to improve irrigation water management is presented. For definitions of terms used in this section, see the glossary included in this report.

4.2. COMPOSITION OF CATEGORY

Irrigated Agriculture (IR). Includes all diversions of water for the irrigation of crops grown on farms, ranches, and wildlife refuges. This category is identified as **Major Group 01 and Industry Group 011-017** in the Standard Industrial Classification Manual (1987).

4.3. PROCEDURE FOR QUANTIFYING IRRIGATION WITHDRAWALS AND DEPLETIONS

Step 1: Identify irrigated cropping areas and tabulate the gross irrigated acreage for each individual crop in the cropping pattern by type of irrigation system. The gross acreage is the irrigated acreage as defined in the glossary, plus the multiple-cropped acreage.

Sources of irrigated cropland data include the U.S. Bureau of Indian Affairs; the U.S. Bureau of Reclamation; the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Natural Resources Conservation Service, and National Agricultural Statistics Service; irrigation districts; and county extension agents. Hydrographic surveys, adjudications and court decrees, licenses and permits for water rights, and recent aerial photography may also be helpful in determining the acreage irrigated.

Step 3: The average temperature and total recorded rainfall for each month is obtained from the weather station which is most representative for a specific cropping area. When an irrigated cropping area is located between two or more weather stations, the influence of each station should be weighted according to its distance from the centroid of the cropping area. The sum of the weighted values from each station yields the composite data to be used in subsequent calculations.

Step 4: The growing or irrigation season for each crop is defined by the earliest and latest moisture use dates. For annual crops such as corn and spring small grains, the earliest moisture use date is normally assumed to be the planting date, and the latest moisture use date as the day before harvest begins. For some annual crops such as corn, spring small grain, and cotton, farmers may apply a preplant irrigation. So, for example, if a 15-day preplant irrigation is applied, seed is planted on April 1 and the crop reaches maturity in 140 days, the beginning of the growing season would be taken as March 17, and consumptive use would be computed for a 155-day growing season.

For perennial crops such as alfalfa and permanent pasture grasses, the earliest moisture use date correlates with the mean daily air temperature which activates the transpiration process, and the latest moisture use date correlates with the mean daily air temperature that signals the cessation of transpiration on the next day. The earliest and latest moisture use dates may also be established by simply observing when growth begins and ends.

Step 5: The theoretical consumptive use (U) or evapotranspiration (ET) of water by individual crops in the cropping pattern tabulated for each type of irrigation system is calculated using the original Blaney-Criddle method (1950, 1962) and seasonal consumptive use coefficients (K). If, for example, part of the overall cropping pattern is flood irrigated and the remaining portion is sprinkler irrigated, two separate CIRs would be computed.

Step 6: Effective rainfall is computed using the procedure presented in Table 3, page 13 of Technical Bulletin No. 1275 (Blaney, 1962) or Table 5, page 21 of Technical Report 32 (Blaney, 1965).

Step 7: The consumptive irrigation requirement (CIR) for each crop in the cropping pattern is computed by subtracting the effective rainfall (R_e) from the consumptive use (U), i.e., the $CIR = U - R_e$, or $CIR = ET - R_e$

Step 8: The crop distribution ratio (CDR) is computed by dividing the acreage planted in a specific crop by the total acreage for all crops included in the cropping pattern.

Step 9: Multiplying the CIR by the crop distribution ratio yields the weighted CIR for a crop. The sum of all the weighted CIRs is the CIR for the cropping pattern. If the cropping pattern includes multiple-cropped acreage, i.e., acreage on which two or more crops are produced in the same year, the CIR for the cropping pattern is multiplied by the ratio of the gross irrigated acreage to the net irrigated acreage to yield the CIR for the cropping pattern. The net irrigated acreage is the difference between the gross irrigated acreage and the multiple-cropped acreage. The adjusted CIR would be computed as follows:

$$CIR_a = CIR[A_g/(A_g - A_m)]$$

where A_g is the gross irrigated acreage and A_m is the multiple-cropped acreage.

It is important that the irrigated acreage be broken out by type of irrigation system because the incidental depletion factors which are used in the determination of total depletions, and the irrigation efficiencies that are used in the determination of total withdrawals, vary with the type of irrigation system. The methods which farmers use to apply water to irrigated cropland can be separated into four categories: (1) drip irrigation, (2) flood irrigation, (3) sprinkler irrigation, and (4) subsurface irrigation. Each of these categories encompasses a variety of water application methods.

Drip or trickle irrigation can be defined as the precise application of water on, above, or beneath the soil by surface drip, subsurface drip, bubbler, spray, mechanical-move, and pulse systems. Water is applied as discrete or continuous drops, tiny streams, or miniature spray through emitters or applicators placed along a water delivery line near the plant.

Flood irrigation includes furrow, border-strip, level-basin, and wild flooding. It is often referred to as "surface irrigation," because the water applied flows over the surface of the irrigated field, or "gravity irrigation," because free water runs downhill.

Sprinkler irrigation systems can be divided into periodic move systems, which are sprinklers that remain at a fixed position while irrigating, and continuous move systems, which are sprinklers that move in either a circular or straight path while irrigating. The periodic move systems include sprinkler lateral, overlapped hose-fed sprinkler grid, perforated pipe, orchard sprinklers, and gun sprinklers. The dominant continuous move systems are center pivot and side-roll sprinklers.

Subsurface irrigation requires the creation of an artificial water table over a natural barrier that prevents deep percolation. The water table is kept at a fixed depth, usually 12 to 30 inches, below the surface. Moisture is supplied to the plant roots through upward capillary movement. Water may be introduced into the soil profile through open ditches, mole drains, or tile drains. However, in most areas where subsurface irrigation is practiced, water is distributed to the fields by canals, laterals, and field ditches. Subsurface irrigation was used on an experimental basis in New Mexico in the early 1900s, but it is no longer practiced today.

Step 2: The irrigated acreage tabulated for each type of irrigation system is further broken down according to the sources of water. Sources of water include surface, ground, and combined water. When a field is irrigated with both ground and surface water, the source is designated combined. In this case, the primary source is usually surface water which is supplemented by water pumped from a well.

Cropland irrigated by combined water is initially tabulated separately because it is impossible to determine from visual inspection of irrigated cropland in the field or from aerial photography how much of the cropland is irrigated by ground water and how much by surface water. To be meaningful however, the acreage irrigated by combined water must eventually be separated into its ground and surface water components. If records of measured withdrawals are available, the components are computed in Step 12 after the theoretical withdrawal has been computed. When measured withdrawals are not available, the components must be estimated. In this case, a rough approximation of the components may be gleaned by (1) an examination of water rights documentation, if such records exist; (2) comparing recorded streamflows with the estimated demand; or (3) by contacting personnel in the Cooperative Extension Service and the Soil Conservation Service, or individual farmers who know the area well.

For New Mexico's 1995 water use inventory, CIRs were computed for 170 different cropping patterns using 1995 weather data, irrigated acreages compiled by Robert L. Lansford (1996), Professor of Agricultural Economics and Agricultural Business, New Mexico State University, and computer software developed by the author (Wilson, 1990).

Step 10: The farm delivery requirement (FDR) is computed by dividing the CIR expressed as a depth or volume by the on-farm irrigation efficiency (E_f). For example, if the CIR is 2.0 acre-feet per acre and E_f=60%, FDR=CIR/E_f=2.0/0.60=3.33 acre-feet per acre.

The on-farm irrigation efficiency is affected by farm and field conditions, i.e., type of soil, slope, length and width of field, land surface preparation (leveling and tillage), root depth of crop at the time of each irrigation event (the root depth of annual crops changes throughout the growing season), antecedent soil moisture conditions, quality of irrigation water, type of irrigation system, available head at the farm headgate, frequency and amount of water applications, and grower water management practices. An efficient irrigation system may result in higher plant transpiration rates than an inefficient system because there will be fewer dry spots on the field (better distribution uniformity); and the crop yield per unit of water transpired will be higher under good management than under poor management (Burt, 1995).

Step 11: The project diversion requirement (PDR) or off-farm diversion requirement is computed by dividing the farm delivery requirement by the off-farm conveyance efficiency (E_c). For example, if the FDR=3.33 acre-feet per acre and E_c=70%, PDR=FDR/E_c=3.33/0.70=4.76 acre-feet per acre.

Step 12: If records of measured withdrawals are available, the ground and surface water components for combined water can be determined by comparing the total theoretical withdrawal with the measured withdrawal. If a shortage occurs, i.e., the measured surface water withdrawal is less than the theoretical withdrawal, it is assumed that the difference is made up with ground water. The acreage irrigated by surface water is then the product of the surface water withdrawal and irrigation efficiency divided by the CIR; and the acreage irrigated by ground water is the difference between the total acreage irrigated and the estimated acreage irrigated by surface water.

It is important that when separating combined water into its ground and surface water components, that the appropriate irrigation efficiencies are used when the source of the surface water is located off-farm while the source of the ground water originates on-farm.

Step 13: Any event or condition imposed by man or nature that affects the robustness of irrigated crops during the growing season will generally reduce the amount of water consumptively used by plants to a level which is below that predicted by the Blaney-Criddle method for a well-watered crop which is free of disease. Thus, it may be necessary to adjust the theoretical CIR and estimated diversion requirements to reflect these conditions. The conditions which should be taken into consideration when estimating crop water requirements can be separated into five categories.

Weather Conditions. Excessive rain and flooding that inundates crops and damages diversion structures or ditch conveyance capacity; hail, high winds, and drought.

Soil Conditions. Salinity, sodicity, pH excesses or deficiencies, nutritional imbalances, i.e., excesses or deficiencies in nitrogen (N), phosphorous (P), and potassium (K); and waterlogging.

Biological Conditions. Crop damage caused by wild animals, birds, and insect infestations; plant diseases; and weeds.

Farm Operations. Application of physical, chemical or organic amendments; application of pesticides and herbicides; equipment failure such as the breakdown of a groundwater pumping plant; shortages of farm laborers.

Economic Conditions. Cost of water and changes in the market price of crops may affect the farmer's decision to irrigate. If crop prices fall during the irrigation season, a farmer may apply fewer irrigations and actually stress the crop at the expense of lower yield rather than supply the full crop water requirement.

If measured withdrawals are available, they are compared with computed withdrawals and the CIRs are adjusted downward where measured withdrawals are less than the computed withdrawals. Records of measured withdrawals are often available for irrigation projects administered by some of the organizations mentioned in Step 1. When measured withdrawals are not available, water shortages and necessary adjustments to CIRs may be estimated on the basis of field observations made during the irrigation season and comparison of recorded streamflows with the irrigation demand.

Step 14: Coefficients for incidental depletions, referred to as incidental depletion factors from hereon, are assigned to each area according to the type of irrigation system and source of water. Incidental depletions may be expressed as a function of irrigation diversions or the CIR. When expressed as a function of irrigation diversions the total incidental depletion is computed as follows:

$$ID = PDR(F_1) + FDR(F_2 + F_3)$$

where PDR is the project diversion requirement; FDR is the farm delivery requirement; and F_1, F_2, and F_3 are the incidental depletion factors above-farm (canals and laterals), on-farm, and below-farm. See glossary for definitions of these terms.

Expressed as a function of the CIR, the total incidental depletion is computed as follows:

$$ID = CIR(G_1 + G_2 + G_3)$$

where G_1, G_2, and G_3 are the incidental depletion factors above-farm, on-farm, and below-farm.

It is important to remember that G_1, G_2, and G_3 will not have the same value as F_1, F_2, and F_3 because they are based on two different functions. Multiplying G_2 and G_3 by the on-farm irrigation efficiency (E_f) will yield the value of F_2 and F_3, i.e., $F_2 = G_2E_f$ and $F_3 = G_3E_f$. Multiplying the CIR by G_1 and dividing the product by the project diversion requirement (PDR) will yield the value of F_1, i.e., $F_1 = G_1CIR/PDR$.

Incidental depletions associated with canals and laterals are generally estimated by determining (1) the total length of canals and laterals, (2) the top width of the water surface, (3) the fringe width on each side of the canal where phreatophytes consumptively use seepage water, (4) the percent of time during the irrigation season when water is flowing, and (5) the net evaporation rate during the irrigation season. Taking the product of all these elements and dividing by the normal CIR (total acre-feet) for the area under study yields the incidental depletion factor for canals and laterals

expressed as a function of the CIR.

Note that because the dimensions, phreatophyte population, and percent of time laterals are flowing will be different from canals, incidental depletions for canals and laterals are generally estimated separately and then aggregated.

In New Mexico, for flood irrigation systems (furrow or basin-border) operating at 55% efficiency, incidental depletions on-farm are generally estimated as 2.75% of the diversions at the farm headgate or well, or 5% (2.75/0.55) of the CIR. For sprinkler irrigation systems operating at 65% efficiency, incidental depletions are estimated as 17% of the farm withdrawals, or 26.2% (17/0.65) of the CIR. In some areas of the state, such as the Roswell Artesian Basin in Chaves and Eddy counties, where sprinklers operate at about 70% efficiency, incidental depletions are estimated as 24.3% (17/0.70) of the CIR. Sternberg (1967) found that sprinkler losses were much greater during the daytime (20% of farm withdrawals) due to higher temperatures and wind movement, than during the nighttime (14% of farm withdrawals). The incidental depletion factors used in this inventory for sprinkler irrigation reflect the average of sprinklers operating day and night. Incidental depletions for sprinkler irrigation in areas where high winds prevail, such as the Northern High Plains of New Mexico, which includes Curry, Harding, Quay, and Union counties, are estimated as 22% of the farm withdrawals, or 33.8% (22/0.65) of the CIR.

Incidental depletions associated with drains below-farm may be estimated using the same technique applied to canals and laterals. Evapotranspiration losses from areas below-farm where runoff and seepage accumulate can be estimated on the basis of the wetted area, percent of time the area is wet, and net evaporation rate or CIR for native vegetation.

In water resources management, it is often assumed that the difference between the total diversion and crop consumptive use is return flow to the stream system or groundwater aquifer. If incidental depletions are ignored, estimates of return flow will be too high. It is important therefore, that incidental depletions be properly accounted for.

Figure 4.1 illustrates how incidental depletions fit into the total water demand on an irrigation project that diverts surface water from a stream or reservoir, and transports it via canals and laterals to farms. In this example, the consumptive irrigation requirement (CIR) is 2.0 acre-feet per acre; the on-farm efficiency (E_f) is 60%; the farm delivery requirement (FDR) is 3.33 acre-feet per acre; the off-farm conveyance efficiency (E_c) is 70%; and the project diversion requirement (PDR) is 4.76 acre-feet per acre. Incidental depletion factors, expressed as a percent of the consumptive irrigation requirement, are 4%, 5%, and 5%, above-farm (canals and laterals), on-farm, and below-farm, respectively.

Step 15: The total quantity of water depleted (D) on a farm or irrigation project is the sum of the CIR and the incidental depletions (ID), i.e., $D=CIR+ID$. For example, if the CIR=2.0 acre-feet per acre and the total incidental depletion expressed as a function of the CIR is 14% ($G=G_1+G_2+G_3=0.14$) then:

Since $ID=CIR(G)$,

$$D=CIR(1+G)=2.0(1+0.14)=2.28 \text{ acre-feet per acre}$$

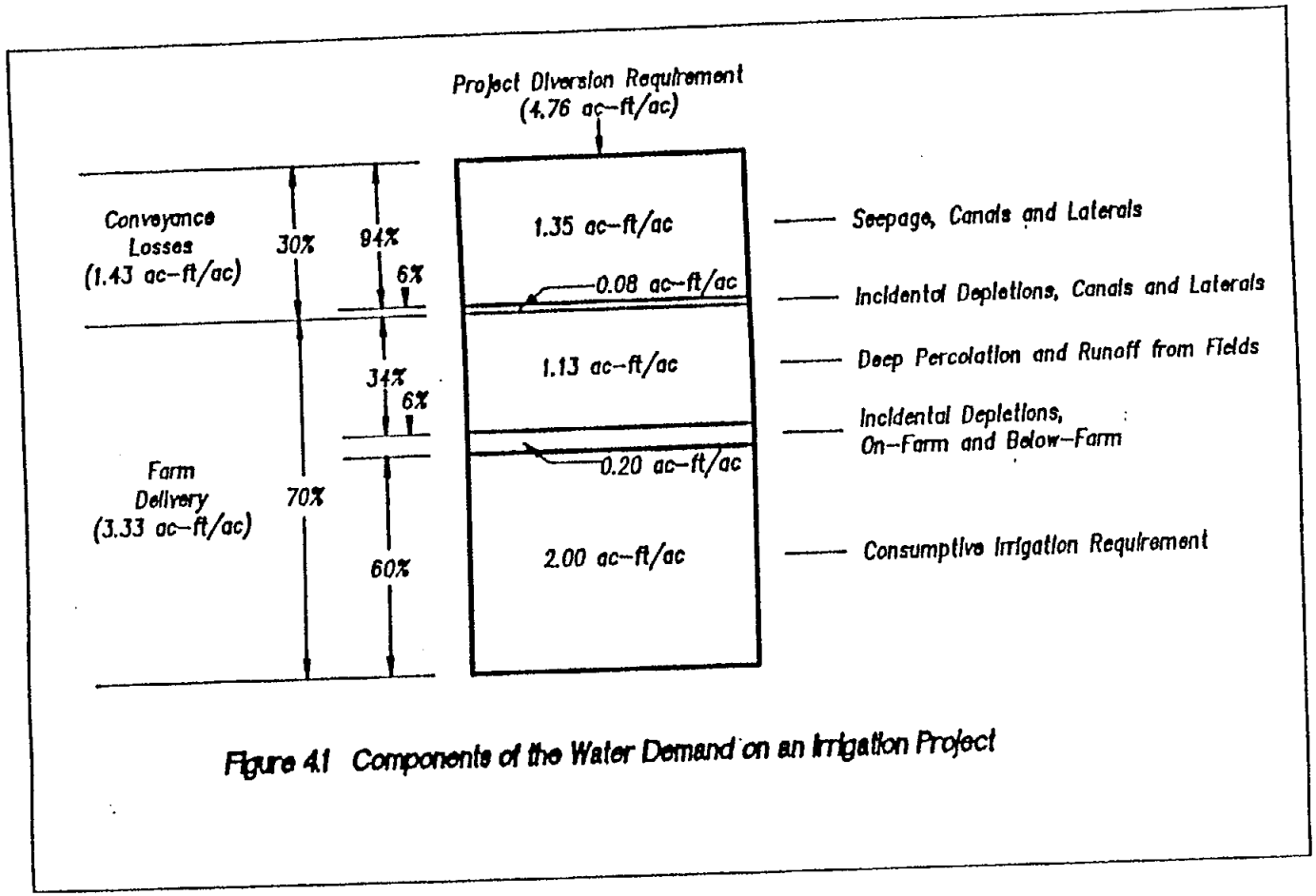


Figure 4.1 Components of the Water Demand on an Irrigation Project

4.4. THE ORIGINAL BLANEY-CRIDDLE METHOD

4.4.1. Consumptive Use (U)

The original Blaney-Criddle method (1950, 1962) was born out of studies conducted in New Mexico during 1939 and 1940 in the Pecos River Joint Investigation initiated by the National Resources Planning Board. It uses mean monthly air temperatures (T) expressed in degrees Fahrenheit, monthly percentage of annual daylight hours (P) based on the latitude of the area under study, seasonal consumptive use coefficients (K), and length of growing season to estimate the total consumptive use (U) or evapotranspiration (ET) of water during the growing season for a crop that is well watered and free of disease. The consumptive use in inches for each month is expressed as:

$$U = ET = [(T)(P)/100](K)$$

Adding the consumptive use computed for each month yields the total consumptive use for a specific crop during the growing season. Note that the monthly values computed using the above expression are not the actual consumptive use that occurs in any one month since the seasonal crop coefficient is used. The monthly values are computed for convenience in determining the seasonal value.

The distinctive feature of the original Blaney-Criddle method is that the consumptive use coefficient (K) remains constant throughout the frost-free period. If the growing season of a crop begins before the last spring frost of 32 degrees Fahrenheit occurs, or extends beyond the occurrence of the first fall frost of 32 degrees Fahrenheit, for this part of the growing season which is outside the frost-free period, another consumptive use coefficient is generally applied which is lower than the value used during the frost-free period. For crops which have a growing season that begins before or extends beyond a frost date, in a month in which a frost occurs, the days inside and outside the frost-free period must be separated into two different components so that the appropriate consumptive use coefficients can be applied. In a month in which the growing season begins or ends, the consumptive use coefficient is multiplied by the ratio of the number of days in the month the crop is "growing" to the total number of days in that month.

4.4.2. USBR Effective Rainfall (R_e)

The amount of rainfall which becomes available to crops is influenced by the following factors: (1) duration and intensity of rainfall; (2) antecedent moisture condition of the soil; (3) infiltration capacity of the soil; (4) presence of surface seals and crusts; (5) slope of fields; (6) root development of the crop; and (7) interception by the plant canopy.

As it was published in 1950, the original Blaney-Criddle method did not include a procedure for estimating effective rainfall. Blaney (1962) later adopted a method which was developed by the U.S. Bureau of Reclamation (USBR). The USBR method expresses effective rainfall as a percentage of the total monthly rainfall and for each one inch increment in rainfall there is a corresponding decrease in the percentage of effective rainfall. The USBR method was originally published as a table of values. However, since the table is often misinterpreted, the effective rainfall is better expressed as a set of equations. Note that the effective rainfall (R_e) cannot exceed the consumptive use (U). Adding the effective rainfall computed for each month yields the total effective rainfall for a specific crop during the growing season.

Table 4.1. USBR effective rainfall.	
Monthly Rainfall (R) (Inches)	Effective Rainfall (R_e) (Inches)
$1 \leq R$	$R_e=0.95R$
$1 < R \leq 2$	$R_e=0.95+0.90(R-1)$
$2 < R \leq 3$	$R_e=1.85+0.82(R-2)$
$3 < R \leq 4$	$R_e=2.67+0.65(R-3)$
$4 < R \leq 5$	$R_e=3.32+0.45(R-4)$
$5 < R \leq 6$	$R_e=3.77+0.25(R-5)$
$R > 6$	$R_e=4.02+0.05(R-6)$
Key to symbols: < means less than; ≤ means less than or equal to; and > means greater than.	

4.5. CALIBRATION OF CONSUMPTIVE USE FOR ALFALFA AND PECANS

4.5.1. Alfalfa

In the late 1970s, researchers at New Mexico State University developed a crop production function for alfalfa which correlates annual evapotranspiration (consumptive use) with annual crop yield (Sammis, 1979, 1982). This crop production function is a linear relationship which may be expressed as follows:

$$Y=0.1572ET_{in}-0.5904$$

where Y is the annual yield in tons per acre at 15% moisture content, which is the normal field-dried condition; and ET_{in} is the annual evapotranspiration in inches. Rearranging this equation to solve for ET_{in}, results in the following expression:

$$ET_{in}=(Y+0.5904)/0.1572$$

By substituting the annual yield reported for a specific calendar year into the equation, the annual consumptive use can be computed, and the weighted consumptive irrigation requirement for the cropping pattern, adjusted accordingly.

For the purpose of this water use inventory, alfalfa yields reported by the New Mexico Agricultural Statistics Service for 1995 were used in Sammis's crop production function to calibrate ET for alfalfa in several counties. If the ET predicted by Sammis's crop production function was higher than the value computed using the original Blaney-Criddle method and a consumptive use coefficient (K) of 0.85 inside the frost free-period and 0.50 outside the frost-free period, the ET produced by the crop production function was used in determining the consumptive irrigation requirement for alfalfa, provided that the reported yields were accurate and sufficient water was available to satisfy the irrigation demand. Counties in which this adjustment was made include: Bernalillo (ground water only in MRGCD), Curry, De Baca, Dona Ana, Grant, Hidalgo, Lea, Luna, Sandoval (ground water only in MRGCD), San Juan, Sierra, Socorro (ground water only in MRGCD), Torrance, and Union (ground water only), Valencia (ground water only in MRGCD).

4.5.2. Pecan Orchards

It is generally accepted amongst both producers as well as agricultural researchers that the water requirements for pecan orchards are much higher than for other deciduous orchards. Studies conducted in the Rio Grande Valley near Las Cruces, New Mexico and El Paso, Texas by the Bureau of Reclamation in 1972-73 and by Miyamoto in 1981 (Miyamoto, 1983) indicate that the annual consumptive use of mature pecan trees typically ranges from 39.36 to 51.24 acre-inches per acre and depends on the tree size and planting density.

Historically, the New Mexico State Engineer Office has estimated the water requirements for pecan orchards using the original Blaney-Criddle method and a seasonal consumptive use coefficient of 0.65. The research conducted by the Bureau of Reclamation and Miyamoto indicates that the seasonal coefficient of 0.65 is much to low and needs to be revised. There is also evidence that the threshold temperatures which are normally used to define the growing season for deciduous orchards are inappropriate for pecan orchards. Transpiration of pecan orchards generally begins when the mean daily air temperature reaches 60 degrees Fahrenheit in the spring, and it ends the day after the first fall frost of 28 degrees Fahrenheit or below occurs in the fall (Miyamoto, 1983).

Using this criteria to define the growing season, and assuming the annual consumptive use of water in a pecan orchard is at least 39.36 inches, and that the value of the consumptive use coefficient outside the frost-free period is 0.40, the author has calibrated the seasonal consumptive use coefficient for the frost-free period. This calibration results in a seasonal consumptive use coefficient (K) of 0.90 inside the frost-free period, and was used to quantify the consumptive irrigation requirements of pecan orchards included in 1995 cropping patterns.

In 1995, pecan production in New Mexico set an alltime record. Dona Ana County accounted for 80.44% of the total production, Chaves for 7.79%, Eddy for 3.33%, Otero for 3.33%, Luna for 2.44%, and Lea for 1.33%; production in several other counties accounted for the remaining 1.34% (New Mexico Agricultural Statistics Service, 1996).

4.6. COMPUTATIONAL AID FOR IRRIGATION TABLES

The equations which follow are used to compute the irrigation withdrawals and depletions shown in Tables 8 and 9 in the latter part of this report. They may also be used for other irrigation studies.

4.6.1. Computing Withdrawals (Table 8)

(1) $TFWSW = CIRSW(ASWO + ASWC)/E_f$
(2) $TFWGW = CIRGW(AGWO + AGWC)/E_f$
(2) $TPWSW = TFWSW/E_c$ where $E_c > 0$
(3) $TPWGW = TFWGW$ (assuming the source of water is on-farm)
(4) $CLSW = TPWSW - TFWSW$

4.6.2. Computing Depletions (Table 9)

(1) $TFDSW = CIRSW(1 + IDFOF)(ASWO + ASWC)$
(2) $TFDGW = CIRGW(1 + IDFOF)(AGWO + AGWC)$

(3) TPDSW=CIRSW(1+IDFSW)(ASWO+ASWC)
(4) TPDGW=CIRGW(1+IDFGWO)(AGWO)+CIRGW(1+IDFGWC)(AGWC)

4.6.3. Key to Acronyms Used in Equations

(a) AGWC=ground water component of acreage irrigated with both surface and ground water (combined water).
(b) AGWO=acreage irrigated with ground water only.
(c) ASWC=surface water component of acreage irrigated with both surface and ground water (combined water).
(d) ASWO=acreage irrigated with surface water only.
(e) CIRGW=consumptive irrigation requirement for acreage irrigated with ground water.
(f) CIRSW=consumptive irrigation requirement for acreage irrigated with surface water.
(g) CLSW=surface water conveyance losses in canals and laterals from stream or reservoir to farm headgate.
(h) E_f=on-farm irrigation efficiency.
(i) E_c=off-farm conveyance efficiency.
(j) IDFBF=incidental depletion factor, below-farm.
(k) IDFCL=incidental depletion factor, canals and laterals, from stream or reservoir to farm headgate.
(l) IDFGWO=sum of incidental depletion factors which apply to withdrawals of ground water only. Note that if the source of water is on-farm (spring or wells), IDFGWO=IFDOF. However, if the source of water is off-farm, IDFGWO=IDFCL+IDFOF.
(m) IDFGWC=sum of incidental depletion factors which apply to the groundwater component of withdrawals where both surface and ground water (combined water) are applied, i.e., IDFGWC=IDFOF+IDFBF when the groundwater source is on-farm.
(n) IDFOF=incidental depletion factor on-farm.
(o) IDFSW=sum of incidental depletion factors which apply to surface water withdrawals, i.e., IDFSW=IDFCL+IDFOF+IDFBF
(p) TFDGW=total farm depletion, ground water.
(q) TFDSW=total farm depletion, surface water.
(r) TFWGW=total farm withdrawal, ground water.
(s) TFWSW=total farm withdrawal, surface water.
(t) TPDGW=total project depletion, ground water.
(u) TPDSW=total project depletion, surface water.
(v) TPWGW=total project withdrawal, ground water.
(w) TPWSW=total project withdrawal, surface water.

4.7. IRRIGABLE CROPLAND AND ACREAGE IRRIGATED

In 1995, there were about 1,453,100 acres of irrigable cropland in the state. This includes idle, fallow, and diverted or setaside acreage. Approximately 78,010 acres of irrigable cropland were enrolled in the U.S. Department of Agriculture's Conservation Reserve Program (CRP); and 980 acres were enrolled in other government production adjustment programs designed to protect farmer's incomes by taking acreage out of production (Lansford, 1996).

The Conservation Reserve Program was authorized by the Food Security Act of 1985 to conserve and improve soil and water resources on cropland classified as highly erodible (U.S. Department

of Agriculture, 1987). Farmers participating in the program sign a 10-year contract with the USDA, agreeing to take eligible land out of production and establish a protective cover of perennial grass, wildlife plants, windbreaks or trees. In return, the USDA provides annual rental payments, in cash or commodities, for the land removed from cultivation and covers half the expense of establishing the permanent cover on the land.

Irrigable cropland enrolled in USDA conservation programs is not normally irrigated, although water may be applied to get a new cover crop started after seeding. Once established, cover crops are generally left to survive on rainfall and snowmelt that infiltrates into the soil.

The total acreage irrigated in 1995 was estimated as 963,050 acre. The irrigated acreage reported for San Juan County in 1995 was significantly reduced from what has been reported in previous years to reflect the results of an inventory of irrigated cropland conducted by the U.S. Bureau of Reclamation and the New Mexico Interstate Stream Commission in 1994 using satellite imagery and a Geographic Information System (GIS). Note however, that the data shown in Table 4.2 for the years 1981-94 does not reflect this correction for San Juan County. In terms of acreage irrigated in 1995, alfalfa ranked first at 25.6%, pasture second at 16.5%, small grains (wheat, barley, and oats) third at 15.0%, high-value crops such as vegetables, orchards and vineyards fourth at 13.2%, corn fifth at 11.8%, sorghum sixth at 7.4%, and cotton seventh at 7.1%. All other crops accounted for the remaining 3.4% of the acreage irrigated. (Lansford, 1996).

Drip irrigation accounted for 5,148 acres or 0.54, flood for 547,608 acres or 56.86%, and sprinkler for 410,294 acres or 42.60%. Counties accounting for the greatest percentage of the total sprinkler irrigated acreage in the state in 1995 were Curry at 107,560 acres or 26.22%; Roosevelt at 77,975 acres or 19.00%; San Juan at 49,745 acres or 12.12%; Lea at 46,425 acres or 11.32%; Union at 44,050 acres or 10.74%; Chaves at 18,110 acres or 4.41%; Eddy at 23,127 acres or 5.64%, Torrance at 11,955 acres or 2.91%; and Quay at 6,542 or 1.59%. Counties accounting for the greatest percentage of the total drip irrigated acreage in the state in 1995 were Otero at 1,895 acres or 36.81%; Lea at 685 acres or 13.31%; Sierra at 660 acres or 12.82%; Luna at 660 acres or 12.82%; Dona Ana at 240 acres or 4.66%; Bernalillo at 230 acres or 4.47%; Chaves at 200 acres or 3.89%; and Curry at 190 acres or 3.69%.

Table 4.2. Acreage irrigated in New Mexico, 1981-1995. (Source: Lansford, 1982-1996; SEO 1990 and 1995).

Year	Acres	Year	Acres	Year	Acres
1981	1,053,220	1986	945,229	1991	1,011,785
1982	1,004,230	1987	897,099	1992	974,718
1983	864,980	1988	879,185	1993	979,780
1984	946,635	1989	990,880	1994	976,746
1985	941,245	1990	984,285	1995	963,050

4.8. SURFACE WATER SHORTAGES

As of May 1, 1995, snowpack ranged from zero percent of average in the Mimbres River Basin, San Francisco, Upper Gila River Basin, and Zuni/Bluewater Basin; to 277 percent in the Canadian River Basin; 223% in the Pecos River Basin; 193% in the Rio Grande Basin; and 152% in the San Juan River Basin (NRCS, 1995). Reservoir storage ranged from 111% of average in the Pecos

Glossary

Acre-foot. The quantity of water required to cover one acre (43,560 square feet) of land with one foot of water. There are 325,851 gallons in an acre-foot of water.

Aquifer. A saturated underground formation of permeable materials capable of storing water and transmitting it to wells, springs, or streams.

Combined water. When both ground and surface water are used on-site for the same purpose, such as the irrigation of a crop, the water supplied is referred to as combined water.

Consumptive irrigation requirement (CIR). The quantity of irrigation water expressed as a depth or volume, exclusive of effective precipitation, that is consumptively used by plants or is evaporated from the soil surface in a specific period of time. It does not include incidental depletions (See definition of incidental depletions) nor does it include water requirements for leaching, frost protection, wind erosion protection or plant cooling. Such requirements are accounted for in the on-farm efficiency values. The consumptive irrigation requirement may be numerically determined by subtracting effective rainfall from consumptive use.

Consumptive use (U) or evapotranspiration (ET). The unit amount of water consumed on a given area in transpiration, building of plant tissue, and evaporated from adjacent soil, water surface, snow, or intercepted precipitation in a specific period of time. The term includes effective rainfall. Consumptive use may be expressed either in volume per unit area such as acre-inches or acre-feet per acre, or depth, such as in inches or feet. Note however, that consumptive use of water by a crop does not include incidental depletions. (See definition of incidental depletions.)

County. The largest administrative division of a U.S. state. Counties may be identified by a two or three-digit code. These numerical codes are presented in "Counties and County Equivalents of the United States, Federal Information Processing Standards Publication 6-2," issued by the National Bureau of Standards (1973)

Cropping pattern. Distribution of the total irrigated acreage in a specific area according to the acreage planted in each individual crop.

Depletion. That part of a withdrawal that has been evaporated, transpired, incorporated into crops or products, consumed by man or livestock, or otherwise removed from the water environment. It includes that portion of ground water recharge resulting from seepage or deep percolation (in connection with a water use) that is not economically recoverable in a reasonable number of years, or is not usable.

Diversion. See withdrawal.

Diverted-setaside acreage. All of the acreage in the production adjustment programs administered by the Agricultural Stabilization and Conservation Service.

Effective rainfall (R_e). Rainfall occurring during the growing period of a crop that becomes available to meet the consumptive water requirements of the crop. It does not include rain which is intercepted by the plant canopy and evaporates, surface runoff, or deep percolation below the root zone.

Evapotranspiration (ET). See consumptive use.

Farm delivery requirement (FDR). The quantity of water exclusive of effective rainfall, that is delivered to the farm headgate or is diverted from a source of water which originates on the farm itself, such as a well or spring, to satisfy the consumptive irrigation requirements of crops grown on a farm in a specific period of time. The farm delivery requirement is computed by dividing the consumptive irrigation requirement, expressed as a depth or volume, by the on-farm irrigation efficiency, expressed as a decimal.

Field application efficiency. The ratio of the low-quarter depth or volume of irrigation water added to the root zone to the depth or volume of water applied to the soil. The application efficiency does not account for the conveyance losses which may occur between the farm headgate and the fields which are irrigated. (See definition of on-farm irrigation efficiency.)

Ground water. Water stored underground, beneath the earth's surface. It is stored in cracks and crevices of rocks and in the pores of geologic materials that make up the earth's crust.

Hydrologic unit. A surface water drainage basin identified by an eight digit code such as 13020101. Starting from the left, there are 4 pairs of digits. The first pair specifies the region; the second pair, the subregion; the third pair, the accounting unit; and the last pair, the cataloging unit. These hydrologic units were established by the U.S. Water Resources Council in 1970 for use in the Second (1975) National Assessment of Water and Related Land Resources.

Idle and fallow. Acreage plowed and cultivated during the current year but left unseeded, or acreage that is left unused one or more years.

Incidental depletions, above-farm. Evaporation from canals and laterals that convey water from stream or reservoir to the farm headgate; transpiration by phreatophytes along canals and laterals; and evaporation of leakage from off-farm water supply pipelines.

Incidental depletions, on-farm. Evaporation from on-farm reservoirs used to store water for irrigation; evaporation from farm ditches and irrigated fields during surface application; transpiration by phreatohphytes along farm ditches, evaporation of leakage from irrigation water pipes; sprinkler spray evaporation and drift losses; and evaporation from wetted crop canopies (interception).

Incidental depletions, below-farm. Evaporation of runoff and seepage from irrigated fields; evaporation from open drains and tailwater recovery pits; and transpiration by phreatophytes along drains and below irrigated fields.

Instream use. Water use taking place within a stream channel. The term "nonwithdrawal use" is frequently used interchangeably with instream use. Instream use is a water use not dependent on a withdrawal or diversion from ground or surface water sources and it usually is classified as flow uses. Examples of flow uses which depend on water running freely in a channel are hydroelectric power generation, navigation, recreation, fish propagation, and water quality improvement.

Irrecoverable water losses. See depletion and incidental depletions.

Irrigable acreage. The sum of irrigated crop acreage, diverted-setaside acreage, and idle and fallow acreage. The term implies that such acreage is developed and that irrigation works exist to apply water to the land. It does not include farmstead, feedlots, area in roads, ditches and the like.

Irrigated acreage (net). Includes agricultural land to which water was artificially applied by controlled means to include preplant, partial, supplemental, and semi-irrigation, during the calendar year. Land flooded during high water periods is included as irrigation only if the water was diverted to agricultural land by dams, canals, or other works. It is equal to the sum of all crop acreage irrigated minus the multiple-cropped acreage.

Multiple-cropped acreage. The same acreage used to produce two or more crops in the same year. When conducting inventories of irrigated acreage, each irrigated crop is included as part of the planted acreage, but the multiple-cropped acreage is subtracted from the sum of all crop acreage irrigated to obtain the net acreage irrigated.

Off-farm conveyance efficiency (Ec). The ratio, expressed as a percentage of the quantity of water delivered to the farm headgate by an open or closed conveyance system, to the quantity of water introduced into the conveyance system at the source or sources of supply.

On-farm distribution system. An on-farm distribution system may consist of a series of ditches or pipes, and related appurtenances, which convey the water delivered to the farm, to the appropriate field.

On-farm irrigation efficiency (Ef). The ratio, expressed as a percentage, of the average low-quarter depth or volume of irrigation water infiltrated and stored in the root zone to the depth or volume of water diverted from the farm headgate or a source of water originating on the farm itself, such as a well or spring. So that the reader may clearly understand what the low quarter means, let's assume that we have measured the change in soil moisture content in the root zone after an irrigation at 12 sampling sites on a field. The low quarter, would be the average of the three lowest values recorded. The on-farm efficiency reflects the efficiency of the on-farm distribution system and application system and includes deep percolation losses necessary as a beneficial use for leaching excess salts from the root zone. In the design and operation of an irrigation system and in the administration of water rights, it is the on-farm irrigation efficiency which is used in the determination of the farm delivery requirement.

Per capita use. The average quantity of water used per person or per head of livestock, per day.

Preplant irrigation. Water applied to fields before seed is sown to provide optimum soil moisture conditions for germination and to store water in the soil profile for consumptive use by plants during the growing season.

Project diversion requirement or off-farm diversion requirement (PDR). When the source of irrigation water does not originate on the farm, the project diversion requirement or off-farm diversion requirement is defined as the quantity of water exclusive of effective rainfall, which is diverted from an off-farm source to satisfy the farm delivery requirement in a specific period of time. An additional quantity of water must be diverted from the ultimate source of supply to make up for conveyance losses between the farm headgate and the source of water. Estimated conveyance losses are added to the farm delivery requirement to arrive at the project diversion

requirement. The off-farm diversion requirement may also be computed by dividing the farm delivery requirement by the off-farm conveyance efficiency, expressed as a decimal.

Project or system irrigation efficiency (Ej). The combined efficiency of the entire irrigation system, from the ultimate diversion point to the crop root zone. In mathematical terms it is the product expressed as a percentage of the on-farm efficiency (E_f) and the off-farm conveyance efficiency (E_c). When the irrigation water originates on the farm itself, such as from a well or spring, the off-farm conveyance efficiency does not apply and thus the project or system efficiency is the same as the on-farm irrigation efficiency.

River basin. The entire area drained by a stream (or river) or system of connecting streams so that all the streamflow originating in the area is discharged through a single outlet.

Rural. Any community, incorporated or unincorporated with a population of less than 2,500 inhabitants and not within a larger community that is classified as urban, is classified as rural by the U.S. Bureau of the Census.

Self-supplied. Water users who withdraw water directly from a ground or surface water source.

Surface water. An open body of water such as a river, stream, or lake.

Transpiration. The process by which water in plants is transferred into water vapor in the atmosphere.

Urban. Any community, incorporated or unincorporated with a population of 2,500 inhabitants or more is classified as urban by the U.S. Bureau of the Census. A self-supplied subdivision or residence (single family home or multiple housing unit) with a population of less than 2,500 inhabitants is classified as urban if it is within the established boundaries of a larger community or metropolitan area which is classified as urban by the Bureau of the Census.

Withdrawal. The quantify of water taken from a ground or surface water source. A diversion is the same as a withdrawal.

TERMS OF CONFUSION

There are three terms which are frequently used in discussions pertaining to water which open the door to confusion and misunderstanding. They are (1) consumed, (2) consumption, and (3) consumptive use.

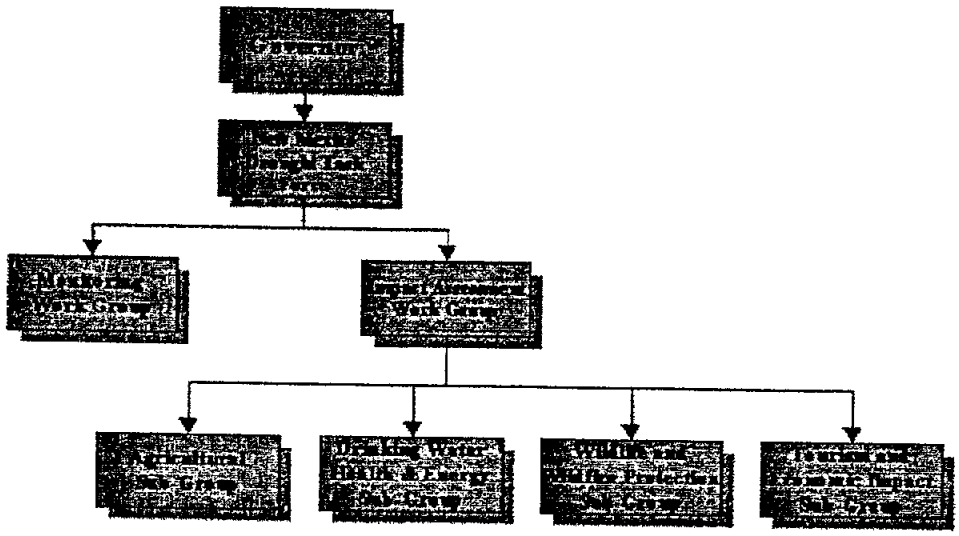
Water consumed and water consumption are often taken as meaning water delivered to a water user whether the user be a water utility, and individual household, or a commercial or industrial enterprise. When used in this sense, these terms do not mean the same thing as depletion as defined in this glossary. Furthermore, water consumption in this context is not synonymous with consumptive use as it is defined in this report.

When water consumed and water consumption are used in reference to a human or an animal taking a drink of water, or water that is evaporated from a water body or land surface, these terms become synonymous with a depletion of water and consumptive use.

APPENDIX S

New Mexico Drought Plan

New Mexico Drought Plan



Purpose of New Mexico Drought Plan

The purpose of this plan is to provide New Mexico with a framework for an integrated approach to minimize the impacts of drought on its people and resources. The plan outlines both long- and short-term measures that are to be used to mitigate the effects of drought and respond to drought conditions. To accomplish this goal the New Mexico Drought Plan:

- defines a process to be followed in addressing drought and drought-related activities,
  including monitoring, vulnerability assessment and mitigation, and impact assessment and response;
- identifies long- and short-term activities that can be implemented to minimize and
  prevent drought impacts;
- identifies the local, state, federal and private sector entities that are involved with state
  drought management and defines their responsibilities; and
- acts as a catalyst for creation and implementation of local drought planning and response efforts.

The New Mexico Drought Plan is intended to compliment on-going water resource planning efforts of regional water planners and existing regional water resource plans. The New Mexico Regional Water Planning Guidelines clearly identify drought planning as an important item of discussion in any water planning effort and it is anticipated that measures and actions outlined in The New Mexico Drought Plan will be incorporated into existing or future water planning efforts.

In designing the action strategies of the New Mexico Drought Plan, effort was made to use existing partnerships and lines of communication and the input of local New Mexico stakeholders in providing feedback as to the effectiveness of planned or implemented mitigation measures. This plan, however, should be considered a living document to which continual review, evaluation and revision must be made to reflect accomplishments, failures and changes. Moreover, because of the ever-changing staffs of state, federal and local governments, two important decisions as to the Plan's format have been made. First, to guarantee flexibility in the Plan's content, a loose-leaf format has been chosen as opposed to a bound document. The loose-leaf format will allow for the modification of the original Plan with the least amount of cost and delay. Second, to allow access of the Plan's content to the largest possible audience without the need for massive document publication costs, the entire New Mexico Drought Plan has been placed on the Internet in conjunction with the New Mexico Climate Center Website ***(http://weather.nmsu.edu/drought/index.htm)***. *The Website will be the location and source of all revisions and users are encouraged to visit this site to ensure they are working from the current version of the Plan. In addition, updates on the status and progress of the Monitoring Work Group (MWG) and the Impact Assessment Work Group (IAWG) will be posted to the web site. This process will allow the greatest flexibility for the review, modification and use of the data in the Plan.*

Definition of Drought

3

Drought is a complex physical and social process of widespread significance. It is not usually a statewide phenomena, with differing conditions in the state often making drought a regional issue. Despite all of the problems that droughts have caused, drought has proven to be difficult to define and there is no universally accepted definition because:

- drought, unlike floods, is not a distinct event;
- drought is often the result of many complex factors such that drought often has no well-defined start nor end; and
- the impacts of drought vary by affected sector, thus often making definitions of drought specific to particular affected groups.

The most commonly used drought definitions are based on meteorological, agricultural, hydrological and socioeconomic effects.

Meteorological drought is often defined by a period of substantially diminished precipitation duration and/or intensity. The commonly used definition of meteorological drought is an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.

Agricultural drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought but before hydrological drought and can also affect livestock and other dry-land agricultural operations.

Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, snowpack, and as lake, reservoir and groundwater levels. There is usually a delay between lack of rain or snow and less measurable water in streams, lakes and reservoirs. Therefore, hydrological measurements tend to lag other drought indicators.

Socioeconomic drought occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

Drought Vulnerability

4

The potential impacts of drought on the State of New Mexico are many and varied and can affect a wide range of economic, environmental and social activities. The relative vulnerability or risk exposure of these activities to the effects of drought usually depends on the types of water demands, how these demands are met and on corresponding water supplies available to meet these demands.

Those human and natural resource activities depending solely on rainfall and soil moisture, such as dry-land farming, ranching, and some environmental water uses, are most at risk from drought. These activities can suffer discernible effects even with droughts of short duration.

Still at relatively high risk, but somewhat less exposed, are those water uses depending on in-stream flows, which includes run-of-the-river irrigation, aquatic, wetland and riparian environmental communities, and recreational water uses. Less exposed to the risks of drought in New Mexico are many urban and agricultural water users who rely on surface water reservoir supplies or on groundwater resources that are not dependent on high rates of aquifer recharge or adversely affected by concentrated levels of high pumping.

The level of risk, which includes vulnerability and hazard, has been considered in the design of the structure of the New Mexico Drought Plan and is integrated into the planning, mitigation, and response activities of the Plan.

Structure & Function of Drought Planning

5 A-B

The following section presents the structure and function of the drought planning process in New Mexico. The structural information is depicted in the **organizational chart in Figure 1**. (Organizational Chart: New Mexico Drought Planning Process)

A. THE DROUGHT TASK FORCE

The New Mexico Drought Task Force (DTF) oversees the implementation of drought-related activities in the State of New Mexico. This Task Force acts as a liaison between the Monitoring and the Impact Assessment Work Groups (described below) and the Office of the Governor. The Task Force also assumes the lead role in intergovernmental drought response coordination and media information releases. (See Section 8)

The Task Force consists of the Cabinet Secretaries of the New Mexico Department of Agriculture and the New Mexico Department of Energy, Minerals and Natural Resources, the State Engineer and the State Emergency Manager. **(See Section 9, for contact list of Task Force members.)** As designated by Governor Johnson in 1996, the Cabinet Secretary of Energy, Minerals and Natural Resources serves as the chair of the Task Force.

B. MONITORING WORK GROUP

The Monitoring Work Group (MWG) is made up of water resource, agricultural and climate professionals from all levels of government. **(See Section 9, for current MWG member list.)** The MWG is responsible for monitoring all available climatological data, soil moisture readings, reservoir storage levels and other pertinent information necessary to analyze the current status level of drought conditions in the State of New Mexico. The MWG also examines and reports on long-term forecasts to assist the DTF and the Impact Assessment Work Group (IAWG) in their preparedness and response actions. The work group assesses the information, makes evaluations as to the current and future status of drought in the state and advises the IAWG and Task Force as to the status of drought in the state. As necessary, the MWG issues "notices" based on various stages of drought that "trigger" actions by the IAWG and the DTF. Details on the monitoring data and techniques are provided in Section 6. Section 7 provides more detail on the work group's responsibility.

Structure & Function of Drought Planning

5C

5.C. IMPACT ASSESSMENT WORK GROUP (IAWG)

The Impact Assessment Work Group (IAWG) serves two functions. First, when the state is not in a drought, the IAWG works year-round to assess vulnerabilities to drought and take action to mitigate those vulnerabilities. Second, during a drought, the IAWG plays the critical role in assessing the actual impacts of drought in the affected areas of the state, communicating those impacts to the DTF and, where possible, taking action to respond to and alleviate the impacts of the drought. However, because of the limited capabilities of the sub-group members, it is also incumbent upon them to make recommendations to the DTF on actions that should be taken at other levels of government to respond to the drought situation. The Task Force also should be advised of any needs that cannot be met through existing in-state resources. Planned Mitigation Actions for each of the IAWG sub-groups are provided under Section 9.

The IAWG is comprised of four sub-groups, each focussing on a specific impact sector. Membership among the subgroups includes individuals from appropriate state, federal and local governments and private, non-profit organizations. **(See Section 10 for IAWG sub-group member lists.)** Each of the sub-groups is chaired by a state agency representative. The chairs to these sub-groups serve as the co-chairs of the IAWG, which is made up of members from all the sub-groups. Many issues may fall under more than one of the sub-group "categories." Therefore, each sub-group must actively communicate and coordinate with one another. The sub-group chairs shall facilitate this communication by periodically meeting among themselves and encouraging membership from other sub-groups on their groups.

The Impact Assessment Work Group is comprised of four specific functional sub-groups representing various sectors of possible drought assistance impact groups. The members are water resource professionals who have experience in the planning, analysis, and use of water resources in New Mexico. They have been chosen as the core of the assessment group to assess the vulnerability of their particular affected customer impact sub-groups, develop long range strategies for assisting their customers and develop mitigation and response alternatives to known and unforeseen customer problems.

The Impact Assessment Work Group monitors and assesses the current and potential impacts of impending or ongoing drought upon the State's economy, environment and natural resources. It is the responsibility of the IAWG to initiate any and all appropriate drought responses within the capabilities of existing state and federal resources, and advise the Drought Task Force of any needs that cannot be met through existing in- state resources.

1. Agriculture Sub-Group

The Agriculture Sub-Group focuses their mitigation and response efforts on the impacts of drought to the agricultural sector. The length and degree of intensity of drought can produce profound impacts on the state's agricultural industries. Farmers and ranchers, historically, have been the communities most visibly affected by drought and numerous federal assistance programs are available for the agricultural sector (See Section 11). Timely and accurate assessment of agricultural conditions allows effective response mechanisms to be activated. Therefore, the Agriculture Sub-Group will be particularly interested in soil moisture and precipitation forecast data provided by the MWG. Moreover, assessing and

mitigating vulnerabilities in the area of agriculture is a challenge undertaken by this sub-group.

2. Drinking Water, Health and Energy Sub-Group

The Drinking Water, Health and Energy Sub-Group has a broad-spectrum of mitigation and response responsibilities. Drought-related impacts on drinking water systems, energy delivery systems and public health conditions are the purview of this sub-group. For example, as droughts worsen, municipal water systems can become increasingly strained. Water quantity and quality problems can become a crisis within certain communities that lack contingencies for drought. In addition, although drought is a climatic condition associated with an unusual and prolonged lack of precipitation, higher than normal temperatures also may be a related concern. Therefore, drought conditions may cause unusual demands on electrical and other energy systems, possibly resulting in brown-outs and grid failure. Finally, the health aspect of drought may include a variety of issues including respiratory problems associated with blowing dust and mental health concerns due to economic failure.

3. Wildlife and Wildfire Protection Sub-Group

Periods of drought in New Mexico have nearly always been associated with severe forest and rangeland fires. In addition, wildlife often suffer from lack of forage, sometimes turning to grazing rangelands and competing with livestock. Fish and riparian areas also suffer during droughts. Low stream flows during drought can increase threats to endangered and threatened fish species. Because of the interrelated aspects of these issues with the agricultural communities, it is important for this sub-group to closely coordinate activities with the Agriculture Sub-Group. The Wildlife and Wildfire Protection Sub-Group assesses impacts, implements mitigation and response activities related to these issues.

4. Tourism and Economic Impact Sub-Group

This sub-groups focuses on assessing impacts of drought and implementing, where possible, response actions related tourism and economic impact. The tourism industry represents a significant sector of the overall state economy, particularly with respect to the skiing industry and recreational opportunities available at the numerous forests and parks. Tourism and the livelihood it brings to many New Mexicans can be negatively impacted by drought. The state's economy, in general, can be dramatically impacted by drought. Economic impacts assessed by the Tourism and Economic Impact Sub-Group includes crop failures, livestock losses, secondary losses to agriculture suppliers, revenue losses due to reduction in skiing and water-based recreation and increased state expenditures on fire suppression.

Drought Monitoring

6

Drought monitoring and the ability to assess the current conditions and predict future drought development are key to implementation of the New Mexico Drought Plan. A network of data gathering sites, operated by various state and federal agencies supply real-time climate, streamflow, and reservoir information for water planning professionals. These data sources are accessed regularly by the MWG. Some of the data sources assessed by the Work Group are described below.

- The National Weather Service collects and analyzes data from **over 200 weather stations in New Mexico.** This information is integrated into various prediction indices and is also available in a real-time and long-term record format from the National Weather Service web site at ***http://www.srh.noaa.gov/abq*** and the New Mexico Climatic Center web site at ***http://weather.nmsu.edu*** .

- The Natural Resource Conservation Service operates a network of 43 snowfall measuring stations throughout New Mexico. The climate and snowpack data from these snow survey sites, 16 of which have been automated, are used to develop monthly streamflow forecasts for the major river basins in New Mexico and are provided by the Western Regional Climate Center web site at *http://www.wrcc.dri.edu/snotel.html* , as well as being published monthly in the New Mexico Basin Outlook Report.

- The U.S. Geological Survey (USGS) maintains, operates and analyzes a network of over 200 streamflow measuring stations throughout the State of New Mexico. Many of these gauging stations have been automated, thus providing real-time access to streamflow data through the USGS web site at *http://wwwdnmalb.cr.usgs.gov/public/* .

- The New Mexico Interstate Streams Commission monitors water storage in the major reservoirs operated by various state, federal and private agencies in the state and provides a monthly summary of the storage status of these reservoirs.

- The New Mexico Department of Agriculture maintains a statewide network of crop status and soil moisture monitoring sites and provides a weekly and monthly analysis of this data in both a newsletter on their web site at ***http://www.nass.usda.gov/nm*** .

DROUGHT MONITORING INDICES. Various indicators and climatic indices have been developed by water resource and climatological professionals for use in drought planning and these indices have been integrated into the New Mexico plan as key elements examined and tracked by the MWG.

New Mexico has been divided into **eight separate climatic zones**, each representing a particular region of the state that has similar climatic conditions. Work is underway to develop smaller subgroups for these zones. The following indices are used in each of the zones to assist in the determination of drought status: the Palmer Drought Severity Index, the Surface Water Supply Index, the Standardized Precipitation Index.

Drought Monitoring

6A

6.A. PALMER DROUGHT SEVERITY INDEX (PDSI)

The Palmer Drought Severity Index (PDSI) is a "meteorological" drought index that responds to weather conditions that have been abnormally dry or abnormally wet. The PDSI is calculated based on precipitation, temperature and Available Water Content of the soil. The PDSI varies from values of +6.0 to -6.0 with a classification scale indicating relative meteorological and hydrological development cycles. Table 1 reflects the range and extent of the PD>

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Table 1: PDSI Classification System	
4.00 or more	Extremely wet
3.00 to 3.99	Very wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Slightly wet
.50 to .99	Incipient wet spell
.49 to -.49	Near normal
-.50 to -.99	Incipient dry spell
-1.00 to 1.99	Mild drought
-2.00 to -2.99	Moderate drought
-3.00 to 3.99	Severe drought
-4.00 or lower	Extreme drought

The PSDI is calculated in New Mexico on a monthly basis and a long term archive is available on the New Mexico Climate Center Web site at **http://weather.nmsu.edu/drought/drought_menu.htm** *It is interesting to note from these graphs that drought conditions do not always occur statewide and that when one area of the state is in a severe drought, another area can be*

experiencing normal or above normal moisture conditions.

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Drought Monitoring

6B

B. SURFACE WATER SUPPLY INDEX (SWSI)

The Surface Water Supply Index (SWSI) was developed to compliment the PDSI. The objective of the SWSI is to incorporate both hydrological and climatological features into a single index. It is intended to be an indicator of surface water conditions where mountain snowpack is a major component. Four inputs are required for the SWSI: snowpack, streamflow, precipitation, and reservoir storage. Because it is dependent on the season, the SWSI is computed with only snowpack, precipitation and reservoir in the winter months, with streamflow replacing snowpack in the equation during the summer months. Current status and historical data for New Mexico reservoirs is available at Website http://www.nm.nrcs.usda.gov/snow/resv/index.htm Like the PDSI, the SWSI is centered on zero and ranges from +4.2 to -4.2, as shown in Table 2.

Table 2: Surface Water Supply Index (SWSI)	
+3.0 to +4.0	Extremely wet
+2.0 to +3.0	Moderately wet
+1.0 to +2.0	Slightly wet
-1.0 to +1.0	Near average
-2.0 to -1.0	Slightly dry
-3.0 to -2.0	Moderately dry
-3.0 to -4.0	Extremely dry

Drought Monitoring

6C

6.C. STANDARDIZED PRECIPITATION INDEX (SPI)

The Standardized Precipitation Index (SPI) is designed to quantify the precipitation deficit for multiple time scales. These time scales reflect the impact of drought on the availability of the different water resources. The SPI is calculated by taking the difference between the actual and mean precipitation for a particular time scale, then dividing by the standard deviation. A drought event is defined as any time the SPI is continuously negative and reaches an intensity where the SPI is -1.0 or lower. The drought event ends when the SPI becomes positive. Each drought event therefore has a duration defined by its beginning and end, and an intensity for each month that the event continues, as shown by example in Table 3.

Table 3: SPI Values for Recent Colorado Drought

SPI Values	Drought Category	Time in Category
0 to -.99	Mild Drought	34.1%
-1.0 to -1.49	Moderate Drought	9.2%
-1.5 to -1.99	Severe Drought	4.4%
-2.00 or less	Extreme Drought	2.3%

Table 3 also shows the percent of time that the SPI was in each of the drought categories based on an analysis of available station data in Colorado. The standardization allows the SPI to determine the rarity of a current drought as well as the probability of the precipitation necessary to end the current drought.

Current and archive values of the SPI for various time frames can be obtained from the Western Regional Climate Center Website at ***http://www.wrcc.sage.dri.edu/spi/spi.html***

Drought Monitoring

6D

6.D. TRIGGERING MECHANISMS

The MWG will assess the information and indices discussed above and in combination with other available real-time information determine, as shown in Table 4, the status of drought in each climatic region in New Mexico. Based on the status, the MWG will report its findings to the IAWG and the DTF. (Further detail on the implementation of the plan is found in Section 7)

Table 4

Drought Triggers

Drought Status	Characteristics for a Single Climate Region
Normal	PDSI between -.9 and + 5.0, Six month SPI positive.
Advisory (approaching or experiencing incipient drought)	One month or 4 week running average PDSI is between -1.0 and -1.9 but period of less than -1.0 does not exceed 2 months. Six month SPI declining and less than 0.25 for 2 consecutive months.
Alert (mild drought)	PDSI is between -1.0 and -1.9 for greater than 2 months or between -2.0 and -2.9 for 1 month. Six month SPI between 0 and -.99 .
Warning (moderate drought)	PDSI is between -1.0 and -1.9 for 9 months or more, -2.0 to -2.9 for at least 2 months, or -3.0 or less for at least 1 month. Six month SPI declining and between -1.00 and -1.49 .
Emergency (severe to extreme drought)	PDSI is between -2.0 to -2.9 for 9 months or more, -3.0 to -3.9 for at least 2 months, or -4.0 or less for at least 1 month. Six month SPI declining and less than -1.5 .
Emergency (drought receding)	After severe to extreme drought criteria has been met, PDSI improves to greater than -2.0 for 2 consecutive months. Six month SPI turns in positive direction for two consecutive months.
Warning (drought receding)	After criteria for moderate or worse drought has been met, PDSI improves to greater than -1.5 for 2 consecutive months.

	Six month SPI rising in positive direction and between -1.00 and -1.49 for two consecutive months.
Alert (drought receding)	After criteria for mild or worse has been met, PDSI improves to greater than -1.0 for 2 consecutive months. Six month SPI rising in positive direction and between 0.0 and -.99 for 2 consecutive months.
Advisory (drought receding)	After criteria for mild or worse drought has been met, PDSI improves to greater than or equal to zero, and the 10 month running total of the PDSI is less than -10.0 . Six month SPI value above zero.

Drought Response & Assessment

7A-C

Figure 15 identifies the sequence of activities triggered by each individual drought status described in Table 4 in Section 6. The frequency of the MWG activities also vary depending on the status of drought. The drought status drives all activities of the IAWG and the DTF. The following discusses the roles and relationships of the various players in implementing the state drought plan.

A. THE ROLE OF THE MONITORING WORK GROUP

The Monitoring Work Group (MWG) meets on a regular basis, more frequently as a drought intensifies. Under "normal" conditions, the work group provides to the DTF and the IAWG a ***Quarterly Drought Monitoring/Status Report*** which briefly summarizes climactic conditions of the state. (See Section 6 for detail on drought monitoring data and triggers.) When the MWG determines that the state has entered various stages of drought, it will issue the appropriate ***"Drought Notices"*** to the IAWG and the DTF. (See Samples in Section 12) These brief notices serve to alert the other drought planning entities. They will identify the stage of drought, where it is occurring and what the forecasted climate outlook is for that region. During moderate, severe and extreme droughts (warning and emergency status), the MWG will send monthly ***"Drought Monitoring/Status Reports"*** to the DTF and IAWG. These reports are similar to the original notice and convey the current situation and any changes in conditions from the previous report. If extreme drought conditions persist, the chairperson of the MWG will coordinate with the chairpersons of the IAWGs to decide on the need for a ***"Drought Executive Order."*** (See sample in Section 12) As the drought recedes, the MWG will meet less frequently and resume issuing its ***"Quarterly Drought Monitoring/Status Report."*** Once the drought recedes and again enters the "advisory" stage, the MWG will compile and provide to the DTF and IAWG an ***"After Action Evaluation Report"*** that assesses the effectiveness and efficiency of their activities under the recent drought and makes any recommended changes to procedures.

B. THE ROLE OF THE IMPACT ASSESSMENT WORK GROUP

The IAWG responsibilities are two-fold. During droughts they serve a response function and in between droughts the sub-groups work to assess and mitigate vulnerabilities to drought. These responsibilities are delineated **in Figure 15** and summarized below.

Drought Mitigation Activities. Each of the sub-groups in the IAWG are responsible for assessing drought vulnerabilities and developing and implementing drought mitigation strategies. These include actions that can be taken before a drought event to prevent, where possible, drought impacts from occurring or lessening their severity. The four sub-groups have analyzed vulnerable sectors of their respective impact groups and have developed numerous preventative action strategies that will mitigate the effects of drought on their target sector (See Section 9). Where possible, the sub-groups will implement the strategies identified. When the sub-group lacks the authority or jurisdiction, they will work with the DTF to implement the actions.

During "normal" and "warning" stages, the individual sub-groups will meet on a quarterly basis to coordinate implementation of the "Planned Mitigation Actions" under Section 9. Over time, sub-groups may revise the "Planned Mitigation Actions," as necessary, and submit changes to

the DTF for review and approval. Annually, each sub-group will submit a **"Drought Impact Action Progress Report"** to the MWG, IAWG and the DTF. The report will not only include a summary of progress made by the sub-group, but will also make recommendations for actions that should be taken by the Task Force or others to reduce drought vulnerability in the state.

Drought Assessment and Response Activities. When a **"Drought Advisory Notice"** is issued by the MWG, the sub-groups will continue implementing their Planned Mitigation Actions, but will also meet to organize contingency activities that may be necessary if the drought conditions worsen. Within one week of issuance of a **"Drought Alert Notice"**, the IAWG and its sub-groups will suspend their mitigation activities and begin assessing actual and potential impacts of the current drought. The sub-groups will summarize and update this information in an **"Impact Action Report"** to the DTF. (See sample in Section 12) When a drought enters the "warning stage", the report will be updated monthly until an **"Improving Drought Conditions Notice"** is issued by the MWG. During these drought stages, the IAWG will implement drought response actions within their capabilities, make recommendations to the DTF on actions the DTF should take and identify any unmet needs. Once the drought emergency has passed, the IAWG resumes their mitigation activities and submits to the DTF an **"IAWG After Action Evaluation Report"** with recommended changes to the process or structure of the drought plan.

C. THE ROLE OF THE DROUGHT TASK FORCE

As indicated in Section 5 above, the DTF oversees the implementation of drought-related activities in the State of New Mexico and is responsible for monitoring and directing the activities of the work groups. **Figure 15** identifies in some detail the actions and responsibilities of the Task Force under each stage of drought. Their role includes: reporting to the governor and cabinet on the drought conditions and impacts in the state, acting upon drought mitigation and response recommendations of the IAWG (both before and during a drought), assuming intergovernmental coordination of state drought response activities during drought emergencies, preparing an **"DTF After Action Evaluation Report"** upon cessation of droughts and, as described in Section 8, responsible for communications.

Drought Response & Assessment

Fig. 15

Figure 15-1A

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Monitoring Work Group (MWG)
NORMAL	Meet quarterly to assess current conditions and analyze forecasts. Forward "**Quarterly Drought Monitoring/Status Report**" with existing conditions and projections to IAWG and DTF.
ADVISORY APPROACHING OR EXPERIENCING INCIPIENT DROUGHT	Submit "**Drought Advisory Notice**" to IAWG and DTF. Designated members will assess data on a monthly basis and call a meeting of the work group if conditions deteriorate. Continue to meet quarterly to assess current and potentially deteriorating conditions or drought emergence and analyze forecasts. Submit "**Quarterly Drought Monitoring/Status Report**" to IAWG and DTF.
ALERT MILD DROUGHT	Issue "**Drought Alert Notice**" to IAWG and DTF. Meet monthly to assess conditions and forecasts. Compile and submit monthly " **Drought Monitoring/Status Reports**" to IAWG and DTF.
WARNING MODERATE DROUGHT	Issue "**Drought Warning Notice**" to IAWG and DTF. Continue to monitor trends and provide "**Drought Monitoring/Status Reports**" to DTF and IAWG on a monthly basis.

Figure 15-1B

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Impact Assessment Work Group (IAWG)
NORMAL	Sub-groups meet quarterly to coordinate implementation of "**Planned Mitigation Actions**." Submit "**Drought Impact Action Report**" to the DTF annually.
ADVISORY APPROACHING OR EXPERIENCING INCIPIENT DROUGHT	Upon receipt of an "**Drought Advisory Notice**" from the MWG, sub-group chairs will meet to organize contingency actions in case conditions deteriorate. Sub-groups continue to meet quarterly to coordinate implementation of "**Planned Mitigation Actions**" and submit "**Drought Impact Action Report**" to the MWG, IAWG and DTF annually.
ALERT MILD DROUGHT	Within 1 week of "**Drought Alert Notice**," sub-groups meet to make initial assessment of their sector's impacts/potential impacts and report findings to IAWG. IAWG compiles "**Impact Action Report**" and submits to MWG and DTF.
WARNING MODERATE DROUGHT	Upon receipt of "**Drought Warning Notice**," the sub-groups will meet to update "**Impact Action Report**" and implement response actions within capabilities of participants, propose appropriate responses outside their authority and report any unmet needs or recommendations to the DTF in the "**Impact Action Report**," which shall be updated monthly. Begin to assemble data necessary to support Governor's request for Presidential Emergency or Agricultural Disaster Declaration by U.S. Agriculture Secretary. Submit to DTF when data warrants declaration.

Figure 15-1C

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Drought Task Force (DTF)
NORMAL	Monitor and oversee work group activities. Advocate administrative, regulatory, legislative, and budgetary changes as recommended by IAWG to mitigate impacts from drought. Report progress of MWG and IAWG to Governor as necessary.
ADVISORY APPROACHING OR EXPERIENCING INCIPIENT DROUGHT	Report "**Drought Advisory Notice**" to Governor. Meet as necessary. Continue to monitor and oversee work group activities and advocate, as necessary, administrative, regulatory, legislative, and budgetary changes as recommended by IAWG to mitigate impacts from drought.
ALERT MILD DROUGHT	Upon receipt of initial "**Drought Alert Notice**" and "**Impact Findings Report**," DTF alerts Governor and Cabinet of drought status and coordinates public information releases from Governor. Meet as necessary.
WARNING MODERATE DROUGHT	Upon receipt of "**Drought Warning Notice**," DTF chair calls a meeting at which chairs of the MWG and IAWG sub-groups provide status reports of conditions and response activities, recommends additional response actions and reports unmet needs. DTF reports status to Governor and Cabinet and takes action to initiate response efforts and resolve unmet needs. This may include requesting Gubernatorial action on drought mitigation and response assistance or other extraordinary measures allowed under State of Emergency declaration. DTF coordinates public information releases from Governor. Meets again as necessary, given monthly notices and reports from work groups.

Figure 15-2A

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Monitoring Work Group (MWG)
EMERGENCY SEVERE TO EXTREME DROUGHT	Issue **"Drought Emergency Notice"** to IAWG and DTF. Monitor trends and provide updated **"Drought Monitoring/Status Reports"** to DTF and IAWG on a monthly basis.
EMERGENCY RECEDING	Continue to monitor trends and provide **"Drought Monitoring/Status Reports"** to DTF and IAWG on a monthly basis.
WARNING RECEDING	Issue **"Drought Improving Condition Notice"** to IAWG and DTF. Continue to monitor trends and provide **"Drought Monitoring/Status Reports"** to DTF and IAWG on a monthly basis.
ALERT RECEDING	Meet monthly to assess conditions and forecasts. Resume submittal of **"Quarterly Drought Monitoring Reports"** to the IAWG and DTF. Designated members will assess data on a monthly basis and call a meeting of the work group if conditions deteriorate. Begin assessment for **"MWG After Action Evaluation Report."**

Figure 15-2B

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Impact Assessment Work Group (IAWG)
EMERGENCY SEVERE TO EXTREME DROUGHT	Continue to assemble and submit to DTF data necessary to support Governor's request for Presidential Emergency or Agricultural Disaster Declaration by U.S. Agriculture Secretary. The sub-groups will continue to meet on a monthly basis and update the **"Impact Action Report,"** implement response actions within capabilities of participants, propose appropriate responses outside their authority and report any unmet needs or recommendations to the DTF.
EMERGENCY RECEDING	As necessary, continue to assemble and submit to DTF data necessary to support Governor's request for Presidential Emergency or Agricultural Disaster Declaration by U.S. Agriculture Secretary. The sub-groups will continue to meet on a monthly basis and update the **"Impact Action Report"** and implement or propose appropriate response actions and report any unmet needs or recommendations to the DTF.
WARNING RECEDING	As necessary, continue to update **"Impact Action Report"** and implement or propose appropriate response actions within capabilities of participants and report any unmet needs or recommendations to the DTF.
ALERT RECEDING	Sub-groups continue to assess impact on sectors and report findings to IAWG, as necessary. Begin assessment for **"IAWG After Action Evaluation Report."**

Figure 15-2C

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Drought Task Force (DTF)
EMERGENCY SEVERE TO EXTREME DROUGHT	DTF assumes intergovernmental coordination of state drought response activities and begins meeting on a monthly basis. Implements response as necessary within capabilities. Makes recommendations on actions that could be taken by others (e.g., local governments, federal agencies) to alleviate drought impacts. If data warrants, recommend Governor request agricultural emergency or disaster declaration status from federal government. Accelerates media and public information outreach. Report drought and impacts status to Governor and Cabinet on a weekly basis, or as necessary.
EMERGENCY RECEDING	As necessary, continue to pursue potential drought response and mitigation assistance, coordinate state drought mitigation and response efforts, and make recommendations on actions that could be taken by others (e.g., local governments, federal agencies) to alleviate drought impacts. Provide press briefings and reports to Governor and Cabinet on a monthly basis.
WARNING RECEDING	As necessary, continue pursuit of potential drought response and mitigation assistance and to coordinate state drought mitigation and response efforts. Provide press briefings and reports to Governor and Cabinet as necessary.
ALERT RECEDING	Provide press briefings and reports to Governor and Cabinet on a monthly basis.

Figure 15-3A

New Mexico Drought Monitoring and Response Sequence

Drought Stage	Monitoring Work Group (MWG)
ADVISORY RECEDING	Meet quarterly to assess conditions and forecasts. Submit "**Quarterly Drought Monitoring/Status Report**" to IAWG and DTF. Compile "**MWG After Action Evaluation Report**" (along with recommended changes) and submit to DTF.
NORMAL	Meet quarterly to assess conditions and forecasts. Submit "**Quarterly Drought Monitoring/Status Report**" to IAWG and DTF.

Figure 15-3B New Mexico Drought Monitoring and Response Sequence	
Drought Stage	**Impact Assessment Work Group (IAWG)**
ADVISORY RECEDING	Sub-groups will meet quarterly to resume coordinated implementation of "**Planned Mitigation Actions.**" "**Drought Impact Action Report**" to be submitted to the DTF annually. Compile "**IAWG After Action Evaluation Report**" (that includes any recommended changes) and submit it to DTF.
NORMAL	Sub-groups meet quarterly to coordinate implementation of "**Planned Mitigation Actions.**" Submit "**Drought Impact Action Report**" to the IAWG and DTF annually.

Figure 15-3C New Mexico Drought Monitoring and Response Sequence	
Drought Stage	**Drought Task Force (DTF)**
ADVISORY RECEDING	Prepare "**DTF After Action Evaluation Report**" based on work group reports and Task Force evaluation of response. Submit report to the Governor and make changes to the Drought Plan and administrative changes as necessary to improve response. Advocate regulatory and legislative change to improve drought mitigation and response capabilities at all levels of government. Resume monitoring and oversight of work group activities and advocate, as necessary, administrative, regulatory, legislative, and budgetary changes as recommended by IAWG to mitigate impacts from drought.
NORMAL	Monitor and oversee work group activities. Advocate administrative, regulatory, legislative, and budgetary changes as recommended by IAWG to mitigate impacts from drought. Report progress of MWG and IAWG to Governor as necessary.

Examples of reports and proclamations mentioned in Figure 15 are shown in Section 12.

Communications

8

The timely dissemination of drought related data plays an important role in assuring the effectiveness of the New Mexico Drought Plan. A targeted effort has been made to develop an information dissemination system using E-mail and FAX communication systems. Existing agency newsletters have been combined with web sites of the Office of the State Engineer, NM Agricultural Statistics, New Mexico State Climatologist, and the US Geological Survey to communicate drought information to the public. Prepared radio and TV spots have also been developed to address the major drought affected customer groups. These efforts have been designed to assure the timely delivery of needed data to not only the state's decision makers but also to the general public.

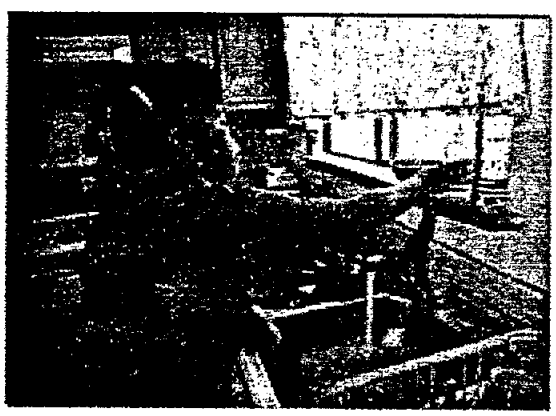
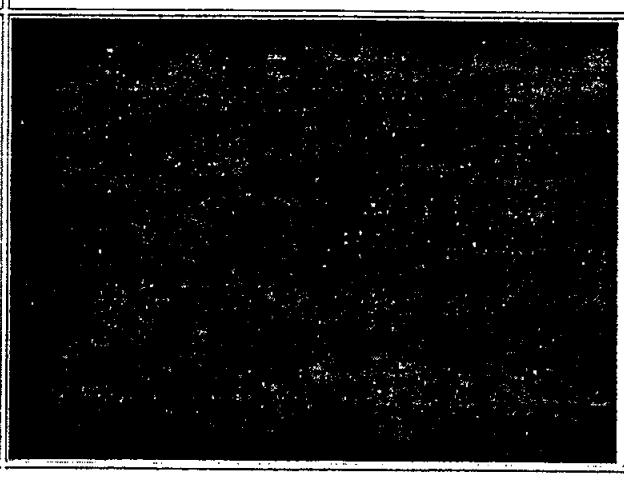
To accomplish this objective, the following communications guidelines have been established:

- 1. Initial release of any drought status or response information, excluding **"Quarterly Drought Monitoring/Status Reports"**, will originate from the Office of the Governor, with technical oversight being provided by members of the NM Drought Task Force.
- 2. Drought press releases from the Office of the Governor will use the existing client list to target media outlets, congressional delegations and State of New Mexico Cabinet and Department heads.
- 3. Other agencies within the State of New Mexico are encouraged to redirect information obtained from the Office of the Governor to their respective client bases, however no information will be released to these clients until after the initial release by the Governor. These agency client lists should emphasize clients not already receiving information from the Office of the Governor and/or those needing drought related services available from the originating agency.

Planned Mitigation Actions

9

Impact assessment Sub-Groups

a. Agriculture	
b. Drinking Water, Health and Energy	
c. Wildlife and Wildfire Protection	

d. Tourism and Economic Impact

AGRICULTURAL IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 1

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Reduced livestock forage and livestock water on rangelands results in poor animal health, soil erosion and possible economic loss to ranchers	1. Prior to and during drought, use public information program and on-site visits to emphasize importance of rangeland management and planning to equalize stocking rates with available forage and the need for permanent water storage and distribution systems. 2. Prior to drought, use range management techniques such as reduced stocking rates, reserve pastures, removing competitive plants and stored feed to improve sustainability of rangelands under drought conditions. 3. During drought, initiate emergency forage program and/or permit grazing of CRP lands. 4. Special emphasis needs to be placed on problems of Economically Stressed Ranchers who now rely on Federal and State Grazing Leases to sustain their herds. In these areas, there needs to be a coordinated plan of action to be taken by land management agencies to provide grazing and/or supplemental feed assistance to lessees. This action may include changing federal and state grazing regulations during drought situations. 5. For long term drought conditions in areas with high concentrations of Economically Stressed Ranchers, develop supplemental natural resource employment oppurtunities to supplement income losses due to grazing restrictions. 6. Explore alternatives for establishing state funded cost-share program for water conservation measures on rangeland	Bureau of Land Management Forest Service, BLM, SLO Natural Resources Cons. Service Coop. Extension Service, SWCD's Farm Bureau, Livestock Producer Organizations, NRCS, FSA, Em.Mgt., SWCD's Ext. Service, Livestock Producer Organizations, BLM, Forest Service, NRCS, State Land Office, SWCD's FAC's, Forest Service, BLM, SWCD's, Ext. Service Livestock Producer Organizations, NMOSE, NMISC
Reduced soil moisture on dry cropland poses economic loss to farmers and possible increased soil erosion and blowing dust	1. Emphasize use of crop insurance programs during high probability drought years. 2. Prior to drought, use public information program to emphasize installation of soil and water conservation systems, including terraces, crop residue use, and contour planting. 3. Prior to and during drought situations, emphasize use of crop residue management, grassing of terraces and emergency tillage to control soil blowing. 4. Investigate use of Rainfall Enhancement Projects in target areas	NRCS, Ext. Service, Soil and Water Conservation Districts NMISC, SWCD's

Decreased irrigation water from surface water sources prevents achieving of crop harvest potential	1. Emphasize adjustment of irrigated acreage to meet expected water availability and use of crop insurance program. 2. Prior to drought, develop local partnerships with major non-agricultural waterusers to develop alternatives for increasing available irrigation water supply by use of temporary water transfers. 3. Prior to drought, develop emergency loan program to encourage installation of on-farm water conservation measures.	NRCS, SWCD's SWCD's, NMOSE NMOSE, NMISC, NRCS, FSA

AGRICULTURAL IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 2

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Increased irrigation pumping costs from underground water sources decreases profitability of irrigated cropping system	1. Prior to drought, emphasize irrigation water management techniques and develop emergency loan program to promote installation of on-farm water conservation measures 2. Increase frequency of water level measurement program to monitor declining acquifer levels.. 3. Based on acquifer water levels, implement in metered groundwater areas emergency order to limit total pumping volume to new reduced limit. 4. Based on acquifer water levels in non-metered areas, implement emergency order to place metering devices on all wells and conform to item 3 above. 5. With metering in place, establish groundwater bank to allow emergency transfer of unused groundwater between parties. 6. Develop water conservation partnerships with underground water districts along the New Mexico-Texas stateline. 7. Emphasize use of crop insurance program in high probability drought years.	NRCS,NMOSE, Groundwater Cons. Districts, NMISC, SWCD's NMOSE NMOSE NMOSE NMOSE NMOSE, NMISC, SWCD's
Loss of farmers and ranchers due to drought	1. Encourage existing agricultural finance advisory committees to develop emergency repayment guidelines with banks due to drought-induced	Agricultural Credit Organizations, FSA, Livestock Producer

ranchers due to drought induced bankruptcy	emergency repayment guidelines with banks due to drought-induced conditions. 2. Use Public Service Announcements to advertise emergency repayment guidelines and crop insurance programs.	FSA, Livestock Producer Organizations (Refer item to Tourism and Econ. Impact Sub-Group)
Drought induced mental anguish of farmers and ranchers resulting in increased suicides, social, and family problems	1. Develop working partnerships with local ministerial alliances and county health departments to develop social counseling and support programs. 2. Use local TV and radio outlets to implement public information program directed at reducing drought-induced mental stress. **This item will be addressed by Drinking Water, Health & Energy Sub-Group.**	County health offices, local ministerial alliances, Ext. Service
Increased health problems for residents of areas experiencing blowing dust problems from drought ravaged agricultural lands	1. Develop county health programs addressing alternatives to diminish health effects of blowing dust. **This item will be adressed by Drinking Water, Health & Energy Sub-Group.**	County health offices, SWCD's

AGRICULTURAL IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 3

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Damage to cropland and rangeland due to intrusion of wildlife species from their drought-ravaged native habitat.	1. Develop emergency guidelines for the emergency feeding and watering of native wildlife in their original habitat. 2. If needed, implement emergency control guidelines for invasion species on private cropland and rangeland.	Fish and Game Dept.,Fish and Wildlife Service, SWCD's, Forest Service, BLM
Decreased income from local dairy and feedlot operations due to drought-induced high cost of feedstocks.	1. Develop statewide and nationwide hotline system for locating economical feedstock sources. 2. Investigate possible system of subsidized purchase of replacement stock from Limited Resource Producers mentioned on Sheet No. 1.	Ext. Service, NMDA, Producer Organizations
Decline in stability of local economy and tax-base due to decreased sales of agricultural support equipment and services.	1. Develop statewide and regionwide ag. support services hotline which would emphasize outside area purchases of agricultural services and equipment from local distributors.	Ext. Service, Local Development Commissions, Local Ag. Dealer Organizations
Lack of available legislation that directly supports drought-induced problems for agricultural sector	1. Create NM Drought Advisory Board to be used as a vehicle for legislative input and responsible for updating of Drought Plan. 2. Create "Haybank" that could use state funds to provide emergency feed to ranching operations. 3. Create Drought Fund, similar to Irrigation Improvement Works Fund, that would have an on-going "draw account" specifically for drought-induced problems, and that could also be used to support a public information. campaign and drought-related research projects.	Drought Task Force

DRINKING WATER, ENERGY, AND HEALTH IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 1

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Drought induced mental anguish of farmers and ranchers resulting in increased suicides, social and family problems	1. Develop working partnerships with local ministerial alliances and county health departments to develop social counseling and support program. 2. Use local TV and radio outlets to implement public information program directed at reducing drought-induced mental stress.	County health offices, local ministerial alliances, Ext. Service
Increased health problems for residents of areas experiencing blowing dust problems from drought affected agricultural lands	1. Develop county health programs addressing alternatives to diminish health effects of blowing dust.	County health offices, Ext. Ser. SWCD's, NMED
Drought induced temperature extremes produce extreme living conditions for both rural and urban residents	1. Develop information program to provide living guidelines and alternatives to enable residents to cope with extreme conditions. 2. Develop partnerships with energy and telephone companies to use billing statements as conduit for public service health information.	County health office, NMED
Many rural domestic water and sewage systems experience system failures when operating for extended periods of drought induced operation	1. Develop list of current rural water systems which have historically experienced operational problems. 2. Develop operational hotline communication system with these system operators, and use NMRWA newsletter and training sessions to emphasize correction of system deficiencies. 3. Develop plan of possible actions for each problem system, which might include increased storage, increased pumping capacity, and system retrofit. 4. Develop emergency fund for use of these systems to install emergency measures. 5. Emphasize planing and implementation of water conservation measures and drought contingency plans. 6. Investigate alternatives for emergency water rights transfers for rural water systems.	NM Rural Water Assn., NMNG, NMED, BIA NM Water Conservation Alliance NMOSE, NMISC

DRINKING WATER, ENERGY, AND HEALTH IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 2

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Due to drought, many municipal water systems experience potable water demand and sewage quality disposal problems	1. Emphasize water conservation measures in municipalities by use of on-going programs and NM Water Conservation Alliance resources. 2. Develop partnerships with energy companies to use energy billings to distribute water conservation and drought related information with billing statements. 3. Emphasize long and short term drought contingency plans for all municipal systems and in long range water resource plans. 4. Investigate alternatives for emergency water rights transfers for municipal water systems.	NM Water Conservation Alliance, NMOSE, Local energy companies, municipal water system operators NMISC NMOSE
Increased presence of large industrial water users may overdraft available aquifers during periods of drought	1. Develop list of large industrial water users and their suppliers in the state. 2. Develop partnerships between industrial users and municipal suppliers to implement appropriate water conservation guidelines for targeted industrial users.	NM Water Conservation Alliance NMOSE NM Assoc. of Commerce and Industry, NM Municipal League
Increased electrical usage in both rural and urban sector may create overloads on available electrical grid network	1. Develop working partnerships with local urban and rural power suppliers to cooperate in providing energy and water conservation guidelines to public. 2. Use electrical company billings as method of getting printed conservation material to public. 3. Encourage energy, telephone, and mining companies to cooperate in	SWCD's, NM Water Alliance, Local power, energy, mining and communication companies, NMOSE

	3. Encourage energy, telephone, and mining companies to cooperate in the funding of water and energy conservation radio and TV spots	

WILDLIFE AND WILDFIRE IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 1

IMPACT	PLANNED ACTIONS	RE
An assessment of drought-related environmental impacts should be conducted for the state to define qualitatively and quantitatively problems for planning purposes and critical decision making.	The assessment will be conducted to: 1. Identify baseline conditions, major potential impacts, and offer an evaluation of findings and considerations of alternatives to alleviate negative impacts. 2. Identify alternatives that involve systems control should be evaluated for their: speed (how quickly stressors or disturbances can be eliminated), precision (the ability to achieve a desired outcome), reliability (conditions under which management approaches succeed or fail), and cost efficiency. 3. Summarize findings and present in regional management plans. 4. Direct effort toward establishment of site-specific assessment categories, criteria and standards for the comprehensive and efficient inventory, monitoring and evaluation of fishery resources. Likewise, efforts will be directed toward extending site-specific assessment to a regional framework in the form of Indices of Biotic Integrity as an aid to biological assessment. 5. Enable NMDGF to analyze contemporary fish distributions with respect to a large suite of environmental variables to establish sensitive, objective indicators of accumulative stress at the community level of ecological organization. 6. Enable NMDGF biologists to perform a regional assessment of the fish fauna of New Mexico to provide a statistical description of historical fish faunal change to reveal aquatic areas most vulnerable to environmental stressors, including those associated with drought conditions.	1, 2 12,
During periods of drought, reduced in-stream flow may affect endangered species of aquatic plants and animals.	1. Prior to drought, develop prioritized list of possible drought affected habitats for endangered species of aquatic plants and animals. 2. Based on priority areas, develop alternatives for sustaining existing habitat or developing emergency habitats for targeted species. 3. Prior to drought, initiate partnerships with local water users and regulatory agencies in priority areas to develop emergency alternatives for in-stream flow manipulation.	ALL
During periods of drought, low stream or lake levels may cause fishing opportunities to diminish.	1. Develop partnerships with major water users to develop alternatives for providing emergency water transfers to affected lakes and/or streams.	1, 2

	affected lakes and/or streams.	
Reduction in income on private drought affected fish and wildlife-based enterprises	• Develop economic analyses, by climatic regions, to reflect reduced private hunting and fishing revenues for 25%, 50%, 75% reduction in hunting and fishing opportunities. • Provide enterprise stabilization training sessions for private fish and wildlife-based enterprises, emphasizing drought contingency planning for the enterprise.	13

*1 –NM DEPT GAME & FISH; 2 – US FISH & WILDLIFE SERVICE; 3 – US FOREST SERVICE; 4 – NM ENVIRONMENT DEPARTMENT - EPA; 5 – NM DIV OF FORESTRY; 6 – NM STATE ENGINEER;
7 – FED WATER DEVELOPMENT AGENCIES; 8 – LOCAL WATER USERS ASSOCIATIONS; 9 – NM STATE LAND OFFICE; 10 – BUREAU OF INDIAN AFFAIRS; 11 – BUREAU OF LAND MANAGEMENT;12 – INTERSTATE STREAM COMMISSION; 13 – ECONOMIC DEVELOPMENT & TOURISM; 14 - NATIONAL PARK SERVICE.

WILDLIFE AND WILDFIRE IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 2

IMPACT	PLANNED ACTIONS	RE
While flows may be adequate to sustain aquatic plants and animals during the irrigation season (except when flows are excluded from natural channels), they often become critically low at other times. Extensive manipulation of flows through large reservoirs and irrigation canals serves to disrupt the continuity of aquatic habitats in time and space, often precluding the existence of an attractive perennial fishery. Habitat simplification and fragmentation often results from regulated flows leading to altered ecological functions, different levels of biological organization, and reduced biological diversity. This may also contribute significantly to the demise of numerous taxa of fish.	1. Several alternative approaches exist for the establishment of in-stream flows that would sustain aquatic life forms, including during periods of drought. These alternative approaches should be assessed for their applicability to different situations and locations in New Mexico, with emphasis on areas of impaired habitat and areas vulnerable to cumulative stress. 2. Initiate discussions with local water users in priority areas to assess alternatives for in-stream flow.	ALL
Many populations of big game species respond to drought conditions through reduced reproductive and survival rates and increased mortality rates. Land uses such as livestock grazing can exacerbate the effect of drought through competition for limited resources. Hunting, especially of females, can also exacerbate the impact for many big game species. Hunting opportunities may diminish due to lack of food and water for affected species. Drought conditions may reduce the amount of available wildlife drinking water, affect the amount of usual food supply for wildlife species and may cause species to migrate to areas of adequate food and water. Drought conditions may also reduce grain production at waterfowl preserves. All of these items may increase the incidence of wildlife depredation on private interests.	1. Examine alternatives for reducing competitive land uses during periods of drought. 1. Consider elimination of hunting female mule deer and other big game species during periods of drought. 1. Develop priority list of waterfowl preserves vulnerable to drought induced feedstock reductions. From priority list, develop waterfowl feeding alternatives, including local farmer emergency agreements. 1. Continue NMDGF wildlife depredation program. 1. Emphasize public education programs to address wildlife survival and hunting restrictions during drought. 1. Prior to drought, determine the effect of alternative hunting seasons on the compensatory response of populations of drought affected species.	1, 2

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7 – FED WATER DEVELOPMENT AGENCIES; 8 – LOCAL WATER USERS ASSOCIATIONS; 9 – NM STATE LAND OFFICE; 10 – BUREAU OF INDIAN AFFAIRS; 11 – BUREAU OF LAND MANAGEMENT; 12 – INTERSTATE STREAM COMMISSION; 13 – ECONOMIC DEVELOPMENT & TOURISM; 14 - NATIONAL PARK SERVICE.

WILDLIFE AND WILDFIRE IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 3

IMPACT	PLANNED ACTIONS	RE
Fish habitat conditions may deteriorate at some sites during times of drought and preclude recreational fishery management programs that are reliant on hatchery produced fish. There may be insufficient water to produce fish at existing hatcheries.	1. If necessary, temporarily curtail fish stocking programs where habitat conditions become unsuitable for species of stocked fish. 2. If necessary, curtail hatchery production and reallocate inventory of fish to alternative recreational fishing sites. 3. Reengineer hatchery water delivery systems to provide technical solutions to possible water quality problems.	1, 2
Loss or impairment of fish and wildlife resources, fragmented ecosystems and animal populations; altered ecosystem functions and energy pathways; reduced productivity.	1. Implement corrective and compensatory adjustments through fishing and hunting regulations 2. Conduct public education programs.	1, 2
Unfavorable public opinion and public concern about fish and wildlife conservation and preservation, along with environmental protection.	1. Enhance sport-fishing opportunities by stocking hatchery-produced fish where habitat conditions permit. 2. Employ aquaculture to secure and enhance the status of nongame species of fish including state and federal listed engangered species.	1, 2
Increased wildfires on private and public lands may present hazards to land users and public domain natural resources. However, wild fire suppression can negatively affect habitat suitability for many species.	1. Review existing Initial Attack Trade-Off Agreements and modify as necessary. 2. Employ managed and prescribed fires to reduce fuel loading and to restore the structure and dynamic functions of natural ecosystems. 3. Use wildfire and controlled fire as a management tool to improve habitat quality for select big game species as appropriate. 4. By use of Public Service Announcements emphasize existing Southwest Area Coordination Center Webpage as source of statewide fire danger information. 5. At onset of "Alert Level" of drought, initiate accelerated public wildfire awareness program in areas targeted by Southwest Area Monthly Fire Potential Assessments. 6. Implement fire control procedures as outlined in Southwest Area Mobilization Guide and Southwest Fire Management Board Handbook.	1, 3 14

*1 –NM DEPT GAME & FISH; 2 – US FISH & WILDLIFE SERVICE; 3 – US FOREST SERVICE; 4 – NM ENVIRONMENT DEPARTMENT - EPA; 5 – NM DIV OF FORESTRY; 6 – NM STATE ENGINEER;
7 - FED WATER DEVELOPMENT AGENCIES; 8 – LOCAL WATER USERS ASSOCIATIONS; 9 – NM STATE LAND OFFICE; 10 – BUREAU OF INDIAN AFFAIRS; 11 – BUREAU OF LAND MANAGEMENT;12 – INTERSTATE STREAM COMMISSION; 13 – ECONOMIC DEVELOPMENT & TOURISM; 14 - NATIONAL PARK SERVICE.

TOURISM AND ECONOMIC IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 1

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Public's negative perception of drought situation in state will have negative effect on tourism	1. Develop PSA's to counteract negative reactions against drought. PSA's should emphasize state's natural beauty and wide diversity of activities and attractions. 2. Develop and maintain positive and accurate telephone hotline information that presents positive reactions to drought problems. 3. On existing Tourism and State Parks Websites, attach links to Drought Info Website and emphasize tourism alternatives.	NM Dept.of Tourism NM State Parks Div., NM Division of Forestry
Reduced livestock forage available to Economically Stressed Ranchers will have negative effects on economic situation of counties with high percentages of these agricultural operations	1. Develop, prior to drought, economic impact analysis for Rio Arriba, Taos, San Miguel and Mora counties which analyzes impacts of reduced grazing on federal and state leases on Economically Stressed Ranchers.. 2. Develop partnership with Forest Service, BLM and SLO to pursue emergency income generating projects for the above mentioned counties to overcome effects of drought. 3. Prior to drought, develop statewide economic impact of reduced grazing.	NM Extension Service NM Econ. Dev, Forest Service, BLM, SLO, Ext. Service, NMDPS
Crop failures in counties with high percentages of dry cropland acreage will have negative effect on economy of county and state	1. Prior to drought, develop economic impact analysis of reduced dry cropland yields and possible county wide dry cropland failures for Curry, Roosevelt, Quay and Union counties. 2. From these analyses, prepare adequate data to be used by Governor's office to justify any of these counties as Federal Disaster Areas.	NRCS, NM Ext. Service, Econ. Dev., FSA
Reduction in statewide revenues due to reduced sales of hunting and fishing licenses and big game availability	1. Develop economic analysis to evaluate impact of reduced license fees on state government and reduced statewide hunting activities on state, private and federal lands. 2. Assist state government prepare necessary documentation for possible emergency supplemental funding of NM Dept. of Game and Fish during prolonged drought conditions.	Econ. Dev., NM Dept. of Game and Fish, USFWS, NM Ext. Service
Drought may have negative economic impact on tourism industry	1. Using existing tourism economic impact assessments, determine which sectors of tourism will be affected by drought.	NM Dept. of Tourism NM Econ. Dev.

industry	which sectors of tourism will be affected by drought. 2. Develop alternative crisis plans for assisting drought affected tourism businesses and develop diversification alternatives for affected businesses.	NM Econ. Dev.

TOURISM AND ECONOMIC IMPACT ASSESSMENT SUB-GROUP

PLANNED MITIGATION ACTIONS

SHEET NO. 2

IMPACT	PLANNED ACTIONS	RESPONSIBLE AGENCY
Decreased irrigation water will reduce irrigated crop yields and have negative impact on county	1. Prior to drought, develop economic impact format for analysis of irrigated cropland failures for major counties using surface water sources (Dona Ana, Chaves, Eddy, Quay, Socorro, San Juan) 2. From these analyses, have adequate available to justify Governor's asking for any one of these counties to be declared a Federal Disaster Area.	Econ. Dev., Ext. Service, FSA
Increased fire danger and low lake levels in National Forests, State and National Parks will decrease user days and affect the income from these parks and also the economy of the county in which the park or forest is located	1. Prior to drought, develop visitation analysis can be used to analyze impact of drought on visitation revenue. 2. Develop series of PSAs to inform public as to current hazards and water levels to inform of the availability of public and private recreation alternatives.	Forest Service, NPS, NM State Parks Div. NM Tourism Dept.
High cost of feedstocks for dairies and feedlots will decrease profits from these operations and have negative impact on economy of county and state	1. Prior to drought, develop economic analysis to determine impact of increased feedstock costs for dairy and feedlot operations in Curry, Union, Roosevelt, Chaves, and Dona Ana counties.	Econ. Dev., Ext. Service, NMDA
Lack of adequate in-stream flow will negatively affect sport fisherman-days and have negative effect on state's economy	1. Prior to drought, develop user-days analysis for each major fishery stream system that can be used to analyze effect on each local county economy. .	Fish & Wildlife Service, NM Game & Fish, NM Tourism Dept.

Drought Planning Group Members

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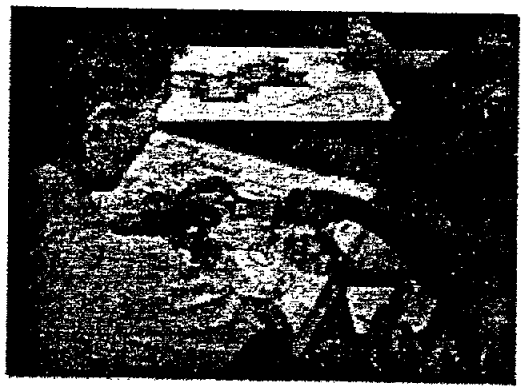
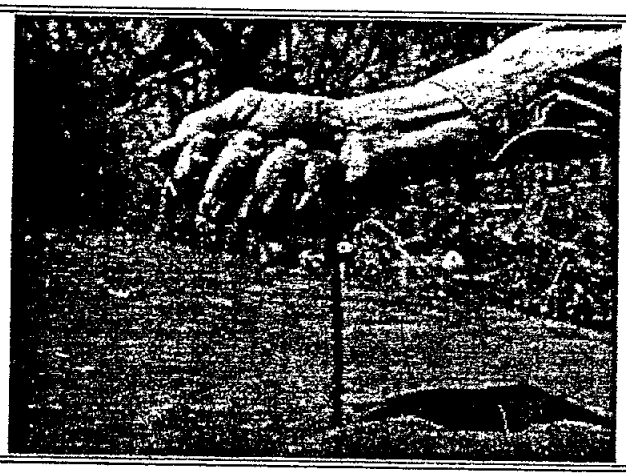
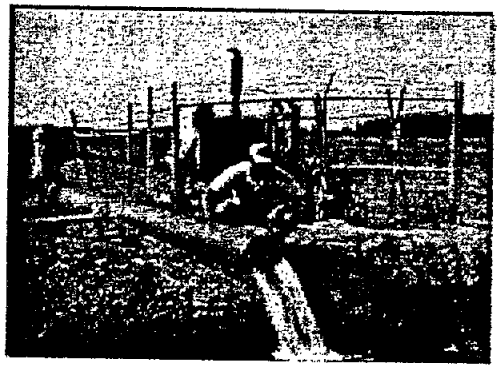
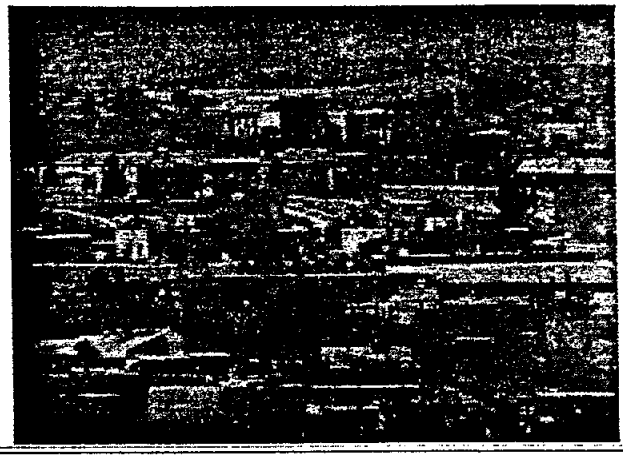
New Mexico Drought Task Force	
Monitoring Work Group	
Agricultural Impact Assessment Sub-Group	

Drinking Water, Energy & Health Impact Assessment Sub-Group	
Wildlife & Wildfire Impact Assessment Sub-Group	
Tourism & Economic Impact Assessment Sub-Group	

NEW MEXICO DROUGHT TASK FORCE

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Jennifer Salisbury	Energy, Minerals & Natural Resources Dept. 2040 S. Pacheco Santa Fe, NM 87505	505-827-5950	505-827-1150	jsalisbury@state.nm.us
Thomas Turney	ONMSE P.O. 25102 Santa Fe, NM 87504-5102	505-827-6091	505-827-6188	tturney@seo.state.nm.us
Frank DuBois	NM Dept. of Ag. Box 30005 MSC 3189 Las Cruces, NM 88003	505-646-3007	505-646-8120	fad@nmda-bubba.nmsu.edu
Ernesto Rodriguez	Dept. of Public Safety 13 Bataan Blvd. P.O. 1628 Santa Fe, NM 87504-1628	505-476-9606	505-476-9637	erodriguez@dps.state.nm.us

MONITORING WORK GROUP

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
David Lucero, Chairperson	NM Dept. of Ag. MSC 5600 Box 30005 Las Cruces, NM 88001	505-646-4929	505-646-3303	dlucero@nmda-bubba.nmsu.ed
Charlie Liles	National Weather Service 2341 Clark Carr Loop, SE Albuquerque, NM 87106	505-243-0702	505-244-9151	charlie.liles@noaa.gov
Dan Murray	USDA-NRCS 6200 Jefferson, NE Albuquerque, NM 87109	505-761-4436	505-761-4462	dmurray@nm.nrcs.usda.go
Scotty Abbott	USDA-FSA 6200 Jefferson, NE Albuquerque, NM 87109	505-761-4912	505-761-4934	Scotty.Abbott@bbs.fsa.usda.go
Scott Waltemeyer	USGS 4510 Indian School, NE Albuquerque, NM 87110	505-262-5353	505-262-5398	sdw@usgs.gov
Ted Sammis	NMSU Agr. & Hort. Dept. Box 30003-MFC3Q Las Cruces, NM 88003	505-646-2104	505-646-6041	tsammis@murphie.nmsu.ed
Paula Buchwald	Dept. of Public Safety P.O. 1628 Santa Fe. NM 87504	505-827-3361	505-827-3434	pbuchwald@dps.state.nm.us
Jerry Wall	USDI-BLM 435 Montano, NE Albuquerque, NM 87107	505-761-8750	505-761-8911	jwall@twrol.com

Dick Kreiner	Corps of Engr. 4101 Jefferson Plaza, NE Albuquerque, NM 87109	505-342-3383	505-342-3195	R.D.Kreiner@usace.army.m

AGRICULTURAL IMPACT ASSESSMENT SUB-GROUP

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Donald Lopez-Chairperson	ONMSE P.O. 25102 Santa Fe, NM 87504	505-827-6139	505-827-6188	lopez_don@seo.state.nm.us
Scotty Abbott	USDA-FSA 6200 Jefferson, NE Room 211 Albuquerque, NM 87109	505-761-4912	505-761-4934	Scotty.Abbott@bbs.fsa.usda.go
Ricardo Rel	NM Dept of Ag. MSC-3GSD P.O. 30005 Las Cruces, NM 88003-8005	505-646-5340	505-646-1774	RRel@nmda-bubba.nmsu.ed
Charlie Jankiewicz	UDSA-FS 1474 Rodeo Road Santa Fe, NM 87504	505-438-7828	505-438-7834	cjankiew/r3_santafe@fs.fed.us
Viola Sanchez	USDI-BOR 505 Marquette, NE Suite 1313 Albuquerque, NM 87102	505-248-5388	505-248-5356	vsanchez@uc.usbr.gov
Bernie Chavez	USDI-BLM P.O. 27115 Santa Fe, NM 87502	505-438-7668	505-438-7426	bchavez@nm.blm.gov
Robert Jenks	NM State Land Office P.O. 1148 Santa Fe, NM 87504-1148	505-827-5793	505-827-5711	rsjslo@nm-us.campus.mci.ne
Paul Guiterrez	NM Farm & Ranch Bureau 12304 Morrow, NE Albuquerque, NM 87112	505-875-6042	505-883-9564	paulg@rt66.com
Debra Hughes	NMACD 163 Trail Canyon Rd. Carlsbad, NM 88220	505-981-2400	505-981-2422	swcd@carlsbadnm.com
Jimmie Hall	Albuq. Prod. Credit 3915 Carlisle,	505-883-5600	505-883-7395	jchall3694@aol.com

	NE Albuquerque, NM 87190			
Bob Grieve	NM Emerg. Mgt. 13 Bataan Blvd. P.O. 1648 Santa Fe, NM 87504	505-476-9611	505-476-9637	bgrieve@dps.state.nm.us
Craig Runyan	NM Coop Ex.Service P.O. 30003 Dept. 3AE NMSU Ext. Plant Sci. Las Cruces, NM 88003	505-646-1131	505-646-8085	crunyan@nmsu.edu
George Chavez	USDA-NRCS 6200 Jefferson, NE Albuq.,NM 87109	505-761-4421	505-761-4462	fchavez@nm.nrcs.usda.gov

DRINKING WATER, ENERGY AND HEALTH IMPACT ASSESSMENT SUB-GROUP

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Alice Darilek, Chairperson	ONMSE P.O. 25102 Santa Fe, NM 87504-5102	505-827-3879	505-827-4692	adarilek@seo.state.nm.us
Don Soards	Corps of Engr. 4101 Jefferson Place, NE Albuquerque, NM 87109	505-342-3269	505-342-3499	don.e.soards@spa01.usace.army.mil
John Tobey	EMS Bureau NM Health Dept. P.O. Box 26110 Santa Fe, NM 87501-6110	505-476-7000 Ext. 124	505-476-7010	johnt@doh.state.nm.us
Col. Barry Stout	NM National Guard 47 Bataan Blvd. Santa Fe, NM 87505-4695	505-474-1290	505-474-1543	stoutbf@nm-arng.ngb.army.mi
Erik Galloway	NMED-Surface Water Quality P.O. 26110 Santa Fe, NM 87502	505-827-2923	505-827-0160	erik_galloway@nmenv.state.nm.
Bill Ewing	NM Emerg. Mgt. P.O. 1628 Santa Fe, NM 87504	505-476-9615	505-476-9637	bewing@dps.state.nm.us
Connie Amidon	NM Health Dept. Behavioral Services Division P.O. 26110 Sante Fe, NM 87501	505-827-2656	505827-0097	camidon@doh.state.nm.us
Terri Baker	NM Rural Water Users Assoc. 3413 Carlisle, NE Albuquerque, NM 87110	505-884-1031	505-884-1032	nmrwassoc@aol.com
Joe Quintana	MRGCOG	505-247-1750	505-247-1753	jquintana@mrgcog.org

	317 Commercial, NE Suite 300 Albuquerque, NM 87102			
Keith Melton	NMED – Drinking Water Bureau P.O. 26110 Santa Fe, NM 87502	505-827-1400 Ext. 1041	505-827-7545	keith_melton@nmenv.state.nm.u
Richard Leonard	Energy, Minerals, & Nat. Resources Dept. 2040 S. Pacheco Santa Fe, NM 87505	505-827-1368	505-827-1149	rleonard@state.nm.us
Brian Lee	Office of Indian Affairs 228 E. Palace Ave. Santa Fe, NM 87401	505-827-6440	505-827-6445	balee@nm-us.campus.mci.net

WILDLIFE AND WILDFIRE IMPACT ASSESSMENT SUB-GROUP

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Michael Hatch Chairperson	NM Dept. of Game & Fish P.O. 25112 Santa Fe, NM 87504	505-827-7905	505-827-7915	mhatch@state.nm.us
Sheila Guinn	NM Emerg. Mgt. P.O. 1628 Santa Fe, NM 87504	505-476-9614	505-476-9637	sguinn@dps.state.nm.us
Dan Murray	USDA-NRCS 6200 Jefferson, NE Albuquerque, NM 87109	505-761-4436	505-761-4462	dmurray@nm.nrcs.usda.gov
Mike Matarrese	USDA-Forest Service 1474 Rodeo Rd. Santa Fe, NM 87504	505-438-7851	505-438-7834	amatarrese@aol.com
Rich Schwab	USDI-BIA P.O. 1667 Albuquerque, NM 87103	505-766-3043	505-766-3787	richard_schwab@mail.bia.go
Bernie Chavez	USDI-BLM P.O. 27115 Santa Fe, NM 87502	505-438-7668	505-438-7426	bchavez@nm.blm.gov
Robert Jenks	NM State Land Office 310 Old Santa Fe Trail P.O. 1148 Santa Fe, NM 87504-1148	505-827-5793	505-827-5711	rsjslo@nm-us.campus.mci.n
Paul Tashjian	USDI-FWS P.O. 1306 Albuquerque, NM 87103	505-248-7958	505-248-7950	paul_tashjian@fws.gov
Frank Smith	NM Div. of Forestry P.O. 1948 Santa Fe, NM 87504	505-827-5838	505-827-3903	fsmith@state.nm.us
Brian Lee	Office of Indian Affairs 228 E. Palace Ave. Santa Fe, NM 87401	505-827-6440	505-827-6445	balee@nm-us.campus.mci.m

Charles Denton	USDA-Forest Service 517 Gold, SW Albuquerque, NM 87102	505-842-3418	505-842-3806	cdenton/r3@fs.fed.us

TOURISM AND ECONOMIC IMPACT ASSESSMENT SUB-GROUP

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Geraldine Lynch-Brown Chairperson	State Parks Division 2040 S. Pacheco Santa Fe, NM 87505	505-827-5939	505-827-1376	gbbrown@state.nm.us
Rob Galbaldon	NM Dept. of Development 1100 St. Francis Dr. Santa Fe, NM 87505	505-827-1734	505-827-0407	robert@edd.state.nm.us
Bob Queen	NM Dept. of Development 1100 St. Francis Dr. Santa Fe, NM 87505	505-827-0227	505-827-0407	robertq@edd.state.nm.us
Gary Romero	NM Dept. of Tourism 491 Old Santa Fe Trail Santa Fe, NM 87501	505-827-7307	505-827-7402	tourismmedia@nm-us.campus.mci.n
Cecilia Matic	National Park Service P.O. 728 Santa Fe, NM 87504	505-988-6014	505-988-6013	cecilia_matic@nps.gov
Craig Runyan	NM Ext. Service P.O. 30003 Dept. 3AE NMSU Ext. Plant Sci. Las Cruces, NM 88003	505-646-1131	505-646-8085	crunyan@nmsu.edu
Ken Britt	Living Desert State Park P.O. 100 Carlsbad, NM 88220	505-887-5516	505-885-4478	livingdesert@caverns.com
Bob Grieve	NM Emerg.Mgt. 13 Bataan Blvd. P.O. 1628 Santa Fe, NM 87504	505-476-9611	505-476-9637	bgrieve@dps.state.nm.us

Federal Drought Relief Programs

11A

This Section provides a comprehensive list of available Federal assistance programs and sources that may be utilized to prevent or mitigate the impacts of a drought event.

This list is available from the Website of the Western Drought Coordination Council at

- Catalog of Federal Assistance Programs (requires PDF reader)

We are currently working on converting the PDF files from this to html format
you may browse or download these files from the above site
but you will need Adobe Acrobat Reader to view them.

- Explanations of Federal Assistance Programs

A specific listing of Disaster Assistance Available from the United States Department of Agriculture is available from the USDA Website at

- http://www.usda.gov/da/disaster.html

The listing of a program in the Appendix does not guarantee that the program is currently active,
as funding availability may vary according to allocations from Congress. Interested parties should
contact the agency involved for details and application procedures.

New Mexico Disaster Relief Assistance Fund

11B

NEW MEXICO DISASTER ASSISTANCE PROGRAM

Under the State Constitution, the State is prohibited from rendering direct financial assistance to the private sector. Federal assistance may be available to private individuals and businesses if a disaster of sufficient magnitude results in a federal disaster declaration. However, the State of New Mexico, through the Governor's Disaster Assistance Program, can provide disaster recovery funding on a 75/25 cost-share basis to political subdivisions of the State and to certain non-profit organizations serving a governmental function. The Local Government Handbook provides detailed information on the procedures and eligibility for these funds. An overview of the program is summarized below.

Statutory Authority: The State Disaster Relief Act provides for assistance to local governments and other eligible public entities when there are emergencies or disasters which cannot be resolved by local sources. The Act requires a declaration of disaster by the Governor before these resources can be made available. The Governor's Authorized Representative (GAR) will consider requests for disaster declaration and make a recommendation to the Governor.

Applicants Eligible: Applicants include political subdivisions of the state; county governments, incorporated municipalities, community ditch associations (acequias), municipal domestic water users, private non-profits performing a public service, and public school districts.

Damage Criteria: Damages to public property and infrastructure caused by emergencies or disasters for which recovery is beyond the financial capability of the local entity are eligible for assistance under this program. The Disaster Assistance Program has not been called on in the past to assist in recovery of damages to public property caused by droughts. However, program officials will work with local emergency managers to assist local governments in determining eligibility or damage on a case-by-case basis.

Governor's Policy on Use of Funds: Prior to recommending a disaster declaration, the GAR will coordinate maximum response by all appropriate state agencies and available state resources. When a disaster declaration is made by executive order, the state agencies and resources will still be considered the primary response assets and expenditures within the legal limit of $750,000 will be kept to a minimum. The GAR will, in considering program applicants, reject any requests for reimbursement when state agencies and resources were available but not utilized. When a state agency provides significant in-kind relief in lieu of force account or contractual services being used, that state agency may become a program applicant for reimbursement of disaster funds.

For More Information: The Disaster Assistance Program Local Government Handbook provides procedures and eligibility requirements and is designed to assist with the effective administration of an emergency response, as well as expedite the repair and restoration of damage once the declared disaster has passed.

For copies of the Local Government Handbook or More Information, contact:

Disaster Assistance Program Office
Response and Recovery Section
NM Department of Public Safety
P.O. 1628
Santa Fe, NM 87504-1628

505-476-9600 or 476-9610

Agricultural Federal Disaster Process

12A

THE PROCESS FOR NATURAL DISASTER DECLARATIONS BY THE US DEPARTMENT OF AGRICULTURE

A disaster declaration by the Secretary of the US Department of Agriculture (USDA) triggers the availability of emergency loans and other USDA emergency assistance programs. A natural disaster declaration must be requested by the governor and based primarily upon agricultural losses.

The communication among state government officials and the USDA Farm Services Agency (FSA) begins well in advance of a disaster of sufficient magnitude to trigger a declaration. The process for initiating a USDA Natural Disaster Declaration begins when the county level office of FSA provides impact reports to the FSA state headquarters in Albuquerque. These reports quantify the actual number of farmers/ranchers impacted, animals lost, acreage/crops destroyed and dollar losses, with an emphasis on the significant impact the disaster has and will have on a major critical industry in the state. At this stage, it is critical for local framers and ranchers to work closely with their county Food and Agricultural Committees (FAC) and County Emergency Boards (CEB) to provide impact assessments and other information.

Once the county FSA reports indicate a disaster of sufficient magnitude state government officials recommend that the Governor request an agricultural disaster declaration, in writing, from the Secretary of Agriculture. This letter describes the losses for which the declaration request is based and to which counties the declaration applies. Upon receipt of the Governor's request, the Secretary Of Agriculture may need 60-90 days, or more, before the declaration is made and assistance becomes available.

For Further Information, contact:

Disaster Assistance Program Office
Response and Recovery Section
NM Department of Public Safety
P.O. 1628
Santa Fe, NM 87504-1628
505-476-9600 or 476-9610

and/or

USDA Farm Services Agency
6200 Jefferson, NE
Albuquerque, NM 87109
505-761-4900

Sample Request For Agricultural Disaster Declaration

12B

Mr. Dan Glickman, Secretary
U.S. Department of Agriculture
Office of the Secretary
Washington, D.C. 20250-0500

Dear Secretary Glickman:

Close monitoring by the State's Natural Hazards Bureau, National Weather Service and the State/County Farm Service Agency offices (FSA), has verified the devastating effect of the current drought on New Mexico's agricultural community. The lack of any beneficial moisture, coupled with very high temperatures and constant winds has severely affected New Mexico's agricultural producers in Chaves, Colfax, Curry, DeBaca, Eddy, Harding, Lea, Quay, Roosevelt and Union Counties.

USDA Flash Reports and Potential Natural Disaster Damage Assessment Reports provided by your local FSA Office in Albuquerque indicate financial damage far in excess of $60,350,9000 .

Pasture losses, dry-land crop losses and reduction in irrigated crop yields continue to occur on approximately 15,386,174 acres in Eastern New Mexico. So far the Reports document damage to 5,965 individual farms and ranches; 2,796 with losses to 60%, 2,058 with losses from 60-80%; 1,111 with losses in excess of 80%.

Spring seeded crops were not planted on non-irrigated fields, livestock producers have continued to supplement cattle all summer, many operators were forced to relocate their cattle and heavy culling of foundation herds are taking place.

Continuous irrigation is generally unable to keep up with crop demand, the continuous, hot dry wind has caused damage to ALL crops, and conditions will not allow the planting of the 1999 wheat crop and other grain/forage crops.

Because of the complex effect of the drought, a total estimate of economic losses suffered in Chaves, Colfax, Curry, DeBaca, Lea and Roosevelt counties is unavailable at this time. The losses are devastating however.

From the severe economic damage documented in the Flash Reports, you can understand why I am so concerned about the financial health of our agricultural producers in these ten counties.

Therefore, the State of New Mexico respectfully requests your resignation of Chaves, Colfax, Curry, DeBaca, Eddy, Harding, Lea, Quay, Roosevelt and Union Counties as disaster areas in order to make available the low-interest Emergency Loan Program, the Non-Insured Assistance Program, and any available Emergency Feed Program or any disaster programs which may become available, and technical/financial advice to New Mexico agricultural producers who have and are suffering tremendous economic losses.

We value the excellent working relationship we have with our State FSA Office and the U.S. Department of Agriculture. Thank you in advance for your assistance.

Sincerely,

Gary E. Johnson

Governor

Sample Drought Status/Monitoring Report

12C

SAMPLE DROUGHT STATUS/MONITORING REPORT

New Mexico Drought Monitoring Group
October 27, 1998

DROUGHT INDICATORS - October 1998

Division 1 - Indicators through September show the bottom extent of "normal" with a drying trend. PDSI weekly averages in October are running between -1 and -2.

Division 2 - Indicators through September show the dry side of normal. There has been little change in October with PDSI running zero to -1.

Division 3 - **Warning** category (PDSI) and Emergency category with respect to the SPI(-1.50 to -1.99 range). Greenness map accurately shows the northern part of division 3 has been wetter than the southern part. Weekly PDSI shows some improvement during October.

Division 4 - **Normal**

Division 5 - **Normal**

Division 6 - Reached the **Advisory** (incipient drought) stage in September. Weekly PDSI shows a continued drying trend with the index down to -2 on October 10. SPI is in the -1.0 to -1.49 range.

Division 7 - **Emergency** stage. Weekly PDSI shows little change, with index hovering around -4. SPI is in the -1.5 to -1.99 range.

Division 8 - Reached the **Advisory** (incipient drought) stage in September. Drying has continued in October, with the weekly PDSI below -2. SPI is in the -1.0 to 1.49 range.

September/October Precipitation

Approximately 90 percent of the state of New Mexico received below normal precipitation in September. Much of the Rio Grande Valley south of Taos received less than 25 percent of the normal precipitation, and some spots were less than 10 percent of normal. Much of the eastern plains received less than 50 percent of normal precipitation, with some spots as low as 5 and 10 percent. The northern portion of Division 2 fared better than the remainder of the state, with above normal precipitation. The area between Eagle Nest and Black Lake received about 200 percent of the normal September precipitation.

Forecasts

Short Term - After a dry nineteen days, the combination of a slow moving dynamic low pressure system over the Southwest U.S. and remnants of Hurricane Madeline has been bringing some rainfall to New Mexico. The first significant winter storm of the season should affect parts of New Mexico the week of October 26. With the present pattern, most areas of

New Mexico should see above normal precipitation the last week of October.

Long Term - The latest long-range forecast from the Climate Prediction Center (issued Oct. 15, 1998) shows greater than normal probabilities of above normal temperatures and below normal precipitation for New Mexico for the remainder of autumn 1998 through the spring of 1999. This is consistent with the forecasts issued for the time period over the past few months. This forecast is also very consistent with the development of a moderate La Nina. Historical data, while only including 8 to 10 La Ninas of the century, show that winter precipitation in New Mexico frequently averages on about 50 to 60 percent of normal during these events.

As of the end of August, New Mexico climate divisions 3 and 7 were in the **Warning** category. Division 3 had experienced a monthly average PDSI between -2 and -3 for two consecutive months, while the monthly PDSI for Division 7 had been between -2 and -3 for three consecutive months. Unless a widespread rain event occurs before the end of September. Division 7 will be in the **Emergency** category by the end of the month.

Summer Precipitation: For the June through August period, the statewide average precipitation for New Mexico was 105 percent of normal. Generally, most of the area north and west of a line from Raton-Las Vegas-Ruidoso-Orogrande had normal to above normal summer precipitation. Most of the area south and east of that line had a dry summer. Lowest (relative to normal) summer precipitation was in the extreme east and southeast, where the worst drought conditions had already developed. Much of the area southeast of a line from Carlsbad to Clovis received less than 50 percent of the normal summer rainfall.

Reservoir and General Agriculture Conditions: Major reservoirs throughout New Mexico remain at 95 percent of the 15 year mean. Reservoir levels along the San Juan River and Rio Grande decreased from last month, mainly due to heavy crop irrigation. The weekly Ag. Update is reporting similar drying conditions statewide. Soil moisture statewide is reported mostly short to very short. Crop conditions are in mostly good to fair conditions with the exception of sorghum which is mostly in poor condition as a result of the dry summer in eastern New Mexico.

Weekly Trends of PDSI: The entire state of New Mexico is in a drying trend. By September 21 (using preliminary numbers), the weekly PDSI was below zero in all but two divisions (4 and 5). A four-week running average of -1.4 places Division 8 in the **Advisory** stage at this time.

Streamflow Conditions/Other Indicators: Streamflow conditions on October 26, 1998 were indicative of other indicators. The Rio Grande Basin stream flows were running 79% of the long-term mean flow, while the Pecos River Basin was 61% of the long-term mean flow. All other basins were near average or above average, particularly the San Juan River which was 273 % of the long-term mean flow. According to USGS, these conditions as of Oct. 26, 1998, are indicative of the daily averages for October.

Sno-Tel sites are reporting near average precipitation throughout the state with the exception of the Gila and Mimbres areas which are approximately 50% of normal.

The Weekly Ag Update is reporting mostly very short to short soil moisture conditions throughout the state. The southeastern and southwestern parts of New Mexico are reporting the driest conditions at this time.

Sample Impact Action Report

12D

Agricultural Impact Assessment Sub-Group

July, 1998

Situation:

Drought **Emergency** Status in Zone 7 and **Warning** Status in Zone 3 have had the greatest effect on dry cropland and livestock operations.

The non-irrigated grain sorghum crop appears to be severely stunted in Zone 3 with many plants barely 3-6 " tall in many fields. Severe wind erosion hazards will exist is adequate plant cover is not obtained by the fall.

Irrigated alfalfa in Zone 7 has experienced a 10-20% decrease in yields due to hot, dry temperatures. Milk production in both zones had fallen 10-15% due to high heat stress on cows.

Users of surface irrigation water sources appear to be keeping up with higher than average crop demands but users of Ogallala aquifer water are experiencing marked declines in pumping levels and well yields.

Livestock producers are culling existing herds but depressed market prices are retarding the process.

Action/Progress Items:

1. Meetings of the local USDA Food and Agricultural Committees (FAC's) have been held for FAC members from all counties in both Zones 7 and 3 to discuss drought mitigation and action items.

2. FAC members are developing plans to approach local ministerial alliances and county health departments to address the need for support groups for agricultural producers.

3. Local Soil and Water Conservation Districts have been advised of the current and future severity of the drought in their districts and are adding developing partnerships with FAC members to conduct drought information meetings in their districts.

4. FAC members have distributed drought Public Service Announcement packages to radio stations in Clovis, Portales, Roswell, Artesia, Carlsbad, Lovington and Hobbs. Package has also been delivered to KBIM-TV in Roswell.

5. USDA-Farm Service Agency (FSA) staff instituted emergency grazing procedures in May for Cropland Reserve Program (CRP) lands in Curry, Roosevelt and Quay counties and are monitoring progress of procedures for possible extended use. USDA-Natural Resources Conservation Service (NRCS) staff have developed emergency grazing plans for these CRP fields and are assisting in field monitoring process.

6. UDSI-Bureau of Land Management (BLM) and State Land Office staff in Zone 7 are closely monitoring grazing of BLM and state lands and are evaluating the need for possible allotment

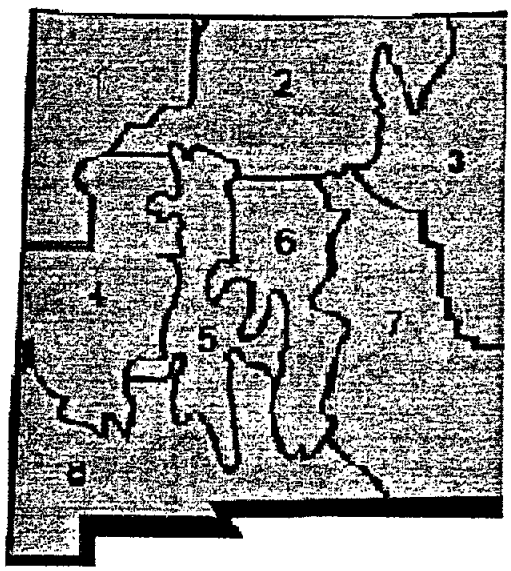
herd size reductions.

Sample Drought Notice

12E

Drought Notice

Climate Zone	Drought Status	Date Zone Entered Drought
1 (Northwest)	Normal	
2 (North Central)	Normal	
3 (Northeast)	Warning/**Emergency**	August 13, 1998
4 (West Central)	Normal	
5 (Rio Grande)	Normal	
6 (Central)	Advisory	October 26, 1998
7 (Southeast)	**Emergency**	August 13, 1998
8 (Southwest)	Advisory	October 26, 1998



Issued by _____, Monitoring Work Group Chair

Date:_____

Sample Drought Executive Order

12F

EXECUTIVE ORDER 98-41

WHEREAS, DROUGHT IS A NORMAL PART OF THE CLIMATE AND A PERIODIC OCCURRENCE IN NEW MEXICO AND DROUGHTS EXPERIENCED IN THE MODERN ERA PROVOKE CRISES THAT INCLUDE: EARLY AND SEVERE WILDFIRE SEASONS; DIRE CONDITIONS ON FARMS AND RANCHES THAT BRING ECONOMIC DEVASTATION AND HARDSHIP TO INDIVIDUALS AND COMMUNITIES; MEAGER TOURISM REVENUES CAUSED BY POOR WINTER SKI SEASONS AND REDUCED RECREATIONAL OPPORTUNITIES; SEVERE SHORTAGES OR EVEN FAILURES OF MUNICIPAL WATER SUPPLIES CAUSING IMPLEMENTATION OF WATER USAGE RESTRICTIONS; THE FURTHER DECLINE AND POSSIBLE EXTINCTION OF ENDANGERED FISH SPECIES AND STARVATION OF OTHER WILDLIFE; LACK OF POTABLE WATER SUPPLIES WITHIN TRIBAL AND RURAL COMMUNITIES; POTENTIAL HEALTH PROBLEMS CAUSED BY BLOWING DUST AND THE DECAYING CARCASSES OF LIVESTOCK STARVED TO DEATH DUE TO LACK OF FORAGE UPON WHICH TO GRAZE; AND MANY OTHER ECONOMIC, HEALTH AND ENVIRONMENTAL CONSEQUENCES; AND

WHEREAS, DROUGHT IS A NATURAL DISASTER THAT, UNLIKE FLOODS, TORNADOES, OR EARTHQUAKES, DOES NOT OCCUR IN A VIOLENT BURST BUT CREEPS UP IN AN ALMOST UNSUSPECTING MANNER AND SLOWLY MAKES ITSELF EVIDENT; AND MOREOVER, THE DURATION IS UNKNOWN; AT ANY TIME RAIN MAY FALL TO REPLENISH RESERVOIRS AND STREAMBEDS AND PROVIDE THE MOISTURE VEGETATION NEEDS TO GROW . . . OR IT MAY NOT; AND DUE TO THESE CHARACTERISTICS, RESPONSE TO DROUGHT AT ALL LEVELS OF GOVERNMENT HAS TYPICALLY BEEN SLOW AND FRAGMENTED, WITH LITTLE FOCUS ON PREPAREDNESS AND MITIGATION; AND

WHEREAS, I HAVE BEEN WORKING AS THE CO-CHAIR OF THE WESTERN DROUGHT COORDINATION COUNCIL AT THE REGIONAL LEVEL AND ANTICIPATE INVOLVEMENT IN THE YET-TO-BE ESTABLISHED NATIONAL DROUGHT POLICY COMMISSION TO WORK ON DROUGHT ISSUES AT THE NATIONAL LEVEL; AND

WHEREAS, THE OFFICE OF THE STATE ENGINEER, THROUGH FUNDING FROM THE U.S. BUREAU OF RECLAMATION, HAS DRAFTED THE "NEW MEXICO DROUGHT PLAN," WHICH IDENTIFIES THE CABINET SECRETARIES OF ENERGY, MINERALS & NATURAL RESOURCES, AND NEW MEXICO AGRICULTURE, THE STATE ENGINEER AND THE NEW MEXICO EMERGENCY MANAGER FROM THE DEPARTMENT OF PUBLIC SAFETY AS THE NEW MEXICO DROUGHT TASK FORCE TO LEAD THE STATE IN IMPLEMENTING THIS PLAN; AND

WHEREAS, THE ENTIRE STATE IS IN A CURRENT DRYING TREND WITH THE SOUTHEASTERN PORTION CURRENTLY EXPERIENCING A PROLONGED DROUGHT AND OTHER AREAS MOVING IN THAT DIRECTION AND THE LONG-TERM WEATHER FORECASTS SHOW BELOW AVERAGE PRECIPITATION AND ABOVE AVERAGE TEMPERATURES FOR NEW MEXICO THROUGH AT LEAST MAY 1999; AND IF THESE FORECASTS HOLD TRUE, MANY AREAS OF THE STATE DEPENDENT ON SURFACE WATER WILL ALSO BE FEELING THE STING OF THE DROUGHT DUE TO LOW SNOWPACK;

NOW, THEREFORE I, GARY E. JOHNSON, GOVERNOR OF THE STATE OF NEW MEXICO, BY VIRTUE OF THE AUTHORITY VESTED IN ME BY THE CONSTITUTION AND LAWS OF THE STATE OF NEW MEXICO, DO HEREBY DIRECT THE NEW MEXICO DROUGHT TASK FORCE TO PROVIDE FOR AN OPPORTUNITY FOR REVIEW AND COMMENT ON THE NEW MEXICO DROUGHT PLAN AND MAKE REVISIONS AS NECESSARY. I FURTHER DIRECT ALL STATE AGENCIES TO IDENTIFY AREAS OF VULNERABILITY WITHIN THEIR JURISDICTIONS AND TO WORK WITH THE DROUGHT TASK FORCE TO IDENTIFY AND IMPLEMENT STRATEGIES TO MITIGATE THEM. MOREOVER, GIVEN THAT DROUGHT MITIGATION AND RESPONSE EFFORTS HISTORICALLY HAVE BEEN INADEQUATE, I DIRECT THE TASK FORCE TO MAKE RECOMMENDATIONS TO THE GOVERNOR ON THE NATIONAL, REGIONAL AND INTERSTATE ADMINISTRATIVE AND LEGISLATIVE INITIATIVES THAT WILL FACILITATE THE MITIGATION OF VULNERABILITIES, IMPROVE PREPAREDNESS AND MAKE RESPONSES TO DROUGHT BY ALL LEVELS OF GOVERNMENT MORE EFFICIENT AND EFFECTIVE. FINALLY, I RECOGNIZE THE NEED FOR AND ENCOURAGE THE COUNTIES, MUNICIPALITIES AND EVEN INDIVIDUALS TO TAKE IT UPON THEMSELVES TO IDENTIFY THEIR VULNERABILITIES TO DROUGHT, PREPARE FOR AND, WHERE POSSIBLE, TAKE STEPS TO MINIMIZE THE IMPACTS OF DROUGHT BEFORE IT OCCURS.

ATTEST: DONE AT THE EXECUTIVE OFFICE

THIS 9TH DAY OF OCTOBER, 1998

WITNESS MY HAND AND THE GREAT

SEAL OF THE STATE OF NEW MEXICO

STEPHANIE GONZALES

SECRETARY OF STATE

GARY E. JOHNSON

GOVERNOR

APPENDIX T

Information Related to the Dairy Industry in Lea County

COOPERATIVE EXTENSION SERVICE

NEW MEXICO STATE UNIVERSITY

COLLEGE OF AGRICULTURE AND HOME ECONOMICS

COUNTY EXTENSION OFFICE

100 N. Main, Suite 10-C
Lovington, NM 88260
January 10, 2000

JAN 2000
RECEIVED

Mr. Dennis Holmberg
Lea County Manager
100 North Main, Suite 4
P. O. Box 2014
Lovington, NM 88260

Dear Mr. Holmberg:

1. 40,000 – Cows Total
   20,000 – Cows in Production
   5,000 – Dry Cows
   15,000 – Growing Heifers

2. It has been said that a cow in peak production during the hottest day of the year can consume 100 gallons of water per day. For the average a producing cow will consume 35 gallons of water per day, a dry cow will consume about 12 gallons of water per day and a growing heifer figuring all growth stages will average 9 gallons of water per day.

3. 40# D.M./day/producing cow
   25# D.M./day/dry cow
   12# D.M./day/growing heifer

D.M. of Alfalfa	90% = 45# of Hay = 40# D.M.
D.M. of Corn Silage	56% = 70# of CS = 40# D.M.
D.M. of Cotton Seed	89%
D.M. of Corn Grain	87%
D.M. of Brewers Grains	90%
D.M. of Hayledge – Alfalfa	44% = 90# Hayledge = 40# D.M.
D.M. of Wheat – Hayledge	34% - 118# Wheatledge = 40# D.M.

4. Alfalfa Hay – 4.5 to 6.0 tons/acre
   All hay – 3.9 tons/acres
   Corn Silage – 17 tons/acre
   Cotton – 1.21 bales/acre — Bale = 480#
   Milo = 52 bu/acre
   Wheat = bu/acre

5. The way I see it 3 acre-feet of water/year has to do it, no more.

Hay or alfalfa will not grow or produce year around, you can't plant each year due to cost of planting – alfalfa should last 5 years, 6 cuttings/year. Wheat, corn planted each year but needs to be rotated for best growth and production. Can't raise wheat and corn on same land because not enough time to allow for 25% maturity of each and make 2 silage crops. If it can be done, it should be done but then you will have to rotate with something else before long.

Juan's difference between total acreage and rangeland acreage is 281,152 acres. But within that 281,152 acres is 5 larger cities and townsites, plus numerous smaller villages such as Crossroads, Maljamar, Humble City, Knowles, Stateline and others. Prior to 1986, we had 119,240 acres of irrigable land since we've had conservation reserve in force we now have 83,500 acres of irrigable land.

Sincerely,

Wallace M. Cox

Wallace M. Cox
Lea County Extension Agent

SURESTE RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL, INC.
1700 South Main
Lovington, New Mexico 88260
(505) 396-2535 FAX (505) 396-5768

To: Dennis Holmberg, County Manager
Lea County Water User's Association
100 North Main, Suite 4
Lovington, New Mexico 88260

January 7, 2000

From: Juan Gauna, Coordinator
Sureste RC&D Council, Inc.
1700 South Main
Lovington, New Mexico 88260

RE: Lea County Acreage

The following figures were obtained from the USDA Natural Resources Conservation Service office here in Lovington.

Total Acreage in Lea County	2,811,520
Rangeland Acres	2,530,368
Cropland/other land	281,152

I am sending Wallace Cox these figures as well for his concurrence. If there is a discrepancy, please discuss the difference with Wallace.

Cc: Wallace Cox

LEEDSHILL – HERKENHOFF, INC. ENGINEERS ARCHITECTS ALBUQUERQUE • SANTA FE COMPUTATIONS	NAME OF PROJECT/CALCULATION: LEA COUNTY 40 yr PLAN			SHEET NO. 1 OF 2
	COMPUTED BY: JHM	CHECKED BY:	JOB/TASK NO.	DATE: 1/10/00

IDENTIFY/ADDRESS THESE ELEMENTS	1.0 SUBJECT	2.0 PURPOSE	3.0 REFERENCES	4.0 ASSUMPTIONS	5.0 CRITERIA / REQUIREMENTS
	6.0 SKETCHES	7.0 CALCULATIONS	8.0 CONCLUSIONS		9.0 ATTACHMENTS

REVISION #	SUPERSEDES CALC TITLE	CHECKED BY:	DATED

LEA COUNTY DAIRY INFORMATION: FROM MR. BOB CARTER – CITY OF LOVINGTON AS STATED BY BUSTER GIBBS AND OTHER DAIRY FARMERS SURVEYED

- ESTIMATED TOTAL COW POPULATION = 30,000 HEAD (INCLUDES MATURE & IMMATURE)
- ESTIMATED TOTAL MILKERS = 16,000 HEAD
- ESTIMATED 4,000 HEAD CATTLE INCREASE IN NEXT 5 YRS.
- EACH MILKING COW PRODUCES 70 LBS MILK / DAY
- CHEESE FACTORY REQUIRES 2 MILLIONS LBS. MILK PER DAY
- LEA COUNTY SUPPLIES 1.2 MILLION LBS. MILK PER DAY
- 0.8 MILLIONS LBS. MILK PROVIDED BY OTHER COUNTIES / STATES
- 10 PARTS MILK PRODUCES 1 PART CHEESE
- 60% OF MILK IN CHEESE PRODUCTION ENDS UP AS WASTE USED FOR IRRIGATION OR SENT TO WWTP.
- LEA COUNTY IMPORTS FEED FROM OTHER COUNTIES AND STATES TO SUPPLEMENT DAIRY HERD NEEDS
- DAIRY COW FEED CONSUMPTION PER DAY

  10 LBS. ALF.
  35 LBS. CORN
  5 LBS. WHEAT
  8 LBS COTTONSEED
  4 LBS. COTTON MILL
  5 LBS. COTTON BURR
  ---
  67 LBS. / COW / DAY

  MISC. ITEMS INCLUDE ADDITIVES SUCH AS BEET SUGAR, MOLASSES, SORGHUM
- FOR ESTIMATED 30,000 HEAD OF DAIRY CATTLE IN LEA COUNTY AND 67 LBS FEED/COW/DAY, 1000 TONS OF FEED IS REQUIRED EACH DAY
-

(CONT'D)

P:\ACAD\REV-SHT

DAIRY INFO. (CONT'D)

- AVERAGE FARM YIELDS IN LEA COUNTY

  CORN 22 TON/ACRE
  COTTON 1,000 LB./AC.
  ALFALFA 3.5 TONS/AC.
  WHEAT 30 BUSHELS/AC. (1 BUSHEL = 60 LBS)
  ∴ 1800 LBS./AC.
  SOME GAIN FROM GRAZING IN WHEAT FIELDS

- DAIRY WATER USE

  RUNOFF WATER REQUIRES A 3:1 MIX OF CLEAN WATER AND PROCESS WATER

  - TAKE 100 GALS./DAY/COW WATER USE INCLUDES
    20 GALS./COW CONSUMPTION AND
    80 GALS./COW RUNOFF WHICH IS USED FOR IRRIGATION/ETC.

P:\ACAD\REV-SHT

New Mexico Agricultural Statistics, 1998

Cattle and Calves: Number on Farms by County[1/]

County	All Cattle		Beef Cows		Milk Cows[2/]		Other Cattle[3/]	
	Head							
	1998[4/]	1999	1998[4/]	1999	1998[4/]	1999	1998[4/]	1999
Bernalillo	17,000	16,000	4,500	4,000	6,500	6,000	6,000	6,000
Catron	31,000	29,000	21,000	20,000	—	—	10,000	9,000
Chaves	155,000	162,000	37,000	36,000	67,000	76,000	51,000	50,000
Cibola	20,000	21,000	12,500	13,500	—	—	7,500	7,500
Colfax	54,000	56,000	20,000	23,000	—	—	34,000	33,000
Curry	135,000	143,000	15,000	16,000	24,000	21,000	96,000	106,000
De Baca	37,000	37,000	12,000	13,000	—	—	25,000	24,000
Doña Ana	77,000	75,000	7,000	7,000	38,000	35,000	32,000	33,000
Eddy	61,000	57,000	21,000	23,000	21,000	15,000	19,000	19,000
Grant	38,000	37,000	25,000	24,000	—	—	13,000	13,000
Guadalupe	33,000	31,000	17,000	16,000	—	—	16,000	15,000
Harding	40,000	41,000	22,000	24,000	—	—	18,000	17,000
Hidalgo	29,000	27,000	19,000	18,000	—	—	10,000	9,000
Lea	71,000	75,000	29,000	28,000	11,000	17,000	31,000	30,000
Lincoln	41,000	38,000	27,000	25,000	—	—	14,000	13,000
Luna	36,000	36,000	11,000	12,000	—	—	25,000	24,000
McKinley	41,000	39,000	17,000	16,000	—	—	24,000	23,000
Mora	26,000	24,000	12,000	11,000	—	—	14,000	13,000
Otero	24,000	23,000	14,500	14,000	—	—	9,500	9,000
Quay	75,000	77,000	31,000	34,000	—	—	44,000	43,000
Rio Arriba	30,000	29,000	16,000	15,500	—	—	14,000	13,500
Roosevelt	90,000	93,000	18,000	17,000	32,000	33,000	40,000	43,000
San Juan	35,000	39,000	17,000	18,000	—	—	18,000	21,000
San Miguel	55,000	53,000	29,000	28,000	—	—	26,000	25,000
Sandoval	24,000	22,000	8,000	10,000	2,200	—	13,800	12,000
Santa Fe	24,000	26,000	6,500	7,500	—	—	17,500	18,500
Sierra	35,000	35,000	9,000	10,000	2,800	3,000	23,200	22,000
Socorro	41,000	42,000	19,000	20,000	5,500	6,300	16,500	15,700
Taos	7,000	7,000	4,000	4,000	—	—	3,000	3,000
Torrance	39,000	44,000	18,000	20,000	—	—	21,000	24,000
Union	151,000	159,000	38,000	38,000	—	—	113,000	121,000
Valencia	28,000	27,000	7,000	6,500	6,000	5,700	15,000	14,800
STATE	1,600,000	1,620,000	504,000	570,000	210,000	210,000	886,000	840,000

APPENDIX U

Information Regarding Mines, Mills, Pits, and Quarries in Lea County

Appendix U. Table of mines, mills, pits, and quarries in Lea County

name	commodity	operation	location	status
National Compaction Plant	potash	mine shaft and mill	T20S.R32E.Sec18	mill – active
National Tailings	salt	mill	T20S.R32E.Sec18	active
Eunice Pit	sand and gravel	pit	T21S.R38E.Sec29	active
Hawthorne Pit	caliche fines	pit	T15S.R36E.Sec17.3	active
Lea County Pit	caliche, crushed rock, fill dirt, sand, top soil, base course	pit/mill	T18S.R38E.Sec19.21	active
Lea County Pit II	aggregate	pit	T25S.R36E.Sec11	temporarily closed
Lea County Pit III	caliche	pit	T14S.R36E.Sec27.2	active
Tatum Pit No. 2	sand and gravel	pit	T12S.R38E.Sec30.1	temporarily closed
Wylie No. 1	sand and gravel	surface mine	T10S.R36E.Sec17.2	active

Source: Hatton, et al., 1998

APPENDIX V

Information Related to Water Use by Major Public Water Suppliers in Lea County

CITY OF JAL

JAL, NEW MEXICO 88252

DRAWER 340

PHONE 395-2222

City of Jal

January 20, 2000

Lea County Water Users Association
ATTN: Monica Russell
100 North Main Street
Lovington, NM 88260-4030

Dear Monica;

The information you requested in reference to the Lea County 40 Year Water Plan is as follows:

- Water use by category for Jal:
  - Residential
  - Commercial
  - Schools and Hospitals
  - City Properties
- Quantity of water processed by the Jal wastewater treatment facility is 6,390,000 gallons per month.
- Quantity of water lost to treatment and evaporation at the Jal waterwater treatment facility is approximately 1,390,000 gallons per month.
- All treated municipal wastewater is sold to Jal County Club for irrigation.
- The City of Jal has completed two phases of water improvements to the distribution system. These improvements replaced lines considered to be leaking and in the worst condition.

If you need any further information please contact me at the above address.

Sincerely,

Iona Kemp

RECEIVED
JAN 20 2000

THE CITY OF
HOBBS, NEW MEXICO
300 NORTH TURNER HOBBS, NEW MEXICO 88240
UTILITIES DEPARTMENT (505) 397-9315 FAX (505) 397-9370

January 27, 2000

MEMORANDUM

TO: MONICA RUSSELL, WATER USERS SECRETARY

FROM: JOHN R. DAVIS, UTILITIES DIRECTOR

SUBJECT: LEA COUNTY WATER USERS ASSOCIATION INFORMATION

Per your request, the four pages which follow provide the best information I have available at this time.

The numbered items in the heading of each sheet refer to the numbered items in your Fax copy of the Leedshill-Herkenhoff letter to me on 1/24/00.

JRD/cmv

RESPONSE TO #6

	Dow	ConocoPhillips	Mobil	Arco	
Jan-99	79,349,200	42,210,500	885,800	5,474,700	
Feb-99	69,973,900	36,081,800	823,600	4,134,300	
Mar-99	86,335,900	46,581,600	1,788,900	7,625,000	
Apr-99	107,554,900	46,796,500	2,572,200	10,347,500	
May-99	134,082,900	56,264,100	5,268,200	12,987,200	
Jun-99	145,976,000	55,658,300	6,197,600	14,422,500	
Jul-99	153,319,700	55,364,100	6,697,700	17,982,700	
Aug-99	159,909,400	58,144,800	6,527,900	15,052,500	
Sep-99	173,443,600	62,339,800	7,288,400	17,771,200	
Oct-99	116,481,400	50,662,500	7,348,800	12,386,000	
Nov-99	106,377,800	46,978,800	4,671,000	10,399,800	
Dec-99	78,842,700	42,518,200	3,384,400	4,825,100	
TOTAL - 1999	1,396,824,700	669,913,900	52,536,200	133,486,500	2,186,563,300

Page 2 of 5

PREPARED BY C. BUTLER
CITY OF HOBBS
1/24/00

RESPONSE TO #7 & #8

	NFL	EFL	Δ
Jan-99	87,707,000	84,764,000	2,943,000
Feb-99	94,017,000	82,764,000	11,253,000
Mar-99	104,156,000	101,954,000	2,202,000
Apr-99	106,332,000	84,913,000	21,419,000
May-99	118,384,000	85,463,000	32,921,000
Jun-99	116,341,000	100,102,000	16,239,000
Jul-99	91,318,000	114,548,000	(23,230,000)
Aug-99	93,484,000	110,717,000	(17,233,000)
Sep-99	81,092,000	110,698,000	(29,606,000)
Oct-99	73,774,000	100,461,000	(26,687,000)
Nov-99	64,482,000	92,250,000	(27,768,000)
Dec-99	80,855,000	97,718,000	(36,863,000)
TOTAL - 1999	1,101,859,000	1,179,250,000	(74,409,000)

PREPARED BY C. BUTLER
CITY OF HOBBS
1/24/00

RESPONSE TO #9

	OILFIELD	FARM
Jan-99	4,813,000	89,722,000
Feb-99	4,309,000	75,176,000
Mar-99	5,965,000	95,304,000
Apr-99	4,561,000	77,339,000
May-99	3,370,000	78,189,000
Jun-99	3,689,000	93,812,000
Jul-99	4,485,000	108,333,000
Aug-99	5,585,000	98,624,000
Sep-99	5,264,000	106,704,000
Oct-99	5,121,000	89,427,000
Nov-99	6,329,000	84,638,000
Dec-99	5,421,000	91,276,000
TOTAL - 1999	61,971,000	1,063,724,000

PAGE 4 of 5

PREPARED BY C. BUTLER
CITY OF HOBBS
1/24/00

City of Hobbs

Question # 11.

System losses

YEAR

Pumped 99	2,745,854,000
Sold 99	2,186,563,300
	559,290,700

YEAR 1999 20.37%

MONTH

DEC 99

gallons pumped	157,015,000
Gallons sold	129,642,400
	27,372,600

MONTH 12/99 17.43%

PAGE 5 of 5

CITY OF LOVINGTON
LOVINGTON, NEW MEXICO 88260

214 South Love
PO Box 1269
BUS: (505) 396-2884
FAX: (505) 396-6328

JAN 2000
RECEIVED

January 12, 2000

Dennis Holmberg
Lea County Manager
100 North Main Suite r
P.O. Box 2014
Lovington, NM 88260

Dear Mr. Holmberg:

As per a fax from Monica Russel on January 11, 2000 requesting information for the Lea County 40 year water plan asking for information on questions #6, #7, #8, #9 and #11. Those questions are as follows:

#6. Water use by Category for each municipality. Categories should include, but not limited to, domestic, commercial, livestock, industrial, parks, golf courses, estimated carriage losses, drilling, secondary oil recovery, fire suppression, municipal offices, and other. All Municipalities

For the year of 1999

Residential use	506,618,800 Gallons
Commercial	105,976,900 Gallons
Industrial	43,443,900 Gallons
Municipal use	
Ball Fields	26,200,000 Gallons
Park Lake	17,400,000 Gallons
Cemetery	2,000,000 Gallons
Fire Dept.	11,500,000 Gallons
City Buildings	1,200,000 Gallons

#7 Quantity of water processed by municipal wastewater treatment facilities per month. All municipalities

The Lovington Wastewater Treatment Plant received 31,400,000 gallons of wastewater in December 1999.

#8 Quantity of water lost to treatment and evaporation at municipal wastewater treatment facilities per month. All Municipalities

The quantity of water lost to treatment and evaporation for the month of December was about 5% or 1,490,000 gallons.

#9 Quantity of treated municipal wastewater sold, or reused per month, broken out by category of reuse. All municipalities

The plant pumped 948,000 gallons of treated water to our farm for watering during December. The plant also placed 11,218 gallons of treated water in a wetland experimental project for that same month.

#11 Recent or planned refurbishing of municipal water supply piping systems. Provide locations of areas known or suspected to be leaking. If possible, provide estimated percent lost by any leaking system. All Municipalities.

Any water leaks known to the City employees is repaired almost immediately

If you need additional information, please feel free to call me.

Sincerely,

Charles Kelley
Assistant City Manager

the ROSS GROUP
consulting engineers

January 11, 2000

Date 1/11 # Pages 5 QUICK FAX Officemate

To: Monica	From: Todd
Co./Dept.	Co./Dept.
Fax # 396-2093	Fax #
Phone #	Phone # 392-7919
Re:	CC:

Mr. Dennis Holmberg
Lea County Manager
100 North Main, Suite 4
P.O. Box 2014
Lovington, New Mexico 88260

RE: City of Eunice's Response to Request for Additional Information for Lea County 40 Year Water Plan

Dear, Mr. Dennis Holmberg;

The following is Eunice's response to Leedshill-Herkenhoff, Inc. (LH) letter requesting additional information for Lea County's 40 year water plan. The source of the following information is from City of Eunice records, "As-Built" drawings, "Eunice Water Supply System Study" prepared by the Ross Group (March 1999) and "Eunice Wastewater Treatment Plant - Preliminary Engineering Report" updated by the Ross Group (October 1999).

Item No. 6.	*Water use by category for each municipality. Categories should include, but not limited to domestic, commercial, livestock, industrial, parks, golf courses, estimated carriage losses, drilling, secondary oil recovery, fire suppression, municipal offices and other.*

The water use is broken up into the City of Eunice's billing classes, which includes residential, out of city use, industrial, water retailers, and commercial. Metered water billing volumes and well production volumes are provided on page 2.

- Average Metered Well Production 1.45 GPD (gal. per day)
- Typical Maximum Day Metered Well Production 2.90 GPD

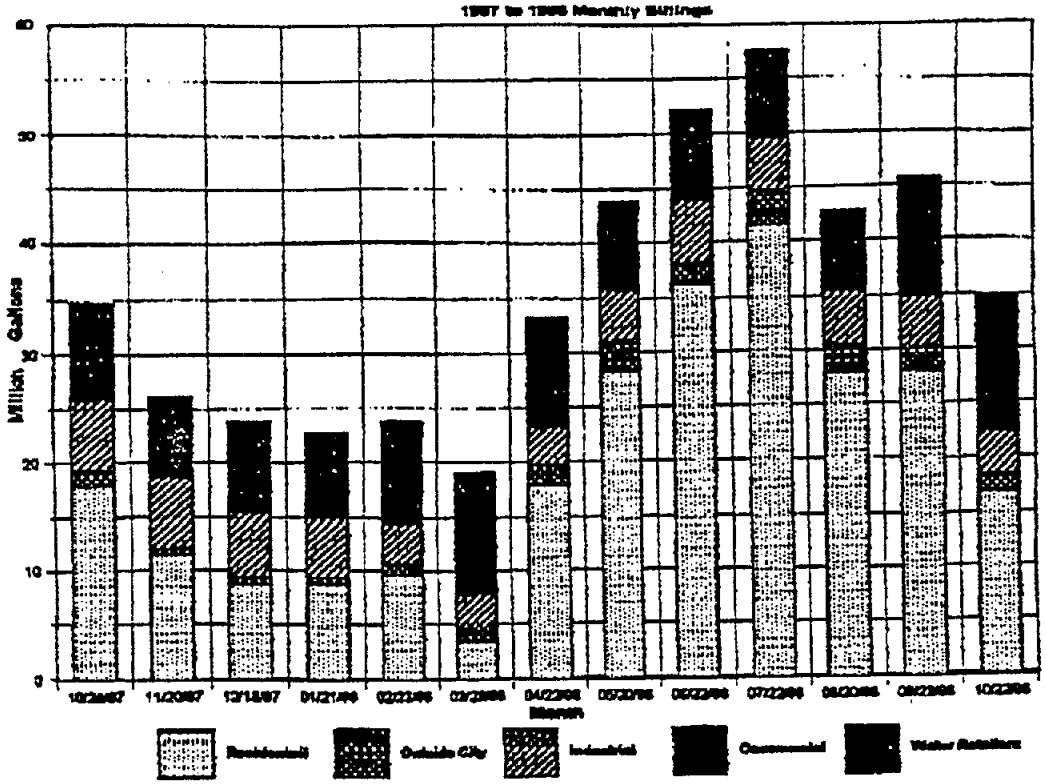
- Average Metered Billing Volume 1.24 GPD
- **Average Percent Waste/Misc. (leaks, city use, evaporation) 14%**

Waste and miscellaneous use is approximately 14% and can be contributed to leaking water mains, faulty meters, evaporation, and public use, such as City parks, recreational areas, and City facilities, not metered for billing.

CITY OF EUNICE - METERED WATER BILLING VOLUMES (gal.)					
DATE	RESIDENTIAL	OUTSIDE CITY	INDUSTRIAL	WATER RETAILERS	COMMERCIAL
07/24/97	37,132,300	234,400	9,878,000	11,486,700	1,971,200
08/22/97	25,535,000	1,976,500	6,057,600	7,534,200	1,530,800
09/25/97	26,250,800	11,646,500	6,983,100	8,284,100	692,400
10/24/97	17,927,800	1,348,000	6,686,800	7,511,200	1,436,300
11/20/97	11,208,200	703,000	6,613,700	6,365,400	1,036,100
12/18/97	8,792,200	695,800	5,268,500	7,291,700	1,046,800
01/21/98	8,837,200	662,000	5,461,300	6,823,100	1,047,700
02/23/98	9,713,100	668,500	3,848,200	8,508,200	757,200
03/23/98	3,403,300	1,295,200	3,067,800	10,673,900	858,100
04/22/98	17,807,500	1,972,800	3,391,100	8,946,800	1,211,500
05/20/98	28,204,800	2,883,100	4,599,600	8,449,700	1,539,700
06/22/98	36,197,400	1,804,800	6,970,800	6,380,300	1,800,800
07/22/98	41,582,900	3,436,600	4,713,800	5,669,800	2,281,400
08/20/98	27,028,300	2,883,200	4,891,100	5,734,900	1,613,900
09/23/98	38,031,400	2,136,200	4,778,800	7,866,300	2,856,600
10/22/98	18,863,300	1,806,900	3,868,700	9,121,900	3,654,400
11/20/98	8,806,200	814,200	3,897,900	8,235,300	1,419,400
12/28/98	19,676,000	982,300	3,833,300	2,786,300	11,502,200
Average Use (10/97 to 10/98)	20,009,750	2,080,483	5,166,478	7,525,676	2,118,144
% Total	47%	5%	12%	17%	5%

WELL PRODUCTION VOLUMES (gal.)

	1995	1996	1997	1998
January	27,954,000	42,324,600	30,359,200	33,968,600
February	21,569,400	34,225,700	33,908,200	35,171,400
March	41,370,900	32,354,200	39,647,700	32,052,300
April	46,102,000	64,370,700	41,999,800	53,486,200
May	46,127,400	69,422,200	47,695,100	71,717,000
June	66,363,700	67,174,600	44,863,400	
July	53,183,400	47,832,100	69,331,900	
August	56,892,200	55,609,200	34,150,800	
September	47,240,600	44,892,100	59,693,100	
October	29,200,800	36,071,200	34,286,500	
November	43,841,500	32,717,000	46,273,600	
December	17,156,000	27,093,600	24,991,000	



The above graph shows the seasonal fluctuation for a representative year.

Item No. 7) Quantity of water processed by municipal wastewater treatment facilities per month.

Average Daily Flow Rate to
Eunice's Waste Water Treatment Facilities ..... 4.575 MG per month (0.15 MGD)

MGD = Million Gallons per Day
MG = Million Gallons

Item No. 8)	*Quantity of water lost to treatment and evaporation at municipal wastewater treatment facilities per month.*

The City of Eunice currently does not have any means of measuring influent or effluent volumes. The Quantity of water lost to evaporation at the treatment facilities has been estimated by the total area exposed to atmosphere and the average evaporation and precipitation for the Eunice area.

Treatment Facilities:
Large Imhoff Tank ..... 950 s.f.
Small Imhoff Tank ..... 225 s.f.
Trickling Filter ..... 1,590 s.f.
Storage / Oxidation Lagoon ..... 43,560 s.f.

Climate Data:
Average Precipitation = 15 inches
Average Evaporation = 72 inches

Estimated average water lost to evaporation at Eunice's waste water treatment Plant ..... 0.14 MG per month (5 acre-ft / yr.)

Disposal of effluent consists of removal from the storage / oxidation lagoon and irrigation by an adjacent land owner. Not enough information is available to determine leaching and evapotranpiration.

Item No. 9)	*Quantity of treated municipal wastewater sold, or reused per month, broken out by category of reuse.*

The City of Eunice does not sale or reuse it's treated municipal waste water. Disposal of effluent consists of removal from the storage / oxidation lagoon and irrigated by an adjacent land owner. Not enough information is available to determine leaching and evapotranpiration.

Item No. 11)	*Recent or planned refurbishing of municipal water supply piping systems. Provide location of areas know or suspected to be leaking. If possible, provide estimated percent lost by any leaking system.*

The City of Eunice does not have any planned projects for refurbishing their municipal water supply piping system.

Areas of known leaks:
- Nadine Ground Storage Tank (western 300,000 gal. tank)
- Eunice Ground Storage Tanks

The estimated percent lost is negligible. There are no know leaks in the water supply piping from the Hobbs well field to the Eunice ground storage tanks.

Deanne Gruben,CMC
Clerk/Treasurer

Town of Tatum
P.O. Box 156
Tatum, NM 88267
(505)398-4633
Fax: (505)398-8288

Betty Rickman
Mayor

JAN 2000
RECEIVED

January 10, 2000

Dennis Holberg
Lea County Manager
100 North Main, Suite
P.O. Box 2014
Lovington, New Mexico 88260

Regard: Lea County 40 Year Water Plan

Dear Mr. Holberg:

Question #6. We produce 63,379,000 annually
We sell 44,999,000 annually
The difference is used for municipal purposes

Question #7. We process 57,000 daily at the WWTP

Question #8. Forty percent is lost to evaporation

Question #9. We recharge 35 acre feet per year

Question #10. We intend to install a ground water storage tank, repair/replace collection
Collection lines, and replace various water lines throughout the city.

Sincerely,

Betty C. Rickman

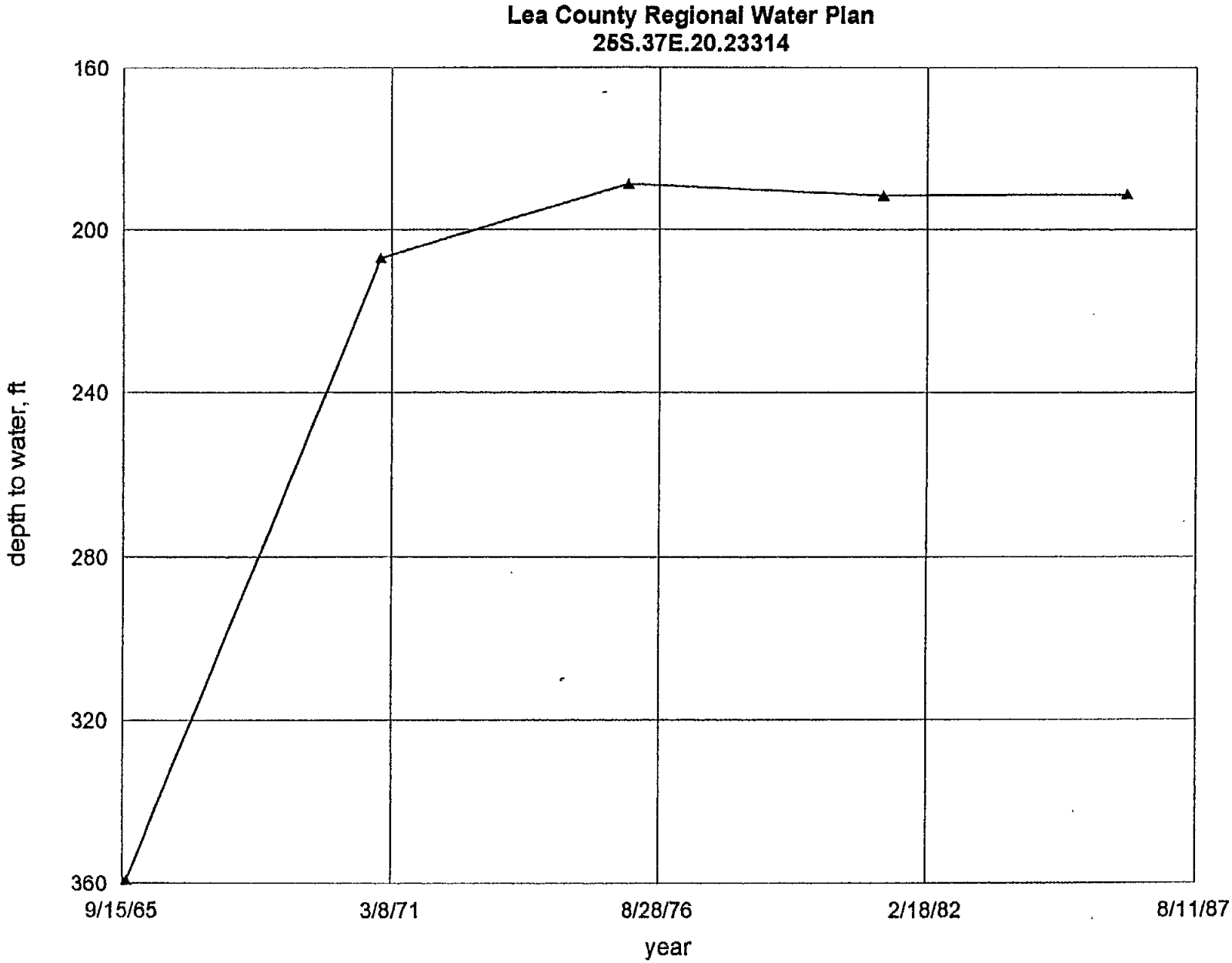
Betty C. Rickman, Mayor
Town of Tatum

If you have any questions or require any additional information, please contact Mr. Philip Ross, P.E. or my self at (505) 392-7918.

Sincerely,
the ROSS GROUP

Todd Randall, EI

xc: Mayor Don Reese, City of Eunice
file



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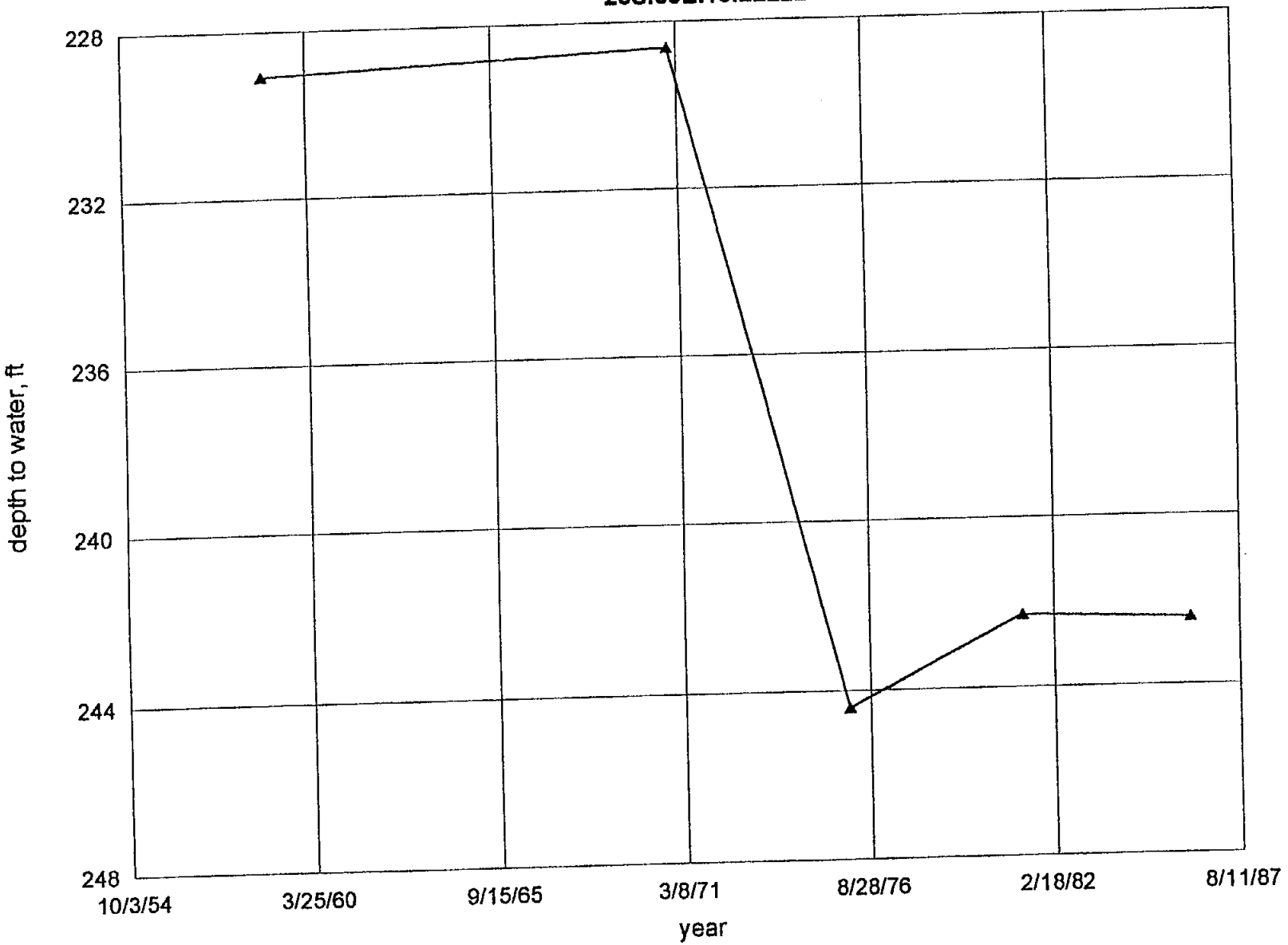
JOHN SHOMAKER & ASSOCIATES, INC.



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JOHN SHOMAKER & ASSOCIATES, INC.

SUMMARY OF AVAILABLE HYDROGEOLOGIC DATA COLLECTED BETWEEN 1973 AND 1995 AND INFORMATION ON ALL PERMEABILITY DATA AND AQUIFER TESTS FOR THE CAPITAN AQUIFER, EDDY AND LEA COUNTIES, NEW MEXICO

U.S. GEOLOGICAL SURVEY

Open-File Report 97–370

Prepared in cooperation with the

NEW MEXICO STATE ENGINEER OFFICE

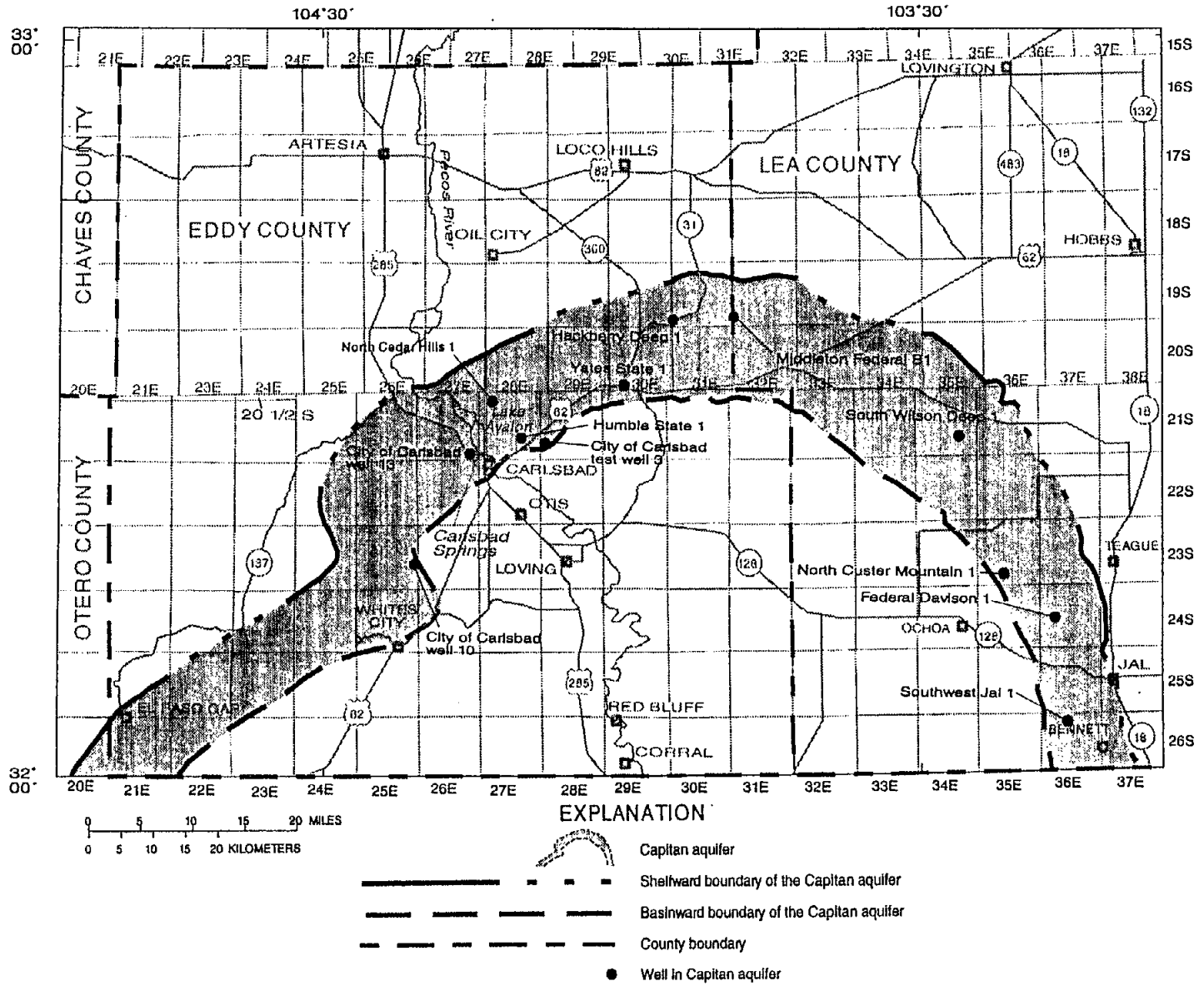

Figure 4.--Location of wells in the Capitan aquifer observation-well network as described by Hiss (1973).

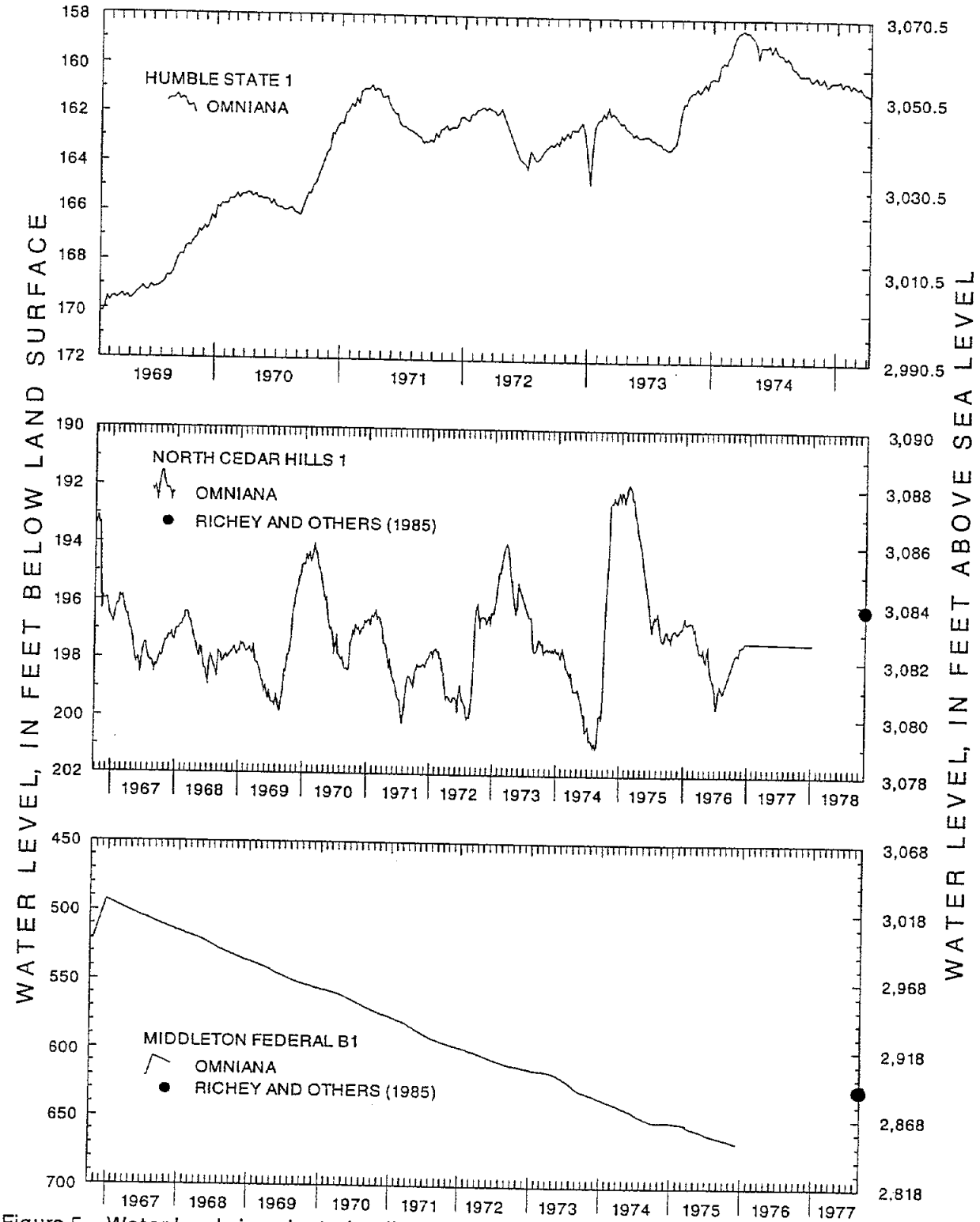

Figure 5.--Water levels in selected wells in the Capitan observation-well network as stored in the OMNIANA data base and tabulated by Richey and others (1985, p. 57-58). Well locations shown in figure 4--Continued.

ALL LEA CO. MONITORS SHOW DECLINING TREND

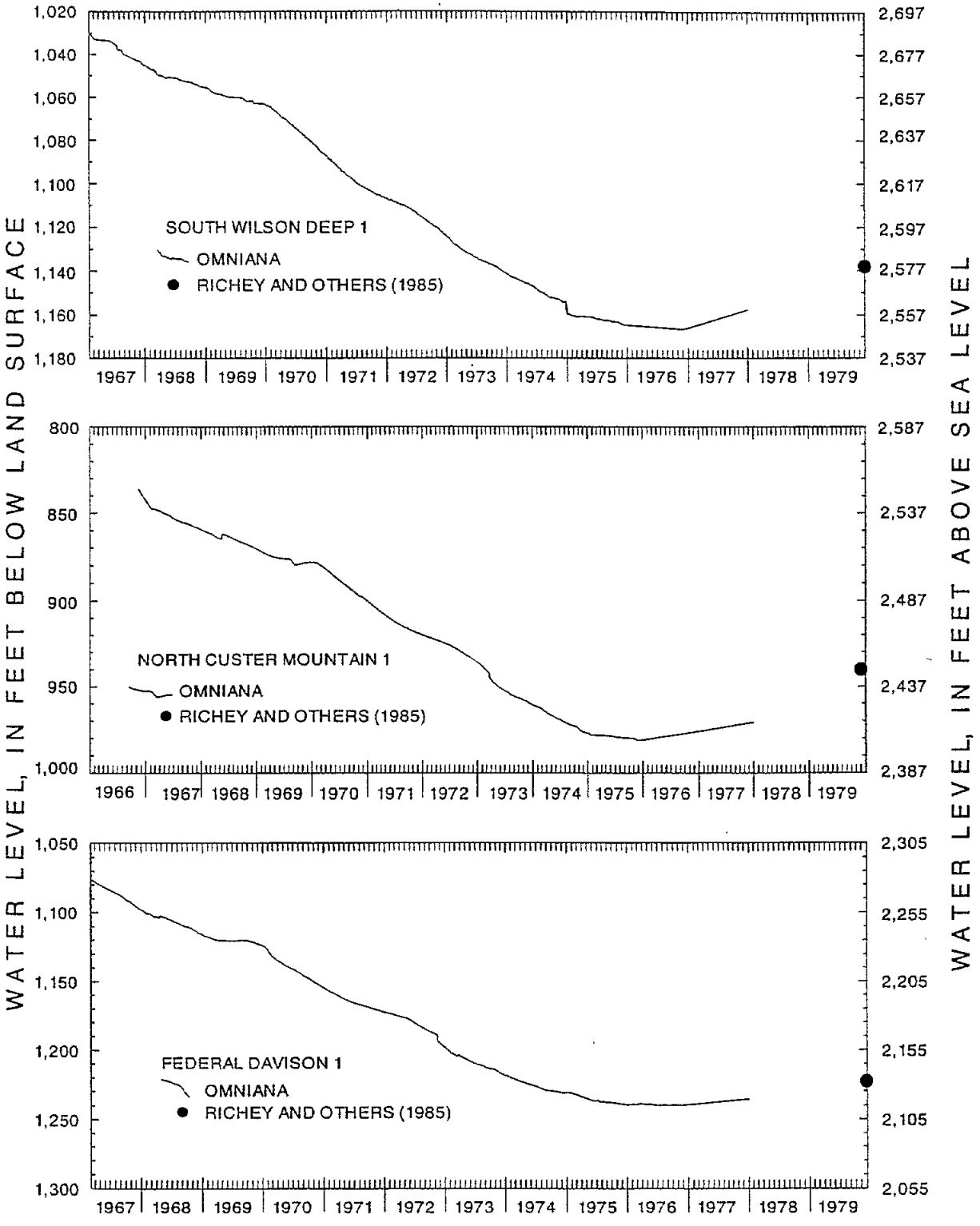

Figure 5.--Water levels in selected wells in the Capitan observation-well network as stored in the OMNIANA data base and tabulated by Richey and others (1985, p. 57-58). Well locations shown in figure 4--Continued.

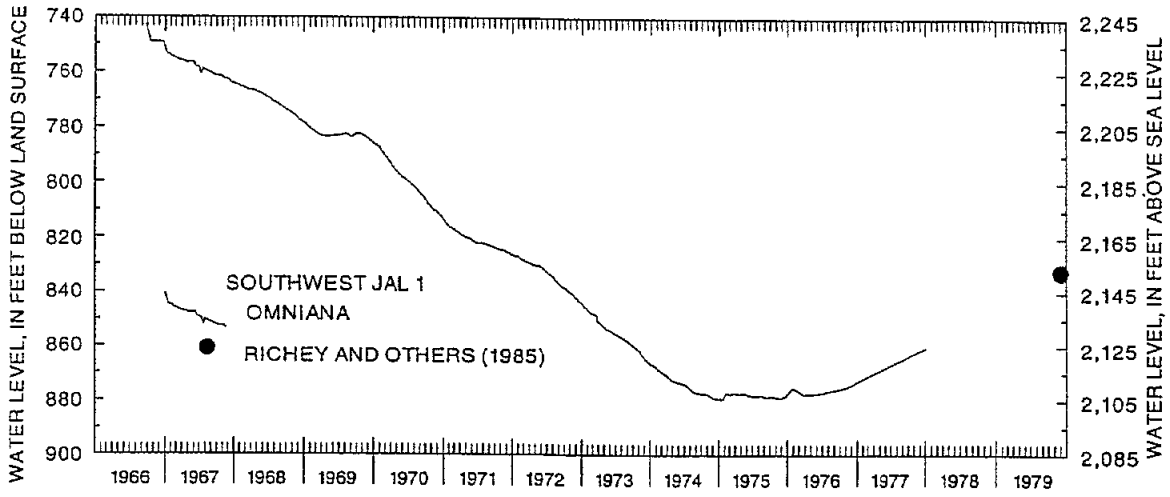

Figure 5.--Water levels in selected wells in the Capitan observation-well network as stored in the OMNIANA data base and tabulated by Richey and others (1985, p. 57-58). Well locations shown in figure 4--Concluded.

Water Levels Stored in the U.S. Geological Survey Data Base

Measured water levels in the Capitan aquifer and the Tansill Formation in Eddy and Lea Counties for 1973-95 that are stored in the GWSI data base are listed in tables 3 and 4, respectively (tables 3-8 are in the back of the report). Locations of water levels measured in the Capitan aquifer and the Tansill Formation during 1973-84 and 1985-95, as recorded in GWSI, are shown in figures 6 and 7, respectively. Available water levels in selected wells in the Capitan aquifer, including City of Carlsbad well 13, for 1973-95 are shown in figure 8.

Water Quality

One water-quality analysis for the Capitan aquifer in Eddy and Lea Counties was available for 1973-95 and is stored in the USGS quality-of-water (QWDATA) data base (table 5). The location of this water-quality analyses is shown in figure 9. The extensive ground-water-quality data tabulation of Hiss (1975) contains only pre-1973 data.