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Final Report on TWDB Project:

Evaluation of "Dry-Year Option" Water Transfers from Agricultural to Urban Use.

By

Dr. Bruce A. McCarl
Dr. Lonnie L. Jones
Dr. Ronald D. Lacewell
Mr. Keith Keplinger
Dr. Manzoor Chowdhury
Mr. Kang Yu
Texas Agricultural Experiment Station
Texas A&M University
College Station, TX 77843
(409) 845-1706 phone
(409) 845-7504 fax

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Executive Summary

This study investigated the economics of an Edwards Aquifer region "dry year" option buyout directed toward decreasing agricultural water use in an effort to augment spring flow.

The research was separated into eleven tasks: (1) deficit irrigation data were developed describing yields in the face of interruption; (2) cost and return budgets were developed for the strategies; (3) a regional level agricultural model was constructed; (4) three dry year option definitions were developed - one involved a November announcement and interruption, the others involved May interruptions: one without prior announcement and the other announced as a possibility in November with the interruption occurring in May under low recharge; (5) a set of regression equations were developed predicting spring flow consequences of interruption; (6) the springflow and regional agricultural model was used to develop data on the consequences of alternative dry year option prices; (7) a third party impact, input output model was developed to look at the off farm implications of the dry year option; (8) potential compensation mechanisms for to mitigate off farm income losses were investigated (9) the question of whether compensation was in order was examined as well as the identities of affected parties (10) the model was delivered to the sponsors in disk form as was a workshop for sponsor employees; and (11) estimates were developed of the Municipal and Industrial demand for water exchanges over a range of prices.

The principal findings during this exercise were

1) There are some adjustment possibilities that farmers selling water can use either in terms of dryland farming or deficit irrigation if a may cutoff is a possibility.

2) The springflow regressions revealed a dramatic difference in the effect due to curtailed pumping in the eastern versus the western counties. Several times more springflow is generated when the option is exercised east as opposed to west of the Knippa gap. This led us to examine separate dry year options for eastern and western counties

3) The November announcement of a dry year option generated some water even at very low prices($10 per acre). At the offer price of $90 per acre most of the water in the region was sold. In the western region considerable higher starting prices are required but about the same top end. However, when using western water the cost per unit springflow is much higher.

4) The cost of the water saved by the buy out becomes substantially more expensive when the option is exercised during the cropping season as prices somewhere around $90/ac need to be paid to get about half as much water as could be gotten under other circumstances. Also an early announcement of the possiblility of a mid season option under low recharge allows land to enter the program more cheaply but lowers the amount of water use curtailed as farmers use a crop mix and irrigation strategies which are not as dependent on late season water.

5) A dry year option program based on local taxes exhibits greater indirect income loss than one wherein compensation is funded externally. As many as 500 jobs are involved with a $5 to 36 million dollar range on loss of regional gross income. The secondary economic impacts fall greatest on Uvalde and Medina counties.

6) History indicates that compensation to third parties affected by a specific economic change is rare. Classical economic theory indicates that regional losses are offset by secondary benefits elsewhere and does not recommend compensation. However, compensation to injured third parties may be a useful strategy for easing dry year option policy implementation.

7) Compensation schemes should probably not pay local government as revenues are not likely to be lost. Compensation may be in order to private businesses and individuals; farm labor; crop tenants; farm supply and service businesses; and speciality production and marketing systems.

8) We found ourselves making a lot of assumptions in setting up and examining the dry year option, some of which may not be absolutely in accord with the way the dry year option is ever implemented. Thus, we developed a transportable model in which assumptions may be modified. However, we cannot deliver the input output model.

9) We found the usage of municipal and industrial water fell from 336 thousand acre feet when water was not priced (a zero price was used) to 133 thousand acre feet when a $500 charge was used. Higher water usage occurred under the drier years and lower water usage in the wetter years.

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Brief description of study:

This study investigated the economics of an Edwards Aquifer region "dry year" option buyout directed toward decreasing agricultural water use in an effort to augment spring flow. In doing this several research phases were pursued. First, we applied crop growth simulation models to quantify expected yield of major crops in dry and wet years for alternative irrigation strategies so we had data on irrigation alternatives for reducing or interrupting water use. Second, these data were incorporated into crop enterprise budgets were formed for entry into a firm level simulation model. Third, equations were developed which predicted the monthly springflow implications of changes in agricultural water use. Fourth, a "dry year" agricultural model which predicted the agricultural consequences of exercise of various forms of the dry year option was developed. Fifth, a model and literature based evaluation was undertaken to arrive at a definition of the term "dry year option". Sixth, the agricultural model was used to determine willingness to sell water at alternative prices by agriculture when the option is exercised. Seventh, a regional IMPLAN model was developed to allow estimates of regional impacts of the dry year option. Eighth, the IO model was used to estimate the effect of water transfers on the local communities, by sector. Ninth, the theory of whether there should be compensation was examined. Tenth, the LP model was put in a form for delivery to the WDB and a training workshop will be held. Eleventh, data on the nonagricultural demand for water were developed.

As of this point in time all project activities are complete and a training workshop scheduled. A workshop will be held in College Station for WDB personnel on Feburary 4, 1997. This document serves as a final report on all project phases. Finally please note partial preliminary results have been presented to interested parties in the San Antonio and ground water communities to garner feedback on modeling procedures, but no written reports have been released. However, this document will soon be releasd through Texas Water Resorces Institute.

Objectives

The overall objective was to examine the effect of the "dry year option" to transfer water from agricultural to urban interests in the context of the Edwards Aquifer. Important activities pursued in the context of this project included:

(I) we developed an operational definition of the dry year option

(II) we evaluated the effect of various irrigation strategies on the water use and yields of farms in the area

(III) we evaluated the potential impact of the "dry-year option" policy when exercised before and part way through the cropping year in various counties upon the economic welfare of the agricultural sector and on springflow(an earlier objective to examine urban welfare impacts was dropped since the dry year option design in the region concentrates on ag reductions for springflow augmentation only not for increasing non ag use)

(IV) we quantified the secondary economic impacts on the local economy due to use of the "dry-year water transfer option" and present material on options for compensation for communities in the impacted region

(V) we developed computerized procedures in this study for assessing the consequences agricultural compensation levels. They are listed herein and we thereby deliver them to TWDB officials.

Justification for Research

To deal with drought, there is a need for an efficient and effective mechanism to transfer water to high priority needs and high value uses. In the west, water is marketed. However, marketing of water generally transfers the water rights in perpetuity with urban and other higher valued usages receiving water rights regardless of the quantity of water available. There is a need for short term transfers due to the magnitude of the fluctuation in water supplies. For example, in Edwards aquifer one finds historical variation in surface water induced recharge from 50,000 to over 2 million acre feet. In the face of such fluctuation, entities which require a relatively constant amount of water across all the years may find themselves short on water in dry years but with an excess of water in wet years. Under such circumstances it is an economically desirable strategy to transfer water from lower value users to higher valued users when water is scarce, but in periods of water abundance to have the water used by lower valued users (e.g., see the arguments in Colby; McCarl and Parandvash; Michelson and Young; McCarl et.al.; Carter, Vaux and Scheuring).

California initiated such a program during the drought by using a water bank (Carter, Vaux, and Scheuring). The state purchases water from willing sellers, then pools the water and distributes it to meet the needs. This is an annual program that is implemented on an as needed basis, Colby reviews other cases. When pursuing such programs major questions arise regarding the appropriate buying and selling price of water as well as third party effects (Michelson and Young).

Many regions in Texas could support water transfers, but an especially relevant Texas location where dry-year water transfers could to be considered is in the Edwards aquifer region. That region is one where urban demand has been growing steadily for many years, but the amount of aquifer recharge water has not grown. The region is also characterized by springflow which supports endangered species. While regional average usage does not exceed average recharge, usage is now about 500,000 ac/ft while average recharge is in the neighborhood of 630,000 ac/ft and historical springflow averages 230,000 ac/ft. This usage exceeds recharge in many years and certainly long term prospects for spring flow portend a much lower level than the historical average. Therefore dry years can be a problem both to the current level of usage and the level of springflow.

This situation has led to a number of societal events. Various parties including the Sierra Club and the Guadalupe Blanco River Authority have initiated legal actions to preserve water for spring flow and base river flow. The most recent suit based on endangered species was upheld and resultant management actions are currently in the process of being implemented. There also has been a long history regarding the implementation of an aquifer management authority. Most recently this culminated in the passage of legislation where a new management authority is put into place. Important issues regarding dry-year water transfer options in the Edwards appear in both the court monitor's document for managing the Edwards and in some of the earlier regional aquifer management plans. In both cases, dry year pumping limitations are suggested with triggers based on recharge, reference well elevation, pumping use, and/or springflow levels. Thus, the Edwards is a fruitful area for study of the dry year water transfer option.

Another aspect of this research requires some justification and that is the focus on agricultural users and springflow quantity. Fundamentally, the situation is stimulated by the court actions. It is almost certain that in the near future pumping will need to be curtailed with more water reserved for springflow. Recent legislation mandates pumping drop to 450,000 acre feet now and 400,000 acre feet in the near future as opposed to the current level of about 500,000 acre feet. Court action has suggested water use restrictions to maintain springflow. The resultant water use reduction as well as the possibility of more severe curtailments in dry years implies a dramatic need to have a mechanism to reduce water use in lower valued usages so as to augment springflow. Often agricultural water is anecdotally referred to as being worth about $30 to $50 per acre foot, while water in urban usages in terms of a tap prices is somewhere in the neighborhood of $500 acre feet In the face of this differential, urban users can afford to purchase reduced agricultural water use from irrigators without a great deal of increase in their water bills (Boggess, Lacewell and Zilberman). The questions then are: what is the economically efficient allocation of water? How could dry year reductions in agricultural use be facilitated? At what cost are spring flows augmented? These are also particularly relevant issues as Texas has historically been under an appropriative system for surface water and a capture system for groundwater. Agricultural users have historically been using the water for a longer time period in most cases and are, in the Edwards, "upstream" with the rights of capture. Thus transfers between low valued agriculture and springflow are in order but will not happen without an explicit compensation effort or a new system of quotas.

In the absence of a market driven mechanism for water allocation, the government assumes the allocation responsibility. Typically, government intervention does not provide efficient management, political and legislative forces tend to make allocation decisions without consideration of value of water in alternative uses. There is a strong incentive to implement a market driven system (Boggess, Lacewell and Zilberman; Collinge et.al., McCarl et.al.).

Farmers when faced with water restrictions or a potential to profitably sell water in any given year can pursue several alternative courses of action. If the information comes in early enough, crop mixes can be changed to drought tolerant crops. If not then crops can be abandoned or managed using deficit irrigation approaches. Furthermore, if a water transfer option is implemented, farmers will make long term changes in irrigation equipment, and farm capitalization. Thus, to study the farm welfare effects of the dry year option a comprehensive economic assessment needs to be made wherein factors such as timing of option, crop mix, deficit irrigation, dryland reversion and irrigation equipment capitalization are considered.

The project also considers the compensation question. Actually there are three parties directly involved in the dry year option transaction. These include the farmer who loses income when water is limited (or must make capital expenditures to improve efficiency) and the urban interest who gains when more water is made available. The amount of compensation that will be paid is bounded below by the loss in farmers profits (or amortized investment to improve efficiency) and above by the amount of income gained by the municipal water users. The transactions cost of bringing the parties together is also relevant. In this project we will estimate the effects on the welfare of both parties and therefore the bounds on compensation.

Third party secondary effects may also be relevant. Historically, compensation for the transfer of water or other natural resources to agricultural producers has included only the direct income loss to the owners of the resource. Examples include the USDA soil bank program of the 1950-60's and the more recent Conservation Reserve Program wherein crop farmers were paid a net return per acre equivalent to take land out of production. In those cases, farmers suffered no economic loss. However, communities in which the private and public economies depended upon continued crop production suffered business income reductions, out migration of labor, declines in local property tax bases and other secondary or "third party" impacts. Less irrigation will be reflected in a reduction of goods and services used by production agriculture and less output which will impact in local and regional economics. Compensation for such losses could be undertaken. Several public entities have provided mitigative compensation for impacts that policies have had on a local economy beyond the immediate impact on resource owners. For example, the Department of Defense considers mitigation payments to communities affected by military base closures. Also, the Department of Energy has offered mitigation payments to communities for radioactive waste disposal.

The research project investigated the question of compensation to third parties from several aspects. These include: 1) the normative and conceptual considerations involved in the issue of compensation for secondary impacts of water transfer in dry years, 2) the analytical techniques needed for estimating the magnitude of secondary impacts under alternative dry year option policies; 3) the procedures for implementing mitigation programs and 4) the transactions costs and regional economic impacts consequences of mitigation compensation.

Activities

The research has been separated into eleven tasks. Here we report activities and results under each task

Task 1 -- Development of deficit irrigation data

The estimation of the level of compensation to farmers due to the exercise of a "dry-year option" requires comparison of net returns among alternative irrigation and management strategies as well as dryland production. This requires information on crop yield and crop response to water for all possible irrigation strategies as well as crop yields for dryland production. EPIC (Erosion Productivity Impact Calculator), a biophysical simulation model, was used to simulate crop yield and irrigation water use for selected crops, vegetables, and hay under alternative irrigation strategies for the Edwards aquifer region. EPIC is a sophisticated process model that runs on a daily time step and simulates the interaction of soil erosion, plant growth, weather, hydrology, nutrient cycling, tillage, soil temperature, and economics. The crops and vegetables selected for simulations were corn, cotton, sorghum, oats, winter-wheat, peanut, cabbage, lettuce, spinach, carrot, cucumber, cantaloupe, and onions.

EPIC allows the user to either: (1) generate all daily weather data(using the internal weather data generation subroutines); (2) input all daily weather data from an external weather data file specified by the user; or (3) combine input and generated data. The actual weather data for the Edwards aquifer area were available from the U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. The simulations were conducted by using seventeen years of actual weather data. These weather years are representative of weather years between 1951 and 1987 and consist of dry, normal, and wet years.

The automatic irrigation feature of EPIC was used to simulate irrigation water use during wet, normal, and dry years. Two methods to trigger automatic irrigation were used: (1) soil moisture tension (Kilopascals, 33 to 1500, positive values) and (2) millimeters of soil water below field capacity. The first method triggers irrigation whenever the soil moisture tension is below a level specified by the user. With the second method, irrigation is scheduled whenever the soil has less than the specified amount of water stored in the root zone relative to field capacity. Using both methods, crop yield and water response was simulated for the same irrigation strategies.

A large number of irrigation strategies (activities) for each major crop and vegetable were formulated. These strategies were selected based on alternative soil moisture scenarios, alternative irrigation ending dates (April 30, May 30, June 30 etc.), and alternative irrigation methods (furrow and sprinkler). For cotton, the irrigation ending dates were based on early bloom (EB), first bloom (FB), and first open boll (FOB) which correspond to irrigation ending dates of May 31, June 30, and July 31, respectively. Simulations for dryland production were also conducted for all major crops.

For vegetables, simulations were performed for alternative soil moisture scenarios and irrigation methods (furrow and sprinkler). Alternative irrigation ending dates were not used for vegetables since vegetables require continuous irrigation.

Four and one point five acre inches of water in each application were used for furrow and sprinkler irrigation, respectively. Irrigation efficiency was assumed to be 70% and 95% for furrow and sprinkler irrigation, respectively, implying that for furrow irrigation, 30% of the water was lost through runoff, evaporation, and/or percolation whereas only 5% was lost under sprinkler irrigation. To simulate crop yield, EPIC also requires other data on fertilizer and pesticide/herbicide use, tillage, as well as other site-specific information. These information were obtained from the Texas Crop Enterprise Budgets.

As hay is harvested many times throughout the year, simulations for hay were based on fraction of growing season where hay was harvested several times a year. Since for hay it is difficult to specify exact dates of tillage and other applications, EPIC allows the users to schedule management operations according to the fraction of crop maturity rather than calendar date. Heat units (thermal time) are used to estimate the rate of crop development, and the fraction of crop maturity in a specific day is expressed as: the number of heat units that have been accumulated to that day divided by the number of heat units required for crop maturity.

A necessary step in applying a biophysical simulation model is that results must be validated to reflect local conditions. Since the two alternative methods to trigger automatic irrigation resulted in different levels of water use, such validation is necessary to ensure that results are applicable to the study area. While the second method to trigger automatic irrigation resulted in water use that roughly approximated the USGS water use data, the soil moisture tension method resulted in water use that closely approximated the recently available TWDB water use data. The TWDB data show that the actual water use during a wet year is indeed considerably higher than the USGS data and thus validates EPIC simulations using the soil moisture tension method.

The simulation results on crop yield and water use are attached in the data section of the GAMS code for the Edwards aquifer economic model (see lines 2717-6146 of appendix A).

Task 2 – Budget Development

Budgets giving per acre costs were obtained from the Texas Crop Enterprise Budgets largely from the Southwest Texas District, as produced by the Texas Agricultural Extension Service(see lines 2164-2720 of appendix A). Net returns by cropping system and weather year were developed based on the crop budgets, simulated crop yields, and crop price projections from several national policy studies(see line 6159-6162 of appendix A). This provides baseline data for doing budgeting analysis and the necessary inputs for developing a regional economic model. Certain items were seperated out from the budets which were yield and/or irrigation watr dependent. These were changed as the irrigation strategies (and thereby yield and water application) were altered.

Task 3 – Development of a regional level agricultural model

Numerous cropping pattern and irrigation strategies exist in the region that can be used to act to the exercise the dry year option. The second task involved development of an agricultural net income maximizing Linear Programming model to simulate farmer decision making in the face of such an option. This model includes the major field, hay and vegetable crops in the region grouped by county (see the lists of crops in appendix A lines 76-100) and will include crop mix decisions, deficit irrigation decisions, irrigation type decisions(sprinkler/furrow) and dryland use decisions for three lift zones. The model will be designed to simulate short run, within season adjustments, to the exercise of dry year water transfer option as well as the medium term adjustments in crop mix and the long term adjustments in crop mix and irrigation equipment.

Notable efforts involved in setting up this model

a) An earlier model of the Edwards was adapted.
b) Lift Zones were added
c) Numerous Irrigation schedules based on the EPIC data were added
d) Sprinkler versus furrow irrigation features were added.

Task 4 – Definition of the Dry Year Option

The project required a definiton of a "dry year option". Two investigations were done to help develop an operational dry year option definition. First a related model which included industrial, municipal, and agricultural usage was used in order to examine optimal water use by agriculture. This was done by looking at year 2000 demand under a 450,000 acft water limits, with agriculture operating unilaterally, maximizing profits and agriculture operating in conjunction with municipal and industrial interests in a cooperative fashion. In turn the difference observed between agricultural water use when it cooperated and when it did not and how that varied by recharge abundance was observed to get some idea of what percentage of the years that agriculture might be cut back. The water use comparison is shown in the graph in Figure 1 and this revealed that 48% of the time agriculture used less than it would under free capture. We will use this in our study of midyear cutbacks.

A second investigation was carried out examining the literature and basically caused us to redesign some of our original proposed research design. Namely, we discovered that a parallel project involving SAWS and the Water Development Board came up with the definition of the dry year option in which water use was interrupted not based on how dry the year was, but based on the initial elevation of the aquifer at the beginning of the year and that also the water gained through the option would be dedicated to springflow (Rothe). Under these circumstances we then decided to operationalize our examination of the dry year option by first indicating that the water could be bought from agriculture, but that water would be dedicated to springflow and not put into non agricultural usages. Second, we considered beginning of year and mid crop year options. In terms of the mid crop year option because of the availability of simulated data on irrigation strategies we considered interruption of any ongoing agricultural usage that used water beyond the 1st of June would be precluded if the dry year buy out happened. Further this will occur either in all years or just in the 48% driest years, i.e., if it would only happen when we had a relatively low elevations at the beginning of the year and the year turned out to be dry.

Given the definition above that the water will not be transferred by the dry year option, but will be allowed springflow, we altered our original objectives and did not extensively estimate the industrial and municipal effects of exercising the dry year option (see task II discussion), but rather looked at the agricultural and springflow effects.

Task 5 -- Development of a model of spring flow impacts

Since the water diverted was to be dedicated to springflow it became desirable to examine how the springflow responded to agricultural water use reductions. This was done using regression equations derived from repeatedly running the Water Development Boards GWBSIM IV model. Equations were estimated for monthly and annual flows at Comal and San Marcos springs as a function of water use, and initial elevation both from east and west pools as well as recharge. The annual regressions are given in Table 1 . The monthly regressions which predict springflow are given in lines 2003-2077 in Appendix A. A related paper by Keplinger and McCarl discusses the regression at more length. Keplinger investigaated the validity of the forecasts and shows that the signs and magnitudes of the coeficients derived from historic data are very close to those from the GWBSIM based regressions.

The GWBSIM IV and regression results show a couple of things which also influenced our study design. First we noticed a differential response based on pumping location. This led us to estimate the equations with respect to east and west pumping with east pumping being everything in Medina, Bexar, Hayes, and Comal counties and west pumping being everything in Uvalde and Kinney counties drawing from the aquifer. The regressions then revealed a dramatic difference in the effect due to the eastern and western counties. This led us to examine separate dry year options for eastern and western counties which includes both eastern and western counties and for the eastern counties only. Our data examination also led us to focus on two measures of springflow -- Annual and August quantity.

Task 6 -- Analysis of Farm and Springflow Reactions to Dry year option

Dry year farm based analysis examined what farmers would do at various offer prices, when the offer prices are based on either an offer before the planting season, perhaps in late November, or an offer that arises to terminate irrigation. We also, in the max month context, look at an offer announced in November which would only occur 48% of the time, i.e., when the recharge was less than 500,000 acft.

The model will be applied assuming :

a) exercise of water transfer options before the crop year (allowing farmers to establish crop mixes knowing water availability)

b) implementation of mid year option with agricultural water use cessation after May assuming the crop mix has been implemented for all years

c) implementation of the mid year option with agricultural water use cessation after May assuming the crop mix has been implemented, water use is interrupted, for dry years only (42%) of the time based on the frequency of years with under 500 thousand acre feet of recharge..

The analysis was also setup to run with the offer for compensation made to only eastern counties, basically Bexar and Medina in agriculture i.e., east of the Kinnipa Gap or to western counties (Uvalde and Kinney) although the Uvalde portion was only considered for case A. The analysis was done with the offer prices from $0-150 an acre. This is operationalized in the model that appears in lines 6652-6925 of the listing in Appendix A. The procedure to repeatedly solve involved varying over the different offer prices and using a couple of different pump lift assumptions. This is implemented by the solving loop that appears between lines 6928 and the end of the Appendix A listing.

A detailed interpretation of the results of this analysis appears in the paper by Keplinger et al (See Appendix C; and in Keplingers thesis). Here let us provide an overview of the results that were found. Figures 2-5 show the basic results. Tables 2-5 summarize the results. When one announces a dry year option in the eastern counties in November, offer prices of around $10 /ac one can get as much as 10,000 acft of water use reduction. This largely occurs in the high lift zones. On the other hand when one does this in Uvalde, the offer price has to be somewhere around $60 /ac which would be about $30 /acft when before any meaningful conversion occurs. Most of the buy out effectiveness occurs in both counties by the time that one gets an offer of $90/ac. The cost of the water saved by the buy out becomes substantially more expensive if one interrupts in the middle of the cropping season as prices somewhere around $90/ac need to be paid to get about half as much water as could be gotten under other circumstances.

There are significant springflow implications depending on whether the water is taken from Medina or Uvalde counties. There is a substantial difference in the springflow impacts, as shown in Figures 4 and 5. Namely for roughly the same amount of water taken out of production, you get several times the springflow implications, if eastern water use is curtailed and if one thinks about the cost of springflow, one gets a substantially larger amount of springflow. Additional technical data surrounding these results appears in Tables 2-8.

Task 7 -- Input Output Model of Counties

In order to investigate the compensation questions, input output models were developed for the counties that involve agriculture, namely Bexar, Medina, Uvalde and that part of Kinney which draws from the Edwards Aquifer. In addition, a regional input output model was developed including all these counties. These models were set up so that the individual crops from the ASM model were aggregated into the appropriate IMPLAN sectors for cotton, feed grains, food grains, oilseeds, vegetables, and other agricultural crops in the region. IMPLAN sectors are aggregations of US Department of Commerce Standard Industrial Classification codes.

Input Output analysis provides an efficient method for estimating the secondary impacts on the county and regional economies that derive from adjustments made in irrigated acreage and other changes in agricultural sectors as a result of imposing the dry year option. Input - Output models have been used widely elsewhere to estimate the secondary or third party impacts of resource management changes (Hazen and Sawyer). While there are alternative input - output models available, this project used the proprietary IMPLAN software package program for constructing input-output models because of its timely data base and flexibility for developing regional models. The IMPLAN model is maintained and periodically updated by a commercial company called the Minnesota IMPLAN Group, Inc. Software and data bases are available for purchase from this company.

IMPLAN was used to estimate input-output relationships for the individual counties and an aggregation of counties in the Edwards Aquifer region. Secondary impacts were estimated in terms of: (1) total industry output, (2) wage and salary income, (3) employment, (4) total income, (5) employment and (6) total value added.

Input-Output multipliers for each of these variables for each county and the Edwards Aquifer region as a whole are presented in Appendix D. Results as to the estimated magnitude of secondary impacts arising from alternative, potential agricultural water management scenarios are presented in the following section.

Task 8 -- Investigate compensation mechanisms for secondary impacts

Results on gross revenue from selected irrigated and non irrigated sectors were taken from the farm model solutions analyzing the dry year option. The differences in gross revenue by sector for each county with and without payments for the dry year option at different compensation levels were analyzed. The values of production from each agricultural sector in the non-dry year, free capture scenario were used as the baseline gross revenue estimates. Then, gross revenues were estimated under a dry year several interruption scenarios and gross revenue differences were estimated for each agricultural sector. These differences (reductions in revenues) were used to estimate the secondary impacts on the regional and county economies.

Estimated secondary impacts may be viewed as the levels of compensation required to offset the negative economic effects on third parties that result from imposing the dry year option. No attempts were made to estimate any of the positive economic effects that may arise from the use of water saved in the aquifer by imposing the dry year option and potentially utilized beneficially elsewhere.

8.1 Estimated magnitude of secondary compensation

Three assumptions were made relative to the source and disposition of compensation when the dry year option is implemented by offering farmers a payment or price per acre to participate by reducing their irrigated acreage.

1) Compensation when paid goes to agricultural producers in proportion to the value of their total output and this was drawn from local tax payers in the four county area.

2) Compensation goes to agricultural producers in proportion to their output, but that the

compensation was drawn from outside the region, i.e., external sources such as federal government, the State of Texas and/or private parties such as beneficiaries of water made available with the imposition of the dry year option.

3) Compensation will be spent entirely outside the region having no effect on the local economy. (This scenario is analogous to achieving the same acreage reductions as in (1) and (2) without payment to farmers).

In addition, secondary impacts were estimate for two scenarios that rely on administrative rather than market approaches. These were:

4) A maximum aquifer withdrawal limit of 450,000 acre feet, and

5) A minimum springflow of 150,000 acre feet per year.

Each of these assumptions was investigated for the different compensation levels assumed in the earlier sections of this report. Specifically reported in this section are compensation levels of $10, $60 and $90 per acre for a November determination. Separate estimates were made for the three aquifer recharge levels during the growing season - wet, medium and dry rainfall conditions.

Summaries of the secondary (third party) impacts of these scenarios are presented in Tables 9 through 12 for the Edwards Aquifer Area, Uvalde, Medina and Bexar counties, respectively. Each table shows the secondary impacts of eleven scenarios of the dry year option. The interpretation of individual estimates are identical among the tables presented. For example, scenario 1.2 in Table 9 shows the estimated impacts on the Edwards Aquifer Area of a $60 per acre payment to farmers for irrigated acreage reduction. In this scenario, it is estimated that regional shipments to final demand (consumers, exports from the region, etc.) would fall by $26.2 million, total industrial output by $32.54 million, employee income by $8.1 million, property income by $9.88 million, and total income by almost $18 million. Regional value added would fall by $19.6 million and total regional employment would fall by 487 jobs.

As expected, impacts from the local tax fund assumption are greater than those estimated under outside funds/local expenditures. Estimated regional impacts under local taxation are about the same as those under outside funds/outside expenditures, which assumes that farmers receive no payments for acreage reductions. This result is not unexpected since payments to farmers from within the region would necessarily reduce government spending elsewhere within the economy or require tax increases. Secondary impacts from these alternatives are evidently about the same.

Estimates for the administrative alternatives (450,000and 150,000) are also shown in Table 1. Comparisons between these scenarios and the market oriented scenarios (1 - 3) are not meaningful because reductions in irrigation and gross revenues from crops may not be comparable.

Estimated economic impacts for Uvalde, Medina and Bexar counties are shown in Tables 10-12. As indicated, the values in the tables relating to each scenario and economic variable may be interpreted in the manner as those in Table 9 except that the impacts in each county table are limited to the economy of that county. Since leakages occur among counties in the region, the aggregation of individual county estimates for a given scenario and economic variable may give a larger value than that estimated for the region using the regional input-output model.

A comparison among counties shows that the secondary economic impacts fall greatest on Uvalde and Medina counties (Tables 10 & 11). Secondary impacts are much less in Bexar county and only exist at payment to farmers levels above $90. Estimated impacts were so small in Kinney county that estimates are not shown separately. Kinney county is included in the regional input output model for the entire Edwards Aquifer area.

As suggested earlier, value added may be the most appropriate economic variable upon which to base a compensation program. Value added is an estimate of the returns to locally employed resources (land, labor, capital and management) throughout the regional or county economies. Under local taxation, value added losses to the region ranged from a low of $4.9 million for a payment level of $10 per acre to a high of $36.75 million for a payment level of $90 per acre (Table 9). Compensation in these amounts would approximately equate the losses to the regional economy from a reduction in employment of resources because of the implementation of the dry year option over the range of per acre payments analyzed.

8.2 Alternative mechanisms of secondary impact compensation

Compensation methods or mechanisms may vary widely. In the low level radioactive waste facility citing work in Texas in the 1980's, consideration was given to cash payments to county, school and city governments. Cash payments in lieu of taxes were to be associated with operation of the nuclear waste disposal facility (Jones et al 1993). Similar considerations have be given in certain military base operations (Jones et al 1994).

In the case of the Everglades restoration project several potential secondary impact mitigation or compensation mechanisms were considered, including job retraining and placement for displaced workers (Hazen & Sawyer). In other cases that involve government actions to limit the commercial use of a natural resource, compensation has taken several forms. In 1978 the US Congress passed *The Redwood National Park Expansion Act* This Act used the power of eminent domain to take a significant part the remaining merchantable inventory of old growth redwood timber in California. This act affected directly industrial forest firms in the area. As compensation, the US Treasury paid just compensation that included the value of timber and severance damages for the loss of economic usefulness of mills, roads, etc. Further, secondary impacts were compensated by paying employees affected by the land acquisition. Employees totally or partially laid off because of the Act were entitled to all employment rights and benefits, pensions and welfare trust funds, layoff and vacation replacement benefits and retraining at the expense of the US Government during a period of protection (Berck and Bentley).

In a more recent case involving the Northern Spotted Owl listing as an endangered species, the Bureau of Land Management developed a program to provide grants and benefit payments to communities and employees who were economically dependent on National Forest System lands and public lands administered by the BLM. The objectives of this program were to; 1) to assist communities in achieving economic diversity and decreased dependency on forest products, 2) to supplement unemployment insurance benefits and extend income maintenance payments, 3) to provide short and long term retraining, 4) to provide base level health care insurance and , 5) to defray job search and relocation expenses (US Department of Interior).

Numerous other individual cases could be cited that used various mechanisms to provide compensation to third parties that result from public policy implementation that reduces the commercial use of a natural resource important to the regional economy. In general, compensation programs have focused on payments to communities and to employees that are displaced by the public policy. As is discussed in the following section, many of these compensation programs appear to have been put in place to reduce opposition to the policy and to ease the process of implementation.

A major difference exists between the dry year option and the programs used as examples in this section. It is expected that the dry year option will be an intermittent event and cause temporary displacements whereas the cases cited above caused permanent displacements of economic activity. Implementation of the dry year option would be expected to reduce irrigated acreage only in that year with a return to normal conditions in the following year in most cases. Hence, the need to provide compensation to third parties would be limited to losses only when they occur, usually one year.

Task 9 – Compensation and the Dry Year option

One other item meritorious of discussion regarding compensation relates to who should be compensated. Impact models are normally used to estimate secondary impacts of a policy change, economic structural shift, new industry location, or other event. Secondary impoact estimates are typically used to anticipate and aid in planning for regional economic and social changes brought about by the event. Estimates of negative secondary impacts do not imply that they compensation must be undertaken. Three aspects of the compensation question merit discussion. Is compensation in order, what amount of compensation arises to third parties, and who are the third parties? All these questions will be discussed below.

Is Compensation in Order?

There are three arguments on whether compensation to non farm entities is in order.

First, history seems to indicate that compensation to third parties affected by a specific economic change is rare. We, as a society, have not chosen to compensate rural areas for public policy changes in most cases. Agriculture programs such as the Soil Bank of the 1960's and the Conservation Reserve Program of the 1990's had significant local economic impacts on food and fiber processing plants, input suppliers, communities and other sectors. While farmers were paid to participate in these programs and remove land from production, no compensation was offered to impacted third parties.

We have never required, as a public policy, private owners of assets to compensate a local area when a privately owned asset was closed or its economic use suspended. For example, over the last one hundred years, technological developments in the agricultural and industrial sectors have created mass migrations of people from rural areas to urban areas with no attempt made to compensate the rural areas. Furthermore, when businesses close they have not been required to compensate for the secondary benefits that are lost in the area. The economic argument against compensation has been that resources are mobile and, if displaced due to a policy or technological change, they will find employment elsewhere.

Second, classical economic theory indicates that estimating the appropriate level of compensation within the context of a particular event is difficult. The reason for this is that secondary benefits (costs), while potentially a valid welfare account, are likely offset by secondary costs (benefits) elsewhere. In the dry year option case, benefit and costs would arise by: a) more water being in the springs, b) more water flowing in the rivers downstream, c) sustained endangered species, d) more water available for urban uses, and e) production increases in other areas that replace crop production that ordinarily would have happened in the Edwards area, as well as other benefits. Generally, this compensation question has always been judged too difficult to handle in order to fully account and develop a rational basis for compensation.

Closely related to this problem is the question as to the appropriate source of resources for compensation. For example, let's say that property taxes must be increased in the area to raise funds for compensation to farmers and third parties. Since increases in property taxes will reduce property values, *ceteris paribus*, are the owners of assets upon which the tax is imposed also due compensation?

Third, consideration of an alternative view of compensation to injured third parties may be beneficial in analyzing the dry year option. This view is based more on a strategy for policy implementation than on the traditional evaluation of whether or not third party compensation is justifiable from a social efficiency standpoint. In the past, in cases where the government action brings about an undesirable change in a region, or in some way injures third parties and consequently may be expected to face resistance, compensation has been judged appropriate. For example, in actions on the siting of a hazardous waste facility or closing of a military base, the federal government has engaged in payments and other forms of mitigation to the region to offset secondary economic losses. Moreover, the State of Texas has offered compensation to third parties in the case of the location of low level radioactive waste storage facilities (Jones, et al.). The purpose of these payments appears to be not an attempt to achieve efficiency or equity in policy actions but rather an attempt to increase the acceptability of the action and reduce the transactions costs and time of implementation of the policy. In most cases, compensation has been made to certain governing bodies of the impacted region. No attempt has been made to make direct compensatory payments to owners of resources that become unemployed as a result of the action.

> Compensation to third parties is fraught with difficulties, including decisions as to who should be compensated and by how much. Nevertheless, setting aside the philosophical question of social efficiency, compensation to third parties may be viewed as a practical policy tool that may reduce local resistance and the transaction costs of implementing a public policy.
>
> Numerous recent cases may be cited in which the question of third party impacts has dominated the debate over environmental policy to the extent that implementation has been significantly delayed and policies have been changed. Two of these will suffice. First, the program to protect the Spotted Owl in the northwestern United States became

embroiled in extreme controversy because of its effect on logging, sawmills, rural communities, jobs and income to rural residents in the impact area. The second case involves the restoration of the Florida Everglades which would have an affect on sugarcane producers in South Florida, reduce the amount of land in production and spin-off secondary impacts in the communities where sugarcane production is the primary economic base for the region.

In both these cases, and in others similar, the delayed implementation, high cost of legal and consultant services and other costs significantly affected the overall transaction costs and effectiveness of the programs to address their intended purposes. The development of a program for third party payments may have been feasible in these and/or other public programs. If used as an implementation tool, then third party payments should be evaluated on a cost/benefit basis and used to the extent that the monetary value of the compensation is less than the expected transactions cost if no compensation is made.

In the case of the Edwards Aquifer, proposed programs for changing underwater ground water allocation to anything but absolute capture have generally been met with resistance. Implementing the dry year option will likely be no exception. Any policy to reallocate water may be expected to be viewed an undesirable policy in the areas where water use is reduced. In this case, third party compensation may be a feasible in terms of the cost of implementation.

What Amount of Compensation Aries to Third Parties?

Beyond the question of whether or not third party payments should be made lies the question of how much should payments be. The dry year option differs from the compensation experiences cited above in at least one significant feature. That is, the reallocation of water would be a periodic, annual event rather than a permanent change in water use. Hence, compensation would be due third parties only in the year in which the dry year option is triggered and the amount of compensation would be limited only to annual, temporary losses to third parties.

One criterion for third party compensation could be to guage the amount of compensation against the loss of regional benefits from the employment of local resources that results from the dry year option. Specifically, an annual reallocation of water that reduces its use in agricultural irrigation would further reduce the employment of land, capital, labor and management resources where the reductions occur. The input-output model provides an estimate of this reduction under an aggregate title of Value Added. Value added losses due to the reallocation are estimated by county and sector of the economy and show the estimated loss in returns to land, capital, labor and management within the region. The estimate includes not only the losses from resource unemployment in irrigated agriculture but also the secondary value added losses to input suppliers, processors, and other related, third party sectors in the economy.

Who are the Third Patties?

Typically, policy initiatives that consider third party compensation focus on replacing potential lost revenue for taxing jurisdictions such as schools, county governments, municipalities and special taxing districts. Mechanisms called "payments in lieu of taxes" have been used to compensate public entities in cases where a public facility exists that is tax exempt by law but creates an increase in demand for public services, expenditures and revenue needs. Examples include military bases, public utility generating plants and other similar entities that use and cause an increase in demand for public services but cannot be taxed by local jurisdictions. This mechanism would seem to have limited applicability in the dry year option program since no physical facilities would be put in place within the Edwards region that would stimulate an increase the need for public spending, hence taxes. Moreover, underground water withdrawn from the aquifer for whatever reason is not taxed directly. Compensation would not, therefore, be in lieu of taxes.

Impacts on Public Jurisdictions

A program of payments to public jurisdictions (county, cities and schools) to replace lost taxes because of reduced agricultural production could be considered. However, the temporary and intermittent nature of the dry year option, combined with the tax laws relating to agricultural production, suggest that tax losses to jurisdictions in the Edwards area should be minimal if they exist at all.

Tax losses to local jurisdictions would occur only if the dry year option program caused changes that reduced their most important tax bases. Counties and city governments and school districts depend primarily on property taxes for revenue. Counties and cities also depend to varying degrees on sales taxes. However, implementation of the dry year option is expected to have little or no affect on either of these tax bases because of special treatment given to farmers and ranchers under Texas tax laws. First, both production inputs purchased and commodity sales made farmers and ranchers are exempt from state and local sales taxes. Federal and state fuel taxes are also exempted. Hence, even if purchased inputs, such as seed, fertilizers, pesticides, irrigation equipment, etc. are reduced in the dry year implementation period, there would be no loss in sales taxes since none are paid in the non-dry years.

In the case of property taxes, farmers and ranchers again receive special treatment under Texas law. The Open Space land valuation law (see Article VIII, Sec. 1-d-1, Tx. Const.) was incorporated into the Texas Constitution in 1980. This law allows qualifying land to be taxed on its agricultural productivity value rather than its market value as is other property. The taxable of value of farm and ranch land is estimated using a capitalization formula that considers only the agricultural returns to land along with a capitalization rate that is also determined by law. The result of this law is that virtually all land used for agricultural production in Texas (over 95 percent in Texas) is qualified and taxed on productivity value rather than market value.

Productivity value is typically significantly less than market value. For example, the productivity values and market values of irrigated cropland in Uvalde and Medina counties are compared as follows (Turner):

	Uvalde	Medina
Market Value ($/acre)	713	1250
Productivity Value	308	413

Under the productivity valuation rules, the productivity value cannot exceed the market value. Hence, to have an affect on tax revenues of taxing jurisdictions the dry year option program would have to cause market values of irrigated cropland to fall below the productivity value. Moreover, since landowners of land receive payments for participating in the program, these payments would be a consideration in any irrigated land sales so that the impact on market values should be minimal. Hence, farmers and ranchers would pay taxes based on productivity value in the dry year just like any other year without any affect on the taxing jurisdictions.

In sum, there appears to be no reason to expect that the local taxing jurisdictions in the areas where farmers choose to participate in the dry option would be impacted. The participation payments should offset any losses from reducing irrigated acreage that might affect the market values of land. Further, even if market values were to decline, it is not likely that the decline would be sufficient to cause a shift in the farmland tax base from productivity value to market value.

Private Businesses and Individuals

Reducing irrigated acreage in the Edwards may affect a number of businesses and individuals directly or indirectly related to irrigated crop production. Most directly impacted would be farm labor, businesses that supply productive inputs (mainly irrigation equipment and supplies), agricultural services, and possibly farmers who lease land from owners for irrigated crop production.

Farm Labor.

Irrigated crop production is more labor intensive than dry land crop or livestock production. Hence, it is expected that implementing the dry year option would displace farm workers in the year in which irrigated acreage is reduced. Compensation may be in order for these farm workers since their income loss is directly related to the dry year policy implementation. A program of temporary compensation would be consistent with that suggested by Berck and Hazen and Sawyer.

Cash and Share Leases.

Some of the irrigated agricultural production in the Edwards is carried out by farmers who do not own the land they a farming. Leasing of farmland is a common practice. Typically, landowners (leasers)and farm operators (leases) enter into agreements that state the terms of the lease which may be based on a cash payment per year or on a share to the production earned during the year.

In a cash lease, the landowner typically provides the land and irrigation well and pays property taxes. The lease provides the variable inputs, farming equipment, (capital) labor and management. The amount of cash lease going to the landowner reflects the return to land after all other inputs to production have been paid.

Obviously, a share lease, while variable in nature, is expected to yield about the same return to the landowner as the cash lease. There is a potential for losses of income by leases depending upon the per acre amount of the offer made to landowners to temporarily take their irrigated land out of production. Landowners who lease out their land would be attracted by any offer that is greater than the amount of the cash lease offered leases or the expected amount of returns to land from a share lease. If these landowners enter the program, the lease loses the opportunity for employment of the productive resources contributed by the lease. The amount of the lease's loss in one year would be the expected returns to labor, capital and management.

Owner operators, those who farm their own land, would likely consider the unemployment consequences of resources other than land that they own. Consequently, they would require an offer to participate in the dry year program that is sufficiently large to cover expected returns to land plus returns to fixed capital, operator and family labor and management (Michelson and Young).

This potential third party loss may be avoided in at least two ways. These are; (1) setting the participation bid price sufficiently high to cover the returns to all resources employed in irrigation production, and (2) requiring that both leasers and leases participate in the benefits of the participation offers. This approach should be equally attractive to owner-operators, landowners and farmers who rent land for irrigated production.

Farm Supply and Service Businesses.

A variety of businesses in the Edwards Aquifer area are established and operate to serve the needs of farmers and ranchers. These include farm implement and equipment companies, irrigation equipment suppliers, input supply companies, custom service operations, etc. The dry year option could impact these businesses as farmers reduce their use of purchased inputs, use less services, and delay investments in machinery and equipment. For most purchases that farmers make, the local businesses earn a wholesale and/or retail margin from the sale of inputs, machinery and equipment that is manufactured outside the region. In dry years, businessmen who supply farmers would be expected to make reductions in orders of materials, equipment and other items purchased for resale during the production year. In this case, the loss to local businesses is limited to the reduced wholesale and retail margins foregone because of reduced sales to farmers who participate in the program. Also, these businesses may also cut back on employees. This would reduce personal income in the locale and have subsequent impacts on retail sales, business and personal service businesses, banks and other businesses that depend primarily upon the local markets for sales of their goods and services.

Speciality Production and Marketing Systems

Within the Edwards Underground Aquifer area, there exist a variety of speciality agricultural production and marketing systems that are integrated or coordinated by use of contracts from production to final consumer. These systems focus primarily on vegetable production and corn for human consumption.

These systems typically serve "niche" or speciality markets, unlike major field crops that sell commodities into a national market. An important ingredient in a coordinated, speciality system is the dependability of supply for specific consumer markets such as restaurants and brand name products. Should the irrigated acreage serving these systems be reduced within the area, adjustments would need to be made elsewhere to sustain the supply of products and efficient alternatives may be limited.

In sum, the dry year option program presents questions relative to third party payments that are quite different from previous public programs adopted to manage natural resources. At this time, it is expected that implementation of the dry year option will be a temporary, annual event which should serve to minimize the impacts on private third parties and on public service providers. The magnitude of these intermittent impacts will depend upon the amount of irrigated land that enters the dry year option program and leaves production in a given year. Of course, the loss of one year's business can be a severe impact for some businesses, but not as severe as the permanent removal of land or other resources as is the case in most previous natural resource management programs.

Task 10 -- Delivery of Models

A lot of assumptions are utilized above in setting up and examining the dry year option, some of which may not be absolutely in accord with the way the dry year option is eventually set up and/or there may be alternative ways that the agricultural producers might respond. Thus, we have developed a transportable model in which assumptions may be modified. We hereby are delivering to the Water Development Board a set of code that allows examination of alternative setups. In particular, we are delivering the base data on the file EDDATA(which is listed in lines 1-6614 of appendix A), the model which simulates the cutoffs which is AGMODEL (and is listed in lines 6615-15067 of appendix A), and the file DRYSTUDY (which simulates the policies listed in lines 15068-15398 of appendix A). Collectively this code composes the total model and analysis.

We are prepared to deliver a disk copy of the model including all related files. However, we cannot deliver the input output model, just the multipliers as we are contractually obligated by the IMPLAN developers to not redistribute the software. If the Board chooses to purchase the IMPLAN software we certainly can make available the procedures for the aggregation and analysis. We also will give a College Station workshop and answer follow up phone queries on the use of these two analysis packages on Feburary 4. 1997.

Task 11 -- Municipal and Industrial Demand

One of the tasks promised in the original write up was development of a composite municipal and industrial demand curve. While in the face of the dry year option, as is currently proposed, we do not think this is absolutely a desirable item to have, we did generate this any way. In this generation, what we did was setup a municipal and industrial only model and observed how much water municipal and industrial interests would buy using the same pumping lifts as in the agricultural model. Here we varied the water price above pumping costs from $0-500. This yielded observations for each recharge years considered as well as average results. Table 13 gives the amount of recharge and the probability of each of the recharge years, while Table 14 gives the usage in an average year and then the usage in each of the recharge years. As can be seen from the table, water use varied from 336,482 acre feet when water was not priced (a zero price was used) to 132,508 ac/ft when a $500 charge was used. Also note higher water usage occured under the drier years and lower water usage in the wetter years.

Figure 1. Difference between Agricultural usage in free capture versus cooperative context

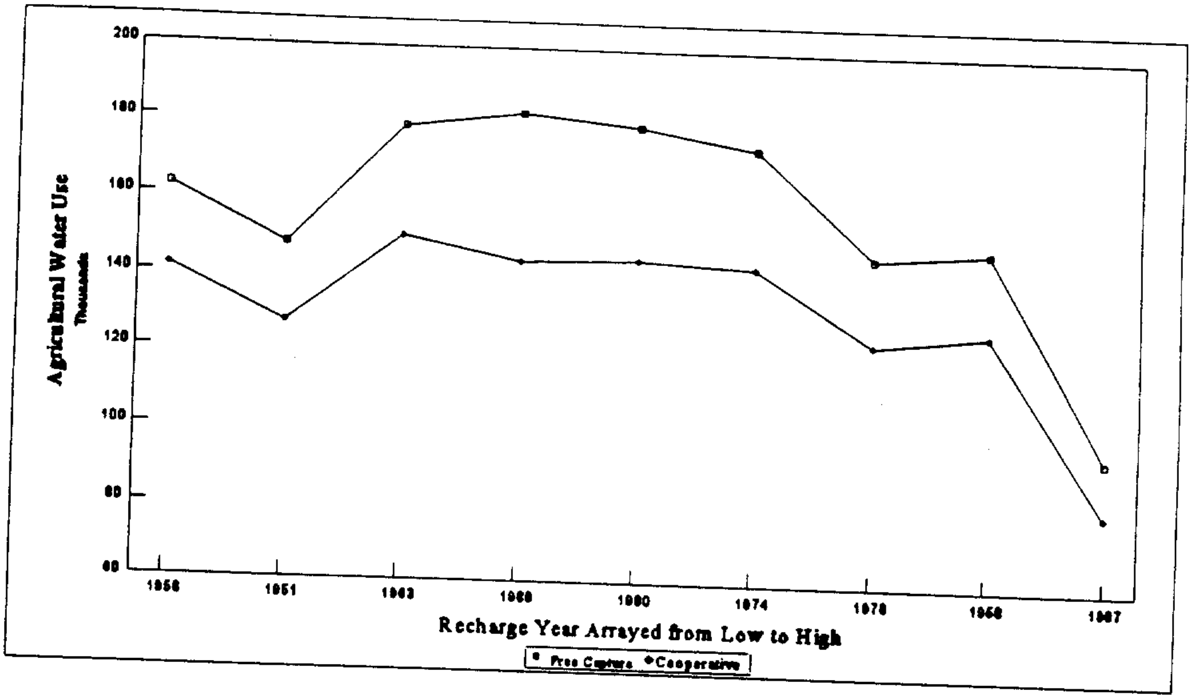

Table 1. Regression Coefficients for Annual Comal and San Marcos Springflow, and J17 and Sabinal Index Well Ending Elevations.				
	Comal Springflow (acre feet)	San Marcos Springflow (acre feet)	J17 Ending Elevation	Sabinal Ending Elevation
			(feet above sea level)	
J17 Starting Elevation (feet above sea level)	2,651	412	0.34	0.28
Sabinal Starting Elevation (feet above sea level)	551	0.0	0.17	0.57
Annual Recharge (acre feet)	0.080	0.024	0.000015	0.000022
Western Pumping (acre feet)	-0.04	-0.0005	-0.000024	-0.000088
Eastern Pumping (acre feet)	-0.28	-0.025	-0.000113	-0.000050
Intercept	-1924677	-203976	321	150
R-Square	0.93	0.77	0.95	0.96

Figure 2. Amount of agricultural Irrigated Land use Reduction by dry year option plans

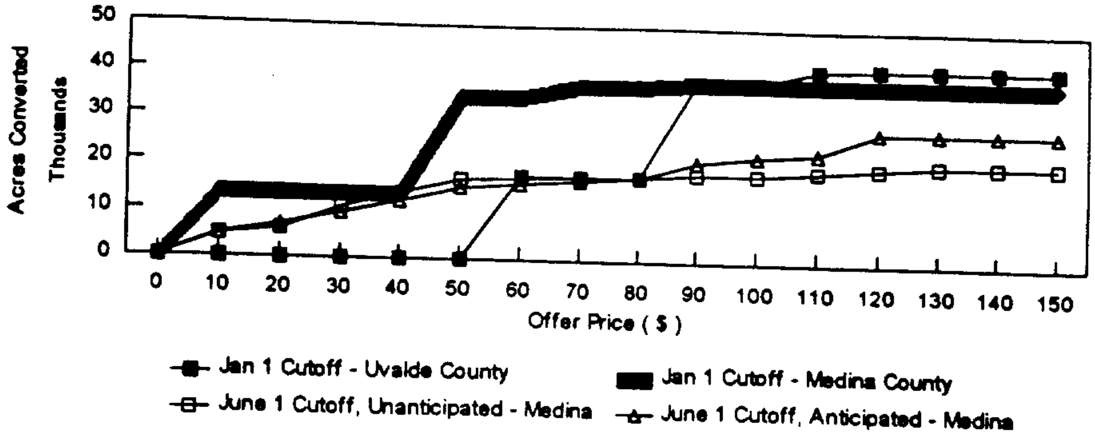

Figure 3. Amount of Agricultural Water use Reduction by dry year option plans

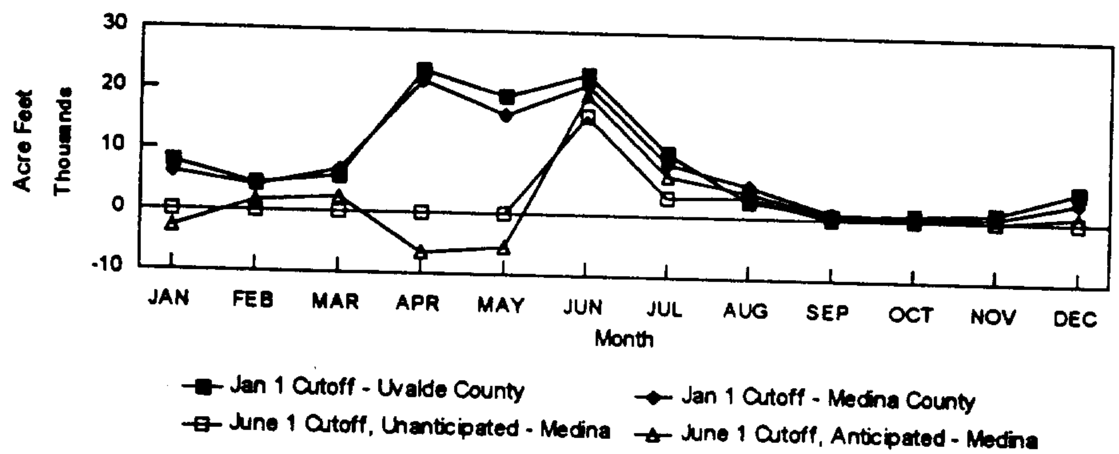

Figure 4. Amount of Comal Spring Flow Increase by dry year option plans

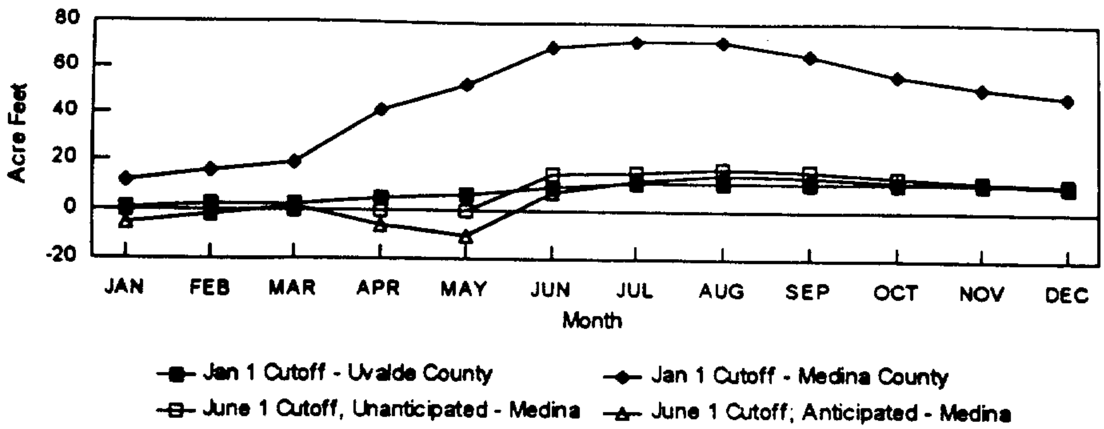

Figure 5. Water Use reduction and Springflow Increase

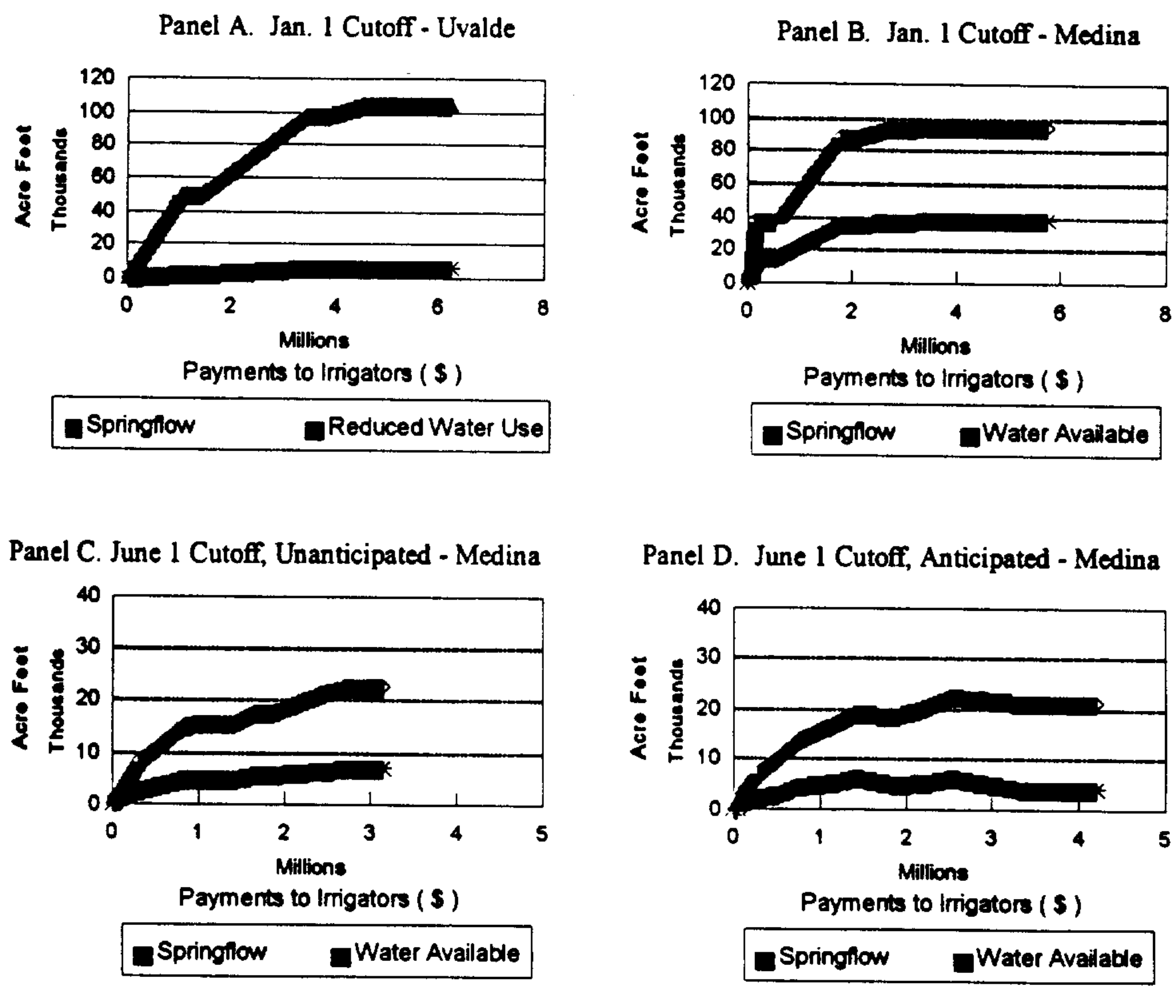

Table 2. Response to Offer Price of Implementing a Dry Year Option: January 1st Cutoff - Uvalde and Kinney Counties.

Offer Price	Type of Land Use				Irrigation Water		Springflow Response		Agricultural Income			Cost of Program			
	Total	Irrigated		Dryland	Applied	Amount of Reduction	Total	Comal		From		Cost of Water		Cost of Springflow	
		Furrow	Sprinkler				Current Yr.	August	Total	Operation	Total	Average	Marginal	Marginal	Average
($)	(Acres)	(Acres)	(Acres)	(Acres)	(AF)	(AF)	(AF)	(CFS)	($)	($)	($)	($/AF)	($/AF)	($/AF)	($/AF)
0	41,560	28,357	13,203	0	104,516	0	0	0.00	2,813,701	2,813,701	0	0	inf	inf	0
10	41,560	28,357	13,203	0	104,551	0	0	0.00	2,813,707	2,813,707	0	0	inf	inf	0
20	41,560	28,357	13,203	0	104,551	0	0	0.00	2,813,707	2,813,707	0	0	inf	inf	0
30	41,560	28,357	13,203	0	104,551	0	0	0.00	2,813,707	2,813,707	0	0	inf	inf	0
40	41,560	28,357	13,203	0	104,551	0	0	0.00	2,813,707	2,813,707	0	0	inf	inf	0
50	41,560	28,357	13,203	0	104,551	0	0	0.00	2,813,707	2,813,707	0	0	inf	inf	0
60	23,941	10,738	13,203	17,618	54,895	49,621	2,789	5.55	3,168,235	2,111,155	1,057,080	93	93	379	379
70	23,941	10,738	13,203	17,618	54,895	49,621	2,789	5.55	3,344,415	2,111,155	1,233,260	109	inf	inf	442
80	23,941	10,738	13,203	17,618	54,895	49,621	2,789	5.55	3,520,595	2,111,155	1,409,440	124	inf	inf	505
90	3,265	0	3,265	38,294	6,092	98,424	5,507	10.93	4,550,983	1,104,523	3,446,460	153	214	879	626
100	3,265	0	3,265	38,294	6,092	98,424	5,507	10.93	4,933,923	1,104,523	3,829,400	170	inf	inf	695
110	234	0	234	41,326	448	104,068	5,812	11.53	5,483,934	938,074	4,545,860	191	851	3,010	782
120	0	0	0	41,560	0	104,516	5,836	11.58	5,908,681	921,481	4,987,200	208	4,304	18,194	855
130	0	0	0	41,560	0	104,516	5,836	11.58	6,324,281	921,481	5,402,800	226	inf	inf	926
140	0	0	0	41,560	0	104,516	5,836	11.58	6,739,881	921,481	5,818,400	243	inf	inf	997
150	0	0	0	41,560	0	104,516	5,836	11.58	7,155,481	921,481	6,234,000	260	inf	inf	1,068

Table 3. Response to Offer Price of Implementing a Dry Year Option : January 1st Cutoff - Medina and Bexar Counties

Offer Price	Type of Land Use				Irrigation Water		Springflow Response		Agricultural Income			Cost of Program			
	Total	Irrigated				Amount of Reduction	Total	Comal		From		Cost of Water		Cost of Springflow	
		Furrow	Sprinkler	Dryland	Applied		Current Yr.	August	Total	Operation	Total	Average	Marginal	Marginal	Average
($)	(Acres)	(Acres)	(Acres)	(Acres)	(AF)	(AF)	(AF)	(CFS)	($)	($)	($)	($/AF)	($/AF)	($/AF)	($/AF)
0	38,332	26,982	11,350	0	94,397	0	0	0.00	1,374,515	1,374,515	0	0	inf	inf	
10	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	1,602,128	1,463,278	138,850	4	4	9	0
20	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	1,740,978	1,463,278	277,700	8	inf	inf	9
30	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	1,879,828	1,463,278	416,550	11	inf	inf	18
40	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	2,018,678	1,463,278	555,400	15	inf	inf	28
50	3,531	0	3,531	34,801	6,737	87,660	35,491	66.86	2,899,836	1,159,786	1,740,050	20	32	78	37
60	3,531	0	3,531	34,801	6,737	87,660	35,491	66.86	3,247,846	1,159,786	2,088,060	24	inf	inf	49
70	950	0	950	37,382	1,858	92,538	37,403	70.45	3,736,095	1,119,355	2,616,740	28	180	458	59
80	950	0	950	37,382	1,858	92,538	37,403	70.45	4,109,915	1,119,355	2,990,560	32	inf	inf	70
90	0	0	0	38,332	0	94,397	38,132	71.81	4,530,525	1,080,645	3,449,880	37	448	1,143	80
100	0	0	0	38,332	0	94,397	38,132	71.81	4,913,845	1,080,645	3,833,200	41	inf	inf	90
110	0	0	0	38,332	0	94,397	38,132	71.81	5,297,165	1,080,645	4,216,520	45	inf	inf	101
120	0	0	0	38,332	0	94,397	38,132	71.81	5,680,485	1,080,645	4,599,840	49	inf	inf	111
130	0	0	0	38,332	0	94,397	38,132	71.81	6,063,805	1,080,645	4,983,160	53	inf	inf	121
140	0	0	0	38,332	0	94,397	38,132	71.81	6,447,125	1,080,645	5,366,480	57	inf	inf	131
150	0	0	0	38,332	0	94,397	38,132	71.81	6,830,445	1,080,645	5,749,800	61	inf	inf	141
															151

Table 4. Response to Offer Price of Implementing a Dry Year Option June 1 Cutoff, Unanticipated, Medina and Bexar Counties.

Offer Price	Total	Type of Land Use: Irrigated: Furrow	Type of Land Use: Irrigated: Sprinkler	Type of Land Use: Dryland	Irrigation Water: Applied	Irrigation Water: Amount of Reduction	Springflow Response: Total Current Yr.	Springflow Response: Comal August	Agricultural Income: Total	Agricultural Income: From Operation	Agricultural Income: From Total	Cost of Program: Cost of Water: Average	Cost of Program: Cost of Water: Marginal	Cost of Program: Cost of Springflow: Marginal	Cost of Program: Cost of Springflow: Average
($)	(Acres)	(Acres)	(Acres)	(Acres)	(AF)	(AF)	(AF)	(CFS)	($)	($)	($)	($/AF)	($/AF)	($/AF)	($/AF)
0	38,332	26,982	11,350	0	94,397	0	0	0.00	1,374,515	1,374,515	0	0	0	0	0
10	33,845	23,762	10,083	4,487	92,972	1,425	470	1.15	1,403,547	1,358,675	44,872	31	31	96	96
20	32,437	22,748	9,689	5,895	91,441	2,955	960	2.38	1,453,702	1,335,804	117,898	40	48	149	123
30	27,743	18,993	8,749	10,589	86,051	8,346	2,665	6.73	1,538,065	1,220,385	317,680	38	37	117	119
40	24,749	17,736	7,013	13,583	83,241	11,156	3,556	8.99	1,651,353	1,108,036	543,317	49	80	253	153
50	21,587	14,825	6,763	16,745	79,304	15,092	4,829	12.17	1,813,155	975,916	837,239	55	75	231	173
60	21,126	14,748	6,378	17,206	78,968	15,429	4,939	12.44	1,984,319	951,981	1,032,338	67	580	1,760	209
70	20,937	14,668	6,269	17,395	78,837	15,560	4,983	12.54	2,158,018	940,368	1,217,650	78	1,413	4,288	244
80	20,937	14,668	6,269	17,395	78,837	15,560	4,983	12.54	2,331,968	940,368	1,391,600	89	inf	inf	279
90	19,956	13,687	6,269	18,376	76,810	17,586	5,509	14.18	2,509,058	855,261	1,653,797	94	215	828	300
100	19,886	13,617	6,269	18,446	76,677	17,720	5,545	14.28	2,693,329	848,773	1,844,556	104	1,428	5,273	333
110	19,046	12,777	6,269	19,286	75,248	19,148	5,943	15.44	2,883,393	761,933	2,121,460	111	194	696	357
120	18,055	11,786	6,269	20,277	73,211	21,186	6,474	17.08	3,082,071	648,817	2,433,253	115	153	588	376
130	17,262	10,993	6,269	21,070	71,863	22,533	6,850	18.16	3,288,346	549,246	2,739,100	122	227	815	400
140	17,262	10,993	6,269	21,070	71,863	22,533	6,850	18.16	3,499,046	549,246	2,949,800	131	inf	inf	431
150	17,262	10,993	6,269	21,070	71,863	22,533	6,850	18.16	3,709,746	549,246	3,160,500	140	inf	inf	461

Table 5. Response to Offer Price of Implementing a Dry Year Option June 1 Cutoff, Anticipated with 48% Probability, Medina and Bexar Counties

Offer Price	Total	Type of Land Use: Irrigated Furrow	Type of Land Use: Irrigated Sprinkler	Type of Land Use: Dryland	Irrigation Water: Applied	Irrigation Water: Amount of Reduction	Springflow Response: Total Current Yr.	Springflow Response: Comal August	Agricultural Income: Total	Agricultural Income From: Operation	Agricultural Income From: Total	Cost of Program: Cost of Water Average	Cost of Program: Cost of Water Marginal	Cost of Program: Cost of Springflow Marginal	Cost of Program: Cost of Springflow Average
($)	(Acres)	(Acres)	(Acres)	(Acres)	(AF)	(AF)	(AF)	(CFS)	($)	($)	($)	($/AF)	($/AF)	($/AF)	($/AF)
0	38,332	26,982	11,350	0	94,397	0	0	0.00	1,374,515	1,374,515	0	0	0	0	0
10	33,787	23,704	10,083	4,545	93,766	631	122	0.51	1,412,152	1,366,699	45,453	72	72	373	373
20	31,373	21,684	9,689	6,959	90,165	4,232	1,367	3.41	1,468,960	1,329,782	139,178	33	26	75	102
30	28,738	19,955	8,783	9,594	87,181	7,216	2,337	5.82	1,554,415	1,266,589	287,826	40	50	153	123
40	26,215	19,203	7,013	12,117	84,868	9,528	3,087	7.68	1,656,287	1,171,618	484,670	51	85	262	157
50	23,456	16,694	6,763	14,876	80,681	13,716	4,529	11.06	1,802,857	1,059,068	743,789	54	62	180	164
60	22,365	15,987	6,378	15,967	78,577	15,820	5,196	12.75	1,958,205	1,000,187	958,018	61	102	321	184
70	21,755	15,486	6,269	16,577	77,373	17,023	5,562	13.72	2,121,298	960,939	1,160,359	68	168	553	209
80	20,773	14,646	6,127	17,559	75,352	19,045	6,196	15.32	2,297,403	892,683	1,404,720	74	121	385	227
90	17,280	11,211	6,069	21,052	75,555	18,842	5,092	14.63	2,669,370	774,690	1,894,680	101	inf.	inf	372
100	16,182	10,657	5,525	22,150	74,088	20,308	5,396	15.68	2,919,469	704,425	2,215,044	109	641	6,275	410
110	15,239	9,714	5,525	23,093	71,808	22,588	6,128	17.51	3,146,362	606,132	2,540,230	112	143	445	415
120	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	3,804,981	435,741	3,369,240	160	inf	inf	834
130	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	4,085,751	435,741	3,650,010	174	inf	inf	904
140	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	4,366,521	435,741	3,930,780	187	inf	inf	974
150	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	4,647,291	435,741	4,211,550	200	inf	inf	1,043

Table 6. Effects of Offering $50 per Acre Not to Irrigate while Implementing a Dry Year Option in Medina and Bexar Counties

	Scenario		
	January 1 Cutoff	June 1 Cutoff (Unanticipated)	June 1 Cutoff (Anticipated)
Type of Land Use:			
Furrow Irrigation (acres)	0	14,825	16,694
Sprinkler Irrigation (acres)	3,531	6,763	6,763
Total Irrigated Acres	3,531	21,587	23,456
Acre Converted to Dryland	34,801	16,745	14,876
Total Acres	38,332	38,332	38,332
Irrigation Water:			
Applied	6,737	79,304	80,681
Reduction	87,660	15,092	13,716
Amount Used w/o Payment	94,397	94,397	94,397
Springflow Response:			
Current Year (Acre feet)	35,491	4,829	4,529
Comal - August (cfs)	66.86	12.17	11.06
Agricultural Income:			
From Operation ($)	1,159,786	975,916	1,059,068
Payments ($)	1,740,050	837,239	743,789
Total Agricultural Income	2,899,836	1,813,155	1,802,857
Cost of Implementing Program:			
Total Cost ($)	1,740,050	837,239	743,789
Cost of Water:			
Average Cost ($/Acre feet)	20	55	54
Marginal Cost ($/Acre feet)	32	75	62
Cost of Comal Springflow:			
Average Cost ($/Acre feet)	49	173	164
Marginal Cost ($/Acre feet)	78	231	180

Table 7. Potential Water Use Reduction from Implementing a Dry Year Option (Acre Feet).

County	Strategy	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Uvalde	Jan 1 Cutoff	7,947	4,527	5,796	23,365	19,090	23,012	10,313	2,605	798	821	1,255	4,987	104,515
Medina	Jan 1 Cutoff	6,135	4,050	6,838	21,605	15,937	21,097	8,377	5,046	849	539	687	3,236	94,396
Medina	June 1 Cutoff Unanticipated	0	0	0	0	0	16,096	3,057	3,380	0	0	0	0	22,532
Medina	June 1 Cutoff Anticipated	(2,781)	1,675	2,163	(6,746)	(5,568)	19,512	6,641	4,137	633	436	110	801	21,014

Table 8. Potential Springflow Effect from Implementing a Dry Year Option - Comal Springs (CFS).

County	Strategy	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Uvalde		0.22	1.87	2.15	5.10	7.00	10.32	11.71	11.58	12.05	11.38	11.44	10.49
Medina	Jan 1 Cutoff	11.61	15.71	19.79	42.17	53.16	69.28	71.65	71.81	66.05	57.28	51.86	48.45
Medina	June 1 Cutoff Unanticipated	0.00	0.00	0.00	0.00	0.00	14.74	16.33	18.16	16.55	14.27	12.82	11.56
Medina	June 1 Cutoff Anticipated		(1.71)	1.23	(6.21)	(10.97)	7.56	12.70	15.34	14.44	12.73	11.50	10.79

Table 9. Analysis of Regional Economic Impacts from the " Dry Year Option " for the Edwards Aquifer Area, by Selected Scenario

Scenario	Economic Impact Variables Estimated						
	Final Demand (MM$)	Industrial Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total Income (MM$)	Value Added (MM$)	Employment (Number of Jobs)
1. Price offers with payments made from inside the region							
1.1 $10	-6.67	-8.38	-1.48	-2.97	-4.44	-4.90	-112.00
1.2 $60	-26.20	-32.54	-8.11	-9.88	-17.99	-19.62	-487.00
1.3 $90	-48.53	-59.99	-16.80	-17.07	-33.88	-36.75	-931.00
2. Price offers with payments made from outside the region							
2.1 $10	-6.43	-8.11	-1.29	-2.94	-4.23	-4.68	-106.00
2.2 $60	-21.41	-27.24	-4.50	-9.33	-13.83	-15.25	-370.00
2.3 $90	-36.58	-46.76	-7.79	-15.71	-23.49	-25.82	-639.00
3. Price offers without benefits from payments to farmers							
3.1 $10	-6.79	-8.99	-1.50	-3.22	-4.72	-5.23	-119.00
3.2 $60	-25.98	-34.57	-5.97	-11.83	-17.81	-19.67	-475.00
3.3 $90	-47.54	-63.44	-11.02	-21.42	-32.44	-35.81	-876.00
4. Administrative maximum aquifer withdrawal of 450,000 ac.ft.	-12.47	-15.74	-2.49	-5.70	-8.19	-9.04	-205.00
5. Administrative minimum springflow of 100,000 ac.ft	-8.24	-10.42	-1.65	-3.74	-5.39	-5.94	-136.00

Table 10. Analysis of Regional Economic Impacts from the " Dry Year Option " for the Uvalde County, by Selected Scenario

Scenario	Economic Impact Variables Estimated						
	Final Demand (MM$)	Industrial Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total Income (MM$)	Value Added (MM$)	Employment (Number of Jobs)
1. Price offers with payments made from inside the region							
1.1 $10 (N/A)							
1.2 $60	-13.20	-20.01	-5.01	-5.59	-10.60	-11.56	-349.00
1.3 $90	-29.64	-44.43	-12.47	-11.81	-24.28	-26.38	-814.00
2. Price offers with payments made from outside the region							
2.1 $10 (N/A)							
2.2 $60	-10.99	-17.25	-3.27	-5.24	-8.51	-9.32	-271.00
2.3 $90	-22.44	-35.42	-6.77	-10.66	-17.44	-19.08	-559.00
3. Price offers without benefits from payments to farmers							
3.1 $10 (N/A)							
3.2 $60	-12.42	-19.26	-3.58	-5.96	-9.54	-10.47	-296.00
3.3 $90	-27.18	-42.13	-7.82	-13.06	-20.88	-22.91	-647.00
4. Administrative maximum aquifer withdrawal of 450,000 ac.ft.	-7.03	-10.43	-1.72	-3.65	-5.37	-5.88	-147.00
5. Administrative minimum springflow of 100,000 ac.ft	-5.69	-8.52	-1.43	-2.90	-4.33	-4.74	-121.00

Table 11. Analysis of Regional Economic Impacts from the " Dry Year Option " for the Medina County, by Selected Scenario

Scenario	Economic Impact Variables Estimated						
	Final Demand (MM$)	Industrial Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total Income (MM$)	Value Added (MM$)	Employment (Number of Jobs)
1. Price offers with payments made from inside the region							
1.1 $10	-6.17	-8.43	-1.16	-3.21	-4.36	-4.81	-108.00
1.2 $60	-14.13	-19.03	-4.51	-6.16	-10.67	-11.68	-339.00
1.3 $90	-16.32	-21.83	-6.26	-6.45	-12.71	-13.87	-443.00
2. Price offers with payments made from outside the region							
2.1 $10	-5.82	-7.99	-0.91	-3.14	-4.05	-4.46	-93.00
2.2 $60	-10.01	-13.79	-1.56	-5.36	-6.92	-7.61	-159.00
2.3 $90	-9.69	-13.39	-1.50	-5.16	-6.66	-7.32	-153.00
3. Price offers without benefits from payments to farmers							
3.1 $10	-6.00	-8.23	-0.94	-3.24	-4.18	-4.61	-96.00
3.2 $60	-12.15	-16.64	-1.90	-6.57	-8.46	-9.34	-195.00
3.3 $90	-13.12	-17.98	-2.05	-7.10	-9.14	-10.09	-211.00
4. Administrative maximum aquifer withdrawal of 450,000 ac.ft.	-5.30	-7.25	-0.82	-2.86	-3.69	-4.07	-85.00
5. Administrative minimum springflow of 100,000 ac.ft	-2.57	3.50	-0.40	-1.40	-1.80	-1.99	-41.00

Table 12. Analysis of Regional Economic Impacts from the " Dry Year Option " for the Bexar County, by Selected Scenario

Scenario	Economic Impact Variables Estimated						
	Final Demand (MM$)	Industrial Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total Income (MM$)	Value Added (MM$)	Employment (Number of Jobs)
1. Price offers with payments made from inside the region							
1.1 $10 (N/A)							
1.1 $60 (N/A)							
1.3 $90	-4.72	-5.59	-1.45	-1.78	-3.23	-3.48	-78.00
2. Price offers with payments made from outside the region							
2.1 $10 (N/A)							
2.2 $60 (N/A)							
2.3 $90	-3.56	-4.32	-0.58	-1.65	-2.23	-2.42	-51.00
3. Price offers without benefits from payments to farmers							
3.1 $10 (N/A)							
3.2 $60 (N/A)							
3.3 $90	-4.46	-5.51	-0.77	-2.12	-2.89	-3.16	-66.00
4. Administrative maximum aquifer withdrawl of 450,000 ac.ft (N/A)							
5. Administrative minimum springflow of 100,000 ac.ft. (N/A)							

Table 13. Level and probability of recharge by year

	AMOUNT	PROB
1956	43758	2
1951	140097	2
1963	170756	9
1989	214455	14
1980	406301	21
1974	658447	21
1976	894088	21
1958	1710171	7
1987	2003643	2

Table 14. Municipal and Industrial Water Use for Different Prices and Recharge Years

PRICE LEVEL	AVG	1956	1951	1963	1989	1980	1974	1976	1958	1987
PRICE0	336482	354971	348255	347465	344001	345968	331572	320261	335478	334887
PRICE10	311557	329103	322731	321963	318728	320472	306980	296362	310133	309458
PRICE20	292358	309005	302990	302292	299225	300803	288041	277984	290715	289976
PRICE30	276931	292846	287140	286439	283529	284990	272829	263236	275168	274356
PRICE40	264156	279446	273988	273305	270519	271886	260233	251035	262321	261501
PRICE50	253331	268083	262841	262157	259483	260777	249562	240703	251457	250631
PRICE60	243994	258264	253187	252550	249961	251190	240356	231795	242102	241261
PRICE70	235822	249674	244767	244128	241621	242797	232300	224003	233915	233096
PRICE80	228584	242057	237266	236668	234232	235362	225166	217104	226683	225857
PRICE90	222110	235238	230589	229990	227620	228710	218785	210935	220215	219402
PRICE100	216270	229081	224549	223965	221654	222708	213029	205372	214385	213583
PRICE125	203837	215968	211688	211131	208946	209928	200777	193534	201987	201200
PRICE150	193710	205285	201202	200671	198590	199514	190796	183894	191899	191137
PRICE175	185234	196334	192423	191912	189920	190797	182445	175831	183464	182719
PRICE200	177995	188686	184921	184430	182512	183350	175311	168945	176264	175537
PRICE225	171709	182044	178409	177930	176078	176882	169118	162968	170016	169309
PRICE250	166179	176196	172677	172211	170416	171191	163669	157710	164522	163830
PRICE275	161259	170992	167571	167121	165378	166128	158822	153033	159635	158959
PRICE300	156842	166320	162992	162552	160855	161582	154470	148834	155250	154589
PRICE325	152844	162091	158844	158416	156761	157468	150532	145036	151283	150634
PRICE350	149203	158240	155067	154647	153030	153720	146944	141575	147669	147033
PRICE375	145865	154705	151602	151192	149611	150284	143656	138403	144357	143731
PRICE400	142790	151450	148412	148009	146460	147118	140626	135481	141307	140692
PRICE425	139943	148436	145457	145062	143544	144187	137822	132777	138484	137880
PRICE450	137297	145635	142711	142323	140833	141463	135216	130264	135860	135265
PRICE475	134829	143022	140149	139768	138304	138922	132784	127919	133413	132829
PRICE500	132519	140575	137750	137376	135936	136543	130508	125725	131123	130545

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Appendix A.GAMS code for system

```
INCLUDE    /mac/mccarl/edwards/dryyear/eddata
*    cccccccccccccccccccccccccccccccccccccccccccccccccccccc

*    Monthly Input data for Edwards Aquifer Optimization Model

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccc
*    Uses original EPIC data (twdbnew) and new irrigation acrage.
*    Note: This data combines 6 ag counties into 2 ag counties.

OPTION ITERLIM = 1000000;
OPTION RESLIM = 1000000;

Set    Zonall           Lift Zones plus total / 1,2,3,All /
       Zone(Zonall)     Lift Zones for Irrigated Agriculture
                        / 1,2,3 /
*                        / 1 /

       YEAR     YEARS IN MODEL / 1956, 1951, 1954, 1953, 1963, 1948,
                                 1934, 1955, 1984, 1950, 1989, 1962,
                                 1943, 1952, 1940, 1988, 1939, 1937,
                                 1980, 1964, 1983, 1982, 1947, 1938,
                                 1967, 1978, 1949, 1945, 1946, 1942,
                                 1944, 1969, 1966, 1965, 1974, 1970,
                                 1959, 1961, 1972, 1960, 1941, 1968,
                                 1976, 1936, 1971, 1977, 1975, 1985,
                                 1979, 1957, 1986, 1935, 1981, 1973,
                                 1958, 1987, Ave /

       RECHARGall(year)  All Recharge Years (States of Nature)
*        Original recharge years, reduced set below now used.
         /1956, 1951, 1963, 1989, 1952, 1988, 1980, 1982, 1969,
          1974, 1972, 1976, 1977, 1979, 1981, 1958, 1987 /

*   cccccccccccccccccccccccccccccccccccccccccccc
*     Choose Set of Recharge Years
  recharge(rechargall) reduced set used in the model
              /1956,1951,1963,1989,1980,1974,1976,1958,1987/;
*    / 1989, 1987 / ;
*   cccccccccccccccccccccccccccccccccccccccccccc


SETS  DATES(YEAR,YEAR)  YEARS REPRESENTED BY A RECHARGE STATE OF NATURE
      / 1956.  1956 ,
        1951.  1951 ,
        1963. (1954,1953,1963,1948,1934) ,
        1989. (1955,1984,1950,1989,1962,1943,1952,1940) ,
        1980. (1988,1939,1937,1980,1964,1983,1982,1947,1938,
               1967,1978,1949) ,
        1974. (1945,1946,1942,1944,1969,1966,1965,1974,1970,
               1959,1961,1972) ,
        1976. (1960,1941,1968,1976,1936,1971,1977,1975,1985,
               1979,1957,1986) ,
        1958. (1935,1981,1973,1958) ,
        1987.  1987 / ;

 PARAMETER
   NDAT                          Total Number of Years
   PROB(YEAR)                    RECHARGE PROBABILITIES
   NRech(rechargAll)             Number of Years in each Group ;

   NDAT =  SUM((RECHARGE,YEAR)$DATES(RECHARGE,YEAR),1);
   NRech(recharge) = Sum(Year$Dates(recharge,year),1) ;
   PROB(RECHARGE) =  NRech(recharge) / NDAT ;

SET     GROUPS        COUNTY GROUPINGS      /UVALDE,KINNEY,MEDINA,
                                             BEXAR ,COMAL ,HAYS,TOTAL/

        COUNTYS(GROUPS)     COUNTIES             /UVALDE,KINNEY,MEDINA,
                                                  BEXAR ,COMAL ,HAYS/

        COUNTY(COUNTYS) COUNTIES FOR TESTING ;
*       COUNTY(COUNTYS) = NO;COUNTY("UVALDE")=YES;COUNTY("Bexar")=YES;
        COUNTY(COUNTYS) = YES;

SETS CROPS    CROPS IN THE MODEL
      / corn            (bu.)
        sorghum         (cwt)
        winwht          Winter Wheat (bu.)
        oats            Grazing Oats (days)
        soybeans        (bu.)
        peanuts         Spanish Peanuts (cwt)
        hay             Hay other than Sorghum Hay (ton)
        sorghay         Sorghum Hay (ton)
        cotton          (lb.)
        cabbage         (bag)
        cantalop        (crtn)
        cucumber        (crtn)
        onion           (bag)
        lettuce         (crtn)
```

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          carrot            (bag)
          SPINACH           (bu.)
          peppers           (crtn)
          honeydew          (crtn)
          potato            (cwt)
          swtcorn           Corn for Food (bu.)
          tomato            (crtn)
          watermel          (cwt)
          guar              (cwt)
          sesame            (cwt)    /

      Crops2(Crops)    Crops used in EPIC crop simulator
       /corn,sorghum,winwht,cabbage,cantalop,cucumber,oats
        onion,lettuce,carrot,PEANUTS,SPINACH ,SORGHAY,cotton /

      Crops1(Crops)    Crops NOT used in EPIC crop simulator

      Crop(Crops)  Crops for testing
      Crop2(Crops) CROPS FOR TESTING - EPIC crops
      Crop1(Crops) CROPS FOR TESTING - non-EPIC crops
      ;
         Crops1(Crops) = yes ;
         Crops1(Crops2) = no ;
         Crops1("guar") = no ;
         Crops1("sesame") = no ;
         Crop2(Crops2) = Yes ;
         Crop1(Crops1) = Yes ;
         Crop(Crop1) = yes ;
         Crop(Crop2) = yes ;


SETS
       GROUP         COUNTY GROUPINGS    /UVALDE, KINNEY, MEDINA,
                                          BEXAR , COMAL , HAYS, TOTAL/

       MIXESA         ALLOWABLE CROP MIXES    /1975*1984/
       MIXES(MIXESA)                          /1975*1984/


agitem   /totrev,totcost,marg,marg2,
           PRICE    ,YIELD       ,FEDINS    ,HERB        ,HERBAPPL
          ,PHOSPHATE,  NITROGEN  ,SEED      ,INSECTIC    ,FUELM
          ,FUELI    ,REPAIRM     ,REPAIRI   ,LABORM      ,LABORI
          ,HARVEST  ,INTEREST    ,FIXED     ,FUNGIC      ,PESTICAPPL
          ,MISC     ,INSECTAPPL  ,LABORo    ,water,
           harvacre ,varcost     ,defic,
           jan-water,feb-water   ,mar-water ,apr-water   ,may-water
          ,jun-water,jul-water   ,aug-water ,sep-water   ,oct-water,
           nov-water,dec-water,
           jan      ,feb         ,mar       ,apr         ,may,
           jun      ,jul         ,aug       ,sep         ,oct,
           nov      ,dec         ,coef      , TOTAL      ,selvage /

  MONTHP(agitem)  MONTHS OF THE YEAR  /JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,
                                       SEP,OCT,NOV,DEC,COEF,TOTAL/

  MONTH(MONTHP) MONTHS  /JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,
                                          SEP,OCT,NOV,DEC/

  LANDA          LAND TYPES              /irr,furrow,sprinkler,dry/
  Lando(Landa)   Original Land Types     /irr,dry/
  LAND(Landa)    LAND TYPES              /furrow,sprinkler,dry/
  WITEM          WEATHER ITEMS           /TEMP,PREC,DAYS/
  USER           PARTIES IN MODEL        /AG, MUNICIPAL, CAT,
                                              INDUSTRIAL, MI,  ALLUSE/
  USEGROUP(USER,USER)                    /ALLUSE.(AG,MI,CAT)/

  STAGE          CROP GROWTH STAGE       /STAGE1*STAGE4/


  REGRESS      REGRESSION PARAMETERS
           / INTERCEPT,RECHARGE,eastUSE,westuse,j17head,sabhead /

  EQU      REGRESSION EQUATIONS     /SPRCOMAL,  SPRSANMAR, CATFISHWAT,
                                      ENDj17head,endsabhead,
                                      eastLIFT,    westLIFT/

  endhead(equ)  ending elevations   /endj17head,endsabhead/

  obs      Observation set for equation estimates
             / all  all observations used
               c1   only observation where Comal Springflow > 0 used
               c2   only observation where Comal Springflow = 0 used /

  SPRINGS(EQU)                       /SPRCOMAL, SPRSANMAR/;

set region(equ) /eastlift,westlift/ ;

ALIAS    (MONTH,MONTHS)

*    cccccccccccccccccccccccccccccccccccccccccccc
```

```
*          POLICY DATA

*   cccccccccccccccccccccccccccccccccccccccccccc

 SETS
    USEYEAR                  SIMULATED YEAR OF MUNICIPAL WATER CONSUMPTION
                                      / 1989,2000,2010 /
    Project(UseYear)         Projected Use Year
                                      / 2000, 2010 /
    AGIRREFF              ADDITIONAL AGRICULTURAL IRRIGATION EFFICIENCY
                                      /BASE,IMPROVED/
    AGEFF(AGIRREFF)       IRRIGATION EFFICIENCY IN CURRENT MODEL
                                      /BASE/
  ;

Parameter   DayMonth(month)   Number of days in the month
 / Jan  31, feb  28, mar  31, apr  30, may  31, jun  30,
   jul  31, aug  31, sep  30, oct  31, nov  30, dec  31  /

   RUNYEAR(USEYEAR)          NUMERICAL IDENTIFIER FOR YEAR
              / 1989 1989 , 2000 2000, 2010 2010 / ;

 PARAMETER  AGIRREFIC(AGIRREFF)     IRRIGATION EFFICIENCY IMPROVEMENT
                                   /BASE 0.00,IMPROVED 0.10/ ;

*   cccccccccccccccccccccccccccccccccccccccccccc
*            3 LIFT ZONE SCENARIO
*   cccccccccccccccccccccccccccccccccccccccccccc

Table  AgDiff(zonall,groups) Difference of Lift Zone from average

        Kinney     Uvalde     Medina      Bexar
   1    -41.81     -61.23     -59.58     -73.55
   2     90.19      -3.02      24.56      15.04
   3                80.21     120.64     111.72 ;

Parameter  miDiff(groups)  Difference from Average for M&I Use
   /  Kinney  -25.98
      Uvalde  -24.20
      Medina   16.61
      Bexar   -17.35
      Comal    58.46
      Hays     39.13  / ;

Table  AgPct(zonall,groups)  Percentage of Total Pumping in Lift Zone

        Kinney  Uvalde   Medina    Bexar
   1     .90      .26      .21      .89
   2              .50      .54      .06
   3     .10      .24      .25      .05 ;

*   cccccccccccccccccccccccccccccccccccccccccccc
*    3 LIFT ZONE SCENARIO - East & West Lift Only
*     4 Ag Counties combined into 2
*   cccccccccccccccccccccccccccccccccccccccccccc

Table  AgDiff(zonall,region) Difference of Lift Zone from average

        Westlift  Eastlift
   1     -62.21    -64.47
   2      -4.02     25.11
   3      80.24    124.11 ;

Parameter  miDiff(region)  Difference from Average for M&I Use
    / Westlift -24.64,  Eastlift -10.82 / ;

*   cccccccccccccccccccccccccccccccccccccccccccc

*          HYDROLOGIC DATA

*   cccccccccccccccccccccccccccccccccccccccccccc


SET BASIN      RIVER BASINS IN RECHARGE DATA AS DEFINED BELOW
        / TOTAL,NUECES,FRIO,SABINAL,SABMED,MEDINA,MEDCIB,CIBCOM,BLANCO/

TABLE
RECHARGED(YEAR,BASIN) RECHARGE LEVELS BY BASIN FRM 1991 COMMITTEE REPORT

*  Edwards Recharge Level by Year and Basin
*  From Special Committee on the Edwards Aquifer
*  Committee Report to the 72nd Legislature

* Calendar  TOTAL   Nueces-W.Frio-Dry Sabinal  Area Bet.Medina   Area Bet.Cibolo-  Blanco
* Year             W.Nueces Frio               Sabinal  Lake     Cibolo CrDry Comal

            TOTAL    NUECES     FRIO    SABINAL  SABMED    MEDINA    MEDCIB    CIBCOM    BLANCO
     1934   179.6       8.6     27.9       7.5     19.9      46.5        21      28.4      19.8
     1935  1258.2     411.3    192.3      56.6    166.2      71.1     138.2     182.7      39.8
     1936   909.6     176.5    157.4      43.5    142.9      91.6     108.9     146.1      42.7
```

```
        1937    400.7    28.8    75.7    21.5    61.3    80.5    47.8    63.9    21.2
        1938    432.7    63.5    69.3    20.9    54.1    65.5    46.2    76.8    36.4
        1939      399     227    49.5      17    33.1    42.4     9.3     9.6    11.1
        1940    308.8    50.4    60.3    23.8    56.6    38.8    29.3    30.8    18.8
        1941    850.7    89.9   151.8    50.6     139    54.1   116.3   191.2    57.8
        1942    557.8   103.5    95.1      34    34.4    51.7    66.9    93.6    28.6
        1943    273.1    36.5    42.3    11.1    33.8    41.5    29.5    58.3    20.1
        1944    560.9    64.1      76    24.8    74.3    50.5    72.5   152.5    46.2
        1945    527.8    47.3    71.1    30.8    78.6    54.8    79.6   129.9    35.7
        1946    556.1    80.9    54.2    16.5      52    51.4   105.1   155.3    40.7
        1947    422.6    72.4    77.7    16.7    45.2      44    55.5    79.5    31.6
        1948    178.3    41.1    25.6      26    20.2    14.8    17.5    19.9    13.2
        1949    508.1     166    86.1    31.5    70.3      33    41.8    55.9    23.5
        1950    200.2    41.5    35.5    13.3      27    23.6    17.3    24.6    17.4
        1951    139.9    18.3    28.4     7.3    26.4    21.1    15.3    12.5    10.6
        1952    275.5    27.9    15.7     3.2    30.2    25.4    50.1   102.3    20.7
        1953    167.6    21.4    15.1     3.2     4.4    36.2    20.1    42.3    24.9
        1954    162.1    61.3    31.6     7.1    11.9    25.3     4.2      10    10.7
        1955      192     128    22.1     0.6     7.7    16.5     4.3     3.3     9.5
        1956     43.7    15.6     4.2     1.6     3.6     6.3       2     2.2     8.2
        1957   1142.6   108.6   133.6    65.4   129.5    55.6   175.6   397.9    76.4
        1958   1711.2   266.7     300   223.8   294.9    95.5   190.9   268.7    70.7
        1959    690.4   109.6   158.9    61.6    96.7    94.7    57.4    77.9    33.6
        1960    824.8    88.7   128.1    64.9     127     104    89.7     160    62.4
        1961    717.1    85.2   151.3    57.4   105.4    88.3    69.3   110.8    49.4
        1962    239.4    47.4    46.6     4.3    23.5    57.3    16.7    24.7    18.9
        1963    170.7    39.7      27       5    10.3    41.9     9.3    21.3    16.2
        1964    413.2   126.1    57.1    16.3    61.3    43.3    35.8    51.1    22.2
        1965    623.5    97.9      83    23.2     104    54.6    78.8   115.3    66.7
        1966    615.2   169.2     134    37.7    78.2    50.5    44.5    66.5    34.6
        1967    466.5    82.2   137.9    30.4    64.8    44.7    30.2    57.3      19
        1968    884.7   130.8     176    66.4   198.7    59.9    83.1   120.5    49.3
        1969    610.5   119.7   113.8    30.7    84.2    55.4    60.2    99.9    46.6
        1970    661.6   112.6   141.9    35.4    81.6      68    68.8   113.8    39.5
        1971    925.3   263.4   212.4    39.2   155.6    68.7    81.4    82.4    22.2
        1972    756.4   108.4   144.6      49   154.6    87.9    74.3   104.2    33.4
        1973   1486.5   190.6   256.9   123.9   286.4    97.6   237.2   211.7    82.2
        1974    658.5    91.1   135.7    36.1   115.3    96.2    68.1    76.9    39.1
        1975      973    71.8   143.6    47.9   195.9    93.4   138.8   195.7    85.9
        1976    894.1   150.7   238.6    68.2     182    94.5    47.9    54.3    57.9
        1977      952   102.9     193    62.7   159.5    77.7    97.9   191.6    66.7
        1978    502.5    69.8    73.1    30.9   103.7    76.7    49.6    72.4    26.3
        1979   1117.8   128.4   201.4    68.6   203.1    89.4    85.4   266.3    75.2
        1980    406.4    58.6    85.6    42.6    25.3    88.3    18.8    55.4    31.8
        1981   1448.3     205   365.2   105.6   252.1    91.3     165   196.8    67.3
        1982    422.4    19.4   123.4      21    90.9    76.8    22.6    44.8    23.5
        1983    420.1    79.2    85.9    20.1    42.9    74.4    31.9    62.5    23.2
        1984    197.7    32.4    40.4     8.8    18.1    43.9    11.3    16.9    25.9
        1985   1003.3   105.9   186.9    50.7   148.5    64.7   136.7   259.2    50.7
        1986   1153.8   188.4   192.8    42.2   173.6    74.7   170.2   267.4    44.5
        1987   2003.5   308.5   473.3   110.7   405.5    90.4   229.3   270.9   114.9
        1988    355.5    59.2   117.9      17    24.9    69.9    12.6    28.5    25.5
        1989    214.4    52.6    52.6     8.4    13.5    46.9     4.6    12.3    23.6 ;

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccc

*    Values summed from TWDB's GWSIM-IV monthly recharge data sets
*    Units in (1000's acre feet)

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccc

TABLE MRECH(YEAR,monthP) Monthly RECHARGE LEVELS (TWDB)
           JAN     FEB     MAR     APR     MAY     JUN     JUL     AUG     SEP     OCT     NOV     DEC

   1934 18.822  15.224  21.189  37.698  24.507   9.979  11.856   7.444   5.631   9.765   8.359   9.132
   1935 10.471  18.847   9.838  13.222 153.751 543.439 122.619  77.590 124.657  67.769  53.443  62.546
   1936 43.943  33.869  36.222  32.929  51.861  73.228  80.150  35.597 253.656 118.957  84.428  64.749
   1937 52.445  40.797  55.142  41.820  25.729  50.627  22.873  16.315  13.702  19.328  16.089  45.744
   1938 71.580  61.811  43.365  63.180  67.942  29.611  30.559  17.130  13.159  11.271  11.091  12.028
   1939 16.326  13.847  13.718  11.891  10.508   8.544 161.072  36.134  17.081  63.190  19.925  26.751
   1940 15.556  20.837  19.330  31.685  38.578  39.254  33.211  14.820  11.384   8.152  19.158  56.836
   1941 26.812  82.214  91.085 111.413 157.218  88.895  57.132  45.909  47.139  62.546  46.254  34.067
   1942 27.998  24.763  23.976  54.037  63.396  28.026  20.940  25.850  94.333  92.850  56.793  44.859
   1943 33.244  22.311  24.598  32.195  24.636  36.542  29.932  14.788  15.380  13.933  11.070  14.478
   1944 24.302  44.258  69.269  48.316  84.899  62.633  28.521  37.189  54.573  30.807  24.143  51.999
   1945 85.756  70.737  77.067  75.920  51.726  29.573  18.362  13.011  18.858  36.680  19.499  30.620
   1946 31.036  42.269  46.803  31.619  58.252  31.910  19.124  12.879  36.449  92.921  87.808  65.024
   1947 91.780  61.634  52.326  37.033  38.256  41.869  31.011  21.949  12.737   9.778  11.105  13.121
   1948 15.918  13.069  13.342  10.122  11.241  44.326  21.739   7.505   9.008  14.546   9.780   7.951
   1949 13.112  64.081  65.338  77.857  79.303  52.657  24.287  36.894  27.403  24.464  22.425  20.273
   1950 17.122  23.046  18.010  16.519  28.490  30.619  20.733   9.811   7.127   7.127   9.523  12.031
   1951  8.837  15.616  17.020  20.797  30.459  17.851   6.754   4.533   6.511   3.127   3.857   4.735
   1952  5.126   4.599   8.313  21.226  34.624  21.849   8.424   4.610 129.645   8.530  10.321  18.228
   1953 22.325  16.856  14.012  11.715   7.911   4.518   4.860   9.366  32.492  17.303  13.837  12.433
   1954 12.299   7.759   6.911   8.098  48.046  25.233  22.611   7.258   5.985   7.381   5.948   4.770
   1955  4.414   8.103   5.891   5.255  13.289   5.495  17.351   7.859  88.105  17.227  12.660   6.486
   1956  5.261   5.195   4.975   3.960   3.620   1.867   4.010   2.432   1.711   4.111   3.616   3.000
   1957  1.746   4.915  31.427 265.450 251.964 189.805  22.859  14.555  77.955 134.137  84.360  60.003
   1958 89.179 142.344 170.073  74.683 225.021 276.721  94.901  42.981 213.573 168.726 133.230  78.739
   1959 44.355  42.952  37.939  51.588  41.528  95.706  82.385  35.684  35.770 126.810  50.879  43.774
   1960 53.988  46.097  44.391  44.335  36.615  31.182  53.831 144.117  50.074 127.626  90.805 101.897
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 1961  77.983 113.596  73.778  51.509  34.874 115.881  31.241  46.214  31.397  43.422  30.237  24.503
 1962  24.272  21.323  19.152  20.615  17.583  30.835  12.896   8.371  12.075  37.333  18.314  17.652
 1963  16.295  17.075  15.151  25.387  35.839  12.420   7.637   6.733   6.034   7.272   9.462  11.451
 1964  15.068  22.186  28.386  21.831  16.113  22.753   7.570  12.677 139.151  59.623  44.625  23.247
 1965  25.388  75.166  34.779  46.457 118.014 106.233  32.730  16.607  25.186  48.043  25.075  69.760
 1966  35.531  32.833  28.087  55.535  48.936  25.988  26.048 158.305 118.009  41.167  24.350  21.034
 1967  18.247  15.959  16.710  17.089  10.984   7.746  15.423  12.145  79.256 100.751 113.263  58.686
 1968 149.501 121.032 114.198  86.263 127.899  67.005  87.913  31.989  27.202  23.186  19.987  27.892
 1969  21.405  25.462  27.551  64.447  60.037  28.381  16.387  17.769  18.323 183.819  60.001  93.608
 1970  46.422  57.510 116.859  46.988 101.195  72.436  26.919  17.213  85.080  44.102  24.294  22.554
 1971  19.701  17.800  20.000  15.099  13.100  29.201  23.530 304.493  89.800 235.397  87.701  69.502
 1972  48.603  37.602  33.802  28.500 158.299  63.801  32.600 165.693  73.701  47.002  36.601  30.201
 1973  32.401  61.998  58.100  71.500  50.601 179.200 420.393  97.701  63.401 309.494  89.303  52.902
 1974  44.111  29.351  30.821  23.761 110.164  35.839  20.331  69.310  79.319  55.330  93.861  66.249
 1975  57.075 217.033  76.510  55.159 212.340 104.574  92.770  42.430  25.879  38.086  26.918  24.365
 1976  19.195  17.080  16.704  56.154 147.797  44.604 285.461  54.275  41.267  56.949  98.256  56.346
 1977  78.543  89.336  60.043 156.126 221.772  93.727  41.245  26.077  19.231  59.680  73.002  33.213
 1978  26.048  24.008  21.847  27.909  15.382  33.522  11.101 140.844  69.298  33.533  46.793  52.311
 1979  66.115  79.607 248.798 191.240  98.909 252.972  62.561  37.011  23.204  21.159  17.274  18.988
 1980  20.305  18.763  20.009  20.223  59.625  27.628  13.496  16.500  70.931  70.071  31.100  37.650
 1981  25.925  24.875  73.591 146.008 194.805 406.856 222.326  56.779  42.979 149.652  71.441  33.163
 1982  28.958  25.281  25.315  21.427 180.029  36.288  21.266  16.326  16.476  14.692  15.713  20.531
 1983  21.495  27.198  36.185  26.469  49.499  71.356  31.613  20.881  22.760  38.688  48.155  25.836
 1984  24.519  19.006  16.927  13.015  18.076  10.808   7.217   6.452   6.224  18.976  35.503  21.191
 1985 184.503  71.892 128.632  58.763  68.214 118.512  63.708  34.436  15.316  58.285 122.130  78.932
 1986  44.691  39.127  27.491  20.883  64.404 160.908  43.670  21.095  88.269 206.347 143.015 293.789
 1987 159.488  77.104 138.379  69.441 130.251 996.064 143.352  86.814  89.802  40.714  34.514  37.720
 1988  28.493  23.430  24.386  20.734  25.900  54.973  68.574  31.952  26.803  17.962  16.121  16.192
 1989  28.161  28.948  25.585  18.512  23.795  12.964   9.219   7.804   6.760  15.359  23.463  13.885
* 1990  13.670  37.141  43.951 148.638 233.121  29.479 333.999 151.794  54.261  29.138  25.693  22.264
 ;

*  Calculate average recharge for each recharge group

*  MRech(recharge,month) =
*            SUM(YEARSDATES(RECHARGE,YEAR), MRech(year,month) )
*             / NRech(recharge) ;

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccc

* Monthly recharge aggregated to current month to correspond
*  with regression coefficients

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccc

Mrech(year,"feb") = Mrech(year,"jan") + Mrech(year,"feb") ;
Mrech(year,"mar") = Mrech(year,"feb") + Mrech(year,"mar") ;
Mrech(year,"apr") = Mrech(year,"mar") + Mrech(year,"apr") ;
Mrech(year,"may") = Mrech(year,"apr") + Mrech(year,"may") ;
Mrech(year,"jun") = Mrech(year,"may") + Mrech(year,"jun") ;
Mrech(year,"jul") = Mrech(year,"jun") + Mrech(year,"jul") ;
Mrech(year,"aug") = Mrech(year,"jul") + Mrech(year,"aug") ;
Mrech(year,"sep") = Mrech(year,"aug") + Mrech(year,"sep") ;
Mrech(year,"oct") = Mrech(year,"sep") + Mrech(year,"oct") ;
Mrech(year,"nov") = Mrech(year,"oct") + Mrech(year,"nov") ;
Mrech(year,"dec") = Mrech(year,"nov") + Mrech(year,"dec") ;

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccc

*   Convert 1000's acre feet to ACRE FEET

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccc

Mrech(recharge,month) = Mrech(recharge,month) * 1000 ;

TABLE ASSIGNBAS(BASIN,GROUPS) ASSIGNMENT OF RECHARGE BASIN TO COUNTIES

                KINNEY  UVALDE  MEDINA   BEXAR   COMAL  HAYS
    NUECES      0.448   0.552
    FRIO                1.000
    SABINAL             1.000
    SABMED                      1.000
    MEDINA                      0.568    0.432
    MEDCIB                               1.000
    CIBCOM                               0.230   0.770
    BLANCO                                       0.155  0.845 ;


*
*  calculating percentage of recharge contribution by county
*

parameter countywts(countys,RECHARGAll)
          percent of annual recharge attributed to county;

countywts("kinney",RECHARGE) = recharged(recharge,"nueces")
                                 * ASSIGNBAS("NUECES","KINNEY")
                                 / recharged(recharge,"total");

countywts("uvalde",recharge) = (recharged(recharge,"nueces")
                                  * ASSIGNBAS("NUECES","UVALDE")
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         + recharged(recharge,"frio")     * ASSIGNBAS("FRIO","UVALDE"
         + recharged(recharge,"sabinal") * ASSIGNBAS("SABINAL","UVALDE"
        / recharged(recharge,"total");

countywts("medina",recharge) = (recharged(recharge,"sabmed")
                                      * ASSIGNBAS("SABMED","MEDINA")
           + recharged(recharge,"medina") * ASSIGNBAS("MEDINA","MEDINA"))
           / recharged(recharge,"total");

countywts("bexar",recharge) = (recharged(recharge,"MEDINA")
                                      * ASSIGNBAS("MEDINA","BEXAR")
           + recharged(recharge,"MEDcib") * ASSIGNBAS("MEDCIB","BEXAR")
           + RECHARGED(RECHARGE,"CIBCOM") * ASSIGNBAS("CIBCOM","BEXAR"))
           / recharged(recharge,"total");

countywts("comal",recharge) = (recharged(recharge,"cibcom")
                                      * ASSIGNBAS("CIBCOM","COMAL")
           + recharged(recharge,"blanco") * ASSIGNBAS("BLANCO","COMAL"))
           / recharged(recharge,"total");

countywts("hays",recharge) = (recharged(recharge,"blanco")
                                    * ASSIGNBAS("BLANCO","HAYS"))
                                    / recharged(recharge,"total");

*display countywts;

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*            HYDROLOGIC CALCULATIONS AND STATE OF NATURE CALCULATIONS

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

 PARAMETER
   RECHARGEL(YEAR)              RECHARGE LEVELS IN 100000 ACRE FEET
   RECHARGEM(YEAR,GROUPS)       RECHARGE INCREASE PROPS
   AVGRECHAR                    AVERAGE RECHARGE ;

   RECHARGEL(RECHARGE) =
        SUM(YEARSDATES(RECHARGE,YEAR),
        SUM(COUNTY,1000*SUM(BASIN,
            ASSIGNBAS(BASIN,COUNTY)*RECHARGED(YEAR,BASIN))))
          / NRech(recharge) /100000;

   AVGRECHAR = SUM(RECHARGE,RECHARGEL(RECHARGE)*PROB(RECHARGE));

*    cccccccccccccccccccccccccccccccccccccccccccccc

*        WEATHER DATA

*    cccccccccccccccccccccccccccccccccccccccccccccc

*    Days is the percent of days with precipiation >= .25 inch.
*    Years 1950 - 1989

TABLE WEATHERD(YEAR,GROUPS,WITEM,MONTH)    PRECIP AND TEMPERATURE BY MONTH


                     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
1950.BEXAR.TEMP       58   56   60   67   77   80   84   82   79   73   59   53
1950.BEXAR.PREC     0.32 1.43 0.24 3.42 2.41 1.03  1.6 6.15 3.02 0.08 0.13 0.03
1950.BEXAR.DAYS        0 3.57    0 13.3 6.45 3.33 6.45 6.45   10    0    0    0
1950.HAYS.TEMP        56   55   58   66   77   80   83   82   77   71   57   53
1950.HAYS.PREC      0.25 3.75 0.38 5.08 1.93 4.41 1.39 0.62 2.16 1.09 0.04    0
1950.HAYS.DAYS         0 14.2 3.23 16.6 12.9 13.3 6.45 3.23   10 3.23    0    0
1950.COMAL.TEMP       61   60   63   69   80   82   86   86   82   76   63   57
1950.COMAL.PREC     0.55 3.76 0.42 4.11 3.14 3.02 2.25 0.72 1.83  1.2 0.13    0
1950.COMAL.DAYS        0 17.8    0 13.3 9.68 6.67 6.45 6.45   10 3.23    0    0
1950.MEDINA.TEMP      59   57   60   68   78   81   84   84   79   73   60   52
1950.MEDINA.PREC    2.66 1.85 0.22 1.27 3.79 3.97 2.26 4.27 4.09 0.23  0.2  0.1
1950.MEDINA.DAYS    3.23 7.14    0 6.67 9.68 16.6 6.45 9.68   20    0    0    0
1950.UVALDE.TEMP      60   58   63   70   78   81   83   83   80   74   60   53
1950.UVALDE.PREC    0.44 1.04 0.18 1.32 3.12 2.63 2.56 3.54 3.04 0.31 0.09    0
1950.UVALDE.DAYS       0    0    0 3.33 9.68 13.3 9.68 9.68 6.67 3.23    0    0
1951.BEXAR.TEMP       50   54   62   69   75   82   86   87   80   73   58   55
1951.BEXAR.PREC     0.25 2.43 2.76 0.93 4.44 7.07 0.51 0.06 3.75 1.44 0.67 0.13
1951.BEXAR.DAYS        0 10.7 9.68 6.67 12.9 6.67 3.23    0   10 9.68 3.33    0
1951.HAYS.TEMP        51   53   62   67   75   82   86   86   80   71   56   53
1951.HAYS.PREC       0.4 3.18 2.91 1.04 4.65 5.77 0.28 0.75 8.42    1 0.97 1.51
1951.HAYS.DAYS      3.23 10.7 12.9 6.67 12.9 6.67    0 3.23 16.6 6.45    0 9.68
1951.COMAL.TEMP       54   57   66   71   78   84   89   90   82   76   57   56
1951.COMAL.PREC     0.41 2.64 2.92 0.92 4.03 4.69 0.04 0.25 5.36 1.38 1.66 0.54
1951.COMAL.DAYS        0 10.7 9.68 3.33 16.1 6.67    0    0 16.6 6.45 13.3    0
1951.MEDINA.TEMP      51   58   61   68   74   84   88   87   80   73   57   53
1951.MEDINA.PREC 0.1015 0.40 2.69 0.52 10.7 2.58  0.1  1.1  4.5 0.33 1.26 0.22
1951.MEDINA.DAYS       0 2.37 9.68    0 16.1 6.67    0 3.23 6.67 3.23 6.67    0
1951.UVALDE.TEMP      51   56   65   71   75   82   87   87   82   74   58   55
1951.UVALDE.PREC    0.06 0.68 1.59 0.45 5.62 1.49 0.03 1.05 0.49 3.79 0.44 0.38
1951.UVALDE.DAYS       0 3.57 6.45 3.33 19.3 6.67    0 3.23 3.33 6.45 3.33    0
1952.BEXAR.TEMP       59   58   61   66   73   82   83   86   77   65   58   51
1952.BEXAR.PREC     0.81 2.01 2.34  3.4 1.91 1.86 2.75    0 3.02    0 4.47 3.67
1952.BEXAR.DAYS     3.23 13.7 9.68   10 6.45 6.67 9.68    0 13.3    0 16.6 9.68
1952.HAYS.TEMP        57   56   58   63   73   81   82   85   76   63   56   49
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548	1952.HAYS.PREC	1.4	1.56	2.77	4.4	3.41	[illegible]	2.4	[illegible]	11.2	[illegible]	[illegible]	3.22
549	1952.HAYS.DAYS	3.23	3.45	12.9	13.3	12.9	10	9.68	0	16.6	0	16.6	9.68
550	1952.COMAL.TEMP	60	61	63	67	76	94	96	89	78	66	59	53
551	1952.COMAL.PREC	1.39	1.79	2.98	3.75	2.89	1.99	2.03	0.02	9.53	0.02	4.4	3.08
552	1952.COMAL.DAYS	3.23	6.9	12.9	13.3	6.45	6.67	6.45	0	13.3	0	20	6.45
553	1952.MEDINA.TEMP	57	58	60	67	74	92	95	88	78	66	59	50
554	1952.MEDINA.PREC	0.09	2.16	2.04	1.45	3.02	3.89	1.46	0.01	4.65	0	3.47	2.32
555	1952.MEDINA.DAYS	0	13.7	3.23	6.67	12.9	13.3	6.45	0	13.3	0	13.3	6.45
556	1952.UVALDE.TEMP	59	58	60	67	74	92	95	87	79	68	59	51
557	1952.UVALDE.PREC	0.27	2.74	2.05	1.73	4.63	0.57	0.56	0	2.07	0	2.2	1.42
558	1952.UVALDE.DAYS	0	10.3	6.45	6.67	6.45	3.33	0	0	6.67	0	10	3.23
559	1953.BEXAR.TEMP	56	54	67	69	76	85	86	84	78	71	58	49
560	1953.BEXAR.PREC	0.41	0.9	0.53	2.08	1	2.19	0.01	3.12	2.48	3.06	0.34	1.44
561	1953.BEXAR.DAYS	0	3.57	3.23	6.67	3.23	3.33	0	9.68	6.67	12.9	0	6.45
562	1953.HAYS.TEMP	54	52	64	65	73	84	84	84	76	70	56	47
563	1953.HAYS.PREC	0.05	1.92	0.91	5.95	1.28	3.96	2.04	3.53	4.42	5.26	0.7	3.16
564	1953.HAYS.DAYS	0	10.7	6.45	16.6	6.45	6.67	6.45	3.23	10	16.1	3.33	9.68
565	1953.COMAL.TEMP	55	56	69	70	76	85	85	85	79	71	59	51
566	1953.COMAL.PREC	0.84	1.24	1.03	4.01	1.05	4.12	0.32	4.15	2.18	3.84	0.33	3.91
567	1953.COMAL.DAYS	3.23	3.57	0	11.6	6.45	10	3.23	9.68	6.67	12.9	0	9.68
568	1953.MEDINA.TEMP	55	54	68	70	78	87	88	85	77	70	57	47
569	1953.MEDINA.PREC	0.03	1.28	1.45	0.7	0.73	0.24	0.63	2.84	7.25	3.49	0.08	1.05
570	1953.MEDINA.DAYS	0	7.14	6.45	0	3.23	0	3.23	9.68	13.3	19.3	0	3.23
571	1953.UVALDE.TEMP	55	56	70	72	80	88	88	85	77	70	59	48
572	1953.UVALDE.PREC	0.11	0.54	0.59	0.24	0.68	0.9	0	5.88	5.26	3.3	0.03	0.81
573	1953.UVALDE.DAYS	0	0	0	0	3.23	3.33	0	9.68	10	16.1	0	3.23
574	1954.BEXAR.TEMP	54	60	62	73	75	83	85	86	83	73	60	58
575	1954.BEXAR.PREC	0.51	0.03	0.03	1.94	1.46	2.71	1.25	1.05	0.52	1.98	2.02	0.2
576	1954.BEXAR.DAYS	0	0	0	6.67	6.45	6.67	6.45	3.23	3.33	9.68	6.67	0
577	1954.HAYS.TEMP	51	58	59	71	73	83	86	86	81	72	58	55
578	1954.HAYS.PREC	1.07	0.07	0.07	2.36	2.54	1.74	0.27	0.95	1.08	2.31	0.71	0.57
579	1954.HAYS.DAYS	6.45	0	0	13.3	9.68	3.33	3.23	6.45	6.67	9.68	3.33	0
580	1954.COMAL.TEMP	56	62	63	74	74	83	86	87	83	74	61	59
581	1954.COMAL.PREC	1.74	0.15	0.08	1.99	1.57	1.74	0.51	0.14	0.41	1.17	0.5	0.12
582	1954.COMAL.DAYS	9.68	0	0	6.67	3.23	3.33	3.23	0	3.33	6.45	3.33	0
583	1954.MEDINA.TEMP	53	60	61	73	76	84	86	86	83	73	59	56
584	1954.MEDINA.PREC	0.42	0.02	0.06	1.15	2.44	3.08	0.52	0.64	0.1	1.91	1.5	0.08
585	1954.MEDINA.DAYS	0	0	0	6.67	9.68	6.67	3.23	3.23	0	6.45	6.67	0
586	1954.UVALDE.TEMP	54	60	63	74	76	83	85	85	83	73	60	57
587	1954.UVALDE.PREC	0.43	0	0.04	1.6	3.56	3.94	0.67	1.66	0.13	3.36	0.21	0
588	1954.UVALDE.DAYS	0	0	0	10	9.68	10	3.23	3.23	0	12.9	0	0
589	1955.BEXAR.TEMP	53	56	63	74	79	81	84	84	82	70	60	53
590	1955.BEXAR.PREC	1.45	2.33	1.4	0.14	4.44	2.88	1.32	0.81	0.79	0.39	1.57	0.66
591	1955.BEXAR.DAYS	6.45	10.7	3.23	0	12.9	10	6.45	3.23	0	3.23	6.67	3.23
592	1955.HAYS.TEMP	51	54	63	72	77	78	83	84	82	70	58	51
593	1955.HAYS.PREC	1.58	7.3	1.09	0.73	3.73	4.5	1.44	1.8	1.21	0.16	1.5	1.4
594	1955.HAYS.DAYS	6.45	10.7	6.45	6.67	16.1	10	3.23	3.23	3.33	0	6.67	3.23
595	1955.COMAL.TEMP	54	56	65	74	78	81	86	86	82	71	62	55
596	1955.COMAL.PREC	1.74	3.85	1.15	0.25	3.5	2.5	3.25	1.37	0.99	0.37	2.63	1.52
597	1955.COMAL.DAYS	6.45	14.2	3.23	0	16.1	13.3	12.9	9.68	6.67	0	6.67	3.23
598	1955.MEDINA.TEMP	51	55	63	73	78	81	85	86	81	70	60	55
599	1955.MEDINA.PREC	1.47	2.32	0.74	0.18	7.49	1.43	1.38	1.55	1.22	0.42	2.17	0.84
600	1955.MEDINA.DAYS	6.45	7.14	3.23	0	16.1	6.67	6.45	6.45	6.67	3.23	6.67	3.23
601	1955.UVALDE.TEMP	52	56	64	74	79	82	83	84	81	69	59	52
602	1955.UVALDE.PREC	0.79	2	0.94	0.15	3.15	2.47	5.18	2.66	0.38	0.41	1.71	0.5
603	1955.UVALDE.DAYS	3.23	10.7	3.23	0	12.9	10	12.9	9.68	0	3.23	3.33	3.23
604	1956.BEXAR.TEMP	52	57	63	69	79	84	85	84	80	73	57	56
605	1956.BEXAR.PREC	0.81	0.85	0.27	0.49	3.07	0.27	0.53	3.94	0.62	1.23	1.13	1.1
606	1956.BEXAR.DAYS	3.23	0	0	3.33	6.45	0	3.23	9.68	3.33	6.45	6.67	3.23
607	1956.HAYS.TEMP	50	55	61	69	78	84	86	84	79	71	57	54
608	1956.HAYS.PREC	1.27	1.06	0.44	1.03	2.13	1.06	0.99	1.28	2.55	1.51	1.96	2.61
609	1956.HAYS.DAYS	6.45	3.45	3.23	3.33	12.9	6.67	3.23	6.45	3.33	3.23	10	6.45
610	1956.COMAL.TEMP	53	58	63	70	78	83	85	84	80	73	60	58
611	1956.COMAL.PREC	1.18	1.06	0.44	0.49	2.63	0.35	0.21	5.88	0.29	1.47	1.55	2.86
612	1956.COMAL.DAYS	3.23	3.45	3.23	3.33	9.68	0	0	12.9	0	6.45	6.67	6.45
613	1956.MEDINA.TEMP	50	58	63	71	80	86	86	85	78	70	58	55
614	1956.MEDINA.PREC	0.55	0.76	0.18	1.12	0.37	0.22	1.68	2.88	0.86	2.55	2.17	0.85
615	1956.MEDINA.DAYS	3.23	3.45	0	3.33	3.23	0	3.23	3.23	3.33	6.45	6.67	0
616	1956.UVALDE.TEMP	51	56	64	71	80	85	85	84	80	74	57	55
617	1956.UVALDE.PREC	0.5	0.58	0.02	0.36	0.33	0.45	1.32	1.24	0.11	3.8	0.16	0.42
618	1956.UVALDE.DAYS	3.23	0	0	0	0	3.33	3.23	6.45	0	6.45	0	0
619	1957.BEXAR.TEMP	53	63	62	66	73	81	86	86	78	67	57	55
620	1957.BEXAR.PREC	0.51	2.53	4.19	9.32	8.22	3.49	0.73	0.21	11.1	4.71	2.9	0.92
621	1957.BEXAR.DAYS	0	7.14	16.1	20	12.9	6.67	3.23	0	20	9.68	13.3	3.23
622	1957.HAYS.TEMP	51	60	60	65	73	82	85	86	76	57	55	53
623	1957.HAYS.PREC	0.56	2.52	3.89	9.98	4.3	3.24	0.81	0.19	10.0	4.37	3.9	1.81
624	1957.HAYS.DAYS	0	7.14	12.9	26.6	9.68	8	3.23	0	20	7.74	13.3	6.45
625	1957.COMAL.TEMP	55	63	62	67	74	80	86	86	78	58	56	56
626	1957.COMAL.PREC	1.77	3.25	4.07	7.8	8.4	4.05	1.08	0.24	10.0	5.47	4.43	1.24
627	1957.COMAL.DAYS	12.9	7.14	12.9	20	16.1	10	3.23	0	20	9.68	13.3	9.68
628	1957.MEDINA.TEMP	54	62	62	66	73	81	87	86	78	65	55	53
629	1957.MEDINA.PREC	0.55	1.4	2.57	7.7	7.41	1.91	0	1.69	3.75	3.76	2.92	1.43
630	1957.MEDINA.DAYS	3.23	7.14	12.9	26.6	22.5	10	0	3.23	6.67	12.9	10	9.68
631	1957.UVALDE.TEMP	53	63	62	66	74	80	86	85	78	67	56	53
632	1957.UVALDE.PREC	0.4	1.53	1.67	9.31	7.19	1.96	0	0.7	5.36	6.53	2.94	1.71
633	1957.UVALDE.DAYS	0	7.14	6.45	20	22.5	10	0	3.23	16.6	6.45	13.3	6.45
634	1957.KINNEY.TEMP	53	63	62	67	73	80	86	88	81	69	57	58
635	1957.KINNEY.PREC	0.21	1.36	1.62	7.88	10.0	1	0	0.03	4.91	2.29	1.77	2.12
636	1957.KINNEY.DAYS	0	10.7	6.45	13.3	12.9	6	0	0	10	6.45	10	3.23
637	1958.BEXAR.TEMP	50	50	56	67	75	83	84	85	79	68	61	50
638	1958.BEXAR.PREC	4.57	3.88	1.08	1.32	1.98	3.39	7.39	0.45	8.36	5.43	0.77	1.07

639	1958.BEXAR.DAYS	12.9	10.7	3.23	6.67	3.23	3.33	9.68	3.23	16.6	22.5	0	3.23
640	1958.HAYS.TEMP	47	47	54	66	73	82	84	84	79	67	60	48
641	1958.HAYS.PREC	3.15	5.93	2.1	1.27	3.82	1.52	3.72	1.78	7.64	5.96	1.28	0.91
642	1958.HAYS.DAYS	12.9	14.2	3.23	10	12.9	13.3	6.45	3.23	20	22.5	3.33	3.23
643	1958.COMAL.TEMP	49	48	57	68	75	83	84	85	78	67	61	51
644	1958.COMAL.PREC	3.73	4.77	1.63	1.38	3.1	2.24	2.94	0.48	7.79	5.74	1.77	0.83
645	1958.COMAL.DAYS	9.68	10.7	3.23	6.67	6.45	10	3.23	3.23	23.3	19.3	6.67	3.23
646	1958.MEDINA.TEMP	48	49	54	66	73	82	84	84	78	65	58	47
647	1958.MEDINA.PREC	6.15	3.5	1.23	2.01	2.69	2.67	1.14	1.68	11.6	7.27	0.42	1.17
648	1958.MEDINA.DAYS	16.13	14.2	0	3.33	9.68	6.67	3.23	6.45	26.6	25.8	3.33	6.45
649	1958.UVALDE.TEMP	47	49	55	67	74	83	85	84	80	67	59	49
650	1958.UVALDE.PREC	5.3	2.64	1.74	0.76	3.69	8.68	1.08	2.35	5.64	5.98	0.57	0.6
651	1958.UVALDE.DAYS	12.9	14.2	6.45	3.33	16.1	13.3	6.45	3.23	20	19.3	0	0
652	1958.KINNEY.TEMP	52	53	57	67	75	83	85	87	80	68	60	50
653	1958.KINNEY.PREC	3.36	3.28	2.66	0.63	3.67	11.3	0.35	1.81	11.3	6.21	0.48	0.31
654	1958.KINNEY.DAYS	12.9	10.7	6.45	3.33	16.1	13.3	3.23	3.23	23.3	22.5	0	0
655	1959.BEXAR.TEMP	49	54	60	65	77	83	84	84	81	70	53	54
656	1959.BEXAR.PREC	0.52	2.5	0.13	2.55	2.43	1.32	1.48	3.05	1.72	5.11	2.17	1.52
657	1959.BEXAR.DAYS	0	10.7	0	10	9.68	3.33	6.45	6.45	6.67	6.45	6.67	6.45
658	1959.HAYS.TEMP	47	52	58	64	75	80	82	83	79	69	52	53
659	1959.HAYS.PREC	0.49	4.49	0.33	5.61	7.06	4.86	0.89	4.16	1.54	9.26	3.46	1.32
660	1959.HAYS.DAYS	0	14.2	0	20	9.68	13.3	3.23	9.68	6.67	12.9	10	3.23
661	1959.COMAL.TEMP	49	54	60	65	76	81	82	82	81	71	54	53
662	1959.COMAL.PREC	0.67	4	0.56	4.74	4	4.02	2.18	4.26	1.71	9.62	2.42	2.27
663	1959.COMAL.DAYS	3.23	17.8	3.23	6.67	12.9	10	12.9	16.1	3.33	9.68	10	12.9
664	1959.MEDINA.TEMP	46	51	57	64	75	81	82	83	79	67	52	54
665	1959.MEDINA.PREC	1.2	2.52	0.22	2.94	2.83	3.79	1.73	0.94	2.98	8.59	1.7	1.24
666	1959.MEDINA.DAYS	6.45	10.7	0	6.67	9.68	10	9.68	3.23	10	9.68	10	6.45
667	1959.UVALDE.TEMP	48	53	59	66	76	82	82	84	81	70	53	53
668	1959.UVALDE.PREC	0.41	1.18	0.03	1.81	4.52	7.17	3.88	1.45	1.72	6.37	1.79	1.18
669	1959.UVALDE.DAYS	0	0	0	10	9.68	16.6	9.68	6.45	6.67	6.45	10	6.45
670	1959.KINNEY.TEMP	49	53	60	67	77	84	84	85	82	70	54	53
671	1959.KINNEY.PREC	0.35	0.84	0.02	3.08	5.03	6.75	1.67	0.75	4.28	2.17	1.73	0.84
672	1959.KINNEY.DAYS	0	3.45	0	10	9.68	13.3	3.23	3.23	6.67	6.45	3.33	3.23
673	1960.BEXAR.TEMP	50	50	56	70	74	83	84	84	78	73	62	50
674	1960.BEXAR.PREC	0.76	1.22	1.65	2.08	1.21	2.7	1.31	5.96	0.76	7.84	1.3	2.97
675	1960.BEXAR.DAYS	3.23	3.45	3.23	6.67	9.68	6.67	6.45	9.68	3.33	22.5	6.67	6.45
676	1960.HAYS.TEMP	48	47	53	68	71	81	82	82	76	72	60	48
677	1960.HAYS.PREC	2.35	2	1.47	5.2	1.47	8.19	0.91	4.35	1.11	12.4	2.57	3.45
678	1960.HAYS.DAYS	3.23	10.3	6.45	10	6.45	6.67	3.23	12.9	3.33	22.5	10	19.3
679	1960.COMAL.TEMP	49	51	56	71	74	84	84	83	79	73	61	50
680	1960.COMAL.PREC	1.11	1.33	1.1	2.97	1.48	7.8	0.8	3.48	0.21	8.46	1.47	2.52
681	1960.COMAL.DAYS	6.45	3.45	3.4	6.67	9.68	10	3.2	16.1	0	19.3	6.67	9.68
682	1960.MEDINA.TEMP	50	50	55	69	73	83	83	82	77	71	60	49
683	1960.MEDINA.PREC	1.6	1.47	2.04	1.36	1.9	1.12	5.77	1.65	1.09	8.04	1.47	4.86
684	1960.MEDINA.DAYS	6.45	3.45	3.23	3.33	9.68	3.33	16.1	6.45	6.67	16.1	6.67	12.9
685	1960.UVALDE.TEMP	49	49	56	70	74	83	84	83	78	74	61	48
686	1960.UVALDE.PREC	0.76	0.74	1.95	0.38	1.82	0.67	5.26	4.96	0.73	3.18	1.1	2.43
687	1960.UVALDE.DAYS	0	3.45	3.23	0	9.68	3.33	16.1	12.9	3.33	12.9	6.67	9.68
688	1960.KINNEY.TEMP	50	49	57	70	77	84	83	82	79	75	60	48
689	1960.KINNEY.PREC	0.54	1.7	1.2	0.8	0.5	0.28	1.87	4.39	0.39	4.63	0.2	2.62
690	1960.KINNEY.DAYS	0	7.14	3.23	3.33	3.23	0	6.45	12.9	3.33	12.9	0	9.68
691	1961.BEXAR.TEMP	48	55	65	68	78	81	82	82	80	71	58	54
692	1961.BEXAR.PREC	0.68	1.79	0.03	0.32	0.17	7.87	7.04	0.15	2.24	3.39	2.09	0.7
693	1961.BEXAR.DAYS	0	3.57	0	3.33	0	23.3	12.9	0	10	9.68	6.67	0
694	1961.HAYS.TEMP	45	54	63	66	76	80	80	81	79	68	56	50
695	1961.HAYS.PREC	1.28	2.13	0.32	1.11	0.27	6.7	5	0.45	2.48	1.79	3.9	0.99
696	1961.HAYS.DAYS	6.45	7.14	0	6.67	0	13.3	16.1	3.23	8.33	9.68	10	3.23
697	1961.COMAL.TEMP	47	56	65	68	77	81	81	80	78	68	57	52
698	1961.COMAL.PREC	0.64	0.27	0.32	1.11	0.27	6.7	5	1.67	2.73	5.08	4.82	0.76
699	1961.COMAL.DAYS	3.23	3.57	0	6.67	0	13.3	16.1	9.68	6.67	9.68	10	3.23
700	1961.MEDINA.TEMP	47	54	64	67	78	81	81	81	80	71	58	53
701	1961.MEDINA.PREC	1.62	3.58	0.28	0.29	0.46	6.79	3.16	1.76	0.48	6.92	0.88	1.14
702	1961.MEDINA.DAYS	6.45	10.7	0	0	3.23	16.6	9.68	6.45	0	16.1	0	3.23
703	1961.UVALDE.TEMP	46	54	64	68	78	82	81	80	79	69	56	53
704	1961.UVALDE.PREC	1.28	2.63	0.06	1.59	0.3	4.36	7.75	0.96	0.23	5.84	0.6	0.66
705	1961.UVALDE.DAYS	6.45	7.14	0	3.33	0	13.3	16.1	3.23	0	9.68	0	0
706	1961.KINNEY.TEMP	47	54	67	69	78	81	83	83	82	72	57	53
707	1961.KINNEY.PREC	1.87	0.71	0.15	0.57	0.75	7.85	3.91	0.97	0.13	0.55	0.19	0.26
708	1961.KINNEY.DAYS	6.45	7.14	0	3.33	6.45	13.3	9.68	3.23	0	3.23	0	0
709	1962.BEXAR.TEMP	45	63	59	69	78	82	86	87	81	75	60	52
710	1962.BEXAR.PREC	0.48	0.9	0.91	4.02	1.31	2.44	0.13	1.57	2.69	2.19	4.97	2.29
711	1962.BEXAR.DAYS	0	3.57	6.45	13.3	3.23	10	0	3.23	10	6.45	6.67	9.68
712	1962.HAYS.TEMP	44	61	56	67	76	81	84	86	80	73	58	51
713	1962.HAYS.PREC	0.96	1.47	1.74	3.58	0.68	4.36	0.3	1.93	6.89	2.12	1.24	3.2
714	1962.HAYS.DAYS	0	7.14	9.68	13.3	3.23	16.6	3.23	3.23	13.3	12.9	6.67	9.68
715	1962.COMAL.TEMP	44	62	56	67	76	81	85	87	80	74	59	50
716	1962.COMAL.PREC	0.81	1.58	1.22	4.88	0.88	3.16	0.19	1.68	5.27	2.71	2.18	2.85
717	1962.COMAL.DAYS	3.23	7.14	6.45	13.3	3.23	10	0	3.23	20	3.23	6.67	9.68
718	1962.MEDINA.TEMP	46	63	57	68	77	82	86	87	81	75	59	51
719	1962.MEDINA.PREC	0.69	0.62	0.89	4.61	1.58	1.89	0	1.22	2.6	0.26	1.74	1.75
720	1962.MEDINA.DAYS	3.23	3.57	6.45	16.6	3.23	10	0	6.45	10	3.23	10	6.45
721	1962.UVALDE.TEMP	45	63	58	70	78	82	86	86	81	75	59	51
722	1962.UVALDE.PREC	0.39	0.42	0.57	2.58	0.64	1.81	0	3.43	1.69	1.15	0.87	0.57
723	1962.UVALDE.DAYS	0	0	3.23	10	3.23	6.67	0	6.45	6.67	3.23	0	3.23
724	1962.KINNEY.TEMP	46	65	60	71	79	83	88	88	82	77	61	51
725	1962.KINNEY.PREC	0.15	0.27	0.49	1.83	1.65	3.16	0	0.43	0.52	1.63	0.47	0.27
726	1962.KINNEY.DAYS	0	0	3.23	3.33	6.45	6.67	0	3.23	3.33	6.45	3.33	0
727	1963.BEXAR.TEMP	46	52	65	74	78	83	85	85	81	74	62	45
728	1963.BEXAR.PREC	0.27	3.59	0.21	1.88	3.03	2.28	0.03	0.63	1.11	2.75	1.93	0.94
729	1963.BEXAR.DAYS	0	14.2	0	6.67	6.45	6.67	0	3.23	6.67	6.45	10	3.23

730	1963.HAYS.TEMP	45	52	62	73	76	82	84	84	79	72	61	44
731	1963.HAYS.PREC	0.3	2.48	0.36	2.18	0.48	3.19	1.17	2.33	2.66	1.51	2.23	1.31
732	1963.HAYS.DAYS	0	10.7	3.23	6.67	0	13.3	6.45	6.45	6.67	6.45	10	6.45
733	1963.COMAL.TEMP	43	52	64	72	76	83	95	85	80	73	61	44
734	1963.COMAL.PREC	0.2	2.34	0.18	2	4.53	1.56	1.66	1.86	3.33	1.85	3.26	0.34
735	1963.COMAL.DAYS	0	10.7	0	6.67	6.45	10	6.45	6.45	10	6.45	16.6	3.23
736	1963.MEDINA.TEMP	45	52	65	74	77	84	85	86	81	74	61	46
737	1963.MEDINA.PREC	0.32	3.26	0.09	4.12	2.07	1.41	0.44	0.85	1.67	1.96	1.86	0.85
738	1963.MEDINA.DAYS	0	14.2	0	6.67	9.68	6.67	3.23	6.45	6.67	6.45	13.3	0
739	1963.UVALDE.TEMP	45	50	66	75	76	83	85	86	80	72	60	44
740	1963.UVALDE.PREC	0.11	2.26	0.07	2.26	5.04	1.99	0.14	0	2.1	1.3	0.76	0.67
741	1963.UVALDE.DAYS	0	7.14	0	6.67	12.9	6.67	0	0	10	6.45	3.33	3.23
742	1963.KINNEY.TEMP	45	52	68	75	77	84	87	89	83	74	60	45
743	1963.KINNEY.PREC	0	1.93	0	1.63	2.13	2.05	0.1	0	1.61	3.95	0.88	0.79
744	1963.KINNEY.DAYS	0	3.45	0	6.67	3.23	6.67	0	0	3.33	6.45	3.33	6.45
745	1964.BEXAR.TEMP	51	50	61	70	77	82	86	86	80	66	62	52
746	1964.BEXAR.PREC	3.4	1.89	1.73	1.16	1.79	4.88	0.02	5.19	4.15	1.64	4.81	1.22
747	1964.BEXAR.DAYS	6.45	10.3	3.23	3.33	6.45	13.3	0	6.45	20	3.23	6.67	3.23
748	1964.HAYS.TEMP	48	49	59	69	76	80	84	84	79	65	61	51
749	1964.HAYS.PREC	2.32	2	1.48	2.14	3.71	4.83	0.62	1.62	5.91	2.07	2.56	1.01
750	1964.HAYS.DAYS	6.45	10.3	3.23	10	6.45	10	3.23	9.68	16.6	3.23	10	3.23
751	1964.COMAL.TEMP	49	49	59	69	76	81	85	86	81	67	62	51
752	1964.COMAL.PREC	2.84	2.27	1.47	1.51	1.98	4.46	0.74	4.51	3.72	2.09	3.89	1.17
753	1964.COMAL.DAYS	6.45	10.3	3.23	6.67	6.45	13.3	3.23	6.45	6.67	3.23	6.67	3.23
754	1964.MEDINA.TEMP	49	49	60	71	77	81	86	86	81	68	63	51
755	1964.MEDINA.PREC	2.52	1.42	1.85	2.27	3.55	4.49	0.72	1.76	3.61	2.06	2.92	1.12
756	1964.MEDINA.DAYS	9.68	6.9	6.45	10	9.68	6.67	3.23	3.23	16.6	6.45	3.33	6.45
757	1964.UVALDE.TEMP	47	49	60	71	77	81	85	84	79	65	61	50
758	1964.UVALDE.PREC	1.2	0.84	1.18	1.18	2.63	0.09	1.65	2.02	8.36	1.88	0.66	0.61
759	1964.UVALDE.DAYS	3.23	6.9	3.23	3.33	6.45	0	3.23	9.68	23.3	6.45	3.33	3.23
760	1964.KINNEY.TEMP	49	49	62	74	79	86	89	88	82	68	62	51
761	1964.KINNEY.PREC	1.54	0.82	1.4	1.21	2.64	0	0.41	1.46	9.53	1.31	0.05	0.38
762	1964.KINNEY.DAYS	3.23	7.14	3.23	6.67	12.9	0	0	9.68	16.6	6.45	0	3.23
763	1965.BEXAR.TEMP	54	49	55	71	75	81	85	84	81	67	64	55
764	1965.BEXAR.PREC	2.4	6.43	2.3	1.97	8.18	2.42	0.08	1.65	3.13	2.69	0.89	4.51
765	1965.BEXAR.DAYS	6.45	21.4	3.23	6.67	19.3	6.67	0	9.68	10	12.9	6.67	9.68
766	1965.HAYS.TEMP	53	48	53	72	73	78	81	82	79	66	64	54
767	1965.HAYS.PREC	4.33	7.27	1.39	2.98	7.32	2.48	1.65	0.83	2.5	4.13	2.55	7.55
768	1965.HAYS.DAYS	12.9	25	9.68	10	19.3	3.33	3.23	3.23	6.67	9.68	6.67	16.1
769	1965.COMAL.TEMP	54	50	55	73	75	83	85	82	80	68	66	55
770	1965.COMAL.PREC	2.71	8.39	1.21	2.98	8.84	2.19	0.09	1.07	3.74	5.03	1.83	7.08
771	1965.COMAL.DAYS	9.68	28.5	6.45	10	22.5	3.33	0	3.23	16.6	6.45	3.33	19.3
772	1965.MEDINA.TEMP	54	49	54	71	73	81	85	83	81	67	64	54
773	1965.MEDINA.PREC	0.4	6	2	2.43	4.98	0.75	0.13	0.59	2.23	3.53	0.76	7
774	1965.MEDINA.DAYS	0	21.4	3.23	10	19.3	3.33	0	0	6.67	9.68	0	12.9
775	1965.UVALDE.TEMP	54	50	56	71	75	81	84	83	80	66	64	55
776	1965.UVALDE.PREC	0.47	3.85	2.67	2.6	3.96	0.92	0.45	2.39	2.54	1.56	1.1	3.7
777	1965.UVALDE.DAYS	0	14.2	6.45	6.67	16.1	3.33	3.23	9.68	10	6.45	3.33	9.68
778	1965.KINNEY.TEMP	50	50	57	72	75	82	87	86	83	69	67	55
779	1965.KINNEY.PREC	0.46	1.81	0.72	2.93	5.33	2.75	0.34	2.52	2.69	0.45	0.73	0.75
780	1965.KINNEY.DAYS	3.23	3.57	6.45	10	9.68	10	3.23	3.23	13.3	3.23	3.33	3.23
781	1966.BEXAR.TEMP	45	50	60	68	73	79	84	81	77	67	63	50
782	1966.BEXAR.PREC	1.47	2.3	1.14	3.2	3.53	1.78	0.06	4.28	2.13	1.11	0	0.44
783	1966.BEXAR.DAYS	9.68	14.2	6.45	6.67	19.3	6.67	0	16.1	10	3.23	0	3.23
784	1966.HAYS.TEMP	44	48	59	68	73	77	82	80	76	66	63	49
785	1966.HAYS.PREC	2.13	3.4	2	2.46	2.83	3.12	0.14	5.6	3.54	0.99	0	0.8
786	1966.HAYS.DAYS	9.68	17.8	3.23	6.67	12.9	10	0	19.3	16.6	6.45	0	3.23
787	1966.COMAL.TEMP	46	50	61	70	76	82	86	83	78	68	65	51
788	1966.COMAL.PREC	1.15	2.78	1.42	0.8	4.19	1.96	0.57	5.19	3.24	0.69	0.04	2.43
789	1966.COMAL.DAYS	3.23	17.8	9.68	3.33	12.9	10	0	19.3	16.6	3.23	0	3.23
790	1966.MEDINA.TEMP	46	50	59	69	74	80	85	81	78	67	63	51
791	1966.MEDINA.PREC	2.02	2.41	0.48	3.92	6.4	0.64	0.22	8.36	4.43	0.51	0	0.07
792	1966.MEDINA.DAYS	12.9	10.7	0	10	19.3	3.33	0	19.3	20	3.23	0	0
793	1966.UVALDE.TEMP	46	50	61	71	75	80	86	82	79	69	64	51
794	1966.UVALDE.PREC	1.96	1.51	0.57	4.31	3.65	0.83	0.25	5.18	1.95	0.62	0	0.04
795	1966.UVALDE.DAYS	9.68	7.14	0	6.67	9.68	6.67	0	12.9	10	3.23	0	0
796	1966.KINNEY.TEMP	47	53	65	74	75	80	86	83	79	69	63	51
797	1966.KINNEY.PREC	0.93	1.51	1.28	6.47	2.09	2.42	0	4.54	1.75	0.64	0	0
798	1966.KINNEY.DAYS	3.23	7.14	3.23	6.67	9.68	10	0	9.68	6.67	3.23	0	0
799	1967.BEXAR.TEMP	50	51	67	76	77	84	85	82	75	67	60	50
800	1967.BEXAR.PREC	0.18	0.48	2.18	0.94	2.22	0.01	2.12	3.17	11.1	2	3.42	1.38
801	1967.BEXAR.DAYS	0	3.57	9.68	3.33	6.45	0	9.68	12.9	33.3	9.68	13.3	6.45
802	1967.HAYS.TEMP	49	50	65	75	75	82	84	82	74	66	57	49
803	1967.HAYS.PREC	0.18	0.48	0.72	1.1	4.39	0	1.18	1.71	7.39	4.39	3.75	0.68
804	1967.HAYS.DAYS	0	3.57	3.23	3.33	6.45	0	6.45	6.45	16.6	12.9	10	0
805	1967.COMAL.TEMP	50	51	65	75	75	83	83	81	74	66	57	48
806	1967.COMAL.PREC	0.17	0.48	2.21	0.87	2.84	0	2.07	4.5	9.69	3.17	4.46	1.28
807	1967.COMAL.DAYS	0	0	9.68	3.33	9.68	0	6.45	12.9	16.6	12.9	13.3	6.45
808	1967.MEDINA.TEMP	50	52	66	75	76	84	85	82	74	67	59	50
809	1967.MEDINA.PREC	0.17	0.96	1.47	5.28	1.12	0.05	1.36	3.71	8.94	2.98	3.12	1.17
810	1967.MEDINA.DAYS	0	3.57	6.45	10	3.23	0	6.45	12.9	20	12.9	10	6.45
811	1967.UVALDE.TEMP	50	53	67	76	77	84	86	81	74	67	59	49
812	1967.UVALDE.PREC	0.25	0.86	0.42	2.48	0.12	1.53	0.32	2.85	5.14	2.42	2.81	0.9
813	1967.UVALDE.DAYS	0	3.57	3.23	10	0	3.33	3.23	12.9	20	6.45	6.67	3.23
814	1967.KINNEY.TEMP	50	52	68	76	78	84	87	83	75	69	60	51
815	1967.KINNEY.PREC	0.04	0.29	1.22	3.02	0	2.6	0.97	1.04	6.67	4.01	1.44	0.65
816	1967.KINNEY.DAYS	0	0	6.45	6.67	0	3.33	3.23	3.23	26.6	9.68	6.67	3.23
817	1968.BEXAR.TEMP	50	48	58	68	75	80	83	84	76	72	56	50
818	1968.BEXAR.PREC	8.52	1.85	1.27	1.92	2.82	2.63	1.53	0.94	2.99	0.69	4.58	0.66
819	1968.BEXAR.DAYS	16.13	6.9	6.45	10	3.23	13.3	3.23	6.45	10	0	16.6	3.23
820	1968.HAYS.TEMP	46	48	55	66	73	78	81	83	74	70	56	50

821	1968.HAYS.PREC	9.2	1.89	1.35	2.89	4.14	[illegible]	1.15	[illegible]	[illegible]	[illegible]	4.44	3.3
822	1968.HAYS.DAYS	19.35	6.9	3.23	13.3	16.1	16.6	3.23	0	20	6.45	13.3	6.45
823	1968.COMAL.TEMP	45	47	57	68	76	81	84	85	77	71	56	49
824	1968.COMAL.PREC	8.96	1.78	1.28	3.6	3.47	3.61	0.58	0.43	3.6	1.36	3.77	3.53
825	1968.COMAL.DAYS	19.35	10.3	3.23	10	12.9	16.6	0	0	6.67	6.45	16.6	6.45
826	1968.MEDINA.TEMP	49	49	57	68	75	90	82	85	75	72	57	51
827	1968.MEDINA.PREC	5.32	2.31	1.95	3.64	3.81	1.05	3.26	0.62	5.76	0.38	1.39	1.82
828	1968.MEDINA.DAYS	16.13	13.7	6.45	16.6	9.68	6.67	6.45	3.23	16.6	0	13.3	6.45
829	1968.UVALDE.TEMP	49	48	57	69	75	80	82	82	74	70	58	53
830	1968.UVALDE.PREC	3.66	1.72	2	2.83	3.88	1.41	1.77	0.21	3.96	1.02	1.71	1.03
831	1968.UVALDE.DAYS	12.9	10.3	3.23	13.3	6.45	6.67	3.23	0	13.3	6.45	6.67	3.23
832	1968.KINNEY.TEMP	49	53	59	68	75	78	82	84	74	70	56	50
833	1968.KINNEY.PREC	3.15	1.39	1.43	0.79	1.19	1.33	0.68	0.03	2.11	2.59	1.42	1.15
834	1968.KINNEY.DAYS	12.9	10.7	3.23	3.33	6.45	3.33	3.23	0	3.33	6.45	3.33	3.23
835	1969.BEXAR.TEMP	52	54	55	69	73	81	87	85	79	69	58	55
836	1969.BEXAR.PREC	1.76	2.9	2.35	2.46	4.61	2.32	0.36	4.19	1.32	5.85	1.02	2.28
837	1969.BEXAR.DAYS	9.68	7.14	9.68	16.6	19.3	10	0	16.1	10	16.1	3.33	9.68
838	1969.HAYS.TEMP	51	53	53	69	73	81	87	85	78	68	56	53
839	1969.HAYS.PREC	1.32	3.16	3.19	5.78	5.43	2.46	0.55	3.03	0.69	3.54	3.39	4.05
840	1969.HAYS.DAYS	3.23	7.14	12.9	16.6	16.1	10	3.23	9.68	3.33	19.3	10	9.68
841	1969.COMAL.TEMP	50	52	53	68	74	82	87	86	79	69	57	53
842	1969.COMAL.PREC	1.35	3.34	4.65	2.97	3.91	2.15	1.35	2.89	1.37	3.42	2.71	2.86
843	1969.COMAL.DAYS	3.23	7.14	16.1	13.3	12.9	10	3.23	12.9	6.67	16.1	10	9.68
844	1969.MEDINA.TEMP	53	54	54	69	73	81	87	86	80	70	58	55
845	1969.MEDINA.PREC	1.11	3.14	1.69	2.18	5.84	2.25	0.36	3.32	2.39	5.27	1.28	3.47
846	1969.MEDINA.DAYS	6.45	3.57	3.23	10	16.1	6.67	3.23	9.68	10	12.9	6.67	12.9
847	1969.UVALDE.TEMP	54	56	58	70	73	81	86	84	78	69	58	55
848	1969.UVALDE.PREC	1.8	0.83	0.74	1.39	4.75	2.5	0.4	3.12	1.14	13.3	2.07	1.26
849	1969.UVALDE.DAYS	3.23	7.14	3.23	6.67	16.1	6.67	0	9.68	6.67	16.1	6.67	6.45
850	1969.KINNEY.TEMP	53	54	54	69	73	82	87	84	78	67	54	54
851	1969.KINNEY.PREC	0.82	0.86	0.48	4.61	3.24	1.45	0.62	2.75	2.54	5.17	4.46	1.26
852	1969.KINNEY.DAYS	6.45	3.57	3.23	6.67	9.68	6.67	3.23	12.9	6.67	19.3	13.3	6.45
853	1970.BEXAR.TEMP	45	55	56	70	72	80	83	85	81	67	58	60
854	1970.BEXAR.PREC	1.1	2.66	1.98	1.13	7.3	0.89	0.91	0.95	4.35	1.31	0.01	0.15
855	1970.BEXAR.DAYS	6.45	10.7	6.45	3.33	22.5	6.67	6.45	6.45	16.6	6.45	0	0
856	1970.HAYS.TEMP	43	52	55	68	71	78	82	84	79	66	55	58
857	1970.HAYS.PREC	1.65	3.98	2.33	2.27	10.4	0.45	1.44	0.53	4.56	4.27	0	0.39
858	1970.HAYS.DAYS	3.23	17.8	6.45	6.67	19.3	3.33	6.45	3.23	20	12.9	0	0
859	1970.COMAL.TEMP	44	54	57	70	71	79	83	84	79	66	55	58
860	1970.COMAL.PREC	1.93	4.36	2.25	1.81	13.1	0.08	0.42	2.85	5.33	2.53	0	0.51
861	1970.COMAL.DAYS	6.45	14.2	6.45	6.67	25.8	0	0	9.68	20	12.9	0	0
862	1970.MEDINA.TEMP	46	53	56	70	72	78	83	84	79	67	58	60
863	1970.MEDINA.PREC	1.13	3.78	1.39	0.91	11.6	1.23	2.3	2.91	4.75	0.59	0.03	0.28
864	1970.MEDINA.DAYS	6.45	10.7	9.68	3.33	16.1	6.67	9.68	6.45	20	3.23	0	0
865	1970.UVALDE.TEMP	47	56	58	70	72	79	82	83	78	67	58	59
866	1970.UVALDE.PREC	0.78	1.98	1.01	0.16	2.05	0.92	0.45	1.25	4.69	0.16	0	0.14
867	1970.UVALDE.DAYS	6.45	7.14	6.45	0	3.23	3.33	3.23	3.23	16.6	0	0	0
868	1970.KINNEY.TEMP	48	48	55	68	71	78	81	83	75	65	54	52
869	1970.KINNEY.PREC	0.8	2.7	1	0	2.5	0.9	0	1.2	6.9	0.5	0	0
870	1970.KINNEY.DAYS	3.23	14.2	6.45	0	3.23	3.33	0	3.23	13.3	3.23	0	0
871	1971.BEXAR.TEMP	56	57	65	69	78	83	86	81	80	74	63	57
872	1971.BEXAR.PREC	0.04	0.81	0.04	1.39	1.52	2.74	1.05	9.42	4.57	4.62	2.74	2.86
873	1971.BEXAR.DAYS	0	3.57	0	3.33	6.45	13.3	3.23	29.0	20	22.5	6.67	9.68
874	1971.HAYS.TEMP	53	54	60	66	74	82	84	79	78	70	60	55
875	1971.HAYS.PREC	0.08	1.42	0.1	1.44	2.4	3.03	0.08	6.7	4.29	3.84	2.14	5.58
876	1971.HAYS.DAYS	0	3.57	0	3.33	12.9	13.3	0	22.5	10	12.9	6.67	16.1
877	1971.COMAL.TEMP	54	55	62	67	77	84	86	81	79	71	59	55
878	1971.COMAL.PREC	0.11	0.86	0.11	0.92	2.84	2.21	0.53	8.34	4.37	2.67	2.11	4.36
879	1971.COMAL.DAYS	0	3.57	0	3.33	12.9	10	3.23	22.5	6.67	12.9	6.67	19.3
880	1971.MEDINA.TEMP	56	57	63	69	78	83	85	79	79	71	62	57
881	1971.MEDINA.PREC	0.04	0.62	0.07	1.61	0.36	3.34	0.26	16.9	1.68	6.28	0.41	1.35
882	1971.MEDINA.DAYS	0	3.57	0	6.67	0	13.3	0	19.3	10	19.3	3.33	6.45
883	1971.UVALDE.TEMP	57	58	66	70	79	82	82	78	78	71	61	57
884	1971.UVALDE.PREC	0	0.39	0.02	1.81	0.73	8.16	0.36	9.45	2.26	6.19	0.04	1.6
885	1971.UVALDE.DAYS	0	3.57	0	6.67	3.23	23.3	3.23	22.5	13.3	12.9	0	6.45
886	1971.KINNEY.TEMP	55	57	63	70	77	81	83	79	79	72	62	54
887	1971.KINNEY.PREC	0	0.39	0	2.1	1.34	9.35	0.5	11.5	2.26	2.19	0.3	0.7
888	1971.KINNEY.DAYS	0	3.57	0	10	6.45	20	3.23	22.5	13.3	6.45	3.33	3.23
889	1972.BEXAR.TEMP	52	56	66	73	73	80	82	82	82	71	54	50
890	1972.BEXAR.PREC	1.35	0.4	0.13	1.94	11.2	2.86	3.13	4.24	1.4	1.99	2.37	0.44
891	1972.BEXAR.DAYS	6.45	0	0	6.67	22.5	13.3	9.68	19.3	6.67	3.23	13.3	0
892	1972.HAYS.TEMP	50	53	65	71	72	79	81	81	81	69	52	46
893	1972.HAYS.PREC	1.01	0.55	0.01	0.78	9.77	2.61	2.11	4.8	1.6	3.9	3.75	1.01
894	1972.HAYS.DAYS	6.45	3.45	0	3.33	19.3	13.3	9.68	12.9	6.67	3.23	13.3	3.23
895	1972.COMAL.TEMP	52	55	67	73	74	82	83	83	83	70	53	47
896	1972.COMAL.PREC	0.86	0.44	0.63	1.91	14.5	4.78	3.14	2.21	4.65	4.96	2.99	0.89
897	1972.COMAL.DAYS	3.23	3.45	3.23	10	22.5	16.6	12.9	6.45	20	9.68	10	3.23
898	1972.MEDINA.TEMP	53	55	67	74	73	81	83	82	81	71	55	50
899	1972.MEDINA.PREC	1.11	0.47	0.36	0.97	5.3	1.27	1.82	6.39	3.51	2.12	1.61	0.5
900	1972.MEDINA.DAYS	3.23	0	3.23	6.67	12.9	6.67	6.45	19.3	10	3.23	3.33	0
901	1972.UVALDE.TEMP	54	57	68	75	73	81	82	81	81	72	57	51
902	1972.UVALDE.PREC	0.84	0.16	0.33	0.26	2.67	1.61	1.18	2.98	3.71	0.71	0.81	0.23
903	1972.UVALDE.DAYS	3.23	0	3.23	0	16.1	6.67	6.45	12.9	13.3	3.23	3.33	0
904	1972.KINNEY.TEMP	50	55	67	75	73	82	84	82	80	73	53	51
905	1972.KINNEY.PREC	0.7	0.8	0.3	1.85	2.05	1.71	0.82	8.49	2.36	0.7	0.75	0.68
906	1972.KINNEY.DAYS	3.23	3.57	3.23	10	12.9	6.67	6.45	12.9	10	6.45	3.33	3.23
907	1973.BEXAR.TEMP	47	52	66	66	75	79	83	82	79	72	65	52
908	1973.BEXAR.PREC	2.77	2.76	1.58	5.41	2.73	10.4	6.91	1.29	13.0	4.85	0.29	0.16
909	1973.BEXAR.DAYS	12.9	14.2	6.45	20	6.45	16.6	12.9	3.23	20	19.3	0	0
910	1973.HAYS.TEMP	45	49	62	63	72	77	82	79	78	69	64	51
911	1973.HAYS.PREC	3.39	4	3.01	3.98	1.55	7.49	6.24	2.51	5.63	8.35	1.25	0.51

912	1973.HAYS.DAYS	16.13	17.8	9.68	13.3	3.23	20	12.9	9.68	3.33	29.0	6.67	3.23
913	1973.COMAL.TEMP	45	49	62	63	73	79	83	80	79	71	65	52
914	1973.COMAL.PREC	3.37	2.79	2.06	5.21	0.3	9.54	5.75	2.42	9.11	10.3	0.54	0.25
915	1973.COMAL.DAYS	19.35	21.4	6.45	13.3	0	16.6	9.68	9.68	16.6	32.2	3.33	0
916	1973.MEDINA.TEMP	46	50	64	64	74	78	81	81	79	70	65	53
917	1973.MEDINA.PREC	2.42	3.12	1.02	5.71	1.4	8.56	11.3	0.5	6.52	6.78	0.34	0.16
918	1973.MEDINA.DAYS	9.68	17.8	3.23	10	3.23	20	19.3	0	13.3	19.3	0	0
919	1973.UVALDE.TEMP	48	51	66	67	77	79	82	82	79	71	66	55
920	1973.UVALDE.PREC	1.62	2.5	1.26	2.72	0.71	4.5	6.26	1.53	4.72	4.93	0.1	0
921	1973.UVALDE.DAYS	6.45	10.7	6.45	6.67	3.23	20	9.68	3.23	10	22.5	0	0
922	1973.KINNEY.TEMP	45	50	64	63	77	78	82	82	78	71	65	53
923	1973.KINNEY.PREC	1.48	2.29	0.66	2.7	0.6	6.5	5.4	0	3.6	8.48	0	0
924	1973.KINNEY.DAYS	3.23	10.7	3.23	10	3.23	23.3	9.68	0	13.3	22.5	0	0
925	1974.BEXAR.TEMP	51	56	67	70	77	79	83	81	72	68	57	51
926	1974.BEXAR.PREC	1.36	0.04	0.94	2.18	4.28	1.02	1.28	11.1	3.85	4.09	5.39	1.83
927	1974.BEXAR.DAYS	6.45	0	6.45	13.3	19.3	6.67	3.23	16.1	16.6	16.1	10	6.45
928	1974.HAYS.TEMP	50	53	65	67	77	78	81	79	70	68	56	48
929	1974.HAYS.PREC	2.9	0.29	1.25	1.91	7.47	-0.0	0.57	7.33	4.49	2.23	9.69	2.35
930	1974.HAYS.DAYS	9.68	0	6.45	6.67	16.1	0	3.23	16.1	13.3	6.45	20	6.45
931	1974.COMAL.TEMP	49	55	66	69	77	79	83	82	73	69	57	50
932	1974.COMAL.PREC	2.9	0.18	0.75	2.24	8.75	2.25	0.78	10.4	2.86	1.65	8.81	1.29
933	1974.COMAL.DAYS	9.68	0	3.23	10	16.1	6.67	6.45	22.5	10	6.45	10	0
934	1974.MEDINA.TEMP	50	56	67	69	77	80	85	82	73	68	57	50
935	1974.MEDINA.PREC	1.8	0.02	1.7	-0.0	6.66	0.21	0.1	16.9	2.72	2.5	1.59	2.25
936	1974.MEDINA.DAYS	6.45	0	3.23	0	19.3	0	0	22.5	6.67	12.9	6.67	9.68
937	1974.UVALDE.TEMP	53	57	69	72	79	81	84	80	72	69	57	50
938	1974.UVALDE.PREC	1.51	0	0.86	1.24	3.8	0.32	0.19	15.8	1.54	1.76	1.71	2.29
939	1974.UVALDE.DAYS	3.23	0	3.23	3.33	12.9	0	0	25.8	6.67	9.68	6.67	6.45
940	1974.KINNEY.TEMP	49	51	66	69	77	82	85	81	70	72	56	49
941	1974.KINNEY.PREC	0.2	0	1.3	1.65	2.8	0.5	0.1	4.9	1.5	3.4	0.6	1.3
942	1974.KINNEY.DAYS	0	0	6.45	3.33	9.68	3.33	0	12.9	13.3	9.68	3.33	3.23
943	1975.BEXAR.TEMP	53	53	61	68	73	80	81	81	76	71	60	53
944	1975.BEXAR.PREC	1.04	3.3	0.52	2.69	6.91	4.6	1.06	1.28	0.51	2.25	0.03	1.88
945	1975.BEXAR.DAYS	6.45	10.7	0	13.3	16.1	13.3	6.45	6.45	0	3.23	0	3.23
946	1975.HAYS.TEMP	52	50	59	66	73	79	81	81	75	69	58	51
947	1975.HAYS.PREC	0.88	5.12	1.27	5.8	13.1	6.05	1.79	5.9	1.56	3.52	0.76	2.35
948	1975.HAYS.DAYS	3.23	14.2	6.45	13.3	32.2	20	6.45	9.68	6.67	6.45	3.33	9.68
949	1975.COMAL.TEMP	54	52	61	67	74	80	82	83	77	70	61	53
950	1975.COMAL.PREC	1.62	2.82	1.68	2.48	10.1	2.93	2.07	2.75	3.12	3.52	0.69	1.36
951	1975.COMAL.DAYS	6.45	10.7	9.68	6.67	25.8	10	6.45	6.45	13.3	6.45	3.33	3.23
952	1975.MEDINA.TEMP	54	54	63	70	75	79	80	81	76	71	62	54
953	1975.MEDINA.PREC	0.61	5.36	0.34	3.71	4.84	4.38	3.84	2.1	2.72	2.64	0.23	1.34
954	1975.MEDINA.DAYS	3.23	14.2	3.23	13.3	19.3	10	19.3	3.23	10	9.68	0	6.45
955	1975.UVALDE.TEMP	54	56	64	71	75	80	81	83	76	71	62	54
956	1975.UVALDE.PREC	0.4	2.58	0.2	5.3	6.65	1.87	1.79	0.67	1.44	2.92	0.02	1.38
957	1975.UVALDE.DAYS	0	10.7	0	10	19.3	6.67	12.9	3.23	3.33	9.68	0	3.23
958	1975.KINNEY.TEMP	54	55	59	68	74	80	79	83	73	65	53	40
959	1975.KINNEY.PREC	1	2.35	0	3.7	4.7	4.7	3.94	1.4	2.46	1.32	0.5	0.55
960	1975.KINNEY.DAYS	6.45	10.3	0	6.67	12.9	10	9.68	3.23	13.3	6.45	3.33	3.33
961	1976.BEXAR.TEMP	49	61	64	69	71	79	80	81	77	61	52	49
962	1976.BEXAR.PREC	0.56	0.13	1.2	5.67	5.8	1.61	5.39	2.09	3.79	8.48	2.46	1.35
963	1976.BEXAR.DAYS	3.23	0	3.23	20	16.1	6.67	25.8	6.45	20	19.3	16.6	6.45
964	1976.HAYS.TEMP	47	59	60	67	69	77	79	81	76	60	51	47
965	1976.HAYS.PREC	0.81	0.65	2.06	8.09	6.54	2.54	6.75	0.63	4.66	10.1	2.89	1.73
966	1976.HAYS.DAYS	6.45	3.45	12.9	30	16.1	6.67	22.5	3.23	16.6	22.5	13.3	6.45
967	1976.COMAL.TEMP	49	61	63	68	70	79	80	83	78	62	54	50
968	1976.COMAL.PREC	0.4	0.83	1.72	9.08	7.44	2.55	4.38	2.62	5.42	9.94	2.68	2
969	1976.COMAL.DAYS	3.23	6.9	6.45	20	19.3	6.67	16.1	12.9	16.6	22.5	13.3	9.68
970	1976.MEDINA.TEMP	50	62	65	69	71	79	78	80	78	62	53	50
971	1976.MEDINA.PREC	0.26	0	1.25	12.6	5.84	1.29	3.84	1.83	4.11	9.31	1.92	2.35
972	1976.MEDINA.DAYS	0	0	3.23	23.3	16.1	3.33	16.1	3.23	16.6	19.3	10	9.68
973	1976.UVALDE.TEMP	51	63	65	69	72	80	78	80	78	63	54	50
974	1976.UVALDE.PREC	0.42	0	1.72	6.11	5.52	2.26	10.1	1.85	9.19	5.53	1.48	1.83
975	1976.UVALDE.DAYS	3.23	0	6.45	23.3	16.1	6.67	29.0	9.68	26.6	16.1	10	9.68
976	1976.KINNEY.TEMP	50	62	64	67	69	80	78	82	78	61	51	47
977	1976.KINNEY.PREC	0.12	0.06	0.28	4.55	3.95	0.52	13.8	0.58	2.07	4.34	1.87	2.2
978	1976.KINNEY.DAYS	0	0	0	16.6	12.9	3.33	41.9	0	13.3	9.68	3.33	6.45
979	1977.BEXAR.TEMP	44	53	61	67	75	81	85	84	82	71	61	53
980	1977.BEXAR.PREC	3.1	0.91	0.88	8.8	1.62	2.26	0.1	0.06	2.11	3.47	6.01	0.32
981	1977.BEXAR.DAYS	12.9	3.57	6.45	26.6	6.45	13.3	0	0	10	12.9	10	0
982	1977.HAYS.TEMP	41	52	59	64	73	80	83	85	82	71	60	51
983	1977.HAYS.PREC	2.94	2.44	1.46	7.4	2.91	3.5	0.11	0.49	2.39	1.11	2.6	0.34
984	1977.HAYS.DAYS	16.13	7.14	9.68	23.3	6.45	16.6	0	0	10	9.68	10	0
985	1977.COMAL.TEMP	43	54	61	67	75	82	85	87	84	72	62	53
986	1977.COMAL.PREC	3.91	1.62	1.39	6.99	0.75	1.35	0.02	0.49	1.13	2.67	4.04	0.47
987	1977.COMAL.DAYS	16.13	7.14	9.68	20	3.23	6.67	0	3.23	3.33	6.45	20	0
988	1977.MEDINA.TEMP	45	55	62	67	75	80	82	84	83	71	61	55
989	1977.MEDINA.PREC	2.35	0.73	0.61	5.03	2.63	4.02	0	0.28	0.65	1.14	1.44	0.52
990	1977.MEDINA.DAYS	9.68	0	3.23	16.6	9.68	6.67	0	0	0	6.45	6.67	0
991	1977.UVALDE.TEMP	46	55	62	68	76	82	84	87	85	73	63	55
992	1977.UVALDE.PREC	2.16	0.78	0.34	2.84	3.35	1.74	0	1.15	2.06	2.15	2.8	0.53
993	1977.UVALDE.DAYS	12.9	3.57	0	13.3	6.45	6.67	0	3.23	3.33	9.68	10	3.23
994	1977.KINNEY.TEMP	42	49	60	67	74	82	84	87	85	71	61	54
995	1977.KINNEY.PREC	2.06	1.36	0.56	1.4	0.25	1.25	0	0.45	0.75	5.52	1.21	0.25
996	1977.KINNEY.DAYS	12.9	3.57	3.23	3.33	0	3.33	0	0	3.33	16.1	3.33	0
997	1978.BEXAR.TEMP	43	46	59	68	77	82	86	83	78	69	62	52
998	1978.BEXAR.PREC	0.68	1.76	1.71	3.62	2.45	3.96	1.43	4.97	8.86	0.55	4.91	1.39
999	1978.BEXAR.DAYS	3.23	7.14	6.45	6.67	9.68	10	6.45	6.45	13.3	3.23	13.3	3.23
1000	1978.HAYS.TEMP	41	43	56	68	76	81	86	83	78	68	60	49
1001	1978.HAYS.PREC	0.96	2.21	1.03	1.2	4.7	2.22	0.41	3.57	5.3	0.39	8.64	2.45
1002	1978.HAYS.DAYS	0	17.8	3.23	3.33	9.68	3.33	0	6.45	13.3	3.23	13.3	3.23

1003	1978.COMAL.TEMP	42	44	57	68	77	81	85	82	73	69	60	51
1004	1978.COMAL.PREC	1.09	2.7	1.09	2.57	2.59	4.72	1	3.46	7.32	0.34	7.97	2.39
1005	1978.COMAL.DAYS	3.23	14.2	3.23	6.67	6.45	13.3	3.23	12.9	16.6	3.23	23.3	3.23
1006	1978.MEDINA.TEMP	44	46	61	71	78	81	84	81	78	69	62	52
1007	1978.MEDINA.PREC	0.38	1.38	0.27	2.09	1.75	2.04	1.02	5.75	3.29	0.76	3.02	2.89
1008	1978.MEDINA.DAYS	0	10.7	0	6.67	9.68	6.67	3.23	12.9	10	3.23	10	3.23
1009	1978.UVALDE.TEMP	46	48	62	73	81	82	84	80	79	70	64	53
1010	1978.UVALDE.PREC	0.37	0.62	0.05	0.9	2.88	4.13	0.04	4.23	1.89	9.7	1.81	0.96
1011	1978.UVALDE.DAYS	0	0	0	3.33	9.68	6.67	0	12.9	6.67	3.23	6.67	3.23
1012	1978.KINNEY.TEMP	45	47	63	73	79	83	87	85	79	70	62	51
1013	1978.KINNEY.PREC	0.1	0.62	0.8	1.14	2.43	3.4	0.9	1.14	2.55	1.45	3.6	0.85
1014	1978.KINNEY.DAYS	0	0	3.23	3.33	9.68	10	3.23	3.23	10	3.23	10	6.45
1015	1979.BEXAR.TEMP	43	52	63	69	74	80	84	83	78	74	58	55
1016	1979.BEXAR.PREC	4.07	1.38	3.55	5.34	1.98	5.59	7.38	2.09	0.86	0.11	1.43	2.06
1017	1979.BEXAR.DAYS	16.13	7.14	16.1	16.6	9.68	6.67	12.9	12.9	3.33	0	10	12.9
1018	1979.HAYS.TEMP	40	47	61	66	71	78	82	81	76	72	56	51
1019	1979.HAYS.PREC	5.82	3.2	4.41	4.61	2.36	2.1	9.06	1.02	1.74	0.39	0.76	3.27
1020	1979.HAYS.DAYS	12.9	10.7	9.68	20	12.9	10	19.3	3.23	10	0	6.67	12.9
1021	1979.COMAL.TEMP	41	49	61	67	71	78	83	81	76	72	56	52
1022	1979.COMAL.PREC	4.41	2.85	3.73	4.95	3.94	2.74	5.36	0.93	2.28	0.34	1.01	4.18
1023	1979.COMAL.DAYS	12.9	10.7	16.1	16.6	12.9	6.67	16.1	3.23	10	3.23	6.67	12.9
1024	1979.MEDINA.TEMP	44	52	62	68	72	78	83	82	78	73	57	53
1025	1979.MEDINA.PREC	2.31	1.14	3.77	5.19	2.08	8.53	1.94	1.24	0.04	0.1	0.82	1.67
1026	1979.MEDINA.DAYS	9.68	3.57	12.9	16.6	6.45	10	6.45	3.23	0	0	6.67	6.45
1027	1979.UVALDE.TEMP	46	53	63	70	74	80	84	82	79	75	59	54
1028	1979.UVALDE.PREC	1.3	1.04	3.53	5.19	1.42	14.9	0.67	0.97	0.33	0.05	2.13	0.82
1029	1979.UVALDE.DAYS	3.23	3.57	12.9	20	6.45	13.3	3.23	3.23	0	0	6.67	9
1030	1979.KINNEY.TEMP	42	51	60	68	71	78	86	86	80	73	56	54
1031	1979.KINNEY.PREC	1.08	3.71	3.99	2.15	0.5	3.41	0	0.25	0	0	1	0.25
1032	1979.KINNEY.DAYS	3.23	17.2	9.68	6.67	3.23	13.3	0	0	0	0	6.67	3
1033	1980.BEXAR.TEMP	53	53	61	67	76	85	88	85	83	70	58	55
1034	1980.BEXAR.PREC	0.72	0.74	0.98	1.67	6.42	0.52	0.26	2.64	5.05	1.09	3.53	0.61
1035	1980.BEXAR.DAYS	3.23	0	3.23	6.67	25.8	3.33	0	12.9	10	3.23	10	3
1036	1980.HAYS.TEMP	50	51	58	64	74	83	86	84	81	67	55	52
1037	1980.HAYS.PREC	1.66	1.62	2.23	1.88	7.58	1.11	0.1	1.25	6.28	1.23	3.9	0.72
1038	1980.HAYS.DAYS	3.23	10.3	6.45	6.67	22.5	3.33	0	3.23	16.6	3.23	10	3.23
1039	1980.COMAL.TEMP	51	51	58	64	75	83	85	84	81	67	56	53
1040	1980.COMAL.PREC	1.87	1.25	1.94	1.3	6.8	2.69	0.34	2.48	7.54	2.72	4.12	0.64
1041	1980.COMAL.DAYS	9.68	10.3	6.45	3.33	25.8	3.33	3.23	6.45	20	3.23	16.6	0
1042	1980.MEDINA.TEMP	53	53	63	68	76	84	85	83	81	69	56	54
1043	1980.MEDINA.PREC	0.43	0.43	0.58	1	5.53	0.03	0.37	4.88	3.66	0.39	3.28	0.69
1044	1980.MEDINA.DAYS	0	0	3.23	3.33	19.3	0	0	6.45	10	0	10	3.23
1045	1980.UVALDE.TEMP	55	56	64	70	78	86	87	84	82	71	58	55
1046	1980.UVALDE.PREC	0.44	0.33	0.33	0.64	7.89	0	0.55	6.21	1.19	1.54	3.06	0.87
1047	1980.UVALDE.DAYS	0	0	0	3.33	19.3	0	3.23	6.45	10	3.23	13.3	3.23
1048	1980.KINNEY.TEMP	54	55	59	68	77	86	88	85	81	69	54	51
1049	1980.KINNEY.PREC	0.9	0	1.2	1.44	5.1	0	0.15	2.1	2	0.1	3.3	2.84
1050	1980.KINNEY.DAYS	3.23	0	6.45	3.33	16.1	0	0	3.23	10	0	6.67	9.68
1051	1981.BEXAR.TEMP	50	53	60	73	75	81	84	85	78	72	62	53
1052	1981.BEXAR.PREC	2.06	0.96	1.96	2.21	6.43	8.71	0.25	2.41	1.36	8.61	0.72	0.69
1053	1981.BEXAR.DAYS	6.45	3.57	12.9	6.67	12.9	23.3	0	9.68	6.67	19.3	3.33	3.23
1054	1981.HAYS.TEMP	50	52	59	72	74	80	82	83	76	70	62	52
1055	1981.HAYS.PREC	2.21	1.44	2.19	2.55	2.92	22.9	2.75	5.27	0.83	4.24	1.69	0.57
1056	1981.HAYS.DAYS	6.45	3.57	12.9	6.67	9.68	30	12.9	3.23	3.33	12.9	6.67	3.23
1057	1981.COMAL.TEMP	51	52	58	71	73	79	82	82	76	71	62	51
1058	1981.COMAL.PREC	1.97	1.47	1.68	2.44	4.94	14.0	2.18	3.97	2.01	7.04	0.75	0.74
1059	1981.COMAL.DAYS	3.23	3.57	9.68	6.67	16.1	36.6	6.45	9.68	3.33	12.9	3.33	9
1060	1981.MEDINA.TEMP	51	54	61	72	75	80	82	83	78	72	63	54
1061	1981.MEDINA.PREC	1.42	0.87	2.96	3.22	5.18	4.01	2.7	0.29	1.48	4.29	0.1	0.88
1062	1981.MEDINA.DAYS	6.45	3.57	9.68	13.3	16.1	23.3	9.68	0	3.33	9.68	0	3.23
1063	1981.UVALDE.TEMP	52	56	62	72	77	81	84	84	80	73	63	56
1064	1981.UVALDE.PREC	0.92	0.36	2.16	7.91	3.46	3.17	0.4	0.16	3.73	3.45	0.15	0.37
1065	1981.UVALDE.DAYS	3.23	0	9.68	16.6	12.9	10	0	0	13.3	12.9	0	8
1066	1981.KINNEY.TEMP	49	54	62	70	74	78	83	84	83	72	62	54
1067	1981.KINNEY.PREC	1.2	0.3	0.75	7.14	1.04	8.44	1.7	2	1.8	3.52	0	0.37
1068	1981.KINNEY.DAYS	3.23	0	3.23	20	6.45	16.6	3.23	3.23	10	9.68	0	8
1069	1982.BEXAR.TEMP	50	49	63	66	74	81	85	86	80	69	59	52
1070	1982.BEXAR.PREC	0.72	1.28	0.69	1.23	6.42	1.37	0.14	0.55	0.87	2.84	4.54	2.31
1071	1982.BEXAR.DAYS	3.23	7.14	0	3.33	19.3	6.67	0	0	3.33	12.9	13.3	12.9
1072	1982.HAYS.TEMP	50	50	64	67	75	81	86	86	79	68	58	51
1073	1982.HAYS.PREC	0.42	1.3	0.71	3.09	6.45	2.85	0	0.04	0.8	2.58	2.4	2.25
1074	1982.HAYS.DAYS	3.23	7.14	3.23	13.3	12.9	10	0	0	3.33	16.1	10	9.68
1075	1982.COMAL.TEMP	50	49	62	67	74	82	86	86	79	69	59	53
1076	1982.COMAL.PREC	0.42	0.75	0.95	1.46	4.16	2.49	0	0.67	1.4	2.61	4.34	1.79
1077	1982.COMAL.DAYS	3.23	3.57	3.23	10	9.68	10	0	3.23	6.67	6.45	16.6	9.68
1078	1982.MEDINA.TEMP	52	52	65	70	75	82	84	85	80	71	61	51
1079	1982.MEDINA.PREC	0.65	1.71	0.41	1.64	7.43	0.69	0.38	1.45	2.22	1.41	2.63	1.37
1080	1982.MEDINA.DAYS	3.23	7.14	0	10	16.1	3.33	3.23	6.45	10	12.9	13.3	6.45
1081	1982.UVALDE.TEMP	53	53	66	72	76	84	85	86	82	72	61	54
1082	1982.UVALDE.PREC	0.64	3.57	0.3	1.14	4.59	2.62	3.55	1.06	0.2	0.82	3.11	1.75
1083	1982.UVALDE.DAYS	3.23	10.7	0	3.33	9.68	10	3.23	6.45	0	0	10	9.68
1084	1982.KINNEY.TEMP	54	54	67	69	76	83	85	86	80	70	56	54
1085	1982.KINNEY.PREC	0	2.16	0.17	1.15	5.47	2.15	0.4	0.67	2.26	1.25	1.68	1.74
1086	1982.KINNEY.DAYS	0	10.7	0	3.33	9.68	6.67	3.23	3.23	10	6.45	10	9.68
1087	1983.BEXAR.TEMP	49	52	59	65	74	79	83	84	78	71	62	43
1088	1983.BEXAR.PREC	1.48	1.54	3.89	0.18	4.37	1.27	2.43	2	3.86	1.64	3.06	0.39
1089	1983.BEXAR.DAYS	6.45	10.7	12.9	0	12.9	3.33	12.9	9.68	10	6.45	10	3.23
1090	1983.HAYS.TEMP	47	51	56	63	73	77	81	82	77	68	60	42
1091	1983.HAYS.PREC	1.94	1.94	5.24	0.15	5.52	5.88	2.74	2.73	5.08	2.34	2.85	0.54
1092	1983.HAYS.DAYS	9.68	10.7	22.5	0	19.3	20	12.9	3.23	3.33	6.45	13.3	3.23
1093	1983.COMAL.TEMP	47	51	57	63	73	77	81	83	78	69	61	42

1094	1983.COMAL.PREC	1.34	2.32	4.23	0.08	5.07	6.64	4.39	2.55	3.31	0.38	2.24	0.48
1095	1983.COMAL.DAYS	6.45	7.14	16.1	0	12.9	20	12.9	6.45	6.67	3.23	10	3.23
1096	1983.MEDINA.TEMP	50	53	60	67	74	78	93	84	78	72	63	43
1097	1983.MEDINA.PREC	2.06	1.26	3.35	0.29	3.41	2.76	0.87	3.43	2.07	2.43	1.82	0.6
1098	1983.MEDINA.DAYS	12.9	3.57	16.1	3.33	16.1	6.67	3.23	3.23	13.3	12.9	6.67	3.23
1099	1983.UVALDE.TEMP	51	55	61	69	77	82	84	85	80	73	64	45
1100	1983.UVALDE.PREC	1.89	1.15	4.35	0.07	2.5	4.18	2.06	3.43	3.16	1.75	2.48	0.31
1101	1983.UVALDE.DAYS	9.68	7.14	12.9	0	6.45	13.3	6.45	3.23	10	3.23	6.67	0
1102	1983.KINNEY.TEMP	54	58	58	67	75	77	80	80	75	66	58	41
1103	1983.KINNEY.PREC	1.12	1.15	1.38	0	2.5	4.1	0.62	1.35	2.41	3.35	1.37	0
1104	1983.KINNEY.DAYS	9.68	3.45	6.45	0	6.45	10	3.23	6.45	6.67	6.45	3.33	0
1105	1984.BEXAR.TEMP	46	54	64	70	77	82	85	85	77	71	58	60
1106	1984.BEXAR.PREC	1.87	0.54	1.91	0.11	3.76	1.4	0	3.04	1.06	5.94	2.91	3.41
1107	1984.BEXAR.DAYS	6.45	0	6.45	0	16.1	10	0	12.9	6.67	16.1	6.67	12.9
1108	1984.HAYS.TEMP	45	53	60	67	75	81	84	84	76	70	57	59
1109	1984.HAYS.PREC	1.56	1.04	2.18	0.2	1.25	1.72	0.31	0.6	0.65	7.91	1.64	3.43
1110	1984.HAYS.DAYS	6.45	3.45	9.68	0	6.45	6.67	0	3.23	3.33	32.2	3.33	9.68
1111	1984.COMAL.TEMP	45	53	61	68	75	81	83	84	77	70	57	58
1112	1984.COMAL.PREC	0.88	0.9	0.22	0.09	2.08	1.29	1.21	0.6	0.65	7.91	1.64	3.43
1113	1984.COMAL.DAYS	3.23	3.45	0	0	9.68	3.33	9.68	3.23	3.33	32.2	3.33	9.68
1114	1984.MEDINA.TEMP	47	54	64	70	77	81	83	84	77	71	58	59
1115	1984.MEDINA.PREC	1.85	0.52	0.43	0.98	0.7	2.61	0.26	0.1	3.21	7.35	0.87	3.28
1116	1984.MEDINA.DAYS	3.23	3.45	3.23	3.33	3.23	6.67	0	0	6.67	25.8	3.33	12.9
1117	1984.UVALDE.TEMP	50	57	66	74	79	83	86	86	79	72	59	61
1118	1984.UVALDE.PREC	1.4	0.07	0.03	0.18	1.41	1.36	0.27	0.1	1.05	6.08	0.87	3.91
1119	1984.UVALDE.DAYS	6.45	0	0	0	6.45	6.67	0	0	10	12.9	3.33	6.45
1120	1984.KINNEY.TEMP	45	55	61	65	72	77	85	86	78	70	58	57
1121	1984.KINNEY.PREC	1.4	0.02	0	0.3	1.65	2.07	0.65	0	1.65	4.6	1	2.9
1122	1984.KINNEY.DAYS	6.45	0	0	3.33	3.23	6.67	3.23	0	3.33	16.1	3.33	6.45
1123	1985.BEXAR.TEMP	44	50	64	69	76	80	82	85	79	71	64	50
1124	1985.BEXAR.PREC	2.68	1.91	2.85	3.27	2.47	8.2	5.8	0.45	4.8	3.91	5	0.09
1125	1985.BEXAR.DAYS	12.9	7.14	12.9	10	9.68	16.6	6.45	0	16.6	12.9	16.6	0
1126	1985.HAYS.TEMP	42	48	62	67	74	82	83	86	80	72	64	50
1127	1985.HAYS.PREC	2.68	1.91	2.85	3.27	2.47	7.72	4.2	0.06	4.51	3.27	13	0.78
1128	1985.HAYS.DAYS	12.9	7.14	12.9	10	9.68	6.67	9.68	0	26.6	12.9	16.6	3.23
1129	1985.COMAL.TEMP	42	48	63	68	75	80	81	85	79	71	63	47
1130	1985.COMAL.PREC	2.41	1.58	1.86	3.39	2.49	7.48	4.85	0.25	4.7	2.56	5.69	0
1131	1985.COMAL.DAYS	9.68	10.7	9.68	10	9.68	20	12.9	0	13.3	6.45	16.6	0
1132	1985.MEDINA.TEMP	42	50	65	69	76	79	81	84	78	71	63	49
1133	1985.MEDINA.PREC	1.81	1.87	0.72	1.44	2.88	3.66	1.78	0	4.5	7.76	2.45	0.1
1134	1985.MEDINA.DAYS	6.45	7.14	3.23	6.67	6.45	10	6.45	0	6.67	12.9	10	0
1135	1985.UVALDE.TEMP	45	53	68	72	79	82	84	87	81	74	66	52
1136	1985.UVALDE.PREC	1.81	1.3	0.72	0.96	4.8	4.14	1.35	0	4.5	0.7	1.1	0
1137	1985.UVALDE.DAYS	6.45	3.57	3.23	3.33	6.45	10	6.45	0	6.67	3.23	3.33	0
1138	1985.KINNEY.TEMP	43	51	66	68	78	80	82	85	79	72	64	50
1139	1985.KINNEY.PREC	0.5	1.3	0.72	2.07	2.55	4.14	1.35	0	4.5	0.7	1.1	0
1140	1985.KINNEY.DAYS	3.23	3.57	3.23	6.67	6.45	10	6.45	0	6.67	3.23	3.33	0
1141	1986.BEXAR.TEMP	53	58	63	73	74	81	86	85	84	69	59	51
1142	1986.BEXAR.PREC	0.76	2.52	0.35	0.6	6.29	11.9	0.05	1.86	2.83	6.58	1.83	7.11
1143	1986.BEXAR.DAYS	3.23	3.57	0	3.33	22.5	23.3	0	6.45	6.67	16.1	6.67	9.68
1144	1986.HAYS.TEMP	53	57	62	71	75	81	86	84	82	68	59	50
1145	1986.HAYS.PREC	1.47	0.89	0.58	1.07	9.94	4.94	0.41	1.73	6.02	5.72	1.77	7.03
1146	1986.HAYS.DAYS	6.45	3.57	0	6.67	22.5	23.3	3.23	9.68	20	12.9	6.67	19.3
1147	1986.COMAL.TEMP	51	56	59	70	72	78	83	83	81	68	58	48
1148	1986.COMAL.PREC	1.47	2.52	1.96	1.23	8.86	5.78	0	1.11	7.61	6.94	1.68	8.03
1149	1986.COMAL.DAYS	6.45	3.57	3.23	3.33	25.8	13.3	0	3.23	23.3	19.3	6.67	19.3
1150	1986.MEDINA.TEMP	48	57	62	72	73	79	82	83	82	68	58	50
1151	1986.MEDINA.PREC	0.38	0.83	0.69	1.57	6.11	5.98	0.58	0.69	2.21	10.9	1.81	4.56
1152	1986.MEDINA.DAYS	0	3.57	3.23	6.67	16.1	6.67	3.23	3.23	6.67	25.8	10	12.9
1153	1987.BEXAR.TEMP	50	55	57	66	76	80	84	86	79	71	60	54
1154	1987.BEXAR.PREC	1.13	4.78	1.1	1.48	12.8	7.69	1.21	0.33	2.24	0.44	2.53	2.18
1155	1987.BEXAR.DAYS	6.45	32.1	9.68	3.33	25.8	23.3	3.23	0	10	3.23	16.6	6.45
1156	1987.HAYS.TEMP	49	54	57	66	75	80	83	86	79	69	59	52
1157	1987.HAYS.PREC	1.07	4.17	1.75	0.28	10.8	9.67	1.2	1.25	2.32	0.41	3.19	1.74
1158	1987.HAYS.DAYS	6.45	14.2	6.45	0	22.5	23.3	3.23	6.45	10	3.23	13.3	6.45
1159	1987.COMAL.TEMP	48	53	55	64	75	78	82	84	77	68	59	52
1160	1987.COMAL.PREC	1.54	4.9	1.1	0.42	9.68	13.5	1.2	0.92	3.87	0.08	1	1.84
1161	1987.COMAL.DAYS	3.23	25	6.45	0	25.8	30	3.23	3.23	13.3	0	6.67	9.68
1162	1987.MEDINA.TEMP	50	54	56	63	74	78	81	83	77	74	60	54
1163	1987.MEDINA.PREC	0.51	3.92	1.67	2.19	13.8	8.66	2.01	2.55	1.11	0.08	1.72	1.84
1164	1987.MEDINA.DAYS	3.23	21.4	9.68	10	32.2	20	9.68	6.45	3.33	0	6.67	9.68
1165	1988.BEXAR.TEMP	47	54	61	69	76	81	84	86	80	73	65	56
1166	1988.BEXAR.PREC	0.39	0.92	0.86	1.23	0.41	5.5	5.58	1.98	0.83	0.62	0.02	0.67
1167	1988.BEXAR.DAYS	3.23	6.9	3.23	10	0	13.3	12.9	6.45	3.33	3.23	0	3.23
1168	1988.HAYS.TEMP	46	52	60	68	74	80	84	87	80	72	64	55
1169	1988.HAYS.PREC	0.54	1.32	2.35	2.58	4.01	1.39	3.14	0.77	3.22	0.93	0.11	1.14
1170	1988.HAYS.DAYS	0	6.9	3.23	10	9.68	6.67	12.9	3.23	13.3	3.23	0	3.23
1171	1988.COMAL.TEMP	45	51	59	67	73	79	83	85	80	71	65	55
1172	1988.COMAL.PREC	0.54	1.32	2.35	2.58	4.01	2.26	3.07	0.28	3.54	0.7	0.52	0.38
1173	1988.COMAL.DAYS	0	6.9	3.23	10	9.68	6.67	16.1	3.23	10	3.23	3.33	0
1174	1988.MEDINA.TEMP	47	54	61	68	74	80	83	85	80	72	63	55
1175	1988.MEDINA.PREC	0.36	1.97	0.86	0.83	1.21	3.34	2.03	0.5	0.48	1.77	0.02	0.25
1176	1988.MEDINA.DAYS	3.23	6.9	3.23	3.33	3.23	10	9.68	3.23	0	6.45	0	0
1177	1989.BEXAR.TEMP	56	52	62	70	82	83	87	86	79	71	62	43
1178	1989.BEXAR.PREC	2.96	0.29	1.24	2.55	0.33	3.96	0.69	0.48	1.54	5.81	1.93	0.36
1179	1989.BEXAR.DAYS	9.68	0	6.45	10	3.23	10	3.23	3.23	6.67	12.9	10	3.23
1180	1989.HAYS.TEMP	55	49	62	69	78	81	84	84	78	70	62	44
1181	1989.HAYS.PREC	3.87	0.69	2.25	4.19	3.56	2.93	0.5	2.22	0.26	2.99	1.8	0.2
1182	1989.HAYS.DAYS	19.35	3.57	6.45	13.3	16.1	10	3.23	6.45	0	12.9	6.67	0
1183	1989.COMAL.TEMP	55	50	61	68	78	81	84	83	77	70	62	42
1184	1989.COMAL.PREC	2.61	0.71	2.75	2.94	2.24	3.96	1.22	1.14	0.26	4.17	1.72	0.3

```
1989.COMAL.DAYS    16.13 3.57 12.9 6.67 6.45   10 6.45 6.45    0 16.1 6.67    0
1989.MEDINA.TEMP      55   51   61   69   80   82   85   84   78   70   60   43
1989.MEDINA.PREC   3.24 0.59 1.93 0.66    1 1.41 0.99 0.24 0.65 3.37 1.52  0.5
1989.MEDINA.DAYS  19.35 3.57 6.45 3.33 6.45 6.67 3.23    0 3.33 12.9 6.67 3.23



 PARAMETER DAYLIGHT(MONTH)  DAYLIGHT HOUR PERCENTAGES FOR USE IN BLANEY CRIDDLE
        /                   JAN            0.2400
                            FEB            0.2500
                            MAR            0.2700
                            APR            0.2900
                            MAY            0.3100
                            JUN            0.3200
                            JUL            0.3100
                            AUG            0.3000
                            SEP            0.2800
                            OCT            0.2600
                            NOV            0.2400
                            DEC            0.2300 / ;

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*        CALCULATED WEATHER DATA BY STATE OF NATURE

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

PARAMETER WEATHER(YEAR,GROUPS,WITEM,MONTH)  Average Weather Info
          ISDATA(YEAR,GROUPS)     Is the year county in weatherd ;

  WEATHERD("1935",COUNTYS,WITEM,MONTH) =
                   1/2*WEATHERD("1979",COUNTYS,WITEM,MONTH)
                  +1/2*WEATHERD("1981",COUNTYS,WITEM,MONTH);

  ISDATA(YEAR,COUNTY) =
         1$SUM((MONTHS,WITEM),WEATHERD(YEAR,COUNTY,WITEM,MONTHS));

  WEATHERD(YEAR,"UVALDE",WITEM,MONTHS)$(ISDATA(YEAR,"UVALDE") EQ 0)
                   = WEATHERD(YEAR,"MEDINA",WITEM,MONTHS);

  WEATHERD(YEAR,"KINNEY",WITEM,MONTHS)$(ISDATA(YEAR,"KINNEY") EQ 0)
                   = WEATHERD(YEAR,"UVALDE",WITEM,MONTHS);

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  Calculate AVERAGE temp, precip, and days for each recharge group.
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  WEATHER(RECHARGE,COUNTY,WITEM,MONTH) =
*     SUM(YEAR $ DATES(RECHARGE,YEAR),
*         WEATHERD(YEAR,COUNTY,WITEM,MONTH) ) / NRech(recharge) ;

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  Since EPIC uses only a single year of temp, precip data to
*  simulate yields and water use, so averages not taken here, either.
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

  WEATHER(recharge,COUNTY,WITEM,MONTH) =
         WEATHERD(recharge,COUNTY,WITEM,MONTH) ;

*   cccccccccccccccccccccccccccccccccccccccccccc

*            NONAGRICULTURAL WATER DEMAND DATA

*   cccccccccccccccccccccccccccccccccccccccccccc

* Monthly Industrial Use (1989) from TWDB (Normal Alford)

TABLE INDEMAND(USEYEAR,month,groups) INDUSTRIAL USEAGE
             KINNEY   UVALDE   MEDINA    BEXAR    COMAL     HAYS
1989.jan        0       130       0       438      164       90
1989.feb        0       117       0       461      158       71
1989.mar        0       215       0       456      177       83
1989.apr        0       242       0       519      173       80
1989.may        0       258       0       635      170       83
1989.jun        0       230       0       578      180       67
1989.jul        0       186       0       563      183       69
1989.aug        0       185       0       630      178       28
1989.sep        0       203       0       578      167       27
1989.oct        0       203       0       532      166       28
1989.nov        0       145       0       442      151       21
1989.dec        0       138       0       454      164       28 ;

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  These estimates were developed by Keith Keplinger using projected
*  use data for the six counties over the aquifer and actual pumping
*  data for 1989.  Data provided by TWDB (N. Alford & S. Densmore).
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

TABLE IndAdd(GROUPS,USEYEAR) PROJECTED Additions ANNUAL INDUSTRIAL
                              2000    2010
              KINNEY            0       0
              UVALDE          283     310
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                 MEDINA           0       0
                 BEXAR         1694    2541
                 COMAL         2195    2163
                 HAYS             0       0 ;

* Note : Municipal Use includes Municipal Use (TWDB - Norman Alford)
*          plus Domestic and Stock (TWDB - GWSIM-IV pumping 1989, by use)

table MUNUSE(useyear,month,groups)
              KINNEY   UVALDE   MEDINA    BEXAR    COMAL     HAYS
1989.jan          94      382      414    18282     1947      879
1989.feb          87      368      405    16651     1944      886
1989.mar         111      490      469    20590     1852      906
1989.apr         116      548      514    22671     2166      962
1989.may         138      649      676    26698     2101      953
1989.jun         141      813      831    25711     2219     1034
1989.jul         159      923      874    30627     2352     1173
1989.aug         152      689      748    31496     2381     1158
1989.sep         152      676      684    27437     2265     1248
1989.oct         128      538      589    24688     2166     1113
1989.nov          95      401      413    19529     2056      946
1989.dec          96      416      431    20826     2114      949 ;

TABLE MUNAdd(GROUPS,USEYEAR) Projected Addition to Annual MUNICIPAL
                              2000    2010
                 KINNEY       -126    -133
                 UVALDE         72     512
                 MEDINA         43     365
                 BEXAR       28966   67278
                 COMAL        3473    7058
                 HAYS         2095    4973  ;

TABLE PDATA(*,USER) PRICES AND PRICE ELASTICITIES
                                       MUNICIPAL     INDUSTRIAL
              PRICE                     41.6          41.6
              ELASTICITY                -0.363        -0.540
              CLIMATELAS                .756           0          ;

Parameter ELAS(month)  Monthly Municipal Elasticity
*  from "Seasonality in Community Water Demand" Griffin & Chang
/  jan -0.311, feb -0.301, mar -0.348, apr -0.369, may -0.382,
   jun -0.391, jul -0.410, aug -0.412, sep -0.394, oct -0.360,
   nov -0.332, dec -0.310 / ;

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*          CALCULATED MUNICIPAL DEMAND

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

PARAMETER MUNDEMAND(YEAR,GROUPS,USEYEAR,month) WATER DEMANDS AFFECTED BY WEATHER
        CLIMATE(YEAR,month,GROUPS)   GRIFFIN AND CHANGS CLIMATE VARIABLE
        CDIF(YEAR,month,GROUPS)      Climate adjustment factor
        AveClimate(month,groups)     Average Climate 2000 & 2010 Demands
        MunPct(month,groups)         1989 monthly distr. of Municipal
        IndPct(month,groups)         1989 monthly distr. of Industrial
        AMun(groups)                 Annual Municipal - 1989
        AInd(groups)                 Annual Industrial - 1989
        ;

*       (Climate = (days<=.25" rain)x(avg temp) (30 day months used) ;
*       (CDIF = 1 + (% change in use) due to the climate variable) ;

        CLIMATE(RECHARGE,month,COUNTY) =
          30/100*(100-WEATHER(RECHARGE,COUNTY,"DAYS",MONTH))*
                      WEATHER(recharge,COUNTY,"TEMP",MONTH);

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*       (Expected weather for 2000 & 2010 is the average weather
*        for the years 1987 to 1991.  For this model, weighted
*        average climate based on recharge years is used.
*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

  AveClimate(month,county) = sum(recharge,
     Climate(recharge,month,county) * prob(recharge) );

*  CDIF(recharge,month,COUNTY) = 1+PDATA("CLIMATELAS","MUNICIPAL")*
*     (CLIMATE(recharge,month,COUNTY) /
*      max(0.0001,CLIMATE("1989",month,COUNTY))-1);

AMun(county) = sum(month, MunUse("1989",month,county) ) ;
AInd(county) = sum(month, INDemand("1989",month,county) ) ;

MunPct(month,county) = MunUse("1989",month,county) / AMun(county) ;
IndPct(month,county) = INDemand("1989",month,county) / AMun(county) ;

INDemand(project,month,county) =
   INDemand("1989",month,county)
    + IndAdd(county,project) * IndPct(month,county) ;

MUNDEMAND(recharge,COUNTY,"1989",month) = MUNUSE("1989",month,county)
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```
    * MAX(0.6,(1+PDATA("CLIMATELAS","MUNICIPAL")
    * ((CLIMATE(recharge,month,COUNTY) /
      MAX(0.0001,CLIMATE("1989",month,COUNTY))-1))));

MUNDEMAND(recharge,COUNTY,project,month) =
  ( MUNUSE("1989",month,county)
    + MunAdd(county,project) * MunPct(month,county) )
 * MAX(0.6,(1+PDATA("CLIMATELAS","MUNICIPAL")
   * ((CLIMATE(recharge,month,COUNTY) /
     MAX(0.0001,AveCLIMATE(month,COUNTY))-1))));

Parameter Use2000(groups,user) Projected year 2000 Usage - Ave Weather;
 Use2000(county,"Industrial")=sum(month,Indemand("2000",month,county));
 Use2000(county,"Municipal") = sum(month, MunUse("1989",month,county)
     + MunAdd(county,"2000")*MunPct(month,county));
 Use2000("total",user) = sum(county,Use2000(county,user)) ;

Parameter Adj2000(groups,user) Projected year 2000 Usage - 1989 Weather;
 Adj2000(county,"Industrial")=sum(month,Indemand("2000",month,county));
 Adj2000(county,"Municipal") = sum(month,
                 MunDemand("1989",county,"2000",month) ) ;
 Adj2000("total",user) = sum(county,Adj2000(county,user)) ;

Parameter Adj2087(groups,user) Projected year 2000 Usage - 1987 Weather;
 Adj2087(county,"Industrial")=sum(month,Indemand("2000",month,county));
 Adj2087(county,"Municipal") = sum(month,
                 MunDemand("1987",county,"2000",month) ) ;
 Adj2087("total",user) = sum(county,Adj2087(county,user)) ;

Parameter Adj2082(groups,user) Projected year 2000 Usage - 1978 Weather;
 Adj2082(county,"Industrial")=sum(month,Indemand("2000",month,county));
 Adj2082(county,"Municipal") = sum(month,
                 MunDemand("1982",county,"2000",month) ) ;
 Adj2082("total",user) = sum(county,Adj2082(county,user)) ;

Parameter Ratio(rechargall,month,groups)  Climate Ratio ;
 Ratio(recharge,month,county) = climate(recharge,month,county)
          / Aveclimate(month,county) ;

*display Use2000, Adj2000 , Adj2087, Adj2082, climate, aveclimate,ratio;

parameter tempfactor(rechargall,groups,useyear,month) ;
tempfactor(recharge,COUNTY,USEYEAR,month) =
   (CLIMATE(recharge,month,COUNTY) /
     MAX(0.0001,CLIMATE("1989",month,COUNTY))-1);

*display munuse, pdata, climate, cdif, tempfactor, mundemand ;

*   OLD PUMPING COST DATA
Parameter  CPump(user) Fixed Costs of Pumping per acre foot
           VPump(user) Variable Costs of Pumping per acre foot;

    CPump("mi") = 35.14 ;
    CPump("ag") = 8.30 ;
    VPump("mi") = 0.0546 ;
    VPump("ag") = 0.0819 ;

*   cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*   NEW PUMPING COST DATA (Dr. Lacewell)
*   cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

  scalar png      price natural gas        /3.00/
         pe       pump efficiency          /.55/
         psi                                /5/
         de       distribution efficiency  /.65/
         repairc  irrigation repair        /.55/
         laborc   irrigation labor         /.55/ ;

*   cccccccccccccccccccccccccccccccccccccccccccccc
*          AGRICULTURAL DATA
*   cccccccccccccccccccccccccccccccccccccccccccccc

*  Cost of Sprinkler based on Pena "Irrigation Water Use ..., 1990"
*  $45,000 / 127 acres / 10 year economic life.

SCALAR COSTIRRIG     COST OF DEVELOPING AN IRRIGATED ACRE  /39/
       CostSprink    Cost of Sprinkler Irrigation  /35.43/ ;


TABLE  AVAILLAND(GROUPS,LANDs)  Total LAND AVAILABLE
*   Source: "Biological Survey of USDA ..." Appendix I, Table 25
*           NRSC and personal communication w/ James Hailey, NRCS.
*           1994 estimates
                        IRR    DRY  Sprinkler
          KINNEY        260     0      260
          UVALDE      41299     0    12943
          MEDINA      29513     0     9430
          BEXAR        8819     0     1920
          COMAL           0     0        0
          HAYS            0     0        0 ;

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  AvailLand(county,"furrow") =
    AvailLand(county,"irr") - AvailLand(county,"sprinkler") ;
  AvailLand("total",landa) = sum(county, Availland(county,landa));

*   cccccccccccccccccccccccccccccccccccccccccccc
*      Put Sprinkler into highest zones first
*   cccccccccccccccccccccccccccccccccccccccccccc

Parameter AvailZone(groups,Zonall,Landa) Available Land for each Zone;
    AvailZone(county,"3","sprinkler") =
       Min(AvailLand(county,"sprinkler"),
           AvailLand(county,"irr") * AgPct("3",county) );
    AvailZone(county,"2","sprinkler") =
       Min( (AvailLand(county,"sprinkler")
                - AvailZone(county,"3","sprinkler") ),
            AvailLand(county,"irr") * AgPct("2",county) );
    AvailZone(county,"1","sprinkler") =
             AvailLand(county,"sprinkler")
               - AvailZone(county,"2","sprinkler")
               - AvailZone(county,"3","sprinkler") ;

    AvailZone(county,zone,"furrow") =
      (AvailLand(county,"irr") * AgPct(zone,county))
         - AvailZone(county,zone,"sprinkler") ;

    AvailZone(county,zone,"irr") =
       AvailZone(county,zone,"furrow")
        + AvailZone(county,zone,"sprinkler") ;

    AvailZone("total",zone,landa) =
      sum(county, Availzone(county,zone,landa) );
    AvailZone(groups,"all",landa) =
      sum(zone, Availzone(groups,zone,landa) );


*   cccccccccccccccccccccccccccccccccccccccccccc
*      4 Counties combined into 2
*   cccccccccccccccccccccccccccccccccccccccccccc

  AvailZone("Uvalde",zone,landa) =
    AvailZone("Uvalde",zone,landa) + AvailZone("Kinney",zone,landa) ;

  AvailZone("Medina",zone,landa) =
    AvailZone("Medina",zone,landa) + AvailZone("Bexar",zone,landa) ;

  AvailZone("Kinney",zone,landa) = 0 ;
  AvailZone("Bexar",zone,landa) = 0 ;

*   cccccccccccccccccccccccccccccccccccccccccccc

TABLE MIXDATA(GROUPS,LANDo,CROPS,MIXESA) HISTORIC ALLOWABLE CROPPING PATTERNS

*        ALLOWABLE CROP MIXES
                         1975      1976      1977      1978      1979
    KINNEY.DRY.COTTON        0         0         0         0    0.0241
    KINNEY.DRY.CORN      0.036    0.0964    0.0398    0.1289    0.0264
    KINNEY.DRY.SORGHUM  0.1065    0.6648    0.5879         0    0.2598
    KINNEY.DRY.SORGHAY       0         0         0    0.1289         0
    KINNEY.DRY.WINWHT   0.8163    0.1425    0.3723    0.3555    0.6106
    KINNEY.DRY.OATS     0.0412    0.0963         0         0    0.0188
    KINNEY.DRY.HAY           0         0         0    0.3867    0.0603
    KINNEY.DRY.SOYBEANS      0         0         0         0         0
    KINNEY.DRY.PEANUTS       0         0         0         0         0

    KINNEY.IRR.COTTON        0         0         0         0    0.1032
    KINNEY.IRR.CORN          0         0         0         0         0
    KINNEY.IRR.SORGHUM   0.292         0         0    0.2497     0.159
    KINNEY.IRR.SORGHAY       0         0         0    0.0886         0
    KINNEY.IRR.WINWHT   0.3893    0.2252    0.5694    0.0749    0.0681
    KINNEY.IRR.OATS     0.0921    0.1866         0         0    0.0806
    KINNEY.IRR.HAY           0         0         0    0.2659    0.2581
    KINNEY.IRR.SOYBEANS      0         0         0         0         0
    KINNEY.IRR.PEANUTS       0         0         0         0         0
    KINNEY.IRR.PEPPERS       0         0         0         0         0
    KINNEY.IRR.CABBAGE  0.0487    0.1126    0.0313    0.0449    0.0323
    KINNEY.IRR.CANTALOP      0         0    0.0626         0    0.0867
    KINNEY.IRR.CARROT        0         0         0     0.025         0
    KINNEY.IRR.CUCUMBER      0    0.0638         0         0         0
    KINNEY.IRR.HONEYDEW      0         0         0         0         0
    KINNEY.IRR.LETTUCE       0         0         0    0.0375    0.0297
    KINNEY.IRR.ONION    0.0973    0.2252    0.1878    0.0874    0.0694
    KINNEY.IRR.POTATO      0         0         0         0         0
    KINNEY.IRR.SPINACH       0         0         0    0.0375         0
    KINNEY.IRR.SWTCORN  0.0806    0.1866    0.1489    0.0886    0.1129
    KINNEY.IRR.TOMATO      0         0         0         0         0
    KINNEY.IRR.WATERMEL      0         0         0         0         0

    UVALDE.DRY.COTTON   0.0057         0         0         0    0.0451
    UVALDE.DRY.CORN     0.1262    0.1238     0.167    0.2259     0.194
    UVALDE.DRY.SORGHUM  0.2604    0.3902     0.235    0.1844     0.145
    UVALDE.DRY.SORGHAY       0     0.016     0.018     0.014    0.0054
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UVALDE.DRY.WINWHT	0.3744	0.1846	0.3189	0.1799	0.3164
UVALDE.DRY.OATS	0.1719	0.2063	0.1604	0.285	0.2246
UVALDE.DRY.HAY	0.0448	0.0688	0.0663	0.0828	0.0293
UVALDE.DRY.SOYBEANS	0.0166	0.0103	0.0344	0.029	0.0402
UVALDE.DRY.PEANUTS	0	0	0	0	0
UVALDE.IRR.COTTON	0.009	0.0297	0.0979	0.0445	0.0543
UVALDE.IRR.CORN	0.1976	0.1713	0.2318	0.23	0.2722
UVALDE.IRR.SORGHUM	0.1139	0.134	0.0655	0.0873	0.087
UVALDE.IRR.SORGHAY	0	0.0222	0.025	0.0142	0.0076
UVALDE.IRR.WINWHT	0.2028	0.1238	0.109	0.1122	0.0699
UVALDE.IRR.OATS	0.2691	0.2856	0.2227	0.2904	0.3153
UVALDE.IRR.HAY	0.0701	0.0952	0.092	0.0843	0.0411
UVALDE.IRR.SOYBEANS	0.0259	0.0143	0.0477	0.0296	0.0563
UVALDE.IRR.PEANUTS	0	0	0	0	0
UVALDE.IRR.PEPPERS	0.0027	0	0	0	0
UVALDE.IRR.CABBAGE	0.0109	0.012	0.009	0.0198	0.0112
UVALDE.IRR.CANTALOP	0.0109	0.0075	0.0194	0.0119	0.0031
UVALDE.IRR.CARROT	0.03	0.039	0.0374	0.0353	0.0401
UVALDE.IRR.CUCUMBER	0.0082	0.006	0.0077	0.006	0
UVALDE.IRR.HONEYDEW	0	0	0.0037	0	0
UVALDE.IRR.LETTUCE	0	0	0	0.0048	0.0026
UVALDE.IRR.ONION	0.0191	0.024	0.0224	0.0085	0.0203
UVALDE.IRR.POTATO	0	0	0	0	0
UVALDE.IRR.SPINACH	0.0163	0.012	0.005	0.0099	0.0055
UVALDE.IRR.SWTCORN	0.0109	0.018	0	0.0085	0.0104
UVALDE.IRR.TOMATO	0	0.0054	0.0038	0.0028	0.0031
UVALDE.IRR.WATERMEL	0.0026	0	0	0	0
MEDINA.DRY.COTTON	0	0	0.0038	0	0.011
MEDINA.DRY.CORN	0.0765	0.0934	0.1353	0.169	0.2045
MEDINA.DRY.SORGHUM	0.4464	0.4991	0.5281	0.4602	0.4364
MEDINA.DRY.SORGHAY	0.0053	0.0307	0.0362	0.0638	0.006
MEDINA.DRY.WINWHT	0.241	0.1394	0.0929	0.0413	0.0997
MEDINA.DRY.OATS	0.1464	0.1352	0.1275	0.1696	0.1522
MEDINA.DRY.HAY	0.0832	0.1004	0.0712	0.0903	0.0721
MEDINA.DRY.SOYBEANS	0	0	0.0045	0.0048	0.0066
MEDINA.DRY.PEANUTS	0.0012	0.0018	0.0005	0.001	0.0115
MEDINA.IRR.COTTON	0	0	0	0	0
MEDINA.IRR.CORN	0.142	0.1816	0.2586	0.2766	0.3986
MEDINA.IRR.SORGHUM	0.2469	0.1399	0.1198	0.0788	0.0541
MEDINA.IRR.SORGHAY	0.0099	0.0596	0.0693	0.1044	0.0116
MEDINA.IRR.WINWHT	0.0398	0.0262	0.016	0	0.0042
MEDINA.IRR.OATS	0.2716	0.263	0.2439	0.2778	0.2966
MEDINA.IRR.HAY	0.1543	0.1951	0.1362	0.1478	0.1406
MEDINA.IRR.SOYBEANS	0	0	0.0087	0.0078	0.0129
MEDINA.IRR.PEANUTS	0.0797	0.0831	0.0752	0.0591	0.0291
MEDINA.IRR.PEPPERS	0	0	0	0	0
MEDINA.IRR.CABBAGE	0.0093	0.01	0.0169	0.0063	0.0097
MEDINA.IRR.CANTALOP	0	0	0	0	0
MEDINA.IRR.CARROT	0.0093	0.0125	0.0169	0.0127	0.0158
MEDINA.IRR.CUCUMBER	0.0046	0	0.0193	0.008	0.0075
MEDINA.IRR.HONEYDEW	0	0	0	0	0
MEDINA.IRR.LETTUCE	0	0	0	0	0
MEDINA.IRR.ONION	0	0	0	0	0
MEDINA.IRR.POTATO	0	0	0	0.0059	0.0044
MEDINA.IRR.SPINACH	0	0	0	0	0
MEDINA.IRR.SWTCORN	0	0.009	0	0	0
MEDINA.IRR.TOMATO	0	0	0	0	0
MEDINA.IRR.WATERMEL	0.0326	0.02	0.0192	0.0148	0.0149
BEXAR.DRY.COTTON	0	0	0	0	0
BEXAR.DRY.CORN	0.0948	0.1075	0.1383	0.1089	0.1423
BEXAR.DRY.SORGHUM	0.3334	0.3121	0.378	0.3973	0.2871
BEXAR.DRY.SORGHAY	0.0479	0.0741	0.051	0.0253	0.0117
BEXAR.DRY.WINWHT	0.1104	0.0914	0.0785	0.0607	0.1579
BEXAR.DRY.OATS	0.215	0.1757	0.1699	0.1783	0.2143
BEXAR.DRY.HAY	0.1778	0.2114	0.1589	0.2074	0.1639
BEXAR.DRY.SOYBEANS	0	0	0	0	0.009
BEXAR.DRY.PEANUTS	0.0207	0.0278	0.0254	0.0221	0.0138
BEXAR.IRR.COTTON	0	0	0	0	0
BEXAR.IRR.CORN	0.0897	0.1171	0.1027	0.144	0.1745
BEXAR.IRR.SORGHUM	0.1973	0.0781	0.3793	0.0338	0.1247
BEXAR.IRR.SORGHAY	0.0453	0.0807	0.0378	0.0335	0.0144
BEXAR.IRR.WINWHT	0.0863	0.0694	0.03	0.0745	0.0074
BEXAR.IRR.OATS	0.2035	0.1914	0.1262	0.2358	0.2628
BEXAR.IRR.HAY	0.1683	0.2305	0.118	0.2743	0.2011
BEXAR.IRR.SOYBEANS	0	0	0	0	0
BEXAR.IRR.PEANUTS	0.1233	0.1128	0.0895	0.1076	0.1473
BEXAR.IRR.PEPPERS	0	0	0.0108	0	0
BEXAR.IRR.CABBAGE	0.0314	0.048	0.0255	0.043	0.0357
BEXAR.IRR.CANTALOP	0	0	0	0	0
BEXAR.IRR.CARROT	0.0235	0.042	0.027	0.0297	0.0131
BEXAR.IRR.CUCUMBER	0.0078	0	0.0378	0.0238	0
BEXAR.IRR.HONEYDEW	0	0	0	0	0
BEXAR.IRR.LETTUCE	0	0	0	0	0
BEXAR.IRR.ONION	0	0	0	0	0
BEXAR.IRR.POTATO	0.0118	0.03	0.0154	0	0.019
BEXAR.IRR.SPINACH	0	0	0	0	0

BEXAR.IRR.SWTCORN	0	0	0	0	0
BEXAR.IRR.TOMATO	0.0118	0	0	0	0
BEXAR.IRR.WATERMEL	0	0	0	0	0
*	1980	1981	1982	1983	1984
KINNEY.DRY.COTTON	0	0	0	0	0
KINNEY.DRY.CORN	0.1187	0	0	0	0
KINNEY.DRY.SORGHUM	0.0818	0	0	0	0
KINNEY.DRY.SORGHAY	0	0	0	0	0
KINNEY.DRY.WINWHT	0.491	0.794	0.5797	1	0.2083
KINNEY.DRY.OATS	0.1187	0.206	0.4203	0	0.7917
KINNEY.DRY.HAY	0.1424	0	0	0	0
KINNEY.DRY.SOYBEANS	0.0474	0	0	0	0
KINNEY.DRY.PEANUTS	0	0	0	0	0
KINNEY.IRR.COTTON	0	0	0	0	0
KINNEY.IRR.CORN	0	0	0	0	0
KINNEY.IRR.SORGHUM	0.2298	0	0	0	0
KINNEY.IRR.SORGHAY	0	0	0	0	0
KINNEY.IRR.WINWHT	0	0.0337	0.2154	0.6	0.104
KINNEY.IRR.OATS	0.1813	0.4068	0.2185	0	0.3951
KINNEY.IRR.HAY	0.2176	0	0	0	0
KINNEY.IRR.SOYBEANS	0.0725	0	0	0	0
KINNEY.IRR.PEANUTS	0	0	0	0	0
KINNEY.IRR.PEPPERS	0	0	0	0	0
KINNEY.IRR.CABBAGE	0	0	0	0	0
KINNEY.IRR.CANTALOP	0.057	0.0584	0	0	0.0454
KINNEY.IRR.CARROT	0	0	0	0	0
KINNEY.IRR.CUCUMBER	0	0	0	0	0
KINNEY.IRR.HONEYDEW	0	0	0	0	0
KINNEY.IRR.LETTUCE	0	0	0	0	0
KINNEY.IRR.ONION	0.0605	0.0629	0.0738	0.4	0.0454
KINNEY.IRR.POTATO	0	0	0	0	0
KINNEY.IRR.SPINACH	0	0	0	0	0
KINNEY.IRR.SWTCORN	0.1813	0.4382	0.4923	0	0.4101
KINNEY.IRR.TOMATO	0	0	0	0	0
KINNEY.IRR.WATERMEL	0	0	0	0	0
UVALDE.DRY.COTTON	0.0132	0	0.0354	0.0209	0
UVALDE.DRY.CORN	0.1926	0.0457	0	0.0759	0
UVALDE.DRY.SORGHUM	0.2001	0.2846	0.2354	0.2436	0.1749
UVALDE.DRY.SORGHAY	0.0253	0.0098	0	0	0
UVALDE.DRY.WINWHT	0.2291	0.343	0.3999	0.1807	0.025
UVALDE.DRY.OATS	0.2575	0.2191	0.2085	0.373	0.6193
UVALDE.DRY.HAY	0.071	0.0978	0.1208	0.0958	0.1712
UVALDE.DRY.SOYBEANS	0.0112	0	0	0.0101	0.0096
UVALDE.DRY.PEANUTS	0	0	0	0	0
UVALDE.IRR.COTTON	0.1502	0.1354	0.0779	0.0816	0.2015
UVALDE.IRR.CORN	0.2065	0.2796	0.3146	0.2447	0.2862
UVALDE.IRR.SORGHUM	0.0513	0.0528	0.0195	0.0359	0.0248
UVALDE.IRR.SORGHAY	0.0272	0.0108	0	0	0
UVALDE.IRR.WINWHT	0.0955	0.0879	0.1167	0.0636	0.0263
UVALDE.IRR.OATS	0.2761	0.2421	0.2134	0.3711	0.2893
UVALDE.IRR.HAY	0.0761	0.1081	0.1237	0.0953	0.0799
UVALDE.IRR.SOYBEANS	0.012	0	0	0.01	0.0045
UVALDE.IRR.PEANUTS	0	0	0	0	0
UVALDE.IRR.PEPPERS	0	0	0	0	0
UVALDE.IRR.CABBAGE	0.0181	0.0094	0.016	0.0162	0.0164
UVALDE.IRR.CANTALOP	0.0173	0.005	0.0113	0.0213	0.0181
UVALDE.IRR.CARROT	0.0244	0.0311	0.0581	0.0311	0.0169
UVALDE.IRR.CUCUMBER	0	0	0	0	0
UVALDE.IRR.HONEYDEW	0	0	0	0	0
UVALDE.IRR.LETTUCE	0	0.0033	0.0098	0.002	0.0039
UVALDE.IRR.ONION	0.0238	0.0125	0.0202	0.0148	0.0213
UVALDE.IRR.POTATO	0	0	0	0	0
UVALDE.IRR.SPINACH	0.0051	0.0039	0.0141	0.01	0.0109
UVALDE.IRR.SWTCORN	0.0134	0.0139	0	0	0
UVALDE.IRR.TOMATO	0.003	0	0	0	0
UVALDE.IRR.WATERMEL	0	0.0042	0.0047	0.0024	0
MEDINA.DRY.COTTON	0.0013	0	0	0.0043	0
MEDINA.DRY.CORN	0.2158	0.104	0.0936	0.1326	0.1137
MEDINA.DRY.SORGHUM	0.3627	0.3996	0.4752	0.3701	0.2256
MEDINA.DRY.SORGHAY	0.0596	0.0094	0.0191	0.0074	0.0159
MEDINA.DRY.WINWHT	0.0738	0.2162	0.1233	0.1433	0.1038
MEDINA.DRY.OATS	0.1329	0.1303	0.1864	0.2384	0.4012
MEDINA.DRY.HAY	0.1234	0.1227	0.1013	0.1018	0.1398
MEDINA.DRY.SOYBEANS	0.0155	0	0	0	0
MEDINA.DRY.PEANUTS	0.015	0.0178	0.0011	0.0021	0
MEDINA.IRR.COTTON	0.0262	0	0.0256	0.0305	0.0304
MEDINA.IRR.CORN	0.2906	0.57	0.4753	0.4746	0.4862
MEDINA.IRR.SORGHUM	0.0675	0.0794	0.0769	0.0631	0.0304
MEDINA.IRR.SORGHAY	0.0802	0.0088	0.0188	0.0067	0.0101
MEDINA.IRR.WINWHT	0.09	0.0624	0.0443	0.0588	0.0397
MEDINA.IRR.OATS	0.179	0.1212	0.1833	0.218	0.2557
MEDINA.IRR.HAY	0.1663	0.1143	0.0997	0.0931	0.0891
MEDINA.IRR.SOYBEANS	0.0209	0	0	0	0
MEDINA.IRR.PEANUTS	0.03	0.017	0.0396	0.0305	0.0421
MEDINA.IRR.PEPPERS	0	0	0	0	0

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        MEDINA.IRR.CABBAGE  0.0206   0.0062        0         0         0
        MEDINA.IRR.CANTALOP      0        0        0         0         0
        MEDINA.IRR.CARROT   0.0153   0.0087    0.012    0.0081     0.011
        MEDINA.IRR.CUCUMBER      0        0        0         0         0
        MEDINA.IRR.HONEYDEW      0        0        0         0         0
        MEDINA.IRR.LETTUCE       0        0        0         0         0
        MEDINA.IRR.ONION         0        0        0         0         0
        MEDINA.IRR.POTATO       0        0        0    0.0059    0.0053
        MEDINA.IRR.SPINACH       0        0        0         0         0
        MEDINA.IRR.SWTCORN       0        0        0         0         0
        MEDINA.IRR.TOMATO       0        0        0         0         0
        MEDINA.IRR.WATERMEL 0.0134    0.012   0.0245    0.0107         0

         BEXAR.DRY.COTTON        0        0        0         0         0
         BEXAR.DRY.CORN     0.1619   0.0324   0.1417    0.1534    0.1123
         BEXAR.DRY.SORGHUM  0.2684   0.3742   0.2428    0.2191    0.2259
         BEXAR.DRY.SORGHAY  0.0841   0.0212   0.0283         0    0.0119
         BEXAR.DRY.WINWHT   0.1076   0.1908   0.0927    0.0931    0.1289
         BEXAR.DRY.OATS     0.1714   0.1876   0.2968    0.2863    0.3178
         BEXAR.DRY.HAY      0.1893   0.1813   0.1842    0.2235    0.1866
         BEXAR.DRY.SOYBEANS      0        0        0         0         0
         BEXAR.DRY.PEANUTS  0.0173   0.0125   0.0135    0.0246    0.0166

         BEXAR.IRR.COTTON        0        0        0         0         0
         BEXAR.IRR.CORN     0.1569   0.5241   0.3094    0.3291    0.2397
         BEXAR.IRR.SORGHUM  0.0611   0.0368   0.0822         0    0.0104
         BEXAR.IRR.SORGHAY  0.0815   0.0138   0.0232         0    0.0057
         BEXAR.IRR.WINWHT   0.0679    0.046   0.0677    0.0748    0.0313
         BEXAR.IRR.OATS      0.166   0.1221   0.2428     0.276    0.1527
         BEXAR.IRR.HAY      0.1835   0.1179   0.1508    0.2153    0.5078
         BEXAR.IRR.SOYBEANS      0        0        0         0         0
         BEXAR.IRR.PEANUTS  0.1222   0.0966   0.0532    0.0224    0.0139
         BEXAR.IRR.PEPPERS       0        0        0         0         0
         BEXAR.IRR.CABBAGE  0.0555   0.0067   0.0096         0         0
         BEXAR.IRR.CANTALOP 0.0242   0.0067        0         0         0
         BEXAR.IRR.CARROT    0.032   0.0134   0.0401    0.0483    0.0193
         BEXAR.IRR.CUCUMBER 0.0297   0.0098        0         0         0
         BEXAR.IRR.HONEYDEW      0        0        0         0         0
         BEXAR.IRR.LETTUCE       0        0        0         0         0
         BEXAR.IRR.ONION         0        0        0         0         0
         BEXAR.IRR.POTATO  0.0078   0.0061   0.0084    0.0165    0.0048
         BEXAR.IRR.SPINACH  0.0117        0        0         0         0
         BEXAR.IRR.SWTCORN       0        0        0         0    0.0048
         BEXAR.IRR.TOMATO       0        0        0         0         0
         BEXAR.IRR.WATERMEL      0        0   0.0126    0.0176    0.0096
   ;

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*       CALCULATE USING MIXDATA WHETHER CROPS ARE GROWN IN A COUNTY
*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

PARAMETER ISCROP(groups,Landa,CROPS)  INDICATES WHETHER A CROP IS IN A COUNTY;

 ISCROP(county,LANDo,CROP) = 1
    $ SUM(MIXES, MIXDATA(COUNTY,LANDo,CROP,MIXES));

 IsCrop(county,"furrow",crop) = IsCrop(county,"irr",crop) ;
 IsCrop(county,"sprinkler",crop) = IsCrop(county,"irr",crop) ;

Parameter IsCrop2(groups,land,crops) ;
 Iscrop2(county,land,crops) = Iscrop(county,land,crops) ;

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*    CROP BUDGET DATA
*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc


TABLE BCDATA(LANDo,CROPS,STAGE,MONTHP)  BC COEF & DAYS LAND USE BY STAGE  MONTH AND BLANEY

* FIRST COLUMN IS BLANEY CRIDDLE COEFFICIENT FOR EVAPOTRANSPIRATION AS IN DILLON
* LATER COLUMNS ARE CROP LAND OCCUPATION BY MONTH AND STAGE
*        THESE DATA ARE BASED ON BLANEY CRIDDLE DATA AND EXTENSION SERV BUDGETS


                            COEF  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
IRR.COTTON    .STAGE1       .450   0.   0.  21.   3.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.COTTON    .STAGE2       .750   0.   0.   0.  27.  13.   0.   0.   0.   0.   0.   0.   0.
IRR.COTTON    .STAGE3      1.150   0.   0.   0.   0.  18.  27.   0.   0.   0.   0.   0.   0.
IRR.COTTON    .STAGE4       .850   0.   0.   0.   0.   0.   3.  31.   2.   0.   0.   0.   0.
DRY.COTTON    .STAGE1       .200   0.   0.  21.  30.   0.   0.   0.   0.   0.   0.   0.   0.
DRY.COTTON    .STAGE2       .500   0.   0.   0.   0.  31.  30.   5.   0.   0.   0.   0.   0.
DRY.COTTON    .STAGE3       .000   0.   0.   0.   0.   0.   0.  26.  10.   0.   0.   0.   0.
DRY.COTTON    .STAGE4       .250   0.   0.   0.   0.   0.   0.   0.  17.   0.   0.   0.   0.
IRR.CORN      .STAGE1       .400   0.  15.   6.   0.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.CORN      .STAGE2       .775   0.   0.  25.  10.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.CORN      .STAGE3      1.125   0.   0.   0.  20.  21.   0.   0.   0.   0.   0.   0.   0.
IRR.CORN      .STAGE4       .875   0.   0.   0.   0.  10.  18.   0.   0.   0.   0.   0.   0.
DRY.CORN      .STAGE1       .400   0.  10.  31.  24.   0.   0.   0.   0.   0.   0.   0.   0.
DRY.CORN      .STAGE2      1.500   0.   0.   0.   6.  14.   0.   0.   0.   0.   0.   0.   0.
DRY.CORN      .STAGE3       .500   0.   0.   0.   0.  17.  30.   2.   0.   0.   0.   0.   0.
DRY.CORN      .STAGE4       .200   0.   0.   0.   0.   0.   0.  16.   0.   0.   0.   0.   0.
IRR.SORGHUM   .STAGE1       .350   0.   0.  21.   0.   0.   0.   0.   0.   0.   0.   0.   0.
```

1824	IRR.SORGHUM	.STAGE2	.725	0.	0.	0.	30.	6.	0.	0.	0.	0.	0.	0.	0.
1825	IRR.SORGHUM	.STAGE3	1.075	0.	0.	0.	0.	25.	17.	0.	0.	0.	0.	0.	0.
1826	IRR.SORGHUM	.STAGE4	.775	0.	0.	0.	0.	0.	13.	19.	0.	0.	0.	0.	0.
1827	DRY.SORGHUM	.STAGE1	.200	0.	10.	31.	17.	0.	0.	0.	0.	0.	0.	0.	0.
1828	DRY.SORGHUM	.STAGE2	.550	0.	0.	0.	13.	10.	0.	0.	0.	0.	0.	0.	0.
1829	DRY.SORGHUM	.STAGE3	.450	0.	0.	0.	0.	21.	30.	0.	0.	0.	0.	0.	0.
1830	DRY.SORGHUM	.STAGE4	.200	0.	0.	0.	0.	0.	0.	18.	0.	0.	0.	0.	0.
1831	IRR.SORGHAY	.STAGE1	.350	0.	19.	21.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1832	IRR.SORGHAY	.STAGE2	.725	0.	0.	10.	30.	30.	0.	0.	0.	0.	0.	0.	0.
1833	IRR.SORGHAY	.STAGE3	.725	0.	0.	0.	0.	1.	30.	31.	17.	0.	0.	0.	0.
1834	IRR.SORGHAY	.STAGE4	.725	0.	0.	0.	0.	0.	0.	0.	14.	30.	16.	0.	0.
1835	DRY.SORGHAY	.STAGE1	.200	0.	19.	31.	30.	16.	0.	0.	0.	0.	0.	0.	0.
1836	DRY.SORGHAY	.STAGE2	.550	0.	0.	0.	0.	15.	24.	0.	0.	0.	0.	0.	0.
1837	DRY.SORGHAY	.STAGE3	.550	0.	0.	0.	0.	0.	6.	31.	31.	16.	0.	0.	0.
1838	DRY.SORGHAY	.STAGE4	.550	0.	0.	0.	0.	0.	0.	0.	0.	14.	16.	0.	0.
1839	IRR.WINWHT	.STAGE1	.400	0.	0.	0.	0.	0.	0.	0.	0.	0.	25.	7.	0.
1840	IRR.WINWHT	.STAGE2	.800	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	23.	30.
1841	IRR.WINWHT	.STAGE3	1.200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	106.
1842	IRR.WINWHT	.STAGE4	.750	0.	0.	0.	15.	31.	18.	0.	0.	0.	0.	0.	0.
1843	DRY.WINWHT	.STAGE1	.200	0.	0.	0.	0.	0.	0.	0.	0.	0.	26.	30.	61.
1844	DRY.WINWHT	.STAGE2	.600	1.	28.	8.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1845	DRY.WINWHT	.STAGE3	.500	0.	0.	23.	30.	19.	0.	0.	0.	0.	0.	0.	0.
1846	DRY.WINWHT	.STAGE4	.000	0.	0.	0.	0.	12.	17.	0.	0.	0.	0.	0.	0.
1847	IRR.OATS	.STAGE1	.400	0.	0.	0.	0.	0.	0.	0.	0.	0.	26.	0.	0.
1848	IRR.OATS	.STAGE2	.800	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.	30.	10.
1849	IRR.OATS	.STAGE3	1.200	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	88.
1850	IRR.OATS	.STAGE4	.750	0.	0.	23.	29.	0.	0.	0.	0.	0.	0.	0.	0.
1851	DRY.OATS	.STAGE1	.200	0.	0.	0.	0.	0.	0.	0.	0.	19.	31.	30.	32.
1852	DRY.OATS	.STAGE2	.600	30.	6.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1853	DRY.OATS	.STAGE3	.600	0.	22.	31.	17.	0.	0.	0.	0.	0.	0.	0.	0.
1854	DRY.OATS	.STAGE4	.600	0.	0.	0.	13.	14.	0.	0.	0.	0.	0.	0.	0.
1855	IRR.HAY	.STAGE1	.350	0.	20.	12.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1856	IRR.HAY	.STAGE2	.725	0.	0.	19.	30.	7.	0.	0.	0.	0.	0.	0.	0.
1857	IRR.HAY	.STAGE3	.725	0.	0.	0.	0.	24.	30.	10.	0.	0.	0.	0.	0.
1858	IRR.HAY	.STAGE4	.725	0.	0.	0.	0.	0.	0.	21.	27.	0.	0.	0.	0.
1859	DRY.HAY	.STAGE1	.200	0.	20.	31.	26.	0.	0.	0.	0.	0.	0.	0.	0.
1860	DRY.HAY	.STAGE2	.550	0.	0.	0.	4.	27.	0.	0.	0.	0.	0.	0.	0.
1861	DRY.HAY	.STAGE3	.550	0.	0.	0.	0.	4.	30.	31.	3.	0.	0.	0.	0.
1862	DRY.HAY	.STAGE4	.550	0.	0.	0.	0.	0.	0.	0.	24.	0.	0.	0.	0.
1863	IRR.SOYBEANS	.STAGE1	.350	0.	0.	0.	0.	12.	5.	0.	0.	0.	0.	0.	0.
1864	IRR.SOYBEANS	.STAGE2	.750	0.	0.	0.	0.	0.	25.	5.	0.	0.	0.	0.	0.
1865	IRR.SOYBEANS	.STAGE3	1.075	0.	0.	0.	0.	0.	0.	26.	26.	0.	0.	0.	0.
1866	IRR.SOYBEANS	.STAGE4	.750	0.	0.	0.	0.	0.	0.	0.	5.	16.	0.	0.	0.
1867	DRY.SOYBEANS	.STAGE1	.200	0.	0.	0.	0.	17.	25.	0.	0.	0.	0.	0.	0.
1868	DRY.SOYBEANS	.STAGE2	.800	0.	0.	0.	0.	0.	5.	23.	0.	0.	0.	0.	0.
1869	DRY.SOYBEANS	.STAGE3	.100	0.	0.	0.	0.	0.	0.	8.	25.	0.	0.	0.	0.
1870	DRY.SOYBEANS	.STAGE4	.000	0.	0.	0.	0.	0.	0.	0.	6.	6.	0.	0.	0.
1871	IRR.PEANUTS	.STAGE1	.450	0.	0.	0.	11.	19.	0.	0.	0.	0.	0.	0.	0.
1872	IRR.PEANUTS	.STAGE2	.750	0.	0.	0.	0.	12.	27.	0.	0.	0.	0.	0.	0.
1873	IRR.PEANUTS	.STAGE3	1.025	0.	0.	0.	0.	0.	3.	27.	0.	0.	0.	0.	0.
1874	IRR.PEANUTS	.STAGE4	.800	0.	0.	0.	0.	0.	0.	4.	17.	0.	0.	0.	0.
1875	DRY.PEANUTS	.STAGE1	.200	0.	0.	21.	30.	5.	0.	0.	0.	0.	0.	0.	0.
1876	DRY.PEANUTS	.STAGE2	.800	0.	0.	0.	0.	26.	18.	0.	0.	0.	0.	0.	0.
1877	DRY.PEANUTS	.STAGE3	.600	0.	0.	0.	0.	0.	12.	29.	0.	0.	0.	0.	0.
1878	DRY.PEANUTS	.STAGE4	.200	0.	0.	0.	0.	0.	0.	2.	17.	0.	0.	0.	0.
1879	IRR.PEPPERS	.STAGE1	.400	0.	0.	0.	0.	0.	0.	18.	16.	0.	0.	0.	0.
1880	IRR.PEPPERS	.STAGE2	.750	0.	0.	0.	0.	0.	0.	0.	15.	24.	0.	0.	0.
1881	IRR.PEPPERS	.STAGE3	1.100	0.	0.	0.	0.	0.	0.	0.	0.	6.	31.	8.	0.
1882	IRR.PEPPERS	.STAGE4	1.000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	22.	0.
1883	IRR.CABBAGE	.STAGE1	.500	0.	0.	0.	0.	0.	0.	13.	7.	0.	0.	0.	0.
1884	IRR.CABBAGE	.STAGE2	.800	0.	0.	0.	0.	0.	0.	0.	24.	6.	0.	0.	0.
1885	IRR.CABBAGE	.STAGE3	1.100	0.	0.	0.	0.	0.	0.	0.	0.	20.	0.	0.	0.
1886	IRR.CABBAGE	.STAGE4	1.000	0.	0.	0.	0.	0.	0.	0.	0.	4.	6.	0.	0.
1887	IRR.CANTALOP	.STAGE1	.500	0.	0.	16.	10.	0.	0.	0.	0.	0.	0.	0.	0.
1888	IRR.CANTALOP	.STAGE2	.800	0.	0.	0.	20.	17.	0.	0.	0.	0.	0.	0.	0.
1889	IRR.CANTALOP	.STAGE3	1.050	0.	0.	0.	0.	14.	27.	0.	0.	0.	0.	0.	0.
1890	IRR.CANTALOP	.STAGE4	.900	0.	0.	0.	0.	0.	3.	18.	0.	0.	0.	0.	0.
1891	IRR.CARROT	.STAGE1	.500	0.	0.	0.	0.	0.	0.	13.	26.	0.	0.	0.	0.
1892	IRR.CARROT	.STAGE2	.850	0.	0.	0.	0.	0.	0.	0.	5.	30.	19.	0.	0.
1893	IRR.CARROT	.STAGE3	1.200	0.	0.	0.	0.	0.	0.	0.	0.	0.	12.	30.	19.
1894	IRR.CARROT	.STAGE4	1.000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	31.
1895	IRR.CUCUMBER	.STAGE1	.500	0.	0.	0.	0.	0.	7.	16.	0.	0.	0.	0.	0.
1896	IRR.CUCUMBER	.STAGE2	.800	0.	0.	0.	0.	0.	0.	15.	17.	0.	0.	0.	0.
1897	IRR.CUCUMBER	.STAGE3	1.050	0.	0.	0.	0.	0.	0.	0.	14.	30.	3.	0.	0.
1898	IRR.CUCUMBER	.STAGE4	.900	0.	0.	0.	0.	0.	0.	0.	0.	0.	18.	0.	0.
1899	IRR.HONEYDEW	.STAGE1	.500	0.	25.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1900	IRR.HONEYDEW	.STAGE2	.800	0.	0.	30.	7.	0.	0.	0.	0.	0.	0.	0.	0.
1901	IRR.HONEYDEW	.STAGE3	1.050	0.	0.	0.	23.	18.	0.	0.	0.	0.	0.	0.	0.
1902	IRR.HONEYDEW	.STAGE4	.900	0.	0.	0.	0.	13.	8.	0.	0.	0.	0.	0.	0.
1903	IRR.LETTUCE	.STAGE1	1.100	0.	0.	0.	0.	0.	0.	0.	0.	0.	22.	0.	0.
1904	IRR.LETTUCE	.STAGE2	1.100	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.	30.	1.
1905	IRR.LETTUCE	.STAGE3	1.100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	17.
1906	IRR.LETTUCE	.STAGE4	1.100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	11.
1907	IRR.ONION	.STAGE1	.600	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	23.	0.
1908	IRR.ONION	.STAGE2	.800	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	35.
1909	IRR.ONION	.STAGE3	1.100	27.	28.	31.	19.	0.	0.	0.	0.	0.	0.	0.	0.
1910	IRR.ONION	.STAGE4	.900	0.	0.	0.	11.	31.	18.	0.	0.	0.	0.	0.	0.
1911	IRR.POTATO	.STAGE1	.500	0.	0.	6.	18.	0.	0.	0.	0.	0.	0.	0.	0.
1912	IRR.POTATO	.STAGE2	.800	0.	0.	0.	12.	16.	0.	0.	0.	0.	0.	0.	0.
1913	IRR.POTATO	.STAGE3	1.200	0.	0.	0.	0.	15.	24.	0.	0.	0.	0.	0.	0.
1914	IRR.POTATO	.STAGE4	.950	0.	0.	0.	0.	0.	6.	18.	0.	0.	0.	0.	0.

```
IRR.SPINACH .STAGE1    1.100   0.   0.   0.   0.   0.   0.   0.   0.  24.  24.   0.   0.
IRR.SPINACH .STAGE2    1.100   0.   0.   0.   0.   0.   0.   0.   0.   0.   7.  30.  12.
IRR.SPINACH .STAGE3    1.100   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.  36.
IRR.SPINACH .STAGE4    1.100  12.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.SWTCORN .STAGE1     .450   0.  10.  31.   4.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.SWTCORN .STAGE2     .800   0.   0.   0.  26.  30.   0.   0.   0.   0.   0.   0.   0.
IRR.SWTCORN .STAGE3    1.125   0.   0.   0.   0.   1.  30.  26.   0.   0.   0.   0.   0.
IRR.SWTCORN .STAGE4    1.075   0.   0.   0.   0.   0.   0.   5.  17.   0.   0.   0.   0.
IRR.TOMATO .STAGE1      .500  27.   7.   0.   0.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.TOMATO .STAGE2      .800   0.  21.  25.   0.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.TOMATO .STAGE3     1.250   0.   0.   6.  30.  15.   0.   0.   0.   0.   0.   0.   0.
IRR.TOMATO .STAGE4      .950   0.   0.   0.   0.  16.  18.   0.   0.   0.   0.   0.   0.
IRR.WATERMEL.STAGE1     .500   0.  10.  15.   0.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.WATERMEL.STAGE2     .800   0.   0.  16.  19.   0.   0.   0.   0.   0.   0.   0.   0.
IRR.WATERMEL.STAGE3    1.050   0.   0.   0.  11.  29.   0.   0.   0.   0.   0.   0.   0.
IRR.WATERMEL.STAGE4     .900   0.   0.   0.   0.   2.  18.   0.   0.   0.   0.   0.   0.
 ;

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*      CROP WATER USE AND DRYLAND YIELD CALCULATIONS VIA BLANEY CRIDDLE

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

PARAMETER BCresult(Lando,CROPS,YEAR,month,GROUPS)  BLANEY CRIDDLE
     ROOTWATER(YEAR,GROUPS,MONTH)  CROP ROOTZONE WATER AVAILABILITY
     BCCONSTANT(YEAR,MONTH,GROUPS) BC MONTHLY CONS ALA HEIMES-LUCKEY
     BCav(LANDo,CROPS,GROUPS,month) AVERAGE BLANEY CRIDDLE COEFICIENTS;

         ROOTWATER(recharge,COUNTY,MONTH) =
           ((25.4*WEATHER(recharge ,COUNTY,"PREC",MONTH))**0.9)/25.4;

        BCCONSTANT(recharge,MONTH,COUNTY) =
          WEATHER(recharge ,COUNTY,"TEMP",MONTH)* DAYLIGHT(MONTH)/100.
             *(0.0173*WEATHER(recharge ,COUNTY,"TEMP",MONTH)-.314);

*    IRRIGATED CROP WATER USE

           BCresult("IRR",CROP,recharge,month,COUNTY)$
                   SUM(STAGE, BCDATA("IRR",CROP,STAGE,"COEF"))
           = MAX(0, -ROOTWATER(recharge,COUNTY,MONTH)
                   +SUM(STAGE,BCDATA("IRR",CROP,STAGE,"COEF")
                         *BCDATA("IRR",CROP,STAGE,MONTH)
                         *BCCONSTANT(recharge,MONTH,COUNTY))) ;

*    DRYLAND CROP YIELDS

           BCresult("DRY",CROP,recharge,month,COUNTY)
              $SUM(STAGE,BCDATA("DRY",CROP,STAGE,"coef")
                   *BCDATA("DRY",CROP,STAGE,month)
                   *BCconstant(recharge,month,county) )
           =  MAX(1,ROOTWATER(recharge,COUNTY,MONTH)
                        /SUM(STAGE,BCDATA("DRY",CROP,STAGE,"COEF")
                              *BCDATA("DRY",CROP,STAGE,MONTH)
                              *BCCONSTANT(recharge,MONTH,COUNTY)))
           /SUM(STAGE $BCDATA("DRY",CROP,STAGE,"COEF"),
                             BCDATA("DRY",CROP,STAGE,MONTH)) ;

   BCav(LANDo,CROP,COUNTY,month) =
     SUM(recharge, PROB(recharge)
       * BCresult(LANDo,CROP,recharge,month,COUNTY));

parameter aBCresult(LANDo,CROPs,year,groups) annual BLANEY CRIDDLE
           aBCavg(LANDo,crops,groups) Annual sum of BCs ;

   aBCresult(LANDo,crop,recharge,county)
     = sum(month,BCresult(LANDo,crop,recharge,month,county)) ;

  aBCavg(LANDo,CROP,COUNTY) =
    SUM(recharge,PROB(recharge)
       * aBCresult(LANDo,CROP,recharge,COUNTY));

    BCresult(LANDo,CROP,recharge,month,COUNTY)
                $BCav(LANDo,CROP,COUNTY,month)
     =  BCresult(LANDo,CROP,recharge,month,COUNTY)
       / BCav(LANDo,CROP,COUNTY,month) ;

  aBCresult(LANDo,CROP,recharge,COUNTY)$aBCavg(LANDo,CROP,COUNTY)=
   aBCresult(LANDo,CROP,recharge,COUNTY)/aBCavg(LANDo,CROP,COUNTY);


*    cccccccccccccccccccccccccccccccccccccccccccccccccccccc

*    Monthly Aquifer Response regression coefficients
*      estimated using OLS with GWSIM-IV output data

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccc

TABLE REGPAR(equ,month,obs,regress)   Monthly Regression Coefficients

                        J17Head   SabHead      Recharge      WestUse      EastUse      Intercept
```

```
SprComal.jan.all      45.6828  153.5382    .00665458   [illegible]   [illegible]    127645.34
SprComal.feb.all     130.4297   89.8079    .01060562   -.00504267   -.05452162   -133792.15
SprComal.mar.all     138.8498   76.9778    .01155231   -.00445546   -.04596196   -129773.72
SprComal.apr.all     134.6944   70.4828    .01170566   -.00462248   -.04186948   -122611.99
SprComal.may.all     128.6897   65.3714    .01188938   -.00452511   -.03865902   -115435.84
SprComal.jun.all     122.8632   61.6283    .00917964   -.00462875   -.03534263   -108481.07
SprComal.jul.all     112.5081   55.6925    .00922574   -.00477420   -.03316921    -97871.28
SprComal.aug.all     100.7452   49.5973    .00869676   -.00461808   -.03017922    -86409.90
SprComal.sep.all      94.1432   50.1529    .00791383   -.00458210   -.02691112    -82756.39
SprComal.oct.all      90.3422   52.4035    .00722293   -.00446794   -.02442934    -81940.43
SprComal.nov.all      89.7172   56.7847    .00719648   -.00441823   -.02212669    -84790.65
SprComal.dec.all      86.6569   57.0233    .00703254   -.00405750   -.02100488    -83110.24
SprSanMar.jan.all     35.3045              .01988889   -.00027157   -.01921846    -18326.44
SprSanMar.feb.all     43.9744              .01346100   -.00094901   -.01223258    -23479.66
SprSanMar.mar.all     45.9060              .00786202   -.00016777   -.00872674    -24512.08
SprSanMar.apr.all     46.1836              .00673408   -.00032466   -.00710069    -24549.11
SprSanMar.may.all     45.9947              .00709280   -.00021616   -.00566707    -24616.14
SprSanMar.jun.all     45.4848              .00890167    .00006155   -.00498045    -25145.90
SprSanMar.jul.all     44.5294              .00395160   -.00009112   -.00470208    -23839.28
SprSanMar.aug.all     43.7638              .00232981   -.00006029   -.00408353    -23022.84
SprSanMar.sep.all     42.7521              .00188863   -.00006963   -.00394530    -22305.91
SprSanMar.oct.all     41.9831              .00268464   -.00013323   -.00364474    -22053.18
SprSanMar.nov.all     41.4006              .00214344   -.00009952   -.00340391    -21526.73
SprSanMar.dec.all     40.5120              .00193312   -.00014915   -.00335760    -20880.20
EndJ17Head.dec.all      .5418     .1550    .00001908   -.00002828   -.00013567       210.41
EndSabHead.dec.all      .3478     .5828    .00002361   -.00009108   -.00005911       102.22
WestLift.dec.all      -.3143    -.5463   -.00001930    .00013454    .00003085       753.13
EastLift.dec.all      -.5227    -.1498   -.00001906    .00002692    .00011801       577.28
SprComal.jan.c1      180.3684  121.2104    .01061773   -.00172791   -.11631810   -191449.08
SprComal.feb.c1      280.2459   50.2790    .01624347   -.00834689   -.08565001   -201927.14
SprComal.mar.c1      288.6519   41.4842    .01741879   -.00724464   -.07147216   -200907.82
SprComal.apr.c1      279.8861   39.7958    .01764821   -.00728350   -.06495643   -194209.82
SprComal.may.c1      265.3099   39.6351    .01797871   -.00709015   -.05990982   -185087.09
SprComal.jun.c1      247.6505   39.0824    .01339289   -.00733009   -.05448249   -172110.89
SprComal.jul.c1      233.1974   40.3336    .01368792   -.00765300   -.05242416   -163895.54
SprComal.aug.c1      221.9370   41.5496    .01321557   -.00736483   -.04956694   -157862.71
SprComal.sep.c1      210.8783   41.8924    .01190292   -.00735823   -.04370491   -150994.45
SprComal.oct.c1      199.1030   43.0783    .01076136   -.00712049   -.03893237   -144158.20
SprComal.nov.c1      187.1714   44.2342    .01037431   -.00684162   -.03385164   -137434.85
SprComal.dec.c1      176.1384   44.4788    .00999996   -.00616985   -.03155824   -130588.84
SprSanMar.jan.c1      -3.5255              .01992879   -.00156296   -.02009487      7801.64
SprSanMar.feb.c1      26.9574              .01314394   -.00057021   -.01173045    -12055.33
SprSanMar.mar.c1      34.6762              .00774400   -.00023509   -.00836484    -16990.84
SprSanMar.apr.c1      36.4454              .00676451   -.00032063   -.00668277    -18067.05
SprSanMar.may.c1      38.3235              .00714758   -.00015938   -.00518931    -19563.33
SprSanMar.jun.c1      42.5959              .00893691    .00007993   -.00499148    -23253.66
SprSanMar.jul.c1      39.1549              .00392051   -.00010666   -.00446499    -20287.29
SprSanMar.aug.c1      36.8948              .00231189   -.00001695   -.00370367    -18519.73
SprSanMar.sep.c1      34.5880              .00180874    .00001865   -.00339055    -16957.11
SprSanMar.oct.c1      33.1755              .00253869   -.00007865   -.00303373    -16262.30
SprSanMar.nov.c1      31.8748              .00198461   -.00002752   -.00272031    -15288.12
SprSanMar.dec.c1      31.3705              .00176356   -.00003507   -.00268235    -14911.79
EndJ17Head.dec.c1       .3210     .1650    .00001361   -.00002153   -.00010564       341.57
EndSabHead.dec.c1       .2863     .5677    .00002224   -.00008694   -.00004852       151.58
WestLift.dec.c1       -.2983    -.4960   -.00001771    .00012745    .00002381       705.39
EastLift.dec.c1       -.3456    -.1580   -.00001469    .00002156    .00009373       472.30
SprSanMar.jan.c2      60.6209              .01983081   -.00004293   -.01837907    -33307.71
SprSanMar.feb.c2      59.3762              .01343075   -.00122627   -.01179001    -32532.06
SprSanMar.mar.c2      58.3007              .00768741    .00005217   -.00834437    -31774.48
SprSanMar.apr.c2      55.8301              .00632231   -.00026182   -.00696706    -30159.42
SprSanMar.may.c2      56.3866              .00670336   -.00023630   -.00600660    -30541.09
SprSanMar.jun.c2      59.4619              .00896462   -.00005657   -.00581102    -33053.29
SprSanMar.jul.c2      53.9436              .00392761   -.00006050   -.00501325    -29241.60
SprSanMar.aug.c2      51.7246              .00216789   -.00009149   -.00428285    -27568.39
SprSanMar.sep.c2      47.4139              .00175781   -.00009414   -.00407926    -24988.59
SprSanMar.oct.c2      47.0022              .00269977   -.00011614   -.00385191    -24991.32
SprSanMar.nov.c2      47.3135              .00213742   -.00004766   -.00368039    -24967.01
SprSanMar.dec.c2      47.4575              .00198737   -.00022470   -.00374582    -24876.05
EndJ17Head.dec.c2       .7993     .1328    .00002688   -.00003792   -.00017827        89.47
EndSabHead.dec.c2       .1120     .8627    .00002418   -.00009748   -.00007247        56.17
WestLift.dec.c2                 -.9009   -.00002017    .00014623    .00003771       806.26
EastLift.dec.c2       -.7137    -.1521   -.00002543    .00003469    .00015314       678.40 ;

* Calibration factors used to equate simulated head levels to actual.
 parameter cal1(endhead)   First calibration factor
           /endj17head  141.3011, endsabhead -85.2896 /
          cal2(endhead)    Second Calibration factor
           /endj17head  0.802976, endsabhead  1.103942 / ;

set allstrat  ALL STRATEGIES (EPIC and Pena)
 /
 C50-May-F,    C50-Jun-F,    C75-May-F,    C75-Jun-F,
 C50-May-S,    C50-Jun-S,    C75-May-S,    C75-Jun-S,
 C-Dryland,
 S50-May-F,    S50-Jun-F,    S75-May-F,    S75-Jun-F,
 S50-May-S,    S50-Jun-S,    S75-May-S,    S75-Jun-S,
 S-Dryland,
 O50-Mar-F,    O50-Apr-F,    O75-Mar-F,    O75-Apr-F,
 O50-Mar-S,    O50-Apr-S,    O75-Mar-S,    O75-Apr-S,
 O-Dryland,
 W50-Mar-F,    W50-Apr-F,    W75-Mar-F,    W75-Apr-F,
```

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W50-Mar-S,   W50-Apr-S,   W75-Mar-S,   W75-Apr-S,
W-Dryland,
Pnut50-F,      Pnut75-F, P50-May-F,     P75-May-F,
Pnut50-S,      Pnut75-S, P50-May-S,    P75-May-S,
Pnut-dry,
Oni50-F,   Oni75-F,
Oni50-S,    Oni75-S,
Cabb50-F,  Cabb75-F,
Cabb50-S,   Cabb75-S,
Carr50-F,  Carr75-F,
Carr50-S,   Carr75-S,
Cant50-F,  Cant75-F,
Cant50-S,   Cant75-S,
Cuc50-F,   Cuc75-F,
Cuc50-S,    Cuc75-S,
Let50-F,   Let75-F,
Let50-S,    Let75-S,
Spin50-F,  Spin75-F,
Spin50-S,   Spin75-S,
Hay50-F,   Hay75-F,
Hay50-S,    Hay75-S,
Hay-Dry,
H50-May-F, H75-May-F,
H50-May-S,  H75-May-S,
Cot50-EB-F, Cot50-FB-F, Cot50-FO-F,
Cot75-EB-F, Cot75-FB-F, Cot75-FO-F,
Cot50-EB-S, Cot50-FB-S, Cot50-FO-S,
Cot75-EB-S, Cot75-FB-S, Cot75-FO-S,
Cot-Dry,
full     full irrigation
full-S  full irrigation using sprinkler
p1      limited in apr may june
p2      limited in july aug sep
p12     limited in phases 1 and 2
a1      to dry land after april
a1-s    to dry land after april
a2      to dry land after july
/

    PenaStrat(allstrat)   Irrigation strategies from Pena
            / full    full irrigation
              full-S  full irrigation using sprinkler
              p1      limited in apr may june
              p2      limited in july aug sep
              p12     limited in phases 1 and 2
              a1-s    to dry land after april
              a1      to dry land after april
              a2      to dry land after july
            /

    waterstat(allstrat)  Irrigation strategies from Pena
    spkstat(allstrat)    Sprinkler strategies for Pena crops
    fstat(allstrat)      Furrow strategies for Pena crops
    drystat(allstrat)    Dryland strategies for Pena crops
    strategy(allstrat)     Irrigation strategies from EPIC ;

    waterstat(PenaStrat) = yes;
    drystat("full") = yes ;
    spkstat("full-S") = yes ;
    spkstat("a1-S") = yes ;
    fstat(PenaStrat) = yes ;
    fstat(spkstat) = no ;

    strategy(allstrat) = yes ;
    strategy(waterstat) = no ;


table ragdata(agitem,lando,allstrat,crops)
*Edwards budgets from 1994
          IRR.full.COTTON irr.p1.cotton irr.(p2).cotton  irr.(a1).cotton
*also                                        p12
PRICE             0.79
YIELD           900.00        750          810                350
HERB              7.50
PHOSPHATE        12.50
NITROGEN         19.50
SEED              8.40
INSECTIC         73.40        53.5         68.20               40
FUELM            16.71
FUELI            61.85
REPAIRM           4.85
REPAIRI          12.04
LABORM           27.53
LABORI           15.00
HARVEST         184.04
HARVacre         27.75
INTEREST         14.88
FIXED           196.97
defic            -32
PESTICAPPL       36.75        22.75        30.50              16.75
LABORO           22.10
```

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FEB-WATER          4.00         4           4              4
APR-WATER          9.00                     ?
may-WATER          4.00         4           4
JUN-WATER         12.00         8           8
jul-WATER           .00                     1.25
+            IRR.full.CORN IRR.(p1).CORN    irr.(p2   ).corn irr.(a2).corn
*also                           p12         a1
PRICE          -2.85
YIELD         110.00            50          80             35
FEDINS         19.50
HERB           15.00
HERBAPPL        3.50
PHOSPHATE      17.50
NITROGEN       20.00
SEED           22.60
INSECTIC        8.50
FUELM          14.62
FUELI          49.48
REPAIRM         3.82
REPAIRI         9.63
LABORM         24.31
LABORI          8.80
HARVEST        15.40
HARvacre       22.00
INTEREST        9.66
FIXED         171.68
defic         -14
feb-WATER       4.00            4           4              4
MAY-WATER       9.00            4           9
JUN-WATER       6.00            4           6
JUl-WATER       3.00            4           1.25
+          irr .(full      ).SORGHUM IRR.(p1     ).SORGHUM IRR.a1.SORGHUM
*also                p2,a2                p12
PRICE                      4.18
YIELD                     50.00             35             15
FEDINS                     3.34
HERB                      10.00
HERBAPPL                   3.50
PHOSPHATE                 15.00
NITROGEN                  12.00
SEED                       3.60
INSECTIC                   6.50
FUELM                     14.62
FUELI                     37.11
REPAIRM                    3.82
REPAIRI                    7.22
LABORM                    24.31
LABORI                     6.60
HARVEST                   42.50
INTEREST                   5.97
FIXED                    140.27
JAN-WATER                  4.00             4              4
MAR-WATER                  0.00
MAY-WATER                  8.00             4
+                  IRR.full.WINWHT
PRICE                      3.80
YIELD                     40.00
PHOSPHATE                 10.00
NITROGEN                   8.00
SEED                      12.80
FUELM                      8.88
FUELI                     37.11
REPAIRM                    2.31
REPAIRI                    7.22
LABORM                    17.17
LABORI                     6.60
HARVEST                   27.50
INTEREST                   4.61
FIXED                    106.52
FUNGIC                     4.00
PESTICAPPL                 1.40
JAN-WATER                  2.00
FEB-WATER                  3.00
MAR-WATER                  3.00
NOV-WATER                  4.00
+                  IRR.full.sesame irr.a1.sesame
PRICE                     23
YIELD                     12.5          .001
PHOSPHATE                 11.25
NITROGEN                  10.00
SEED                       6.87
misc                       8.5
FUELM                     13.48
FUELI                     37.11
REPAIRM                    3.54
REPAIRI                    7.22
LABORM                    22.70
LABORI                     6.60
HARVEST                   23.75
INTEREST                   5.28
FIXED                    145.03
```

```
JAN-WATER            4.00         4
FEB-WATER            3.00
MAR-WATER            4.00         4
may-WATER            4.00        .00
+                  IRR.full.oats
PRICE                0.28
YIELD              475.00
FUELI               33.37
misc               107.78
JAN-WATER            2.00
FEB-WATER            3.00
MAR-WATER            3.00
NOV-WATER            4.00
+                  IRR.full.soybeans   irr.a1.soybeans
PRICE                5.5
YIELD               42.00              24
FUELI               33.37
misc               187.26
harvest             37.80
FEB-WATER            4.00              4
MAy-WATER            4.00
jun-WATER            4.00
+                  IRR.(full    ).hay IRR.(p2     ).hay  IRR.a1.hay irr.a2.hay
+                  IRR.(full,p1).hay IRR.(p2,p12).hay  IRR.a1.hay irr.a2.hay
PRICE               65.
YIELD               10.00              7               4          6
FUELI               75.37
misc               117.26
haRvest            350
mar-WATER            4.00              4               4          4
apr-WATER            4.00              4                          4
jun-WATER            4.00              4                          4
jul-WATER            4.00              1.25
aug-WATER            4.00              1.25
+                  IRR.full.GUAR irr.a1.guar
PRICE               16.00
YIELD               18.50        .001
HERB                 7.50
HERBAPPL             3.50
PHOSPHATE           11.25
NITROGEN            10.00
SEED                 4.40
INSECTIC             6.50
FUELM               14.20
FUELI               40.20
REPAIRM              3.69
REPAIRI              7.83
LABORM              22.94
LABORI               7.15
HARVEST             25.55
INTEREST             7.53
FIXED              131.18
INSECTAPPL           3.50
LABORO              11.05
MAR-WATER            4.00        4
MAY-WATER            3.00
JUN-WATER            3.00
JUL-WATER            3.00
+                  IRR.full.CABBAGE irr.a2.cabbage
PRICE                3.50
YIELD              650.00             .001
HERB                 7.50
PHOSPHATE           18.75
NITROGEN            25.00
SEED               130.00
INSECTIC           150.00
FUELM               17.00
FUELI               36.29
REPAIRM              4.56
REPAIRI              8.00
LABORM              27.02
LABORI               8.80
HARVEST           1072.50
INTEREST            13.06
FIXED              146.70
PESTICAPPL          35.00
LABORO             132.59
JUL-WATER            6.00
AUG-WATER            6.00
SEP-WATER            4.00
+                  IRR.full.CANTALOP irr.a1.cantalop
PRICE                6.00
YIELD              300.00             .001
HERB                 7.50
PHOSPHATE           18.75
NITROGEN            25.00
SEED                50.00
INSECTIC            22.50
FUELM               18.20
FUELI               34.02
REPAIRM              5.03
```

REPAIRI	7.50		
LABORM	32.45		
LABORI	8.25		
HARVEST	1275.00		
INTEREST	10.95		
FIXED	157.24		
FUNGIC	40.00		
PESTICAPPL	14.00		
LABORO	99.44		
FEB-WATER	3.00		3
MAR-WATER	4.00		4
APR-WATER	4.00		
MAY-WATER	4.00		
+	IRR.full.CUCUMBER	irr.a2.cucumber	
PRICE	6.50		
YIELD	250.00		.001
HERB	8.00		
PHOSPHATE	20.00		
NITROGEN	20.00		
SEED	78.00		
INSECTIC	10.00		
FUELM	15.79		
FUELI	36.74		
REPAIRM	4.30		
REPAIRI	8.10		
LABORM	28.07		
LABORI	8.91		
HARVEST	1125.00		
INTEREST	5.96		
FIXED	146.37		
FUNGIC	30.00		
PESTICAPPL	14.00		
LABORO	49.72		
JUL-WATER	4.20		
AUG-WATER	4.00		
SEP-WATER	4.00		
OCT-WATER	4.00		
+	IRR.full.ONION	irr.a1.onion	
PRICE	7.50		
YIELD	500.00		0.001
PHOSPHATE	18.75		
NITROGEN	25.00		
SEED	111.00		
INSECTIC	30.00		
FUELM	18.65		
FUELI	40.82		
REPAIRM	5.01		
REPAIRI	9.00		
LABORM	33.34		
LABORI	9.90		
HARVEST	2125.00		
INTEREST	20.17		
FIXED	170.10		
FUNGIC	42.00		
PESTICAPPL	17.50		
LABORO	55.25		
JAN-WATER	4.00		
MAR-WATER	3.00		
APR-WATER	3.00		
OCT-WATER	4.00		
DEC-WATER	4.00		
+	IRR.full.tomato		
PRICE	7.90		
YIELD	165.00		
varcost	370.00		
HARVEST	726.00		
dec-WATER	12.00		
mar-WATER	6.00		
may-WATER	6.00		
+	IRR.full.watermel		
PRICE	6.00		
YIELD	165.00		
varcost	330.00		
HARVEST	450.00		
feb-WATER	12.00		
mar-WATER	6.00		
apr-WATER	6.00		
may-WATER	6.00		
+	IRR.full.honeydew		
PRICE	7.48		
YIELD	600.00		
varcost	463.00		
HARVEST	2040.00		
feb-WATER	12.00		
mar-WATER	6.00		
apr-WATER	6.00		
may-WATER	6.00		
+	IRR.full.swtcorn		
PRICE	3.73		
YIELD	100.00		
varcost	249.76		

```
HARVEST          14.00
jan-WATER         3.00
may-WATER         9.00
jun-WATER         8.00
jul-WATER         4.00
+               IRR.full.potato
PRICE             9.00
YIELD           225.00
varcost        1810.49
HARVEST        1012.50
jan-WATER         3.00
may-WATER         9.00
jun-WATER         8.00
jul-WATER         4.00
+               IRR.full.peppers
PRICE             6.50
YIELD           400.00
varcost         770.5
HARVEST        1360.00
jul-WATER         7.00
aug-WATER        12.00
sep-WATER        12.00
oct-WATER         6.00
nov-WATER         6.00
+               IRR.full.LETTUCE
PRICE             5.50
YIELD           500.00
PHOSPHATE        20.00
NITROGEN         56.25
SEED             28.00
INSECTIC         88.00
FUELM            18.26
FUELI            27.21
REPAIRM           4.78
REPAIRI           6.00
LABORM           29.93
LABORI            6.60
HARVEST        2250.00
INTEREST          6.53
FIXED           144.95
FUNGIC           35.50
PESTICAPPL       38.50
LABORO           66.29
OCT-WATER         4.00
NOV-WATER         4.00
DEC-WATER         4.00
+               IRR.full.CARROT   irr.a2.carrot
PRICE             5.75
YIELD           340.00               0.001
HERB              7.50
PHOSPHATE        18.75
NITROGEN         30.00
SEED             70.00
INSECTIC          3.25
FUELM            15.47
FUELI            40.82
REPAIRM           4.30
REPAIRI           9.00
LABORM           26.57
LABORI            9.90
HARVEST        1350.00
INTEREST         11.80
FIXED           152.45
FUNGIC           30.00
PESTICAPPL       10.50
JUL-WATER         6.00
AUG-WATER         3.00
SEP-WATER         3.00
OCT-WATER         3.00
NOV-WATER         3.00
+               IRR.full.PEANUTS   irr.a1.peanuts
PRICE            33.75
YIELD            35.00                .001
FEDINS           19.23
HERB             11.02
HERBAPPL         20.89
PHOSPHATE        17.50
SEED             67.20
INSECTIC         15.32
FUELM            17.78
FUELI            60.35
REPAIRM           4.93
REPAIRI          25.34
LABORM           31.83
LABORI           11.70
HARVEST          60.82
INTEREST         13.51
FIXED           435.15
FUNGIC           72.50
PESTICAPPL       40.20
LABORO           16.57
```

MAY-WATER	4.00	
JUN-WATER	10.00	
JUL-WATER	5.00	
+	IRR.full.SPINACH irr.a2.spinach	
PRICE	6.00	
YIELD	450.00	450
PHOSPHATE	30.00	
NITROGEN	22.50	
SEED	36.00	
INSECTIC	70.00	
FUELM	18.12	
FUELI	36.29	
REPAIRM	4.93	
REPAIRI	8.00	
LABORM	31.89	
LABORI	8.80	
HARVEST	1957.50	
INTEREST	13.41	
FIXED	154.49	
FUNGIC	35.00	
PESTICAPPL	24.50	
LABORO	38.67	
JAN-WATER	4.00	4
SEP-WATER	4.00	
oct-WATER	0.00	4
NOV-WATER	4.00	4
+	IRR.full.SORGHAY	
PRICE	65.00	
YIELD	10.00	
PHOSPHATE	15.00	
NITROGEN	6.00	
SEED	12.80	
FUELM	10.30	
FUELI	49.48	
REPAIRM	2.30	
REPAIRI	9.64	
LABORM	19.15	
LABORI	11.10	
haRvest	350	
INTEREST	2.20	
FIXED	144.51	
APR-WATER	4.00	
JUN-WATER	4.00	
JUL-WATER	4.00	
AUG-WATER	4.00	
+	dry.full.COTTON	
PRICE	0.71	
YIELD	350.00	
FEDINS	20.66	
HERB	7.50	
PHOSPHATE	5.00	
NITROGEN	2.50	
SEED	7.20	
INSECTIC	17.10	
FUELM	13.85	
REPAIRM	3.61	
LABORM	24.60	
HARVEST	77.94	
INTEREST	4.89	
FIXED	79.42	
PESTICAPPL	10.50	
defic	-16	
+	dry.full.CORN	
PRICE	2.60	
YIELD	59.00	
FEDINS	10.14	
HERB	15.00	
HERBAPPL	3.50	
PHOSPHATE	10.00	
NITROGEN	6.00	
SEED	15.72	
FUELM	13.18	
REPAIRM	3.46	
LABORM	22.33	
HARVEST	30.26	
INTEREST	4.15	
FIXED	68.46	
defic	-8	
+	dry.full.SORGHUM	
PRICE	4.18	
YIELD	30.00	
FEDINS	5.54	
HERB	10.00	
HERBAPPL	3.50	
PHOSPHATE	10.00	
NITROGEN	6.00	
SEED	2.40	
FUELM	13.18	
REPAIRM	3.46	
LABORM	22.33	
HARVEST	27.00	

```
INTEREST                  3.25
FIXED                    67.96
+                   dry.full.WINWHT
PRICE                     3.78
YIELD                    20.00
PHOSPHATE                 7.50
NITROGEN                  3.00
SEED                      9.60
FUELM                     7.73
REPAIRM                   2.04
LABORM                   15.56
HARVEST                  22.50
INTEREST                  2.35
FIXED                   125.14
+                   dry.full.GUAR
PRICE                    16.00
YIELD                     8.00
HERB                      7.50
HERBAPPL                  3.50
PHOSPHATE                 3.75
NITROGEN                  5.00
SEED                      4.40
INSECTIC                  6.50
FUELM                    11.90
REPAIRM                   3.01
LABORM                   19.72
HARVEST                  22.40
INTEREST                  2.40
FIXED                    67.06
INSECTAPPL                3.50
+                   dry.full.PEANUTS
PRICE                    33.75
YIELD                     5.10
FEDINS                   34.01
HERB                     12.89
SEED                     33.60
FUELM                    15.38
REPAIRM                   4.22
LABORM                   25.59
HARVEST                  15.70
INTEREST                  5.56
FIXED                   108.91
FUNGIC                    7.80
PESTICAPPL               22.50
LABORO                    8.29
+                   dry.full.SORGHAY
PRICE                    65.00
YIELD                     4.50
PHOSPHATE                10.00
NITROGEN                  4.00
SEED                      9.60
FUELM                     8.26
REPAIRM                   2.18
LABORM                   13.01
haRvest                 157.50
INTEREST                  1.35
FIXED                    45.93
*Note: misc and harvest for dry soy are .6 of irr soy.
+                   dry.full.soybeans
PRICE                     5.5
YIELD                    22.68
misc                    112.36
harvest                  23.09
* Note: yield for dry oats is irr oats * .5 .
*       misc set to .6 of irr oats.
+                   dry.full.oats
PRICE                     0.28
YIELD                   237.50
misc                     64.67
* Note: yield for dry hay same as yield for dry sorghay.
*       harvest is irr hay harvest * .45 .
*       misc is irr hay misc * .6 .
+                   dry.full.hay
PRICE                    65.
YIELD                     4.5
misc                     70.36
haRvest                 157.50
;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
```

EPIC simulations of crop yield and water use were conducted for selected crops, vegetables, and sorghum-hay for the Edwards aquifer area. The selected crops and vegetables were corn, cotton, sorghum, oats, winter-wheat, peanut, cabbage, lettuce, spinach, carrot, cucumber, canteloupe, and onion. Sixteen actual weather year data for Uvalde County were used for EPIC simulations. These years were 1956, 1951, 1963, 1962, 1988, 1980, 1982, 1969, 1974, 1972, 1976, 1977, 1979, 1981, 1958, and 1987. Weather year data beyond 1987 were not used since weather years between 1956 and 1987 account for the most dry, most wet, and average (normal) years.

For crops, irrigation strategies were used for alternative soil moisture scenarios (50% and 75% soil moisture), alternative irrigation ending dates (e.g. Apr 30, May 30, June 30 etc.) and alternative irrigation methods (furrow and sprinkler). An irrigation strategy of C50-May-F thus implies a simulation for corn when soil moisture reaches 50%, irrigation application ends on May 30 and when furrow irrigation is used. Similarly, C75-May-S implies a simulation for corn with 75% soil moisture, irrigation ending date of May 30 and sprinkler irrigation. For cotton, the irrigation ending dates were based on early bloom (EB), first bloom (FB), and first open boll (FO) which correspond to irrigation ending dates of May 31, June 30, and July 31, respectively. Simulations for dryland scenario were also conducted for all crops.

For vegetables, simulations were conducted for alternative soil moistures and irrigation methods (furrow and sprinkler). Alternative irrigation ending dates were not used for vegetables since vegetables require continuous irrigation.

Simulations for hay were based on fraction of growing season (a procedure used in EPIC) where hay was harvested several times throughout the year.

4" and 1.5" of water per application were used for furrow and sprinkler irrigation, respectively. Irrigation efficiency was assumed to be 70% and 95% for furrow and sprinkler irrigation, respectively, implying that for furrow irrigation, 30% of the water was lost through runoff, evaporation, and/or percolation whereas only 5% was lost under sprinkler irrigation.

Units for crop and vegetable yields are the same as in Jose Pena's Crop Enterprise Budgets and the unit for monthly water use is in acre inches.

```
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

 set cropstrat(crops,lando,allstrat)  Link between crops and strategies

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  EPIC YIELD and WATER USE output by IRRIATION STRATEGY
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccc

table corn(agitem,rechargall,allstrat)
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	C50-May-F	C50-Jun-F	C75-May-F	C75-Jun-F	C50-May-S	C50-Jun-S	C75-May-S	C75-Jun-S	C-Dryland
Yield.1956	93	100	114	128	98	113	105	132	50
Jan-Water.1956	4	4	4	4	3	3	3	3	
Feb-Water.1956									
Mar-Water.1956									
Apr-Water.1956	12	12	16	16	7.5	7.5	9	9	
May-Water.1956	12	12	16	16	7.5	7.5	9	9	
Jun-Water.1956		12		16		7.5		9	
Jul-Water.1956									
Aug-Water.1956									
Sep-Water.1956									
Oct-Water.1956									
Nov-Water.1956									
Dec-Water.1956									
Yield.1951	117	138	128 .	156	122	143	133	162	61
Jan-Water.1951	4	4	4	4	3	3	3	3	
Feb-Water.1951									
Mar-Water.1951									
Apr-Water.1951	12	12	16	16	7.5	7.5	9	9	
May-Water.1951	8	8	12	12	6	6	7.5	7.5	
Jun-Water.1951		12		16		7.5		9	
Jul-Water.1951									
Aug-Water.1951									
Sep-Water.1951									
Oct-Water.1951									
Nov-Water.1951									
Dec-Water.1951									
Yield.1963	123	142	135	162	128	149	140	168	67
Jan-Water.1963	4	4	4	4	3	3	3	3	
Feb-Water.1963									
Mar-Water.1963									
Apr-Water.1963	12	12	16	16	7.5	7.5	9	9	
May-Water.1963	8	8	12	12	6	6	7.5	7.5	
Jun-Water.1963		12		16		7.5		9	

2811	Jul-Water.1963									
2812	Aug-Water.1963									
2813	Sep-Water.1963									
2814	Oct-Water.1963									
2815	Nov-Water.1963									
2816	Dec-Water.1963									
2817										
2818	Yield.1989	95	111	101	130	100	116	109	133	54
2819	Jan-Water.1989	4	4	4	4	3	3	3	3	
2820	Feb-Water.1989									
2821	Mar-Water.1989									
2822	Apr-Water.1989	12	12	16	16	7.5	7.5	9	9	
2823	May-Water.1989	8	8	12	12	6	6	7.5	7.5	
2824	Jun-Water.1989		12		16		7.5		9	
2825	Jul-Water.1989									
2826	Aug-Water.1989									
2827	Sep-Water.1989									
2828	Oct-Water.1989									
2829	Nov-Water.1989									
2830	Dec-Water.1989									
2831										
2832	Yield.1952	114	133	125	155	119	140	130	158	59
2833	Jan-Water.1952	4	4	4	4	3	3	3	3	
2834	Feb-Water.1952									
2835	Mar-Water.1952									
2836	Apr-Water.1952	12	12	16	16	7.5	7.5	9	9	
2837	May-Water.1952	8	8	12	12	6	6	7.5	7.5	
2838	Jun-Water.1952		12		16		7.5		9	
2839	Jul-Water.1952									
2840	Aug-Water.1952									
2841	Sep-Water.1952									
2842	Oct-Water.1952									
2843	Nov-Water.1952									
2844	Dec-Water.1952									
2845										
2846	Yield.1988	97	115	105	133	105	119	114	137	58
2847	Jan-Water.1988	4	4	4	4	3	3	3	3	
2848	Feb-Water.1988									
2849	Mar-Water.1988									
2850	Apr-Water.1988	12	12	16	16	7.5	7.5	9	9	
2851	May-Water.1988	8	8	12	12	6	6	7.5	7.5	
2852	Jun-Water.1988		12		16		7.5		9	
2853	Jul-Water.1988									
2854	Aug-Water.1988									
2855	Sep-Water.1988									
2856	Oct-Water.1988									
2857	Nov-Water.1988									
2858	Dec-Water.1988									
2859										
2860	Yield.1980	119	139	130	158	124	145	135	164	64
2861	Jan-Water.1980	4	4	4	4	3	3	3	3	
2862	Feb-Water.1980									
2863	Mar-Water.1980									
2864	Apr-Water.1980	12	12	16	16	7.5	7.5	9	9	
2865	May-Water.1980	8	8	12	12	6	6	7.5	7.5	
2866	Jun-Water.1980		12		16		7.5		9	
2867	Jul-Water.1980									
2868	Aug-Water.1980									
2869	Sep-Water.1980									
2870	Oct-Water.1980									
2871	Nov-Water.1980									
2872	Dec-Water.1980									
2873										
2874	Yield.1982	117	138	128	156	122	143	133	162	61
2875	Jan-Water.1982	4	4	4	4	3	3	3	3	
2876	Feb-Water.1982									
2877	Mar-Water.1982									
2878	Apr-Water.1982	12	12	16	16	7.5	7.5	9	9	

2879	May-Water.1982	8	8	12	12	6	6	7.5	7.5	
2880	Jun-Water.1982		12		16		7.5		9	
2881	Jul-Water.1982									
2882	Aug-Water.1982									
2883	Sep-Water.1982									
2884	Oct-Water.1982									
2885	Nov-Water.1982									
2886	Dec-Water.1982									
2887										
2888	Yield.1969	121	140	132	160	126	147	137	166	65
2889	Jan-Water.1969	4	4	4	4	3	3	3	3	
2890	Feb-Water.1969									
2891	Mar-Water.1969									
2892	Apr-Water.1969	12	12	16	16	7.5	7.5	9	9	
2893	May-Water.1969	8	8	12	12	6	6	7.5	7.5	
2894	Jun-Water.1969		12		16		7.5		9	
2895	Jul-Water.1969									
2896	Aug-Water.1969									
2897	Sep-Water.1969									
2898	Oct-Water.1969									
2899	Nov-Water.1969									
2900	Dec-Water.1969									
2901										
2902	Yield.1974	96	113	104	132	103	118	112	135	56
2903	Jan-Water.1974	4	4	4	4	3	3	3	3	
2904	Feb-Water.1974									
2905	Mar-Water.1974									
2906	Apr-Water.1974	12	12	16	16	7.5	7.5	9	9	
2907	May-Water.1974	8	8	12	12	6	6	7.5	7.5	
2908	Jun-Water.1974		12		16		7.5		9	
2909	Jul-Water.1974									
2910	Aug-Water.1974									
2911	Sep-Water.1974									
2912	Oct-Water.1974									
2913	Nov-Water.1974									
2914	Dec-Water.1974									
2915										
2916	Yield.1972	95	112	102	130	101	116	110	134	55
2917	Jan-Water.1972	4	4	4	4	3	3	3	3	
2918	Feb-Water.1972									
2919	Mar-Water.1972									
2920	Apr-Water.1972	12	12	16	16	7.5	7.5	9	9	
2921	May-Water.1972	8	8	12	12	6	6	7.5	7.5	
2922	Jun-Water.1972		12		16		7.5		9	
2923	Jul-Water.1972									
2924	Aug-Water.1972									
2925	Sep-Water.1972									
2926	Oct-Water.1972									
2927	Nov-Water.1972									
2928	Dec-Water.1972									
2929										
2930	Yield.1976	127	146	139	166	133	154	142	173	70
2931	Jan-Water.1976	4	4	4	4	3	3	3	3	
2932	Feb-Water.1976									
2933	Mar-Water.1976									
2934	Apr-Water.1976	8	8	12	12	6	6	7.5	7.5	
2935	May-Water.1976	8	8	12	12	6	6	7.5	7.5	
2936	Jun-Water.1976		12		16		7.5		9	
2937	Jul-Water.1976									
2938	Aug-Water.1976									
2939	Sep-Water.1976									
2940	Oct-Water.1976									
2941	Nov-Water.1976									
2942	Dec-Water.1976									
2943										
2944	Yield.1977	115	135	126	155	120	141	132	160	60
2945	Jan-Water.1977	4	4	4	4	3	3	3	3	

```
Feb-Water.1977
Mar-Water.1977
Apr-Water.1977  12    12    16    16    7.5   7.5   9     9
May-Water.1977  8     8     12    12    6     6     7.5   7.5
Jun-Water.1977        12          16          7.5         9
Jul-Water.1977
Aug-Water.1977
Sep-Water.1977
Oct-Water.1977
Nov-Water.1977
Dec-Water.1977

Yield.1979      134   153   145   172   140   158   149   176   76
Jan-Water.1979  4     4     4     4     3     3     3     3
Feb-Water.1979
Mar-Water.1979
Apr-Water.1979  4     4     8     8     3     3     4.5   4.5
May-Water.1979  4     4     8     8     3     3     4.5   4.5
Jun-Water.1979        4           8           3           4.5
Jul-Water.1979
Aug-Water.1979
Sep-Water.1979
Oct-Water.1979
Nov-Water.1979
Dec-Water.1979

Yield.1981      129   148   141   168   135   156   144   175   72
Jan-Water.1981  4     4     4     4     3     3     3     3
Feb-Water.1981
Mar-Water.1981
Apr-Water.1981  8     8     12    12    6     6     7.5   7.5
May-Water.1981  8     8     12    12    6     6     7.5   7.5
Jun-Water.1981        12          16          7.5         9
Jul-Water.1981
Aug-Water.1981
Sep-Water.1981
Oct-Water.1981
Nov-Water.1981
Dec-Water.1981

Yield.1958      126   145   138   165   132   152   140   172   69
Jan-Water.1958  4     4     4     4     3     3     3     3
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958  8     8     12    12    6     6     7.5   7.5
May-Water.1958  8     8     12    12    6     6     7.5   7.5
Jun-Water.1958        12          16          7.5         9
Jul-Water.1958
Aug-Water.1958
Sep-Water.1958
Oct-Water.1958
Nov-Water.1958
Dec-Water.1958

Yield.1987      136   155   147   174   142   160   151   178   78
Jan-Water.1987  4     4     4     4     3     3     3     3
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987  4     4     8     8     3     3     4.5   4.5
May-Water.1987  4     4     8     8     3     3     4.5   4.5
Jun-Water.1987        4           8           3           4.5
Jul-Water.1987
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987
Nov-Water.1987
Dec-Water.1987
;
```

table cotton(agitem,rechargall,allstrat)

	Cot50-EB-F	Cot50-FB-F	Cot50-FO-F	Cot75-EB-F	Cot75-FB-F	Cot75-FO-F	Cot50-EB-S	Cot50-FB-S	Cot50-FO-S	Cot75-EB-S	Cot75-FB-S	Cot75-FO-S	Cot-Dry
Yield.1956	502	541	579	536	603	662	511	547	587	543	609	668	303
Jan-Water.1956													
Feb-Water.1956													
Mar-Water.1956													
Apr-Water.1956	8	8	8	12	12	12	4.5	4.5	4.5	6	6	6	
May-Water.1956	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
Jun-Water.1956		8	8		12	12		4.5	4.5		7.5	7.5	
Jul-Water.1956			8			12			4.5			7.5	
Aug-Water.1956													
Sep-Water.1956													
Oct-Water.1956													
Nov-Water.1956													
Dec-Water.1956													
Yield.1951	552	593	629	587	656	714	562	600	636	593	661	718	341
Jan-Water.1951													
Feb-Water.1951													
Mar-Water.1951													
Apr-Water.1951	4	4	4	8	8	8	3	3	3	4.5	4.5	4.5	
May-Water.1951	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
Jun-Water.1951		8	8		12	12		4.5	4.5		7.5	7.5	
Jul-Water.1951			8			12			4.5			7.5	
Aug-Water.1951													
Sep-Water.1951													
Oct-Water.1951													
Nov-Water.1951													
Dec-Water.1951													
Yield.1963	561	604	639	596	665	720	571	610	647	602	672	727	352
Jan-Water.1963													
Feb-Water.1963													
Mar-Water.1963													
Apr-Water.1963	4	4	4	8	8	8	3	3	3	4.5	4.5	4.5	
May-Water.1963	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
Jun-Water.1963		8	8		12	12		4.5	4.5		7.5	7.5	
Jul-Water.1963			8			12			4.5			7.5	
Aug-Water.1963													
Sep-Water.1963													
Oct-Water.1963													
Nov-Water.1963													
Dec-Water.1963													
Yield.1989	541	579	618	575	643	699	549	586	624	579	648	707	323
Jan-Water.1989													
Feb-Water.1989													
Mar-Water.1989													
Apr-Water.1989	8	8	8	12	12	12	4.5	4.5	4.5	6	6	6	
May-Water.1989	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
Jun-Water.1989		8	8		12	12		4.5	4.5		7.5	7.5	
Jul-Water.1989			8			12			4.5			7.5	
Aug-Water.1989													
Sep-Water.1989													
Oct-Water.1989													
Nov-Water.1989													
Dec-Water.1989													
Yield.1952	553	593	629	587	656	714	562	599	636	593	662	718	341
Jan-Water.1952													
Feb-Water.1952													
Mar-Water.1952													
Apr-Water.1952	4	4	4	8	8	8	3	3	3	4.5	4.5	4.5	
May-Water.1952	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
Jun-Water.1952		8	8		12	12		4.5	4.5		7.5	7.5	

3080	Jul-Water.1952						9			12			4.5
				7.5									
3081	Aug-Water.1952												
3082	Sep-Water.1952												
3083	Oct-Water.1952												
3084	Nov-Water.1952												
3085	Dec-Water.1952												
3086													
3087	Yield.1988		555		597		633	589	660	714	564	603	641
	596	666		721		349							
3088	Jan-Water.1988												
3089	Feb-Water.1988												
3090	Mar-Water.1988												
3091	Apr-Water.1988		4		4		4	8	8	8	3	3	3
	4.5	4.5		4.5									
3092	May-Water.1988		8		8		8	12	12	12	4.5	4.5	4.5
	7.5	7.5		7.5									
3093	Jun-Water.1988				8		8		12	12		4.5	4.5
		7.5		7.5									
3094	Jul-Water.1988						8			12			4.5
				7.5									
3095	Aug-Water.1988												
3096	Sep-Water.1988												
3097	Oct-Water.1988												
3098	Nov-Water.1988												
3099	Dec-Water.1988												
3100													
3101	Yield.1980		554		595		631	588	658	715	563	601	638
	595	663		719		344							
3102	Jan-Water.1980												
3103	Feb-Water.1980												
3104	Mar-Water.1980												
3105	Apr-Water.1980		4		4		4	8	8	8	3	3	3
	4.5	4.5		4.5									
3106	May-Water.1980		8		8		8	12	12	12	4.5	4.5	4.5
	7.5	7.5		7.5									
3107	Jun-Water.1980				8		8		12	12		4.5	4.5
		7.5		7.5									
3108	Jul-Water.1980						8			12			4.5
				7.5									
3109	Aug-Water.1980												
3110	Sep-Water.1980												
3111	Oct-Water.1980												
3112	Nov-Water.1980												
3113	Dec-Water.1980												
3114													
3115	Yield.1982		582		624		661	617	684	742	591	631	669
	623	694		747		370							
3116	Jan-Water.1982												
3117	Feb-Water.1982												
3118	Mar-Water.1982												
3119	Apr-Water.1982		4		4		4	8	8	8	3	3	3
	4.5	4.5		4.5									
3120	May-Water.1982		8		8		8	12	12	12	4.5	4.5	4.5
	7.5	7.5		7.5									
3121	Jun-Water.1982				8		8		12	12		4.5	4.5
		7.5		7.5									
3122	Jul-Water.1982						8			12			4.5
				7.5									
3123	Aug-Water.1982												
3124	Sep-Water.1982												
3125	Oct-Water.1982												
3126	Nov-Water.1982												
3127	Dec-Water.1982												
3128													
3129	Yield.1969		562		605		640	597	665	722	572	711	648
	603	673		728		355							
3130	Jan-Water.1969												
3131	Feb-Water.1969												
3132	Mar-Water.1969												
3133	Apr-Water.1969		4		4		4	8	8	8	3	3	3
	4.5	4.5		4.5									
3134	May-Water.1969		8		8		8	12	12	12	4.5	4.5	4.5
	7.5	7.5		7.5									
3135	Jun-Water.1969				8		8		12	12		4.5	4.5
		7.5		7.5									
3136	Jul-Water.1969						8			12			4.5
				7.5									
3137	Aug-Water.1969												
3138	Sep-Water.1969												
3139	Oct-Water.1969												
3140	Nov-Water.1969												
3141	Dec-Water.1969												
3142													
3143	Yield.1974		544		583		622	579	647	704	553	590	628
	584	652		709		329							
3144	Jan-Water.1974												
3145	Feb-Water.1974												
3146	Mar-Water.1974												
3147	Apr-Water.1974		8		8		8	12	12	12	4.5	4.5	4.5
	6	6		6									

3148	May-Water.1974	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
3149	Jun-Water.1974		8	8		12	12		4.5	4.5		7.5	7.5	
3150	Jul-Water.1974			8			12			4.5			7.5	
3151	Aug-Water.1974													
3152	Sep-Water.1974													
3153	Oct-Water.1974													
3154	Nov-Water.1974													
3155	Dec-Water.1974													
3156														
3157	Yield.1972	542	581	620	578	646	702	551	589	627	583	650	708	327
3158	Jan-Water.1972													
3159	Feb-Water.1972													
3160	Mar-Water.1972													
3161	Apr-Water.1972	8	8	8	12	12	12	4.5	4.5	4.5	6	6	6	
3162	May-Water.1972	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
3163	Jun-Water.1972		8	8		12	12		4.5	4.5		7.5	7.5	
3164	Jul-Water.1972			8			12			4.5			7.5	
3165	Aug-Water.1972													
3166	Sep-Water.1972													
3167	Oct-Water.1972													
3168	Nov-Water.1972													
3169	Dec-Water.1972													
3170														
3171	Yield.1976	710	754	790	750	816	870	720	761	798	750	820	875	452
3172	Jan-Water.1976													
3173	Feb-Water.1976													
3174	Mar-Water.1976													
3175	Apr-Water.1976	0	0	0	0	0	0	0	0	0	0	0	0	
3176	May-Water.1976	4	4	4	8	8	8	3	3	3	4.5	4.5	4.5	
3177	Jun-Water.1976		4	4		8	8		3	3		4.5	4.5	
3178	Jul-Water.1976			4			8			3			4.5	
3179	Aug-Water.1976													
3180	Sep-Water.1976													
3181	Oct-Water.1976													
3182	Nov-Water.1976													
3183	Dec-Water.1976													
3184														
3185	Yield.1977	549	589	626	584	652	710	558	596	633	589	657	714	340
3186	Jan-Water.1977													
3187	Feb-Water.1977													
3188	Mar-Water.1977													
3189	Apr-Water.1977	4	4	4	8	8	8	3	3	3	4.5	4.5	4.5	
3190	May-Water.1977	8	8	8	12	12	12	4.5	4.5	4.5	7.5	7.5	7.5	
3191	Jun-Water.1977		8	8		12	12		4.5	4.5		7.5	7.5	
3192	Jul-Water.1977			8			12			4.5			7.5	
3193	Aug-Water.1977													
3194	Sep-Water.1977													
3195	Oct-Water.1977													
3196	Nov-Water.1977													
3197	Dec-Water.1977													
3198														
3199	Yield.1979	715	760	795	756	821	875	725	766	804	755	826	882	459
3200	Jan-Water.1979													
3201	Feb-Water.1979													
3202	Mar-Water.1979													
3203	Apr-Water.1979	0	0	0	0	0	0	0	0	0	0	0	0	
3204	May-Water.1979	4	4	4	8	8	8	3	3	3	4.5	4.5	4.5	
3205	Jun-Water.1979		4	4		8	8		3	3		4.5	4.5	
3206	Jul-Water.1979			4			8			3			4.5	
3207	Aug-Water.1979													
3208	Sep-Water.1979													
3209	Oct-Water.1979													
3210	Nov-Water.1979													
3211	Dec-Water.1979													
3212														
3213	Yield.1981	619	662	697	655	721	779	628	667	706	657	730	785	395
3214	Jan-Water.1981													

```
Feb-Water.1981
Mar-Water.1981
Apr-Water.1981     4            4            4           8           8           8           3           3           3
    4.5       4.5       4.5
May-Water.1981     4            4            4           8           8           8           3           3           3
    4.5       4.5       4.5
Jun-Water.1981                  4            4                       8           8                       3           3
              4.5       4.5
Jul-Water.1981                               4
                        4.5                                                      8                                   3
Aug-Water.1981
Sep-Water.1981
Oct-Water.1981
Nov-Water.1981
Dec-Water.1981

Yield.1958         613          655          691         648         715         772         621         661         700
    654       724       778          390
Jan-Water.1958
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958     4            4            4           8           8           8           3           3           3
    4.5       4.5       4.5
May-Water.1958     4            4            4           8           8           8           3           3           3
    4.5       4.5       4.5
Jun-Water.1958                  4            4                       8           8                       3           3
              4.5       4.5
Jul-Water.1958                               4
                        4.5                                                      8                                   3
Aug-Water.1958
Sep-Water.1958
Oct-Water.1958
Nov-Water.1958
Dec-Water.1958

Yield.1987         755          802          836         796         862         914         764         804         843
    796       864       923          486
Jan-Water.1987
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987     0            0            0           0           0           0           0           0           0
    0         0         0
May-Water.1987     4            4            4           8           8           8           3           3           3
    4.5       4.5       4.5
Jun-Water.1987                  4            4                       8           8                       3           3
              4.5       4.5
Jul-Water.1987                               4
                        4.5                                                      8                                   3
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987
Nov-Water.1987
Dec-Water.1987
;

table oats(agitem,rechargall,allstrat)
                   O50-Mar-F     O50-Apr-F     O75-Mar-F     O75-Apr-F     O50-Mar-S     O50-Apr-S     O75-Mar-S
O75-Apr-S     O-Dryland
Yield.1956         45            50            52            54            47            51            53
  57            27
Jan-Water.1956     4             4             4             4             3             3             3
  3
Feb-Water.1956     4             4             4             4             3             3             3
  3
Mar-Water.1956     4             4             4             4             1.5           1.5           1.5
  1.5
Apr-Water.1956                   4                           4                           3
  3
May-Water.1956
Jun-Water.1956
Jul-Water.1956
Aug-Water.1956
Sep-Water.1956
Oct-Water.1956
Nov-Water.1956     4             4             8             8             3             3             4.5
  4.5
Dec-Water.1956     4             4             8             8             3             3             4.5
  4.5

Yield.1951         50            54            57            59            52            56            58
  62            32
Jan-Water.1951     4             4             4             4             3             3             3
  3
Feb-Water.1951     4             4             4             4             3             3             3
  3
Mar-Water.1951     4             4             4             4             1.5           1.5           1.5
  1.5
Apr-Water.1951                   4                           4                           3
  3
May-Water.1951
Jun-Water.1951
```

3279	Jul-Water.1951									
3280	Aug-Water.1951									
3281	Sep-Water.1951									
3282	Oct-Water.1951									
3283	Nov-Water.1951	4	4	8	8	3	3	4.5	4.5	
3284	Dec-Water.1951	4	4	8	8	3	3	4.5	4.5	
3285										
3286	Yield.1963	55	59	62	54	57	61	63	67	36
3287	Jan-Water.1963	4	4	4	4	3	3	3	3	
3288	Feb-Water.1963	4	4	4	4	3	3	3	3	
3289	Mar-Water.1963	4	4	4	4	1.5	1.5	1.5	1.5	
3290	Apr-Water.1963		4		4		3		3	
3291	May-Water.1963									
3292	Jun-Water.1963									
3293	Jul-Water.1963									
3294	Aug-Water.1963									
3295	Sep-Water.1963									
3296	Oct-Water.1963									
3297	Nov-Water.1963	0	0	4	4	0	0	1.5	1.5	
3298	Dec-Water.1963	4	4	8	8	3	3	4.5	4.5	
3299										
3300	Yield.1989	56	61	63	66	58	62	65	68	37
3301	Jan-Water.1989	4	4	4	4	3	3	3	3	
3302	Feb-Water.1989	4	4	4	4	3	3	3	3	
3303	Mar-Water.1989	4	4	4	4	1.5	1.5	1.5	1.5	
3304	Apr-Water.1989		4		4		3		3	
3305	May-Water.1989									
3306	Jun-Water.1989									
3307	Jul-Water.1989									
3308	Aug-Water.1989									
3309	Sep-Water.1989									
3310	Oct-Water.1989									
3311	Nov-Water.1989	0	0	4	4	0	0	1.5	1.5	
3312	Dec-Water.1989	4	4	8	8	3	3	4.5	4.5	
3313										
3314	Yield.1952	57	63	64	67	59	64	67	69	39
3315	Jan-Water.1952	4	4	4	4	3	3	3	3	
3316	Feb-Water.1952	4	4	4	4	3	3	3	3	
3317	Mar-Water.1952	4	4	4	4	1.5	1.5	1.5	1.5	
3318	Apr-Water.1952		4		4		3		3	
3319	May-Water.1952									
3320	Jun-Water.1952									
3321	Jul-Water.1952									
3322	Aug-Water.1952									
3323	Sep-Water.1952									
3324	Oct-Water.1952									
3325	Nov-Water.1952	0	0	4	4	0	0	1.5	1.5	
3326	Dec-Water.1952	4	4	8	8	3	3	4.5	4.5	
3327										
3328	Yield.1988	52	57	59	61	54	58	60	64	34
3329	Jan-Water.1988	4	4	4	4	3	3	3	3	
3330	Feb-Water.1988	4	4	4	4	3	3	3	3	
3331	Mar-Water.1988	4	4	4	4	1.5	1.5	1.5	1.5	
3332	Apr-Water.1988		4		4		3		3	
3333	May-Water.1988									
3334	Jun-Water.1988									
3335	Jul-Water.1988									
3336	Aug-Water.1988									
3337	Sep-Water.1988									
3338	Oct-Water.1988									
3339	Nov-Water.1988	4	4	8	8	3	3	4.5	4.5	
3340	Dec-Water.1988	4	4	8	8	3	3	4.5		

									4.5	
3341										
3342	Yield.1980	55	59	62	64	57	61	63	67	36
3343	Jan-Water.1980	4	4	4	4	3	3	3	3	
3344	Feb-Water.1980	4	4	4	4	3	3	3	3	
3345	Mar-Water.1980	4	4	4	4	1.5	1.5	1.5	1.5	
3346	Apr-Water.1980		4		4		3		3	
3347	May-Water.1980									
3348	Jun-Water.1980									
3349	Jul-Water.1980									
3350	Aug-Water.1980									
3351	Sep-Water.1980									
3352	Oct-Water.1980									
3353	Nov-Water.1980	0	0	4	4	0	0	1.5	1.5	
3354	Dec-Water.1980	4	4	8	8	3	3	4.5	4.5	
3355										
3356	Yield.1982	66	71	73	75	68	72	74	78	44
3357	Jan-Water.1982	4	4	4	4	3	3	3	3	
3358	Feb-Water.1982									
3359	Mar-Water.1982	4	4	4	4	1.5	1.5	1.5	1.5	
3360	Apr-Water.1982		4		4		3		3	
3361	May-Water.1982									
3362	Jun-Water.1982									
3363	Jul-Water.1982									
3364	Aug-Water.1982									
3365	Sep-Water.1982									
3366	Oct-Water.1982									
3367	Nov-Water.1982	4	4	8	8	3	3	4.5	4.5	
3368	Dec-Water.1982	0	0	4	4	0	0	1.5	1.5	
3369										
3370	Yield.1969	59	63	66	68	61	65	67	71	39
3371	Jan-Water.1969	4	4	4	4	3	3	3	3	
3372	Feb-Water.1969	4	4	4	4	3	3	3	3	
3373	Mar-Water.1969	4	4	4	4	1.5	1.5	1.5	1.5	
3374	Apr-Water.1969		4		4		3		3	
3375	May-Water.1969									
3376	Jun-Water.1969									
3377	Jul-Water.1969									
3378	Aug-Water.1969									
3379	Sep-Water.1969									
3380	Oct-Water.1969									
3381	Nov-Water.1969	0	0	4	4	0	0	1.5	1.5	
3382	Dec-Water.1969	4	4	8	8	3	3	4.5	4.5	
3383										
3384	Yield.1974	59	64	66	68	61	65	67	71	39
3385	Jan-Water.1974	4	4	4	4	3	3	3	3	
3386	Feb-Water.1974	4	4	4	4	3	3	3	3	
3387	Mar-Water.1974	4	4	4	4	1.5	1.5	1.5	1.5	
3388	Apr-Water.1974		4		4		3		3	
3389	May-Water.1974									
3390	Jun-Water.1974									
3391	Jul-Water.1974									
3392	Aug-Water.1974									
3393	Sep-Water.1974									
3394	Oct-Water.1974									
3395	Nov-Water.1974	0	0	4	4	0	0	1.5	1.5	
3396	Dec-Water.1974	4	4	8	8	3	3	4.5	4.5	
3397										
3398	Yield.1972	48	52	55	57	50	54	56	60	30
3399	Jan-Water.1972	4	4	4	4	3	3	3	3	
3400	Feb-Water.1972	4	4	4	4	3	3	3	3	

3401	Mar-Water.1972	4	4	4	4	1.5	1.5	1.5	1.5	
3402	Apr-Water.1972		4		4		3		3	
3403	May-Water.1972									
3404	Jun-Water.1972									
3405	Jul-Water.1972									
3406	Aug-Water.1972									
3407	Sep-Water.1972									
3408	Oct-Water.1972									
3409	Nov-Water.1972	4	4	8	8	3	3	4.5	4.5	
3410	Dec-Water.1972	4	4	8	8	3	3	4.5	4.5	
3411										
3412	Yield.1976	66	70	73	75	68	72	74	78	44
3413	Jan-Water.1976	4	4	4	4	3	3	3	3	
3414	Feb-Water.1976									
3415	Mar-Water.1976	4	4	4	4	1.5	1.5	1.5	1.5	
3416	Apr-Water.1976		4		4		3		3	
3417	May-Water.1976									
3418	Jun-Water.1976									
3419	Jul-Water.1976									
3420	Aug-Water.1976									
3421	Sep-Water.1976									
3422	Oct-Water.1976									
3423	Nov-Water.1976	4	4	8	8	3	3	4.5	4.5	
3424	Dec-Water.1976	0	0	4	4	0	0	1.5	1.5	
3425										
3426	Yield.1977	62	66	69	71	64	68	70	74	41
3427	Jan-Water.1977	4	4	4	4	3	3	3	3	
3428	Feb-Water.1977	4	4	4	4	3	3	3	3	
3429	Mar-Water.1977	4	4	4	4	1.5	1.5	1.5	1.5	
3430	Apr-Water.1977		4		4		3		3	
3431	May-Water.1977									
3432	Jun-Water.1977									
3433	Jul-Water.1977									
3434	Aug-Water.1977									
3435	Sep-Water.1977									
3436	Oct-Water.1977									
3437	Nov-Water.1977	0	0	4	4	0	0	1.5	1.5	
3438	Dec-Water.1977	4	4	8	8	3	3	4.5	4.5	
3439										
3440	Yield.1979	74	79	81	83	76	80	82	86	49
3441	Jan-Water.1979	4	4	4	4	3	3	3	3	
3442	Feb-Water.1979									
3443	Mar-Water.1979	4	4	4	4	1.5	1.5	1.5	1.5	
3444	Apr-Water.1979		4		4		3		3	
3445	May-Water.1979									
3446	Jun-Water.1979									
3447	Jul-Water.1979									
3448	Aug-Water.1979									
3449	Sep-Water.1979									
3450	Oct-Water.1979									
3451	Nov-Water.1979	4	4	8	8	3	3	4.5	4.5	
3452	Dec-Water.1979	0	0	4	4	0	0	1.5	1.5	
3453										
3454	Yield.1981	69	73	76	78	71	75	77	81	47
3455	Jan-Water.1981	4	4	4	4	3	3	3	3	
3456	Feb-Water.1981									
3457	Mar-Water.1981	4	4	4	4	1.5	1.5	1.5	1.5	
3458	Apr-Water.1981		4		4		3		3	
3459	May-Water.1981									
3460	Jun-Water.1981									
3461	Jul-Water.1981									
3462	Aug-Water.1981									
3463	Sep-Water.1981									
3464	Oct-Water.1981									

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Nov-Water.1981       4        4        8        8        3        3        4.5
   4.5
Dec-Water.1981       0        0        4        4        0        0        1.5
   1.5

Yield.1958           69       74       76       78       71       75       77
   81            47
Jan-Water.1958       4        4        4        4        3        3        3
   3
Feb-Water.1958
Mar-Water.1958       4        4        4        4        1.5      1.5      1.5
   1.5
Apr-Water.1958                4                 4                 3
   3
May-Water.1958
Jun-Water.1958
Jul-Water.1958
Aug-Water.1958
Sep-Water.1958
Oct-Water.1958
Nov-Water.1958       4        4        8        8        3        3        4.5
   4.5
Dec-Water.1958       0        0        4        4        0        0        1.5
   1.5

Yield.1987           69       73       76       78       71       75       77
   81            47
Jan-Water.1987       4        4        4        4        3        3        3
   3
Feb-Water.1987
Mar-Water.1987       4        4        4        4        1.5      1.5      1.5
   1.5
Apr-Water.1987                4                 4                 3
   3
May-Water.1987
Jun-Water.1987
Jul-Water.1987
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987
Nov-Water.1987       4        4        8        8        3        3        4.5
   4.5
Dec-Water.1987       0        0        4        4        0        0        1.5
   1.5
 ;

table sorghum(agitem,rechargall,allstrat)
                  S50-May-F  S50-Jun-F  S75-May-F  S75-Jun-F  S50-May-S  S50-Jun-S  S75-May-S
S75-Jun-S      S-Dryland
Yield.1956           36       47       42       50       38       48       44
   54            22
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956       12       12       16       16       7.5      7.5      9
   9
May-Water.1956       12       12       16       16       7.5      7.5      9
   9
Jun-Water.1956                12                16                7.5
   9
Jul-Water.1956
Aug-Water.1956
Sep-Water.1956
Oct-Water.1956
Nov-Water.1956
Dec-Water.1956

Yield.1951           46       56       52       60       48       58       54
   64            29
Jan-Water.1951
Feb-Water.1951
Mar-Water.1951
Apr-Water.1951       8        8        12       12       6        6        7.5
   7.5
May-Water.1951       8        8        12       12       6        6        7.5
   7.5
Jun-Water.1951                12                16                7.5
   9
Jul-Water.1951
Aug-Water.1951
Sep-Water.1951
Oct-Water.1951
Nov-Water.1951
Dec-Water.1951

Yield.1963           47       58       52       61       49       58       55
   63            30
Jan-Water.1963
Feb-Water.1963
Mar-Water.1963
Apr-Water.1963       8        8        12       12       6        6        7.5
```

									7.5	
3532	May-Water.1963	8	8	12	12	6	6	7.5	7.5	
3533	Jun-Water.1963		12		16		7.5		9	
3534	Jul-Water.1963									
3535	Aug-Water.1963									
3536	Sep-Water.1963									
3537	Oct-Water.1963									
3538	Nov-Water.1963									
3539	Dec-Water.1963									
3540										
3541	Yield.1989	39	49	45	52	41	50	47	57	24
3542	Jan-Water.1989									
3543	Feb-Water.1989									
3544	Mar-Water.1989									
3545	Apr-Water.1989	8	8	12	12	6	6	7.5	7.5	
3546	May-Water.1989	8	8	12	12	6	6	7.5	7.5	
3547	Jun-Water.1989		12		16		7.5		9	
3548	Jul-Water.1989									
3549	Aug-Water.1989									
3550	Sep-Water.1989									
3551	Oct-Water.1989									
3552	Nov-Water.1989									
3553	Dec-Water.1989									
3554										
3555	Yield.1952	44	54	50	57	46	56	52	61	27
3556	Jan-Water.1952									
3557	Feb-Water.1952									
3558	Mar-Water.1952									
3559	Apr-Water.1952	8	8	12	12	6	6	7.5	7.5	
3560	May-Water.1952	8	8	12	12	6	6	7.5	7.5	
3561	Jun-Water.1952		12		16		7.5		9	
3562	Jul-Water.1952									
3563	Aug-Water.1952									
3564	Sep-Water.1952									
3565	Oct-Water.1952									
3566	Nov-Water.1952									
3567	Dec-Water.1952									
3568										
3569	Yield.1988	42	52	48	56	44	54	50	60	26
3570	Jan-Water.1988									
3571	Feb-Water.1988									
3572	Mar-Water.1988									
3573	Apr-Water.1988	8	8	12	12	6	6	7.5	7.5	
3574	May-Water.1988	8	8	12	12	6	6	7.5	7.5	
3575	Jun-Water.1988		12		16		7.5		9	
3576	Jul-Water.1988									
3577	Aug-Water.1988									
3578	Sep-Water.1988									
3579	Oct-Water.1988									
3580	Nov-Water.1988									
3581	Dec-Water.1988									
3582										
3583	Yield.1980	46	56	52	60	48	58	54	64	29
3584	Jan-Water.1980									
3585	Feb-Water.1980									
3586	Mar-Water.1980									
3587	Apr-Water.1980	8	8	12	12	6	6	7.5	7.5	
3588	May-Water.1980	8	8	12	12	6	6	7.5	7.5	
3589	Jun-Water.1980		12		16		7.5		9	
3590	Jul-Water.1980									
3591	Aug-Water.1980									
3592	Sep-Water.1980									
3593	Oct-Water.1980									
3594	Nov-Water.1980									
3595	Dec-Water.1980									
3596										
3597	Yield.1982	46	56	52	60	48	58	54	64	29
3598	Jan-Water.1982									
3599	Feb-Water.1982									
3600	Mar-Water.1982									
3601	Apr-Water.1982	8	8	12	12	6	6	7.5	7.5	

3602	May-Water.1982	8	8	12	12	6	6	7.5	7.5	
3603	Jun-Water.1982		12		16		7.5		9	
3604	Jul-Water.1982									
3605	Aug-Water.1982									
3606	Sep-Water.1982									
3607	Oct-Water.1982									
3608	Nov-Water.1982									
3609	Dec-Water.1982									
3610										
3611	Yield.1969	46	56	52	60	48	58	54	64	29
3612	Jan-Water.1969									
3613	Feb-Water.1969									
3614	Mar-Water.1969									
3615	Apr-Water.1969	8	8	12	12	6	6	7.5	7.5	
3616	May-Water.1969	8	8	12	12	6	6	7.5	7.5	
3617	Jun-Water.1969		12		16		7.5		9	
3618	Jul-Water.1969									
3619	Aug-Water.1969									
3620	Sep-Water.1969									
3621	Oct-Water.1969									
3622	Nov-Water.1969									
3623	Dec-Water.1969									
3624										
3625	Yield.1974	41	51	47	55	43	53	49	59	25
3626	Jan-Water.1974									
3627	Feb-Water.1974									
3628	Mar-Water.1974									
3629	Apr-Water.1974	8	8	12	12	6	6	7.5	7.5	
3630	May-Water.1974	8	8	12	12	6	6	7.5	7.5	
3631	Jun-Water.1974		12		16		7.5		9	
3632	Jul-Water.1974									
3633	Aug-Water.1974									
3634	Sep-Water.1974									
3635	Oct-Water.1974									
3636	Nov-Water.1974									
3637	Dec-Water.1974									
3638										
3639	Yield.1972	40	50	46	54	42	52	48	58	25
3640	Jan-Water.1972									
3641	Feb-Water.1972									
3642	Mar-Water.1972									
3643	Apr-Water.1972	8	8	12	12	6	6	7.5	7.5	
3644	May-Water.1972	8	8	12	12	6	6	7.5	7.5	
3645	Jun-Water.1972		12		16		7.5		9	
3646	Jul-Water.1972									
3647	Aug-Water.1972									
3648	Sep-Water.1972									
3649	Oct-Water.1972									
3650	Nov-Water.1972									
3651	Dec-Water.1972									
3652										
3653	Yield.1976	53	64	59	67	55	66	62	71	33
3654	Jan-Water.1976									
3655	Feb-Water.1976									
3656	Mar-Water.1976									
3657	Apr-Water.1976	8	8	12	12	6	6	7.5	7.5	
3658	May-Water.1976	8	8	12	12	6	6	7.5	7.5	
3659	Jun-Water.1976		12		16		7.5		9	
3660	Jul-Water.1976									
3661	Aug-Water.1976									
3662	Sep-Water.1976									
3663	Oct-Water.1976									
3664	Nov-Water.1976									
3665	Dec-Water.1976									
3666										
3667	Yield.1977	45	55	51	59	47	57	53	63	28
3668	Jan-Water.1977									
3669	Feb-Water.1977									
3670	Mar-Water.1977									
3671	Apr-Water.1977	8	8	12	12	6	6	7.5	7.5	
3672	May-Water.1977	8	8	12	12	6	6	7.5		

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   7.5
    Jun-Water.1977                       12                          16                          7.5
   9
    Jul-Water.1977
    Aug-Water.1977
    Sep-Water.1977
    Oct-Water.1977
    Nov-Water.1977
    Dec-Water.1977

    Yield.1979          59              70             65             71            61            72            67
   77            35
    Jan-Water.1979
    Feb-Water.1979
    Mar-Water.1979
    Apr-Water.1979      4               4              8              8             3             3             4.5
   4.5
    May-Water.1979      4               4              8              8             3             3             4.5
   4.5
    Jun-Water.1979                      4                             8                           3
   4.5
    Jul-Water.1979
    Aug-Water.1979
    Sep-Water.1979
    Oct-Water.1979
    Nov-Water.1979
    Dec-Water.1979

    Yield.1981          54              65             60             68            56            67            63
   72            33
    Jan-Water.1981
    Feb-Water.1981
    Mar-Water.1981
    Apr-Water.1981      8               8              12             12            6             6             7.5
   7.5
    May-Water.1981      8               8              12             12            6             6             7.5
   7.5
    Jun-Water.1981                      12                            16                          7.5
   9
    Jul-Water.1981
    Aug-Water.1981
    Sep-Water.1981
    Oct-Water.1981
    Nov-Water.1981
    Dec-Water.1981

    Yield.1958          52              63             58             66            54            65            61
   70            32
    Jan-Water.1958
    Feb-Water.1958
    Mar-Water.1958
    Apr-Water.1958      8               8              12             12            6             6             7.5
   7.5
    May-Water.1958      8               8              12             12            6             6             7.5
   7.5
    Jun-Water.1958                      12                            16                          7.5
   9
    Jul-Water.1958
    Aug-Water.1958
    Sep-Water.1958
    Oct-Water.1958
    Nov-Water.1958
    Dec-Water.1958

    Yield.1987          60              71             66             72            62            73            68
   78            35
    Jan-Water.1987
    Feb-Water.1987
    Mar-Water.1987
    Apr-Water.1987      4               4              8              8             3             3             4.5
   4.5
    May-Water.1987      4               4              8              8             3             3             4.5
   4.5
    Jun-Water.1987                      4                             8                           3
   4.5
    Jul-Water.1987
    Aug-Water.1987
    Sep-Water.1987
    Oct-Water.1987
    Nov-Water.1987
    Dec-Water.1987
    ;

    table winwht(agitem,rechargall,allstrat)
                        W50-Mar-F       W50-Apr-F      W75-Mar-F      W75-Apr-F     W50-Mar-S     W50-Apr-S     W75-Mar-S
W75-Apr-S        W-Dryland
    Yield.1956          30              35             37             40            32            36            38
   42            15
    Jan-Water.1956      4               4              4              4             3             3             3
   3
    Feb-Water.1956      4               4              4              4             3             3             3
```

No.	Variable									
									3	
3743	Mar-Water.1956	4	4	4	4	1.5	1.5	1.5	1.5	
3744	Apr-Water.1956		4		4		3		3	
3745	May-Water.1956									
3746	Jun-Water.1956									
3747	Jul-Water.1956									
3748	Aug-Water.1956									
3749	Sep-Water.1956									
3750	Oct-Water.1956									
3751	Nov-Water.1956	4	4	8	8	3	3	4.5	4.5	
3752	Dec-Water.1956	4	4	8	8	3	3	4.5	4.5	
3753										
3754	Yield.1951	31	36	38	41	33	37	39	43	17
3755	Jan-Water.1951	4	4	4	4	3	3	3	3	
3756	Feb-Water.1951	4	4	4	4	3	3	3	3	
3757	Mar-Water.1951	4	4	4	4	1.5	1.5	1.5	1.5	
3758	Apr-Water.1951		4		4		3		3	
3759	May-Water.1951									
3760	Jun-Water.1951									
3761	Jul-Water.1951									
3762	Aug-Water.1951									
3763	Sep-Water.1951									
3764	Oct-Water.1951									
3765	Nov-Water.1951	4	4	8	8	3	3	4.5	4.5	
3766	Dec-Water.1951	4	4	8	8	3	3	4.5	4.5	
3767										
3768	Yield.1963	35	39	41	45	36	40	42	46	20
3769	Jan-Water.1963	4	4	4	4	3	3	3	3	
3770	Feb-Water.1963	4	4	4	4	3	3	3	3	
3771	Mar-Water.1963	4	4	4	4	1.5	1.5	1.5	1.5	
3772	Apr-Water.1963		4		4		3		3	
3773	May-Water.1963									
3774	Jun-Water.1963									
3775	Jul-Water.1963									
3776	Aug-Water.1963									
3777	Sep-Water.1963									
3778	Oct-Water.1963									
3779	Nov-Water.1963	0	0	4	4	0	0	1.5	1.5	
3780	Dec-Water.1963	4	4	8	8	3	3	4.5	4.5	
3781										
3782	Yield.1989	36	41	42	47	37	42	43	48	21
3783	Jan-Water.1989	4	4	4	4	3	3	3	3	
3784	Feb-Water.1989	4	4	4	4	3	3	3	3	
3785	Mar-Water.1989	4	4	4	4	1.5	1.5	1.5	1.5	
3786	Apr-Water.1989		4		4		3		3	
3787	May-Water.1989									
3788	Jun-Water.1989									
3789	Jul-Water.1989									
3790	Aug-Water.1989									
3791	Sep-Water.1989									
3792	Oct-Water.1989									
3793	Nov-Water.1989	0	0	4	4	0	0	1.5	1.5	
3794	Dec-Water.1989	4	4	8	8	3	3	4.5	4.5	
3795										
3796	Yield.1952	37	42	43	47	38	43	45	49	22
3797	Jan-Water.1952	4	4	4	4	3	3	3	3	
3798	Feb-Water.1952	4	4	4	4	3	3	3	3	
3799	Mar-Water.1952	4	4	4	4	1.5	1.5	1.5	1.5	
3800	Apr-Water.1952		4		4		3		3	
3801	May-Water.1952									
3802	Jun-Water.1952									

3803	Jul-Water.1952									
3804	Aug-Water.1952									
3805	Sep-Water.1952									
3806	Oct-Water.1952									
3807	Nov-Water.1952	0	0	4	4	0	0	1.5	1.5	
3808	Dec-Water.1952	4	4	8	8	3	3	4.5	4.5	
3809										
3810	Yield.1988	34	38	40	44	35	39	41	45	19
3811	Jan-Water.1988	4	4	4	4	3	3	3	3	
3812	Feb-Water.1988	4	4	4	4	3	3	3	3	
3813	Mar-Water.1988	4	4	4	4	1.5	1.5	1.5	1.5	
3814	Apr-Water.1988		4		4		3		3	
3815	May-Water.1988									
3816	Jun-Water.1988									
3817	Jul-Water.1988									
3818	Aug-Water.1988									
3819	Sep-Water.1988									
3820	Oct-Water.1988									
3821	Nov-Water.1988	4	4	8	8	3	3	4.5	4.5	
3822	Dec-Water.1988	4	4	8	8	3	3	4.5	4.5	
3823										
3824	Yield.1980	35	39	41	45	36	40	42	46	20
3825	Jan-Water.1980	4	4	4	4	3	3	3	3	
3826	Feb-Water.1980	4	4	4	4	3	3	3	3	
3827	Mar-Water.1980	4	4	4	4	1.5	1.5	1.5	1.5	
3828	Apr-Water.1980		4		4		3		3	
3829	May-Water.1980									
3830	Jun-Water.1980									
3831	Jul-Water.1980									
3832	Aug-Water.1980									
3833	Sep-Water.1980									
3834	Oct-Water.1980									
3835	Nov-Water.1980	0	0	4	4	0	0	1.5	1.5	
3836	Dec-Water.1980	4	4	8	8	3	3	4.5	4.5	
3837										
3838	Yield.1982	42	45	48	52	43	47	49	53	26
3839	Jan-Water.1982	4	4	4	4	3	3	3	3	
3840	Feb-Water.1982									
3841	Mar-Water.1982	4	4	4	4	1.5	1.5	1.5	1.5	
3842	Apr-Water.1982		4		4		3		3	
3843	May-Water.1982									
3844	Jun-Water.1982									
3845	Jul-Water.1982									
3846	Aug-Water.1982									
3847	Sep-Water.1982									
3848	Oct-Water.1982									
3849	Nov-Water.1982	4	4	8	8	3	3	4.5	4.5	
3850	Dec-Water.1982	0	0	4	4	0	0	1.5	1.5	
3851										
3852	Yield.1969	38	42	44	48	39	43	45	49	23
3853	Jan-Water.1969	4	4	4	4	3	3	3	3	
3854	Feb-Water.1969	4	4	4	4	3	3	3	3	
3855	Mar-Water.1969	4	4	4	4	1.5	1.5	1.5	1.5	
3856	Apr-Water.1969		4		4		3		3	
3857	May-Water.1969									
3858	Jun-Water.1969									
3859	Jul-Water.1969									
3860	Aug-Water.1969									
3861	Sep-Water.1969									
3862	Oct-Water.1969									
3863	Nov-Water.1969	0	0	4	4	0	0	1.5	1.5	
3864	Dec-Water.1969	4	4	8	8	3	3	4.5	4.5	

3865										
3866	Yield.1974	38	42	44	48	39	43	45	49	23
3867	Jan-Water.1974	4	4	4	4	3	3	3	3	
3868	Feb-Water.1974	4	4	4	4	3	3	3	3	
3869	Mar-Water.1974	4	4	4	4	1.5	1.5	1.5	1.5	
3870	Apr-Water.1974		4		4		3		3	
3871	May-Water.1974									
3872	Jun-Water.1974									
3873	Jul-Water.1974									
3874	Aug-Water.1974									
3875	Sep-Water.1974									
3876	Oct-Water.1974									
3877	Nov-Water.1974	0	0	4	4	0	0	1.5	1.5	
3878	Dec-Water.1974	4	4	8	8	3	3	4.5	4.5	
3879										
3880	Yield.1972	30	35	37	40	32	36	38	42	15
3881	Jan-Water.1972	4	4	4	4	3	3	3	3	
3882	Feb-Water.1972	4	4	4	4	3	3	3	3	
3883	Mar-Water.1972	4	4	4	4	1.5	1.5	1.5	1.5	
3884	Apr-Water.1972		4		4		3		3	
3885	May-Water.1972									
3886	Jun-Water.1972									
3887	Jul-Water.1972									
3888	Aug-Water.1972									
3889	Sep-Water.1972									
3890	Oct-Water.1972									
3891	Nov-Water.1972	4	4	8	8	3	3	4.5	4.5	
3892	Dec-Water.1972	4	4	8	8	3	3	4.5	4.5	
3893										
3894	Yield.1976	42	45	48	52	43	47	49	53	26
3895	Jan-Water.1976	4	4	4	4	3	3	3	3	
3896	Feb-Water.1976									
3897	Mar-Water.1976	4	4	4	4	1.5	1.5	1.5	1.5	
3898	Apr-Water.1976		4		4		3		3	
3899	May-Water.1976									
3900	Jun-Water.1976									
3901	Jul-Water.1976									
3902	Aug-Water.1976									
3903	Sep-Water.1976									
3904	Oct-Water.1976									
3905	Nov-Water.1976	4	4	8	8	3	3	4.5	4.5	
3906	Dec-Water.1976	0	0	4	4	0	0	1.5	1.5	
3907										
3908	Yield.1977	39	43	45	49	40	44	46	50	24
3909	Jan-Water.1977	4	4	4	4	3	3	3	3	
3910	Feb-Water.1977	4	4	4	4	3	3	3	3	
3911	Mar-Water.1977	4	4	4	4	1.5	1.5	1.5	1.5	
3912	Apr-Water.1977		4		4		3		3	
3913	May-Water.1977									
3914	Jun-Water.1977									
3915	Jul-Water.1977									
3916	Aug-Water.1977									
3917	Sep-Water.1977									
3918	Oct-Water.1977									
3919	Nov-Water.1977	0	0	4	4	0	0	1.5	1.5	
3920	Dec-Water.1977	4	4	8	8	3	3	4.5	4.5	
3921										
3922	Yield.1979	46	49	52	56	47	51	53	57	30
3923	Jan-Water.1979	4	4	4	4	3	3	3	3	
3924	Feb-Water.1979									
3925	Mar-Water.1979	4	4	4	4	1.5	1.5	1.5	1.5	

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Apr-Water.1979                       4                    4                    3
 3
May-Water.1979
Jun-Water.1979
Jul-Water.1979
Aug-Water.1979
Sep-Water.1979
Oct-Water.1979
Nov-Water.1979          4            4          8         8          3         3          4.5
 4.5
Dec-Water.1979          0            0          4         4          0         0          1.5
 1.5

Yield.1981              44           47         50        54         45        49         51
 55          28
Jan-Water.1981          4            4          4         4          3         3          3
 3
Feb-Water.1981
Mar-Water.1981          4            4          4         4          1.5       1.5        1.5
 1.5
Apr-Water.1981                       4                    4                    3
 3
May-Water.1981
Jun-Water.1981
Jul-Water.1981
Aug-Water.1981
Sep-Water.1981
Oct-Water.1981
Nov-Water.1981          4            4          8         8          3         3          4.5
 4.5
Dec-Water.1981          0            0          4         4          0         0          1.5
 1.5

Yield.1958              44           47         50        54         45        49         51
 55          28
Jan-Water.1958          4            4          4         4          3         3          3
 3
Feb-Water.1958
Mar-Water.1958          4            4          4         4          1.5       1.5        1.5
 1.5
Apr-Water.1958                       4                    4                    3
 3
May-Water.1958
Jun-Water.1958
Jul-Water.1958
Aug-Water.1958
Sep-Water.1958
Oct-Water.1958
Nov-Water.1958          4            4          8         8          3         3          4.5
 4.5
Dec-Water.1958          0            0          4         4          0         0          1.5
 1.5

Yield.1987              44           47         50        54         45        49         51
 55          28
Jan-Water.1987          4            4          4         4          3         3          3
 3
Feb-Water.1987
Mar-Water.1987          4            4          4         4          1.5       1.5        1.5
 1.5
Apr-Water.1987                       4                    4                    3
 3
May-Water.1987
Jun-Water.1987
Jul-Water.1987
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987
Nov-Water.1987          4            4          8         8          3         3          4.5
 4.5
Dec-Water.1987          0            0          4         4          0         0          1.5
 1.5
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table Peanuts(agitem,rechargall,allstrat)
                    Pnut50-F    Pnut75-F    Pnut50-S    Pnut75-S    Pnut-dry
Yield.1956          20          24          21          26          7
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956      8           12          4.5         6
May-Water.1956      8           12          4.5         6
Jun-Water.1956      16          20          10.5        13.5
Jul-Water.1956      12          16          9           10.5
Aug-Water.1956
Sep-Water.1956
Oct-Water.1956
Nov-Water.1956
Dec-Water.1956

Yield.1951          23.5        27          24.5        29          9
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3996	Jan-Water.1951					
3997	Feb-Water.1951					
3998	Mar-Water.1951					
3999	Apr-Water.1951	4	8	3	4.5	
4000	May-Water.1951	8	12	4.5	6	
4001	Jun-Water.1951	16	20	10.5	13.5	
4002	Jul-Water.1951	12	16	9	10.5	
4003	Aug-Water.1951					
4004	Sep-Water.1951					
4005	Oct-Water.1951					
4006	Nov-Water.1951					
4007	Dec-Water.1951					
4008						
4009	Yield.1963	25	29	27	31	9.5
4010	Jan-Water.1963					
4011	Feb-Water.1963					
4012	Mar-Water.1963					
4013	Apr-Water.1963	4	8	3	4.5	
4014	May-Water.1963	8	12	4.5	6	
4015	Jun-Water.1963	16	20	10.5	13.5	
4016	Jul-Water.1963	12	16	9	10.5	
4017	Aug-Water.1963					
4018	Sep-Water.1963					
4019	Oct-Water.1963					
4020	Nov-Water.1963					
4021	Dec-Water.1963					
4022						
4023	Yield.1989	21	24.5	22.5	27	7.5
4024	Jan-Water.1989					
4025	Feb-Water.1989					
4026	Mar-Water.1989					
4027	Apr-Water.1989	8	12	4.5	6	
4028	May-Water.1989	8	12	4.5	6	
4029	Jun-Water.1989	16	20	10.5	13.5	
4030	Jul-Water.1989	12	16	9	10.5	
4031	Aug-Water.1989					
4032	Sep-Water.1989					
4033	Oct-Water.1989					
4034	Nov-Water.1989					
4035	Dec-Water.1989					
4036						
4037	Yield.1952	24	27.5	25	29.5	9.5
4038	Jan-Water.1952					
4039	Feb-Water.1952					
4040	Mar-Water.1952					
4041	Apr-Water.1952	4	8	3	4.5	
4042	May-Water.1952	8	12	4.5	6	
4043	Jun-Water.1952	16	20	10.5	13.5	
4044	Jul-Water.1952	12	16	9	10.5	
4045	Aug-Water.1952					
4046	Sep-Water.1952					
4047	Oct-Water.1952					
4048	Nov-Water.1952					
4049	Dec-Water.1952					
4050						
4051	Yield.1988	23.5	27	24.5	29	9
4052	Jan-Water.1988					
4053	Feb-Water.1988					
4054	Mar-Water.1988					
4055	Apr-Water.1988	4	8	3	4.5	
4056	May-Water.1988	8	12	4.5	6	
4057	Jun-Water.1988	16	20	10.5	13.5	
4058	Jul-Water.1988	12	16	9	10.5	
4059	Aug-Water.1988					
4060	Sep-Water.1988					
4061	Oct-Water.1988					
4062	Nov-Water.1988					
4063	Dec-Water.1988					
4064						
4065	Yield.1980	26	30	27.5	32.5	10
4066	Jan-Water.1980					
4067	Feb-Water.1980					
4068	Mar-Water.1980					
4069	Apr-Water.1980	4	8	3	4.5	
4070	May-Water.1980	8	12	4.5	6	
4071	Jun-Water.1980	16	20	10.5	13.5	
4072	Jul-Water.1980	12	16	9	10.5	
4073	Aug-Water.1980					
4074	Sep-Water.1980					
4075	Oct-Water.1980					
4076	Nov-Water.1980					
4077	Dec-Water.1980					
4078						
4079	Yield.1982	28	31.5	29	34	10.5
4080	Jan-Water.1982					
4081	Feb-Water.1982					
4082	Mar-Water.1982					
4083	Apr-Water.1982	4	8	3	4.5	
4084	May-Water.1982	8	12	4.5	6	
4085	Jun-Water.1982	12	16	9	12	
4086	Jul-Water.1982	12	16	9	10.5	

4087	Aug-Water.1982					
4088	Sep-Water.1982					
4089	Oct-Water.1982					
4090	Nov-Water.1982					
4091	Dec-Water.1982					
4092						
4093	Yield.1969	26	30	27.5	32.5	10
4094	Jan-Water.1969					
4095	Feb-Water.1969					
4096	Mar-Water.1969					
4097	Apr-Water.1969	4	8	3	4.5	
4098	May-Water.1969	8	12	4.5	6	
4099	Jun-Water.1969	16	20	10.5	13.5	
4100	Jul-Water.1969	12	16	9	10.5	
4101	Aug-Water.1969					
4102	Sep-Water.1969					
4103	Oct-Water.1969					
4104	Nov-Water.1969					
4105	Dec-Water.1969					
4106						
4107	Yield.1974	21.5	25	23	27.5	8
4108	Jan-Water.1974					
4109	Feb-Water.1974					
4110	Mar-Water.1974					
4111	Apr-Water.1974	8	12	4.5	6	
4112	May-Water.1974	8	12	4.5	6	
4113	Jun-Water.1974	16	20	10.5	13.5	
4114	Jul-Water.1974	12	16	9	10.5	
4115	Aug-Water.1974					
4116	Sep-Water.1974					
4117	Oct-Water.1974					
4118	Nov-Water.1974					
4119	Dec-Water.1974					
4120						
4121	Yield.1972	22	26	23	28	9.5
4122	Jan-Water.1972					
4123	Feb-Water.1972					
4124	Mar-Water.1972					
4125	Apr-Water.1972	4	8	3	4.5	
4126	May-Water.1972	8	12	4.5	6	
4127	Jun-Water.1972	16	20	10.5	13.5	
4128	Jul-Water.1972	12	16	9	10.5	
4129	Aug-Water.1972					
4130	Sep-Water.1972					
4131	Oct-Water.1972					
4132	Nov-Water.1972					
4133	Dec-Water.1972					
4134						
4135	Yield.1976	33	35.5	32.5	39	14
4136	Jan-Water.1976					
4137	Feb-Water.1976					
4138	Mar-Water.1976					
4139	Apr-Water.1976	4	8	3	4.5	
4140	May-Water.1976	8	12	4.5	6	
4141	Jun-Water.1976	8	12	6	9	
4142	Jul-Water.1976	12	16	9	10.5	
4143	Aug-Water.1976					
4144	Sep-Water.1976					
4145	Oct-Water.1976					
4146	Nov-Water.1976					
4147	Dec-Water.1976					
4148						
4149	Yield.1977	24	28	26	29.5	9.5
4150	Jan-Water.1977					
4151	Feb-Water.1977					
4152	Mar-Water.1977					
4153	Apr-Water.1977	4	8	3	4.5	
4154	May-Water.1977	8	12	4.5	6	
4155	Jun-Water.1977	16	20	10.5	13.5	
4156	Jul-Water.1977	12	16	9	10.5	
4157	Aug-Water.1977					
4158	Sep-Water.1977					
4159	Oct-Water.1977					
4160	Nov-Water.1977					
4161	Dec-Water.1977					
4162						
4163	Yield.1979	31	34	31.5	37	13
4164	Jan-Water.1979					
4165	Feb-Water.1979					
4166	Mar-Water.1979					
4167	Apr-Water.1979	4	8	3	4.5	
4168	May-Water.1979	8	12	4.5	6	
4169	Jun-Water.1979	8	12	6	9	
4170	Jul-Water.1979	12	16	9	10.5	
4171	Aug-Water.1979					
4172	Sep-Water.1979					
4173	Oct-Water.1979					
4174	Nov-Water.1979					
4175	Dec-Water.1979					
4176						
4177	Yield.1981	30	33.5	30	35.5	11.5

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Jan-Water.1981
Feb-Water.1981
Mar-Water.1981
Apr-Water.1981     4        8        3        4.5
May-Water.1981     8        12       4.5      6
Jun-Water.1981     12       16       9        12
Jul-Water.1981     12       16       9        10.5
Aug-Water.1981
Sep-Water.1981
Oct-Water.1981
Nov-Water.1981
Dec-Water.1981

Yield.1958         29       33       30       35       11
Jan-Water.1958
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958     4        8        3        4.5
May-Water.1958     8        12       4.5      6
Jun-Water.1958     12       16       9        12
Jul-Water.1958     12       16       9        10.5
Aug-Water.1958
Sep-Water.1958
Oct-Water.1958
Nov-Water.1958
Dec-Water.1958

Yield.1987         34.5     37       34       41       16
Jan-Water.1987
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987     4        8        3        4.5
May-Water.1987     4        8        3        4.5
Jun-Water.1987     12       16       9        10.5
Jul-Water.1987     4        8        3        4.5
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987
Nov-Water.1987
Dec-Water.1987
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table Onion(agitem,rechargall,allstrat)
                   Oni50-F  Oni75-F  Oni50-S  Oni75-S
Yield.1956         450      459      455      466
Jan-Water.1956     4        8        3        6
Feb-Water.1956     4        8        3        6
Mar-Water.1956     4        8        3        6
Apr-Water.1956     4        8        3        6
May-Water.1956
Jun-Water.1956
Jul-Water.1956
Aug-Water.1956
Sep-Water.1956
Oct-Water.1956     4        8        3        6
Nov-Water.1956
Dec-Water.1956     4        8        3        6

Yield.1951         451      460      456      467
Jan-Water.1951     4        8        3        6
Feb-Water.1951     4        8        3        6
Mar-Water.1951     4        8        3        6
Apr-Water.1951     4        8        3        6
May-Water.1951
Jun-Water.1951
Jul-Water.1951
Aug-Water.1951
Sep-Water.1951
Oct-Water.1951     4        8        3        6
Nov-Water.1951
Dec-Water.1951     4        8        3        6

Yield.1963         454      463      459      470
Jan-Water.1963     4        8        3        6
Feb-Water.1963     4        8        3        6
Mar-Water.1963     4        4        1.5      3
Apr-Water.1963     4        4        1.5      3
May-Water.1963
Jun-Water.1963
Jul-Water.1963
Aug-Water.1963
Sep-Water.1963
Oct-Water.1963     4        8        3        6
Nov-Water.1963
Dec-Water.1963     4        8        3        6

Yield.1989         458      465      462      472
Jan-Water.1989     4        8        3        6
Feb-Water.1989     4        8        3        6
Mar-Water.1989     4        4        1.5      3
Apr-Water.1989     4        4        1.5      3
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4269	May-Water.1989				
4270	Jun-Water.1989				
4271	Jul-Water.1989				
4272	Aug-Water.1989				
4273	Sep-Water.1989				
4274	Oct-Water.1989	4	8	3	6
4275	Nov-Water.1989				
4276	Dec-Water.1989	4	8	3	6
4277					
4278	Yield.1952	459	466	463	474
4279	Jan-Water.1952	4	8	3	6
4280	Feb-Water.1952	4	8	3	6
4281	Mar-Water.1952	4	4	1.5	3
4282	Apr-Water.1952	4	4	1.5	3
4283	May-Water.1952				
4284	Jun-Water.1952				
4285	Jul-Water.1952				
4286	Aug-Water.1952				
4287	Sep-Water.1952				
4288	Oct-Water.1952	4	8	3	6
4289	Nov-Water.1952				
4290	Dec-Water.1952	4	8	3	6
4291					
4292	Yield.1988	454	463	459	470
4293	Jan-Water.1988	4	8	3	6
4294	Feb-Water.1988	4	8	3	6
4295	Mar-Water.1988	4	4	1.5	3
4296	Apr-Water.1988	4	4	1.5	3
4297	May-Water.1988				
4298	Jun-Water.1988				
4299	Jul-Water.1988				
4300	Aug-Water.1988				
4301	Sep-Water.1988				
4302	Oct-Water.1988	4	8	3	6
4303	Nov-Water.1988				
4304	Dec-Water.1988	4	8	3	6
4305					
4306	Yield.1980	451	460	456	467
4307	Jan-Water.1980	4	8	3	6
4308	Feb-Water.1980	4	8	3	6
4309	Mar-Water.1980	4	8	3	6
4310	Apr-Water.1980	4	8	3	6
4311	May-Water.1980				
4312	Jun-Water.1980				
4313	Jul-Water.1980				
4314	Aug-Water.1980				
4315	Sep-Water.1980				
4316	Oct-Water.1980	4	8	3	6
4317	Nov-Water.1980				
4318	Dec-Water.1980	4	8	3	6
4319					
4320	Yield.1982	459	464	462	470
4321	Jan-Water.1982	4	8	3	6
4322	Feb-Water.1982	4	8	3	6
4323	Mar-Water.1982	4	4	1.5	3
4324	Apr-Water.1982	4	4	1.5	3
4325	May-Water.1982				
4326	Jun-Water.1982				
4327	Jul-Water.1982				
4328	Aug-Water.1982				
4329	Sep-Water.1982				
4330	Oct-Water.1982	4	8	3	6
4331	Nov-Water.1982				
4332	Dec-Water.1982	4	8	3	6
4333					
4334	Yield.1969	456	464	460	471
4335	Jan-Water.1969	4	8	3	6
4336	Feb-Water.1969	4	8	3	6
4337	Mar-Water.1969	4	4	1.5	3
4338	Apr-Water.1969	4	4	1.5	3
4339	May-Water.1969				
4340	Jun-Water.1969				
4341	Jul-Water.1969				
4342	Aug-Water.1969				
4343	Sep-Water.1969				
4344	Oct-Water.1969	4	8	3	6
4345	Nov-Water.1969				
4346	Dec-Water.1969	4	8	3	6
4347					
4348	Yield.1974	457	464	460	470
4349	Jan-Water.1974	4	8	3	6
4350	Feb-Water.1974	4	8	3	6
4351	Mar-Water.1974	4	4	1.5	3
4352	Apr-Water.1974	4	4	1.5	3
4353	May-Water.1974				
4354	Jun-Water.1974				
4355	Jul-Water.1974				
4356	Aug-Water.1974				
4357	Sep-Water.1974				
4358	Oct-Water.1974	4	8	3	6
4359	Nov-Water.1974				

4360	Dec-Water.1974	4	8	3	6
4361					
4362	Yield.1972	450	459	455	466
4363	Jan-Water.1972	4	8	3	6
4364	Feb-Water.1972	4	8	3	6
4365	Mar-Water.1972	4	8	3	6
4366	Apr-Water.1972	4	8	3	6
4367	May-Water.1972				
4368	Jun-Water.1972				
4369	Jul-Water.1972				
4370	Aug-Water.1972				
4371	Sep-Water.1972				
4372	Oct-Water.1972	4	8	3	6
4373	Nov-Water.1972				
4374	Dec-Water.1972	4	8	3	6
4375					
4376	Yield.1976	463	469	467	475
4377	Jan-Water.1976	4	4	3	3
4378	Feb-Water.1976	4	8	3	6
4379	Mar-Water.1976	4	4	1.5	3
4380	Apr-Water.1976	4	0	1.5	0
4381	May-Water.1976				
4382	Jun-Water.1976				
4383	Jul-Water.1976				
4384	Aug-Water.1976				
4385	Sep-Water.1976				
4386	Oct-Water.1976	4	0	3	0
4387	Nov-Water.1976				
4388	Dec-Water.1976	4	4	1.5	3
4389					
4390	Yield.1977	458	463	461	469
4391	Jan-Water.1977	4	8	3	6
4392	Feb-Water.1977	4	8	3	6
4393	Mar-Water.1977	4	4	1.5	3
4394	Apr-Water.1977	4	4	1.5	3
4395	May-Water.1977				
4396	Jun-Water.1977				
4397	Jul-Water.1977				
4398	Aug-Water.1977				
4399	Sep-Water.1977				
4400	Oct-Water.1977	4	8	3	6
4401	Nov-Water.1977				
4402	Dec-Water.1977	4	8	3	6
4403					
4404	Yield.1979	468	474	472	480
4405	Jan-Water.1979	4	4	3	3
4406	Feb-Water.1979	4	8	3	6
4407	Mar-Water.1979	4	4	1.5	3
4408	Apr-Water.1979	4	0	1.5	0
4409	May-Water.1979				
4410	Jun-Water.1979				
4411	Jul-Water.1979				
4412	Aug-Water.1979				
4413	Sep-Water.1979				
4414	Oct-Water.1979	4	0	3	0
4415	Nov-Water.1979				
4416	Dec-Water.1979	4	4	1.5	3
4417					
4418	Yield.1981	469	475	473	481
4419	Jan-Water.1981	4	4	3	3
4420	Feb-Water.1981	4	8	3	6
4421	Mar-Water.1981	4	4	1.5	3
4422	Apr-Water.1981	4	0	1.5	0
4423	May-Water.1981				
4424	Jun-Water.1981				
4425	Jul-Water.1981				
4426	Aug-Water.1981				
4427	Sep-Water.1981				
4428	Oct-Water.1981	4	0	3	0
4429	Nov-Water.1981				
4430	Dec-Water.1981	4	4	1.5	3
4431					
4432	Yield.1958	465	471	469	477
4433	Jan-Water.1958	4	4	3	3
4434	Feb-Water.1958	4	8	3	6
4435	Mar-Water.1958	4	4	1.5	3
4436	Apr-Water.1958	4	0	1.5	0
4437	May-Water.1958				
4438	Jun-Water.1958				
4439	Jul-Water.1958				
4440	Aug-Water.1958				
4441	Sep-Water.1958				
4442	Oct-Water.1958	4	0	3	0
4443	Nov-Water.1958				
4444	Dec-Water.1958	4	4	1.5	3
4445					
4446	Yield.1987	463	469	467	475
4447	Jan-Water.1987	4	4	3	3
4448	Feb-Water.1987	4	8	3	6
4449	Mar-Water.1987	4	4	1.5	3
4450	Apr-Water.1987	4	0	1.5	0

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May-Water.1987
Jun-Water.1987
Jul-Water.1987
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987          4         3         3         0
Nov-Water.1987
Dec-Water.1987          4         4         1.5       3
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table Cabbage(agitem,rechargall,allstrat)
                        Cabb50-F  Cabb75-F  Cabb50-S  Cabb75-S
Yield.1956              580       590       592       603
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956
May-Water.1956
Jun-Water.1956
Jul-Water.1956          8         12        4.5       6
Aug-Water.1956          8         8         4.5       4.5
Sep-Water.1956          8         8         4.5       4.5
Oct-Water.1956
Nov-Water.1956
Dec-Water.1956

Yield.1951              570       581       577       589
Jan-Water.1951
Feb-Water.1951
Mar-Water.1951
Apr-Water.1951
May-Water.1951
Jun-Water.1951
Jul-Water.1951          8         12        4.5       6
Aug-Water.1951          8         8         4.5       4.5
Sep-Water.1951          8         8         4.5       4.5
Oct-Water.1951
Nov-Water.1951
Dec-Water.1951

Yield.1963              571       579       576       590
Jan-Water.1963
Feb-Water.1963
Mar-Water.1963
Apr-Water.1963
May-Water.1963
Jun-Water.1963
Jul-Water.1963          8         12        4.5       6
Aug-Water.1963          8         8         4.5       4.5
Sep-Water.1963          8         8         4.5       4.5
Oct-Water.1963
Nov-Water.1963
Dec-Water.1963

Yield.1989              573       581       578       592
Jan-Water.1989
Feb-Water.1989
Mar-Water.1989
Apr-Water.1989
May-Water.1989
Jun-Water.1989
Jul-Water.1989          8         12        4.5       6
Aug-Water.1989          8         8         4.5       4.5
Sep-Water.1989          8         8         4.5       4.5
Oct-Water.1989
Nov-Water.1989
Dec-Water.1989

Yield.1952              572       580       577       591
Jan-Water.1952
Feb-Water.1952
Mar-Water.1952
Apr-Water.1952
May-Water.1952
Jun-Water.1952
Jul-Water.1952          8         12        4.5       6
Aug-Water.1952          8         8         4.5       4.5
Sep-Water.1952          8         8         4.5       4.5
Oct-Water.1952
Nov-Water.1952
Dec-Water.1952

Yield.1988              576       581       583       592
Jan-Water.1988
Feb-Water.1988
Mar-Water.1988
Apr-Water.1988
May-Water.1988
Jun-Water.1988
Jul-Water.1988          8         12        4.5       6
Aug-Water.1988          8         8         4.5       4.5
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4542	Sep-Water.1988	8	8	4.5	4.5
4543	Oct-Water.1988				
4544	Nov-Water.1988				
4545	Dec-Water.1988				
4546					
4547	Yield.1980	610	620	619	627
4548	Jan-Water.1980				
4549	Feb-Water.1980				
4550	Mar-Water.1980				
4551	Apr-Water.1980				
4552	May-Water.1980				
4553	Jun-Water.1980				
4554	Jul-Water.1980	8	12	4.5	6
4555	Aug-Water.1980	4	4	3	3
4556	Sep-Water.1980	4	8	3	4.5
4557	Oct-Water.1980				
4558	Nov-Water.1980				
4559	Dec-Water.1980				
4560					
4561	Yield.1982	600	610	615	622
4562	Jan-Water.1982				
4563	Feb-Water.1982				
4564	Mar-Water.1982				
4565	Apr-Water.1982				
4566	May-Water.1982				
4567	Jun-Water.1982				
4568	Jul-Water.1982	4	8	3	4.5
4569	Aug-Water.1982	8	8	4.5	4.5
4570	Sep-Water.1982	8	8	4.5	4.5
4571	Oct-Water.1982				
4572	Nov-Water.1982				
4573	Dec-Water.1982				
4574					
4575	Yield.1969	620	627	630	639
4576	Jan-Water.1969				
4577	Feb-Water.1969				
4578	Mar-Water.1969				
4579	Apr-Water.1969				
4580	May-Water.1969				
4581	Jun-Water.1969				
4582	Jul-Water.1969	4	8	3	4.5
4583	Aug-Water.1969	4	8	3	4.5
4584	Sep-Water.1969	4	4	3	3
4585	Oct-Water.1969				
4586	Nov-Water.1969				
4587	Dec-Water.1969				
4588					
4589	Yield.1974	640	648	651	660
4590	Jan-Water.1974				
4591	Feb-Water.1974				
4592	Mar-Water.1974				
4593	Apr-Water.1974				
4594	May-Water.1974				
4595	Jun-Water.1974				
4596	Jul-Water.1974	4	8	3	4.5
4597	Aug-Water.1974	0	0	0	0
4598	Sep-Water.1974	0	4	0	1.5
4599	Oct-Water.1974				
4600	Nov-Water.1974				
4601	Dec-Water.1974				
4602					
4603	Yield.1972	610	620	622	630
4604	Jan-Water.1972				
4605	Feb-Water.1972				
4606	Mar-Water.1972				
4607	Apr-Water.1972				
4608	May-Water.1972				
4609	Jun-Water.1972				
4610	Jul-Water.1972	4	8	3	4.5
4611	Aug-Water.1972	4	8	3	4.5
4612	Sep-Water.1972	4	4	3	3
4613	Oct-Water.1972				
4614	Nov-Water.1972				
4615	Dec-Water.1972				
4616					
4617	Yield.1976	642	650	655	667
4618	Jan-Water.1976				
4619	Feb-Water.1976				
4620	Mar-Water.1976				
4621	Apr-Water.1976				
4622	May-Water.1976				
4623	Jun-Water.1976				
4624	Jul-Water.1976	0	4	0	1.5
4625	Aug-Water.1976	4	4	1.5	3
4626	Sep-Water.1976	0	4	1.5	3
4627	Oct-Water.1976				
4628	Nov-Water.1976				
4629	Dec-Water.1976				
4630					
4631	Yield.1977	570	577	574	585
4632	Jan-Water.1977				

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Feb-Water.1977
Mar-Water.1977
Apr-Water.1977
May-Water.1977
Jun-Water.1977
Jul-Water.1977          8          12         4.5        6
Aug-Water.1977          8          8          4.5        4.5
Sep-Water.1977          8          8          4.5        4.5
Oct-Water.1977
Nov-Water.1977
Dec-Water.1977

Yield.1979              610        620        625        633
Jan-Water.1979
Feb-Water.1979
Mar-Water.1979
Apr-Water.1979
May-Water.1979
Jun-Water.1979
Jul-Water.1979          0          4          1.5        3
Aug-Water.1979          4          8          3          4.5
Sep-Water.1979          4          8          3          4.5
Oct-Water.1979
Nov-Water.1979
Dec-Water.1979

Yield.1981              590        597        594        605
Jan-Water.1981
Feb-Water.1981
Mar-Water.1981
Apr-Water.1981
May-Water.1981
Jun-Water.1981
Jul-Water.1981          8          8          3          4.5
Aug-Water.1981          4          8          3          4.5
Sep-Water.1981          4          8          3          4.5
Oct-Water.1981
Nov-Water.1981
Dec-Water.1981

Yield.1958              640        647        652        660
Jan-Water.1958
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958
May-Water.1958
Jun-Water.1958
Jul-Water.1958          0          4          1.5        3
Aug-Water.1958          4          4          1.5        3
Sep-Water.1958          0          4          1.5        3
Oct-Water.1958
Nov-Water.1958
Dec-Water.1958

Yield.1987              649        655        661        672
Jan-Water.1987
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987
May-Water.1987
Jun-Water.1987
Jul-Water.1987          0          4          1.5        1.5
Aug-Water.1987          4          4          1.5        3
Sep-Water.1987          4          4          1.5        3
Oct-Water.1987
Nov-Water.1987
Dec-Water.1987
;

table Carrot(agitem,rechargall,allstrat)
                     Carr50-F   Carr75-F   Carr50-S   Carr75-S
Yield.1956              311        322        319        330
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956
May-Water.1956
Jun-Water.1956
Jul-Water.1956          8          12         6          9
Aug-Water.1956          4          8          3          6
Sep-Water.1956          4          8          3          6
Oct-Water.1956          4          8          3          6
Nov-Water.1956          8          8          4.5        6
Dec-Water.1956

Yield.1951              307        314        312        322
Jan-Water.1951
Feb-Water.1951
Mar-Water.1951
Apr-Water.1951
May-Water.1951
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4724	Jun-Water.1951				
4725	Jul-Water.1951	8	12	6	9
4726	Aug-Water.1951	4	8	3	6
4727	Sep-Water.1951	4	8	3	6
4728	Oct-Water.1951	4	8	3	6
4729	Nov-Water.1951	8	8	4.5	6
4730	Dec-Water.1951				
4731					
4732	Yield.1963	305	315	311	321
4733	Jan-Water.1963				
4734	Feb-Water.1963				
4735	Mar-Water.1963				
4736	Apr-Water.1963				
4737	May-Water.1963				
4738	Jun-Water.1963				
4739	Jul-Water.1963	8	12	6	9
4740	Aug-Water.1963	4	8	3	6
4741	Sep-Water.1963	4	8	3	6
4742	Oct-Water.1963	4	8	3	6
4743	Nov-Water.1963	8	8	4.5	6
4744	Dec-Water.1963				
4745					
4746	Yield.1989	312	323	320	331
4747	Jan-Water.1989				
4748	Feb-Water.1989				
4749	Mar-Water.1989				
4750	Apr-Water.1989				
4751	May-Water.1989				
4752	Jun-Water.1989				
4753	Jul-Water.1989	8	12	6	9
4754	Aug-Water.1989	4	8	3	6
4755	Sep-Water.1989	4	8	3	6
4756	Oct-Water.1989	4	8	3	6
4757	Nov-Water.1989	8	8	4.5	6
4758	Dec-Water.1989				
4759					
4760	Yield.1952	306	314	312	321
4761	Jan-Water.1952				
4762	Feb-Water.1952				
4763	Mar-Water.1952				
4764	Apr-Water.1952				
4765	May-Water.1952				
4766	Jun-Water.1952				
4767	Jul-Water.1952	8	12	6	9
4768	Aug-Water.1952	4	8	3	6
4769	Sep-Water.1952	4	8	3	6
4770	Oct-Water.1952	4	8	3	6
4771	Nov-Water.1952	8	8	4.5	6
4772	Dec-Water.1952				
4773					
4774	Yield.1988	307	315	313	322
4775	Jan-Water.1988				
4776	Feb-Water.1988				
4777	Mar-Water.1988				
4778	Apr-Water.1988				
4779	May-Water.1988				
4780	Jun-Water.1988				
4781	Jul-Water.1988	8	12	6	9
4782	Aug-Water.1988	4	8	3	6
4783	Sep-Water.1988	4	8	3	6
4784	Oct-Water.1988	4	8	3	6
4785	Nov-Water.1988	8	8	4.5	6
4786	Dec-Water.1988				
4787					
4788	Yield.1980	321	335	330	342
4789	Jan-Water.1980				
4790	Feb-Water.1980				
4791	Mar-Water.1980				
4792	Apr-Water.1980				
4793	May-Water.1980				
4794	Jun-Water.1980				
4795	Jul-Water.1980	4	8	3	6
4796	Aug-Water.1980	4	8	3	6
4797	Sep-Water.1980	4	8	3	6
4798	Oct-Water.1980	4	8	3	6
4799	Nov-Water.1980	4	8	3	6
4800	Dec-Water.1980				
4801					
4802	Yield.1982	317	327	324	337
4803	Jan-Water.1982				
4804	Feb-Water.1982				
4805	Mar-Water.1982				
4806	Apr-Water.1982				
4807	May-Water.1982				
4808	Jun-Water.1982				
4809	Jul-Water.1982	4	8	4.5	6
4810	Aug-Water.1982	4	8	3	6
4811	Sep-Water.1982	4	8	3	6
4812	Oct-Water.1982	4	8	3	6
4813	Nov-Water.1982	8	8	4.5	6
4814	Dec-Water.1982				

4815					
4816	Yield.1969	386	396	392	403
4817	Jan-Water.1969				
4818	Feb-Water.1969				
4819	Mar-Water.1969				
4820	Apr-Water.1969				
4821	May-Water.1969				
4822	Jun-Water.1969				
4823	Jul-Water.1969	4	8	3	6
4824	Aug-Water.1969	0	0	0	0
4825	Sep-Water.1969	0	0	0	0
4826	Oct-Water.1969	4	4	1.5	3
4827	Nov-Water.1969	4	4	1.5	3
4828	Dec-Water.1969				
4829					
4830	Yield.1974	387	397	393	404
4831	Jan-Water.1974				
4832	Feb-Water.1974				
4833	Mar-Water.1974				
4834	Apr-Water.1974				
4835	May-Water.1974				
4836	Jun-Water.1974				
4837	Jul-Water.1974	4	8	3	6
4838	Aug-Water.1974	0	0	0	0
4839	Sep-Water.1974	0	0	0	0
4840	Oct-Water.1974	4	4	1.5	3
4841	Nov-Water.1974	4	4	1.5	3
4842	Dec-Water.1974				
4843					
4844	Yield.1972	316	327	324	337
4845	Jan-Water.1972				
4846	Feb-Water.1972				
4847	Mar-Water.1972				
4848	Apr-Water.1972				
4849	May-Water.1972				
4850	Jun-Water.1972				
4851	Jul-Water.1972	4	8	4.5	6
4852	Aug-Water.1972	4	8	3	6
4853	Sep-Water.1972	4	8	3	6
4854	Oct-Water.1972	4	8	3	6
4855	Nov-Water.1972	8	8	4.5	6
4856	Dec-Water.1972				
4857					
4858	Yield.1976	390	401	398	410
4859	Jan-Water.1976				
4860	Feb-Water.1976				
4861	Mar-Water.1976				
4862	Apr-Water.1976				
4863	May-Water.1976				
4864	Jun-Water.1976				
4865	Jul-Water.1976	0	0	0	0
4866	Aug-Water.1976	4	4	1.5	3
4867	Sep-Water.1976	0	0	0	0
4868	Oct-Water.1976	0	0	0	0
4869	Nov-Water.1976	4	4	1.5	3
4870	Dec-Water.1976				
4871					
4872	Yield.1977	315	326	323	336
4873	Jan-Water.1977				
4874	Feb-Water.1977				
4875	Mar-Water.1977				
4876	Apr-Water.1977				
4877	May-Water.1977				
4878	Jun-Water.1977				
4879	Jul-Water.1977	4	8	4.5	6
4880	Aug-Water.1977	4	8	3	6
4881	Sep-Water.1977	4	8	3	6
4882	Oct-Water.1977	4	8	3	6
4883	Nov-Water.1977	8	8	4.5	6
4884	Dec-Water.1977				
4885					
4886	Yield.1979	306	314	312	321
4887	Jan-Water.1979				
4888	Feb-Water.1979				
4889	Mar-Water.1979				
4890	Apr-Water.1979				
4891	May-Water.1979				
4892	Jun-Water.1979				
4893	Jul-Water.1979	8	12	6	9
4894	Aug-Water.1979	4	8	3	6
4895	Sep-Water.1979	4	8	3	6
4896	Oct-Water.1979	4	8	3	6
4897	Nov-Water.1979	8	8	4.5	6
4898	Dec-Water.1979				
4899					
4900	Yield.1981	315	326	323	336
4901	Jan-Water.1981				
4902	Feb-Water.1981				
4903	Mar-Water.1981				
4904	Apr-Water.1981				
4905	May-Water.1981				

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Jun-Water.1981
Jul-Water.1981          4          8          4.5        6
Aug-Water.1981          4          8          3          6
Sep-Water.1981          4          8          3          6
Oct-Water.1981          4          8          3          6
Nov-Water.1981          8          8          4.5        6
Dec-Water.1981

Yield.1958              322        336        330        343
Jan-Water.1958
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958
May-Water.1958
Jun-Water.1958
Jul-Water.1958          4          8          3          6
Aug-Water.1958          4          8          3          6
Sep-Water.1958          4          8          3          6
Oct-Water.1958          4          8          3          6
Nov-Water.1958          4          8          3          6
Dec-Water.1958

Yield.1987              313        324        320        331
Jan-Water.1987
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987
May-Water.1987
Jun-Water.1987
Jul-Water.1987          8          12         6          9
Aug-Water.1987          4          8          3          6
Sep-Water.1987          4          8          3          6
Oct-Water.1987          4          8          3          6
Nov-Water.1987          8          8          4.5        6
Dec-Water.1987
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table Cantalop(agitem,rechargall,allstrat)
                        Cant50-F   Cant75-F   Cant50-S   Cant75-S
Yield.1956              250        260        253        262
Jan-Water.1956
Feb-Water.1956          4          8          3          4.5
Mar-Water.1956          8          12         4.5        9
Apr-Water.1956          8          12         4.5        9
May-Water.1956          8          12         4.5        9
Jun-Water.1956
Jul-Water.1956
Aug-Water.1956
Sep-Water.1956
Oct-Water.1956
Nov-Water.1956
Dec-Water.1956

Yield.1951              260        268        263        270
Jan-Water.1951
Feb-Water.1951          4          8          3          4.5
Mar-Water.1951          4          8          3          4.5
Apr-Water.1951          8          12         4.5        9
May-Water.1951          8          12         4.5        9
Jun-Water.1951
Jul-Water.1951
Aug-Water.1951
Sep-Water.1951
Oct-Water.1951
Nov-Water.1951
Dec-Water.1951

Yield.1963              267        275        270        277
Jan-Water.1963
Feb-Water.1963          4          8          3          4.5
Mar-Water.1963          4          8          3          4.5
Apr-Water.1963          8          12         4.5        9
May-Water.1963          4          8          3          4.5
Jun-Water.1963
Jul-Water.1963
Aug-Water.1963
Sep-Water.1963
Oct-Water.1963
Nov-Water.1963
Dec-Water.1963

Yield.1989              254        262        257        264
Jan-Water.1989
Feb-Water.1989          4          8          3          4.5
Mar-Water.1989          8          12         4.5        9
Apr-Water.1989          8          12         4.5        9
May-Water.1989          8          12         4.5        9
Jun-Water.1989
Jul-Water.1989
Aug-Water.1989
Sep-Water.1989
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Oct-Water.1989				
Nov-Water.1989				
Dec-Water.1989				
Yield.1952	257	265	260	267
Jan-Water.1952				
Feb-Water.1952	4	8	3	4.5
Mar-Water.1952	4	8	3	4.5
Apr-Water.1952	8	12	4.5	9
May-Water.1952	8	12	4.5	9
Jun-Water.1952				
Jul-Water.1952				
Aug-Water.1952				
Sep-Water.1952				
Oct-Water.1952				
Nov-Water.1952				
Dec-Water.1952				
Yield.1988	256	264	259	266
Jan-Water.1988				
Feb-Water.1988	4	8	3	4.5
Mar-Water.1988	4	8	3	4.5
Apr-Water.1988	8	12	4.5	9
May-Water.1988	8	12	4.5	9
Jun-Water.1988				
Jul-Water.1988				
Aug-Water.1988				
Sep-Water.1988				
Oct-Water.1988				
Nov-Water.1988				
Dec-Water.1988				
Yield.1980	265	273	268	275
Jan-Water.1980				
Feb-Water.1980	4	8	3	4.5
Mar-Water.1980	4	8	3	4.5
Apr-Water.1980	8	12	4.5	9
May-Water.1980	8	12	4.5	9
Jun-Water.1980				
Jul-Water.1980				
Aug-Water.1980				
Sep-Water.1980				
Oct-Water.1980				
Nov-Water.1980				
Dec-Water.1980				
Yield.1982	269	277	272	280
Jan-Water.1982				
Feb-Water.1982	4	8	3	4.5
Mar-Water.1982	4	8	3	4.5
Apr-Water.1982	8	12	4.5	9
May-Water.1982	4	8	3	4.5
Jun-Water.1982				
Jul-Water.1982				
Aug-Water.1982				
Sep-Water.1982				
Oct-Water.1982				
Nov-Water.1982				
Dec-Water.1982				
Yield.1969	261	269	264	271
Jan-Water.1969				
Feb-Water.1969	4	8	3	4.5
Mar-Water.1969	4	8	3	4.5
Apr-Water.1969	8	12	4.5	9
May-Water.1969	8	12	4.5	9
Jun-Water.1969				
Jul-Water.1969				
Aug-Water.1969				
Sep-Water.1969				
Oct-Water.1969				
Nov-Water.1969				
Dec-Water.1969				
Yield.1974	255	263	258	265
Jan-Water.1974				
Feb-Water.1974	4	8	3	4.5
Mar-Water.1974	4	8	3	4.5
Apr-Water.1974	8	12	4.5	9
May-Water.1974	8	12	4.5	9
Jun-Water.1974				
Jul-Water.1974				
Aug-Water.1974				
Sep-Water.1974				
Oct-Water.1974				
Nov-Water.1974				
Dec-Water.1974				
Yield.1972	253	261	256	263
Jan-Water.1972				
Feb-Water.1972	4	8	3	4.5

5088	Mar-Water.1972	8	12	4.5	9
5089	Apr-Water.1972	8	12	4.5	9
5090	May-Water.1972	8	12	4.5	9
5091	Jun-Water.1972				
5092	Jul-Water.1972				
5093	Aug-Water.1972				
5094	Sep-Water.1972				
5095	Oct-Water.1972				
5096	Nov-Water.1972				
5097	Dec-Water.1972				
5098					
5099	Yield.1976	277	284	279	287
5100	Jan-Water.1976				
5101	Feb-Water.1976	4	8	3	4.5
5102	Mar-Water.1976	4	8	3	4.5
5103	Apr-Water.1976	8	12	4.5	9
5104	May-Water.1976	4	8	3	4.5
5105	Jun-Water.1976				
5106	Jul-Water.1976				
5107	Aug-Water.1976				
5108	Sep-Water.1976				
5109	Oct-Water.1976				
5110	Nov-Water.1976				
5111	Dec-Water.1976				
5112					
5113	Yield.1977	258	266	261	268
5114	Jan-Water.1977				
5115	Feb-Water.1977	4	8	3	4.5
5116	Mar-Water.1977	4	8	3	4.5
5117	Apr-Water.1977	8	12	4.5	9
5118	May-Water.1977	8	12	4.5	9
5119	Jun-Water.1977				
5120	Jul-Water.1977				
5121	Aug-Water.1977				
5122	Sep-Water.1977				
5123	Oct-Water.1977				
5124	Nov-Water.1977				
5125	Dec-Water.1977				
5126					
5127	Yield.1979	273	280	275	283
5128	Jan-Water.1979				
5129	Feb-Water.1979	4	8	3	4.5
5130	Mar-Water.1979	4	8	3	4.5
5131	Apr-Water.1979	8	12	4.5	9
5132	May-Water.1979	4	8	3	4.5
5133	Jun-Water.1979				
5134	Jul-Water.1979				
5135	Aug-Water.1979				
5136	Sep-Water.1979				
5137	Oct-Water.1979				
5138	Nov-Water.1979				
5139	Dec-Water.1979				
5140					
5141	Yield.1981	282	289	284	292
5142	Jan-Water.1981				
5143	Feb-Water.1981	4	8	3	4.5
5144	Mar-Water.1981	4	8	3	4.5
5145	Apr-Water.1981	8	12	4.5	9
5146	May-Water.1981	4	8	3	4.5
5147	Jun-Water.1981				
5148	Jul-Water.1981				
5149	Aug-Water.1981				
5150	Sep-Water.1981				
5151	Oct-Water.1981				
5152	Nov-Water.1981				
5153	Dec-Water.1981				
5154					
5155	Yield.1958	263	271	266	273
5156	Jan-Water.1958				
5157	Feb-Water.1958	4	8	3	4.5
5158	Mar-Water.1958	4	8	3	4.5
5159	Apr-Water.1958	8	12	4.5	9
5160	May-Water.1958	8	12	4.5	9
5161	Jun-Water.1958				
5162	Jul-Water.1958				
5163	Aug-Water.1958				
5164	Sep-Water.1958				
5165	Oct-Water.1958				
5166	Nov-Water.1958				
5167	Dec-Water.1958				
5168					
5169	Yield.1987	292	300	294	302
5170	Jan-Water.1987				
5171	Feb-Water.1987	4	8	3	4.5
5172	Mar-Water.1987	4	8	3	4.5
5173	Apr-Water.1987	4	8	3	4.5
5174	May-Water.1987	4	8	3	4.5
5175	Jun-Water.1987				
5176	Jul-Water.1987				
5177	Aug-Water.1987				
5178	Sep-Water.1987				

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Oct-Water.1987
Nov-Water.1987
Dec-Water.1987
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table Cucumber(agitem,rechargall,allstrat)
                     Cuc50-F       Cuc75-F       Cuc50-S       Cuc75-S
Yield.1956           221           232           224           238
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956
May-Water.1956
Jun-Water.1956
Jul-Water.1956       8             12            4.5           6
Aug-Water.1956       8             12            4.5           9
Sep-Water.1956       8             12            4.5           9
Oct-Water.1956       4             8             3             4.5
Nov-Water.1956
Dec-Water.1956

Yield.1951           222           232           225           237
Jan-Water.1951
Feb-Water.1951
Mar-Water.1951
Apr-Water.1951
May-Water.1951
Jun-Water.1951
Jul-Water.1951       8             12            4.5           6
Aug-Water.1951       8             12            4.5           9
Sep-Water.1951       8             12            4.5           9
Oct-Water.1951       4             8             3             4.5
Nov-Water.1951
Dec-Water.1951

Yield.1963           183           193           187           196
Jan-Water.1963
Feb-Water.1963
Mar-Water.1963
Apr-Water.1963
May-Water.1963
Jun-Water.1963
Jul-Water.1963       8             12            4.5           6
Aug-Water.1963       8             12            4.5           9
Sep-Water.1963       8             12            4.5           9
Oct-Water.1963       8             12            6             9
Nov-Water.1963
Dec-Water.1963

Yield.1989           187           195           189           198
Jan-Water.1989
Feb-Water.1989
Mar-Water.1989
Apr-Water.1989
May-Water.1989
Jun-Water.1989
Jul-Water.1989       8             12            4.5           6
Aug-Water.1989       8             12            4.5           9
Sep-Water.1989       8             12            4.5           9
Oct-Water.1989       8             12            6             9
Nov-Water.1989
Dec-Water.1989

Yield.1952           191           199           193           202
Jan-Water.1952
Feb-Water.1952
Mar-Water.1952
Apr-Water.1952
May-Water.1952
Jun-Water.1952
Jul-Water.1952       8             12            4.5           6
Aug-Water.1952       8             12            4.5           9
Sep-Water.1952       8             12            4.5           9
Oct-Water.1952       8             12            6             9
Nov-Water.1952
Dec-Water.1952

Yield.1988           184           193           186           195
Jan-Water.1988
Feb-Water.1988
Mar-Water.1988
Apr-Water.1988
May-Water.1988
Jun-Water.1988
Jul-Water.1988       8             12            4.5           6
Aug-Water.1988       8             12            4.5           9
Sep-Water.1988       8             12            4.5           9
Oct-Water.1988       8             12            6             9
Nov-Water.1988
Dec-Water.1988
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5270	Yield.1980	256	267	259	271
5271	Jan-Water.1980				
5272	Feb-Water.1980				
5273	Mar-Water.1980				
5274	Apr-Water.1980				
5275	May-Water.1980				
5276	Jun-Water.1980				
5277	Jul-Water.1980	8	12	4.5	6
5278	Aug-Water.1980	8	12	4.5	9
5279	Sep-Water.1980	4	8	3	4.5
5280	Oct-Water.1980	4	8	3	4.5
5281	Nov-Water.1980				
5282	Dec-Water.1980				
5283					
5284	Yield.1982	181	192	186	195
5285	Jan-Water.1982				
5286	Feb-Water.1982				
5287	Mar-Water.1982				
5288	Apr-Water.1982				
5289	May-Water.1982				
5290	Jun-Water.1982				
5291	Jul-Water.1982	8	12	4.5	6
5292	Aug-Water.1982	8	12	4.5	9
5293	Sep-Water.1982	8	12	4.5	9
5294	Oct-Water.1982	8	12	6	9
5295	Nov-Water.1982				
5296	Dec-Water.1982				
5297					
5298	Yield.1969	276	287	281	293
5299	Jan-Water.1969				
5300	Feb-Water.1969				
5301	Mar-Water.1969				
5302	Apr-Water.1969				
5303	May-Water.1969				
5304	Jun-Water.1969				
5305	Jul-Water.1969	4	8	3	4.5
5306	Aug-Water.1969	4	8	3	4.5
5307	Sep-Water.1969	4	8	3	4.5
5308	Oct-Water.1969	4	8	3	4.5
5309	Nov-Water.1969				
5310	Dec-Water.1969				
5311					
5312	Yield.1974	278	288	282	294
5313	Jan-Water.1974				
5314	Feb-Water.1974				
5315	Mar-Water.1974				
5316	Apr-Water.1974				
5317	May-Water.1974				
5318	Jun-Water.1974				
5319	Jul-Water.1974	4	8	3	4.5
5320	Aug-Water.1974	4	8	3	4.5
5321	Sep-Water.1974	4	8	3	4.5
5322	Oct-Water.1974	4	8	3	4.5
5323	Nov-Water.1974				
5324	Dec-Water.1974				
5325					
5326	Yield.1972	250	262	254	266
5327	Jan-Water.1972				
5328	Feb-Water.1972				
5329	Mar-Water.1972				
5330	Apr-Water.1972				
5331	May-Water.1972				
5332	Jun-Water.1972				
5333	Jul-Water.1972	8	12	4.5	6
5334	Aug-Water.1972	8	12	4.5	9
5335	Sep-Water.1972	4	8	3	4.5
5336	Oct-Water.1972	4	8	3	4.5
5337	Nov-Water.1972				
5338	Dec-Water.1972				
5339					
5340	Yield.1976	275	286	280	291
5341	Jan-Water.1976				
5342	Feb-Water.1976				
5343	Mar-Water.1976				
5344	Apr-Water.1976				
5345	May-Water.1976				
5346	Jun-Water.1976				
5347	Jul-Water.1976	4	8	3	4.5
5348	Aug-Water.1976	4	8	3	4.5
5349	Sep-Water.1976	4	8	3	4.5
5350	Oct-Water.1976	4	8	3	4.5
5351	Nov-Water.1976				
5352	Dec-Water.1976				
5353					
5354	Yield.1977	223	234	226	240
5355	Jan-Water.1977				
5356	Feb-Water.1977				
5357	Mar-Water.1977				
5358	Apr-Water.1977				
5359	May-Water.1977				
5360	Jun-Water.1977				

```
Jul-Water.1977          8           12          4.5         6
Aug-Water.1977          8           12          4.5         9
Sep-Water.1977          8           12          4.5         9
Oct-Water.1977          4           8           3           4.5
Nov-Water.1977
Dec-Water.1977

Yield.1979              180         191         185         194
Jan-Water.1979
Feb-Water.1979
Mar-Water.1979
Apr-Water.1979
May-Water.1979
Jun-Water.1979
Jul-Water.1979          8           12          4.5         6
Aug-Water.1979          8           12          4.5         9
Sep-Water.1979          8           12          4.5         9
Oct-Water.1979          8           12          6           9
Nov-Water.1979
Dec-Water.1979

Yield.1981              253         264         256         268
Jan-Water.1981
Feb-Water.1981
Mar-Water.1981
Apr-Water.1981
May-Water.1981
Jun-Water.1981
Jul-Water.1981          8           12          4.5         6
Aug-Water.1981          8           12          4.5         9
Sep-Water.1981          4           8           3           4.5
Oct-Water.1981          4           8           3           4.5
Nov-Water.1981
Dec-Water.1981

Yield.1958              270         281         274         286
Jan-Water.1958
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958
May-Water.1958
Jun-Water.1958
Jul-Water.1958          8           12          4.5         6
Aug-Water.1958          4           8           3           6
Sep-Water.1958          4           8           3           4.5
Oct-Water.1958          4           8           3           4.5
Nov-Water.1958
Dec-Water.1958

Yield.1987              220         231         224         236
Jan-Water.1987
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987
May-Water.1987
Jun-Water.1987
Jul-Water.1987          8           12          4.5         6
Aug-Water.1987          8           12          4.5         9
Sep-Water.1987          8           12          4.5         9
Oct-Water.1987          4           8           3           4.5
Nov-Water.1987
Dec-Water.1987
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table Lettuce(agitem,rechargall,allstrat)
                     Let50-F     Let75-F     Let50-S     Let75-S
Yield.1956              480         490         485         496
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956
May-Water.1956
Jun-Water.1956
Jul-Water.1956
Aug-Water.1956
Sep-Water.1956
Oct-Water.1956          8           12          4.5         9
Nov-Water.1956          8           12          4.5         9
Dec-Water.1956          8           12          4.5         9

Yield.1951              481         490         485         495
Jan-Water.1951
Feb-Water.1951
Mar-Water.1951
Apr-Water.1951
May-Water.1951
Jun-Water.1951
Jul-Water.1951
Aug-Water.1951
Sep-Water.1951
Oct-Water.1951          8           12          4.5         9
```

Nov-Water.1951	8	12	4.5	9
Dec-Water.1951	8	12	4.5	9
Yield.1963	475	482	480	483
Jan-Water.1963				
Feb-Water.1963				
Mar-Water.1963				
Apr-Water.1963				
May-Water.1963				
Jun-Water.1963				
Jul-Water.1963				
Aug-Water.1963				
Sep-Water.1963				
Oct-Water.1963	8	12	4.5	9
Nov-Water.1963	8	12	4.5	9
Dec-Water.1963	8	12	4.5	9
Yield.1989	475	480	479	485
Jan-Water.1989				
Feb-Water.1989				
Mar-Water.1989				
Apr-Water.1989				
May-Water.1989				
Jun-Water.1989				
Jul-Water.1989				
Aug-Water.1989				
Sep-Water.1989				
Oct-Water.1989	8	12	4.5	9
Nov-Water.1989	8	12	4.5	9
Dec-Water.1989	8	12	4.5	9
Yield.1952	474	481	479	482
Jan-Water.1952				
Feb-Water.1952				
Mar-Water.1952				
Apr-Water.1952				
May-Water.1952				
Jun-Water.1952				
Jul-Water.1952				
Aug-Water.1952				
Sep-Water.1952				
Oct-Water.1952	8	12	4.5	9
Nov-Water.1952	8	12	4.5	9
Dec-Water.1952	8	12	4.5	9
Yield.1988	470	476	474	480
Jan-Water.1988				
Feb-Water.1988				
Mar-Water.1988				
Apr-Water.1988				
May-Water.1988				
Jun-Water.1988				
Jul-Water.1988				
Aug-Water.1988				
Sep-Water.1988				
Oct-Water.1988	8	12	4.5	9
Nov-Water.1988	8	12	4.5	9
Dec-Water.1988	8	12	4.5	9
Yield.1980	492	498	493	505
Jan-Water.1980				
Feb-Water.1980				
Mar-Water.1980				
Apr-Water.1980				
May-Water.1980				
Jun-Water.1980				
Jul-Water.1980				
Aug-Water.1980				
Sep-Water.1980				
Oct-Water.1980	4	8	3	6
Nov-Water.1980	8	12	4.5	9
Dec-Water.1980	8	12	4.5	9
Yield.1982	492	498	494	504
Jan-Water.1982				
Feb-Water.1982				
Mar-Water.1982				
Apr-Water.1982				
May-Water.1982				
Jun-Water.1982				
Jul-Water.1982				
Aug-Water.1982				
Sep-Water.1982				
Oct-Water.1982	4	8	3	6
Nov-Water.1982	8	12	4.5	9
Dec-Water.1982	8	12	4.5	9
Yield.1969	520	528	526	533
Jan-Water.1969				
Feb-Water.1969				
Mar-Water.1969				

5543	Apr-Water.1969				
5544	May-Water.1969				
5545	Jun-Water.1969				
5546	Jul-Water.1969				
5547	Aug-Water.1969				
5548	Sep-Water.1969				
5549	Oct-Water.1969	4	8	3	6
5550	Nov-Water.1969	4	8	3	6
5551	Dec-Water.1969	4	8	3	6
5552					
5553	Yield.1974	490	498	494	502
5554	Jan-Water.1974				
5555	Feb-Water.1974				
5556	Mar-Water.1974				
5557	Apr-Water.1974				
5558	May-Water.1974				
5559	Jun-Water.1974				
5560	Jul-Water.1974				
5561	Aug-Water.1974				
5562	Sep-Water.1974				
5563	Oct-Water.1974	4	8	3	6
5564	Nov-Water.1974	8	12	4.5	9
5565	Dec-Water.1974	8	12	4.5	9
5566					
5567	Yield.1972	470	476	474	480
5568	Jan-Water.1972				
5569	Feb-Water.1972				
5570	Mar-Water.1972				
5571	Apr-Water.1972				
5572	May-Water.1972				
5573	Jun-Water.1972				
5574	Jul-Water.1972				
5575	Aug-Water.1972				
5576	Sep-Water.1972				
5577	Oct-Water.1972	8	12	4.5	9
5578	Nov-Water.1972	8	12	4.5	9
5579	Dec-Water.1972	8	12	4.5	9
5580					
5581	Yield.1976	496	503	499	508
5582	Jan-Water.1976				
5583	Feb-Water.1976				
5584	Mar-Water.1976				
5585	Apr-Water.1976				
5586	May-Water.1976				
5587	Jun-Water.1976				
5588	Jul-Water.1976				
5589	Aug-Water.1976				
5590	Sep-Water.1976				
5591	Oct-Water.1976	4	8	3	6
5592	Nov-Water.1976	8	12	4.5	9
5593	Dec-Water.1976	8	12	4.5	9
5594					
5595	Yield.1977	491	497	494	503
5596	Jan-Water.1977				
5597	Feb-Water.1977				
5598	Mar-Water.1977				
5599	Apr-Water.1977				
5600	May-Water.1977				
5601	Jun-Water.1977				
5602	Jul-Water.1977				
5603	Aug-Water.1977				
5604	Sep-Water.1977				
5605	Oct-Water.1977	4	8	3	6
5606	Nov-Water.1977	8	12	4.5	9
5607	Dec-Water.1977	8	12	4.5	9
5608					
5609	Yield.1979	474	480	479	484
5610	Jan-Water.1979				
5611	Feb-Water.1979				
5612	Mar-Water.1979				
5613	Apr-Water.1979				
5614	May-Water.1979				
5615	Jun-Water.1979				
5616	Jul-Water.1979				
5617	Aug-Water.1979				
5618	Sep-Water.1979				
5619	Oct-Water.1979	8	12	4.5	9
5620	Nov-Water.1979	8	12	4.5	9
5621	Dec-Water.1979	8	12	4.5	9
5622					
5623	Yield.1981	475	481	479	486
5624	Jan-Water.1981				
5625	Feb-Water.1981				
5626	Mar-Water.1981				
5627	Apr-Water.1981				
5628	May-Water.1981				
5629	Jun-Water.1981				
5630	Jul-Water.1981				
5631	Aug-Water.1981				
5632	Sep-Water.1981				
5633	Oct-Water.1981	8	12	4.5	9

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Nov-Water.1981          8            12          4.5          9
Dec-Water.1981          8            12          4.5          9

Yield.1958              494          500         496          506
Jan-Water.1958
Feb-Water.1958
Mar-Water.1958
Apr-Water.1958
May-Water.1958
Jun-Water.1958
Jul-Water.1958
Aug-Water.1958
Sep-Water.1958
Oct-Water.1958          4            8           3            6
Nov-Water.1958          8            12          4.5          9
Dec-Water.1958          8            12          4.5          9

Yield.1987              476          482         480          486
Jan-Water.1987
Feb-Water.1987
Mar-Water.1987
Apr-Water.1987
May-Water.1987
Jun-Water.1987
Jul-Water.1987
Aug-Water.1987
Sep-Water.1987
Oct-Water.1987          8            12          4.5          9
Nov-Water.1987          8            12          4.5          9
Dec-Water.1987          8            12          4.5          9
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table Spinach(agitem,rechargall,allstrat)
                        Spin50-F     Spin75-F    Spin50-S     Spin75-S
Yield.1956              436          441         438          446
Jan-Water.1956
Feb-Water.1956
Mar-Water.1956
Apr-Water.1956
May-Water.1956
Jun-Water.1956
Jul-Water.1956
Aug-Water.1956
Sep-Water.1956          8            12          4.5          7.5
Oct-Water.1956          8            12          4.5          7.5
Nov-Water.1956          8            12          4.5          7.5
Dec-Water.1956          8            12          4.5          7.5

Yield.1951              435          441         439          446
Jan-Water.1951
Feb-Water.1951
Mar-Water.1951
Apr-Water.1951
May-Water.1951
Jun-Water.1951
Jul-Water.1951
Aug-Water.1951
Sep-Water.1951          8            12          4.5          7.5
Oct-Water.1951          8            12          4.5          7.5
Nov-Water.1951          8            12          4.5          7.5
Dec-Water.1951          8            12          4.5          7.5

Yield.1963              436          443         438          447
Jan-Water.1963
Feb-Water.1963
Mar-Water.1963
Apr-Water.1963
May-Water.1963
Jun-Water.1963
Jul-Water.1963
Aug-Water.1963
Sep-Water.1963          8            12          4.5          7.5
Oct-Water.1963          8            12          4.5          7.5
Nov-Water.1963          8            12          4.5          7.5
Dec-Water.1963          8            12          4.5          7.5

Yield.1989              440          446         442          450
Jan-Water.1989
Feb-Water.1989
Mar-Water.1989
Apr-Water.1989
May-Water.1989
Jun-Water.1989
Jul-Water.1989
Aug-Water.1989
Sep-Water.1989          8            12          4.5          7.5
Oct-Water.1989          8            12          4.5          7.5
Nov-Water.1989          8            12          4.5          7.5
Dec-Water.1989          8            12          4.5          7.5

Yield.1952              437          442         437          446
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5725	Jan-Water.1952				
5726	Feb-Water.1952				
5727	Mar-Water.1952				
5728	Apr-Water.1952				
5729	May-Water.1952				
5730	Jun-Water.1952				
5731	Jul-Water.1952				
5732	Aug-Water.1952				
5733	Sep-Water.1952	8	12	4.5	7.5
5734	Oct-Water.1952	8	12	4.5	7.5
5735	Nov-Water.1952	8	12	4.5	7.5
5736	Dec-Water.1952	8	12	4.5	7.5
5737					
5738	Yield.1988	429	440	434	447
5739	Jan-Water.1988				
5740	Feb-Water.1988				
5741	Mar-Water.1988				
5742	Apr-Water.1988				
5743	May-Water.1988				
5744	Jun-Water.1988				
5745	Jul-Water.1988				
5746	Aug-Water.1988				
5747	Sep-Water.1988	8	12	4.5	7.5
5748	Oct-Water.1988	8	12	4.5	7.5
5749	Nov-Water.1988	8	12	4.5	7.5
5750	Dec-Water.1988	8	12	4.5	7.5
5751					
5752	Yield.1980	451	460	455	464
5753	Jan-Water.1980				
5754	Feb-Water.1980				
5755	Mar-Water.1980				
5756	Apr-Water.1980				
5757	May-Water.1980				
5758	Jun-Water.1980				
5759	Jul-Water.1980				
5760	Aug-Water.1980				
5761	Sep-Water.1980	8	12	4.5	7.5
5762	Oct-Water.1980	8	12	4.5	7.5
5763	Nov-Water.1980	4	8	3	4.5
5764	Dec-Water.1980	8	12	4.5	7.5
5765					
5766	Yield.1982	443	451	447	455
5767	Jan-Water.1982				
5768	Feb-Water.1982				
5769	Mar-Water.1982				
5770	Apr-Water.1982				
5771	May-Water.1982				
5772	Jun-Water.1982				
5773	Jul-Water.1982				
5774	Aug-Water.1982				
5775	Sep-Water.1982	8	12	4.5	7.5
5776	Oct-Water.1982	8	12	4.5	7.5
5777	Nov-Water.1982	4	8	3	4.5
5778	Dec-Water.1982	8	12	4.5	7.5
5779					
5780	Yield.1969	482	491	486	497
5781	Jan-Water.1969				
5782	Feb-Water.1969				
5783	Mar-Water.1969				
5784	Apr-Water.1969				
5785	May-Water.1969				
5786	Jun-Water.1969				
5787	Jul-Water.1969				
5788	Aug-Water.1969				
5789	Sep-Water.1969	4	8	3	4.5
5790	Oct-Water.1969	4	8	3	4.5
5791	Nov-Water.1969	4	8	3	4.5
5792	Dec-Water.1969	4	8	3	4.5
5793					
5794	Yield.1974	450	459	454	463
5795	Jan-Water.1974				
5796	Feb-Water.1974				
5797	Mar-Water.1974				
5798	Apr-Water.1974				
5799	May-Water.1974				
5800	Jun-Water.1974				
5801	Jul-Water.1974				
5802	Aug-Water.1974				
5803	Sep-Water.1974	8	12	4.5	7.5
5804	Oct-Water.1974	8	12	4.5	7.5
5805	Nov-Water.1974	4	8	3	4.5
5806	Dec-Water.1974	8	12	4.5	7.5
5807					
5808	Yield.1972	442	450	446	454
5809	Jan-Water.1972				
5810	Feb-Water.1972				
5811	Mar-Water.1972				
5812	Apr-Water.1972				
5813	May-Water.1972				
5814	Jun-Water.1972				
5815	Jul-Water.1972				

Aug-Water.1972				
Sep-Water.1972	8	12	4.5	7.5
Oct-Water.1972	8	12	4.5	7.5
Nov-Water.1972	4	8	3	4.5
Dec-Water.1972	8	12	4.5	7.5
Yield.1976	483	492	487	498
Jan-Water.1976				
Feb-Water.1976				
Mar-Water.1976				
Apr-Water.1976				
May-Water.1976				
Jun-Water.1976				
Jul-Water.1976				
Aug-Water.1976				
Sep-Water.1976	4	8	3	4.5
Oct-Water.1976	4	8	3	4.5
Nov-Water.1976	4	8	3	4.5
Dec-Water.1976	4	8	3	4.5
Yield.1977	458	467	462	471
Jan-Water.1977				
Feb-Water.1977				
Mar-Water.1977				
Apr-Water.1977				
May-Water.1977				
Jun-Water.1977				
Jul-Water.1977				
Aug-Water.1977				
Sep-Water.1977	8	12	4.5	7.5
Oct-Water.1977	8	12	4.5	7.5
Nov-Water.1977	4	8	3	4.5
Dec-Water.1977	8	12	4.5	7.5
Yield.1979	430	442	435	449
Jan-Water.1979				
Feb-Water.1979				
Mar-Water.1979				
Apr-Water.1979				
May-Water.1979				
Jun-Water.1979				
Jul-Water.1979				
Aug-Water.1979				
Sep-Water.1979	8	12	4.5	7.5
Oct-Water.1979	8	12	4.5	7.5
Nov-Water.1979	8	12	4.5	7.5
Dec-Water.1979	8	12	4.5	7.5
Yield.1981	459	468	463	472
Jan-Water.1981				
Feb-Water.1981				
Mar-Water.1981				
Apr-Water.1981				
May-Water.1981				
Jun-Water.1981				
Jul-Water.1981				
Aug-Water.1981				
Sep-Water.1981	8	12	4.5	7.5
Oct-Water.1981	8	12	4.5	7.5
Nov-Water.1981	4	8	3	4.5
Dec-Water.1981	8	12	4.5	7.5
Yield.1958	472	480	476	485
Jan-Water.1958				
Feb-Water.1958				
Mar-Water.1958				
Apr-Water.1958				
May-Water.1958				
Jun-Water.1958				
Jul-Water.1958				
Aug-Water.1958				
Sep-Water.1958	4	8	3	4.5
Oct-Water.1958	4	8	3	4.5
Nov-Water.1958	4	8	3	4.5
Dec-Water.1958	8	12	4.5	7.5
Yield.1987	438	445	440	449
Jan-Water.1987				
Feb-Water.1987				
Mar-Water.1987				
Apr-Water.1987				
May-Water.1987				
Jun-Water.1987				
Jul-Water.1987				
Aug-Water.1987				
Sep-Water.1987	8	12	4.5	7.5
Oct-Water.1987	8	12	4.5	7.5
Nov-Water.1987	8	12	4.5	7.5
Dec-Water.1987	8	12	4.5	7.5
;				

table sorgHay(agitem,rechargall,allstrat)

	Hay50-F	Hay75-F	Hay50-S	Hay75-S
Yield.1956	8.1	8.4	8.2	8.5
Jan-Water.1956				
Feb-Water.1956	4	8	3	6
Mar-Water.1956	4	8	3	6
Apr-Water.1956	4	4	3	3
May-Water.1956	4	4	3	3
Jun-Water.1956	4	4	3	3
Jul-Water.1956	4	4	3	3
Aug-Water.1956	4	4	3	3
Sep-Water.1956				
Oct-Water.1956				
Nov-Water.1956				
Dec-Water.1956				
Yield.1951	8.2	8.4	8.3	8.5
Jan-Water.1951				
Feb-Water.1951	4	8	3	6
Mar-Water.1951	4	8	3	6
Apr-Water.1951	4	4	3	3
May-Water.1951	4	4	3	3
Jun-Water.1951	4	4	3	3
Jul-Water.1951	4	4	3	3
Aug-Water.1951	4	4	3	3
Sep-Water.1951				
Oct-Water.1951				
Nov-Water.1951				
Dec-Water.1951				
Yield.1963	8.7	8.9	8.8	9
Jan-Water.1963				
Feb-Water.1963	4	8	3	6
Mar-Water.1963	4	8	3	6
Apr-Water.1963	4	4	3	3
May-Water.1963	4	4	3	3
Jun-Water.1963	4	4	3	3
Jul-Water.1963	4	4	3	3
Aug-Water.1963	4	4	3	3
Sep-Water.1963				
Oct-Water.1963				
Nov-Water.1963				
Dec-Water.1963				
Yield.1989	8.1	8.4	8.2	8.5
Jan-Water.1989				
Feb-Water.1989	4	8	3	6
Mar-Water.1989	4	8	3	6
Apr-Water.1989	4	4	3	3
May-Water.1989	4	4	3	3
Jun-Water.1989	4	4	3	3
Jul-Water.1989	4	4	3	3
Aug-Water.1989	4	4	3	3
Sep-Water.1989				
Oct-Water.1989				
Nov-Water.1989				
Dec-Water.1989				
Yield.1952	8.5	8.6	8.7	8.8
Jan-Water.1952				
Feb-Water.1952	4	8	3	6
Mar-Water.1952	4	8	3	6
Apr-Water.1952	4	4	3	3
May-Water.1952	4	4	3	3
Jun-Water.1952	4	4	3	3
Jul-Water.1952	4	4	3	3
Aug-Water.1952	4	4	3	3
Sep-Water.1952				
Oct-Water.1952				
Nov-Water.1952				
Dec-Water.1952				
Yield.1988	8.8	8.9	9	9.1
Jan-Water.1988				
Feb-Water.1988	4	8	3	6
Mar-Water.1988	4	8	3	6
Apr-Water.1988	4	4	3	3
May-Water.1988	4	4	3	3
Jun-Water.1988	4	4	3	3
Jul-Water.1988	4	4	3	3
Aug-Water.1988	4	4	3	3
Sep-Water.1988				
Oct-Water.1988				
Nov-Water.1988				
Dec-Water.1988				
Yield.1980	8.9	9.1	9.2	9.4
Jan-Water.1980				
Feb-Water.1980	4	8	3	6
Mar-Water.1980	4	8	3	6
Apr-Water.1980	4	4	3	3

5998	May-Water.1980	4	4	1.5	1.5
5999	Jun-Water.1980	4	4	3	3
6000	Jul-Water.1980	4	4	3	3
6001	Aug-Water.1980	4	4	3	3
6002	Sep-Water.1980				
6003	Oct-Water.1980				
6004	Nov-Water.1980				
6005	Dec-Water.1980				
6006					
6007	Yield.1982	9.3	9.5	9.6	9.8
6008	Jan-Water.1982				
6009	Feb-Water.1982	4	4	1.5	3
6010	Mar-Water.1982	4	4	3	3
6011	Apr-Water.1982	4	4	3	3
6012	May-Water.1982	0	4	1.5	1.5
6013	Jun-Water.1982	4	4	1.5	1.5
6014	Jul-Water.1982	4	4	1.5	1.5
6015	Aug-Water.1982	4	4	3	3
6016	Sep-Water.1982				
6017	Oct-Water.1982				
6018	Nov-Water.1982				
6019	Dec-Water.1982				
6020					
6021	Yield.1969	8.3	8.4	8.5	8.6
6022	Jan-Water.1969				
6023	Feb-Water.1969	4	8	3	6
6024	Mar-Water.1969	4	8	3	6
6025	Apr-Water.1969	4	4	3	3
6026	May-Water.1969	4	4	3	3
6027	Jun-Water.1969	4	4	3	3
6028	Jul-Water.1969	4	4	3	3
6029	Aug-Water.1969	4	4	3	3
6030	Sep-Water.1969				
6031	Oct-Water.1969				
6032	Nov-Water.1969				
6033	Dec-Water.1969				
6034					
6035	Yield.1974	10.2	10.4	10.5	10.8
6036	Jan-Water.1974				
6037	Feb-Water.1974	4	4	3	3
6038	Mar-Water.1974	4	4	3	3
6039	Apr-Water.1974	4	4	1.5	1.5
6040	May-Water.1974	4	4	1.5	1.5
6041	Jun-Water.1974	4	4	3	3
6042	Jul-Water.1974	4	4	3	3
6043	Aug-Water.1974	0	0	0	0
6044	Sep-Water.1974				
6045	Oct-Water.1974				
6046	Nov-Water.1974				
6047	Dec-Water.1974				
6048					
6049	Yield.1972	8.6	8.8	8.9	9
6050	Jan-Water.1972				
6051	Feb-Water.1972	4	8	3	6
6052	Mar-Water.1972	4	8	3	6
6053	Apr-Water.1972	4	4	3	3
6054	May-Water.1972	4	4	3	3
6055	Jun-Water.1972	4	4	3	3
6056	Jul-Water.1972	4	4	3	3
6057	Aug-Water.1972	4	4	3	3
6058	Sep-Water.1972				
6059	Oct-Water.1972				
6060	Nov-Water.1972				
6061	Dec-Water.1972				
6062					
6063	Yield.1976	10.4	10.7	11	11.5
6064	Jan-Water.1976				
6065	Feb-Water.1976	4	4	3	3
6066	Mar-Water.1976	4	4	3	3
6067	Apr-Water.1976	0	0	0	1.5
6068	May-Water.1976	0	4	1.5	1.5
6069	Jun-Water.1976	4	4	1.5	3
6070	Jul-Water.1976	0	0	0	0
6071	Aug-Water.1976	4	4	1.5	1.5
6072	Sep-Water.1976				
6073	Oct-Water.1976				
6074	Nov-Water.1976				
6075	Dec-Water.1976				
6076					
6077	Yield.1977	8.8	9	8.9	9.1
6078	Jan-Water.1977				
6079	Feb-Water.1977	4	8	3	6
6080	Mar-Water.1977	4	8	3	6
6081	Apr-Water.1977	4	4	3	3
6082	May-Water.1977	4	4	3	3
6083	Jun-Water.1977	4	4	3	3
6084	Jul-Water.1977	4	4	3	3
6085	Aug-Water.1977	4	4	3	3
6086	Sep-Water.1977				
6087	Oct-Water.1977				
6088	Nov-Water.1977				

```
Dec-Water.1977

Yield.1979          10.5     10.8     11.1     11.6
Jan-Water.1979
Feb-Water.1979      4        4        3        3
Mar-Water.1979      4        4        1.5      1.5
Apr-Water.1979      0        0        0        1.5
May-Water.1979      4        4        1.5      1.5
Jun-Water.1979      0        0        0        0
Jul-Water.1979      0        4        0        1.5
Aug-Water.1979      4        4        1.5      1.5
Sep-Water.1979
Oct-Water.1979
Nov-Water.1979
Dec-Water.1979

Yield.1981          10.4     10.6     11       11.2
Jan-Water.1981
Feb-Water.1981      4        4        3        3
Mar-Water.1981      4        4        1.5      1.5
Apr-Water.1981      0        0        0        1.5
May-Water.1981      0        4        1.5      1.5
Jun-Water.1981      0        4        1.5      1.5
Jul-Water.1981      4        4        1.5      3
Aug-Water.1981      4        4        3        3
Sep-Water.1981
Oct-Water.1981
Nov-Water.1981
Dec-Water.1981

Yield.1958          11       11.2     11.3     11.6
Jan-Water.1958
Feb-Water.1958      0        4        1.5      1.5
Mar-Water.1958      0        4        1.5      1.5
Apr-Water.1958      4        4        1.5      3
May-Water.1958      0        4        1.5      1.5
Jun-Water.1958      0        0        0        0
Jul-Water.1958      0        4        1.5      1.5
Aug-Water.1958      0        4        1.5      1.5
Sep-Water.1958
Oct-Water.1958
Nov-Water.1958
Dec-Water.1958

Yield.1987          11.4     11.6     11.8     12.2
Jan-Water.1987
Feb-Water.1987      0        4        1.5      1.5
Mar-Water.1987      4        4        1.5      1.5
Apr-Water.1987      4        4        1.5      1.5
May-Water.1987      0        0        0        0
Jun-Water.1987      0        0        0        0
Jul-Water.1987      4        4        1.5      1.5
Aug-Water.1987      4        4        1.5      1.5
Sep-Water.1987
Oct-Water.1987
Nov-Water.1987
Dec-Water.1987
;
* Create Dryland info. for EPIC Sorghay
  sorghay("yield",recharge,"Hay-Dry") =
     sorghay("yield",recharge,"Hay50-F") * .441 ;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
* End of Data
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*   Percent Change in Prices to Reflect NO FARM PROGRAM
*        (from Bill Nyda's work)
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
 Parameter Pchange(crops)
  / cotton    35.2,    corn      4.1,    soybeans  -1.9,
    winwht     4.3,    sorghum   7.9,
    hay       -1.3,    sorghay  -1.3 / ;

 ragdata("price",lando,penastrat,crop) =
    ragdata("price",lando,penastrat,crop)*(1+Pchange(crop)/100);
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

sets    drystrat(allstrat)  EPIC Dryland Strategies
        / C-Dryland, Cot-Dry, S-Dryland, O-Dryland,
          W-Dryland, Pnut-dry, Hay-Dry ,full/

        wetstrat(allstrat)  EPIC Irrigation Strategies
        spkstrat(allstrat)  EPIC Sprinkler Strategies

        fstrat(allstrat)  EPIC Furrow Strategies
/C50-May-F,   C50-Jun-F,   C75-May-F,   C75-Jun-F,
 S50-May-F,   S50-Jun-F,   S75-May-F,   S75-Jun-F,
 O50-Mar-F,   O50-Apr-F,   O75-Mar-F,   O75-Apr-F,
 W50-Mar-F,   W50-Apr-F,   W75-Mar-F,   W75-Apr-F,
```

```
  Pnut50-F,      Pnut75-F, P50-May-F,     P75-May-F,
  Oni50-F,   Oni75-F,
  Cabb50-F,  Cabb75-F,
  Carr50-F,  Carr75-F,
  Cant50-F,  Cant75-F,
  Cuc50-F,   Cuc75-F,
  Let50-F,   Let75-F,
  Spin50-F,  Spin75-F,
  Hay50-F,   Hay75-F,
  H50-May-F, H75-May-F,
  Cot50-EB-F, Cot50-FB-F, Cot50-FO-F,
  Cot75-EB-F, Cot75-FB-F, Cot75-FO-F/
 ;
       wetstrat(strategy) = yes ;
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*   This says whether dryland is an irrigation strategy.
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
       wetstrat(drystrat)$(not sameas(drystrat,"full")) = no ;

       spkstrat(wetstrat) = yes ;
       spkstrat(fstrat) = no ;
       fstat(fstrat)=yes

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  Include Dryland in Furrow Strategies.
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*      fstrat(drystrat) = yes ;
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

set watr(agitem)     Monthly water use
/jan-water,feb-water,mar-water,apr-water,may-water,jun-water
jul-water,aug-water,sep-water,oct-water,nov-water,dec-water/

    epicitem(agitem)   Items produced by EPIC (yield & water) ;
    epicitem(watr) = yes ;
    epicitem("yield") = yes ;

parameter ragdata2(agitem,rechargall,lando,allstrat,crops) ;
*                 ragdata (yields and irr use) developed by EPIC ;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*     FILL IN LARGE TABLE WITH CROP TABLES
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

ragdata2(epicitem,recharge,"irr",wetstrat,"corn")
  = corn(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"corn")
  = corn(epicitem,recharge,drystrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"sorghum")
  = sorghum(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"sorghum")
  = sorghum(epicitem,recharge,drystrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"winwht")
  = winwht(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"winwht")
  = winwht(epicitem,recharge,drystrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"peanuts")
  = peanuts(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"peanuts")
  = peanuts(epicitem,recharge,drystrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"cabbage")
  = cabbage(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"lettuce")
  = lettuce(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"spinach")
  = spinach(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"carrot")
  = carrot(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"cucumber")
  = cucumber(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"cantalop")
  = cantalop(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"onion")
  = onion(epicitem,recharge,wetstrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"sorghay")
  = sorghay(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"sorghay")
  = sorghay(epicitem,recharge,drystrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"cotton")
```

```
  = cotton(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"cotton")
  = cotton(epicitem,recharge,drystrat) ;

ragdata2(epicitem,recharge,"irr",wetstrat,"oats")
  = oats(epicitem,recharge,wetstrat) ;
ragdata2(epicitem,recharge,"dry",drystrat,"oats")
  = oats(epicitem,recharge,drystrat) ;

*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*          Adjust Oats to reflect Oat Pasture
*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

ragdata2("yield",recharge,"irr",wetstrat,"oats")
  = oats("yield",recharge,wetstrat) * 475/66 ;
ragdata2("yield",recharge,"dry",drystrat,"oats")
  = oats("yield",recharge,drystrat) * 475/66 ;

*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*    Transfer Values from Sorghum hay to Hay (or don't)
*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*ragdata2(agitem,recharge,"irr",wetstrat,"hay")
*  = ragdata2(agitem,recharge,"irr",wetstrat,"sorghay") ;

*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*     Total (Annual) irrigation water required
*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

ragdata2("water",recharge,"irr",wetstrat,crop2)
     =
  sum(watr, ragdata2(watr,recharge,"irr",wetstrat,crop2));

*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  Create monthly irrigation water required conforming to month
*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

   ragdata2("jan",recharge,"irr",wetstrat,crop2)
     = ragdata2("jan-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("feb",recharge,"irr",wetstrat,crop2)
     = ragdata2("feb-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("mar",recharge,"irr",wetstrat,crop2)
     = ragdata2("mar-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("apr",recharge,"irr",wetstrat,crop2)
     = ragdata2("apr-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("may",recharge,"irr",wetstrat,crop2)
     = ragdata2("may-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("jun",recharge,"irr",wetstrat,crop2)
     = ragdata2("jun-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("jul",recharge,"irr",wetstrat,crop2)
     = ragdata2("jul-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("aug",recharge,"irr",wetstrat,crop2)
     = ragdata2("aug-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("sep",recharge,"irr",wetstrat,crop2)
     = ragdata2("sep-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("oct",recharge,"irr",wetstrat,crop2)
     = ragdata2("oct-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("nov",recharge,"irr",wetstrat,crop2)
     = ragdata2("nov-water",recharge,"irr",wetstrat,crop2) ;
   ragdata2("dec",recharge,"irr",wetstrat,crop2)
     = ragdata2("dec-water",recharge,"irr",wetstrat,crop2) ;

*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*        Create Sprinkler Strategies for Pena Crops
*  ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

  ragdata("yield","irr","full-s","soybeans") =
    ragdata("yield","irr","full","soybeans") *
    sum(recharge, prob(recharge) *
    ragdata2("yield",recharge,"irr","s75-jun-s","sorghum") ) /
    sum(recharge, prob(recharge) *
    ragdata2("yield",recharge,"irr","s75-jun-f","sorghum") ) ;

  ragdata(watr,"irr","full-s","soybeans") =
    ragdata(watr,"irr","full","soybeans") *
    sum(recharge, prob(recharge) *
    ragdata2("water",recharge,"irr","s75-jun-s","sorghum") ) /
    sum(recharge, prob(recharge) *
    ragdata2("water",recharge,"irr","s75-jun-f","sorghum") ) ;

  ragdata("yield","irr","full-s","hay") =
    ragdata("yield","irr","full","hay") *
    sum(recharge, prob(recharge) *
    ragdata2("yield",recharge,"irr","hay75-s","sorghay") ) /
    sum(recharge, prob(recharge) *
    ragdata2("yield",recharge,"irr","hay75-f","sorghay") ) ;
set repcropal(crops) /hay,sesame,soybeans,guar,cantalop,onion,peanuts/
;
  ragdata("yield","irr","al-s",repcropal) =
    ragdata("yield","irr","al",repcropal);
  ragdata(watr   ,"irr","al-s",repcropal) =
```

```
 ragdata(watr   ,"irr","al",repcropal)*0.6/0.9;

 ragdata(watr,"irr","full-s","hay") =
   ragdata(watr,"irr","full","hay") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","hay75-s","sorghay") ) /
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","hay75-f","sorghay") ) ;

 ragdata("yield","irr","full-s","peppers") =
   ragdata("yield","irr","full","peppers") *
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cuc75-s","cucumber") ) /
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cuc75-f","cucumber") ) ;

 ragdata(watr,"irr","full-s","peppers") =
   ragdata(watr,"irr","full","peppers") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cuc75-s","cucumber") ) /
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cuc75-f","cucumber") ) ;

 ragdata("yield","irr","full-s","honeydew") =
   ragdata("yield","irr","full","honeydew") *
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cant75-s","cantalop") ) /
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cant75-f","cantalop") ) ;

 ragdata(watr,"irr","full-s","honeydew") =
   ragdata(watr,"irr","full","honeydew") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cant75-s","cantalop") ) /
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cant75-f","cantalop") ) ;

 ragdata("yield","irr","full-s","potato") =
   ragdata("yield","irr","full","potato") *
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","carr75-s","carrot") ) /
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","carr75-f","carrot") ) ;

 ragdata(watr,"irr","full-s","potato") =
   ragdata(watr,"irr","full","potato") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","carr75-s","carrot") ) /
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","carr75-f","carrot") ) ;

 ragdata("yield","irr","full-s","swtcorn") =
   ragdata("yield","irr","full","swtcorn") *
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","c75-jun-s","corn") ) /
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","c75-jun-f","corn") ) ;

 ragdata(watr,"irr","full-s","swtcorn") =
   ragdata(watr,"irr","full","swtcorn") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","c75-jun-s","corn") ) /
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","c75-jun-f","corn") ) ;

 ragdata("yield","irr","full-s","tomato") =
   ragdata("yield","irr","full","tomato") *
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cuc75-s","cucumber") ) /
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cuc75-f","cucumber") ) ;

 ragdata(watr,"irr","full-s","tomato") =
   ragdata(watr,"irr","full","tomato") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cuc75-s","cucumber") ) /
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cuc75-f","cucumber") ) ;

 ragdata("yield","irr","full-s","watermel") =
   ragdata("yield","irr","full","watermel") *
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cant75-s","cantalop") ) /
   sum(recharge, prob(recharge) *
   ragdata2("yield",recharge,"irr","cant75-f","cantalop") ) ;

 ragdata(watr,"irr","full-s","watermel") =
   ragdata(watr,"irr","full","watermel") *
   sum(recharge, prob(recharge) *
   ragdata2("water",recharge,"irr","cant75-s","cantalop") ) /
   sum(recharge, prob(recharge) *
```

```
     ragdata2("water",recharge,"irr","cant75-f","cantalop")  ;


*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*        Make dryland an option for any given year
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*ragdata(agitem,"irr","dry",crop)$ragdata("yield","dry","full",crop)
*      = ragdata(agitem,"dry","full",crop) ;

parameter cost(agitem)  cost of ag items/
harvacre 1, FEDINS    1 ,HERB      1  ,HERBAPPL   1,PHOSPHATE 1
NITROGEN 1, SEED      1 ,INSECTIC 1  ,FUELM      1,FUELI       0
REPAIRM  1, fixed     0 ,varcost  1,  defic  0,
REPAIRI  0 ,LABORM    1 ,LABORI   0  ,HARVEST    0,INTEREST   0
FUNGIC   1 ,PESTICAPPL 1,MISC       1,INSECTAPPL 1,LABORo   1/

set       adjust(agitem)  ag items whose usage can be adjusted
   / harvacre,   FEDINS     ,HERB        ,HERBAPPL   ,PHOSPHATE
NITROGEN , SEED       ,INSECTIC   ,FUELM
REPAIRM  ,  varcost,
LABORM   ,  interest,
FUNGIC    ,PESTICAPPL ,MISC       ,INSECTAPPL ,LABORo  /

set waterdep(agitem)  items whose use depends on water use
       / FUELI, REPAIRI ,LABORI  /

set ws(PenaStrat);ws(PenaStrat)=yes;ws("full")=no;

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccc
*     ADJUST WATER USE TO CONFORM WITH ACTUAL WATER USE
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccc

ragdata(watr,"irr",waterstat,crop)$ragdata("yield","irr","full",crop)
     = ragdata(watr,"irr",waterstat,crop) * 107.8 / 66.126105;

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  Total (Annual) irrigation water required
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccc

ragdata("water","irr",waterstat,crop)
    $ragdata("yield","irr",waterstat,crop)=
  sum(watr, ragdata(watr,"irr",waterstat,crop));

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*        Reassign monthly irrigation water to month
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

   ragdata("jan","irr",waterstat,crop)
     = ragdata("jan-water","irr",waterstat,crop) ;
   ragdata("feb","irr",waterstat,crop)
     = ragdata("feb-water","irr",waterstat,crop) ;
   ragdata("mar","irr",waterstat,crop)
     = ragdata("mar-water","irr",waterstat,crop) ;
   ragdata("apr","irr",waterstat,crop)
     = ragdata("apr-water","irr",waterstat,crop) ;
   ragdata("may","irr",waterstat,crop)
     = ragdata("may-water","irr",waterstat,crop) ;
   ragdata("jun","irr",waterstat,crop)
     = ragdata("jun-water","irr",waterstat,crop) ;
   ragdata("jul","irr",waterstat,crop)
     = ragdata("jul-water","irr",waterstat,crop) ;
   ragdata("aug","irr",waterstat,crop)
     = ragdata("aug-water","irr",waterstat,crop) ;
   ragdata("sep","irr",waterstat,crop)
     = ragdata("sep-water","irr",waterstat,crop) ;
   ragdata("oct","irr",waterstat,crop)
     = ragdata("oct-water","irr",waterstat,crop) ;
   ragdata("nov","irr",waterstat,crop)
     = ragdata("nov-water","irr",waterstat,crop) ;
   ragdata("dec","irr",waterstat,crop) =
      ragdata("dec-water","irr",waterstat,crop) ;
      ragdata("jan-water","irr",waterstat,crop)=0 ;
      ragdata("feb-water","irr",waterstat,crop)=0 ;
      ragdata("mar-water","irr",waterstat,crop)=0 ;
      ragdata("apr-water","irr",waterstat,crop)=0 ;
      ragdata("may-water","irr",waterstat,crop)=0 ;
      ragdata("jun-water","irr",waterstat,crop)=0 ;
      ragdata("jul-water","irr",waterstat,crop)=0 ;
      ragdata("aug-water","irr",waterstat,crop)=0 ;
      ragdata("sep-water","irr",waterstat,crop)=0 ;
      ragdata("oct-water","irr",waterstat,crop)=0 ;
      ragdata("nov-water","irr",waterstat,crop)=0 ;
      ragdata("dec-water","irr",waterstat,crop)=0 ;

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  c                    FILL IN BLANK VALUES                c
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

ragdata(adjust,lando,ws,crop)
     $(ragdata("yield",lando,ws,crop) gt 0)
```

```
      = ragdata(adjust,lando,"full",crop)
        $( ragdata(adjust,lando,ws,crop) eq 0)
      + 1$ragdata(adjust,lando,ws,crop)*
        ragdata(adjust,lando,ws,crop);

 ragdata("price",lando,ws,crop)$ragdata("yield",lando,ws,crop)
      = ragdata("price",lando,"full",crop);

 *  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
 *      Deficiency Payment and harvest cost are based on Yield
 *       (fill in)
 *  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

    ragdata("defic" ,lando,ws,crop)
             $ragdata("yield",lando,"full",crop)=
         ragdata("defic" ,lando,"full",crop)
       / ragdata("yield",lando,"full",crop);

    ragdata("harvest" ,lando,waterstat,crop)
             $ragdata("yield",lando,waterstat,crop)=
         ragdata("harvest" ,lando,"full",crop)
       / ragdata("yield",lando,"full",crop);

 *  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
 *   Caluclate Total Acre Costs, Total Revenue, and Margin
 *  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

 ragdata("totrev",lando,waterstat,crop)
        $ragdata("yield",lando,waterstat,crop)=
     ragdata("price",lando,waterstat,crop)
   * ragdata("yield",lando,waterstat,crop);

 ragdata("totcost",lando,waterstat,crop)
        $ragdata("yield",lando,waterstat,crop) =
    sum(adjust,cost(adjust)*ragdata(adjust,lando,waterstat,crop));

 *display ragdata,waterstat,crop;

 ragdata("marg",lando,waterstat,crop) =
     ragdata("totrev",lando,waterstat,crop)
   - ragdata("totcost",lando,waterstat,crop) ;

 ragdata("marg2",lando,waterstat,crop) =
     ragdata("marg",lando,waterstat,crop)
   - ragdata("harvest",lando,waterstat,crop)
      * ragdata("yield",lando,waterstat,crop) ;

 *  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
 *       Rearrange Data
 *  cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
 PARAMETER BCRESULTS(Lando,groups,YEAR,crops,month)  BLANEY CRIDDLE;
    BCRESULTS(Lando,county,recharge,crops,month)
     = BCresult(Lando,CROPS,recharge,month,county) ;

 parameter aBCresults(LANDo,groups,year,CROPs) annual BLANEY CRIDDLE;
   aBCresults(LANDo,county,recharge,CROPs)
     = aBCresult(LANDo,CROPs,recharge,county) ;

 parameter  BCAVG(LANDo,GROUPS,CROPS,month) AVERAGE BLANEY CRIDDLE;
     BCAVG(LANDo,county,CROPS,month)
      =  BCav(LANDo,CROPS,county,month) ;

 parameter agdata2(agitem,rechargall,lando,crops,allstrat) ;
 set savagitem(agitem);
 savagitem("yield")=yes;
 savagitem("price")=yes;
 savagitem("harvest")=yes;
 savagitem("totcost")=yes;
  agdata2(savagitem,recharge,lando,crop1,allstrat) =
     ragdata(savagitem,lando,allstrat,crop1);
 option agdata2:3:2:3;
 *display agdata2,ragdata;
  parameter agdata(agitem,lando,crops) ;
 savagitem("yield")=no;
   agdata(savagitem,lando,crops)=
     ragdata(savagitem,lando,"full",crops);

  agdata2("yield",recharge,"dry",crop1,"full") =
       + ( ragdata("yield","dry","full",crop1)
           * aBCRESULTS("DRY","uvalde",RECHARGE,crop1) );
  agdata2(month,recharge,"irr",crop1,spkstat) =
            ragdata(month,"irr",spkstat,crop1)
           * BCRESULTS("IRR","uvalde",RECHARGE,CROP1,month);
  agdata2(month,recharge,"irr",crop1,fstat) =
            ragdata(month,"irr",fstat,crop1)
           * BCRESULTS("IRR","uvalde",RECHARGE,CROP1,month);
 *display agdata2,crop1,crop2;

 savagitem("yield")=yes;
 savagitem(month)=yes;
 agdata2(savagitem,recharge,lando,crop2,allstrat)
```

```
 $ragdata2(savagitem,recharge,lando,allstrat,crop2) =
  ragdata2(savagitem,recharge,lando,allstrat,crop2) ;

option agdata2:3:2:3;
option agdata:3:2:1;
display agdata2;
display agdata;
  cropstrat(crops,lando,allstrat)=yes$
sum((savagitem,recharge)
       ,agdata2(savagitem,recharge,lando,crops,allstrat) );
  cropstrat(crop2,"dry","full")=no;
display cropstrat;

     spkstrat(spkstat)=yes;
display spkstrat;

INCLUDE    /mac/mccarl/edwards/dryyear/agmodel
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*        This Model Produces Free Capture Ag Values
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

OPTION LIMROW = 0;
OPTION LIMCOL = 0;
OPTION ITERLIM = 1000000;
OPTION RESLIM = 1000000;

set ecounty(groups) /hays,bexar,medina,comal/
    wcounty(groups) /kinney,uvalde/
    beghead(regress) /j17head,sabhead/
    maploc(regress,equ) /j17head.endj17head,sabhead.endsabhead/
*    agcounty(groups) / Uvalde, Medina, Kinney, Bexar /
    agcounty(groups) / Uvalde, Medina /
    payelig(agcounty) counties eligable for payment ;
    payelig(agcounty)=yes;
alias(month,month2) ;
 set strattype(landa,allstrat)
     irrtype(lando,landa) irrigation relationships /
        dry.dry,irr.(sprinkler,furrow)/;
     strattype("dry",drystrat)=yes;
     strattype("sprinkler",spkstrat)=yes;
     strattype("furrow",fstat )=yes;
     display strattype;

Parameter Liftp(rechargall,region) Pumping Distance as Adjusted ;
 Liftp(recharge,region)=1;
Table  LIFTo(rechargall,region) Original PUMPING DISTANCE IN VERT FEET
*  From optimization (no restrictions).

        EASTLIFT    WESTLIFT

1956         168         163
1951         166         162
1963         165         161
1989         164         160
1980         161         156
1974         156         151
1976         151         145
1958         140         131
1987         134         124 ;

scalar  sprinkon   pos value activates sprinkler / 1 /
        spktrans do i allow furrow to sprinkler conversions / 0 /
        Price    dry year option price                    / 0 /
        fixacres  do we have a fixed acreage base         /0/
 ;
set
cropuses(crops)  crops which use water during blocked period
cROPelig(rechargall,crops,lando,allstrat) irrigat strategies elig for payment
buyoutyear(rechargall)  buyout years;

cropuses(crops)=no;
cROPelig(recharge,cropuses,lando,allstrat) =no;
buyoutyear(recharge)=yes;
*cropuses("corn")=yes;
*cROPelig(recharge,cropuses,lando,allstrat) =yes;

parameter
holdacres(agcounty,zone,landa,crops,recharge) acres that must be irrigat
;
   holdacres(agcounty,zone,landa,crop,recharge)=0.1;

 set     WATUSEYEAR(USEYEAR)   YEAR OF WATER USE IN CURRENT MODEL
          / 1989 / ;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*             Total Pumping and Sprinflow Limits
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

scalar  Limit      Overall pumping limit - 0 450000 or 400000
          / 0 /
        springmin  Minimum Comal springflow - 0 150 or 200
```

```
          / 0 / ;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

set       mlink(month,month2)       Set linking months for aggregation
     /jan.jan, feb.(jan,feb), mar.(jan,feb,mar),
      apr.(jan,feb,mar,apr), may.(jan,feb,mar,apr,may),
      jun.(jan,feb,mar,apr,may,jun),
      jul.(jan,feb,mar,apr,may,jun,jul),
      aug.(jan,feb,mar,apr,may,jun,jul,aug),
      sep.(jan,feb,mar,apr,may,jun,jul,aug,sep),
      oct.(jan,feb,mar,apr,may,jun,jul,aug,sep,oct),
      nov.(jan,feb,mar,apr,may,jun,jul,aug,sep,oct,nov),
      dec.(jan,feb,mar,apr,may,jun,jul,aug,sep,oct,nov,dec) /

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

*           EDWARDS AQUIFER MODEL SPECIFICATION

*    cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

VARIABLES

 AgProfit

POSITIVE VARIABLES
 LIFT(rechargall,region)           Regional PUMPING DISTANCE IN VERT FEET
 AgPumpCost(region,zonall,rechargall)  Acre Foot Cost of Pumping - AG
 ENDWATER(endhead,rechargall)      ENDING WATER LEVEL
 AGWATER(groups,zonall,rechargall,month)  AGRICULTURAL WATER USE
 DEVIRRIG(groups,zonall)              DEVELOPED IRRIGABLE LAND
 FurrTODRY(agcounty,zonall)              Furrow LAND CONVERTED TO DRYLAND USE
 SpkTODRY(agcounty,zonall)               sprinkler LAND CONVERTED TO DRYLAND
 FurrToSpk(agcounty,zonall)              Furrow land converted to sprinkler
 CROPMIX(agcounty,zonall,MIXESA,landa)  CROP MIXES USED (Acres)
 ARTSPRING(rechargall,SPRINGS)   ARTIFICIAL SPRINGFLOW NO INFEASIBILITY
 CROPPROD(agcounty,zonall,YEAR,crops,allstrat) CROP PRODUCTION Acres
 INITWATER(beghead)                INITIAL WATER LEVEL
 paybuyout(agcounty,zone,rechargall)     acres bought out

EQUATIONS

 OBJ                                    OBJECTIVE FUNCTION
 IRRPUMP(agcounty,zonall,YEAR,month)       IRRIGATION PUMPING BALANCE
 CropAcre(groups,zonall,landa,CROPS,YEAR)  ACRES for Cropsl furrow
 DRYLAND(groups,zonall)                   DRYLAND Acres
 FurrowLand(groups,zonall)                Furrow Irrigation Acres
 SpkLand(groups,zonall)                   Sprinkler Irrigation Acres
 IrrLand(groups,zonall)                  Total Irrigated Acres
 PumpCoAgEq(region,zonall,rechargall)  Per Acre Foot Cost of Irr Eqn
 PumpLft(region,rechargall)            Base PUMPING LIFT BALANCE
 MaxConvert(groups,zonall)                Max amt converted to sprinkler
 fixacre(agcounty,zonall,landa,crops,year) required landuse
 buyoutpay(agcounty,zone,rechargall)                         acres bought out
 ;

  OBJ..  AgProfit =E=


   - SUM((agcounty,zone), DEVIRRIG(agcounty,zone)) * COSTIRRIG

   - sum((agcounty,zone),
         (AvailZone(agcounty,zone,"sprinkler")
        + FurrToSpk(agcounty,zone)$spktrans )) * CostSprink

 +SUM(RECHARGE,PROB(RECHARGE)*(
   +Sum((agcounty,zone),paybuyout(agcounty,zone,recharge)*price)
   +SUM(agcounty,
      sum(lando,
        sum(crop$iscrop(agcounty,lando,crop ),
          sum(irrtype(lando,landa),
            sum(zone,
              sum(strattype(landa,allstrat)
                 $agdata2("yield",recharge,lando,crop ,allstrat)
                 ,CROPPROD(agcounty,zone,RECHARGe,crop ,allstrat)
            * ( agdata2("yield",recharge,lando,crop ,allstrat)
            *  ( agdata("price",lando,crop)
                - agdata("harvest",lando,crop) )
            -  agdata("totcost",lando,crop ) )))))))
            - sum(zone,
                sum(month, AgWater("Uvalde",zone,RECHARGE,month))
                   * AgPumpcost("westlift",zone,recharge) )
            - sum(zone,
                sum(month, AgWater("Medina",zone,RECHARGE,month))
                   * AgPumpcost("eastlift",zone,recharge) )
         ) ) ;

PUMPLFT(region,RECHARGE)..
 LIFT(RECHARGE,region) =e= LiftP(recharge,region) ;

PumpCoAgEq(region,zone,recharge)..
```

```
  AgPumpCost(region,zone,recharge)
      =E=
   12 * (repairc + laborc + ( 0.0014539 *
   ( Lift(recharge,region) + AgDiff(zone,region) + 2.31*psi)
         * png/(pe*de) ) );

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*     Water Use Constraints
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccc

IRRPUMP(agcounty,zone,RECHARGE,month)$AvailZone(agcounty,zone,"irr")..
              (1-SUM(AGEFF,AGIRREFIC(AGEFF))) * (
        sum(crop$iscrop(agcounty,"irr",crop ),
          sum(irrtype("irr",landa),
              sum(strattype(landa,allstrat)
                      $cropstrat(crop,"irr" ,allstrat),
            CROPPROD(agcounty,zone,RECHARGe,crop ,allstrat)
           * agdata2(month,recharge,"irr",crop ,allstrat)/12 ))))
            =l=AGWATER(agcounty,zone,RECHARGE,month);


* cccccccccccccccccccccccccccccccccccccccccccccccccccccc
*  dry year buyout constraints
*  ccccccccccccccccccccccccccccccccccccccccccccccccccccc

 fixacre(agcounty,zone,landa,crop,recharge)$(
         fixacres  and
         irrtype("irr",landa)  and
   holdacres(agcounty,zone,landa,crop,recharge))..
    sum(allstrat $ ( strattype(landa,allstrat) and
                   cropstrat(crop,"irr",allstrat)
                and iscrop(agcounty,"irr",crop)),
    CROPPROD(agcounty,zone,RECHARGE,crop,allstrat)
      )
      =e=
   holdacres(agcounty,zone,landa,crop,recharge);

 buyoutpay(agcounty,zone,buyoutyear)..
  paybuyout(agcounty,zone,buyoutyear)
  =l=
    (sum(crop,
       sum(cROPelig(buyoutyear,crop,lando,allstrat)$
            (cropstrat(crop,lando,allstrat)
         and iscrop(agcounty,lando,crop)),
        CROPPROD(agcounty,zone,buyoutyear,crop,allstrat))))
      $payelig(agcounty)
;

*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*        Crop Land Constraints
*  cccccccccccccccccccccccccccccccccccccccccccccccccccccccc

CropAcre(agcounty,zone,landa,CROP,RECHARGE)..
   sum((irrtype(lando,landa), strattype(landa,allstrat))
        $ (cropstrat(crop,lando,allstrat)
            and iscrop(agcounty,lando,crop)),
    CROPPROD(agcounty,zone,RECHARGE,crop,allstrat) )
     =e=
    sum(irrtype(lando,landa),
       SUM(MIXES, CROPMIX(agcounty,zone,MIXES,landa)
             * MIXDATA(agcounty,lando,CROP,MIXES)))
       ;

DRYLAND(agcounty,zone)..
  SUM(MIXES,SUM(CROP, MIXDATA(agcounty,"DRY",CROP,MIXES))
     * CROPMIX(agcounty,zone,MIXES,"DRY"))
                  =L=
    AVAILzone(agcounty,zone,"DRY") + SpkToDry(agcounty,zone)$sprinkon
     + FurrToDry(agcounty,zone) ;

FURROWLAND(agcounty,zone)..
  SUM(MIXES,SUM(CROP, MIXDATA(agcounty,"irr",CROP,MIXES))
     * CROPMIX(agcounty,zone,MIXES,"furrow"))
                  =L=
  AVAILzone(agcounty,zone,"sprinkler") $ (Sprinkon eq 0) +
  AVAILzone(agcounty,zone,"furrow") - FurrToDry(agcounty,zone)
     - FurrToSpk(agcounty,zone)$SpkTrans ;

SPKLAND(agcounty,zone) $ sprinkon..
  SUM(MIXES,sum(CROP, MIXDATA(agcounty,"irr",CROP,MIXES))
       * CROPMIX(agcounty,zone,MIXES,"sprinkler"))
                  =L=
  AvailZone(agcounty,zone,"sprinkler") - SpkToDry(agcounty,zone)
     + FurrToSpk(agcounty,zone)$SpkTrans ;

IrrLand(agcounty,zone)..
          DevIrrig(agcounty,zone)
                =E=
  sum(irrtype("irr",landa),
   SUM(MIXES,SUM(CROP, MIXDATA(agcounty,"irr",CROP,MIXES))
     * CROPMIX(agcounty,zone,MIXES,landa   )));
```

```
MaxConvert(agcounty,zone) $ SpkTrans..
           FurrToSpk(agcounty,zone)
                -L=
        AvailZone(agcounty,zone,"furrow") * .8 ;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccc

MODEL EDWARDS /ALL/ ;

   Option NLP = MINOS5 ;
*   Option NLP = gamsbas ;
*  Option NLP = gamschk ;

   EDWARDS.OPTFILE = 1 ;

*$INCLUDE "edag1.bas"
   SOLVE EDWARDS MaxIMIZING AgProfit USING NLP ;

INCLUDE    /mac/mccarl/edwards/dryyear/drystudy
option solprint = off ;
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*   This program solve edag1 and writes out values
*     FOR STARTING AND ENDING HEADS and offer prices
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
set scenario dry year option scenarios
         /base,mallyear,mjuneall,mjune48
              ,uallyear,ujuneall,ujune48/
alias(month,smonth);
set scenarios(scenario) dry year option scenarios to run
        /mallyear/
set assume
         /janinter,juneint,allyear,48years,fixacre,uvaldec,medinac/
table scendata(assume,scenario)  scenario assumptions
           base   mallyear mjuneall mjune48 uallyear ujuneall ujune48
 janinter   0        1         0       0       1        0       0
 juneint    0        0         1       1       0        1       1
 allyear    0        1         1       0       1        1       0
 48years    0        0         0       1       0        0       1
 fixacre    0        0         1       0       0        1       0
 uvaldec    0        0         0       0       1        1       1
 medinac    0        1         1       1       0        0       0;

Set Dryyear(Rechargall) identify years which are dry
                     / 1956,1951,1963,1989,1980 / ;

set PriceSetX   Set of Offer Prices
      / 0,10,20,30,40,50,60,70,80,90,100,110,120,130,140,150,160,
        170,180,190,200 /
    PriceSet(PriceSetX)  set of prices to simulate
*     / 0,10,20,30,40,50,60,70,80,90,100,110,120,130,140,150 /
      /0, 90 /
    HeadSet    Set of pumping lifts that can be used
     / m50, m40, m30, m20, m10, m0, p10, p20, p30, p40, p50 /
    HSet(HeadSet)
*     / m50, m40, m30, m20, m10, m0, p10, p20, p30, p40, p50 /
     / m0 /
  ;

parameters
  J17Head(HeadSet)  J17 Head Difference
  / m50 -50, m40 -40, m30 -30, m20 -20, m10 -10, m0 0, p10 10,
    p20 20, p30 30, p40 40, p50 50 /
  SabHead(HeadSet)  Sabinal Head Difference
  / m50 -50, m40 -40, m30 -30, m20 -20, m10 -10, m0 0, p10 10,
    p20 20, p30 30, p40 40, p50 50 /
  LiftL(HeadSet,rechargall,region)  adjust Lift for head levels;

  LiftL(HSet,recharge,"eastlift") = Lifto(recharge,"eastlift")
       -.3456*J17Head(HSet) - .158*SabHead(HSet) ;
  LiftL(HSet,recharge,"westlift") = Lifto(recharge,"westlift")
       -.2983*J17Head(HSet) - .496*SabHead(HSet) ;

parameters
  objsum
  PriceP(PriceSetX) alternative compensation prices
  / 0 0,10 10,20 20,30 30,40 40,50 50,60 60,70 70,80 80,
    90 90,100 100,110 110,120 120,130 130,
    140 140,150 150,160 160,170 170,180 180,190 190,200 200 /
  ;

set
blockmonth(month) month when water use is bought out by midyear option
                / jun, jul, aug, sep, oct, nov, dec /
cropuses2(crops)  crops which use water during blocked period;
*figure crops which use water in june or after

cropuses2(crops)=yes$sum(blockmonth,
    sum(allstrat,
      sum(recharge,agdata2(blockmonth,recharge,"irr",crops,allstrat))));

```

```
set cROPelig2(rechargall,crops,allstrat) ;
cROPelig2(recharge,cropuses2,allstrat)
   =yes$(sum(blockmonth,
            agdata2(blockmonth,recharge,"irr",cropuses2,allstrat) )
                        eq 0);

   holdacres(agcounty,zone,landa,crop,recharge)
    = sum(allstrat $ strattype(landa,allstrat),
             CROPPROD.L(agcounty,zone,RECHARGE,crop,allstrat));
set
    CGroup  io model Groupings
        / Feed, Food, Oil, Hayg, Cot, Veg, TotCrop, Payment /
    CCGroup  io model Crop Groupings
        / Feed, Food, Oil, Hayg, Cot, Veg /
    InCGroup(CCGroup,crops)  Which crops in crop groupings
       / Feed. (corn, sorghum, oats),
         Food.  winwht,
         Oil.   (peanuts, soybeans),
         Hayg.  (hay, sorghay),
         Cot.   (cotton),
         Veg.   (cabbage, cantalop, cucumber, onion, lettuce,
                carrot, SPINACH, peppers, honeydew, potato, swtcorn,
                tomato, watermel) / ;

* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*     Create Parameters for Saving Values
* cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

Set rech(year)  Recharge years and Average ;
    rech(recharge) = yes ;
    rech("Ave") = yes ;

set itemtype
      /agincome   direct ag income
       payment    dry year payment in all counties
       totincome  ag income + payments,
       irracres   irrigated acres farmed
       dryacres   dryland acres farmed
       totacres   total acres farmed
       agwater    ag water use
       wellelev   well ending elevation increment
       comalinc   increase in comal springs flow
       sanmarinc  increase in san marcos springs flow
       grossinc   county gross output/
     itemname  /incomeint  income when interrupted,
                incomeun   income when not interrupted
                payment    payments to farms
                avgincome  average total income
                /

parameter summarytab(scenario,itemtype,groups,*,    priceset)
          summarytb(scenario,itemtype,*,zone,priceset);

Parameters
AbanLand(groups,zonall,scenario,priceset)       Abandoned Land
sprnkland2(groups,zonall,year,scenario,priceset)    Sprinkler Land
dryland2(groups,zonall,year,scenario,priceset)      Total to Dryland
furrland2(groups,zonall,year,scenario,priceset)      Furrow Land by Zone
totland2(groups,zonall,year,scenario,priceset)      Total Land in Ag
Agrwater(groups,year,month,scenario,priceset)    Ag Water
AgMargin(groups,zonall,year,scenario,priceset)   Ag Variable Prof.
SumIrrig(scenario,priceset)
SumToDry(scenario,priceset)
SumAgWater(scenario,priceset)
;

  Option NLP = Minos5 ;
*  Option NLP = gamschk ;
   EDWARDS.OPTFILE = 1 ;

     LiftP(recharge,region) = smax(hset,LiftL(HSet,recharge,region));
display cropstrat,iscrop;
parameter itt(scenario);
  loop(scenarios,
     itt(scenario)=0;
     itt(scenarios)=1;
     display itt;
     fixacres=0;
     payelig(agcounty)=no;
     cROPelig(rechargall,crops,lando,allstrat) =no;
    if(scendata("uvaldec",scenarios) gt 0, payelig("uvalde")=yes);
    if(scendata("medinac",scenarios) gt 0, payelig("medina")=yes);
    if(scendata("fixacre",scenarios) gt 0, fixacres=1);
    if(scendata("janinter",scenarios) gt 0,
     cROPelig(recharge,crops,"dry",drystrat) =yes$
         agdata2("yield",recharge,"dry",crops ,drystrat);
      );
    if(scendata("juneint",scenarios) gt 0,
     cROPelig(recharge,cropuses2,"irr",allstrat) =yes
        $(cROPelig2(recharge,cropuses2,allstrat) and
          agdata2("yield",recharge,"irr",cropuses2,allstrat));
```

```
        );
     if(scendata("48years",scenarios) gt 0,
      cROPelig(recharge,cropuses2,lando,allstrat)$
         (not(dryyear(recharge))) =no;);
      display  cropelig,fixacres,payelig;
   Loop (PriceSet,
        Price = PriceP(PriceSet) ;

     SOLVE EDWARDS MaxIMIZING AgProfit USING NLP ;

objsum=
 +SUM(RECHARGE,PROB(RECHARGE)*(
   + SUM((agcounty,zone),
      -DEVIRRIG.l(agcounty,zone) * COSTIRRIG
   - ( AvailZone(agcounty,zone,"sprinkler")
        +  FurrToSpk.l(agcounty,zone)$spktrans ) * CostSprink
+ paybuyout.l(agcounty,zone,recharge)*price
   + sum(lando,
        sum(crop$iscrop(agcounty,lando,crop ),
          sum(irrtype(lando,landa),
             sum(strattype(landa,allstrat)
                $agdata2("yield",recharge,lando,crop ,allstrat)
                ,CROPPROD.l(agcounty,zone,RECHARGe,crop ,allstrat)
           * ( agdata2("yield",recharge,lando,crop ,allstrat)
           *  ( agdata("price",lando,crop)
              - agdata("harvest",lando,crop) )
           -  agdata("totcost",lando,crop ) )))))
           - ( sum(month, AgWater.l(agcounty,zone,RECHARGE,month))
                 *(AgPumpcost.l("westlift",zone,recharge)
                      $sameas(agcounty,"uvalde")
                 + AgPumpcost.l("eastlift",zone,recharge)
                      $sameas(agcounty,"medina")))
        ) )) ;
AgMargin(agcounty,zone,recharge,scenarios,priceset) =
      -DEVIRRIG.l(agcounty,zone) * COSTIRRIG
   - ( AvailZone(agcounty,zone,"sprinkler")
        +  FurrToSpk.l(agcounty,zone)$spktrans ) * CostSprink
*+ paybuyout.l(agcounty,zone,recharge)*price
   + sum(lando,
        sum(crop$iscrop(agcounty,lando,crop ),
          sum(irrtype(lando,landa),
             sum(strattype(landa,allstrat)
                $agdata2("yield",recharge,lando,crop ,allstrat)
                ,CROPPROD.l(agcounty,zone,RECHARGe,crop ,allstrat)
           * ( agdata2("yield",recharge,lando,crop ,allstrat)
           *  ( agdata("price",lando,crop)
              - agdata("harvest",lando,crop) )
           -  agdata("totcost",lando,crop ) )))))
           - ( sum(month, AgWater.l(agcounty,zone,RECHARGE,month))
                 *(AgPumpcost.l("westlift",zone,recharge)
                      $sameas(agcounty,"uvalde")
                 + AgPumpcost.l("eastlift",zone,recharge)
                      $sameas(agcounty,"medina")))
           ;

agrwater(agcounty,recharge,month,scenarios,priceset)
    =  sum(zone, agwater.l(agcounty,zone,recharge,month) );

sprnkland2(agcounty,zone,recharge,scenarios,priceset) =
    sum((crop,spkstrat),
     CROPPROD.l(agcounty,zone,recharge,crop,spkstrat));

furrland2(agcounty,zone,recharge,scenarios,priceset) =
    sum((crop,fstat ),
     CROPPROD.l(agcounty,zone,recharge,crop,fstat ))
;
dryland2(agcounty,zone,recharge,scenarios,priceset) =
    sum((crop,drystrat) ,
     CROPPROD.l(agcounty,zone,recharge,crop,drystrat))
;
totland2(agcounty,zone,recharge,scenarios,priceset) =
    sum((crop,strategy),
     CROPPROD.l(agcounty,zone,recharge,crop,strategy))
;
abanland(agcounty,zone,scenarios,priceset) = availzone(agcounty,zone,"irr")
      - DevIrrig.L(agcounty,zone)
      - furrToDry.L(agcounty,zone)
      - spkToDry.L(agcounty,zone) ;
  abanland(groups,zone,scenarios,priceset)
     $(abanland(groups,zone,scenarios,priceset) lt .1)=0;

* ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
*   The following values to be saved and displayed
* ccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

SumIrrig(scenarios,priceset)
      = sum((agcounty,zone),DevIrrig.L(agcounty,zone));
SumToDry(scenarios,priceset) = sum((agcounty,zone),
     sum(recharge,prob(recharge)
                *DryLand2(agcounty,zone,recharge,scenarios,priceset))) ;
SumAgWater(scenarios,priceset) = sum((agcounty,recharge,month),
```

```
    (agrwater(agcounty,recharge,month,scenarios,priceset)
                 * Prob(recharge) ) ) ;

*set itemtype
*      /agincome,agwatuse,agacres,wellelev,comalinc,sanmarinc,elev
*       grossout/
*     itemname  /incomeint  income when interrupted,
*                incomeun   income when not interrupted
*                payment    payments to farms
*                avgincome  average total income
*                /

*parameter summarytab(itemtype,*,scenario)
*           summarytb(itemtype,*,zone,scenario);

 summarytab(scenarios,"agincome",agcounty,zone,priceset)=
      sum(recharge,prob(recharge)*
        AgMargin(agcounty,zone,recharge,scenarios,priceset) ) ;
 summarytab(scenarios,"agincome",agcounty,"all",priceset)=
    sum(zone,summarytab(scenarios,"agincome",agcounty,zone,priceset));
 summarytab(scenarios,"agincome","total",zonall,priceset)=
    sum(agcounty,
         summarytab(scenarios,"agincome",agcounty,zonall,priceset));
 summarytab(scenarios,"payment",agcounty,zone,priceset)=
         sum(recharge,prob(recharge)*
              paybuyout.l(agcounty,zone,recharge) )*price;
 summarytab(scenarios,"payment",agcounty,"all",priceset)=
    sum(zone,summarytab(scenarios,"payment",agcounty,zone,priceset));
summarytab(scenarios,"payment","total",zonall,priceset)=
sum(agcounty,summarytab(scenarios,"payment",agcounty,zonall,priceset));
summarytab(scenarios,"totincome",groups,zonall,priceset)=
summarytab(scenarios,"agincome",groups,zonall,priceset)+
summarytab(scenarios,"payment",groups,zonall,priceset);

summarytab(scenarios,"irracres",agcounty,zone,priceset)=
       sum(recharge,prob(recharge)
          *sum((crop,allstrat)
           $(not drystrat(allstrat)),
           CROPPROD.L(agcounty,zone,RECHARGE,crop,allstrat)));
summarytab(scenarios,"dryacres",agcounty,zone,priceset)=
       sum(recharge,prob(recharge)
          *sum((crop,allstrat)
            $(drystrat(allstrat)),
           CROPPROD.L(agcounty,zone,RECHARGE,crop,allstrat)));
summarytab(scenarios,"IRRacres",agcounty,"all",priceset)=
 sum(zone,summarytab(scenarios,"IRRacres",agcounty,zone,priceset));
summarytab(scenarios,"dryacres",agcounty,"all",priceset)=
 sum(zone,summarytab(scenarios,"dryacres",agcounty,zone,priceset));
summarytab(scenarios,"totacres",agcounty,zonall,priceset)=
summarytab(scenarios,"dryacres",agcounty,zonall,priceset)+
summarytab(scenarios,"irracres",agcounty,zonall,priceset);
summarytab(scenarios,"dryacres","total",zonall,priceset)=
 sum(agcounty,
   sum(zone,summarytab(scenarios,"dryacres",agcounty,zonall,priceset)));
summarytab(scenarios,"irracres","total",zonall,priceset)=
 sum(agcounty,
   sum(zone,summarytab(scenarios,"irracres",agcounty,zonall,priceset)));
summarytab(scenarios,"totacres","total",zonall,priceset)=
 sum(agcounty,
   sum(zone,summarytab(scenarios,"totacres",agcounty,zonall,priceset)));
summarytab(scenarios,"agwater",agcounty,month,priceset)=
    sum(recharge,prob(recharge)*
     Agrwater(agcounty,recharge,month,scenarios,priceset));
summarytab(scenarios,"agwater","total",month,priceset)=
  sum(agcounty,summarytab(scenarios,"agwater",agcounty,month,priceset));
summarytab(scenarios,"agwater",groups,"all",priceset)=
    sum(month,summarytab(scenarios,"agwater",groups,month,priceset));

summarytab(scenarios,"wellelev","total","j17",priceset)=
     REGPAR("endj17head","dec","c1","eastuse")*
      sum(smonth,
          summarytab(scenarios,"agwater","medina",smonth,priceset)
         -summarytab(scenarios,"agwater","medina",smonth,"0"))
    +REGPAR("endj17head","dec","c1","westuse")*
      sum(smonth,
          summarytab(scenarios,"agwater","uvalde",smonth,priceset)
         -summarytab(scenarios,"agwater","uvalde",smonth,"0"));
summarytab(scenarios,"wellelev","total","sabinal",priceset)=
     REGPAR("endsabhead","dec","c1","eastuse")*
      sum(smonth,
          summarytab(scenarios,"agwater","medina",smonth,priceset)
         -summarytab(scenarios,"agwater","medina",smonth,"0"))
    +REGPAR("endsabhead","dec","c1","westuse")*
      sum(smonth,
          summarytab(scenarios,"agwater","uvalde",smonth,priceset)
         -summarytab(scenarios,"agwater","uvalde",smonth,"0"));
summarytab(scenarios,"comalinc","total",month,priceset)=
     REGPAR("sprcomal",month,"c1","eastuse")*
      sum(smonth$(ord(smonth) le ord(month)) ,
          summarytab(scenarios,"agwater","medina",smonth,priceset)
         -summarytab(scenarios,"agwater","medina",smonth,"0"))
```

```
    +REGPAR("sprcomal",month,"c1","westuse")*
      sum(smonth$(ord(smonth) le ord(month)) ,
          summarytab(scenarios,"agwater","uvalde",smonth,priceset)
         -summarytab(scenarios,"agwater","uvalde",smonth,"0"));
summarytab(scenarios,"comalinc","total","all",priceset)=
 sum(month,summarytab(scenarios,"comalinc","total",month,priceset));
summarytab(scenarios,"sanmarinc","total",month,priceset)=
     REGPAR("sprsanmar",month,"c1","eastuse")*
      sum(smonth$(ord(smonth) le ord(month)) ,
          summarytab(scenarios,"agwater","medina",smonth,priceset)
         -summarytab(scenarios,"agwater","medina",smonth,"0"))
    +REGPAR("sprsanmar",month,"c1","westuse")*
      sum(smonth$(ord(smonth) le ord(month)) ,
          summarytab(scenarios,"agwater","uvalde",smonth,priceset)
         -summarytab(scenarios,"agwater","uvalde",smonth,"0"));
summarytab(scenarios,"sanmarinc","total","all",priceset)=
 sum(month,summarytab(scenarios,"sanmarinc","total",month,priceset));
summarytab(scenarios,"grossinc",agcounty,ccgroup,priceset)=
    + sum((zone,lando),
         sum(recharge,prob(recharge)*
            sum(InCGroup(CCGroup,crop),
               sum(irrtype(lando,landa),
                   sum(strattype(landa,allstrat) ,
                  CROPPROD.l(agcounty,zone,RECHARGe,crop ,allstrat)
            *  agdata2("yield",recharge,lando,crop ,allstrat))
            *  agdata("price",lando,crop)))));

   )
  ) ;
option summarytab:2:4:1;
display summarytab,objsum,paybuyout.l;
```

Appendix B. Guide to item uses in GAMS code

Table B.1 Files where actions on SETS appear

ITEM NAME	DECLARED	DEFINED	ASSIGNED	CONTROL	REF	
ADJUST	eddata	eddata		eddata	eddata	
AGCOUNTY	agmodel	agmodel		agmodel drystudy	agmodel drystudy	
AGEFF	eddata	eddata		agmodel	agmodel	
AGIRREFF	eddata	eddata			eddata	
AGITEM	eddata	eddata			eddata	
ALLSTRAT	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	
ASSUME	drystudy	drystudy			drystudy	
BASIN	eddata	eddata		eddata	eddata	
BEGHEAD	agmodel	agmodel			agmodel	
BLOCKMONTH	drystudy	drystudy		drystudy	drystudy	
BUYOUTYEAR	agmodel		agmodel	agmodel	agmodel	
CCGROUP	drystudy	drystudy		drystudy	drystudy	
CGROUP	drystudy	drystudy				**** no use
COUNTY	eddata		eddata	eddata	eddata	
COUNTYS	eddata	eddata		eddata	eddata	
CROP	eddata		eddata	eddata agmodel drystudy	eddata agmodel drystudy	
CROP1	eddata		eddata	eddata	eddata	
CROP2	eddata		eddata	eddata	eddata	
CROPELIG	agmodel		agmodel drystudy	agmodel	drystudy	
CROPELIG2	drystudy		drystudy		drystudy	
CROPS	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	
CROPS1	eddata		eddata	eddata		
CROPS2	eddata	eddata		eddata		
CROPSTRAT	eddata		eddata		eddata agmodel drystudy	
CROPUSES	agmodel		agmodel	agmodel		
CROPUSES2	drystudy		drystudy	drystudy	drystudy	
DATES	eddata	eddata			eddata	

DRYSTAT	eddata		eddata			**** no use
DRYSTRAT	eddata	eddata		eddata agmodel drystudy	eddata drystudy	
DRYYEAR	drystudy	drystudy			drystudy	
ECOUNTY	agmodel	agmodel				**** no use
ENDHEAD	eddata	eddata			eddata agmodel	
EPICITEM	eddata		eddata	eddata	eddata	
EQU	eddata	eddata			eddata agmodel	
FSTAT	eddata		eddata	eddata agmodel drystudy	eddata drystudy	
FSTRAT	eddata	eddata		eddata		
GROUP	eddata	eddata				**** no use
GROUPS	eddata	eddata		eddata drystudy	eddata agmodel drystudy	
HEADSET	drystudy	drystudy			drystudy	
HSET	drystudy	drystudy		drystudy	drystudy	
INCGROUP	drystudy	drystudy		drystudy		
IRRTYPE	agmodel	agmodel		agmodel drystudy	agmodel	
ITEMNAME	drystudy	drystudy				**** no use
ITEMTYPE	drystudy	drystudy			drystudy	
LAND	eddata	eddata		eddata	eddata	
LANDA	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	
LANDO	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	
MAPLOC	agmodel	agmodel				**** no use
MIXES	eddata	eddata		eddata agmodel	eddata agmodel	
MIXESA	eddata	eddata			eddata agmodel	
MLINK	agmodel	agmodel				**** no use
MONTH	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	
MONTH2	agmodel				agmodel	
MONTHP	eddata	eddata			eddata	
MONTHS	eddata			eddata	eddata	

OBS	eddata	eddata			eddata	
PAYELIG	agmodel		agmodel drystudy		agmodel drystudy	
PENASTRAT	eddata	eddata		eddata	eddata	
PRICESET	drystudy	drystudy		drystudy	drystudy	
PRICESETX	drystudy	drystudy			drystudy	
PROJECT	eddata	eddata		eddata	eddata	
RECH	drystudy		drystudy			**** no use
RECHARGALL	eddata	eddata		drystudy	eddata agmodel drystudy	
RECHARGE	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	
REGION	eddata	eddata		agmodel drystudy	eddata agmodel drystudy	
REGRESS	eddata	eddata			eddata agmodel	
REPCROPA1	eddata	eddata		eddata	eddata	
SAMEAS					eddata drystudy	**** no assn val
SAVAGITEM	eddata		eddata	eddata	eddata	
SCENARIO	drystudy	drystudy		drystudy	drystudy	
SCENARIOS	drystudy	drystudy		drystudy	drystudy	
SMONTH	drystudy			drystudy	drystudy	
SPKSTAT	eddata		eddata	eddata	eddata	
SPKSTRAT	eddata		eddata	agmodel drystudy	eddata drystudy	
SPRINGS	eddata	eddata			agmodel	
STAGE	eddata	eddata		eddata	eddata	
STRATEGY	eddata		eddata	eddata drystudy	drystudy	
STRATTYPE	agmodel		agmodel	agmodel drystudy	agmodel drystudy	
USEGROUP	eddata	eddata				**** no use
USER	eddata	eddata			eddata	
USEYEAR	eddata	eddata			eddata agmodel	
WATERDEP	eddata	eddata				**** no use
WATERSTAT	eddata		eddata	eddata	eddata	
WATR	eddata	eddata		eddata	eddata	
WATUSEYEAR	agmodel	agmodel				**** no use

WCOUNTY	agmodel	agmodel				**** no use
WETSTRAT	eddata		eddata	eddata	eddata	
WITEM	eddata	eddata		eddata	eddata	
WS	eddata		eddata	eddata	eddata	
YEAR	eddata	eddata		eddata	eddata agmodel drystudy	
ZONALL	eddata	eddata		drystudy	eddata agmodel drystudy	
ZONE	eddata	eddata		eddata agmodel drystudy	eddata agmodel drystudy	

Table B.2 Files where actions on PARAMETERS appear

ITEM NAME	DECLARED	DEFINED	ASSIGNED	REF	
ABANLAND	drystudy		drystudy	drystudy	
ABCAVG	eddata		eddata	eddata	
ABCRESULT	eddata		eddata	eddata	
ABCRESULTS	eddata		eddata	eddata	
AGDATA	eddata		eddata	eddata agmodel drystudy	
AGDATA2	eddata		eddata	eddata agmodel drystudy	
AGDIFF	eddata	eddata		agmodel	
AGIRREFIC	eddata	eddata		agmodel	
AGMARGIN	drystudy		drystudy	drystudy	
AGPCT	eddata	eddata		eddata	
AGRWATER	drystudy		drystudy	drystudy	
AIND	eddata		eddata		**** no use
AMUN	eddata		eddata	eddata	
ASSIGNBAS	eddata	eddata		eddata	
AVAILLAND	eddata	eddata	eddata	eddata	
AVAILZONE	eddata		eddata	eddata agmodel drystudy	
AVECLIMATE	eddata		eddata	eddata	
AVGRECHAR	eddata		eddata		**** no use
BCAV	eddata		eddata	eddata	
BCAVG	eddata		eddata		**** no use
BCCONSTANT	eddata		eddata	eddata	
BCDATA	eddata	eddata		eddata	
BCRESULT	eddata		eddata	eddata	
BCRESULTS	eddata		eddata	eddata	
CABBAGE	eddata	eddata		eddata	
CAL1	eddata	eddata			**** no use
CAL2	eddata	eddata			**** no use
CANTALOP	eddata	eddata		eddata	
CARROT	eddata	eddata		eddata	
CDIF	eddata				**** no use
CLIMATE	eddata		eddata	eddata	

CORN	eddata	eddata		eddata	
COST	eddata	eddata		eddata	
COSTIRRIG	eddata	eddata		agmodel drystudy	
COSTSPRINK	eddata	eddata		agmodel drystudy	
COTTON	eddata	eddata		eddata	
COUNTYWTS	eddata		eddata		**** no use
CPUMP	eddata		eddata		**** no use
CUCUMBER	eddata	eddata		eddata	
DAYLIGHT	eddata	eddata		eddata	
DAYMONTH	eddata	eddata			**** no use
DE	eddata	eddata		agmodel	
DRYLAND2	drystudy		drystudy	drystudy	
ELAS	eddata	eddata			**** no use
FIXACRES	agmodel	agmodel	drystudy	agmodel drystudy	
FURRLAND2	drystudy		drystudy		**** no use
HOLDACRES	agmodel		agmodel drystudy	agmodel	
INDADD	eddata	eddata		eddata	
INDEMAND	eddata	eddata	eddata	eddata	
INDPCT	eddata		eddata	eddata	
ISCROP	eddata		eddata	eddata agmodel drystudy	
ISCROP2	eddata		eddata		**** no use
ISDATA	eddata		eddata	eddata	
ITT	drystudy		drystudy	drystudy	
J17HEAD	drystudy	drystudy		drystudy	
LABORC	eddata	eddata		agmodel	
LETTUCE	eddata	eddata		eddata	
LIFTL	drystudy		drystudy	drystudy	
LIFTO	agmodel	agmodel		drystudy	
LIFTP	agmodel		agmodel drystudy	agmodel	
LIMIT	agmodel	agmodel			**** no use
MIDIFF	eddata	eddata			**** no use
MIXDATA	eddata	eddata		eddata agmodel	

MRECH	eddata	eddata	eddata	eddata	
MUNADD	eddata	eddata		eddata	
MUNDEMAND	eddata		eddata		**** no use
MUNPCT	eddata		eddata	eddata	
MUNUSE	eddata	eddata		eddata	
NDAT	eddata		eddata	eddata	
NRECH	eddata		eddata	eddata	
OATS	eddata	eddata		eddata	
OBJSUM	drystudy		drystudy	drystudy	
ONION	eddata	eddata		eddata	
PCHANGE	eddata	eddata		eddata	
PDATA	eddata	eddata		eddata	
PE	eddata	eddata		agmodel	
PEANUTS	eddata	eddata		eddata	
PERCENT	eddata				**** no use
PNG	eddata	eddata		agmodel	
PRICE	agmodel	agmodel	drystudy	agmodel drystudy	
PRICEP	drystudy	drystudy		drystudy	
PROB	eddata		eddata	eddata agmodel drystudy	
PSI	eddata	eddata		agmodel	
RAGDATA	eddata	eddata	eddata	eddata	
RAGDATA2	eddata		eddata	eddata	
RECHARGED	eddata	eddata		eddata	
RECHARGEL	eddata		eddata	eddata	
RECHARGEM	eddata				**** no use
REGPAR	eddata	eddata		drystudy	
REPAIRC	eddata	eddata		agmodel	
ROOTWATER	eddata		eddata	eddata	
RUNYEAR	eddata	eddata			**** no use
SABHEAD	drystudy	drystudy		drystudy	
SCENDATA	drystudy	drystudy		drystudy	
SORGHAY	eddata	eddata	eddata	eddata	
SORGHUM	eddata	eddata		eddata	
SPINACH	eddata	eddata		eddata	
SPKTRANS	agmodel	agmodel		agmodel drystudy	

SPRINGMIN	agmodel	agmodel			**** no use
SPRINKON	agmodel	agmodel		agmodel	
SPRNKLAND2	drystudy		drystudy		**** no use
SUMAGWATER	drystudy		drystudy		**** no use
SUMIRRIG	drystudy		drystudy		**** no use
SUMMARYTAB	drystudy		drystudy	drystudy	
SUMMARYTB	drystudy				**** no use
SUMTODRY	drystudy		drystudy		**** no use
TOTLAND2	drystudy		drystudy		**** no use
VPUMP	eddata		eddata		**** no use
WEATHER	eddata		eddata	eddata	
WEATHERD	eddata	eddata	eddata	eddata	
WINWHT	eddata	eddata		eddata	

Table B.3 Files where actions on EQUATIONS appear

ITEM NAME	DECLARED	DEFINED	ASSIGNED	REF
BUYOUTPAY	agmodel	agmodel		agmodel
CROPACRE	agmodel	agmodel		agmodel
DRYLAND	agmodel	agmodel		agmodel
FIXACRE	agmodel	agmodel		agmodel
FURROWLAND	agmodel	agmodel		agmodel
IRRLAND	agmodel	agmodel		agmodel
IRRPUMP	agmodel	agmodel		agmodel
MAXCONVERT	agmodel	agmodel		agmodel
OBJ	agmodel	agmodel		agmodel
PUMPCOAGEQ	agmodel	agmodel		agmodel
PUMPLFT	agmodel	agmodel		agmodel
SPKLAND	agmodel	agmodel		agmodel

Table B.4 Files where actions on VARIABLES appear

ITEM NAME	DECLARED	DEFINED	ASSIGNED	REF	
AGPROFIT	agmodel			agmodel drystudy	
AGPUMPCOST	agmodel			agmodel drystudy	
AGWATER	agmodel			agmodel drystudy	
ARTSPRING	agmodel				**** no use
CROPMIX	agmodel			agmodel	
CROPPROD	agmodel			agmodel drystudy	
DEVIRRIG	agmodel			agmodel drystudy	
ENDWATER	agmodel				**** no use
FURRTODRY	agmodel			agmodel drystudy	
FURRTOSPK	agmodel			agmodel drystudy	
INITWATER	agmodel				**** no use
LIFT	agmodel			agmodel	
PAYBUYOUT	agmodel			agmodel drystudy	
SPKTODRY	agmodel			agmodel drystudy	

Table B.5 Files where actions on MODELS appear

ITEM NAME	DECLARED	DEFINED	ASSIGNED	REF
EDWARDS	agmodel	agmodel	agmodel drystudy	agmodel drystudy

Table B.6 Items worked on in file agmodel

SETS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
AGCOUNTY	X	X			X	X
AGEFF					X	X
ALLSTRAT					X	X
BEGHEAD	X	X				X
BUYOUTYEAR		X	X		X	X
CROP					X	X
CROPELIG		X	X		X	
CROPS					X	X
CROPSTRAT						X
CROPUSES		X	X		X	
DRYSTRAT					X	
ECOUNTY	X	X				
ENDHEAD						X
EQU						X
FSTAT					X	
GROUPS						X
IRRTYPE	X	X			X	X
LANDA					X	X
LANDO					X	X
MAPLOC	X	X				
MIXES					X	X
MIXESA						X
MLINK	X	X				
MONTH					X	X
MONTH2		X				X
PAYELIG		X	X			X
RECHARGALL						X
RECHARGE					X	X
REGION					X	X
REGRESS						X
SPKSTRAT					X	
SPRINGS						X
STRATTYPE		X	X		X	X
USEYEAR						X
WATUSEYEAR	X	X				
WCOUNTY	X	X				
YEAR						X
ZONALL						X
ZONE					X	X

PARAMETERS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
AGDATA						X
AGDATA2						X
AGDIFF						X
AGIRREFIC						X
AVAILZONE						X
COSTIRRIG						X
COSTSPRINK						X
DE						X
FIXACRES	X	X				X
HOLDACRES		X	X			X
ISCROP						X
LABORC						X
LIFTO	X	X				
LIFTP		X	X			X
LIMIT	X	X				
MIXDATA						X
PE						X
PNG						X
PRICE	X	X				X
PROB						X
PSI						X
REPAIRC						X
SPKTRANS	X	X				X
SPRINGMIN	X	X				
SPRINKON	X	X				X

EQUATIONS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
BUYOUTPAY	X	X		X		X
CROPACRE	X	X		X		X
DRYLAND	X	X		X		X
FIXACRE	X	X		X		X
FURROWLAND	X	X		X		X
IRRLAND	X	X		X		X
IRRPUMP	X	X		X		X
MAXCONVERT	X	X		X		X
OBJ	X	X		X		X
PUMPCOAGEQ	X	X		X		X
PUMPLFT	X	X		X		X
SPKLAND	X	X		X		X

VARIABLES

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
AGPROFIT		X		X		X
AGPUMPCOST		X		X		X
AGWATER		X		X		X
ARTSPRING		X				
CROPMIX		X		X		X
CROPPROD		X		X		X
DEVIRRIG		X		X		X
ENDWATER		X				
FURRTODRY		X		X		X
FURRTOSPK		X		X		X
INITWATER		X				
LIFT		X		X		X
PAYBUYOUT		X		X		X
SPKTODRY		X		X		X

MODELS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
EDWARDS	X	X	X	X		X

Table B.7 Items worked on in file drystudy

SETS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
AGCOUNTY					X	X
ALLSTRAT					X	X
ASSUME	X	X				X
BLOCKMONTH	X	X			X	X
CCGROUP	X	X			X	X
CGROUP	X	X				
CROP					X	X
CROPELIG			X			X
CROPELIG2		X	X			X
CROPS					X	X
CROPSTRAT						X
CROPUSES2		X	X		X	X
DRYSTRAT					X	X
DRYYEAR	X	X				X
FSTAT					X	X
GROUPS					X	X
HEADSET	X	X				X
HSET	X	X			X	X
INCGROUP	X	X			X	
IRRTYPE					X	
ITEMNAME	X	X				
ITEMTYPE	X	X				X
LANDA					X	X
LANDO					X	X
MONTH					X	X
PAYELIG			X			X
PRICESET	X	X			X	X
PRICESETX	X	X				X
RECH		X	X			
RECHARGALL					X	X
RECHARGE					X	X
REGION					X	X
SAMEAS						X
SCENARIO	X	X			X	X
SCENARIOS	X	X			X	X
SMONTH		X			X	X
SPKSTRAT					X	X
STRATEGY					X	X
STRATTYPE					X	X
YEAR						X
ZONALL					X	X
ZONE					X	X

PARAMETERS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
ABANLAND		X	X			X
AGDATA						X
AGDATA2						X
AGMARGIN		X	X			X
AGRWATER		X	X			X
AVAILZONE						X
COSTIRRIG						X
COSTSPRINK						X
DRYLAND2		X	X			X
FIXACRES			X			X
FURRLAND2		X	X			
HOLDACRES			X			
ISCROP						X
ITT		X	X			X
J17HEAD	X	X				X
LIFTL		X	X			X
LIFTO						X
LIFTP			X			
OBJSUM		X	X			X
PRICE			X			X
PRICEP	X	X				X
PROB						X
REGPAR						X

SABHEAD	X	X				X
SCENDATA	X	X				X
SPKTRANS						X
SPRNKLAND2		X	X			
SUMAGWATER		X	X			
SUMIRRIG		X	X			
SUMMARYTAB		X	X			X
SUMMARYTB		X				
SUMTODRY		X	X			
TOTLAND2		X	X			

EQUATIONS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
BUYOUTPAY				X		
CROPACRE				X		
DRYLAND				X		
FIXACRE				X		
FURROWLAND				X		
IRRLAND				X		
IRRPUMP				X		
MAXCONVERT				X		
OBJ				X		
PUMPCOAGEQ				X		
PUMPLFT				X		
SPKLAND				X		

VARIABLES

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
AGPROFIT				X		X
AGPUMPCOST				X		X
AGWATER				X		X
CROPMIX				X		
CROPPROD				X		X
DEVIRRIG				X		X
FURRTODRY				X		X
FURRTOSPK				X		X
LIFT				X		
PAYBUYOUT				X		X
SPKTODRY				X		X

MODELS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
EDWARDS			X	X		X

Table B.8 Items worked on in file eddata

SETS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
ADJUST	X	X			X	X
AGEFF	X	X				
AGIRREFF	X	X				X
AGITEM	X	X				X
ALLSTRAT	X	X			X	X
BASIN	X	X			X	X
COUNTY		X	X		X	X
COUNTYS	X	X			X	X
CROP		X	X		X	X
CROP1		X	X		X	X
CROP2		X	X		X	X
CROPS	X	X			X	X
CROPS1		X	X		X	
CROPS2	X	X			X	
CROPSTRAT		X	X			X
DATES	X	X				X
DRYSTAT		X	X			
DRYSTRAT	X	X			X	X
ENDHEAD	X	X				X
EPICITEM		X	X		X	X
EQU	X	X				X
FSTAT		X	X		X	X
FSTRAT	X	X			X	
GROUP	X	X				
GROUPS	X	X			X	X
LAND	X	X			X	X
LANDA	X	X			X	X
LANDO	X	X			X	X
MIXES	X	X			X	X
MIXESA	X	X				X
MONTH	X	X			X	X
MONTHP	X	X				X
MONTHS		X			X	X
OBS	X	X				X
PENASTRAT	X	X			X	X
PROJECT	X	X			X	X
RECHARGALL	X	X				X
RECHARGE	X	X			X	X
REGION	X	X				X
REGRESS	X	X				X
REPCROPA1	X	X			X	X
SAMEAS						X
SAVAGITEM		X	X		X	X
SPKSTAT		X	X		X	X
SPKSTRAT		X	X			X
SPRINGS	X	X				
STAGE	X	X			X	X
STRATEGY		X	X		X	
USEGROUP	X	X				
USER	X	X				X
USEYEAR	X	X				X
WATERDEP	X	X				
WATERSTAT		X	X		X	X
WATR	X	X			X	X
WETSTRAT		X	X		X	X
WITEM	X	X			X	X
WS		X	X		X	X
YEAR	X	X			X	X
ZONALL	X	X				X
ZONE	X	X			X	X

PARAMETERS

Item Name	DEFINED	DECLARED	ASSIGNED	IMPL-ASN	CONTROL	REF
ABCAVG		X	X			X
ABCRESULT		X	X			X
ABCRESULTS		X	X			X
AGDATA		X	X			X
AGDATA2		X	X			X
AGDIFF	X	X				

AGIRREFIC	X	X		
AGPCT	X	X		X
AIND		X	X	
AMUN		X	X	X
ASSIGNBAS	X	X		X
AVAILLAND	X	X	X	X
AVAILZONE		X	X	X
AVECLIMATE		X	X	X
AVGRECHAR		X	X	
BCAV		X	X	X
BCAVG		X	X	
BCCONSTANT		X	X	X
BCDATA	X	X		X
BCRESULT		X	X	X
BCRESULTS		X	X	X
CABBAGE	X	X		X
CAL1	X	X		
CAL2	X	X		
CANTALOP	X	X		X
CARROT	X	X		X
CDIF		X		
CLIMATE		X	X	X
CORN	X	X		X
COST	X	X		X
COSTIRRIG	X	X		
COSTSPRINK	X	X		
COTTON	X	X		X
COUNTYWTS		X	X	
CPUMP		X	X	
CUCUMBER	X	X		X
DAYLIGHT	X	X		X
DAYMONTH	X	X		
DE	X	X		
ELAS	X	X		
INDADD	X	X		X
INDEMAND	X	X	X	X
INDPCT		X	X	X
ISCROP		X	X	X
ISCROP2		X	X	
ISDATA		X	X	X
LABORC	X	X		
LETTUCE	X	X		X
MIDIFF	X	X		
MIXDATA	X	X		X
MRECH	X	X	X	X
MUNADD	X	X		X
MUNDEMAND		X	X	
MUNPCT		X	X	X
MUNUSE	X	X		X
NDAT		X	X	X
NRECH		X	X	X
OATS	X	X		X
ONION	X	X		X
PCHANGE	X	X		X
PDATA	X	X		X
PE	X	X		
PEANUTS	X	X		X
PERCENT		X		
PNG	X	X		
PROB		X	X	X
PSI	X	X		
RAGDATA	X	X	X	X
RAGDATA2		X	X	X
RECHARGED	X	X		X
RECHARGEL		X	X	X
RECHARGEM		X		
REGPAR	X	X		
REPAIRC	X	X		
ROOTWATER		X	X	X
RUNYEAR	X	X		
SORGHAY	X	X	X	X
SORGHUM	X	X		X
SPINACH	X	X		X

VPUMP		X	X	
WEATHER		X	X	X
WEATHERD	X	X	X	X
WINWHT	X	X		X

Table B.9 List of Parameters which are given input values

Parameter	File where values are entered
FIXACRES	agmodel
LIFTO	agmodel
LIMIT	agmodel
PRICE	agmodel
SPKTRANS	agmodel
SPRINGMIN	agmodel
SPRINKON	agmodel
J17HEAD	drystudy
PRICEP	drystudy
SABHEAD	drystudy
SCENDATA	drystudy
AGDIFF	eddata
AGIRREFIC	eddata
AGPCT	eddata
ASSIGNBAS	eddata
AVAILLAND	eddata
BCDATA	eddata
CABBAGE	eddata
CAL1	eddata
CAL2	eddata
CANTALOP	eddata
CARROT	eddata
CORN	eddata
COST	eddata
COSTIRRIG	eddata
COSTSPRINK	eddata
COTTON	eddata
CUCUMBER	eddata
DAYLIGHT	eddata
DAYMONTH	eddata
DE	eddata
ELAS	eddata
INDADD	eddata
INDEMAND	eddata
LABORC	eddata
LETTUCE	eddata
MIDIFF	eddata
MIXDATA	eddata
MRECH	eddata
MUNADD	eddata
MUNUSE	eddata
OATS	eddata
ONION	eddata
PCHANGE	eddata
PDATA	eddata
PE	eddata
PEANUTS	eddata
PNG	eddata
PSI	eddata
RAGDATA	eddata
RECHARGED	eddata
REGPAR	eddata
REPAIRC	eddata
RUNYEAR	eddata
SORGHAY	eddata
SORGHUM	eddata
SPINACH	eddata
WEATHERD	eddata
WINWHT	eddata

Table B.10 List of Parameters which are Computed

Parameter	File where values are computed
HOLDACRES	agmodel
LIFTP	agmodel
ABANLAND	drystudy
AGMARGIN	drystudy
AGRWATER	drystudy
DRYLAND2	drystudy
FIXACRES	drystudy
FURRLAND2	drystudy
HOLDACRES	drystudy
ITT	drystudy
LIFTL	drystudy
LIFTP	drystudy
OBJSUM	drystudy
PRICE	drystudy
SPRNKLAND2	drystudy
SUMAGWATER	drystudy
SUMIRRIG	drystudy
SUMMARYTAB	drystudy
SUMTODRY	drystudy
TOTLAND2	drystudy
ABCAVG	eddata
ABCRESULT	eddata
ABCRESULTS	eddata
AGDATA	eddata
AGDATA2	eddata
AIND	eddata
AMUN	eddata
AVAILZONE	eddata
AVECLIMATE	eddata
AVGRECHAR	eddata
BCAV	eddata
BCAVG	eddata
BCCONSTANT	eddata
BCRESULT	eddata
BCRESULTS	eddata
CLIMATE	eddata
COUNTYWTS	eddata
CPUMP	eddata
INDPCT	eddata
ISCROP	eddata
ISCROP2	eddata
ISDATA	eddata
MUNDEMAND	eddata
MUNPCT	eddata
NDAT	eddata
NRECH	eddata
PROB	eddata
RAGDATA2	eddata
RECHARGEL	eddata
ROOTWATER	eddata
VPUMP	eddata
WEATHER	eddata

Appendix C. Dry Year Option Analysis Paper

Appendix C. Special Paper

Economic and Hydrologic Implications of Implementing a Dry Year Option For the Edwards Aquifer

K.O. Keplinger

B.A. McCarl

M.E. Chowdhury

R.D. Lacewell

Department of Agricultural Economics
Texas A&M University
(409) 845-1706

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Economic and Hydrologic Implications of Implementing a Dry Year Option
For the Edwards Aquifer

Recent events regarding management of the Edwards aquifer (aquifer) have focused attention on ways to reduce pumping from the aquifer in order to augment declining springflows. This interest has occurred within the context of: years of litigation centered around springflows; a severe drought which has plagued the region; several new lawsuits which have recently been filed; a nascent (and cash strapped) Edwards Aquifer Authority; and a federal court order to limit pumping which has been challenged by both the city of San Antonio and the state of Texas.

Despite political and legal wrangling on how the aquifer should be managed, all aquifer interests agree that the Edwards aquifer can no longer produce enough water to fully satisfy all demands during dry years. One way to relieve the burden on municipalities, who are most often the entities forced to cut back in times of drought, is by implementing a dry year option. As envisioned, this arrangement would involve private contacts between irrigators and a purchasing entity which would require irrigators not to pump during dry years in exchange for cash payments on a per acre basis. This paper provides 1) a brief background to the aquifer debate and dry year options, mostly focusing on recent events, 2) a summary of previous research upon which this study builds, 3) a description of the methodology used in the analysis, 4) a report on the economic and hydrologic results of the investigation, and 5) several conclusions regarding the viability and effectiveness of implementing a dry year option.

BACKGROUND

The Edwards Aquifer has historically met water demands by agricultural, municipal and industrial users in a six county area in south central Texas while simultaneously providing virtually continuous springflow to two large springs at the eastern end of the aquifer. In 1865, the first well into the Edwards aquifer was drilled and by 1900, wells had become the major source of water for the region (EUWD, 1993). Prior to the 1950's, the aquifer was able to supply all demands from agricultural, municipal, and industrial users as well as supply springflow. Steadily increasing pumping, however, combined with a severe drought during the 1950s resulted in the complete cessation of springflow at Comal Springs during a period in 1956. This event signaled the first major conflict among various aquifer interests and presaged the more recent legislative and legal battles.

The Edwards aquifer region is now home to more than a million and a half people and a considerable economy virtually all of which depends upon the aquifer for water supply. The primary use of water in the portion of the aquifer west of San Antonio (Kinney, Uvalde and Medina counties) is for crop irrigation. The overwhelming portion of water pumped in Bexar county is for municipal usage in the city of San Antonio. East of San Antonio, in Comal and Hays counties, relatively small amounts of water are pumped for municipal and industrial purposes. The aquifer, however, also supplies water to the two largest springs in the southwestern United States: San Marcos Springs in San Marcos and Comal Springs in New Braunfels. These springs provide habitat for several endangered species (Longley,1981), feed into rivers which support a river rafting and inner tubing recreation industry, and eventually join the Guadalupe River where their springflow components constitute from 30% to 70% of the Gaudalupe's base flow (GBRA, 1988). The springs are also natural attractions in their own right attracting tourists and scientists to the region.

Yet, while springflow is of undoubted social, environmental, and economic value to the region, it has no standing under the predominant legal doctrine governing groundwater withdrawals in the state of Texas. Groundwater in Texas has historically been governed by the "rule of capture" or "absolute ownership" (Kaiser, 1993), often referred to as "free capture." Under this doctrine, the right to pump water is appurtenant to land ownership and a land owner may pump an indeterminate amount of water so long as the water is applied to a beneficial use. Court rulings have modified the absolute nature of this common law doctrine only in cases of subsidence and malicious intent (Kaiser, 1993).

In the case of the Edwards, the relationship between pumping and springflow is quite strong and direct (Keplinger and McCarl, 1995). Springflow, being the hydrologic residual of recharge over pumping, is vulnerable to pumping, yet those benefitting from springflow can exert no direct control over pumping. Springflow interests have made numerous attempts by various legal means to regulate withdrawals from the aquifer in order to protect springflows. Their most potent legal recourse, and, to date, the only one which holds the potential to achieve its objectives, has been legal challenges which cite violations of the Endangered Species Act (1973) (ESA).

Citing the lack of progress in managing the aquifer to preserve springflow, the Sierra Club, backed by the Guadalupe-Blanco River Authority, filed suit against the U.S. Fish and Wildlife Service (USFWS) (*Sierra Club v. Babbitt*, 1991), under statues of the ESA, claiming that the USFWS and other government agencies were not adequately protecting endangered species that depend on springflow at Comal and San Marcos Springs. This suit provided a catalyst to the formulation and ultimately passage of Senate Bill 1477 (SB1477), comprehensive legislation to manage the aquifer.

SB1477 stipulated the formation of a new agency, the Edwards Aquifer Authority (EAA), and endowed it with strong powers to adjudicate and define water rights, monitor and regulate pumping, and maintain springflows. Although the bill was due to take effect on September 1, 1993, its implementation was held up in the federal pre-clearance procedure by a voting rights challenge. The challenge was successfully addressed by a bill which was approved in the 1995 legislative session and signed into law by the governor. A few days before the legislation was scheduled to take effect, a constitutional "takings" challenge was made in state court by the Medina County Underground Water Conservation District and several pumpers. Although the state court upheld the challenge, the decision was appealed to the Texas Supreme Court, which ruled, on June 28, 1996, that SB1477 was not *prima facie* unconstitutional.

As of this writing, the EAA is in place, but cash strapped, and has not yet taken any action to manage the aquifer. Meanwhile, 1996 has produced one of the severest droughts in recent history, placing springflows at Comal Springs at risk. Despite significant attempts on the part of San Antonio to limit pumping, springflow at Comal Springs dropped below the "take" level of 150 cfs from May 23rd to September 14, 1996. The perceived urgency of the situation prompted the Sierra Club to file another suit (*Sierra Club v. San Antonio, et al.*, 1996) against all pumpers. This suit seeks to limit summer and fall pumping to 1.2 times winter usage for all municipalities. The Court delayed its judgement to allow the nascent EAA to declare a drought emergency and draft an emergency drought management plan. In a 7 to 6 vote, however, the EAA ruled that there was no drought emergency although the agency subsequently drafted a drought management plan. On August 23, 1996, The U.S. District Court issued its own "Emergency Withdrawal Reduction Plan for the Edwards Aquifer" (Bunton, 1996) and ordered pumpers to comply with the plan. Citing federal interference in a area of law historically controlled by state and local institutions, both the city of San Antonio and the State Attorney General have appealed the decision.

Although control over the aquifer remains unsettled, many parties to the aquifer debate have shown interest in reducing water use, particularly during times of drought, by instituting a dry year option. Judge Bunton's emergency plan, for instance, states:

> Unless there is significant recharge in the remaining months of 1996, plans for restricting irrigation water use in 1997 should be ready by Jan. 1, 1997, at the latest.
>
> One possible solution is activation of the so called "dry year option," under which irrigation farmers would be compensated for their lost profits when irrigated production is curtailed to assure springflow. SAWS and Bexar Met, or other [water purveyors] and agencies, should take the lead, in consultation with the Edwards Aquifer Authority, to develop such an option before Jan. 1, 1997. Income from drought surcharges imposed this year by purveyors can be used to purchase the necessary options from irrigators. (Bunton, 1996)

Dry year options for the Edwards aquifer have also been considered in previous aquifer management plans. A 1992 interim management plan drafted by the Texas Water Commission (TWC) suggests a two stage dry year option to curtail water use: 1) 25% of irrigated land to be withheld from irrigation when the J17 index well is at, or below 649 feet mean sea level (msl) on January 1, and 2) 75% of irrigated land to be withheld from irrigation when the J17 index well is at or below 632 feet msl on January 1 (Texas Water Commission, 1992). The plan proposed compensating farmers with cash payments of about $75 per acre, the approximated average net return per irrigated acre.

PREVIOUS RESEARCH

Despite the prominence the Edwards aquifer debate has assumed in recent years, few studies have preformed detailed analyses of the economic and hydrologic impacts of aquifer management plans. Most of these analyses rely on an economic/hydrologic optimization model of the Edwards aquifer (EDOPT) initially specified by Dillon (1991).

Dillon's model implemented a stochastic programming with risk (SPR) specification where states of nature were specified as levels of recharge to the aquifer. Three economic sectors were modeled: agriculture, municipal, and industrial. For the agricultural sector, overall crop production mixes were selected over all states of nature, but separate irrigation strategies were allowed for each state of nature and each crop. Weather history, crop prices, input costs, and biological relationships between crop water use, yields, and weather were used to determine irrigation water use. Sectoral demands for municipal and industrial water were also developed from current water use patterns and economic studies defining price-quantity relationships. The Texas Water Development Board's (TWDB's) GWSIM-IV Edwards Aquifer simulation model (Thorkildsen and McElhaney, 1992) was used to develop hydrologic relationships between recharge, pumping, aquifer head level, and springflow. A non-linear programming specification was employed to maximize total surplus of all sectors in the model subject to the policy constraints imposed. Dillon's specification was later refined and employed to assess aquifer management plans by and McCarl et al. (1993), New (1994), and Williams (1996).

Very little research effort, to date, has focused specifically on implementing dry year options in the Edwards aquifer region. A study by Rothe (1996) outlines the procedure and contract elements of a pilot dry year option program in sufficient detail for legal counsel to draft an option contract document which could be executed by the buyer and farmers. Issues and price determination are also explored. A thesis by Phillips (1996) explores barriers to water marketing and opinions of major pumpers on water marketing issues in the Edwards aquifer region. No studies, to date, however, have attempted to quantify the relationship between a dry year offer and the number of acres which will respond to the offer, the reduction in water use this will produce, and the potential effect on springflow which can be achieved. In 1995, the Texas Water Development Board funded a study to evaluate dry year water transfers from agricultural to urban use. This study is partially funded by this grant.

METHODOLOGY

The methodology used in this analysis falls into three major categories: 1) a hydrologic investigation used to develop relationships describing springflow, ending aquifer elevations, and lifts as functions of recharge, pumping, and beginning aquifer elevations; 2) improvements to the existing EDOPT framework; and 3) a detailed description of the agricultural sector models used in the analysis. Although the complete EDOPT model was not directly employed in this analysis, the agricultural sector models, being subsets of EDOPT, incorporate most of the improvements to it.

Hydrologic Investigations

Hydrologic improvements to the model were made by employing an updated monthly version of GWSIM-IV (Thorkildsen and McElhaney, 1992) to output hydrologic variables for different combinations of eastern pumping, western pumping, starting head levels, and historical recharge. OLS regression was employed on simulated output to develop linear relationships where Comal springflow, San Marcos springflow, J17 ending elevation, Sabinal index well elevation, eastern lift, and western lift were specified as functions of beginning J17 elevation, beginning Sabinal index well elevation, annual recharge, eastern pumping (Medina, Bexar, Comal and Hays counties), and western pumping (Uvalde and Kinney counties). Details of this hydrologic investigation are documented in Keplinger and McCarl (1995a).

Table 1 lists regression coefficients and R-square values for annual explanatory models of springflow and ending elevations. Although monthly springflow equations are also used in this analysis, the annual models more clearly show the major hydrologic relationships discovered in the investigation. Focusing on the eastern and western pumping coefficients of the Comal springflow equation, the coefficient for eastern pumping was found to be -.28 versus a value of -.04 for western pumping, implying that for every acre foot of water pumped from Medina and Bexar counties, Comal springflow will be reduced by .28 acre feet during the calendar year which the pumping took place, whereas for every acre foot of water pumped from Uvalde or Kinney counties for the current year, Comal springflow will be reduced by .04 acre feet during the year of pumping, or only about one seventh that of pumping from the eastern pool.

The foregoing does not imply that eastern pumping has a greater overall effect on springflow, but only that the pumping-springflow linkage is felt more immediately for eastern pumping. Hydrologic dynamics demonstrate that pumping not only reduces current year springflow, but also lowers aquifer elevations, thereby reducing springflows in future years. If we assume no leakage from the aquifer, other than that of springs, then the hydrologic balance of mass relationship predicates that eastern and western pumping will have the same effect over time on springflow, even though pumping from the eastern pool is manifest much more quickly as reduced springflows.

The annual and monthly coefficients produced in this investigation were used to develop hydrologic responses to cutbacks in agricultural pumping due to implementations of dry year option programs as explained in the following sections.

Results of another hydrologic investigation (Keplinger and McCarl, 1995b) provides some evidence that western pumping may have a lower overall impact on springflow, even accounting for the delay between pumping from the western regions and eastern springflows. Because of the policy implications this may have for long term management of the aquifer, this issue requires more thorough investigation. In sum, results of the hydrologic investigations indicate that cutbacks in eastern pumping have a more immediate and, possibly, a greater overall effect on springflow than cutbacks in western pumping. Two reasons can be advanced to explain the differential impact of eastern versus western pumping on springflows. First, the western region of Uvalde and Kinney counties is further from the springs than Medina and Bexar counties. Second, and perhaps more importantly, an impermeable igneous rock intrusion into the Edwards limestone formation, called the Knippa gap, located in the eastern part of Uvalde county, impedes not only the flow, but piezometric surface movement (changes in head level) between the western and eastern portions of the aquifer.

The Edwards Aquifer Optimization Model

The equations developed in the foregoing hydrologic investigation were implemented in the existing EDOPT framework, thereby transforming the existing annual specification to a monthly specification, with regard to springflow. Water use variables and municipal demand parameters were also specified on a monthly basis, rather than annual. In addition, the aquifer was modeled as having two pools (eastern and western) rather than just one, based on the results of the hydrologic investigation.

Other enhancements to the EDOPT specification include dividing each agricultural county into three lift zones to better account for the effects of pumping lifts on irrigators' decisions; replacing many irrigation strategies with new strategies, developed from the EPIC crop simulator; and fully integrating sprinkler irrigation and sprinkler irrigation strategies into the model. These improvements produced a larger, but more refined representation of the hydrologic, biological, and economic phenomena affecting water use and springflow from the aquifer, allowing us to investigate more policy questions, especially with regard to eastern versus western pumping, and their effects on monthly springflow.

An Agricultural Sector Optimization Model

Although maximizing overall social welfare from all sectors (agricultural, municipal and industrial) is an important consideration, agricultural practices under current institutions can best be simulated by employing only the agricultural sector of the model. This is because the predominant legal doctrine in Texas governing groundwater withdrawals is the "rule of capture" or "absolute ownership" (Kaiser, 1993), often referred to as "free capture." Under this doctrine, the right to pump water is appurtenant to land ownership and a land owner may pump an indeterminate amount of water so long as the water is applied to a beneficial use. Since water rights are neither established or tradable, water does not automatically "flow" to its highest valued use, as the three sector model simulates. Irrigators make their cropping and pumping decisions based on personal cost and revenue consideration without the (current) ability to market water rights to the highest bidder. This environment is most accurately simulated by an "agricultural sector only" model where the objective function is maximizing expected profits to agriculture. Thus, the agricultural sector of the complete EDOPT model was extracted and modified to simulate dry year option scenarios.

The agricultural sector model incorporates 9 states of nature which are based on aquifer recharge. These states of nature are developed by ordering historical recharge (as estimated by USGS) for the years 1934 to 1989 from low to high, grouping the resulting series into 9 groups, and assigning one year from each group to represent each state of nature. Associated with each state of nature is the probability that it will occur. This is found by dividing the number of years in each state of nature grouping by 56, the total number of years in the series. The resultant states of nature used in the analysis, associated levels of recharge, and associated probabilities are depicted in Table 2.

The objective function of the agricultural model incorporates the following profit maximizing behavior. The first decision for irrigators to decide is what to plant, i.e., the crop mix. After planting, the current year's weather pattern is revealed, whereupon this additional information is used to determine which irrigation strategy to use for each crop throughout the year. Both decisions are made with regard to maximizing profits. For the first decision, the irrigator does not know what weather patterns will develop, and thus makes his decision with regard to maximizing expected profits, based on his knowledge (or perception) of the probability of experiencing various weather conditions. The agricultural model assumes that an irrigator's perceptions for the coming year are based on historical probabilities of receiving various weather conditions.

Associated with each year used to represent each state of nature are weather conditions (precipitation and temperature) which occurred during the representative year. These weather conditions are highly correlated with total recharge to the aquifer upon which the states of nature are selected. Thus, the probability of each recharge grouping occurring is also used as the probability of receiving the particular weather conditions for each state of nature. These weather variables and associated probabilities are instrumental in determining what crop mix the model will choose.

A key constraint is imposed, however, to prevent the model from assigning all crop acres to the most profitable crop. Since irrigators are generally risk averse, cannot always accurately predict crop prices, and have different perceptions, real world behavior shows a variety of crops being grown, even though only one of the crops is the most profitable. To reflect this behavior, the agricultural model restricts crop mixes to combinations of crop mixes which have been observed in a sequence of recent years, i.e., from 1975 to 1985.

Another consideration of the irrigator which is incorporated into the model is pumping cost. Pumping cost is product of both the amount and distance (in vertical feet) of water pumped. Thus, irrigators in higher lift zones incur higher pumping costs than those in lower lift zones, leading to model results which suggest less water intensive crop mixes and irrigation strategies are employed in higher lift zones. Three lift zones are used in the analysis: high, average, and low. The amount of land in each lift zone is determined by the elevation of each irrigation well, the number of acres it irrigates, and the cutoff values used to divide adjacent lift zones, as determined from the GWSIM-IV data set.

Sprinkler irrigation strategies (as mentioned earlier) are fully implemented into the current EDOPT and agricultural sector models. Total number of acres irrigated from the Edwards aquifer, and number of acres irrigated by sprinkler systems were obtained from the Natural

Resource Conservation Service (NRCS) and are presented in Table 3. Table 2 indicates that of the 79,891 acres currently being irrigated from the aquifer, 24,553 or 31% are being irrigated with sprinkler systems. Sprinkler acres are assigned sprinkler irrigation strategies in the agricultural models as determined by the EPIC crop simulator.

Because data are not readily available which indicates the lift zones (elevations) in which sprinkler irrigation takes place, sprinkler irrigation acres are assigned to the high lift zone first. If there are more irrigated acres than acres in the high lift zone, the remainder of irrigated acres is assigned to the middle lift zone. This assignment is based on the premise that irrigators with greater pumping lifts have a greater incentive to convert to sprinkler irrigation systems, because higher lifts translate into higher pumping costs, thus a reduction in pumping attributable to sprinkler irrigation reduces pumping costs more in high lift zones.

For a given lift zone, pumping costs for sprinkler irrigation are lower reflecting lower water requirements, while revenues are somewhat higher reflecting slightly higher yields. This leads to higher margins being produced by sprinkler irrigations. Countering this are fixed costs associated with financing sprinkler irrigation systems. Annualized fixed costs of maintaining a sprinkler irrigation system were calculated by dividing the cost of a typical new system ($45,000) by its expected life (10 years), then dividing by the number of acres serviced by a system (127) in order to produce a per acre annualized cost of $35.43.

Another fixed cost for both furrow and sprinkler irrigation was also calculated. This figure reflects the fixed costs associated with maintaining pumping facilities and is estimated to be $39 per acre.

Finally, the analysis is conducted on a county basis. Thus, the items discussed above apply to each of the 4 agricultural counties overlying the Edwards aquifer: Kinney, Uvalde, Medina, and Bexar. For this analysis, however, Kinney and Uvalde counties are aggregated into one region, while Medina and Bexar counties are aggregated into a second region.

The objective function for the agricultural model maximizes expected profits based on the following relationship:

Max. Expected Profit

= Expected Revenues
- Operating Cost
- Expected Harvest Costs
- Fixed Cost of Irrigation
- Fixed Cost of Sprinkler Irrigation Systems
- Expected Cost of Pumping.

Here, expected revenues are probabalistic average of revenue for all states of nature, as described earlier. For each state of nature, revenue is the summation of the revenues from all crops where:

Revenue = price x yield x number of acres (for each crop).

Since yield varies according to weather variables, a different revenue is produced for each state of nature.

Operating costs for each crop include the cost of herbicide, pesticide and fertilizer applications, labor, fuel, repair, and miscellaneous costs and are supplied in Peña (1995). In all but a few cases, these costs are considered fixed on a per acre basis. Operating costs, thus, vary according to the number of acres devoted to each crop in the crop mix.

Harvest costs are a function, not only of the number of acres devoted to each crop, but of the crop yield per acre of each crop. Since yield varies by state of nature, the expected value of harvest cost is considered where, for each state of nature:

Harvest cost = (harvest cost / unit harvested) x (units harvested / acre) x number of acres harvested.

Pumping cost depends on the quantity of water pumped (in acre feet) times the cost of pumping each acre foot of water. The quantity of water pumped depends on the amount of water required on irrigate one acre for each irrigation strategy used, multiplied by the number of acres devoted to each irrigation strategy. Thus, it is evident that the particular irrigation strategies chosen by the optimization routine depend largely on the amount of water required by each strategy (and to a lesser extend on differences in yield between strategies).

A formula describing pumping costs, provided in Lacewell and McCarl (1995), is adapted for use in the EDOPT formulation. This formulation, as modified, specifies pumping cost per acre foot as a function of the price of natural gas, pump efficiency, distribution efficiency, repair costs, labor costs, and lift. All variables in the equation are held constant at current levels, except for lift, which varies by state of nature. Low recharge states of nature correlate with higher water demand, both of which contribute to lower aquifer levels and higher lifts during low recharge states of nature. Again, since irrigators cannot predict recharge, expected pumping costs are of relevance.

Model Assumptions

Three dry year option scenarios are simulated. All three scenarios assume a payment structure where all irrigators are offered a set per acre payment for agreeing not to irrigate for the remainder of the year. This departs somewhat from the specific payment determination mechanism suggested in Rothe (1996). The pilot dry year option program developed by Rothe involves eliciting sealed bids from irrigators offering farm units for participation, where price per acre, number of acres, and total dollars is filled in by the farmer; and where farm unit is defined as "a well and the actual acres currently irrigated from the well with the current arrangement of pipe, ditches, pivots or other conveyance and distribution components on the farm unit."

The pricing structure used in the agricultural model assumes a perfectly efficient market with regard to land withdrawn from irrigation, that is, irrigators will always withdraw land from irrigation when the payment exceeds net returns to land use. If we assume that irrigators are profit maximizers, that they possess perfect information, that there is no collusion, and that the buyer selects farm units for participation solely on the basis of price per acre, then the mechanism proposed by Rothe should approach an efficient market with respect to land, as implied in the agricultural model.

In practice, one or more of these assumptions is likely to be violated. Contrary to economic theory, some farmers may not want to participate in a dry year option program for social or political reasons. Non-participation would shift in the supply curve of land available of any given offer price. In addition, farmers may not have a good idea of the price which the buying authority is likely to accept, especially since this would be a new program. Thus, they may bid "too high," seeking economic rent, but eliminate themselves from contention. Collusion by farmers, whether successful (the bid is accepted) or unsuccessful (the bid is not accepted), would also tend to diminish water sales and raise costs. Both overbidding, and collusion, whether successful or unsuccessful, would shift up the supply curve thereby diminishing a socially efficient amount of water transfer (assuming a downward sloping demand curve). If we assume that the amount of land placed under contract is determined by a set budget appropriated for this purpose, rather than by a demand curve, *per se*, the reduction in the amount of land purchased, due to violated assumptions of an efficient market, would likely be much greater than that implied by a demand curve. Since it is likely that the aforementioned assumptions are violated to some extent, cost of a dry year program for a desired amount of land under contract may be higher than model results. On the other hand, it is possible for an irrigator, under the rules proposed by Rothe, to bid "too low;" i.e., to make a per acre bid well below the cutoff price of the purchasing authority.

Since some crop land requires more irrigation that other land, the model does not necessarily imply a perfect market with regard to water. On the other hand, the contract buyer may have information regarding potential water saved for individual farm units. If so, the buyer could accept different prices for farm units, based on their potential for reducing irrigation. In theory, this could be done in such a way as to maximize the amount of water saved for a given program cost, thereby producing an efficient market with respect to water, although the quality of this information is problematic, and, even if available, may not be used by the purchasing authority.

There are two reasons, however, why the "single price per acre assumption" inherent in the agricultural sector models may be a valid representation of a dry year option. First, it may be politically unpalatable for the buying authority to offer some irrigators more to withdraw their land the others. Second, the buying authority may not know how much each farm is likely to irrigate. Thus, from both lack of knowledge and equity considerations, the buying authority may well be obliged to offer a set price on a per acre basis for all irrigators who wish to participate.

Dry Year Option Scenarios

The first dry year option scenario simulated involves offering a set per acre payment to irrigators not to irrigate for the entire year starting January 1st which would be offered sometime in the fall. The second and third dry year option scenarios simulate offering irrigators a per acre payment to stop irrigating as of June 1st. The second scenario assumes that irrigators do not anticipate a dry year offer, i.e., the irrigator's planting decision is unaffected by a possible dry year offer. By contrast, the third scenario assumes that irrigators are told in January to anticipate a possible dry year offer on June 1st. This information enables them to modify their planting decisions accordingly to account for this possibility..

Specifically, the third scenario assumes that irrigators expect a dry year offer to be made if the year is dry, where a dry year is defined as a year whose recharge falls within the lowest 48% of observed recharges (see Table 3). This scenario assumes the buying authority will pay the dry land offer only to qualifying crops, which are defined as those crops which are normally irrigated after the month of May.

All three dry year option scenarios assume that aquifer irrigators can obtain revenues from three sources: 1) from irrigated crop production, 2) from dry land crop production and 3) from receiving dry year option payments which require them either not to irrigate for the cropping season or to suspend irrigation after May. Model results, as well as observed behavior, indicate that all potentially irrigable land is irrigated in the absence of a dry land option or other programs designed to withdraw land from production. Irrigators, however, may convert irrigated production to dry land production and still receive dry year option payments for all scenarios considered.

RESULTS

Selected results of the three dry year option scenarios are presented in Table 4. All figures in Table 4 apply to those dry years where farmers are eligible for dry year payments. Specifically, the figures in the columns under "Irrigation Water," "Springflow Response," "Agricultural Income," and "Cost of Program" represent probabilistic average values for all dry years. As previously described, we assume that dry year offers will be made to irrigators for 48%, or almost half, of all years (Table 2).

Because of the differential impact of pumping on springflow between the eastern and western regions of the aquifer discovered in the hydrologic investigation, separate analyses were performed to simulate dry year option programs for each region. Sections A and B of Table 4 depict the January 1st cutoff scenario for Uvalde and Kinney counties (Section A) and Medina and Bexar counties (Section B). Sections C and D portray a June 1st cutoff strategies for Medina and Bexar counties where the cutoff is unanticipated by irrigators (Section C) and anticipated by irrigators with a 48% probability (Section D). June 1st cutoff strategies for Uvalde and Kinney counties are not investigated because of the very limited impact these strategies would have in producing more water for municipal use or springflow.

Eastern Agricultural Counties Versus Western Agricultural Counties

Comparing Section A to Section B, we find that the total number of acres irrigated from the Edwards Aquifer is somewhat higher in Uvalde and Kinney counties (the western agricultural counties) than from Medina and Bexar counties (the eastern agricultural counties): 41,560 acre versus 38,332 acres, for a total of 79,892 irrigated acres for the region. (Irrigated acres for individual counties are presented in Table 3.) The "Dryland" column in Table 4 and Figure 1 shows that as the dry year offer price is increased, the number of dry land acres increases, but at a faster rate for Medina and Bexar counties than for the Uvalde and Kinney counties. This is due, in part, to higher average pumping lifts and correspondingly higher pumping costs experienced in the eastern agricultural counties.

Model results suggest that irrigators in Medina and Bexar counties will withdraw 13,885 acres from irrigated production for a dry year offer price of only $10 per acre. All of this production is diverted from *furrow* irrigation to dry land agriculture. This suggests that a substantial amount of furrow irrigation is only marginally profitable and that a $10 per acre payment combined with the profit obtainable from dry land agriculture more than makes up for the lost profit that could have been obtained from these furrow irrigated acres. Not until a dry year offer of $50/acre is reached does the number of *sprinkler* irrigated acres start to decline, suggesting that sprinkler irrigation is substantially more profitable, requiring a higher dry year payment to induce it to convert to dryland.

When the dry year offer is raised to $90/acre, model results indicate that all irrigated production in Medina and Bexar counties, both sprinkler and furrow, will convert to dry land production. For an offer of $50/acre, 34,801 acres, or about 91% of irrigated acres in Medina and Bexar counties convert to dry land agriculture.

For Uvalde and Kinney counties (Table 4, Section A), irrigated acres do not begin to convert to dry land until an offer price of $60/acre is reached. At $60/acre, model results suggest that 17,618 acres in Uvalde county will accept the dry year offer. At a $120/acre offer, all the irrigated land in Uvalde and Kinney counties converts to dryland.

In the absence of a dry year option (zero offer price), Sections A and B of Table 4 suggest that, for dry years, Uvalde and Kinney counties apply an average of 104,516 acre feet of water while Medina and Bexar counties apply an average of 94,397 acre feet, yielding an average application by irrigators for the Edwards aquifer region of 198,913 acre feet during dry years. Dividing total irrigation water applied by total irrigated acres, we find that both Uvalde and Kinney counties, and Medina and Bexar counties apply an average of about 2.5 acre feet of water per irrigated acre for dry years. The actual amount of water applied for any given acre and year may vary considerably, depending on the crop, the irrigation strategy used, type of irrigation system used (furrow or sprinkler), and the amount and timing of rainfall received throughout the cropping season. Nonetheless, the correlation between the amount of irrigated land converted to dry land ("Dryland") and the reduction in water use ("Amount of Reduction") is quite direct as illustrated in Table 4.

Interest in implementing dry year option programs derives from two competing benefits that can be obtained by cutbacks in agricultural pumping. First, springflows can be increased, assuming there is no increase in municipal pumping. Second, municipal pumping by San Antonio can be increased without adversely affecting springflows. Although combinations of each benefit can be obtained, more of one implies less of the other. This investigation explores the two extreme points on the spectrum of benefits: 1) all reductions in pumping will be applied to increasing springflow, and 2) reductions in agricultural pumping will be offset by increases in municipal pumping by the city of San Antonio to the maximum extent possible such that Comal springflow is not reduced below the level it would have been in the absence of agricultural cutbacks. Springflow benefits are first examined.

Results of the hydrologic investigations referred to earlier are used to determine the effects of reduced eastern and western pumping on springflows. Agricultural sector model results suggest that as a result of 13,885 acres accepting the January 1st dry year offer in Medina and Bexar counties (Section B), irrigation pumping is reduced by 37,011 acre feet. Our hydrologic findings indicate that this will result in increased springflow at Comal and San Marcos springs of 15,034 acre feet during the calendar year of the dry year option. The remainder of the reduction in irrigation pumping goes into storage, thereby raising aquifer elevation.

The result of the 17,618 acre reduction in Uvalde and Kinney counties converting to dry land is an reduction in water use of 49,621 acre feet but only results in an increase in springflow of 2,789 acre feet. This disparity in the pumping/springflow relationship between the eastern and western agricultural regions is often explained by the existence of the Knippa gap, as described earlier.

Of critical importance to the ongoing aquifer debate is maintaining minimum springflows, especially at Comal springs, the more vulnerable of the two springs to declining aquifer levels. Coefficients from monthly Comal springflow equations developed in the hydrologic investigation were used to determine the effects of reduced irrigation pumping on average monthly Comal springflow in term of cfs. Table 5 and Figure 2 show the reduction in monthly water use for the four dry year option scenarios investigated, assuming a $150/acre offer price, an offer which induces all or almost all of irrigated acres to convert to dryland. The resulting monthly springflow effect at Comal springs is depicted in Table 6 and Figure 3. Focusing on the Medina and Bexar county January 1st cutoff scenario, note the somewhat delayed impact of reduced pumping on augmenting Comal springflow. Most of the reduction in irrigation occurs in April, May and June, whereas the greatest impact on Comal springs occurs in June, July, August and September. This should be of particular interest since, historically, the lowest springflow and aquifer levels are often experienced in August and September.

Returning to Table 4, Sections A, we find the effect of the reduction of irrigation pumping of 37,011 in Medina and Bexar counties as a result of the $10/acre dry year offer, results in an increase in Comal springflow during the month of August of 28.25 cfs, whereas a pumping cutback of 87,660 acre feet as a result of a dry year offer of $50 results in and increase in Comal springflow of 66.86 cfs for the month of August. On the other hand, the effect of reducing irrigation pumping by 49,621 acre feet in Uvalde and Kinney counties (Table 4, Section B) as a result of the $60/acre dry year offer results in an increase in Comal springflow of only 5.55 cfs. The complete elimination of pumping from the western region results in only an increase in August Comal springflow of 11.58 cfs.

Although the primary purpose of implementing a dry year option program is to increase springflows or to allow additional municipal pumping without harming springflows, it should not be overlooked that reductions in agricultural pumping also raise aquifer levels. Higher aquifer levels benefit future springflow, reduce pumping costs, and reduce the probability that pumping from the aquifer will need to be cut back in future years. The amount which aquifer levels would be raised, holding municipal pumping constant, is shown in Table 4, under the column "Aquifer Response." As expected, cutbacks in western pumping raise levels in the western region of the aquifer, but, since both regions of the aquifer are hydrologically connected, cutbacks in western pumping also help raise aquifer levels in the eastern region. The corollary statement applies to pumping from the eastern pool of the aquifer.

Now, we turn to the amount that the city of San Antonio can increase pumping without effecting springflows. In the case of Medina and Bexar counties this relationship is theoretically very straightforward. Since the city of San Antonio draws from the same hydrologic pool as irrigators in Medina and Bexar counties, the city of San Antonio can increase its withdrawals by an amount roughly equal to the entire amount of the reduction in irrigation pumping in Medina and Bexar counties without impacting springflows. Because the division of the aquifer into two pools vastly simplifies the complex hydrology of the aquifer, this relationship should be viewed as a rough, rather than an exact equality.

The "Irrigation Water, Amount of Reduction" column, therefore, in Table 4, Section B, can also be viewed as roughly the amount that San Antonio could increase its pumping without impacting springflow. Under this scenario, the dry year option could be considered a 1:1 transfer of water from agriculture to municipal use.

Because of the delayed impact of pumping on springflows of the western agricultural counties, the amount that San Antonio could increase pumping for the current year as a result of reduced irrigation pumping in Uvalde and Bexar counties is considerably less than the amount of the reduction in irrigation pumping. The coefficients in Table 1 suggest that San Antonio could increase pumping by only about 14% or only 1/7th of the reduction in pumping by irrigators in Uvalde and Kinney counties. (This relationship is developed in Appendix A.) This finding suggests that only 14% of the amount in the "Irrigation Water, Amount of Reduction" column in Table 4, Section A, could be applied to increasing municipal pumping by San Antonio without adversely affecting Comal springflow, suggesting a 1:7 transfer of water from agriculture to municipal use when the reduction is in the western agricultural counties.

The effects of dry year options on agricultural incomes are also examined. Since irrigated acreage is converted to less profitable dry land agriculture when dry year option programs are implemented, agricultural income from operations, in general, is reduced. Irrigators, on the other hand, receive dry year option payments for each acre converted to dry land. The net effect is that agricultural incomes rise when dry land option programs are implemented. The column headings under "Agricultural Income" and "Cost of Program, Total" bare this out. Here, the total cost of the dry year option program represents transfer payments to irrigators. (No overhead or administrative costs are included in "Cost of the Program, Total." Total cost of the program or transfer payments to farmers is found simply by multiplying the amount of the dry year offer times the number of acres converted to dry land agriculture as a result of the offer.

Table 4, Section B, for instance, suggests that 34,801 acres in Medina and Bexar counties will accept a dry year offer of $50, resulting in payments to irrigators of $1,740,050. Income from operations is reduced from $1,374,515 to $1,159,786, a reduction of $214,729 which is more than compensated for by the transfer payment to irrigators. The net result is that agricultural incomes increase from $1,374,515 to $2,899,836, an increase of $1,525,321.

Finally, total, average, and marginal costs of implementing a dry year option program were investigated. Supply schedules for springflow or water produced are presented in Figure 4. These figures depict additional water available to San Antonio (Water Available) and additional springflow produced (Springflow) as a functions of total payments to irrigators, i.e., the total cost of the program. Panel A of Figure 4 includes one additional relationship, the amount of the reduction of irrigation water use by Uvalde and Kinney counties (Reduced Water Use). In the case of the eastern agricultural counties, reduction in water use by irrigators is identical to the additional amount made available to San Antonio, whereas, the western agricultural counties, the amount of additional water made available to San Antonio for the current year without impacting springflow is only 1/7 of the amount of reduction by irrigators. Figure 4, Panel A graphically shows this relationship.

The last four columns of Table 4 display the average and marginal costs of 1) the additional water which San Antonio could pumping without impacting Comal springflow and 2) the increase in Comal springflow due to due to implementation of a dry year option assuming no increase in municipal use by San Antonio as a result of program implementation. In Section A of Table 4, "Cost of Water, Average" equals "Cost of Program, Total" divided by the "Amount of Reduction" multiplied by 7 (since San Antonio can pump only 1/7 of this amount without affecting Comal springflow). For Sections B, C, and D of Table 4, "Cost of Water, Average" is simply the "Cost of Program, Total" divided by "Amount of Reduction." Here, we assume the entire amount of reduction by agriculture can be applied to municipal pumping by San Antonio without affection Comal springflow, as described earlier.

Marginal cost refers to the cost of additional units of water or springflow. Thus, marginal costs are only calculated when an increase in the dry year offer leads to additional water use reductions by irrigators. Referring to Table 4, Section B, a $10/acre offer induces reduction in water use. Additional reductions, however, are not produced until a $50 dry year offer is made. Thus, the "Cost of Water, Marginal" is the additional cost of the program (cost of the $50/acre offer minus cost of the $10/acre offer) divided by the additional "Amount of Reduction" in irrigation water.

Table 4, Section B shows the average cost of water, gained by implementing a dry year option in Medina and Bexar counties on January 1st, ranging from $4/af to $37/af, while the marginal cost of water varies from $4/af to $448/af. The upward trends for both average and marginal costs reflects the common economic relationship of increasing marginal costs as more product is extracted from a fixed resource, or decreasing returns to expenditures. For the 87,660 acre feet of water made available by retiring 34,801 acres from irrigation as a result of a $50 dry year offer, the average cost of water is $20/af, while its marginal cost $32/af. This finding suggests that large amounts of water can be made available for a relatively small per acre foot cost.

Currently, residential customers of the San Antonio Water System (SAWS) pay from between $.05 and $.32 per one hundred gallons of water, according to an inverted block rate structure. SAWS recently imposed a surcharge which effectively increased the top rate to $.64 per one hundred gallons. Converting these figures to their acre foot equivalents, San Antonio residents pay between $162 and $1,043 per acre foot on a regular basis. Those residents paying the surcharge pay an equivalent of $2,086 per acre foot of water consumed at the margin, yet this study suggests that water can be purchased from irrigators for about $32 per acre foot at the margin. Even accounting for fixed and variable water system infrastructure costs, this cursory comparison suggests that water is much more valuable for municipal versus agricultural use, especially when municipal users are forced to cut back.

If we assume that all reductions in agricultural water use will accrue to springflow, then the 87,660 acre foot reduction in agricultural water use as a result of the $50 dry year offer will produce 35,491 acre feet of additional springflow. This additional springflow is attained at a total cost of $1,740,050, an average cost of $49/af and a marginal cost of $78/af.

Average and marginal costs of water and springflow are considerably higher when irrigation water use is reduced in Uvalde and Kinney counties. This is due, in large part, to the 7 times higher current year springflow response to agricultural pumping in the eastern pool versus the western pool of the aquifer. Although this 7 to 1 advantage applies only to the current year of the cutback, this quicker response may be very important, given that dry year options are considered "emergency" plans, and a quick response may be needed to ensure continuous springflow or provide relief to municipal users.

Summarizing the results in Table 4, Sections A and B: large, and roughly equivalent amounts of water can potentially be obtained from irrigators in the agricultural counties which overlie the aquifer: 94,397 acre feet from the eastern agricultural counties versus 104,516 acre feet from the western agricultural counties, as displayed in Figure 5. Current year springflow response, however, is seven times greater for eastern agricultural counties than for western agricultural counties. Thus, if irrigation were completely halted, San Antonio could pump only 1/7 or 14,931 of the 104,516 acre feet of the water saved in the western agricultural counties without affecting Comal Springs, as depicted in Figure 6. If all of the reduced pumping were applied to springflow, the cutback in the eastern agricultural counties would produce 38,132 acre feet of additional springflow, while the western agricultural counties would produce only 5,836 acre feet of additional springflow for the current year, as shown in Figure 7.

Maintaining continuous levels of springflow is an important consideration in the consideration in implementing any dry year option program. Model results indicate that cutting off all irrigation in Medina and Bexar counties would result in an additional 72 cfs of springflow for Comal Springs in August, whereas August Comal springflow is increased by about 12 cfs if all ag pumping in Uvalde and Kinney counties were to cease.

June 1st Cutoff Strategies

Results of simulating the two June 1st cutoff strategies are presented in Table 4, Sections C and D. The results in Section C assume that planting decisions are unaffected by the possibility of a dry year offer, whereas Section D assumes irrigators are told in January to anticipate a dry year offer to be made for the driest 48% of the years. Since the results in Section D assume irrigators can anticipate the possibility of a dry year offer, we would expect at least as many acres to take advantage of the dry year offer as in the unanticipated scenario, Section C. Although small differences in model specifications prevent this from happening for all offer prices, this expected relationship is clearly seen for offer prices of $80/acre and above, where acres converted to dry land ("Dryland") is always higher for the anticipated June 1st cutoff scenario. These higher offer prices encourage irrigators to make planting decisions in a way that enables them to take advantage of a dry year offer, should it occur.

For the unanticipated June 1st cutoff, Table 4, Section C, higher offer prices always result in greater reductions in water use, ("Amount of Reduction") and springflow responses, ("Springflow Response"). For the anticipated June 1st cutoff scenario, however, when the offer price is increased from $110 to $120 per acre, water application by irrigators actually increases, while the springflow response decreases. This is because, given sufficient incentive, irrigators are able to shift to crops which don't need to be irrigated after June 1 in order to receive the payment. Even within the fairly substantial constraints imposed on cropping patterns in all agricultural sector models, results suggest that irrigators will move to more water intensive crops which do not require irrigation after June 1st, if a high enough offer price is made. In some cases, this leads to more water being applied to crops when the offer price is increased, not less. This, of course, would be counter-productive, given the intent of implementing a dry year option program is to reduce water use.

Figure 2 shows that for the anticipated June 1st cutoff, water use increases in January, April, and May. This results in declines in Comal springflow (Figure 3) from January through May, and smaller increases in springflow for the remainder of the year than for the unanticipated

June 1 cutoff. Figure 4, Panel D, shows that the supply of "Water Available" and "Springflow" actually decreases, as the cost of the program moves beyond $2.54 million, i.e., when irrigators are offered more than $110/acre not to irrigate, due to the reasons cited in the previous paragraph.

For offer prices from $10 to $110, the average and marginal costs of water and springflow (last four column of Table 4, Sections C and D) are relatively similar for both anticipated and unanticipated June 1st cutoff scenarios. For offer prices of $120 and above, however, the cost of water and springflow is substantially less when a June 1st cutoff is unanticipated.

June 1st Cutoff versus January 1st Cutoff

For a given offer price, a January 1st cutoff is more effective in reducing agricultural pumping for two reasons: 1) water use is cut for the entire year, rather than for the last seven months of the year (see Figure 2), and 2) land is not yet committed to a particular cropping pattern. Conversely, for the June 1st cutoff scenarios, irrigated crops have already been planted, fixed costs have been incurred, and, more importantly, a June 1st cutoff for many crops would substantially reduce, or eliminate, yields and therefore, revenue. Thus, a June 1st cutoff carries with it a substantially higher opportunity cost for irrigators, since revenue from production is at stake and planting costs are sunk. This is particularly the case for the unanticipated June 1st cutoff scenario. One manifestation of the higher opportunity cost of a June 1st cutoff is that a smaller number of acres accept a June 1st dry year offer for any given offer price, as portrayed in Figure 1. The much smaller potential of a June 1st cutoff on reducing water use by irrigators and on increasing springflow is depicted in Figures 5-7.

SUMMARY AND CONCLUSIONS

Growing aquifer demands, interest in maintaining springflow, and episodic drought conditions such as the one experienced throughout much of 1996, have produced conditions where all demands made on the Edwards aquifer cannot be met during dry years. One proposal to reduce demand during dry years is through the implementation of a dry year option, an agreement whereby irrigators receive cash payment in exchange for not pumping. Given that the conditions do exist which merit consideration of dry year options, two important considerations are ***when*** and ***where*** a dry year option should be implemented.

This study examines two different timing scenarios for implementing a dry year option: a January 1st cutoff and a June 1st cutoff. The effects of implementing a dry year option are also examined for two regions: an eastern region, comprised of Medina and Uvalde counties, and a western region, comprised of Uvalde and Kinney counties. These regions roughly overlie two hydrologic pools of the aquifer, divided by the Knippa gap, an igneous rock formation which impedes flow from the western pool to the eastern pool.

Results suggest that reduced pumping in the eastern region is much more effective in producing current year springflow or in supplying additional water to San Antonio, than from reduced pumping in the western region. This is because the effect eastern pumping on near-term Comal springflow is approximately 7 times greater than the effect of western pumping on Comal Springs. It is also shown that purchasing water is a little cheaper in the eastern region than in the western region, due, in part, to lower lifts in the eastern region.

For Medina and Bexar counties (the eastern region) June 1st cutoff scenarios were examined in addition to a January 1st cutoff scenario. The results of these analyses indicates that a January 1st cutoff is much more effective in generating additional water or springflow for two reasons. First, the opportunity cost to irrigators of cutting off irrigation on June 1st, after crops have been planted, is considerably higher than that of not irrigating the entire year. This is because irrigators can plant dry land crops if the dry year option is offered before planting decisions are made and irrigators are not, therefore, locked into crops which require irrigation. Second, five months of irrigation has already occurred by June 1st, thereby lowering the total possible amount of pumping reduction for a June 1st cutoff scenario. Therefore, much less water for municipal use or springflow is produced from a June 1st versus a January 1st dry year option scenario, and the cost of obtaining the water or springflow is much higher.

Results suggest that large reductions in agricultural water use can be obtained for a relatively small per acre foot cost. The simulated effects of offering irrigators in Medina and Bexar counties $50 not to irrigate for the January 1st cutoff strategy and the two June 1st scenarios are depicted in Table 4. A $50 per acre offer price to irrigators in Medina and Bexar counties for a January 1st dry year option, for instance, results in 34,801 acres in the region (or 91% of total acreage) converting to dry land. This produces a reduction in agricultural water use of 87,660 acre feet, or about 93% of average use during dry years. San Antonio and other communities in the eastern region could increase pumping by roughly this amount without impacting springflow. On the other hand, if municipal pumping were not increased, this reduction in agricultural pumping would result in an increase in springflow of 35,491 acre feet for the current year. Springflow at Comal Springs during the month of August, a month often experiencing low flows, would increase by an estimated 67 cfs.

The total cost for implementing this version of a dry year option would be $1,740,050. This works out to an average cost of additional water saved, which could be applied to municipal use, at about $20 per acre foot, while the corresponding marginal cost would be about $32 per acre foot. If the cutback in agricultural pumping were applied to springflow, the average cost of additional springflow would be approximately $49 per acre foot, while the marginal cost would be about $78 per acre foot.

Many techniques for providing more water to the region's growing population while preserving springflow are currently being considered. Developing a dry year option exhibits several advantages over other potential solutions. First, unlike solutions requiring costly public works, implementing a dry year option requires no physical infrastructure or costly conveyance systems. Conveyance to municipal purveyors or to Comal Springs is provided by the aquifer itself. Second, the type of dry year option considered here does not rely on established and tradable water rights which currently do not exist. Thirdly, a dry year option can be implemented as needed, based on aquifer levels. Fourth, the cost of obtaining additional water by implementing a dry year option is likely to be much less than obtaining water by other methods. Finally, there are no negative environmental consequences associated with implementing a dry year option.

Given that municipal users in San Antonio are willing to pay several times the amount which this study indicates that water can be "purchased" from irrigators, this analysis suggests that significant gains in economic efficiency can be obtained by implementing a dry year option for the Edwards aquifer region when aquifer levels are low.

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Appendix A

The Relationship Between Cutbacks in Agricultural Pumping in Uvalde and Kinney Counties, and Increases in Municipal Pumping by San Antonio.

This relationship assumes that pumping by San Antonio (Eastern pumping) is increased to the maximum extent possible without negatively impacting Comal springflow during the year of the cutback.

The greek character β is used to denote coefficients for the Comal springflow equation in Table 1. Subscripts indicate the corresponding variable of the coefficient.

ΔComal Springflow = ΔEastern Pumping x $\beta_{\text{Eastern Pumping}}$ + ΔWestern Pumping x $\beta_{\text{Western Pumping}}$.

Since we desire Comal springflow to remain unchanged,

ΔEastern Pumping x $\beta_{\text{Eastern Pumping}}$ = - ΔWestern Pumping x $\beta_{\text{Western Pumping}}$.

Rearranging terms,

ΔEastern Pumping / ΔWestern Pumping = - $\beta_{\text{Western Pumping}}$ / $\beta_{\text{Eastern Pumping}}$.

Thus,

ΔEastern Pumping / ΔWestern Pumping = -(-.04 / -.28) = -.1429 = - 1/7.

Table 1. Regression Coefficients for Annual Comal and San Marcos Springflow, and J17 and Sabinal Index Well Ending Elevations				
	Comal Springflow (acre feet)	San Marcos Springflow (acre feet)	J17 Ending Elevation (feet above sea level)	Sabinal Ending Elevation (feet above sea level)
J17 Starting Elevation (feet above sea level)	2,651	412	0.34	0.28
Sabinal Starting Elevation (feet above sea level)	551	0.0	0.17	0.57
Annual Recharge (acre feet)	0.080	0.024	0.000015	0.000022
Western Pumping (acre feet)	-0.04	-0.0005	-0.000024	-0.000088
Eastern Pumping (acre feet)	-0.28	-0.025	-0.000113	-0.000050
Intercept	-1924677	-203976	321	150
R-Square	0.93	0.77	0.95	0.96

Table 2. States of Nature, Recharge Levels, and Probabilities Used in Analysis				
Recharge (Sorted lowest to highest) (1,000 af)	Year of Recharge (19xx)	State of Nature	Probability (of total)	Dry Years
43.7	56	1	0.02	
139.9	51	2	0.02	
162.1	54			
167.6	53			
170.7	63	3	0.09	
178.3	48			
179.6	34			
192.0	55			
197.9	84			
200.2	50			
214.4	89	4	0.14	0.48
239.4	62			
273.1	43			of
275.5	52			
308.8	40			Total
355.5	88			
399.0	39			
400.7	37			
406.4	80	5	0.21	
413.2	64			
420.1	83			
422.4	82			
422.6	47			
432.7	38			
466.5	67			
502.5	78			
508.1	49			
527.8	45			
556.1	46			
557.8	42			
560.9	44			
610.5	69			
615.2	66			
623.5	65			
658.5	74	6	0.21	
661.6	70			
690.4	59			
717.1	61			
756.4	72			
824.8	60			
850.7	41			
884.7	68			
894.1	76	7	0.21	
909.6	36			
925.3	71			
952.0	77			
973.0	75			
1,003.3	85			
1,117.8	79			
1,142.6	57			
1,153.7	86			
1,258.2	35			
1,448.4	81			
1,486.5	73			
1,711.2	58	8	0.07	

2,003.6	87	9	0.02	
628.0	Average .			

Table 3. Total, Furrow, and Sprinkler Irrigated Acres Drawing from Edwards Aquifer			
County	Total Irrigated Acres	Furrow Irrigated Acres	Sprinkler Irrigated Acres
Kinney	260	0	260
Uvalde	41,299	28,356	12,943
Medina	29,513	20,083	9,430
Bexar	8,819	6,899	1,920
Comal	0	0	0
Hays	0	0	0
Total	79,891	55,338	24,553
Percent of Total	100%	69%	31%
Source: NRCS			

Table 4. Response to Offer Price of Implementing a Dry Year Option

Section A. January 1st Cutoff - Uvalse and Kinney Counties

Offer Price ($)	Type of Land Use				Irrigation Water		Springflow Response		Aquifer Response		Agricultural Income		Cost of Program				
	Irrigated			Dryland (Acres)	Applied (AF)	Amount of Reduction (AF)	Total Current Yr. (AF)	Comal August (CFS)	Eastern Region (feet)	Western Region (feet)	Total ($)	From Operation ($)	Total ($)	Cost of Water		Cost of Springflow	
	Total (Acres)	Furrow (Acres)	Sprinkler (Acres)											Average ($/AF)	Marginal ($/AF)	Average ($/AF)	Marginal ($/AF)
0	41,560	28,357	13,203	0	104,516	0	0	0.00	0.00	0.00	2,813,701	2,813,701	0	0	inf.	0	inf.
10	41,560	28,357	13,203	0	104,551	0	0	0.00	0.00	0.00	2,813,707	2,813,707	0	0	inf.	0	inf.
20	41,560	28,357	13,203	0	104,551	0	0	0.00	0.00	0.00	2,813,707	2,813,707	0	0	inf.	0	inf.
30	41,560	28,357	13,203	0	104,551	0	0	0.00	0.00	0.00	2,813,707	2,813,707	0	0	inf.	0	inf.
40	41,560	28,357	13,203	0	104,551	0	0	0.00	0.00	0.00	2,813,707	2,813,707	0	0	inf.	0	inf.
50	41,560	28,357	13,203	0	104,551	0	0	0.00	0.00	0.00	2,813,707	2,813,707	0	0	inf.	0	inf.
60	23,941	10,738	13,203	17,618	54,895	49,621	2,789	5.55	1.67	6.14	3,168,235	2,111,155	1,057,080	149	149	379	379
70	23,941	10,738	13,203	17,618	54,895	49,621	2,789	5.55	1.67	6.14	3,344,415	2,111,155	1,233,260	174	inf.	442	inf.
80	23,941	10,738	13,203	17,618	54,895	49,621	2,789	5.55	1.67	6.14	3,520,595	2,111,155	1,409,440	199	inf.	505	inf.
90	3,265	0	3,265	38,294	6,092	98,424	5,507	10.93	3.30	12.12	4,550,983	1,104,523	3,446,460	245	343	626	879
100	3,265	0	3,265	38,294	6,092	98,424	5,507	10.93	3.30	12.12	4,933,923	1,104,523	3,829,400	272	inf.	695	inf.
110	234	0	234	41,326	448	104,068	5,812	11.53	3.49	12.79	5,483,934	938,074	4,545,860	306	1,364	782	3,610
120	0	0	0	41,560	0	104,516	5,836	11.58	3.50	12.84	5,908,681	921,481	4,987,200	334	6,899	855	18,194
130	0	0	0	41,560	0	104,516	5,836	11.58	3.50	12.84	6,324,281	921,481	5,402,800	362	inf.	926	inf.
140	0	0	0	41,560	0	104,516	5,836	11.58	3.50	12.84	6,739,881	921,481	5,818,400	390	inf.	997	inf.
150	0	0	0	41,560	0	104,516	5,836	11.58	3.50	12.84	7,155,481	921,481	6,234,000	418	inf.	1,068	inf.

Table 4. Continued

Section B. January 1st Cutoff - Medina and Bexar Counties.

Offer Price ($)	Type of Land Use				Irrigation Water		Springflow Response		Aquifer Response		Agricultural Income		Cost of Program				
	Irrigated			Dryland (Acres)	Applied (AF)	Amount of Reduction (AF)	Total Current Yr. (AF)	Comal August (CFS)	Eastern Region (feet)	Western Region (feet)	Total ($)	From Operation ($)	Total ($)	Cost of Water		Cost of Springflow	
	Total (Acres)	Furrow (Acres)	Sprinkler (Acres)											Average ($/AF)	Marginal ($/AF)	Average ($/AF)	Marginal ($/AF)
0	38,332	26,982	11,350	0	94,397	0	0	0.00	0.00	0.00	1,374,515	1,374,515	0	0	inf.	0	inf.
10	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	6.07	2.68	1,602,128	1,463,278	138,850	4	4	9	9
20	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	6.07	2.68	1,740,978	1,463,278	277,700	8	inf.	18	inf.
30	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	6.07	2.68	1,879,828	1,463,278	416,550	11	inf.	28	inf.
40	24,447	13,097	11,350	13,885	57,385	37,011	15,034	28.25	6.07	2.68	2,018,678	1,463,278	555,400	15	inf.	37	inf.
50	3,531	0	3,531	34,801	6,737	87,660	35,491	66.86	14.32	6.34	2,899,836	1,159,786	1,740,050	20	32	49	78
60	3,531	0	3,531	34,801	6,737	87,660	35,491	66.86	14.32	6.34	3,247,846	1,159,786	2,088,060	24	inf.	59	inf.
70	950	0	950	37,382	1,858	92,538	37,403	70.45	15.09	6.68	3,736,095	1,119,355	2,616,740	28	180	70	458
80	950	0	950	37,382	1,858	92,538	37,403	70.45	15.09	6.68	4,109,915	1,119,355	2,990,560	32	inf.	80	inf.
90	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	4,530,525	1,080,645	3,449,880	37	448	90	1,143
100	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	4,913,845	1,080,645	3,833,200	41	inf.	101	inf.
110	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	5,297,165	1,080,645	4,216,520	45	inf.	111	inf.
120	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	5,680,485	1,080,645	4,599,840	49	inf.	121	inf.
130	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	6,063,805	1,080,645	4,983,160	53	inf.	131	inf.
140	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	6,447,125	1,080,645	5,366,480	57	inf.	141	inf.
150	0	0	0	38,332	0	94,397	38,132	71.81	15.39	6.81	6,830,445	1,080,645	5,749,800	61	inf.	151	inf.

Table 4. Continued

Section C. June 1st Cutoff, Unanticipated, Medina and Bexar Counties

Offer Price ($)	Type of Land Use				Irrigation Water		Springflow Response		Aquifer Response		Agricultural Income		Cost of Program				
	Irrigated													Cost of Water		Cost of Springflow	
	Total (Acres)	Furrow (Acres)	Sprinkler (Acres)	Dryland (Acres)	Applied (AF)	Amount of Reduction (AF)	Total Current Yr. (AF)	Comal August (CFS)	Eastern Region (feet)	Western Region (feet)	Total ($)	From Operation ($)	Total ($)	Average ($/AF)	Marginal ($/AF)	Average ($/AF)	Marginal ($/AF)
0	38,332	26,982	11,350	0	94,397	0	0	0.00	0.00	0.00	1,374,515	1,374,515	0	0	0	0	0
10	33,845	23,762	10,083	4,487	92,972	1,425	470	1.15	0.19	0.08	1,403,547	1,358,675	44,872	31	31	96	96
20	32,437	22,748	9,689	5,895	91,441	2,955	960	2.38	0.39	0.17	1,453,702	1,335,804	117,898	40	48	123	149
30	27,743	18,993	8,749	10,589	86,051	8,346	2,665	6.73	1.08	0.48	1,538,065	1,220,385	317,680	38	37	119	117
40	24,749	17,736	7,013	13,583	83,241	11,156	3,556	8.99	1.44	0.64	1,651,353	1,108,036	543,317	49	80	153	253
50	21,587	14,825	6,763	16,745	79,304	15,092	4,829	12.17	1.95	0.86	1,813,155	975,916	837,239	55	75	173	231
60	21,126	14,748	6,378	17,206	78,968	15,429	4,939	12.44	1.99	0.88	1,984,319	951,981	1,032,338	67	580	209	1,760
70	20,937	14,668	6,269	17,395	78,837	15,560	4,983	12.54	2.01	0.89	2,158,018	940,368	1,217,650	78	1,413	244	4,288
80	20,937	14,668	6,269	17,395	78,837	15,560	4,983	12.54	2.01	0.89	2,331,968	940,368	1,391,600	89	inf.	279	inf.
90	19,956	13,687	6,269	18,376	76,810	17,586	5,509	14.18	2.22	0.98	2,509,058	855,261	1,653,797	94	215	300	828
100	19,886	13,617	6,269	18,446	76,677	17,720	5,545	14.28	2.24	0.99	2,693,329	848,773	1,844,556	104	1,428	333	5,273
110	19,046	12,777	6,269	19,286	75,248	19,148	5,943	15.44	2.40	1.06	2,883,393	761,933	2,121,460	111	194	357	696
120	18,055	11,786	6,269	20,277	73,211	21,186	6,474	17.08	2.61	1.16	3,082,071	648,817	2,433,253	115	153	376	588
130	17,262	10,993	6,269	21,070	71,863	22,533	6,850	18.16	2.76	1.22	3,288,346	549,246	2,739,100	122	227	400	815
140	17,262	10,993	6,269	21,070	71,863	22,533	6,850	18.16	2.76	1.22	3,499,046	549,246	2,949,800	131	inf.	431	inf.
150	17,262	10,993	6,269	21,070	71,863	22,533	6,850	18.16	2.76	1.22	3,709,746	549,246	3,160,500	140	inf.	461	inf.

Table 4. Continued

Section D. June 1st Cutoff, Anticipated with 48% Probability, Medina and Bexar Counties

Offer Price ($)	Total (Acres)	Type of Land Use: Irrigated Furrow (Acres)	Irrigated Sprinkler (Acres)	Dryland (Acres)	Irrigation Water: Applied (AF)	Amount of Reduction (AF)	Springflow Response: Total Current Yr. (AF)	Comal August (CFS)	Aquifer Response: Eastern Region (feet)	Western Region (feet)	Agricultural Income: Western Total ($)	From Operation ($)	Total ($)	Cost of Program: Cost of Water Average ($/AF)	Cost of Water Marginal ($/AF)	Cost of Springflow Average ($/AF)	Cost of Springflow Marginal ($/AF)
0	38,332	26,982	11,350	0	94,397	0	0	0.00	0.00	0.00	1,374,515	1,374,515	0	0	0	0	0
10	33,787	23,704	10,083	4,545	93,766	631	122	0.51	0.05	0.02	1,412,152	1,366,699	45,453	72	72	373	373
20	31,373	21,684	9,689	6,959	90,165	4,232	1,367	3.41	0.55	0.24	1,468,960	1,329,782	139,178	33	26	102	75
30	28,738	19,955	8,783	9,594	87,181	7,216	2,337	5.82	0.94	0.42	1,554,415	1,266,589	287,826	40	50	123	153
40	26,215	19,203	7,013	12,117	84,868	9,528	3,087	7.68	1.25	0.55	1,656,287	1,171,618	484,670	51	85	157	262
50	23,456	16,694	6,763	14,876	80,681	13,716	4,529	11.06	1.83	0.81	1,802,857	1,059,068	743,789	54	62	164	180
60	22,365	15,987	6,378	15,967	78,577	15,820	5,196	12.75	2.10	0.93	1,958,205	1,000,187	958,018	61	102	184	321
70	21,755	15,486	6,269	16,577	77,373	17,023	5,562	13.72	2.24	0.99	2,121,298	960,939	1,160,359	68	168	209	553
80	20,773	14,646	6,127	17,559	75,352	19,045	6,196	15.32	2.50	1.11	2,297,403	892,683	1,404,720	74	121	227	385
90	17,280	11,211	6,069	21,052	75,555	18,842	5,092	14.63	2.05	0.91	2,669,370	774,690	1,894,680	101	inf.	372	inf.
100	16,182	10,657	5,525	22,150	74,088	20,308	5,396	15.68	2.18	0.96	2,919,469	704,425	2,215,044	109	641	410	6,275
110	15,239	9,714	5,525	23,093	71,808	22,588	6,128	17.51	2.47	1.09	3,146,362	606,132	2,540,230	112	143	415	445
120	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	1.63	0.72	3,804,981	435,741	3,369,240	160	inf.	834	inf.
130	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	1.63	0.72	4,085,751	435,741	3,650,010	174	inf.	904	inf.
140	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	1.63	0.72	4,366,521	435,741	3,930,780	187	inf.	974	inf.
150	10,255	6,376	3,879	28,077	73,383	21,014	4,038	15.34	1.63	0.72	4,647,291	435,741	4,211,550	200	inf.	1,043	inf.

Table 5. Potential Water Use Reduction from Implementing a Dry Year Option (Acre Feet).

County	Strategy	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Uvalde	Jan 1 Cutoff	7,947	4,527	5,796	23,365	19,090	23,012	10,313	2,605	798	821	1,255	4,987	104,515
Medina	Jan 1 Cutoff	6,135	4,050	6,838	21,605	15,937	21,097	8,377	5,046	849	539	687	3,236	94,396
Medina	June 1 Cutoff Unanticipated	0	0	0	0	0	16,096	3,057	3,380	0	0	0	0	22,532
Medina	June 1 Cutoff Anticipated	(2,781)	1,675	2,163	(6,746)	(5,568)	19,512	6,641	4,137	633	436	110	801	21,014

Table 6. Potential Springflow Effect from Implementing a Dry Year Option - Comal Springs (CFS).

County	Strategy	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Uvalde	Jan 1 Cutoff	0.22	1.87	2.15	5.10	7.00	10.32	11.71	11.58	12.05	11.38	11.44	10.49
Medina	Jan 1 Cutoff	11.61	15.71	19.79	42.17	53.16	69.28	71.65	71.81	66.05	57.28	51.86	48.45
Medina	June 1 Cutoff Unanticipated	0.00	0.00	0.00	0.00	0.00	14.74	16.33	18.16	16.55	14.27	12.82	11.56
Medina	June 1 Cutoff Anticipated	-5.26	-1.71	1.23	-6.21	-10.97	7.56	12.70	15.34	14.44	12.73	11.50	10.79

Figure 1. Conversion to Dry Land Agriculture for Various Dry Year Option Offer Prices.

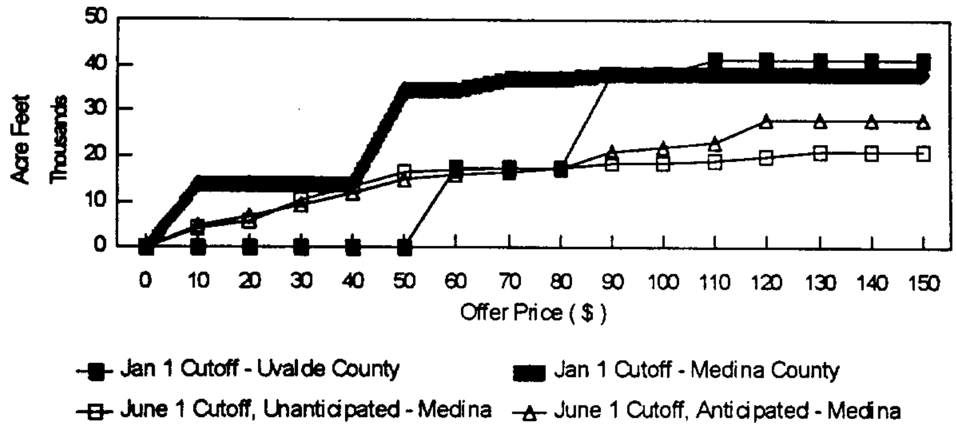


Figure 2. Potential Monthly Water Use Reduction from Implementing a Dry Year Option

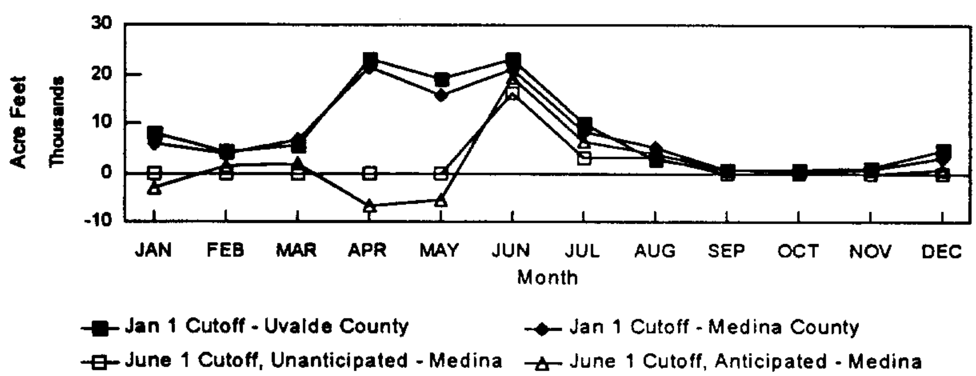


Figure 3. Potential Current -Year Monthly Increase in Comal Springflow from Implementing a Dry Year Option

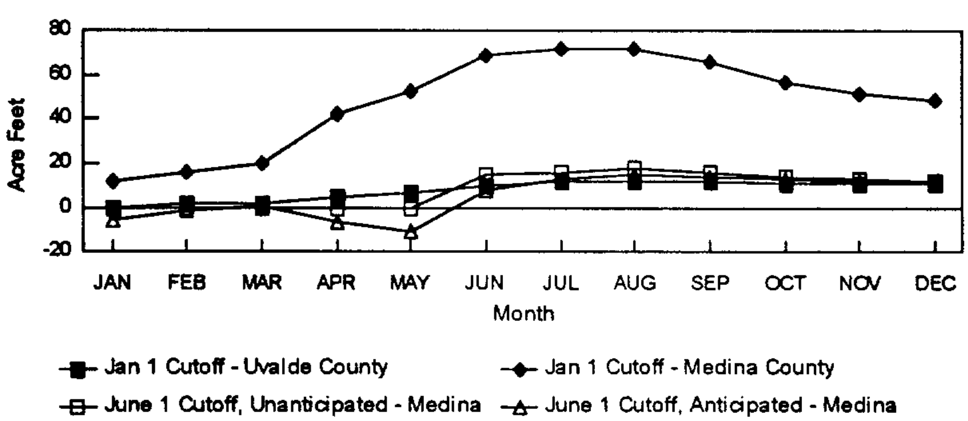


Figure 4. Cost of Water and Springflow for Dry Year Option Alternatives.

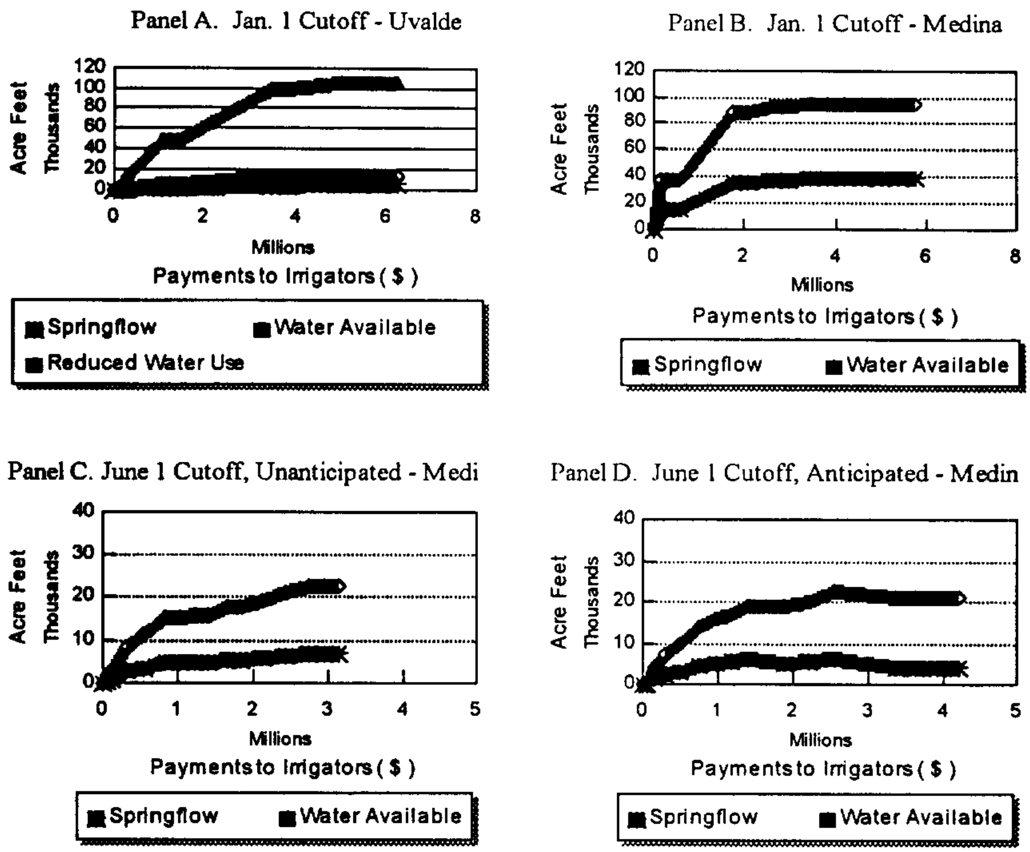


Figure 5. Potential Annual Water Use Reduction from Implementing a Dry Year Option

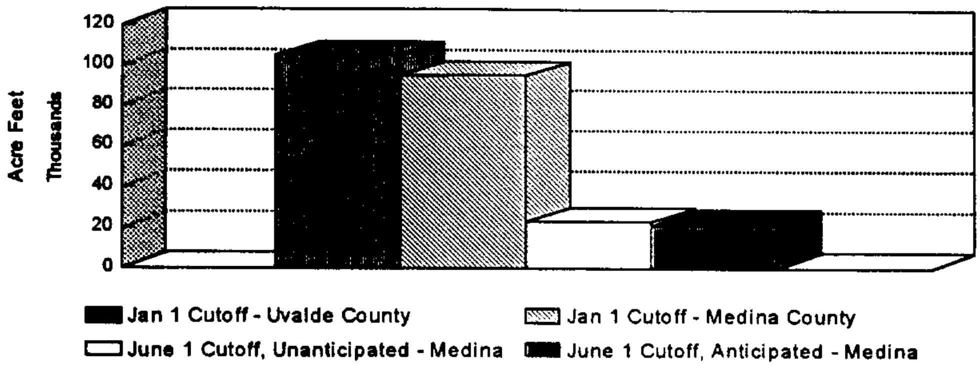


Figure 6. Additional Water Available to Bexar County Without Impacting Springflow.

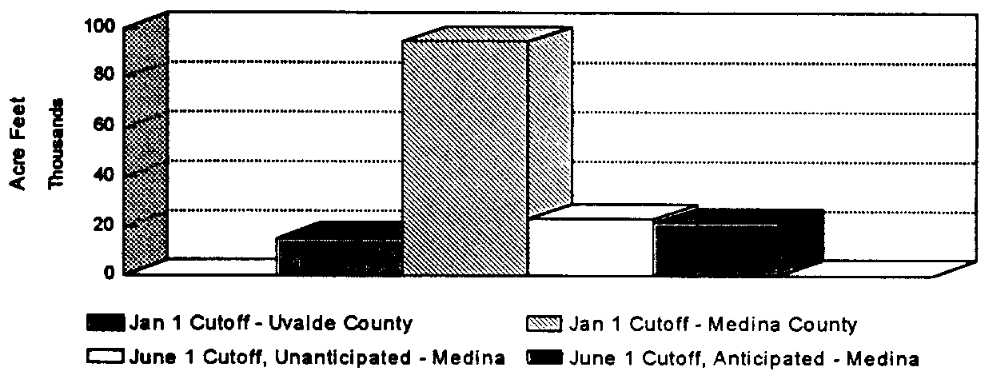
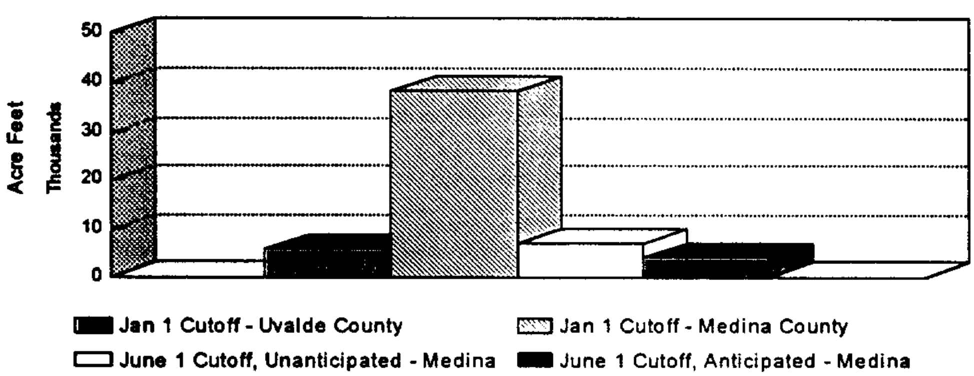


Figure 7. Potential Current Year Increase in Springflow from Implementing a Dry Year Option.



Appendix D. Input Output Modeling Multipliers

Table D1-1 OUTPUT MULTIPLIERS OF BEXAR COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	1	0.2179	0.4478	1.6657	1.2179	1.6657
3	AGG RANCH/RANGE FED CATTLE	1	0.2155	0.6143	1.8298	1.2155	1.8298
5	Cattle Feedlots	1	0.2016	0.5635	1.7651	1.2016	1.7651
6	Sheep, Lambs And Goats	1	0.0657	2.9668	4.0325	1.0657	4.0325
7	Hogs, Pigs And Swine	1	0.2117	0.517	1.7287	1.2117	1.7287
9	Miscellaneous Livestock	1	0.1981	0.2713	1.4693	1.1981	1.4693
10	Cotton	1	0.1744	0.5612	1.7356	1.1744	1.7356
11	Food Grains	1	0.292	0.5047	1.7967	1.2920	1.7967
12	Feed Grains	1	0.1758	0.4554	1.6312	1.1758	1.6312
13	Hay And Pasture	1	0.2284	0.4325	1.6610	1.2284	1.6610
16	Fruits	1	0.3014	0.4777	1.7791	1.3014	1.7791
18	Vegetables	1	0.1992	0.3933	1.5925	1.1992	1.5925
20	Miscellaneous Crops	1	0.1535	0.7211	1.8746	1.1535	1.8746

Table D1-2 PERSONAL INCOME MULTIPLIERS OF BEXAR COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.027	0.0713	0.1501	0.2484	3.6433	9.2074
3	AGG RANCH/RANGE FED CATTLE	0.0532	0.0623	0.206	0.3215	2.1693	6.0377
5	Cattle Feedlots	0.0713	0.0584	0.189	0.3186	1.8190	4.4698
6	Sheep, Lambs And Goats	0.1406	0.0197	0.9948	1.1551	1.1404	8.2167
7	Hogs, Pigs And Swine	0.0538	0.0634	0.1734	0.2905	2.1784	5.4014
9	Miscellaneous Livestock	0.0245	0.0586	0.091	0.174	3.3925	7.1087
10	Cotton	0.0355	0.0493	0.1882	0.2729	2.3905	7.6973
11	Food Grains	0.034	0.0767	0.1692	0.2798	3.2570	8.2393
12	Feed Grains	0.0393	0.0478	0.1527	0.2398	2.2169	6.1022
13	Hay And Pasture	0.0291	0.0621	0.145	0.2362	3.1344	8.1196
16	Fruits	0.008	0.0872	0.1602	0.2554	11.8463	31.7630
18	Vegetables	0.0117	0.0536	0.1319	0.1972	5.574	16.8257
20	Miscellaneous Crops	0.0485	0.0419	0.2418	0.3321	1.8638	6.8529

Table D1-3 TOTAL INCOME MULTIPLIERS OF BEXAR COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2308	0.1135	0.2494	0.5937	1.4918	2.5722
3	AGG RANCH/RANGE FED CATTLE	0.3205	0.1049	0.3421	0.7675	1.3274	2.395
5	Cattle Feedlots	0.3633	0.0983	0.3139	0.7755	1.2705	2.1343
6	Sheep, Lambs And Goats	0.7571	0.0326	1.6524	2.4421	1.0431	3.2256
7	Hogs, Pigs And Swine	0.3022	0.1046	0.288	0.6948	1.3462	2.2989
9	Miscellaneous Livestock	0.3437	0.0967	0.1511	0.5915	1.2815	1.7211
10	Cotton	0.3614	0.0812	0.3126	0.7552	1.2248	2.0898
11	Food Grains	0.4501	0.136	0.2811	0.8672	1.3023	1.9268
12	Feed Grains	0.6005	0.0825	0.2536	0.9366	1.1373	1.5597
13	Hay And Pasture	0.4795	0.1071	0.2409	0.8275	1.2233	1.7257
16	Fruits	0.1648	0.1592	0.2661	0.59	1.9659	3.5807
18	Vegetables	0.4945	0.1007	0.2191	0.8143	1.2037	1.6467
20	Miscellaneous Crops	0.6224	0.0747	0.4016	1.0987	1.12	1.7652

Table D1-4 VALUE ADDED MULTIPLIERS OF BEXAR COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2356	0.126	0.2866	0.6483	1.5348	2.7513
3	AGG RANCH/RANGE FED CATTLE	0.3414	0.1204	0.3932	0.8551	1.3526	2.5043
5	Cattle Feedlots	0.3821	0.1128	0.3608	0.8557	1.2951	2.2391
6	Sheep, Lambs And Goats	0.7982	0.0375	1.8992	2.7349	1.0469	3.4265
7	Hogs, Pigs And Swine	0.3247	0.1203	0.331	0.776	1.3705	2.39
9	Miscellaneous Livestock	0.3661	0.1064	0.1737	0.6462	1.2907	1.7651
10	Cotton	0.3949	0.0923	0.3593	0.8465	1.2338	2.1436
11	Food Grains	0.4839	0.166	0.3231	0.9729	1.3430	2.0108
12	Feed Grains	0.6458	0.099	0.2915	1.0363	1.1533	1.6048
13	Hay And Pasture	0.5321	0.1286	0.2769	0.9376	1.2416	1.7620
16	Fruits	0.1769	0.1745	0.3058	0.6571	1.9866	3.7157
18	Vegetables	0.5163	0.113	0.2518	0.8811	1.2188	1.7065
20	Miscellaneous Crops	0.6334	0.0861	0.4616	1.1812	1.1359	1.8647

Table D1-5 EMPLOYMENT MULTIPLIERS OF BEXAR COUNTY

		DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	10.0389	3.0174	7.5722	20.6285	1.3006	2.0549
3	AGG RANCH/RANGE FED CATTLE	15.0786	2.8332	10.3882	28.3	1.1879	1.8768
5	Cattle Feedlots	13.7826	2.6497	9.5302	25.9625	1.1923	1.8837
6	Sheep, Lambs And Goats	84.21	0.8731	50.1718	135.2549	1.0104	1.6062
7	Hogs, Pigs And Swine	12.3142	2.7619	8.7436	23.8197	1.2243	1.9343
9	Miscellaneous Livestock	5.747	2.4316	4.5874	12.766	1.4231	2.2213
10	Cotton	12.9537	3.4108	9.4909	25.8554	1.2633	1.996
11	Food Grains	11.0972	3.6187	8.5348	23.2507	1.3261	2.0952
12	Feed Grains	11.0741	2.2042	7.701	20.9793	1.199	1.8944
13	Hay And Pasture	9.7501	2.8625	7.3149	19.9275	1.2936	2.0438
16	Fruits	7.0268	6.9025	8.0785	22.0077	1.9823	3.132
18	Vegetables	7.2835	4.1859	6.6519	18.1214	1.5747	2.488
20	Miscellaneous Crops	18.5856	2.4402	12.1943	33.2202	1.1313	1.7874

Table D2-1 OUTPUT MULTIPLIERS OF KINNEY COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	1	0.2236	0.184	1.4076	1.2236	1.4076
3	AGG Range/Ranch Fed Cattle	1	0.123	0.1912	1.3143	1.123	1.3143
6	Sheep, Lambs And Goats	1	0.0418	0.7222	1.764	1.0418	1.764
9	Miscellaneous Livestock	1	0.1049	0.1329	1.2378	1.1049	1.2378
13	Hay And Pasture	1	0.1188	0.1665	1.2853	1.1188	1.2853

Table D2-2 PERSONAL INCOME MULTIPLIERS OF KINNEY COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	1	0.2236	0.184	1.4076	1.2236	1.4076
3	AGG Range/Ranch Fed Cattle	1	0.123	0.1912	1.3143	1.123	1.3143
6	Sheep, Lambs And Goats	1	0.0418	0.7222	1.764	1.0418	1.764
9	Miscellaneous Livestock	1	0.1049	0.1329	1.2378	1.1049	1.2378
13	Hay And Pasture	1	0.1188	0.1665	1.2853	1.1188	1.2853

Table D2-3 TOTAL INCOME MULTIPLIERS OF KINNEY COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2459	0.1021	0.101	0.4489	1.4151	1.8258
3	AGG Range/Ranch Fed Cattle	0.3455	0.0579	0.1049	0.5083	1.1677	1.4715
6	Sheep, Lambs And Goats	0.7608	0.0196	0.3964	1.1768	1.0258	1.5468
9	Miscellaneous Livestock	0.3815	0.0496	0.0729	0.504	1.13	1.3211
13	Hay And Pasture	0.484	0.0536	0.0914	0.6289	1.1107	1.2995

Table D2-4 VALUE ADDED MULTIPLIERS OF KINNEY COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2507	0.1094	0.1239	0.4839	1.4363	1.9304
3	AGG Range/Ranch Fed Cattle	0.3676	0.0638	0.1287	0.5601	1.1735	1.5237
6	Sheep, Lambs And Goats	0.7982	0.0216	0.4862	1.306	1.0271	1.6362
9	Miscellaneous Livestock	0.4039	0.0541	0.0894	0.5475	1.1339	1.3553
13	Hay And Pasture	0.5321	0.0604	0.1121	0.7046	1.1136	1.3242

Table D2-5 EMPLOYMENT MULTIPLIERS OF KINNEY COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	10.4592	5.458	3.3274	19.2447	1.5218	1.84
3	AGG Range/Ranch Fed Cattle	13.9395	2.6033	3.4582	20.0011	1.1868	1.4348
6	Sheep, Lambs And Goats	61.598	0.8815	13.0612	75.5407	1.0143	1.2263
9	Miscellaneous Livestock	9.2362	2.2581	2.4029	13.8972	1.2445	1.5046
13	Hay And Pasture	11.7033	2.701	3.0112	17.4155	1.2308	1.4881

Table D3-1 OUTPUT MULTIPLIERS OF MEDINA COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	1	0.2543	0.2796	1.5338	1.2543	1.5338
3	AGG Ranch/Range Fed Cattle	1	0.1809	0.354	1.5349	1.1809	1.5349
5	Cattle Feedlots	1	0.3121	0.3855	1.6975	1.3121	1.6975
6	Sheep, Lambs And Goats	1	0.0534	1.2428	2.2962	1.0534	2.2962
7	Hogs, Pigs And Swine	1	0.1804	0.2611	1.4415	1.1804	1.4415
9	Miscellaneous Livestock	1	0.1755	0.181	1.3565	1.1755	1.3565
10	Cotton	1	0.2642	0.3779	1.6421	1.2642	1.6421
11	Food Grains	1	0.1804	0.2697	1.4502	1.1804	1.4502
12	Feed Grains	1	0.1093	0.2792	1.3885	1.1093	1.3885
13	Hay And Pasture	1	0.139	0.2541	1.3931	1.139	1.3931
16	Fruits	1	0.3217	0.3088	1.6305	1.3217	1.6305
18	Vegetables	1	0.1995	0.2421	1.4416	1.1995	1.4416
20	Miscellaneous Crops	1	0.1208	0.5198	1.6406	1.1208	1.6406
21	Oil Bearing Crops	1	0.1538	0.2809	1.4347	1.1538	1.4347

Table D3-2 PERSONAL INCOME MULTIPLIERS OF MEDINA COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.0241	0.0526	0.0859	0.1627	3.1792	6.7401
3	AGG Ranch/Range Fed Cattle	0.0461	0.0382	0.1088	0.1931	1.8281	4.1897
5	Cattle Feedlots	0.0635	0.0462	0.1185	0.2281	1.7269	3.5927
6	Sheep, Lambs And Goats	0.1399	0.0116	0.382	0.5335	1.0826	3.8125
7	Hogs, Pigs And Swine	0.0473	0.039	0.0803	0.1666	1.8251	3.5216
9	Miscellaneous Livestock	0.0223	0.0364	0.0556	0.1143	2.6355	5.1344
10	Cotton	0.0315	0.0671	0.1162	0.2147	3.1287	6.8153
11	Food Grains	0.0305	0.0448	0.0829	0.1583	2.4684	5.1838
12	Feed Grains	0.039	0.0266	0.0858	0.1514	1.6812	3.8817
13	Hay And Pasture	0.0295	0.0335	0.0781	0.1412	2.1359	4.781
16	Fruits	0.0074	0.0808	0.0949	0.1832	11.8948	24.6882
18	Vegetables	0.0105	0.0512	0.0744	0.1362	5.8777	12.961
20	Miscellaneous Crops	0.0484	0.0305	0.1598	0.2386	1.6306	4.9351
21	Oil Bearing Crops	0.0348	0.0368	0.0863	0.158	2.0577	4.5363

Table D3-3 TOTAL INCOME MULTIPLIERS OF MEDINA COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2065	0.129	0.1543	0.4898	1.6247	2.3721
3	AGG Ranch/Range Fed Cattle	0.2886	0.0888	0.1954	0.5728	1.3076	1.9847
5	Cattle Feedlots	0.3237	0.1289	0.2128	0.6654	1.3983	2.0556
6	Sheep, Lambs And Goats	0.7536	0.0266	0.686	1.4662	1.0353	1.9455
7	Hogs, Pigs And Swine	0.2659	0.0897	0.1441	0.4997	1.3372	1.8794
9	Miscellaneous Livestock	0.3126	0.0836	0.0999	0.4961	1.2675	1.587
10	Cotton	0.3211	0.1193	0.2086	0.649	1.3716	2.0211
11	Food Grains	0.4046	0.0847	0.1489	0.6382	1.2093	1.5773
12	Feed Grains	0.5959	0.051	0.1541	0.801	1.0855	1.3441
13	Hay And Pasture	0.4867	0.065	0.1403	0.692	1.1335	1.4217
16	Fruits	0.152	0.1545	0.1704	0.4769	2.0164	3.1377
18	Vegetables	0.4433	0.0964	0.1336	0.6733	1.2176	1.519
20	Miscellaneous Crops	0.621	0.0574	0.2869	0.9654	1.0925	1.5545
21	Oil Bearing Crops	0.5141	0.0707	0.155	0.7398	1.1376	1.4391

Table D3-4 VALUE ADDED MULTIPLIERS OF MEDINA COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2113	0.1409	0.1807	0.5329	1.667	2.5223
3	AGG Ranch/Range Fed Cattle	0.3101	0.098	0.2288	0.6369	1.316	2.0539
5	Cattle Feedlots	0.3425	0.1413	0.2491	0.7329	1.4127	2.1401
6	Sheep, Lambs And Goats	0.7982	0.0293	0.8032	1.6307	1.0368	2.0431
7	Hogs, Pigs And Swine	0.2883	0.099	0.1688	0.5561	1.3435	1.9289
9	Miscellaneous Livestock	0.335	0.0917	0.117	0.5437	1.2737	1.6228
10	Cotton	0.3546	0.1261	0.2442	0.725	1.3556	2.0444
11	Food Grains	0.4384	0.0961	0.1743	0.7088	1.2192	1.6169
12	Feed Grains	0.6458	0.0572	0.1804	0.8834	1.0885	1.3679
13	Hay And Pasture	0.546	0.0728	0.1642	0.7831	1.1334	1.4342
16	Fruits	0.1641	0.1637	0.1996	0.5273	1.9975	3.2137
18	Vegetables	0.4651	0.1027	0.1565	0.7242	1.2208	1.5573
20	Miscellaneous Crops	0.6334	0.0624	0.336	1.0318	1.0985	1.6289
21	Oil Bearing Crops	0.5521	0.0796	0.1815	0.8132	1.1441	1.4729

Table D3-5 EMPLOYMENT MULTIPLIERS OF MEDINA COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	9.93	3.5432	4.6142	18.0875	1.3568	1.8215
3	AGG Ranch/Range Fed Cattle	14.6363	2.4251	5.8431	22.9045	1.1657	1.5649
5	Cattle Feedlots	14.242	4.3338	6.3617	24.9376	1.3043	1.751
6	Sheep, Lambs And Goats	58.4031	0.7183	20.5112	79.6327	1.0123	1.3635
7	Hogs, Pigs And Swine	10.1726	2.4124	4.31	16.895	1.2371	1.6608
9	Miscellaneous Livestock	6.6555	2.0651	2.9866	11.7072	1.3103	1.759
10	Cotton	13.0091	5.2017	6.2367	24.4475	1.3999	1.8793
11	Food Grains	10.7385	2.2601	4.4516	17.4502	1.2105	1.625
12	Feed Grains	12.13	1.3245	4.6078	18.0623	1.1092	1.4891
13	Hay And Pasture	10.5619	1.6844	4.194	16.4403	1.1595	1.5566
16	Fruits	8.0808	6.7995	5.0961	19.9764	1.8414	2.4721
18	Vegetables	7.3686	4.2992	3.9959	15.6638	1.5835	2.1257
20	Miscellaneous Crops	22.721	2.0082	8.5794	33.3085	1.0884	1.466
21	Oil Bearing Crops	11.5477	1.9867	4.6352	18.1697	1.172	1.5734

Table D4-1 OUTPUT MULTIPLIERS OF UVALDE COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	1	0.3296	0.3731	1.7027	1.3296	1.7027
3	AGG Ranch/Range Fed Cattle	1	0.2086	0.4141	1.6227	1.2086	1.6227
5	Cattle Feedlots	1	0.3415	0.4501	1.7916	1.3415	1.7916
6	Sheep, Lambs And Goats	1	0.0634	1.6349	2.6983	1.0634	2.6983
7	Hogs, Pigs And Swine	1	0.2078	0.4135	1.6213	1.2078	1.6213
9	Miscellaneous Livestock	1	0.1896	0.2808	1.4704	1.1896	1.4704
10	Cotton	1	0.5692	0.65	2.2192	1.5692	2.2192
11	Food Grains	1	0.2365	0.3471	1.5835	1.2365	1.5835
12	Feed Grains	1	0.1395	0.318	1.4576	1.1395	1.4576
13	Hay And Pasture	1	0.1815	0.3177	1.4992	1.1815	1.4992
16	Fruits	1	0.5937	0.5434	2.1371	1.5937	2.1371
18	Vegetables	1	0.3779	0.3911	1.7691	1.3779	1.7691
20	Miscellaneous Crops	1	0.2086	0.5742	1.7828	1.2086	1.7828

Table D4-2 PERSONAL INCOME MULTIPLIERS OF UVALDE COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.0256	0.0966	0.1224	0.2446	4.7773	9.5625
3	AGG Ranch/Range Fed Cattle	0.0488	0.059	0.1358	0.2437	2.2081	4.9891
5	Cattle Feedlots	0.0673	0.0687	0.1476	0.2836	2.0213	4.2163
6	Sheep, Lambs And Goats	0.1404	0.0184	0.5363	0.6951	1.1309	4.9492
7	Hogs, Pigs And Swine	0.0512	0.0602	0.1356	0.2471	2.1759	4.8235
9	Miscellaneous Livestock	0.0237	0.0539	0.0921	0.1697	3.2793	7.1725
10	Cotton	0.0334	0.1887	0.2132	0.4353	6.6505	13.0348
11	Food Grains	0.0323	0.0692	0.1138	0.2153	3.1416	6.6647
12	Feed Grains	0.0392	0.0414	0.1043	0.1849	2.0571	4.7202
13	Hay And Pasture	0.029	0.0538	0.1042	0.187	2.8569	6.4549
16	Fruits	0.0077	0.1994	0.1783	0.3853	27.0273	50.2937
18	Vegetables	0.0111	0.1253	0.1283	0.2647	12.2537	23.7793
20	Miscellaneous Crops	0.0484	0.0661	0.1883	0.3029	2.3662	6.2566

Table D4-3 TOTAL INCOME MULTIPLIERS OF UVALDE COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2188	0.1614	0.2085	0.5887	1.7379	2.6909
3	AGG Ranch/Range Fed Cattle	0.3063	0.1028	0.2314	0.6405	1.3355	2.0908
5	Cattle Feedlots	0.3428	0.1459	0.2515	0.7401	1.4255	2.1592
6	Sheep, Lambs And Goats	0.7563	0.0316	0.9136	1.7014	1.0417	2.2497
7	Hogs, Pigs And Swine	0.2878	0.1034	0.2311	0.6223	1.3593	2.162
9	Miscellaneous Livestock	0.3321	0.0944	0.1569	0.5835	1.2844	1.7567
10	Cotton	0.3403	0.2558	0.3632	0.9593	1.7517	2.8189
11	Food Grains	0.4281	0.1103	0.1939	0.7324	1.2576	1.7105
12	Feed Grains	0.5985	0.0658	0.1777	0.842	1.1099	1.4068
13	Hay And Pasture	0.4774	0.0856	0.1775	0.7405	1.1793	1.5512
16	Fruits	0.157	0.27	0.3037	0.7306	2.7201	4.6548
18	Vegetables	0.4696	0.1718	0.2186	0.86	1.3659	1.8313
20	Miscellaneous Crops	0.6218	0.0957	0.3209	1.0384	1.154	1.67

Table D4-4 VALUE ADDED MULTIPLIERS OF UVALDE COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2236	0.1733	0.2426	0.6395	1.7751	2.8603
3	AGG Ranch/Range Fed Cattle	0.3278	0.1125	0.2693	0.7096	1.3431	2.1646
5	Cattle Feedlots	0.3616	0.1588	0.2927	0.8131	1.4392	2.2486
6	Sheep, Lambs And Goats	0.7982	0.0346	1.0632	1.8959	1.0433	2.3754
7	Hogs, Pigs And Swine	0.3103	0.1133	0.2689	0.6924	1.365	2.2317
9	Miscellaneous Livestock	0.3546	0.1027	0.1826	0.6399	1.2897	1.8046
10	Cotton	0.3738	0.2642	0.4227	1.0607	1.7067	2.8374
11	Food Grains	0.4619	0.124	0.2257	0.8116	1.2685	1.757
12	Feed Grains	0.6458	0.0733	0.2068	0.9259	1.1135	1.4338
13	Hay And Pasture	0.5321	0.0954	0.2066	0.8342	1.1793	1.5676
16	Fruits	0.169	0.2809	0.3534	0.8034	2.6618	4.7524
18	Vegetables	0.4914	0.1796	0.2544	0.9254	1.3654	1.883
20	Miscellaneous Crops	0.6334	0.1018	0.3734	1.1087	1.1608	1.7503

Table D4-5 EMPLOYMENT MULTIPLIERS OF UVALDE COUNTY

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	9.9682	6.2918	6.0155	22.2754	1.6312	2.2347
3	AGG Ranch/Range Fed Cattle	14.6508	3.396	6.6766	24.7234	1.2318	1.6875
5	Cattle Feedlots	14.2443	5.3696	7.2563	26.8703	1.377	1.8864
6	Sheep, Lambs And Goats	69.1399	1.0377	26.3594	96.537	1.015	1.3963
7	Hogs, Pigs And Swine	14.6231	3.3972	6.6668	24.687	1.2323	1.6882
9	Miscellaneous Livestock	9.2362	2.9992	4.5266	16.762	1.3247	1.8148
10	Cotton	12.7544	15.1464	10.4798	38.3807	2.1875	3.0092
11	Food Grains	10.9679	4.1568	5.5955	20.7203	1.379	1.8892
12	Feed Grains	11.3932	2.4669	5.1276	18.9877	1.2165	1.6666
13	Hay And Pasture	10.639	3.2072	5.1225	18.9687	1.3015	1.7829
16	Fruits	8.0808	15.2462	8.7618	32.0889	2.8867	3.971
18	Vegetables	7.4319	9.6141	6.3063	23.3523	2.2936	3.1422
20	Miscellaneous Crops	19.9207	4.7262	9.2576	33.9045	1.2372	1.702

Table D5-1 OUTPUT MULTIPLIERS OF EDWARDS AREA

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	1	0.2906	0.5104	1.8009	1.2906	1.8009
3	AGG RANCH/RANGE FED CATTLE	1	0.315	0.6666	1.9816	1.315	1.9816
5	Cattle Feedlots	1	0.3087	0.6502	1.959	1.3087	1.959
6	Sheep, Lambs And Goats	1	0.0959	2.369	3.4649	1.0959	3.4649
7	Hogs, Pigs And Swine	1	0.2488	0.5399	1.7887	1.2488	1.7887
9	Miscellaneous Livestock	1	0.239	0.329	1.568	1.239	1.568
10	Cotton	1	0.3388	0.7271	2.0658	1.3388	2.0658
11	Food Grains	1	0.3432	0.5424	1.8856	1.3432	1.8856
12	Feed Grains	1	0.197	0.5079	1.7049	1.197	1.7049
13	Hay And Pasture	1	0.2519	0.4799	1.7318	1.2519	1.7318
16	Fruits	1	0.455	0.6589	2.1139	1.455	2.1139
18	Vegetables	1	0.3104	0.5082	1.8186	1.3104	1.8186
20	Miscellaneous Crops	1	0.2054	0.8771	2.0826	1.2054	2.0826
21	Oil Bearing Crops	1	0.2895	0.5477	1.8372	1.2895	1.8372

Table D5-2 PERSONAL INCOME MULTIPLIERS OF EDWARDS AREA

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.0255	0.0882	0.1705	0.2841	4.4568	11.1409
3	AGG RANCH/RANGE FED CATTLE	0.0486	0.0761	0.2227	0.3474	2.5648	7.1439
5	Cattle Feedlots	0.0644	0.0741	0.2172	0.3557	2.1504	5.5218
6	Sheep, Lambs And Goats	0.1409	0.0248	0.7913	0.957	1.1758	6.7903
7	Hogs, Pigs And Swine	0.0519	0.071	0.1803	0.3032	2.3689	5.8461
9	Miscellaneous Livestock	0.0234	0.0664	0.1099	0.1997	3.8399	8.5382
10	Cotton	0.0324	0.0997	0.2429	0.375	4.0787	11.5751
11	Food Grains	0.0318	0.0898	0.1812	0.3028	3.8237	9.5189
12	Feed Grains	0.0391	0.0531	0.1696	0.2618	2.3582	6.7001
13	Hay And Pasture	0.0293	0.068	0.1603	0.2575	3.3224	8.7984
16	Fruits	0.0076	0.1341	0.2201	0.3618	18.5272	47.3031
18	Vegetables	0.0109	0.0865	0.1697	0.2672	8.9321	24.4887
20	Miscellaneous Crops	0.0484	0.0557	0.293	0.397	2.1506	8.2058
21	Oil Bearing Crops	0.0348	0.0764	0.1829	0.2942	3.1943	8.4472

Table D5-3 TOTAL INCOME MULTIPLIERS OF EDWARDS AREA

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.2182	0.1492	0.2836	0.651	1.6839	2.9835
3	AGG RANCH/RANGE FED CATTLE	0.305	0.1442	0.3704	0.8197	1.4729	2.6871
5	Cattle Feedlots	0.3284	0.1411	0.3613	0.8307	1.4296	2.5297
6	Sheep, Lambs And Goats	0.759	0.0524	1.3162	2.1275	1.069	2.8031
7	Hogs, Pigs And Swine	0.2914	0.1225	0.3	0.7139	1.4202	2.4495
9	Miscellaneous Livestock	0.3285	0.1146	0.1828	0.6259	1.349	1.9055
10	Cotton	0.3302	0.1584	0.4039	0.8925	1.4798	2.7033
11	Food Grains	0.4215	0.1593	0.3014	0.8822	1.378	2.0929
12	Feed Grains	0.597	0.0922	0.2822	0.9714	1.1544	1.627
13	Hay And Pasture	0.4824	0.1177	0.2666	0.8667	1.2439	1.7965
16	Fruits	0.1567	0.2316	0.3661	0.7543	2.4778	4.8139
18	Vegetables	0.4603	0.1537	0.2823	0.8964	1.3339	1.9472
20	Miscellaneous Crops	0.6215	0.1002	0.4873	1.2089	1.1612	1.9453
21	Oil Bearing Crops	0.5141	0.1314	0.3043	0.9498	1.2556	1.8475

Table D5-4 VALUE ADDED MULTIPLIERS OF EDWARDS AREA

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	0.223	0.1638	0.3258	0.7125	1.7345	3.1954
3	AGG RANCH/RANGE FED CATTLE	0.3265	0.163	0.4255	0.915	1.4991	2.8023
5	Cattle Feedlots	0.3472	0.1593	0.415	0.9215	1.4588	2.6543
6	Sheep, Lambs And Goats	0.7982	0.0584	1.5121	2.3687	1.0731	2.9677
7	Hogs, Pigs And Swine	0.3139	0.1394	0.3446	0.7979	1.4443	2.5423
9	Miscellaneous Livestock	0.3509	0.1256	0.21	0.6865	1.3579	1.9564
10	Cotton	0.3637	0.1718	0.4641	0.9995	1.4723	2.7484
11	Food Grains	0.4553	0.1915	0.3462	0.9931	1.4207	2.181
12	Feed Grains	0.6458	0.1091	0.3242	1.0791	1.169	1.671
13	Hay And Pasture	0.5381	0.1394	0.3063	0.9838	1.2591	1.8283
16	Fruits	0.1688	0.2488	0.4206	0.8381	2.4739	4.9656
18	Vegetables	0.4821	0.1679	0.3244	0.9744	1.3483	2.0211
20	Miscellaneous Crops	0.6334	0.1123	0.5599	1.3056	1.1772	2.0611
21	Oil Bearing Crops	0.5521	0.1574	0.3496	1.0591	1.2851	1.9183

Table D5-5 EMPLOYMENT MULTIPLIERS OF EDWARDS AREA

CODE	SECTOR	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
1	Dairy Farm Products	10.0019	4.5896	8.6066	23.1981	1.4589	2.3194
3	AGG RANCH/RANGE FED CATTLE	14.6225	4.4365	11.2418	30.3008	1.3034	2.0722
5	Cattle Feedlots	14.2414	4.3482	10.9649	29.5545	1.3053	2.0753
6	Sheep, Lambs And Goats	64.5843	2.2956	39.9491	106.8289	1.0355	1.6541
7	Hogs, Pigs And Swine	11.9643	3.4711	9.1044	24.5399	1.2901	2.0511
9	Miscellaneous Livestock	6.6181	3.1175	5.5484	15.284	1.4711	2.3094
10	Cotton	12.9065	7.88	12.2607	33.0472	1.6105	2.5605
11	Food Grains	10.8858	4.6217	9.1469	24.6545	1.4246	2.2648
12	Feed Grains	11.8502	2.67	8.5645	23.0846	1.2253	1.948
13	Hay And Pasture	10.3051	3.4138	8.0919	21.8108	1.3313	2.1165
16	Fruits	7.7487	11.089	11.1112	29.949	2.4311	3.865
18	Vegetables	7.3926	7.1354	8.5691	23.0971	1.9652	3.1244
20	Miscellaneous Crops	21.2912	3.7861	14.7916	39.8688	1.1778	1.8725
21	Oil Bearing Crops	11.5477	4.1112	9.2363	24.8952	1.356	2.1559